TESE DE DOUTORAMENTO

PARTICIPATORY CONSTRUCTION OF WILDFIRE RISK SCENARIOS IN THE BRAZILIAN AMAZON AND GALICIA TO ADVANCE RISK GOVERNANCE

Nathália Thaís Cosmo da Silva

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Da Tese de Doutoramento titulada

"PARTICIPATORY CONSTRUCTION OF WILDFIRE RISK SCENARIOS IN THE BRAZILIAN AMAZON AND GALICIA TO ADVANCE RISK GOVERNANCE"

Presentada por **Dna. Nathália Thaís Cosmo da Silva** alumna do Programa de Doutoramento Enxeñaría para o Desenvolvemento Rural do Departamento de Enxeñaría Agroforestal

Autoriza a presentación da tese indicada, considerando que reúne os requisitos esixidos no artigo 34 do regulamento de Estudos de Doutoramento, e que como director, codirector e titor non incurre nas causas de abstención establecidas na lei 40/2015.

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Dedicated to Edimar, Elizane and Dayse for all their love, and without whom this dissertation would have never become a reality.

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Per fare una statua basta vederla dentro un blocco di marmo e togliere quello che avanza

(Michelangelo)

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Resumen

Este trabajo propone una integración entre la perspectiva técnico-científica y sociológica de los riesgos ambientales. Estudia la gobernanza del riesgo de incendios forestales en el estado de Rondônia (Amazonia brasileña) y Galicia (España). Los incendios forestales afectan a las dos zonas, a escala y en contextos muy distintos, pero con desafíos similares. Se interpretan como procesos históricos cuya complejidad se fue incrementando a lo largo del tiempo por los cambios en la acción humana, inducida por múltiples procesos socioeconómicos y decisiones políticas. Rondônia se enfrenta al problema de una ocupación rápida y masiva del territorio, así como a la conservación de los sistemas naturales y socioecológicos. Ha evolucionado de un estado natural a una sociedad rural, mezclando rasgos de la tradición (comunidades indígenas y tradicionales) y de la modernidad (nuevas formas constructivas, redes viarias, servicios, nuevas prácticas agrícolas y cultivos, y falta de comprensión de los procesos ecológicos locales), combinando prácticas tradicionales agrícolas, tales como el sistema de rozas, con la agricultura industrial y la ganadería extensiva. Los incendios forestales en Galicia están asociados a procesos de desagrarización y crecimiento urbano, pasando rápidamente de una sociedad rural a una sociedad urbana basada en una economía de servicios y expansión de algunos sectores industriales; acompañado de un proceso de reforestación de tierras forestales y agrarias para la producción forestal comercial. Para analizar el papel de los actores principales y sus interacciones se parte de un mapa de actores. A continuación se analiza la comunicación de riesgo examinando el papel de los medios de comunicación local, internacional y medios oficiales. La recogida de datos mediante técnicas participativas desencadena un proceso de aprendizaje social sobre el riesgo de desastres. Para ello se utilizan entrevistas a actores clave y grupos focales como fuente de ponderación de los factores de riesgo. Mediante el proceso de negociación y aprendizaje colectivo es posible abordar la complejidad del problema y construir escenarios futuros de riesgo de incendio forestal, permitiendo una interpretación de las actuales y posibles condiciones de la gobernanza del riesgo en las dos áreas de estudio. La participación de actores sociales y políticos en el proceso favorece la mejora de la gestión del riesgo y una gobernanza participativa. Los métodos de análisis utilizados responden a la necesidad y promueven que los gobiernos incorporen a la sociedad civil en el proceso de toma de decisiones para la reducción más efectiva del riesgo de incendio.

Palabras clave: gobernanza de riesgo, incendios forestales, participación, escenarios, Rondônia, Galicia.

Summary

This thesis proposes an integration between the technical-scientific and sociological perspective of environmental risks. It focuses on wildfire risk governance in the state of Rondônia (Brazilian Amazon) and in Galicia (Spain). Wildfires affect both areas, on different scales and in different contexts, but they present similar challenges. Wildfires are considered as historic processes, which complexity has been increasing over time because of changes resulting from anthropogenic action, induced by multiple socio-economic processes and political decisions. Wildfires in Rondônia are associated with various challenges stemming from the rapid and massive transformation of land cover as well as the conservation of natural and socio-ecological systems. Rondônia has evolved from a natural and wild state towards a more rural society, mixing traditional features (indigenous and rubber traditional gatherer communities) and more modern features (new building forms, road networks, services, new agricultural and livestock practices but also an unawareness about the local ecological processes), combining old traditional farming practices, such as slash and burn system with industrial agriculture and cattle raising. Wildfires in Galicia are associated with rural flight and urban growth, evolving rapidly from a rural society towards an urban one based on service economy and on the expansion of some industrial sectors; accompanied by the afforestation of both agrarian and forested areas for commercial forestry production. In order to analyze the role of the main actors and their interactions, it starts from actors' maps. Then, the risk communication is analyzed by examining the role of the local, international and official Medias. By using participative techniques the data collection triggers a social learning process about disaster risk. For that purpose, interviews with key-actors and focus groups were used as a means of balancing risk factors. Via the negotiation and collective learning processes it is possible to tackle the complexity of the problem and construct future wildfire risk scenarios, which allows an interpretation of current and potential conditions in which risk governance is necessary for both studied areas. The social and political actors' participation in the process encourages the improvement of risk management and participative governance. The analysis methods used respond to necessity and cause the Government to take civil society into account in the decision-making process in order to reduce the wildfire risk more effectively.

Keywords: risk governance, wildfire, participation, scenarios, Rondônia, Galicia.

Publications derived from this research

Silva, N.T.C.; Fra Paleo, U.; Ferreira Neto, J.A. **Construcción de escenarios de riesgo para la mejora de la gobernaza en el sistema sócio ecológico en Brasil y en España**. Presentation of the paper in poster format. *In*: II Encontro Mocidade Investigadora, celebrated in Santiago de Compostela, Spain, on 29 and 31 January 2014.

Silva, N.T.C.; Fra Paleo, U.; Ferreira Neto, J.A. **Amazonia y Galicia: Comparando lo incomparable? Riesgo de incendios forestales, procesos sociales y territorios**. Science Clips. Lugo: Escola Politécnica Superior, 03 February 2015. Event prepared by Asociación de Doutorandos da Universidade Santiago de Compostela.

Silva, N.T.C.; Fra Paleo, U.; Ferreira Neto, J.A. **La investigación participativa y su aportación a la gobernanza del riesgo de desastres**. XVII. Congreso Español de Sociología. Gijón. Spain. 30 June, 01 and 02 July 2016. (Paper and oral presentation).

Silva, N.T.C.; Fra Paleo, U.; Ferreira Neto, J.A. **Los incendios forestales como resultado del comportamiento de sistemas complejos en Rondônia (Brasil) y Galicia (España**). XVII Congreso Español de Sociología. Gijón. Spain. 30 June, 01 and 02 July 2016. (Abstract accepted).

Contents

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List of Abbreviations

ADEGA	Asociación para a Defensa Ecolóxica de Galiza
AEMET	Agência Estatal de Meteorología
AROM	Associação Rondoniense de Municípios
ARPA	Programa de Áreas Protegidas da Amazônia
BAPV	Base Aérea de Porto Velho
BASA	Banco da Amazônia Financiamentos
BNDES	Banco Nacional de Desenvolvimento Econômico e Social
BPA-RO	Batalhão da Polícia Militar de Rondônia
CAERD	Companhia de Águas e Esgotos do estado de Rondônia
CAP	Common Agricultural Policy
CAR	Cadastro Ambiental Rural
CBMRO	Corpo de Bombeiros Militar do estado de Rondônia
CCB	Climate, Community and Biodiversity
CENSIPAM	Centro Gestor e Operacional do Sistema de Proteção da Amazônia
CEPLAC	Comissão Executiva do Plano da Lavoura Cacaueira
CONFEMADERA	Confederación de Empresas de la Madera de Galicia
CPPT	Centro de Pesquisas de Populações Tradicionais Cuniã
CU/UC	Unidades de conservação
EC	European Community
EFFIS	European Forest Fire Information System
EGIF	Base de Datos Nacional de Incendios Forestales
EMATER	Empresa Brasileira de Assistência Técnica e Extensão Rural
EMBRAPA	Empresa Brasileira de Pesquisa Agropecuária
EM-DAT	Emergency Events Database
ENCE	Energía y Celulosa
EU	European Union
FEMIB	Federation of the European Building Joinery Associations
Funbio	Fundo Brasileiro para a Biodiversidade
FETAGRO	Federação dos Trabalhadores na Agricultura de Rondônia
FSC	Forest Stewardship Council
FUNAI	Fundação Nacional do Índio
IBAMA	Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis
IBGE	Instituto Brasileiro de Geografia e Estatística
IPEAdata	Base de dados do Instituto de Pesquisa Econômica Aplicada
ICMBio	Instituto Chico Mendes de Conservação da Biodiversidade
IDARON	Agência de Defesa Sanitária Agrosilvopastoril do estado de Rondônia
IGE	Instituto Galego de Estatística
INC	Instituto Nacional de Colonización
INCRA	Instituto Nacional de Colonização e Reforma Agrária
INPA	Instituto Nacional de Pesquisas da Amazônia
INPE	Instituto Nacional de Pesquisas Espaciais
IPAM	Instituto de Pesquisa Ambiental da Amazônia
IPCC	Intergovernmental Panel on Climate Change

IRGC	International Risk Governance Council
ITERON	Instituto de Terras de Rondônia
LC	Land Consolidation
LTSER	Long-Term Social-Ecological Research
Meteogalicia	Unidade de Observación e Predición Meteorolóxica
MPRO	Ministério Público do Governo de Rondônia
MVMC	Montes veciñais en man común
NASA	National Aeronautics and Space Administration
NGO	Non-Governmental Organizations
NRC	US National Research Council
PAC	Programa de Acelaração do Crescimento
PAD	Projetos de Assentamento Dirigido
PEFC	Programme for the Endorsement of Forest Certification Schemes
PIC	Projetos Integrados de Colonização
PIN	Programa de Integração Nacional
PLADIGA	Plan de Prevención e Defensa Contra os Incendios Forestais de Galicia
PLANAFLORO	Plano Agropecuário e Florestal de Rondônia
POLONOROESTE	Programa Integrado de Desenvolvimento do Noroeste do Brasil
PrevFogo	Centro Nacional de Prevenção e combate aos incêndios florestais
PROARCO	Programa Integrado de Monitoramento, Prevenção e Controle do Desmatamento
SEAGA	Empresa Pública de Servizos Agrarios Galegos
SEAGRI	Secretaria de Agricultura do estado de Rondônia
SEDAM	Secretaria Estadual do Desenvolvimento Ambiental em Rondônia
SEMA	Secretaria Municipal de Meio Ambiente de Porto Velho
SEMEIA	Secretaria Municipal de Meio Ambiente de Ji-Paraná
SEPRONA	Servicio de Protección de la Naturaleza
SNREST	Servicio Nacional de Reforma Económica y Social de la Tierra
SFA	Superintendência Federal de Agricultura
SIPAM	Sistema de Proteção da Amazônia
UNIR	Universidade Federal de Rondônia
VCS	Verified Carbon Standard
WB	World Bank
WUI	Wildland-Urban Interface
WWF	World Wide Fund to Nature

List of figures

List of tables

1. Introduction

This dissertation has been written in a period of great political and social uncertainty. Brazil has seen a presidential impeachment; in Europe, heads of state must now grapple with the United Kingdom's departure from the European Union; national states diverge in the extent to which they conduct the aperture of frontiers to refugees; the results of the recent presidential election in the United States have reignited discussions regarding sovereignty of nation states and global markets.

Although these examples are not the subject of this dissertation, the outcomes of this work are inseparable from the historic period circumscribing it. Recent events illustrate how these uncertainties complicate any attempt to predict how risks evolve. With the advent of modernity ushered in by techno-scientific revolution, some scientists have highlighted that uncertainties and new risks are continuously being generated. The late Zygmunt Bauman, famed sociologist of liquid modernity, made his mark on contemporary societies by generating much-needed reflection on where societies are headed, what they are leaving in their wake, and what they truly have to gain and lose by making rational decisions. As liquid modernity suggests, the present social configuration cannot maintain itself for much longer. The consequences of modernity were discussed by Beck (1992) in his thesis of world risk society, which states that the development of technology transformed the way that society thinks and organizes itself in response to risk. By using the network society framework, Castells (2000) pointed out that contemporary age is mainly organized around new communication technologies, which have enabled extraordinary changes in the social structure. Focusing on essential tension in modernity, Flyvbjerg (1998) highlights both consensus and conflict as ways of framing duality between idealism and realism - in other words, the gap between what should be done and what is actually done.

The problem in the sociologic paradigms of contemporary societies, according to Gomá (2013) and Fra Paleo (2015) is that present theories are not fully operational. These theories, according to Fra Paleo (2015), only provide an explanation of how society is rather than provide clues as to how society might be. In policymaking, governments (national, regional and local) face uncertainty and complexity as well as ever-changing environmental, political, and social scenarios (Fra Paleo, 2010). On the other hand, reactive approaches in dealing with risk are observed while governments do not –or cannot- promote coherent spatial and risk planning. Hence, proactively tackling future risks should be a responsibility divided equitably between the various political, scientific, and social arenas. Focus on future risk has been widely put within numerous fields of study and under diverse names (Boyd et al., 2015).

When discussing future risk, many related analytic categories are available, such as adaption, mitigation, governance, decision-making, and socioecological systems. Anticipation, according to Nuttall (2010), is a prerequisite for thinking about adaptation, which is considered to be both reactive and anticipatory (Smit and Wandel 2006; Chapin et al., 2009). In the framework of anticipatory governance, Quay (2010) highlighted that a set of possible futures is needed in order to prepare for change and to guide current decision-making toward maximizing future alternatives and minimizing the production of disaster risk. The increasing interest in the construction of future risk scenarios is associated with supporting decision making in risk governance.

Nevertheless, anticipating the future by means of scenario- building is not limited to policymaking. Anticipation has also demonstrated to be an opportunity to raise awareness about possible futures and to mobilize society to the consequences of individual and collective choices (Poli, 2010; 2011). Considering the evidence that knowledge generated is not fed forward to the next iteration of problem-solving and learning, Boyd et al. (2015) pointed out that anticipating future events and promoting constant knowledge feedbacks among actors is a way to trigger change in the coupled social-ecological system. The fact that future is progressively perceived to be more complex with superior connectivity and complexity is the reason why the needed changes of this century are associated with the way that litigious societies and policies envision and understand future risks (Allison, 2015). Interaction among various societal actors can be advantageous to simultaneously frame future risk decisions and raise actors' awareness. Thus, engaging societal actors in risk assessment is necessary to capture social values, interests, priorities and needs, and construct future scenarios. This gives societies the opportunity to build trust among actors, to integrate multiple forms of knowledge, to increase the knowledgebase, building on similarities and differences in perception (Murungweni et al., 2011; Gray et al., 2012; Kontogianni et al., 2013).

Also, when dealing with uncertainty, exploring consequences -especially to societal actors- seems to be a common arena among the various purposes and challenges of risk governance and scenario-building. In De Marchi's (2015) words, a transformation of attitude towards the "uncertainty monster" will have relevant consequences for risk governance, including risk communication. "What have to live with awareness that there are no simple solutions to complex problem" (De Marchi, 2015, p.158).

Therefore, risk governance is best, according to Heath and McComas (2015), when it aspires to result in wholly functioning societies, once the evaluation of the fairness of risk depends on the collective way of thinking. Thus, this study takes advantage of participatory methods and instruments to envision the future by driving attention to societal actors. They are recognized by Fra.Paleo (2015) as key actors who unceasingly intervene in the environment by using natural resources or benefiting from environmental services, and they determine –although with different power- the evolution of political processes.

Those actors with less power thus demand higher levels of transparency and accountability in risk communication. They are central to build and maintain trust, which determines the credibility both of message and source and because it might affect the receiver's willingness to engage in communication (Höppner et al., 2010) and participation. In this way, risk communication is the base of actors' engagement. Complementarity between participatory methods and representative democracy occurs when actors' engagement is approached as a means of opening up the range of possible decisions in the governance process (Levidow, 2007). The problem pointed out by Renn (2004, p. 311) regarding assessment of probabilities of risk is that public perception may differ substantially from scientific analysis. The main argument is that stakeholders want to make sure that "their interests are served". However, this is not only valid for stakeholders. Different actors, inclusive scientists, have divergent interests and perceptions regarding risk problem.

Although Renn (2004) indicates that stakeholders can be "educated about the subject", his analysis does not make it clear the fact that educational and communication

process is multi-directional. In other words, actors of different sectors have valuable knowledge that should be integrated in fluent and non-hierarchical feedbacks in negotiation processes within risk governance.

The main assumption is that when societal actors frame future risk, a collective learning process is triggered by accommodating various points of views and types of knowledge. In acknowledging the role of the public in risk governance and communication, Jönsson et al. (2016) have highlighted that the inclusion of the public in governance processes is also associated with increase in awareness.

An increasing awareness and social sensitivity by different societal actors of possible futures should be expected when assessing the complexities and interdependencies of a risk problem. In this way, this study aims to advance risk governance in the Brazilian Amazon and Galicia by posing the following research problem:

How can we learn about the interpretations of societal actors and about their actions by engaging them in the construction of wildfire risk scenarios?

This question involves different analytical categories and demands placing the problem in the context of various areas of study. Subsequent sections give explanation in detail of these issues.

1.1. Risk governance

In 2005, the International Risk Governance Council (IRGC) developed a framework for risk governance. According to their definition, risk governance refers to the totality of actors, rules, conventions, processes, and mechanisms concerned with how relevant risk information is collected, analyzed, and communicated, and how regulatory decisions are taken (IRCG, 2005, van Asselt, 2005). This framework was primarily developed to deal with technological risks and to structure risk governance process in four phases: pre-assesment, appraisal, characterization and evaluation, and risk management (Renn and Kinkle, 2015).

The framework has received many critics since being published in 2005. This reinforces that the debate, fluent exchange and continuous progress around the concept of risk governance are manifestations of its lively nature and young history (Fra.Paleo, 2015). The problem found by Rosa (2008) in the framework is the lack of a clear definition of risk, of internal consistency, and of guidelines in order to balance scientific understanding and knowledge with public concerns. Regarding the application of the IRGC framework, Tait (2008) mentioned that the participatory mode of decision-making proposed tended to respond to waves of public protest, amplified by political lobbying and pressures from industry. Boholm et al. (2012) pointed out that the framework pays too little attention to the contextual situatedness of risk. These authors understand that conceptions of risk are inseparable from the mixed influences of the contexts in which they emerge, are communicated, and shared. Actors jointly manage various aspects of risk. This is the reason why risk governance should connect public authorities, private companies and other stakeholders at national, regional, and local levels (Boholm et al., 2012). Hence, the governance system should well develop capacities for learning process with societal interests, feedback loops, monitoring

schemes, resources, and capital as well problem-solving capacity of existing multilevel governance systems (Duit and Galaz, 2008). Furthermore, giving attention to multiple societal and economic actors in risk governance process is the only way to expand policy options (Fra.Paleo, 2015).

Other criticisms to the IRGC model were related to the rigidity in the phasing (such as assesment and management) of the governance process and to the lack of specification regarding stakeholder involvement and participation (Renn and Kinkle, 2015; Renn and Walker, 2008; van Asselt, 2005). A new version attempted to respond to the demand of a more adaptive and more inclusive risk governance process. These demands are associated with the ability of politics and society to collectively design and implement a systematic approach to organizational and policy learning in institutional settings (Kinkle and Renn, 2012). The updated framework consists of the steps: pre-estimation, interdisciplinarity, risk estimation, risk characterization, risk evaluation and risk management (Renn and Kinkle, 2015). The inclusion of interdisciplinarity might be interpreted as an instrument to promote reflection about risk not only from multiple disciplines, but also with the participation of societal actors. Achieving an adequate involvement of experts, stakeholders and the public in risk governance process demanded the incorporation of concerns about the adaptive and integrative capacity in governance institutions (Pelling et at., 2008; Renn and Kinkle, 2015).

The term risk governance translates the core principles of governance (van Asselt and Renn, 2011) to the context of risk and risk-related decision-making (IRGC 2005; Renn and Walker, 2008). Therefore, it is still inextricably linked to the updates and advancement in the field of governance. The novel governance approach emphasizes group decision making that accommodates plurality of views, values and shared learning as social sources of adaptability, renewal, and transformation to manage complex social-ecological systems under conditions of uncertainty (Folke et al., 2005, Armitage et al., 2008; Popa et al., 2015).

Therefore, by exploring the contexts associated with risk emergence and modes of communication as well as encouraging societies and institutions to be adaptive, represents advancements in the discussion as well in the practices of risk governance. This can be achieved through participatory modes of decision making and constructing learning processes among societal actors.

1.2. Can we talk about wildfire risk governance?

This question emerges because governance, wildfire and risk are analytical categories widely used by scholars while adopting different frameworks in different contexts.

As defined by Merrill and Alexander (1987), a wildfire is an unplanned or unwanted natural or person-caused fire occurring in a natural setting or wilderness. Patterns of wildland fire shaped by the dynamic interaction of vegetation (fuel) and human populations (ignition) came to be named anthropogenic fire regime (Guyette et al., 2002). In more recent times, the use of the term wildfire is linked to an increasing anthropogenic fire activity and to land use changes in reshaping wildfire regimes (Bajocco et al., 2010) or, similarly, understanding human-dominated landscapes (Prestemon et al., 2002). Actually, anthromes (Ellis and Ramankutty, 2008) represent

the intervened terrestrial biomes based on global patterns of direct human interaction with ecosystems, including fire. The occurrence of wildfires is tied to human presence in landscapes historically shaped by human activities, which have transformed most of the terrestrial biosphere into anthromes (Bistinas et al., 2013; Tedim and Xanthopoulos, 2016).

Wildfire risk is considered by Fischer et al. (2016) as a socio-ecological pathology because of a set of interrelated social and ecological conditions and processes that deviate from what is considered healthy or desirable. This author explains that forests, in many cases, have become more hazardous due to the disrupted traditions of indigenous fire management, practices of fire exclusion or fire suppression, establishment of flammable plants, warming climate and population change. This results in feedbacks between fire and humans with transitions in land use and environmental management practices as main drivers. However, the enduring existence of a wildfire policy and studies solely focused on wildfire suppression drives actions to the elimination of the problem, and are the result of giving simple solutions to a complex problem. Indeed, simple solutions might represent right answers to wrong questions (De Marchi, 2015). Therefore, advances in constructing a bridge among social, ecological, technological and political dimensions represent a way of tackling the wildfire problem by considering its complexities.

Social, economic, and ecological dimensions have been incorporated into some wildfire risk frameworks. Estimations of socio-economic losses or damages to property are recurrent in studies of wildfires in wildland-urban interface (WUI) such as Tutsch (2009) and Massada et al. (2009). In WUI areas houses intermix with vegetation (Radeloff et al., 2005) in natural or cultural landscapes. An increase in the number of people living on WUI areas has intensified the risk of wildfire damage to property and people with urban growth (Anton and Laurence, 2016). Some great wildfires in WUI were conspicuous. Colloquially named as 'Black Saturday', WUI fires occurred on 7 February 2009 caused 390 fatalities, predominantly in the state of Victoria, Australia. (Cruz et al., 2012). In Galicia, wildfires during the summer of 2006 highlighted the need of considering these interfaces. These wildfires brought immediate losses regarding goods and services of forest ecosystems about 300 million euros (Martinez et al., 2007). Discussion of wildfires in the Brazilian Amazon usually focuses on the dichotomy of forest' sustainability and rural fires. On the other hand, the progressive development of nuclei of population in Rondônia implies the existence WUI fires. The local printed media in Rondônia usually shows wildfires' negative effects over infrastructures of the cities and causing respiratory problems in the population, what increases the demand for public health care, as illustrated in the chapter 3.

Many studies focusing on fires in WUI usually highlight socio-economic dimensions of fire are considered in terms of monetary losses in relation to public and private assets. Qualitative studies are needed in order to discuss the role of societal actors, which are intervening in these settlement pattern changes. Actually, placing the wildfire risk discussion in the framework of governance denotes that attention should be driven to the societal actors to manage their "common risk affairs". This expression is used by to De Marchi (2015), who has highlighted the need of including different types of knowledge and confirming the multi-faced nature of the problem at hand.

In this regard, some recent efforts have been done to place the wildfire problem in the framework of environmental governance (see Linke et al., 2014; Jönsson, 2016).

Other studies place the problem in the framework of adaptive governance when discussing climate change and wildfire as a secondary stress (see Österblom and Folke, 2013; Mees et al., 2014; Hurlbert and Gupta, 2016). The framework of adaptive governance gives opportunities think adaptation generated by the people in order to facilitate vegetation management must be accommodated into deliberations on policy (Bardley et al., 2015). He argues that the emerging challenge in governance is to mitigate wildfire risk and –-at the same time- maintain conservation practices

Reframing wildfire risk by the framework of socio-ecological system is presented as a way to explore risk governance challenges. Steelman (2016), for instance, puts wildfire risk in the framework of anticipatory wildfire governance. He calls for a reframing of wildfire risk as a social-ecological one, which can be advantageous in identifying cross-scale dynamics - that are not of much concern in the discussion on wildfires – in order to promote an anticipatory wildfire governance system.

Explicitly using the term wildfire risk governance, Thompson et al. (2011; 2013) propose to develop an integrated wildfire risk assessment approach. The use of integrated, according to these authors, refers to the integration of three analytical components: stochastic wildfire simulation and burn probability modeling, expert-based modeling, and multi-criteria decision analysis. The term integrated as used by Thompson et al. (2011; 2013) does not match the emergent notion of integrated risk research, once they focus strictly on approaches that integrate different statistical modeling of risk assessments. On the other hand, integrated disaster risk approaches attempts to embrace multiple government scales, stakeholders, knowledge, disciplines, methodological approaches, areas of application and real experiences (Gall et al., 2015). Furthermore, the adoption of integrated approaches means that "risk governance cannot be reduced to calculable quantitative risk, but must be interpreted broadly, as referring to situations characterized by uncertainty, even ignorance, and complexity, implying a plurality of irreducible perspectives" (De Marchi, 2015, p. 151).

Recent advances in recognizing societal actors are noticeable in Koch et al. (2016) and in Fischer et al. (2016). Wildfire risk governance is associated with actors' networks capacity to design and implement preventive action (Koch et al., 2016). Considering the wildfire governance system as the complex interplay between the social and ecological conditions and processes that influence human decision making, Fischer et al. (2016) have indicated that adaptive actions and social learning expand the problem solving capacity needed to address wildfire risk at appropriate spatial, temporal, and social scales.

Repercussions of risk integration are probed in open processes of deliberation and negotiation, as a learning process to surpass the formal and prescriptive modes of regulation and knowledge generation (Assmuth et al., 2009). Thus, social learning and negotiation are essential to place wildfire risk in the integrated risk approach. In this regard, Merino (2015) has created environmental scenarios with local actors' participation as an instrument of current fire management strategies in the context of social-ecological systems in France. Edgeley and Paveglio (2016) examined the factors that contribute to stakeholder involvement for a successful implementation of early warning systems (EWS), which findings illustrate that EWSs are most likely to be successful when stakeholders have shared understandings of the hazard and opportunities for collective planning to address risk.

As seen, there are there are different ways of framing the wildfire risks. Classically, studies focus on building knowledges to support calculable quantitative wildfire risk or focus on fire management, whas means generate knowledge to the reactive mitigation of wildfire. Nevertheless, the thesis presented here is that a better way of framing wildfire risk is associated with anticipatory approach in order to manage complex social-ecological systems under conditions of uncertainty as well the need of recognising societal actors by considering the plurality of views, and enhancement of social learning.

1.3. Learning from societal actors

The transformation of meaning, purposes and consequences of fire use in Rondônia and Galicia can be either interpreted as a gradual increase or decrease of complexity in their socio-ecological systems over time because of changes resulting from anthropogenic action, induced by multiple socio-economic processes and political decisions. The perspective of social-ecological systems overcomes the dichotomy between society and nature attempting to understand the interface between ecology and social sciences (Folke, 2007). The incessant recreation of situations that engender wildfire in the social-ecological systems requires the study of historic processes, and the identification of the several drivers and actors involved in wildfire scenario. Unexpected catastrophic shifts in social-ecological systems and economic crises that cascade across national borders and regions are events that challenge the steering capacity of governance at all political levels (Duit and Galaz, 2008) and at all societal sectors. Hence, look backward by examining the interplay among societal actors, the emergence of organizational structures, institutional dynamics, and power relations associated with the wildfire risk could be advantageous to understand the current governance conditions and better envision the future. Furthermore, look frontward implies the need of acknowledging the advances in risk governance framework, which can contribute to a better understanding of the possibility of governing wildfire risk in both areas.

A central part of risk governance is risk communication (Kasperson, 2015; Renn, 2015) because the experience of risk is "the result of communication processes by which groups and individuals learn to acquire or create interpretations of risk and risk frames" (Kasperson, 2015, p.485).

Risk communication is understood by the Committee on Risk Perception and Communications of the US National Research Council (NRC) as:

> […] an interactive process of exchange of information and opinion among individuals, groups and institutions. It involves multiple messages about the nature of risk and other messages, not strictly about risk, that express concerns, opinions or reactions to risk messages or to legal and institutional arrangements for risk management. (US NRC 1989: 1)

There is a contradiction in this conceptualization. Risk communication is said to involve multiple messages, but the expression 'reaction to risk messages' disaffirm the extended way of understanding risk communication.

Commonly, the discussion of risk communication focuses on the dicothomy of two approaches: one-way and two-way communication. The discussion presented here seeks to go beyond because communication is understood as a social learning process.

Although conceptually risk communication evolve towards social learning process, in practice, these approaches co-exist and overlap. The evolution of the main ideas concerning risk communication are illustrate in Figure 1. The figure presents the analytical categories that will be explored through the chapters of this dissertation.

Figure 1.Conceptual evolution of risk communication

The one-way risk communication risk information is conveyed from experts or authorities to lay citizens. In this traditional approach there is an imbalance between superior, competent knowledge of experts and inferior knowledge or ignorance of lay citizen (De Marchi, 2015). There is a clear demarcation between the arena of experts and the public arena. Experts are considered the legitimated actors to construct risk analysis, which attempts turn uncertainties into calculable risks. On the other hand, the public is considered as a passive agent who must receive the expert information and be educated to decrease their level of ignorance about the risks. The ultimate aim of risk communication, in this approach, is to reduce public ignorance. One-way risk communication is also utilized by media when framing risk and transforming risk information in news. Ironically, the role of media is, in many contexts, the most effective form of transmiting risk information in the one-way approach.

The emergence of two-way communication opens way for public feedbacks. The two-way information flow by near-instantaneous feedback is able to clarify and rectify

the broadcast of disaster information (Sood, 1987).

The emergence of two-way communication does not mean that one-way communication is abandoned. A key conclusion of Jönsson et al. (2016) is that public risk communication in the array of cross-national environmental risks is restricted to one-way information. Using the term 'two-way learning' between science and society, Pidgeon et al. (2006) have attempted to conceptualize – in a more inclusive approach – the public participation in risk policy. Nevertheless, 'two-way' does not seem to be the suitable expression to address the learning process. A more inclusive approach implies that the learning process is multi-directional and interactive.

The ultimate goal of risk communication, according to Renn (2010), is to assist stakeholders (understood as parties affected by risks) to make informed choices about matters that concern them. In this study, it is presented a basic discordance with this statement. The expression stakeholders limits the understanding the range of actors in the risk scene. Societal actors are spread in the public and private sectors, unions and parties, academy and different sectors of civil society at different levels. Not considering the wholeness of actors - means a simplification in invisioning complex problems. Considering the societal actors in the learning process implies that all actors can learn from each other. The idea of societal learning in terms of fire risk stands on "the notion of management of risk, with individuals, communities, governments and other organizations learning together what they can each do to create a sustainable approach to wildland fire management" (Olson et al., 2015, p.18). Thus, emphasis in learning implies the much-needed deconstruction of hierarquies among knowledges.

Disasters, according to Fra.Paleo (2015) entail a learning gain, but "opportunities for sharing, on a continued basis, information, knowledge, and concerns about gaps on the construction and distribution of risk among societal groups, as an instrumental component of risk communication, are lacking" (Fra.Paleo, 2015, p. 243). In this way, participatory instruments can be a powerful ally to construct spaces for sharing risk knowledge among societal actors. Rigorous and participatory methods are required to to recognize complex problem and find acceptable solutions (Godet, 2010). More than finding acceptable solutions, participatory methods can represent their selves a learning gain among societal actors. In other words, considering the different experiences and perceptions of the problem is itself an act of thinking complexly the problem handled. In this way, scenario building as a disciplined method for imagining and describing possible future developments, dynamics and exploring the consequences or joint impact of uncertainties and complexities (Schoemaker, 1995; Chermack et al., 2004; Van Notten and Rotmans, 2001; Duinker and Greig, 2007, Kosow and Gabner, 2008) can be constructed participatively. Via negotiaton, societal actors can discuss, handle uncertainties, and think together about possible futures. Uncertainty ceases to be a "monster", using a De Marchi (2015) expression, or a subject strictly of experts, to become a part of the discourse of societal actors.

Hence, a coherent inclusion of societal actors in governance processes also contributes to advance the discussion of integrated disaster risk research because this framework attempts to embrace multiple scales, the multiple societal actors, types of knowledge, disciplines, methodological approaches, areas of application and real experiences (Gall et al., 2015). This in no way means that this process is free of conflicts. On the contrary, the emergence of conflicts and different points of view can highlight the existent dilemmas in the arena of wildfire risk. The learning process itself

contributes qualitatively with the discussion of the risk governance by the possibility of extending the actors' comprehension of the risk and raise societal awareness. Besides, the outcomes of negotiation and collective learning processes achieved in the participatory sessions are translated in future wildfire risk scenarios, which can be an instrument to guide decision-making.

1.4. Wildfire in context

Two study areas are examined, Rondônia (in the Brazilian Amazon) and Galicia (in northwestern Spain). Different as they are, the comparative analysis will serve to identify harmonies and discordances in wildfire risk in dissimilar social-ecological systems. The first discernible difference is that wildfires in Rondônia are inseparably and complexly connected to deforestation processes while in Galicia they are linked (as well complexly) to the afforestation process. According to PRODES1 (2016) the accumulated deforested area in Rondônia from 1988 (when monitoring started) to 2016, is of 57.879 km². The deforested area in Rondônia since 1998 is almost as twice as large as the total area of Galicia[2]. Thus, the dimensions of wildfires in the studied areas are very dependent on geographical scale (Figure 2). However, it does not mean that the problem is less relevant in Galicia. In this region, between 2001 and 2010, fires affected 1,183 km of forested areas and 1,768 km² of bushland, representing a total of 2,887 km² (MAGRAMA, 2012). This means that about 4.99% of the total area of Galicia is affected by wildfires. In the same period, wildfires affected 22.184 km² (PRODES, 2016) in Rondônia, which is about 9.34% of the total area. Bearing in mind their geographical extent, wildfires represent a threat in both social-ecological systems. In fact, the framework of social-ecological systems to frame wildfire risk in both areas is a way of recognizing the interdependencies among risk factors in their wider contexts.

[1]Data based on satellite monitoring provided from INPE http://www.obt.inpe.br/prodes/index.php
[2] The area of Rondônia is of 237.590,543 km² (IBGE, 2016) while the area of Galicia is of 29.574 km² (IGE, 2016).

Figure 2.Location of the areas of study. Source: elaborated with information from Natural Earth

Wildfire risk in Rondônia should be understood in the wider context of the Brazilian Amazon. Rondônia, together with Mato Grosso (one of its neighboring states), constitute almost half of the Brazilian arc of deforestation (Fearnside et al., 2009). The arc of deforestation is a wide farming front based on industrial farming and cash crops that make the rainforest retreat, with the highest rates of deforestation of the Amazon. There are 500 thousand km² of land that go from the east and south of Pará in a westerly direction, passing through Mato Grosso, Rondônia and Acre (Malhado et al., 2010, IPAM, 2016). The expansion of this frontier is indicated by the expansion of pastures and crops and clearing fires throughout the Amazonia (Le Page et al., 2010) with goods produced on illegally deforested areas. In 2008, the Brazilian government elaborated a "black list" of municipalities with the highest deforestation rates in the Amazon. With the purpose to deter deforestation, the government reduces access to credit lines, eliminating subsidies for farmers and applying fines for illegal clearing and burning in that region (Stickler and Almeida , 2008; Nepstadet al., 2009). This further increases the constraints for small and poor farmers, who are more dependent on these credit lines than landowners.

The 'queimadas' are a multipurpose practice – mostly farming-related -, such as clearing, favoring grass growth and coverage, vegetation control on streets and roadsides (Pyne, 2012). However, Fearnside (2005) used the term queimadas to identify the practice of burning degraded forests after having cleared the old-growth forest. Deforestation and fire are thus inseparably interrelated in the Amazon and, by extension, in Rondônia. This is how queimadas are identified as deforestation fires (Adeney et al., 2009; Le Page et al., 2010) or as clearing fires (Cochrane, 2003; Cochrane and Laurence, 2002), while Barlow et al. (2012) prefer to call them

Amazonian fires as associated to the region. They receive different names, but all refer to the expansion of a farming frontier whose root causes are related to the increase of global markets for commodities replacing local demand as the primary driver of tropical forest conversion for agriculture (De Fries et al., 2010). Road construction has also been identified as the major driver of deforestation fires. Kirby et al. (2006) indicate that, without road access, colonization and deforestation would be virtually inexistent. Other scholars anticipate that deforestation fires tend to become more dominant in the Amazonia because of the increasing feedback between rapid frontier expansion and droughts (Cochrane and Laurence, 2008, Lee et al., 2011, Davidson et al., 2012, Brando et al. 2014). Nevertheless, multiple factors intervene in the wildfire problem. The demand for pasture and cash crops – more specifcally soy - to support the industrial farming of animal husbandry, driven by an increasing global demand of beef, as well as changes in the value of the Brazilian currency (Real) made deforestation fires escalate in the Amazon area (Arima et al., 2007; Nepstad et al., 2006; Adney et al., 2009). Those are some evidences that corroborates that wildfires in Rondônia shoud be framed as complex problem.

In Spain and Galicia, the terms forest fire[3] and wildfire are used indistinctively in the scientific literature and policy making. Wildfire can be found, for example, in Martinez et al. (2007), and Pausas et al. (2009) in the context of Spain. In the Galician context, the term wildfire is used, for example, by Balsa-Barreiro and Hermosilla (2013), Varela et al. (2010) and Rios Pena et al. (2015). The fact that Galicia has a sparsely population pattern and that nearly half of the population lives in highly populated areas (IGE, 2011), explains why authors such as Calviño-Cancela et al. (2016) believe that wildfire risk should be understood in that region as a case of generalized wildland-urban interface. Framing wildfire as a complex problem entails the need to consider more factors such as rural flight and urban growth, in a rapidly transition from a rural to a urban society, based on service economy and on the expansion of some industrial sectors; accompanied by the afforestation of both agrarian and forested areas for commercial forestry. Wildfire risk in Galicia should be understood in the wider context of the European Union. Other southern European countries, such as Portugal, France, Italy and Greece are also seriously affected by wildfires every year (Calviño-Cancelas et al., 2016). From 2006 to 2011, these five countries registered more than 280,000 wildfires, burning about 2,000,000 ha (European Commission, 2014; Calviño-Cancela et al., 2016). Actually, a range of European countries exchange practices on fire prevention, mitigation, restoration and other activities related to fire management by the European Forest Fire Information System (EFFIS) (European Commission, 2014). This represents an attempt of collectively tackling the problem by having an overview of the national and regional efforts undertaken.

The wildfire data of Rondônia is provided by the Brazilian national program Queimadas[4], endorsed by the national Institute for Space Research (INPE – Instituto Nacional de Pesquisas Espaciais). Data collection is based on wildfire monitoring with satellite observation –MODIS-, and modelling of wildfire risk based on near real-time hot spot detection. The INPE has unparalleled ability capacity to monitor its forest from space by using USA satellites NOAA, Terra and GOES are used in this modeling.

[3] http://mediorural.xunta.gal/areas/forestal/incendios_forestais/
[4] http://www.inpe.br/queimadas

Satellite monitoring data was made available to state governments by a team of NASA-supported scientists working on the large-scale biosphere–atmosphere experiment in Amazonia (Boyd, 2008). The cooperation among Brazilian and north-American scientists pioneering methods and technologies for tracking monitoring deforestation in the Amazon illustrates an international attempt of tackling a problem, which is not considered as limited to the national or regional scales. According to Tollesfson (2008) the greatest rates of deforestation in the world, responsible for 20% of the world's greenhouse gas emissions, are taking place in the Brazilian states of Mato Grosso, Pará and Rondônia. Due to the climate change discussions and the sustainable demands of transnational civil society, wildfires in Rondônia are associated with the international debate on global sustainability. Evolution of the number of hotspots in Rondônia detected by mentioned satellite monitoring is showed in the Figure 3.

Figure 3. Evolution of the number of hotspots in Rondônia as detected through satellite monitoring from 1998 to 2016. Source: Elaborated with data from Queimadas Program, INPE (2016).

If concerns and strategies to cope with deforestation fires in the Brazilian Amazon are not limited to national or regional scales, environmental changes triggered by the dynamics of global market cannot be forgotten. Boundaries, basic rules are being negotiated among global business and national States, trasnational civil society movements, supranational organizations and national governments and societies (Beck, 2005). Thus, wildfires in Rondônia reflect not only the inability of regional and national public policies to cope with unsustainable activities, but it is also related to the role of global markets. Translegal power, according to Beck (1992), also means quasi-states authority over authority, once they have to make quasi-political decisions. This is discussed in detail in the chapter 2. The point is that the diversity of responsibility is associated with the increasing of the complexity both in the understanding of the wildfire risk and the suitable measures.

Regarding the national agencies responsible for mitigating wildfires in Rondônia, the national Environmental Agency (IBAMA- *Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis*), through the PrevFogo program, is responsible for the promotion, support, coordination and implementation of education,

research, monitoring, prevention and suppression of forest fires throughout the whole country (IBAMA, 2015). ICMbio (*Instituto Chico Mendes de Conservação da Biodiversidade*) is the department responsible for conservation units (CUs) [5]and therefore, their fire management. Regionally, the state Environmental Agency (SEDAM - *Secretaria do estado de desenvolvimento ambiental*) does not have any wildfire mitigation program. Finally, the Environmental Military Police of the State of Rondônia is responsible for investigating and applying fines in case of environmental offences, inclusive wildfires.

There is a hiatus among international, national and regional in framing and designing measures to tackle wildfire risk. On the one hand, international and national efforts are noticeable in monitoring fires such as the cooperation between Brazilian and North-American research agencies. On the other hand, the regional environmental agency does not give any practical treatment to the question. Regionally, there is not reactive, and even less preventive mitigation policies.

The agency responsible for mitigating wildfires in Galicia is under the Department of Rural Affairs of the regional administration, the Xunta de Galicia. This department provides information on the fire risk index on a daily basis and elaborates a yearly plan for prevention and suppression of wildfires, so-called PLADIGA (*Plan de prevención e defensa contra os incendios forestais de Galicia*). Data is gathered through fieldwork, using a standard questionnaire, applied by officials of the department of Xunta de Galicia or by officials of the nature protection service of the National Guard, SEPRONA (Servicio de Protección de la Naturaleza). This questionnaire examines the causes of wildfires classified as lightning, negligence and accidental, intentional, unknown, previous fire reproductions (MAGRAMA, 2012). Data are submitted to build the national database EGIF (*Estadística General de Incendios Forestales*), which submits wildfire information annually to the European Forest Fire Information System (EFFIS). The EFFIS provides harmonized information on forest fires in the pan-European region – beyond the European Union (European Commission, 2014). Sharing on continued basis wildfire risk information can represent a step more in advancing the disaster learning process. The Figure 4 shows the evolution of the number of wildfire ignitions in Galicia from 1998 to 2015 elaborated with data from MAGRAMA.

[5] In response to the high rate of deforestation observed in Rondônia and other Amazonian states, state and federal agencies worked to create a network of conservation units (CUs) in Brazil during the 1990s that was signed into law (Law 9985/00) in 2000. The creation of conservation units in Rondônia has been useful in curbing deforestation within their boundaries; however, many CUs face pressure from the combined activities of illegal loggers, cattle ranchers and small scale farmers seeking new sources of timber and agricultural land (Pedlowski, et al., 2005).

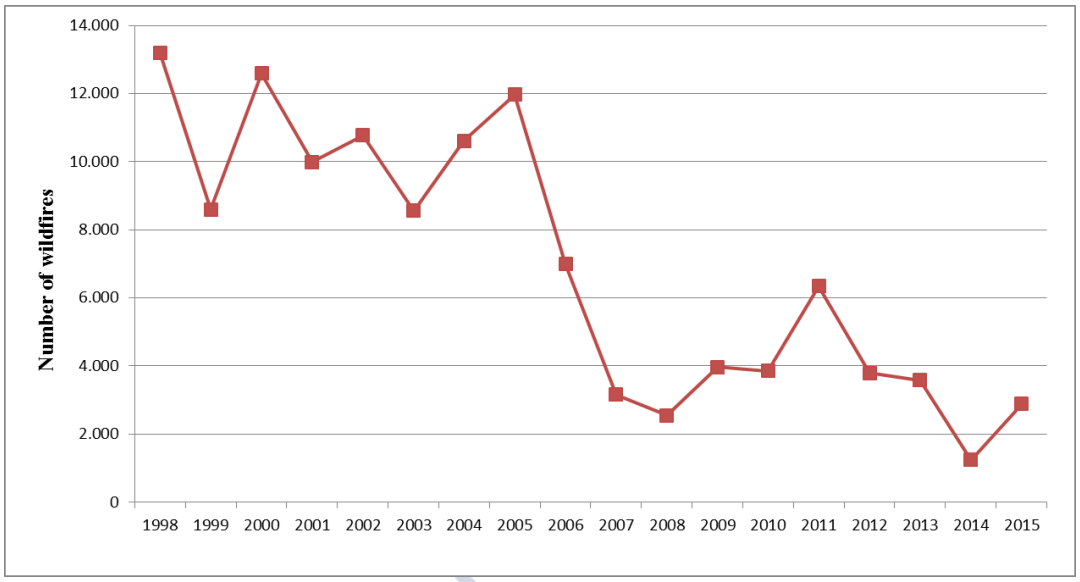


Figure 4. Evolution of the number of wildfire ignitions in Galicia from 1998 to 2015. Source: Elaborated with wildfire statistics from MAGRAMA (2002).

In Rondônia and Galicia wildfires have a paired legal consideration. In Rondônia, the first regulatory instrument for the management of wildfire risk is the federal Forest Code (Law 4.771/1965), later updated through the Law 12.651/2012. But wildfire risk is also regulated by the law 9.605/98, which deals with environmental violations. In Galicia, wildfire risk policy making and management fall under the regional administration. Law 3/2007 regulates the prevention and suppression of wildfires. But in 2016, landscape management through the Decree 119/2016 identifies wildfires as triggering environmental impact – degradation - on various Galician landscapes. Although this study does not focus on legal issues, this example reveals non-negotiated ways of framing and understanding the problem within the same government level.

According to Burton (1993), public agencies are expected to move away from a focus on natural hazard reduction to integrate hazard mitigation as an integral part of sustainable development. Although wildfire risk in Rondônia and Galicia is very different in terms of geographical scale, it represents similar challenges due the need of a shift in their governance models. In both places, wildfire results from complex socio-economic processes and political decisions, but integrated mechanisms and institutions able to frame and tackle the problem in a complex way are lacking. The Galician wildfires' guidelines provides that means of mitigating fires cannot be implemented an isolated fashion, but rather integrating it in a broader context of territorial planning and rural development. However, scholars have criticized the excessive focus on reactive mitigation of wildfires in Galicia (Pérez and Delgado, 1995; Corbelle and Crecente, 2008). Whether due to the lack of a territorial plan in Rondônia or due to the lack of a precautionary approach in Galicia, both realities highlight the need for coherent risk governance. Integrated risk governance - able to embrace societal actors in a learning process – can be an instrument to produce a shift in their governance models.

1.5. Methods

Methods, instruments and data collection procedures are explained further in each chapter but an overview is provided here to inform about set of approaches, which are: a) textual analysis of local printed media and websites to explore aspects of risk communication; b) actor mapping in order to identify the range of actors directly or indirectly intervening in the wildfire scenario; c) informant interview with actors identified in the map in order to explore the perception and values of societal actors about the evolution of wildfire risk; and a d) focus group in which societal actors voluntarily participate in order to construct scenarios of wildfire risk through processes of public participation and negotiation.

The comparative study is justified by the possibility of constructing scenarios through exploring - together with societal actors - historical, political, economic, demographic, and environmental factors related to the evolution of wildfire risk. These factors, or root causes, are associated -according to Collins (2008) - with dynamic processes such as population changes, rapid urbanization, and depletion of natural resources, global economic pressures, and political conflict. This author pointed out that qualitative methods, including historical synthesis and analysis of interview transcripts and field notes, provided a subtle understanding of lived experiences and contextual processes that influence differential risk.

This study examines these experiences in two different areas to identify harmonies and distinctiveness in wildfire risk. Based on societal actors' perceptions and values, the negotiation in a non-hierarchical process is advantageous to achieve societal learning about wildfire risk. Nevertheless, an analytical prevention must be taken. Although there are similarities in ideas and institutions between societies, this does not imply that their meanings are the same, highlighting the need for exploring the way in which risks are embedded in the social fabric, requiring intensive qualitative case analysis (Boholm, 1998). This reinforces further the negotiation process in which actors can agree and disagree, bringing not only the driving factors but also the current dilemmas regarding wildfire risk in each area.

a) Textual analysis

Analysis of local printed media was used to explore the nature of risk information transmitted in both places. News articles dealing with wildfires published in mainstream printed media in 2015 in Rondônia (Diário da Amazônia) and Galicia (El Progreso) have been used. Since the Amazonia is the focus of world attention as regards to environmental processes, an analysis of on-line news articles on wildfires in Rondônia in 2015 has been performed. Thus, this analysis focuses on media as an actor in wildfire risk and their role in collecting, interpreting and producing information. The existing risk communication channels, the types of information generated, and how it is communicated have been examined in order to understand the dominant approach of risk communication in Rondônia and Galicia.

b) Actor mapping

Actor analysis supports the identification of key actors, their interests, influence and importance, mobilizing relevant knowledge from a broad actor base and providing important building block in the preparation of participatory policy processes (Grimble and Wellard, 1997; Hermans et al., 2006). Actor mapping was the method used to identify the actors of different sectors closely associated with wildfire risk in both areas. It was also necessary to compare and identify matching, similar or nonexistent institutions/organizations in Rondônia and Galicia, that organize the actors around their goals in each territory. It has served as a base to identify which actors should be interviewed in each study area and join the focus groups. Finally, field interviews allowed having feedback and completing the actor map.

c) Informant interviews

The potential benefit of robust qualitative interviewing is to explore the ways in which participants experience and construct their lives (Ritchie, et al., 2014). In this study, the interviews enriched the identification of perceived factors of wildfire risk and recognize the key discourses. 65 and 83 field interviews were respectively conducted in Rondônia (Figure 5) and Galicia (Figure 6).

The interviews were semi-structured, with open-ended questions within a standard framework used for both areas. There were two types of target groups interviewed, farmers, and actors from two governmental levels and civil society representatives. The interview was organized in three sections: 1) perception of citizens about changes in the area including land use and landscapes, population change, farming and forest property, as well actors perception of industrial and economic services in the areas where they reside; 2) risk memory, perception, attitude, actors, and proposed risk mitigation measures; 3) links between common land management and wildfire risk.

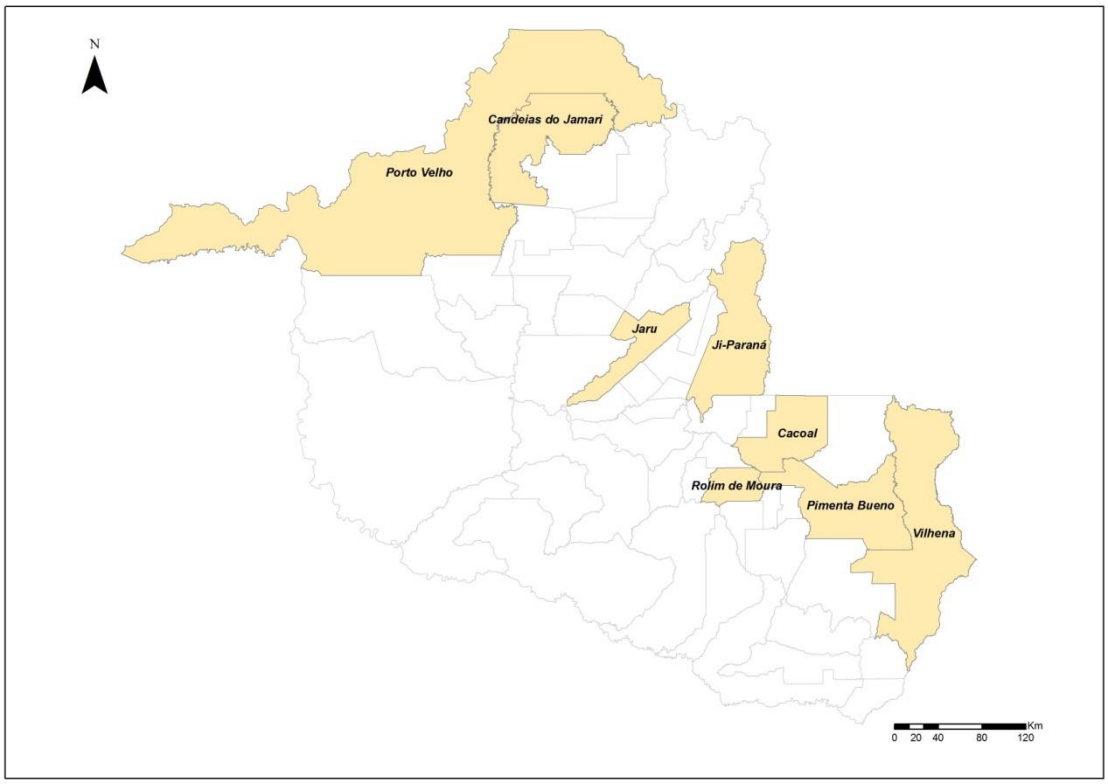


Figure 5. Municipalities where the interviews were performed in Rondônia. Source: elaborated with data from with IBGE, 2016.

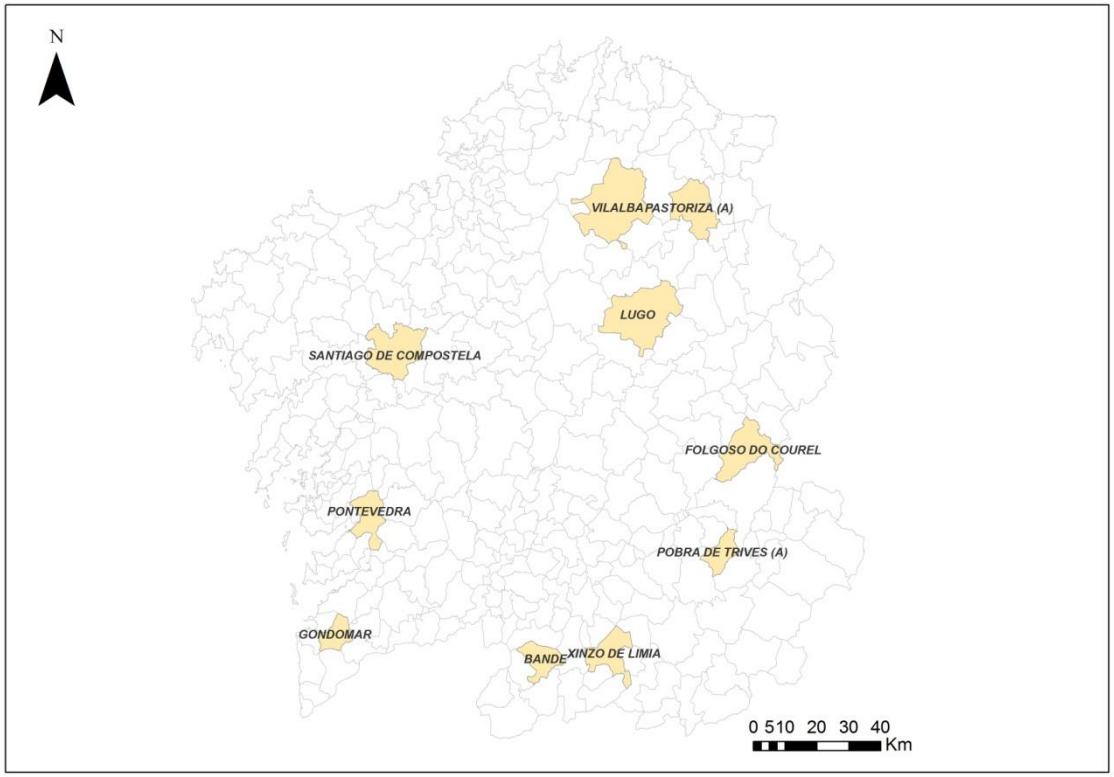


Figure 6. Municipalities where the interviews were performed in Galicia. Source: elaborated with data from with IGN, 2016.

d) Focus group

The distinguishing feature of the focus group is the interaction between participants with different backgrounds and representing various societal groups to generate information (including strangers or friends, lay people or professionals). They are encouraged to talk to one another and engage in debate: questioning, commenting on each other's' experiences and points of view, wishes and concerns (Kitzinger and Barbour, 1999). The sessions sought the participatory construction of future scenarios of wildfire risk. Four sessions took place in Rondônia and three in Galicia to reach the ultimate goal.

When studying wildfire risk, some recent use of this instrument is noticeable. Edgeley and Paveglio (2016) used focus groups comprising a broad range of local stakeholders to explore how residents, resource managers, and hazard management professionals conceive wildfire risk and the implementation of early warning systems as a mitigation approach.

Participatory methods similar to those applied in this study were used by Devisscher et al. (2016) who adopted a participatory approach to involve local actors drove attention to the anticipation of wildfire future risk in the Bolivian Amazon. They combined informant interviews (with indigenous communities, private cattle ranchers, local authorities and regional experts) and focus groups. The main difference between these two examples is that their focus groups were conducted just with experts. The fact that participants of their focus groups were just experts - who interpreted informant interviews construct scenarios – legitimates the perceptions of experts as the most suitable. Differently, the present study attempted creates a space for deliberation, social learning and awareness among other societal actors.

1.6. Organization and content of the dissertation

This dissertation is organized in five chapters. The discussion regarding wildfire risk governance in the study areas takes a chronological approach, examining elements of the past, present and future.

Chapter Two presents a discussion about the historic evolution of wildfires and the notion of hazard in Rondônia and Galician. Although the evolution of wildfire risk is unique to each context, in the realities of Rondonian and Galician people and ecosystems, increasing exposure to wildfires is not accompanied (or is weakly accompanied) by the emergent challenges of risk governance. In this way, past experience is considered a source of learning about the nature of the mechanisms developed by these societies to deal with the wildfire risk over time.

Chapters Three and Four address to the present, in that they explore current conditions and specifications related to wildfire risk in the areas studied, but more importantly, identify contemporary challenges in the introduction of communicative and participative approaches in models of governance.

Hence, Chapter Three seeks to examine how wildfire risk is communicated by

different actors via local and international media, official public channels and at the local level.

The main purpose of Chapter Four, in turn, is to understand what can be learned about disaster risk through a pluralistic consideration of societal values and perspectives, when research takes a more participatory form.

Since this participatory research was ultimately aimed at wildfire risk scenarios, Chapter Five explores future challenges to risk governance in the study areas through a discussion of wildfire risk scenarios.

References

Adeney, J. M., Christensen Jr, N. L., & Pimm, S. L. (2009). Reserves protect against deforestation fires in the Amazon. *PLos one*, 4(4), e5014.

Allison, H. E. (2015). Understanding and Conceptualizing Risk in Large-Scale Social-Ecological Systems. In: U. Fra. Paleo (Ed.) *Risk Governance: The Articulation of Hazard, Politics and Ecology*. New York-London: Springer, 99-115.

Anton, C. E., & Lawrence, C. (2016). Does place attachment predict wildfire mitigation and preparedness? A comparison of wildland–urban interface and rural communities. *Environmental management*, 57(1), 148-162.

Arima, E. Y., Simmons, C. S., Walker, R. T., & Cochrane, M. A. (2007). Fire in the Brazilian Amazon: a spatially explicit model for policy impact analysis. *Journal of Regional Science*, *47*(3), 541-567.

Armitage, D. R., Plummer, R., Berkes, F., Arthur, R. I., Charles, A. T., Davidson-Hunt, I. J., Diduck, A. P., Dubleday, N. C., Johnson, D. S., Marschke, M., McConney, P., Pinkerton, E. W.,& Wollenberg, E.K. (2008). Adaptive co-management for social–ecological complexity. *Frontiers in Ecology and the Environment*, 7(2), 95-102.

Assmuth, T., Hilden, M., Lyytimaki, J., Benighaus, C., & Renn, O. (2009). Big pictures, close-ups, roadmaps and mind-maps: perspectives on integrated treatment of multiple risks. *International Journal of Risk Assessment and Management*, *13*(3-4), 294-312.

Bajocco, S., Pezzatti, G. B., Mazzoleni, S., & Ricotta, C. (2010). Wildfire seasonality and land use: when do wildfires prefer to burn?. *Environmental monitoring and assessment*, 164(1-4), 445-452.

Bardsley, D. K., Weber, D., Robinson, G. M., Moskwa, E., & Bardsley, A. M. (2015). Wildfire risk, biodiversity and peri-urban planning in the Mt Lofty Ranges, South Australia. *Applied Geography*, *63*, 155-165.

Barlow, J., Parry, L., Gardner, T. A., Ferreira, J., Aragão, L. E., Carmenta, R., ... & Cochrane, M. A. (2012). The critical importance of considering fire in REDD+ programs. *Biological Conservation*, *154*, 1-8.

Balsa-Barreiro, J. & Hermosilla, T. (2013). Socio-geographic analysis of the causes of the 2006's wildfires in Galicia (Spain). *Forest Systems*, *22*(3), 497-509.

Beck, U. (1992). *Risk society: Towards a new modernity* . London: Sage Publications.

Beck, U. (2005). *Power in the global age*. Cambridge: Polity

Bistinas, I., Oom, D., Sá, A. C., Harrison, S. P., Prentice, I. C., & Pereira, J. M. (2013). Relationships between human population density and burned area at continental and global scales. *PLoS One*, *8*(12), e81188.

Boholm, A. (1998). Comparative studies of risk perception: a review of twenty years of research. *Journal of risk research*, *1*(2), 135-163.

Boholm, Å., Corvellec, H., & Karlsson, M. (2012). The practice of risk governance: lessons from the field. *Journal of Risk Research*, *15*(1), 1-20.

Boyd, E. (2008). Navigating Amazonia under uncertainty: past, present and future environmental governance. *Philosophical Transactions of the Royal Society of London B: Biological Sciences*, *363*(1498), 1911-1916.

Boyd, E., Nykvist, B., Borgström, S., & Stacewicz, I. A. (2015). Anticipatory governance for social-ecological resilience. *Ambio*, *44*(1), 149-161.

Brando, P. M., Balch, J. K., Nepstad, D. C., Morton, D. C., Putz, F. E., Coe, M. T., & Alencar, A. (2014). Abrupt increases in Amazonian tree mortality due to drought–fire interactions. *Proceedings of the National Academy of Sciences*, *111*(17), 6347-6352.

Breakwell, G. M. (2007). *The Psychology of Risk*. United Kingdom: Cambridge University Press.

Brenkert-Smith, H., Dickinson, K. L., Champ, P. A., & Flores, N. (2013). Social amplification of wildfire risk: The role of social interactions and information sources. *Risk Analysis*, *33*(5), 800-817.

Bryman, A. (2012). *Social research methods* (4th ed*)*. United Kingdom: Oxford University Press.

Burton, I., Kates, R. W., White, G. F. (1993). *The environment as hazard*. New York: The Guilford Press.

Burton, L. (2012). The Comparative Jurisprudence of Wildfire Mitigation: Moral Community, Political Culture, and Policy Learning. *Oñati Socio-Legal Series*, *3*(2), 234-253.

Calkin, D. E., Ager, A. A., & Gilbertson-Day, J. (2010). *Wildfire risk and hazard: procedures for the first approximation*. General Technical Report RMRS-GTR-235.

Calviño-Cancela, M., Chas-Amil, M. L., García-Martínez, E. D., & Touza, J. (2016). Wildfire risk associated with different vegetation types within and outside wildland-urban interfaces. *Forest ecology and management*, *372*, 1-9

Castells, M. (2000). The contours of the network society. *Foresight*, *2*(2), 151-157.

Chapin, F. S., Kofinas, G. P., & Folke, C. (Eds.). (2009). *Principles of ecosystem stewardship: resilience-based natural resource management in a changing world*. New York: Springer.

Chermack, T. J. (2004). Improving decision-making with scenario planning. *Futures*, 36(3), 295-309.

Cochrane, M. A. (2003). Fire science for rainforests. *Nature*, *421*(6926), 913-919.

Cochrane, M. A., & Laurance, W. F. (2002). Fire as a large-scale edge effect in Amazonian Forests. *Journal of Tropical Ecology*, 18(3), 311-325.

Cochrane M. A., Skole, D.L., Matricardi, E.A.T., Chomentowski, W.H. (2002). *Interaction and synergy between selective logging, forest fragmentation and fire disturbance in tropical forests*: Case study Mato Grosso, Brazil. OGCEO Research Advances 03-02/W. East Lansing, Michigan USA. 26.

Cruz, M. G., Sullivan, A. L., Gould, J. S., Sims, N. C., Bannister, A. J., Hollis, J. J., & Hurley, R. J. (2012). Anatomy of a catastrophic wildfire: the Black Saturday Kilmore East fire in Victoria, Australia. *Forest Ecology and Management*, *284*, 269-285.

Davidson, E. A., de Araújo, A. C., Artaxo, P., Balch, J. K., Brown, I. F., Bustamante, M. M.,. & Munger, J. W. (2012). The Amazon basin in transition. *Nature*, *481*(7381), 321-328.

Decree 119/2016. Catalog of landscape of Galicia. 25 August 2016.

De Fries, R. S., Rudel, T., Uriarte, M., & Hansen, M. (2010). Deforestation driven by urban population growth and agricultural trade in the twenty-first century. *Nature Geoscience*, *3*(3), 178-181.

De Marchi, B. (2015). Risk Governance and the Integration of Different Types of Knowledge. In: U. Fra.Paleo (Ed.). *Risk Governance: The Articulation of Hazard, Politics and Ecology*.New York-London: Springer, 149-165.

Del Gaudio, C., Ricci, P., Verderame, G. M., & Manfredi, G. (2016). Observed and predicted earthquake damage scenarios: the case study of Pettino (L'Aquila) after the 6th April 2009 event. *Bulletin of Earthquake Engineering*, 1-36.

Desportes, I., Waddell, J., & Hordijk, M. (2016). Improving flood risk governance through multi-stakeholder collaboration: a case study of Sweet Home informal settlement, Cape Town. *South African Geographical Journal*, *98*(1), 61-83.

Devisscher, T., Boyd, E., & Malhi, Y. (2016). Anticipating future risk in social-ecological systems using fuzzy cognitive mapping: the case of wildfire in the Chiquitania, Bolivia. *Ecology and Society*, *21*(4).

Douglas, M. (1985). *Risk acceptability according to the social sciences*. New York: Russell Sage Foundation.

Duinker, P. N., & Greig, L. A. (2007). Scenario analysis in environmental impact assessment: Improving explorations of the future. *Environmental impact assessment review*, 27(3), 206-219.

Duit, A., & Galaz, V. (2008). Governance and complexity—emerging issues for governance theory. *Governance*, *21*(3), 311-335.

Ebi, K. L., & Burton, I. (2008). Identifying practical adaptation options: an approach to address climate change-related health risks. *Environmental Science & Policy*, *11*(4), 359-369.

Edgeley, C. M., & Paveglio, T. B. (2016). Influences on stakeholder support for a wildfire early warning system in a UK protected area. *Environmental hazards*, *15*(4), 327-342.

Eiser, J. R., Bostrom, A., Burton, I., Johnston, D. M., McClure, J., Paton, D., van der Pligt, J., & White, M. P. (2012). Risk interpretation and action: A conceptual framework for responses to natural hazards. *International Journal of Disaster Risk Reduction*, *1*, 5-16.

Ellis, E. C., & Ramankutty, N. (2008). Putting people in the map: anthropogenic biomes of the world. *Frontiers in Ecology and the Environment*, *6*(8), 439-447.

European Commission (2014). Forest fires in Europe, middle east and north Africa 2013. Available in: http://bookshop.europa.eu/is-bin/INTERSHOP.enfinity/WFS/EU-Bookshop-Site/en_GB/-/EUR/ViewPublication-Start?PublicationKey=LBNA26791 Accessed 21 December 2016.

Fearnside, P. M. (2005). Desmatamento na Amazônia brasileira: história, índices e conseqüências. *Megadiversidade*, *1*(1), 113-123.

Fearnside, P. M., Righi, C. A., de Alencastro Graça, P. M. L., Keizer, E. W., Cerri, C. C., Nogueira, E. M., & Barbosa, R. I. (2009). Biomass and greenhouse-gas emissions from land-use change in Brazil's Amazonian "arc of deforestation": The states of Mato Grosso and Rondônia. *Forest Ecology and Management*, *258*(9), 1968-1978.

Fischer, A. P., Spies, T. A., Steelman, T. A., Moseley, C., Johnson, B. R., Bailey, J. D., & Kline, J. D. (2016). Wildfire risk as a socioecological pathology. *Frontiers in Ecology and the Environment*, *14*(5), 276-284.

Flyvbjerg, B. (1998). Habermas and Foucault: thinkers for civil society?. *The British Journal of Sociology*, *49*(2), 210-233.

Folke, C., Hahn, T., Olsson, P., & Norberg, J. (2005). Adaptive governance of social-ecological systems. *Annu. Rev. Environ. Resour.*, *30*, 441-473.

Folke, C. (2007). Social–ecological systems and adaptive governance of the commons. *Ecological research*, *22*(1), 14-15.

Fournier, M., Larrue, C., Alexander, M., Hegger, D., Bakker, M., Pettersson, M., Crabbé, A., Mees, H., & Chorynski, A. (2016). Flood risk mitigation in Europe: how far away are we from the aspired forms of adaptive governance?. *Ecology and Society*, *21*(4).

Fra.Paleo, U. (2010). *Recursos naturais, sistemas de informação geográfica e processos sociais.* Viçosa, MG: UFV; Visconde do Rio Branco: Suprema.

Fra.Paleo, U. (Ed.) (2015). *Risk Governance: The Articulation of Hazard, Politics and Ecology*. New York-London: Springer.

Gall, M., Nguyen, K. H., & Cutter, S. L. (2015). Integrated research on disaster risk: Is it really integrated?. *International journal of disaster risk reduction*, *12*, *255-267*.

Godet, M. (2000). The art of scenarios and strategic planning: tools and pitfalls. *Technological forecasting and social change*, *65*(1), 3-22.

Gomá, J. (2013). ¿Dónde está la gran filosofía. *El País*, *14*(03).

Gray, S. A., Gray, S., Cox, L. J., & Henly-Shepard, S. (2013, January). Mental modeler: a fuzzy-logic cognitive mapping modeling tool for adaptive environmental

management. In *System Sciences (HICSS), 2013 46th Hawaii International Conference on* IEEE. pp. 965-973

Grimble, R., & Wellard, K. (1997). Stakeholder methodologies in natural resource management: a review of principles, contexts, experiences and opportunities. *Agricultural systems*, *55*(2), 173-193

Guyette, R. P., Muzika, R. M., & Dey, D. C. (2002). Dynamics of an anthropogenic fire regime. *Ecosystems*, *5*(5), 472-486.

Hermans, L. M. 2008. *Exploring the promise of actor analysis for environmental policy analysis: lessons from four cases in water resources management*. Ecology and Society 13(1): 21. [online]

Höppner, C., Buchecker, M., & Bründl, M. (2010). *Risk communication and natural hazards*. CapHaz-Net WP5 Report, Swiss Federal Research Institute WSL.. Available at: http://caphaznet.org/outcomes-results/CapHaz-Net_WP5_Risk-Communication.pdf Accessed 02 February 2017.

Hurlbert, M., & Gupta, J. (2016). Adaptive Governance, Uncertainty, and Risk: Policy Framing and Responses to Climate Change, Drought, and Flood. *Risk Analysis*, *36*(2), 339-356.

IBAMA - Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis. . Available in: http://www.ibama.gov.br/index.php?option=com_content&view=article&id=644:centro-nacional-de-prevencao-e-combate-aos-incendios-florestais-prevfogo&catid=344&Itemid=101. Accessed 15 May 2015.

INPE - Instituto Nacional de Pesquisas Espaciais (2016). Portal do Monitoramento de Queimadas e Incêndios. Available in: http://www.inpe.br/queimadas. Accessed 17 January 2017.

International Risk Governance Council. (2005). *Risk governance: Towards an integrative approach*. Geneva: IRGC.

IPAM - Instituto de pesquisa ambiental da amazônia (2016). *Glossário.* Available in: http://ipam.org.br/glossario/. Accesed 16 July 2016.

Jönsson, A. M., Boström, M., Dreyer, M., & Söderström, S. (2016). Risk Communication and the Role of the Public: Towards Inclusive Environmental Governance of the Baltic Sea?. In *Environmental Governance of the Baltic Sea* (pp. 205-227). Springer International Publishing.

Kalabokidis, K., Ager, A., Finney, M., Athanasis, N., Palaiologou, P., & Vasilakos, C. (2015, May). AEGIS: Wildfire Prevention and Management Information System. In *Book of Abstracts of International Conference on Fire Behaviour and Risk* , 26-29.

Kasperson, J. X., & Kasperson, R. E. (2001). Border crossings. *Transboundary risk management*, 207-243.

Kasperson, R. E. Risk governance and the social amplification of risk: a commentary. In: U. Fra.Paleo (Ed.) (2015). *Risk Governance: The Articulation of Hazard, Politics and Ecology*. New York-London: Springer, 485-488.

Kirby, K. R., Laurance, W. F., Albernaz, A. K., Schroth, G., Fearnside, P. M., Bergen, S., & Da Costa, C. (2006). The future of deforestation in the Brazilian Amazon. *Futures*, *38*(4), 432-453.

Klinke, A., & Renn, O. (2012). Adaptive and integrative governance on risk and uncertainty. *Journal of Risk Research*, *15*(3), 273-292.

Koch, G., Ager, A., Kline, J., & Fischer, P. (2016). Polishing the prism: improving wildfire mitigation planning by coupling landscape and social dimensions. Science Findings 189. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

Koivisto, R., Wessberg, N., Eerola, A., Ahlqvist, T., Kivisaari, S., Myllyoja, J., Halonen, M. (2009). Integrating future-oriented technology analysis and risk assessment methodologies. Technol. Forecast. Soc. Change, 76 (9), 1163–1176.

Kontogianni, A. D., Papageorgiou, E. I., & Tourkolias, C. (2012). How do you perceive environmental change? Fuzzy Cognitive Mapping informing stakeholder analysis for environmental policy making and non-market valuation. *Applied Soft Computing*, *12*(12), 3725-3735.

Kosow, H., & Gaßner, R., Deutsches Institut für Entwicklungspolitik gGmbH (Ed.): (2008). *Methods of future and scenario analysis: overview, assessment, and selection criteria*. Bonn, DIE Studies 39.

Lana, J.M. (2016). From privatisation to governed nature. Old and new approaches to rural commons in Spain. *Ländliche Gemeingüter: Kollektive Ressourcennutzung in der europäischen Agrarwirtschaft= Rural commons: collective use of resources in the European agrarian economy/Niels Grüne, Jonas Hübner, Gerhard Siegl (Hg.)*, 12-26.

Law 4771/1965. Brazilian Forest Code, 15 September 1965.

Law 12.651/2012. New Brazilian Forest Code, 25 May 2012.

Law 9605/98. Environmental Crimes, 12 February 1998.

Law 3/2007. Prevention and mitigation of wildfires in Galicia. 9 April 2007.

Le Page, Y., van der Werf, G. R., Morton, D. C., & Pereira, J. M. C. (2010). Modeling fire-driven deforestation potential in Amazonia under current and projected climate conditions. *Journal of Geophysical Research: Biogeosciences*, *115*(G3).

Lee, J. E., Lintner, B. R., Boyce, C. K., & Lawrence, P. J. (2011). Land use change exacerbates tropical South American drought by sea surface temperature variability. *Geophysical Research Letters*, *38*(19).

Levidow, L. (2007). European public participation as risk governance: enhancing democratic accountability for agbiotech policy?. *East Asian Science, Technology and Society: an International Journal*, *1*(1), 19-51.

Linke, S., Gilek, M., Karlsson, M., & Udovyk, O. (2014). Unravelling science-policy interactions in environmental risk governance of the Baltic Sea: comparing fisheries and eutrophication. *Journal of Risk Research*, *17*(4), 505-523.

Linkov, I., Satterstrom, F. K., Kiker, G., Batchelor, C., Bridges, T., & Ferguson, E. (2006). From comparative risk assessment to multi-criteria decision analysis and

adaptive management: Recent developments and applications. *Environment International*, 32(8), 1072-1093.

Lövkvist-Andersen, A. L., Olsson, R., Ritchey, T., & Stenström, M. (2004). Modelling Society's Capacity to Manage Extraordinary Events. In *Conference of the SRA (Society for Risk Analysis), Paris.* 15-17.

MAGRAMA (2012). *Los Incendios Forestales en España. Decenio 2001-2010*. Ministerio de Agricultura, Alimentación y Medio Ambiente: Madrid.

Malhado, A. C. M., Pires, G. F., Costa, M. H., & Ferreira, T. D. M. E. (2010) A conservação do cerrado é essencial para proteger a floresta amazônica. Resenhas e críticas. *Ambio*: A Journal of Human Environment.

Marey-Pérez, M. (2006). Using GIS to measure changes in the temporal and spatial dynamics of forestland: experiences from north-west Spain. *Forestry: An International Journal of Forest Research*, *79*(4), 409-423.

Martínez, M. B., García, M. L. L., & Amil, M. L. C. (2007). Aproximación a las pérdidas económicas ocasionadas a corto plazo por los incendios forestales en Galicia en 2006. *Economía agraria y recursos naturales*, (14), 45-64.

Massada, A. B., Radeloff, V. C., Stewart, S. I., & Hawbaker, T. J. (2009). Wildfire risk in the wildland–urban interface: a simulation study in northwestern Wisconsin. *Forest Ecology and Management*, *258*(9), 1990-1999.

Mees, H. L., Driessen, P. P., & Runhaar, H. A. (2014). Legitimate adaptive flood risk governance beyond the dikes: the cases of Hamburg, Helsinki and Rotterdam. *Regional Environmental Change*, *14*(2), 671-682.

Merino, A. (2015). Vivre avec le feu en région méditerranéenne: une approche participative multicritère et multi-scénarios appliquée au cas du massif des Maures (Var, France). Doctoral dissertation, Université de Versailles-Saint-Quentin-en-Yvelines.

Merrill, D. F., & Alexander, M. E. (1987). *Glossary of forest fire management terms*. (4th edition). Canadian Committee on Fores Fire Management. National research Council of Canada, Ottawa, Ontaro.

Murungweni, C., Van Wijk, M. T., Andersson, J. A., Smaling, E. M., & Giller, K. E. (2011). Application of fuzzy cognitive mapping in livelihood vulnerability analysis. *Ecology and Society*, *16*(4), 8.

Mythen, G. (2015). The Problem of Governance in the Risk Society: Envisaging Strategies, Managing Not-knowing. In U. Fra.Paleo, *Risk Governance: The Articulation of Hazard, Politics and Ecology*. New York-London: Springer. 43-57

Nepstad, D., Schwartzman, S., Bamberger, B., Santilli, M., Ray, D., Schlesinger, P., & Rolla, A. (2006). Inhibition of Amazon deforestation and fire by parks and indigenous lands. *Conservation Biology*, *20*(1), 65-73.

Nepstad, D., Soares-Filho, B. S., Merry, F., Lima, A., Moutinho, P., Carter, J., Browman, M., Cattaneo, A., Rodrigues, H., Schwartzman, S., McGrath, D. G., Stickler, C. M., Lubowski, R., Piris-Cabezas, P., Rivero, S., Alencar, A., Almeida, O., & Stella, O. (2009). The end of deforestation in the Brazilian Amazon. *Science*, *326* (5958), 1350-1351.

Nuttall, M. (2010). Anticipation, climate change, and movement in Greenland. *Études/Inuit/Studies*, 21-37.

Olson, R.L.; Bengston, D.N.; DeVaney, L.A.; Thompson, T.A.C. (2015). *Wildland Fire Management Futures: Insights from a Foresight Panel*; USDA Forest Service General Report NRS-152.

Österblom, H., & Folke, C. (2013). Emergence of global adaptive governance for stewardship of regional marine resources. *Ecology and Society*, *18*(2), 4.

Pausas, J. G., Llovet, J., Rodrigo, A., & Vallejo, R. (2009). Are wildfires a disaster in the Mediterranean basin?–A review. *International Journal of Wildland Fire*, 17(6), 713-723.

Pedlowski, M. A., Matricardi, E. A. T., Skole, D., Cameron, S. R., Chomentowski, W., Fernandes, C., & Lisboa, A. (2005). Conservation units: A new deforestation frontier in the Amazonian state of Rondônia, Brazil. *Environmental Conservation*, *32*(02), 149-155.

Pelling, M., High, C., Dearing, J., & Smith, D. (2008). Shadow spaces for social learning: a relational understanding of adaptive capacity to climate change within organisations. *Environment and Planning A*, 40(4), 867-884.

Pérez J, Delgado JL, (1995). Análisis del riesgo de incendio forestal en Galicia. *Agricultura y Sociedad* 77, 109-123.

Pidgeon, N., Simmons, P., & Henwood, K. (2006). Risk, environment and technology. In P. Taylor-Gooby, & J. Zinns (Eds.), *Risk in social science*. Oxford: Oxford University Press.

Poli, R. (2010). The many aspects of anticipation. *Foresight-The journal of future studies, strategic thinking and policy*, 12(3), 7-17.

Poli, R. (2011). Steps toward an explicit ontology of the future. *Journal of Futures Studies*, 16(1), 67-78.

Popa, F., Guillermin, M., & Dedeurwaerdere, T. (2015). A pragmatist approach to transdisciplinarity in sustainability research: From complex systems theory to reflexive science. *Futures*, 65, 45-56.

Prestemon, J. P., Pye, J. M., Butry, D. T., Holmes, T. P., & Mercer, D. E. (2002). Understanding broadscale wildfire risks in a human-dominated landscape. *Forest Science*, 48(4), 685-693.

PRODES. Monitoramento da floresta amazônica brasileira por satélite Available in: http://www.obt.inpe.br/prodes/index.php. Accessed 04 January 2016.

Pyne, S. J. (2012). *Fire*: nature and culture. London: Reaktion Books.

Quay, R. (2010). Anticipatory governance: A tool for climate change adaptation. *Journal of the American Planning Association*, 76(4), 496-511.

Radeloff, V. C., Hammer, R. B., Stewart, S. I., Fried, J. S., Holcomb, S. S., & McKeefry, J. F. (2005). The wildland–urban interface in the United States. *Ecological applications*, 15(3), 799-805.

Renn, O. (2004). The challenge of integrating deliberation and expertise. *Risk analysis and society: An interdisciplinary characterisation of the field*, 289-366.

Renn, O. (2010). Risk communication: insights and requirements for designing successful communication programs on health and environmental hazards. *Handbook of Risk and Crisis Communication.* New York/London: Routledge, 80-98.

Renn, O., & Klinke, A. (2015). Risk governance and resilience: New approaches to cope with uncertainty and ambiguity. In U. Fra. Paleo (Ed.). *Risk Governance: The Articulation of Hazard, Politics and Ecology*. New York-London: Springer. p. 19-41.

Renn, O. (2015). Stakeholder and public involvement in risk governance. *International Journal of Disaster Risk Science*, *6*(1), 8-20.

Renn, O., & Walker, K. (2008). Lessons learned: A re-assessment of the IRGC framework on risk governance. In: Renn, O & Walker,K. (Eds.). *Global risk governance: concept and practice using the IRGC Framework*. Netherlands: Springer, 331-367.

Ritchey, T. (2006). Modeling multi-hazard disaster reduction strategies with computer-aided morphological analysis. In *Reprint from the Proceedings of the 3rd International ISCRAM Conference, Newark, NJ*. 9-11.

Ritchey, T. (2009). Developing scenario laboratories with computer-aided morphological analysis. In *14th international command and control research and technology symposium, Washington DC*. 15 (17), 6.

Ritchie, D. A. (2014). *Doing oral history*. Oxford University Press.

Robles, A., Rodríguez-Garrido, M. A., & Alvarez-Taboada, M. F. (2016). Characterization of wildland-urban interfaces using LiDAR data to estimate the risk of wildfire damage. *Revista de Teledetección*, (45), 57-69.

Rosa, E. A. (2008). White, black, and gray: critical dialogue with the International Risk Governance Council's Framework for Risk Governance. In: O. Renn & K. Walker (Eds.). *Global risk governance: concept and practice using the IRGC Framework.*. Netherlands: Springer, 101-118.

Schoemaker, Paul J.H., (1995) Scenario planning: a tool for strategic thinking. *Sloan Management Review* 36(2), 25-40

Smit, B., & Wandel, J. (2006). Adaptation, adaptive capacity and vulnerability. *Global environmental change*, *16*(3), 282-292.

Sood, B. R., Stockdale, G., & Rogers, E. M. (1987). How the news media operate in natural disasters. *Journal of Communication*, *37*(3), 27-41.

Steelman T. A (2008) Communities and wildfire policy. In: Donoghue EM, Sturtevant V (eds) *Forest community connections: implications for research, management, and governance*. Washington DC: Resources for the Future.

Steelman, T. (2016). US wildfire governance as social-ecological problem. *Ecology and Society*, *21*(4):3, 1-14.

Stickler, C. M., & Almeida, O. T. (2008). Harnessing international finance to manage the Amazon agro-industrial explosion? The case of international finance corporation loans to Grupo Maggi. *Journal of Sustainable Forestry*, *27*(1-2), 57-86.

Tait, J. (2008). Risk governance of genetically modified crops–European and American perspectives. In O. Renn & K. Walker (Eds.). *Global risk governance: concept and practice using the IRGC Framework*. Netherlands: Springer, 133-153

Tedim, F., Leone, V., & Xanthopoulos, G. (2016). A wildfire risk management concept based on a social-ecological approach in the European Union: Fire Smart Territory. *International Journal of Disaster Risk Reduction*, *18*, 138-153.

Thompson, M. P., Calkin, D. E., Finney, M. A., Ager, A. A., & Gilbertson-Day, J. W. (2011). Integrated national-scale assessment of wildfire risk to human and ecological values. *Stochastic Environmental Research and Risk Assessment*, *25*(6), 761-780.

Thompson, M. P., Scott, J., Helmbrecht, D., & Calkin, D. E. (2013). Integrated wildfire risk assessment: framework development and application on the Lewis and Clark National Forest in Montana, USA. *Integrated environmental assessment and management*, *9*(2), 329-342.

Tollesfson, J. (2008). *Brazil goes to war against logging*. Published online 12 March 2008/Nature 452, 134-135.

Tutsch, M. S. (2009). *People are the problem and the solution: characterizing wildfire risk and risk mitigation in a wildland-urban intermix area in the Southern Gulf Islands*. Doctoral dissertation, School of Resource and Environmental Management-Simon Fraser University.

US NRC (National Research Council) (1989*) Improving risk communication*. Washington, DC: National Academy Press.

Van Asselt, M. B. (2005). The complex significance of uncertainty in a risk era: logics, manners and strategies in use. *International Journal of Risk Assessment and Management*, *5*(2-4), 125-158.

Van Asselt, M. B., & Renn, O. (2011). Risk governance. *Journal of Risk Research*. 14 (4), 431-449.

Van Notten, P.; Rotmans, J. (2001). The future of scenarios. *Scenario and Strategy Planning*, 1(3), 4–8.

Varela, M. E., Benito, E., & Keizer, J. J. (2010). Effects of wildfire and laboratory heating on soil aggregate stability of pine forests in Galicia: The role of lithology, soil organic matter content and water repellency. *Catena*, *83*(2), 127-134.

Wachinger, G., Renn, O., Begg, C., & Kuhlicke, C. (2013). The risk perception paradox—implications for governance and communication of natural hazards. *Risk analysis*, *33*(6), 1049-1065.

2. Evolution of wildfire context in Rondônia and Galicia

2.1. Introduction

Throughout history, both fire and the notion of hazards have been present in social-ecological systems. The view presented in this chapter holds that, in the realities of Rondonian and Galician people and ecosystems, increasing exposure to wildfires is not accompanied or is weakly accompanied by the emergent challenges of risk governance.

Those challenges are conditioned by the historic evolution of the problem unique to each context. At the same time, those challenges are associated with the social sources of adaptability, renewal, and transformation to manage complex social-ecological systems (Folke et al., 2005, Armitage et al., 2008; Popa et al., 2015). According to the viewpoint of social-ecological systems, the dichotomy between society and nature is overcome by understanding the interfaces between ecology and social sciences (Folke, 2007). As well, the Long-Term Social-Ecological Research (LTSER) has emerged with the objective of providing knowledge base by examining changes in social-ecological systems over time in order to reorient socioeconomic paths towards more sustainable ways (Singh et al., 2013). Fire is, in this way, the analytic category used in this study that permits an analysis of the imbalance between changes and the challenges of governance and sustainability in the social-ecological systems of Rondônia and Galicia.

The transformation in the use of fire and the notion of fire as a hazard in both areas parallels the transformation of models and notions that have guided societies in their various and intermixed processes of development. The ancient use of fire is a defining feature of human-environmental interaction (Goudsblom, 1992; Bowman et al., 2011).

Fire regimes, to use the scientific terminology, address those human interactions which assume a distinguishable pattern. Authors have argued that wildfires become a problem when changes in land use or the pattern of settlement are driven by substantial changes in socio-economic model, which in turn, may result in abrupt shifts in the wildfires regimes (Velez-Muñoz, 1999; Pausas, 2012). Besides, the continual use of fire is culturally framed and transmitted even in the context of rapid changes (Pyne, 1997). The ideas, values, beliefs, social construction around fire give clues about how societies frame this problem, or if even societies consider it one problem. The definition of 'unwanted' perturbations and risks depends on the particular style of development predominant in a given society, and may be interpreted in different ways by various societal actors or by different traditions of fire management. Social, economic, politic, environmental and technological changes also engender a new way of understanding and handling risks. Thus, risk as an aspect of decision making is linked to an attribution process constructed by the observer. Nevertheless, "when future possible damages are seen as being caused by a decision, this decision runs a risk – whether or not the negative outcome in fact occurs and whether or not the decision maker takes such possibility into account or whether it is attributed to him only after the event" (Luhmann, 1996, p.6)

If framing risk decisions is an attempt in modern societies to legitimate the potential failures of rational decision-making (Luhmann, 1993), the reverse can also be true. Omitting risk decisions or making up actions as risk decisions is an attempt to obscure elements that are engendering risk. Rothstein (2006) pointed out that framing the objects of governance as risks is a matching attempt to manage threats to society as well as reflexively manage the negative institutional externalities of governance itself. That is the reason why, according to the author, concerns about risk are driven less by a changing distribution of real (or imagined) ills in society, than by an ever-changing distribution of ills in governance (Rothstein, 2006).

The transformation of the meaning, purposes and consequences of fire employment can be interpreted as a gradual increase (or decrease) in the complexity of socio-ecological systems over time because of changes resulting from anthropogenic action, induced by multiple socio-economic processes and political decisions. The evolution complexity of socio-ecologic systems is, in turn, inseparably linked to changes and the emergence of uncertainties. In Allison's (2015) view, the efforts to reduce the risk of "unwanted" perturbations in social –ecological systems and the potential to cross a threshold should address changes that affect resilience rather than the mere control of disturbance. Resilience is, in turn, the analytic category by which to understand how social and natural systems can face disturbances and changes (Gunderson and Holling, 2002). In order to face changes and uncertainties, "social-ecological systems may display resilience or alternatively cross a threshold and enter a maladaptive functional state, in which there is reduced ability to continue to produce the goods and services required by society" (Allison, 2015, p.106).

Understanding different cultural traditions and political influences, on both the local and geopolitical scale, in the management of fire is essential for evaluating the costs and benefits of contrasting fire regimes within individual landscapes and biomes (Bowman et al., 2011). In their analysis, Bowman et al. (2011) cite Brazil as one example, where environmental measures have contributed to reducing Amazonian deforestation rates by over 70%. Nevertheless, recent PRODES data reveals that in the period 2015 and 2016 total deforestation in Amazon increased 29%, and in Rondônia, 35% (INPE, 2017). The persistence of the problem, whether in Rondônia or Galicia, demonstrate that the governance models adopted are continuouslty re-creating situations that engender wildfire in landscapes. The incoherent or inexistent risk governance fully demonstrates the presence of a rational choice based in ideas or ideology that led to the current day's scenario. Exploring wildfires historic context in the social-ecological systems can give clues about why institutional, scientific, social or bureaucratic mechanisms are weakly lined up to the risk governance challenges.

2.1.1. Fire, hazards and risks in Rondônia and Galicia

The use of fire and also the notion of hazard in the socio-ecological systems of Rondônia and Galicia have been changing over time. The evolution of the ideas - that guide social practices and rational decisions, certainly those related to risk - interact with various processes of development of each society.

Beck et al. (1994) has coined the term 'reflexive modernity' to refer to the transition from the industrial period of modernity to risk society, which comes about in an unwanted, unperceived and compulsive manner as a consequence of the autonomous

dynamism of modernization. In first modernity, the distinction between national and international helped to shape the world, including its key concepts of society, identity, state, sovereignty, legitimacy, violance and state authority (Beck, 2006). On the other hand, the conceptualization of the world marked by global dynamics goes beyond the national-international distinction. Boundaries, basic rules, and basic distinctions are being negotiated among global business, and the Estate, transnational civil society movements, supranational organizations, national governments, and socities (Beck, 2006).

The view presented here argues that those notions or key-concepts that guide societies' transformation do not evolve toward any unified direction. Far from it, those notions overlap each other; furthermore, they interact locally or regionally with the social-ecological systems. These interactions play a decisive role in the social practices and social understanding of human actions over the environment. In this way, Figure 7 attempts to capture the ways in which these ideas have interacted as to lead to new conceptions of using fire, and the new consequences associated with fire threats in Rondônia and Galicia.

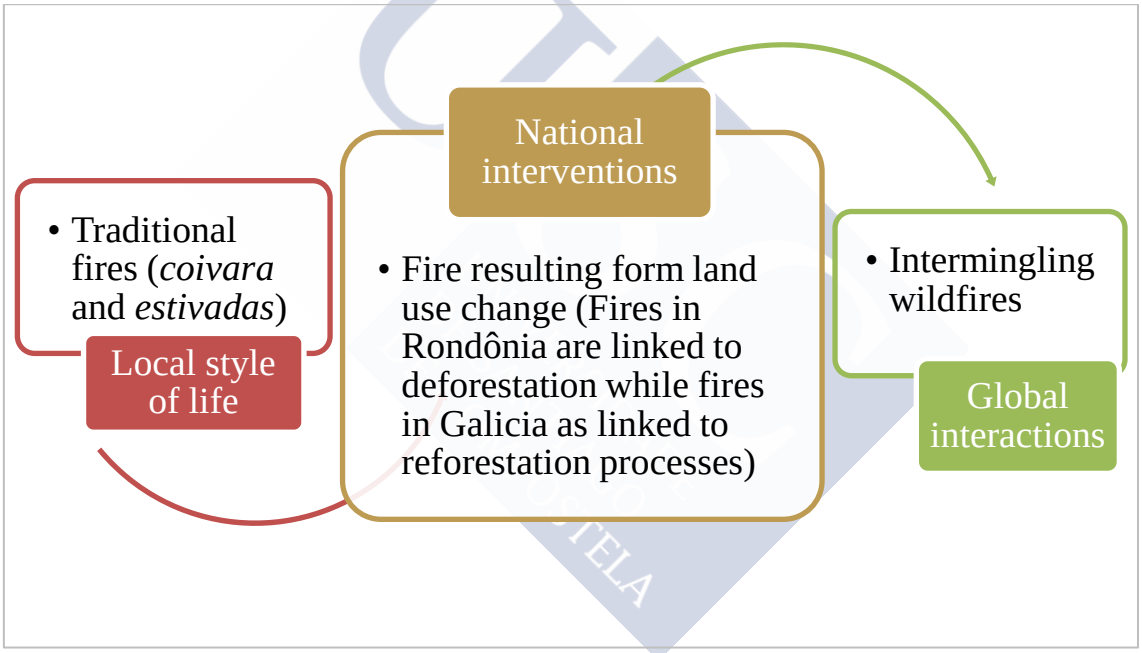


Figure 7. Co-evolution of ideas and practices which led to wildfires in Rondônia and Galicia.

These notions that guide societies' development do not take place synchronically in both areas, but certain key concepts of these notions coincide – albeit in different chronologic times - and similar practices can be found in the ancient style of development of social-ecological systems. There is evidence – such as the high abundance of coal in many soils of Amazon – to suggest that indigenous cultures used to employ fire extensively (Pausas, 2012). In fact, informant interviews with indigenous people in Rondônia, Suruí, Gavião and Karitiana have confirmed that they used to manage fire for agricultural purposes - named as *coivaras* - before first coming into contact with non-indigenous people. Indigenous people of Rondônia used to plant yams, sweet potatoes, and fruit (Fraser, 2010) as well as indigenous corn, Suruí sources have

reported. In Galician rural society, fire has been employed since ancient times as well. Known as *estivadas*, fire was employed as a tool in supplementary cereal harvesting and was the basis of the entire old farming system (Bouhier, 1979; Balboa, 1990). In both places, those traditional practices were aimed at achieving the same goal, employing ash as a fertilizer for the cropland that provided them the essentials of their daily life.

The notion of hazards is also prevalent in both societies throughout their respective histories. One Suruí interviewee reported that, one day before making *coivaras*, people involved in the burning were not allowed to drink water. It was a preventive action based on their traditions and beliefs, aimed at ensuring that the rain would not extinguish the fire, or the wind, spread it. In this case, the major perceived risk is that of not obtaining a suitable harvest. Similarly, villagers living in various rural Galician hamlets have attested to the use of church bells as a traditional fire warning system, by which village members might be recruited to help mitigate damage. In the period of interventions of national states, wildfires emerge in both locations as a result of deliberate change in land use. Based on the ideology of national integration promoted by the military government in Brazil, agrarian settlements were developed in Rondônia. Those policies were incorporated into the National Integration Program (*Programa Nacional de Integração – PIN I and PIN II*), which, apart from national integration objectives, had as its main goals development of new regions as to accelerate growth of the Brazilian economy and conquer foreign markets (Becker, 2004; Pimenta and Rabelo, 2010; Souza and Pessôa, 2009). These policies were distilled into the catchphrase, "Land without people for people without land." Nevertheless, these interventions had the financial support of international agencies. As a result, Rondônia have evolved - by means of deforestation fires - from a natural and wild state towards a more rural society, mixing traditional features (indigenous, traditional river side, and rubber-gathering communities) and more modern features new building forms, road networks, services, new agricultural and livestock practices), and at the same time, a certain amnesia of local ecologic processes. The late advance of global markets towards Rondônia, and a need to respond to increasing demand for raw materials, has led to the establishment of industrial agriculture and cattle rising. In recent years, traditional farming practices, such as slash and burn, have been combined with agribusiness. This suggests that notions of development styles are interacting as well. This reflects that the notions of various styles of development also are interacting.

These interactions are also significant in the context of Galicia, and generate separate outcomes. In Franco-era Spain, policy-making goals varied from the fascist-inspired quest for autarky in the 1940s to an overriding concern for neo-liberalism in the 1960s (Harrison, 1980). In Galicia, the policy of autarky under the Franco dictatorship manifested in an increased production of raw forestry materials for industrial use (Lana, 2016), promoting massive afforestation. This afforestation was accompanied by the imposition of restrictions on agrarian uses. The emergence of a new political and economic framework forced the forest use and criminalized fire resultant traditional agricultural activity (Cabana, 2009a). In this way, risk – as a conceptualization instituted by the alien and inadequate models of human nature and human relations tacitly embodied in prescriptions or forms of social control - can pose a threat to basic social identities (Wynne, 1996). Thus, the meaning of wildfire as a threat in Galicia was in the Franco regime strongly related to the limitation of rural uses and emergence of dissuasive sanctions. Complexity around wildfires evolved as notions of development evolved towards international agreements, such as Spain's inclusion into the European Community in 1986, and the dynamic of global markets led to institutional

arrangements such as those promoted by Common Agricultural Policy (CAP). Wildfires in the present day comprise an intermix of complex processes such as rural flight and urban growth, and rapid evolution of rural societies into service-based urban economies, and the expansion of some industrial sectors; accompanied by the afforestation of both agrarian and forested areas for commercial forestry production.

In more recent times, both realities illustrate the interaction among local dynamics, impact of economic development, technological change, international policies, agreements, and interventions.

The capacity of the environment to sustain societal development has diminished over historical time because activities have become globally interconnected and intensified through new technology, capital markets, and systems of governance, with decisions in one place influencing people elsewhere, which leads to vulnerability in many places and regions (Folke et al., 2008). Paying attention to the historical context of wildfires by exploring the factors and elements in interaction and in co-evolution that have made wildfires a risk problem in Rondônia and Galicia can provide the clues needed to understand processes of change and to analyze governance conditions in the highlighted regions.

2.2. Methods

Qualitative analysis of the context of wildfires in Rondônia and Galicia is aimed at examining governance conditions and challenges in these dynamic and complex social-ecological systems. Qualitative approaches are, according to Duit et al. (2010), indispensable to understand governance efforts and also how societies can cope with, reorganizes themselves by, and develop from, disturbances and change. These issues, according to Holling (2001) are the most neglected both in resources management and in scientific study. Critical of the tendency of mathematic models to predominate in resource management, Folke (2006) demanded advances in the understanding of social processes such as learning and social memory, integration of knowledge, scenario building and adaptive governance systems.

For this chapter, bibliographical review and informant interviews *in locu* were combined. The interviews enable, according to Braudel (1974), to access to the various and at times controversial perspectives of social actors, who are at once a substance of the past and matter of current social living practices. In this sense, the interactions between human beings and fire can be interpreted as “experience and what is experienced” (Dewey, 1958) by the human beings in the environment through a reflexive process in which past experience allows for a remodeling of the future (Dewey y Ramos,1949). Past experience is, in this way, an element of learning about the nature of the mechanisms activated by these societies to deal with the wildfire risk.

2.3. Evolution of wildfire context in Rondônia

2.3.1. Traditional fires

Since ancient times, Rondônia was a territory inhabited by Indigenous population. The traditional indigenous way of living in Rondônia in the XVIII century was distinguished by conflicts between different groups and the practice of "slash and burn" on a small scale with agricultural purposes (Mello, 2014). As explained before, coivaras was a practice used for slashing forest and burning areas in order to fertilize the soils (due to the concentration ash and charcoal on it) aimed at producing crops. Traditional people used to produce crops of yam, corn, sweet potato and banana (Fraser, 2010; Abi-Eçab, 2012). It is known that, in the XVIII century, the Tupinambarana (or Tupinambá) indigenous people, from the lower Madeira River (region that currently belongs to the Rondônia State) had commercial relationships with the towns of Viceroyalty in Peru and inter-tribal relationships, participating in political, economic and social networks whose inter-tribal tributes were paid with stone axes, possibly used in the agricultural technique of *coivara* (slash-and-burn) (Mello, 2014).

Attempts of exogenous interventions are noticeable in the construction of the fortress *Príncipe da Beira in Rondônia*, started in 1775, aiming at safeguarding this valuable and unstable Portuguese-Spanish border (Mello, 2016). The workers recruited to carry out this work were the military, indigenous population (the Pareci, Cautario, Txapacura, and Pakaás Novos), black slaves and mestizos (half-breed); which reflect the complex and diverse demographic scene (Nascimento, 2013; Mello, 2016). Due to the Jesuit[6] missions with the indigenous people, livestock and seeds had been brought to the region in order to develop the plains with grass (Bowman, 1913). Théry (2012) pointed out that in that period Rondônia was an isolated and depressing region. This is not completely true. Indigenous populations and some people influx in a small scale are elements by which dynamicity is noticeable by indigenous people in their networks, but also by people's interaction in the context of borders protection.

In the late nineteenth and in the early twentieth centuries, more attempts of exogenous interventions were associated with the rubber boom and the construction of *Madeira Mamoré Railway*. Many workers were brought to that area to construct that railway. It was a feat which engaged Brazilian, North American, Turkish, German, Chinese, Barbados, English, Antillean, Italian and Spanish people (Ott, 2002). Many workers were unable to lay down a single beam, and many died from illnesses such as malaria, yellow fever, and also from conflicts with the natives. In addition, working conditions were hideous, which has interrupted many times the efforts of constructing the highway (Santos Rodrigues, 2010; Théry, 2012).

Not only rubber, but also, cacao, coffee, tobacco, and quinine were in demand, so that the construction of the railway represented the possibility of transporting raw materials to the international market (Vergara, 2015). The Amazonian rubber was used in the automobile industry in the industrialized United States, achieving its zenith in the period of 1880-1910 (Garcia, 2001). Between 1890 and 1910, Amazon produced 60% of wild rubber in the world, so that the increase in prices of rubber managed to

[6]Jesuits is a catholic missionary group that between the sixteenth and eighteenth centuries, with the Society of Jesus, acted in the Catechization of Indigenous populations in Brazil and Latin America.

accomplish what no other previous colonization had been able to: attract dozens of thousands of migrants to the Amazon Forest (Barham & Coomes, 1994). However, from 1910 Asia has become the largest supplier of rubber in the international market. In Brazil, natural rubber was collected randomly in the forest, which made work more difficult and limited the productivity. In Malaysia, the regular and organized plantations of the rubber trees (*hevea brasiliensis*) facilitated work and increased productivity. The transfer of rubber plantations from Brazil to Asia has meant a higher offer of rubber, with less production costs, and a diversification of the use of rubber especially for attending the automotive industry (Dean, 1987). It is also relevant to consider that in Brazil, the harvest was only possible six months per year due to the rain period in addition to illness problems, such as yellow fever and malaria, which made survival conditions in the rainforest more difficult, while in Malaysia the harvest season was more extensive and there were better living conditions in the English and Dutch colonies (Marichal, 2006).

The production of Asian rubber represented 80% of the global production before the II World War, so when Japan conquered the southeast of Asia in 1942, the Allies demanded rubber production in Africa, Latin America, and South Asia to increase (Fenske, 2014). The United States called Brazil and other Latin American countries to take urgent measures to increase the production of natural rubber (Wilkinson, 2009). It is under these circumstances that Rondônia is the scene of a recovery and revival of the rubber cycle in a context of cross-scale economic and social interactions. Two essential factors merged: 1) Brazilian participation in the II World War, and 2) a great drought in the northeast region of Brazil in 1942 that caused 34, 000 workers to move towards the Amazon to be rubber-tappers (Nascimento, 1998). A natural hazard - the drought in the northeast – played in this context an outstanding role that, combined with other factors, has triggered a considerably amount of people to the Amazon in this times characterized by wild features in a context that there were not communication routes.

This migratory process intensified the pressure on the indigenous lands, so that negotiations between rubber-tappers and natives became common in order to obtain a workforce and stop the hostile attacks in exchange for firearms (Wilkinson, 2009). The interview with the Arara Gavião tribe indicates the presence of rubber farmers towards indigenous lands in the middle of the twentieth century:

> In 1952 there was the first contact of non-indigenous with our ethnic group, Arara-Gavião with a rubber farmer and rubber gatherer. Our lands are 50 km away from the Ji-Paraná municipality. (Heliton Gavião, Porto Velho, 53 years, 2015)

A small, gradual, and effective occupation policy was designed to settle people to the land in defense of the borders (Souza, 2011). The railway system provided these places with light, pavement, drinking water, and telephones, as well as schools and community health centers (Ott, 2002), assuring the foundation for future urban systems. The exogenous occupation of Rondônia, since its first attempts, is distinguished by the transnational power as coined by Beck (2002) to refer to *quasi*-political decisions. The railway construction led to *quasi-political* decisions as the additional infrastructure has been built. Although the railways supposed integrated public and private agreements, this infrastructure would not be installed if there were no private power as player of Amazon exploitation.

The construction of the highway made way for a more effective regional occupation in the beginning of the twentieth century on the banks of the Madeira, Mamoré, and Guaporé Rivers, reproducing the forest-wetland-river pattern (*río-várzea-floresta)* in the territorial organization (Silva, 2014).

Although the rubber economical exploration in the Amazon did not achieve expected results by The United States (Nasimento, 1998), this event initiates the insertion of modernity features in the Amazon style of life reproduction. In Pedlowski et al. (1997) viewpoint none of the first settlements in Rondônia that had taken place during rubber boom cycles (the first in the XIX century and the second during the Second World War), had such a lasting impact on the occupation of that portion of the Amazon. Framing the problem by the inter-regional and transnational world-system perspective developed by Wallerstein (1979), these events can be interpreted as the beginning process in which Rondônia became a periphery of core countries. In fact, ecological degradation is seen as both a cause and effect of underdevelopment in non-core regions (Boswell and Chase-Dunn 2000; Burns et al 2003). However, underdevelopment is also a social construction of the core-countries. The discussion presented here is that elements that engender disturbances do not consider previous types of livelihoods.

In the context of the First Republic of Brazil[7] (1889-1930), the idea of national sovereignty through engineering services, cartographical rising, and inspection of the Army Border emerges (Rodrigues, 2010). In 1906, the Brazilian government, interested in fast communication with the Amazon region in order to control the international commerce that went into the territory, designated the military Cândido Mariano da Silva Rondon to build the telegraphic lines that were to connect the state of Mato Grosso with the Amazon (Rodrigues, 2010). The mission would contribute to the settlement of the national telegraphic circuit (Ribeiro, 1958). Rondon's expedition lasted from 1907 to 1915, achieving the first connection between Porto Velho and Cuiabá (capital of Mato Grosso state), 2,700 kilometers long (Théry, 2012). The Commission installed 28 stations, proceeded the geographic raising of 50,000 lineal kilometers of land and water, defined more than 200 geographic coordinates, and registered 12 unknown rivers on the Brazilian map (Ribeiro, 1958).

On Rondon's reports on August 2, 1908, he mentions a large wildfire started by expeditionary close to a lagoon, and extending to the surroundings of the camp at the Juruena Meseta, invading the outlined path and threatening the lives of workers (Rondon, 1916). In the plateaus of the Parecis, according to the description made by Rondon, 1916), hurricanes were not uncommon, mentioning the destruction caused by the wind. However, it is known that in Rondônia there are no hurricanes. Probably these destructed areas mentioned in Rondon's writings were caused by lightning fires. More recent studies have shown that the Parecis plateaus are areas of Brazilian *cerrado*[8] (Prado et al., 2001) and lightning fires in the wet season were shown to be very frequent and probably represent the natural fire pattern in the open vegetation (wet field or grassy savanna-cerrado) (Ramos-Neto and Pivello, 2000). A part of natural fires, in different sections of the writings about the expedition, Rondon mentions the *coivaras* (slash and burn) done by several natives. For example, it is documented that the Nhambiquara had

[7] After the proclamation of the republic on November 15, 1989, the period of government led by the military in Brazil started.
[8] Cerrado one of biomes present in Brazil.

fires to create fields to grow pineapple trees, a fruit that was vital in the diet of an indigenous group (Rondon, 1916). In addition, Rondon mentioned a change of route where telegraphic lines would be installed following these fields to make easier the territory penetration. In other words, fire practiced by indigenous people marked the way of exogenous penetration.

Concerning this period, Bowman (1913) pointed out that in the heart of a long fluvial system and dense rainforest there was a railway, telegraphy system, a harbor for steamboats from the high seas, and a huge potential commercial future, reducing the mystery of the Amazon area.Therefore, this is the very beginning of substantive changes in these socio-ecological systems, by which fire is fire is an enduring and adapted feature.

2.3.2. Wildfires in the context of massive land use change

For centuries, colonization of Rondônia and environmental change was a slow process and boosted the late colonization in the second half of the XX century. Intensive landscape change was driven by the military government political goals, from the 1960s (Silva, 2015; Théry, 2012, Becker, 1991). These policies consisted of relocating people excluded by the process of rural modernization in the south and southeast, or from the dry northeast to the inland. This made possible opening new areas to conquer foreign markets in the context of accelerated growth of Brazilian economy (Becker, 2004; Pimenta and Rabelo, 2010; Souza and Pessôa, 2009). The population settlement in Rondônia is also a result of the rural activities mechanization that excluded many small farmers and farm workers in the South and Northeast (Souza and Grossi, 2010).

Rainforest deforestation is highly cited as the effects of colonization, changing the landscape and the economical activity in the region, formely focused in the subsistence extractive economy and transformed into agrobusiness activities (Silva, 2016). This has produced negative effects on the sustainability and the Amazonian lifestyle, such as the increase in deforestation fires, the dismantling of indigenous groups and of traditional riverside communities – *ribeirinhos* and rubber gathering people. Some protected areas in Brazil hold the diversity of actors as compatible with the sustainable purposes, such as Indigenous lands and conservation unities known as *resex*. These protected areas in Rondônia can be visualized in the figure below.

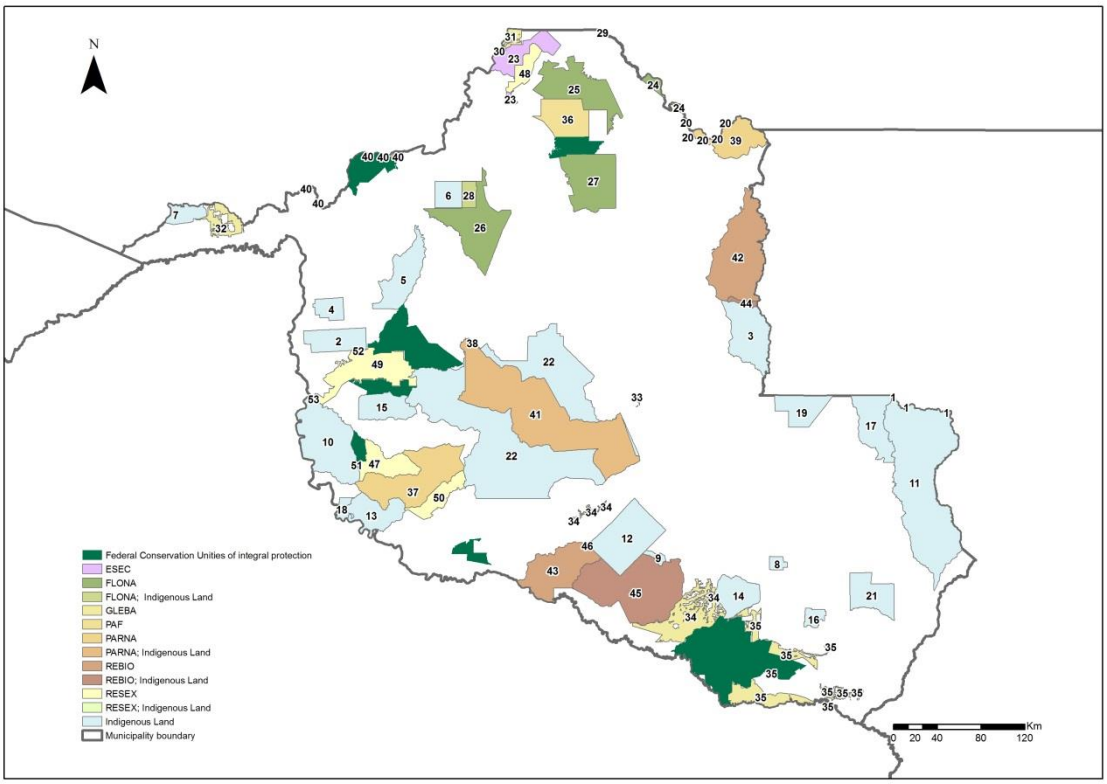
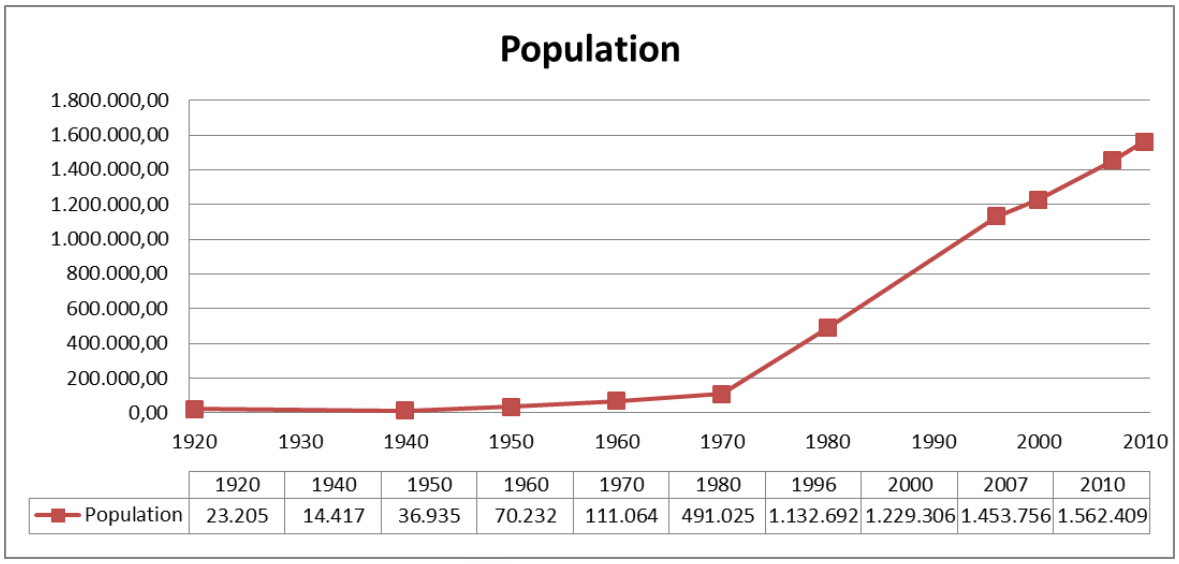


Figure 8. Protected areas in Rondônia. Source: elaborated with information from IBGE, 2015.

In fact, the traditional slash-and-burn system was disseminated in Rondônia as the tool that allowed the entire colonization process. There was a change in the purpose of employing fire. This sets the change in the relationship between society and nature established in the previous centuries.

The creation and paving of the main means of communication (BR-364) and the promotion of settlement projects of colonization generated the abrupt population afflux, presented in the Figure 9.



	1920	1940	1950	1960	1970	1980	1996	2000	2007	2010
Population	23.205	14.417	36.935	70.232	111.064	491.025	1.132.692	1.229.306	1.453.756	1.562.409

Figure 9. Population evolution in Rondônia (number of inhabitants). Source: Elaborated with information from IBGE/IPEAdata (2014).

The highway BR 364, which entails the stretch from Porto Velho to Cuiabá (capital of Mato Grosso), was developed on the axis where the telegraph lines were implanted, which had given rise to the first villages of Rondônia. Once they no longer depended solely on aerial transportation and the navigability of the river, this axis broke up the "isolation" of Rondônia (Théry, 2012).

The construction of the BR 364 road and the colonization projects were two instruments in the occupational strategy of Rondônia, with a spatial movement in the form of a fish spine, in which the principal axis would be BR 364 and in its branches the recently arrived population would be settled. This attracted people officially and spontaneously to the territory (Becker, 1991). Main highways in Rondônia and main urban nuclei are showed in the Figure 10.

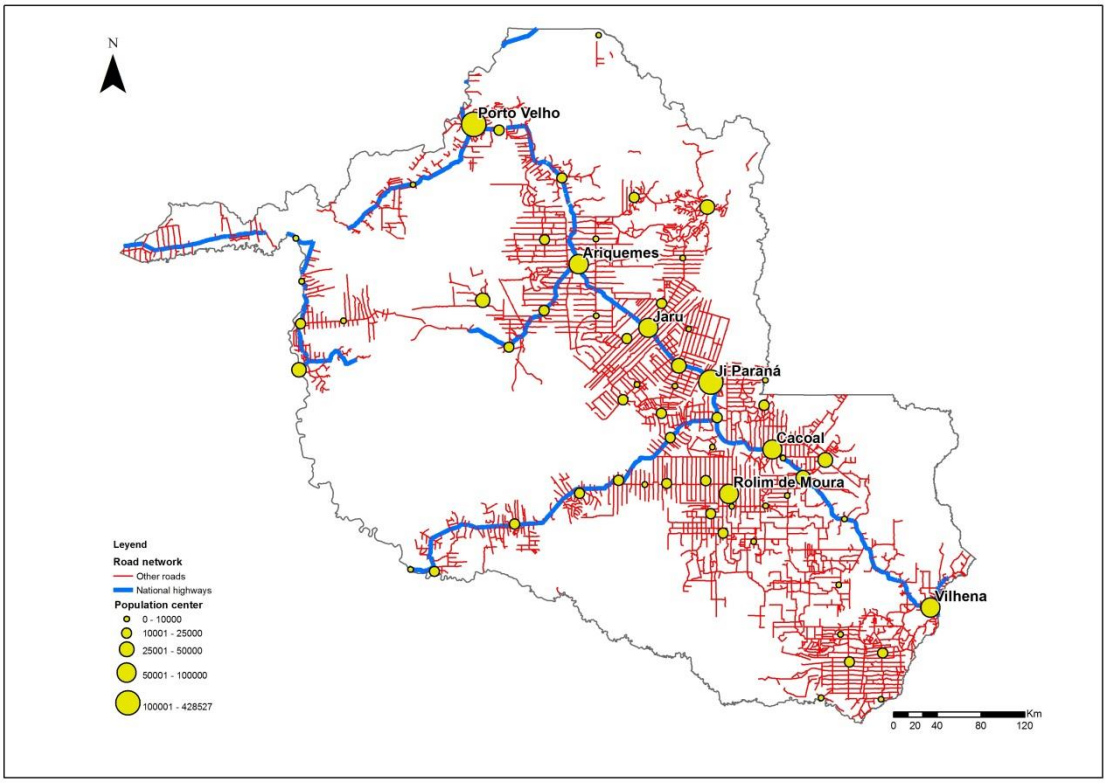


Figure 10. Main highways in Rondônia and main urban nuclei. Source: elaborated with information from IBGE, 2016.

The official colonization of Rondônia occurred through public and private projects. The national Land Statute of 1964 - promulgated in the military dictatorship – was the formal legislation to the agrarian reform that constituted of a set of actions that would promote better distribution of land through modification in the regime of its tenure and use in order to achieve the goals of social justice and productivity (Bruno, 1995). Different modalities[9] of settlements were foreseen in this statute. Using public means, the INCRA implemented in Rondônia the *Projetos Integrados de Colonização* (PIC) and *Projetos de Assentamento Dirigido* (PAD) in which 100 and 200 hectares were granted to colonists (Coy, 1988; Becker, 1991; Théry, 2012). Through interviews with civil servants of INCRA in 2015, for the current study, it was found evidence that there was a project named *Projetos Fundiarios*, which granted up to 2,000 hectares not only to corporations, but also to interested people. One of them, *Projeto Fundiario Corumbiara*, implemented in 1974, related the INCRA civil servant, from Pimenta Bueno (south of the State) to the extreme north of the border with Bolivia.

Regarding the private colonization, the role of the private companies was thought of as a support to the regularization of the property of the land. However, in those times, the area which in the present day is known as Rondônia state was a federal territory named as Guaporé. That is the reason why the private colonizers had no legal

[9] 1) Project of Official Colonization(Projeto de Colonização Oficial);2) Driven project of settlement (AddressedProjeto de Assentamento Dirigido); 3) Project of fast Settlement (Projeto de Assentamento Rápido); Project of special colonization (Projeto Especial de Colonização); Integrated project of colonization (Projeto Integrado de Colonização); Project of grouped settlement (Projeto de Assentamento Conjunto); Land Credit program (Projeto Fundiário).

protection to sell lands of the federal government (Teixeira, 2015). Although there was a land marked, it was constrained by the lack of formal registration of private lands and by federal government's difficulty in controlling it. The lack of the private title to the land ownership made difficult the establishment of a real land market. Since just the federal government had the formal legal land's title, the land marked was controlled by the government. Only in 19981 Rondônia obtained status of state, what made possible the registration of private lands.

For Silva (2014), the line between society and nature was broken in 1970 when the agricultural colonization, associated with the axis and the migration stimulated by territorial policies, culminated in deforestation to make way for livestock and agriculture - a process in which nature has lost its sense as common use. The basis of this intensified process of interventions in the 1970s had been provided by Land Statute of 1964.

The flow of migrants attracted by the agricultural and livestock activity in Rondônia caused deep changes in the landscape, presenting a mosaic of uses, such as areas of official colonization, areas of spontaneous and disorderly settlement, and great farming projects (Batistella & Moran, 2005). Interviewed colonists reported the spontaneous colonization:

> I arrived in Rondônia and bought my land in 1984, I bought the land from a third party. The previous owner had already deforested even the riverbank. I've cultivated rice, beans, corn, coffee, and I had animals. Now that I'm retired I don't do any of that because there are no incentives. I know many people who had land and now have nothing. And there are many people who have increased the size of their exploitation. (Juvenil, Pimenta Bueno, 2015)

> I still live in the countryside. When my parents arrived, they deforested in order to plant, to build the house, to have animals, otherwise we wouldn't have anything to eat. Back then everything was taken with the slash and burn. In my house we only had money once a year due to the harvest of corn, rice, beans, peanuts, and coffee. My parents used to go to the city and do the yearly shopping. (Mariane, Rolim de Moura, 2015)

The spontaneous colonization was also produced by the search of the miners of El Dorado, as shown in the narrative:

> I came to Rondônia in 1982 motivated to explore gold, but I stayed here because of the land. (José Dantas, Porto Velho, 2015)

Criticisms to the inability of the National department responsible for the colonization (INCRA) are noticeable in the testimonial:

> The problem with the relationship with the INCRA is that when they aren't capable of finishing the settlement, the colonists sell the land. The INCRA doesn't have control over the illicit environment as a result of the illegal land market. They don't identify who burns (Elen, Porto Velho, 2015).

The group of adventurers who went to Rondônia in search of new opportunities was very heterogeneous. In this scenario, indicates Minc (1985), there were maneuvers of big proprietors with the objective of creating a climate of hostility and conflict over the land between squatters and indigenous people, in a situation explained as the

expropriated against the expropriated, such that the squatters was transformed into the spearhead of a process in which, in turn, later they became the expropriated.

The tale of a Gavião Indian allows a glimpse of the changing scenario in which traditional fire used by this group is progressively adapted to the non-indigenous purposes:

> All of the indigenous lands are fragile. In the 1970s our land was invaded. In the 1980s the invaders were taken away from indigenous land. Then in the 1990s the illicit timber activity began. The pastures ended up as inheritance of the invasion and some indigenous people had milk cows in the village. There are always forests fires caused by man as well as by nature. The pastures burn and the fire propagate through the native forest. Before the white man, people burnt the forest, before the contact we burned a lot of brush (Josias Gavião, Ji-Paraná, 2015).

The purposes of using fire from colonization period became as diverse as the presence of the new and old actors of these socio-ecological systems. The indigenous model of cutting and burning is maintained, but its purposes, intensity and scales changes.

Authors such as Théry (2012) and Teixeira (2015) highlight the colonists are the agents of deforestation, the sale of wood, wildfires in order to have conditions to subsist or overcome miserable conditions; they used to sale lands, occupying new areas, the reason why conflicts over land are so frequent in Rondônia (Teixeira, 2015). However, in this period the colonists received, as a minimum, 100 hectares, an amount very different of peasant or small farmers even in the Brazilian context. It is also true that the different types of settlements illustrate that differences in the style of occupation in Rondônia was also fruit of a rational decision. The argument presented here is that the main goal to be achieved in the colonization process was an effective and massive occupation of the countryside, and the fire was the instrument cheaper and available that made it possible.

After clearing the forests, the colonists practice "slash and burn", cultivation of annual crops for a few years and then turn the land to pasture which is burned annually (Coy, 1988). Due to the low productivity of soil, vegetation is burnt annually to regenerate pastures. As the land becomes degraded it does not sustain any type of farming. The result has been major deforestation with little economical gain for the colonist in the long run (Jones et. al. 1995). Traditional burning practiced by natives has leapt beyond traditional landscapes without the development of commensurate institutions to cope with it (Pyne, 1997). The description of colonists explain their reason in employing fire:

> We need fire, but it is complicated because the earth weakens if you are always burning (Claudinei, 44, Vilhena, 2015).

> In 1987 we won 14.5 hectares of forest land from the INCRA. With the profit we deforested all of it. With the good wood we built our house. The rest was bad wood, so we burnt it. Now itis time to reforest the area under permanent protection, we have a water mine there (Cícero, Pimenta Bueno, 2015).

For Leroy (2005), harvesters and small producers widely practice *queimadas* because it is the unique option to make their exploitations economically viable. On the

other hand, large-scale farmers also used fire to starting their big crops and pastures. The high cost of alternatives to the use of fire is reality for small and big farmers. Besides, fire was the tool to open roads as well, which means that it was also an alternative used by the government bodies. The descriptions below support this statement.

> The migrants did not receive any orientation. When my grandfather arrived, he tried to produce here what he had produced in the South. In the first and second year he planted corn, then cacao. In the third year he looked for new areas (Katia, Ji-Paraná, 2015).
>
> In Rondônia the family farmers became ranchers and the simplest and cheapest way to renew the pasture *brachiaria* was to use fire (Lidiane, Jaru, 2015)
>
> Nowadays, in our State, livestock and agriculture do not have available technology. The use of fire is to facilitate the preparation of the ground, the sown land. The pastures are already depleted. The farmers have the perception that fire eliminates plagues (*cigarrinha*), fungus (*bracuiarao*), because a very green pasture sprouts up, which makes them believe that fire is synonymous of soil fertility, which is a fallacy (Queicianne, Pimenta Bueno, 2015).

There are various perceptions of the problem. The study of Fujisaka et al., (1996) is a counter-argument to last fragment of interview highlighted. Analyzing the settlement project Theobroma in Rondônia, Fujisaka et al., (1996) indicate that the parched fields (obtained by slash and burn) is utilized by the majority of colonists under the justification of making more space for crops, and by a minority that believes that it can improve the soil fertility or that fire reduces the occurrence of weeds and other infestations. Their study also points out that farmers cultivate forest lands primarily eliminated for 2.5 years on average, after implanting the crops. In this sense, Fujisaka & White (1998) warn that the traditional methods of slash and burn practiced by the colonists of the western Amazons can be considered sustainable. The problem, according to the authors, is that the increase of population in the region has elevated the pressure on the soil and forest resources, resulting in unsustainable responses, especially when the colonists convert the use of agriculture for survival to pastures or the production of perennial crops after the harvest phase.

In this way, Fearnside (2005) has mentioned a vicious cycle, expressed in the figure below. The author has pointed out that the selective falling of wood, especially of *Swietenia macrophylla*, would bring an increase in the vulnerability of the autochthonous forest to forest fires.

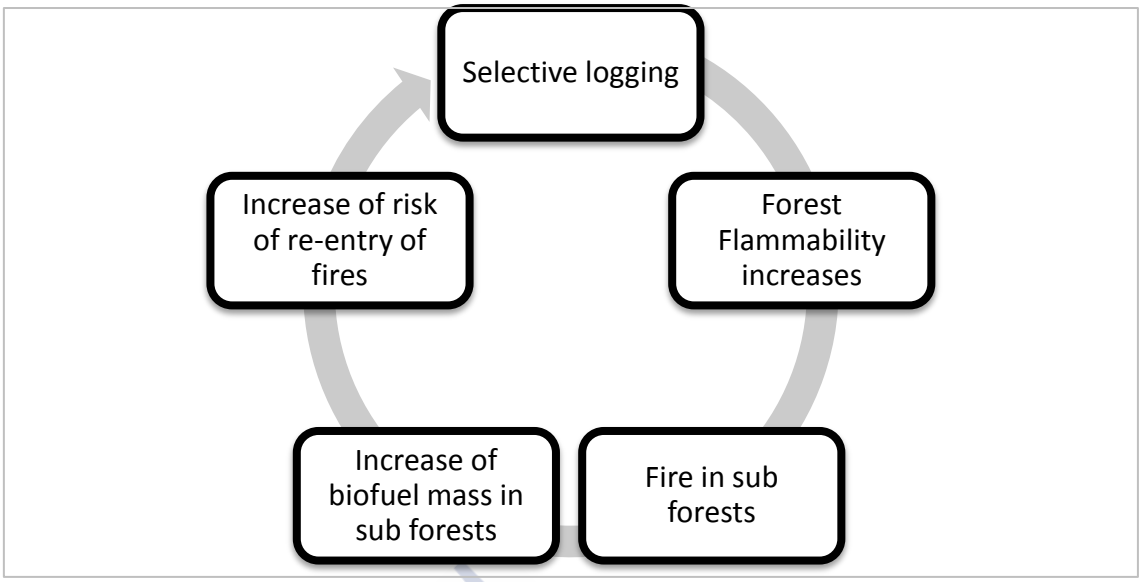


Figure 11. Vicious cycle of deforestation and fires. Elaborated with key-findings of Fearnside's (2005) research

This figure suggests that the cutting down of trees entails the death of others; the opening of the canopy allows the sun and the wind to affect the ground of the forest, resulting in drier micro-climates (Fearnside, 2005). Thus, it promotes ignitable conditions this forest affected by the selective extraction. Some interview's fragments corroborate this finding:

> When I arrived in 1971 they lit fires with clear intentions to burn trees. Now fires happen without you wanting them to happen because there is a lot of pasture, agricultural areas, and open land. Whoever has pasture lights fires intentionally because when it rains, it blooms pretty (Antônio, Porto Velho, 2015).

> Nowadays fires are more and more extensive than in the past because there are many pastures and they spread much more, the dryness is much stronger. If you toss a cigarette butt, right away you start a fire. In our settlement, the fire always comes from the BR-RO 010 motorway (Marli, Pimenta Bueno, 2015).

In addition, Fearnside (2005) has pointed out that the trees of the Amazon Forest are not adapted to fire, so that the mortality of the trees increases after the first burn, which provides fuel and the aridity necessary for subsequent *queimadas* that are even more disastrous. Nevertheless, it is also important to consider that there are two biomes in Rondônia, the amazon and *cerrado* (or neotropical savanna). In this sense, in one interview *in situ*, the head of the National Park of Mapinguari has indicated the difference between natural wildfires in the cerrado areas and those caused by human action:

> In the national park there are dense forest areas and natural fields, when there is lightning you can see fire starting. In these cases, the forest fires are produced when the rain season begins. The fire does not advance towards the forest, on account of the vegetation and humidity the fire does not spread, so that who determines the limit between *cerrado* and forest is the fire (Wilhan, Porto Velho, 2015).

Therefore, there are different fire regimes in Rondônia, which might interact differently with changes in land use or the pattern of settlement. Abrupt shifts in the wildfires regimes in Rondônia are associated with massive occupation, intense exploration of natural resources and the establishment of agriculture, cattle industry, and timber exploration. This is also associated with the role of the World Bank (WB) in the process of economic development of the state as an imperative fountain of financial resources and as an activator of public policy (Rich, 1985; Pedlowski, 1997). Brazil Northwest Development Program, locally known as POLONORESTE, was a great project organized regionally and executed by the WB in Rondônia between 1981 and 1988. Its objective consisted of the strengthening of institutions, land entitlement for colonists, improvement of the infrastructure with the paving of the primary motorway BR-364 from Cuiabá to Porto Velho, fulfillment of a less predatory occupation of the territory, seeing itself on sustainable agriculture (Ott, 2002, Brown and Purcell, 2005). With resources from the Brazilian government and the World Bank, 1,400 kilometers of the BR-364 were paved, which accelerated the migratory process towards Rondônia (Arruzzo, 2012; Silva and Ferreira Neto, 2014). In spite of the negotiations between the Brazilian government and the WB, some experts indicated that the paving would bring with it a massive migration to Rondônia, an invasion of indigenous lands, and the acceleration of deforestation, the funding has been approved, allotting only a minor fraction of resources to environmental conservation and protection of indigenous communities that would suffer the impact of this occupation (Pedlowiski, 1997; Ott, 2002).

As a result, thousands of families from the south of Brazil caused environmental degradation and social conflicts (Brown and Purcell, 2005). POLONOROESTE also had negative effects on the indigenous communities, facilitating, via the paving of the BR 364 axis, the settlement of timber merchants in their environment and the invasion of timber merchants in the indigenous communities, provoking conflicts, deaths, and economic dependence (PARMSRN, 2010). The main critiques that POLONOROESTE has reserved make reference to its incapacity to adjust its objectives to the human, institutional, and physical reality of the Amazon and of the borderline.

Théry (2012) pointed out that the improvement of routes allowed for the connection with São Paulo and the profitability of wood production, but its exploration was done empirically, as only a small part of the fallen trees arrived to the saw mill or to São Paulo, so that many trees were simply burnt to clear space for farming activities. The statement below clarifies the matter:

> The loggers and sawyers were part of a very primary process, generating the depletion of the wood, stimulating internal migration, selling the land more expensive to increase the price of the cheaper land (Edgar, Porto Velho, 2015).

Regarding the predominant image of the colonists of Rondônia as people who indiscriminately burn valuable wood, Browder (1994) shows that 54% of the surveyed farmers, in 1985, in the colonization project Gy Paraná, had commercialized the wood at least once, often providing quick money. On the other hand, the availability of commercial wood in any area of a settlement can be very flexible, so that wood is not an omnipresent resource, but forests (or what is left of forests) are. Théry (2012) points out

the ¨perfect coincidence¨ between the axis of the highway that permitted access to the colonization projects with the axes of deforestation.

In many interviews with representatives of environmental institutions or indigenous leadership, they mentioned that the invasion of indigenous land by timber merchants and the illegal wood cutting is more worrying than the burning, which although they exist, they are a vestige from the colonist activities when they invaded their lands.

> In the Karitiana land we use fire only to slash-and-burn yucca and banana, and to burn garbage. When I was a girl, we did the slash-and-burn ourselves. Nowadays the children study, they don't do the slash-and-burn. There are not many *queimadas*, it's not like colonial lands where there are many. What there are timber merchants. The fire from slash-and-burn methods usually spreads through the forest (Maria Karitiana, Porto Velho, 2015).

Criticisms to POLONOROESTE have highlighted that this measures to aid the indigenous communities and the environmental conservation projects were not effective due to the manner they were implemented (Ott, 2002). There was an imbalance between a large investment in productive infrastructure and a reduced investment in socio-environmental development. In fact, they only created three settlements: Urupá, Machadinho, and Cujubim (Souza and Pessôa, 2009). All these criticisms had a strong resonance in the United States, especially after a campaign promoted by non-profit organizations that brought the topic to Congress, resulting in operational changes in the World Bank such as a reorientation in the preparation and implementation of projects funded by the institution (Pedlowiski et al., 1999).

That way, to mitigate the social and environmental problems caused by POLONOROESTE, the WB designed the Rondônia Natural Resources Development Project, known locally as PLANAFLORO which entered into effect in 1993 (Smeraldi and Millikan, 1997). The objectives of the new program were to improve the management of natural resources, integrate the use of the forest and agriculture, make investments in infrastructures, adopt an agro-ecological zoning of occupied and deforested lands, and improve the institutional infrastructure of the state (Smeraldi and Millikan, 1997; Ott, 2002). However, the planned goals collided with the antagonic interests of different actors involved in its implementation. As a result PLANAFLORO did not achieve any development goals (Ott, 2002). The civil servant of regional environment body gave his point of view of these programs:

> In the 1980s, a time of expansion in livestock in Rondônia, there was a lot of internal and external ecological pressure. The international entities like the World Bank perceived that POLONOROESTE had been bad in the constitution of the first model of fixation of the man in rural and urban nuclei, the creation of the motorways. In 1991 the created PLANAFLORO that was the first step towards the territorial ordinance, with agricultural and forest zoning, approved in 2000 that brought with it better control of production, verticalizing the production due to the policies of exploration and new areas (Edgar, Porto Velho, 2015).

As seen, it is a positive WB actions in Rondônia. However, the project had serious problems in its execution. The international NPOs formed a forum that has identified irregularities such as the failure of the government of Rondônia to increase public participation in the decision making (Brown and Purcell, 2005). These situations are described by Beck (2002) as ones where human rights in the national or arena are strengthened and upheld through instruments of observations and control and where this

process is guaranteed if necessary against the opposition of national states. This is noticeable by the WB actions attempting to fix the mistakes of previous intervention. The PLANAFLORO has encouraged the creation of Conservation Unities (CU) for traditional people such as rubber-tappers. The process that guarantees land use especially for rubber-tappers is different of indigenous land demarcation, once rubber-tappers were attracted to Rondônia due a boom of an economic cycle. The creation of CU is justified by an international understanding that the style of life of this collective does not cause environmental damage. This is also associated to a hidden substrate of modernization, which, according to Beck et al. (1994), refers to the notion of detraditionalization. It is a social order in which the status of tradition changes with impacting on family, local comunities or other aspects of social life as increases their exposure to political examination and debate.

One of the conditions of the conservation units was the transference of the property rights from the federal government to the state government. This procedure has received international critiques due to the lack of institutional agreement and disputes of jurisdiction between the INCRA and the *Instituto de Terras de Rondônia* (ITERON), as well as between INCRA, FUNAI, and IBAMA. This facilitates the illegal occupation of new areas that should be transformed into conservation units by timber farmers, ranchers, and farmers without land (Pedlowiski et al., 1997). Thus, this illustrates that international actions - well-intentioned or not – inevitably deals with the local style of governance existent or inexistent, which seems to be the Rondonian case.

Despite the institutional conflicts, Rondônia was the first state to adopt the model of conservation units at a statewide level, because the local social movements guaranteed that at least the communities of rubber harvesters would gain immediate rights to the land (Gomes, 2009). However, the constitution of these units has not come with an institutional strengthening (Pedlowiski, 1997). The proposed state conservation units were created, but not effectively implemented, once it triggered many illegal actions with environmental deterioration (Costa et al., 2015). The application and consolidation of the concept of rubber gathering reserves as environmental policy is more vulnerable in the local dynamics than at a state level (Gomes, 2009).

Attempting to cope with high rates of forest fire risks in the Amazon, in 1998 the World Bank invested $15 million to support prevention of wildfires under the arc of deforestation by the program PROARCO managed by IBAMA (Goldammer, 2001). The program oversees forming land and air brigades and to provide a map of risk of fires, updated daily, result of the integration of data of precipitation, water-related stress, historic incidence of heat, among other focuses extracted from orbital products of the INPE (Krug, 1999).

Wildfires are results of the complex interrelation of factors such as the colonization process, the mining exploration, the projects executed by the WB with paving the roadways, the advance of livestock of the state, and the reproduction of big landowners.

Over the last three decades, policies have flopped from large investment schemes, to conservation ones, to equally narrow community development ones, to libertarian market solutions, they have presented many failures but scarce sharing learning of that has occurred across regions (Holling, 2006). Changing perspectives of the WB prescribed as suitable interventions in the Amazon, this institution by means of

paving main roads engendered, in theory, unwanted side effects, such as loss of biodiversity and wildfires. On the other hand, it was stimulated the creation of local CUs as an attempt to promote sustainable development or actions such as PROARCO, whose main goal was to decrease deforestation and wildfires.

The advancement of world market towards Rondônia in conjunction with the contradictory action of international agencies has engendered the conditions to the increase of risks and also dilemmas regarding the suitable notion of development. In the circle of globalization, according to Beck (2002, p.69), the 'necessities' of the world market and the 'good intentions' of global civil society become linked to a chain of 'unwanted side-effects'. These environmental management programs to protect Amazon are conducted simultaneously with another that stimulates agribusiness activity or development of infrastructures, which are described in the next subsection.

2.3.3. Wildfires of the latest frontier

The current period is marked by the consolidation of the road network and the development of river transport in order to increase the commercialization of commodities of grain and meat (Figure 12). It is also outstanding the construction of mega-infrastructure to supply energy demand of the national scenario. The regional polices are aligned with the national and the international demand. In Wallerstein (1979) perspective, Rondônia is not only periphery of core countries, but it is also periphery of more industrialized states (which are in the south and southeast region). All these factors coexist with the establishment of new types of relationships between indigenous and non-indigenous societies. These are the reasons why it is the latest frontier. Although the soybean advancement towards Amazon is usually questionable in terms of environment, commodities of exportation highlighted are part of the official discourse as sign of needed modernization for the regional development (Silva, 2007).

In the south and southeast of Rondônia, there is a gradual replacement of cattle by grains such corn, rice and soy (Saraiva and Leite, 2008). This process has started in the end of 1990s in the south of the state border with Mato Grosso, pioneer state in soy production in Brazil (Schlindwein et al., 2012). The development of soybean crops is associated with the development of river transportation in the Madeira-Amazonas basins in the end of the 1990s. The companies *Cargil* and *Maggi* dominate the producer market using the Maderia's network of river transport developed in 1997 (Oliveira, 2006). In this way, Beck (2002) highlighted that translegal power also means *quasi-states* authority over authority, once they have to make *quasi-political* decisions. The transportations of commodities through Madeira River supposed public and private investments in the constructions of ports and additional infrastructure. This means that the demands those companies are promoting are *quasi-political* decisions in the scenario of Rondônia. The soybean commercialization also triggered the development of genetically enhancement researches by EMBRAPA, which made possible the production of seed adapted to the local condition (Pereira and Kahil, 2010). According to Beck (2002), translegal power is also translated in meta-power of innovation. This means that companies have systematic access to the institutional and cognitive conditions for producing new things. They maintain their power over productive and innovative forces of science.

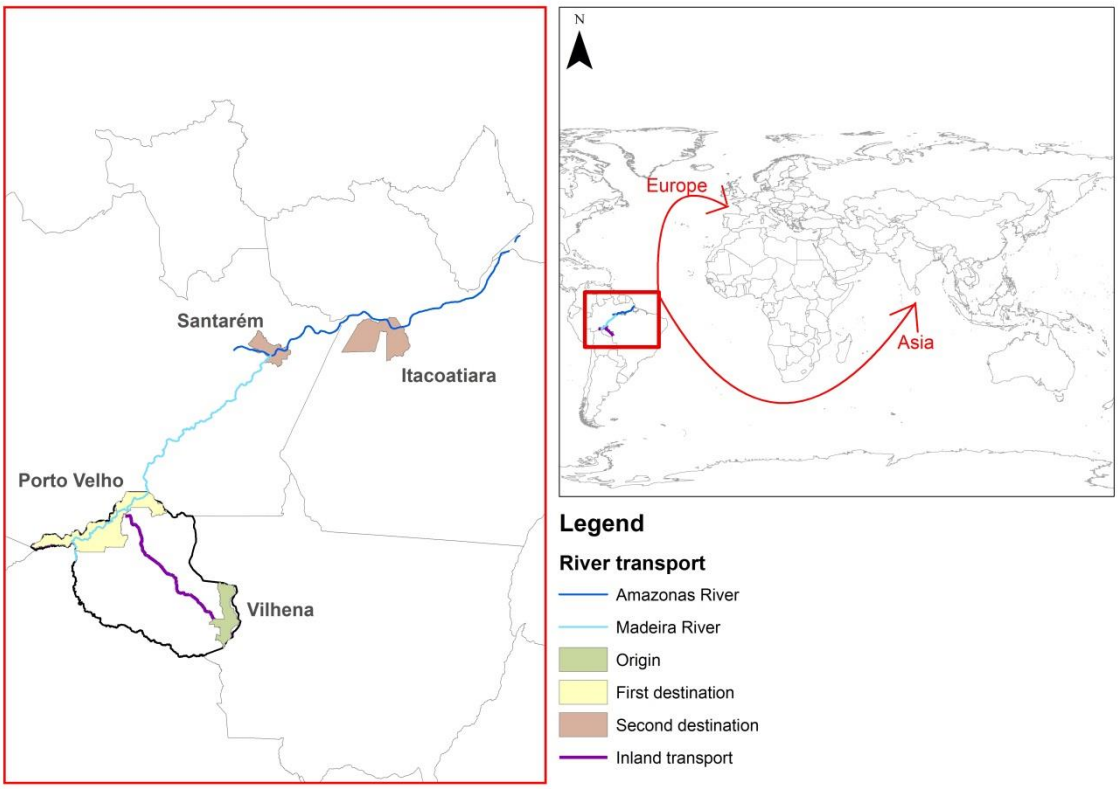


Figure 12. Exportation itinerary followed by soybeans produced in Rondônia. Source: Elaborated with information from IBGE data and Natural Earth using free vector and raster map data.

The narrations of local farmers highlight this process:

> When we first came to Rondônia in 1978 there was not paved roads. Beyond 1980 the first road was paved. At the beginning of 1990 people started planting soy, corn and other grains (Eliardo, Vilhena, 2015).
>
> I have planted 300 hectares of soy. The soy production is just profitable plantings if you plant 150 hectares as minimum. My plantation was financed by private companies such Maggi, Cargil and Bunge. They support the plantation. Lately the agriculture just brought economic losses (Mauro, Rolim de Moura, 2015).

Regarding problems engendered by soybean production, Fearnside (2001) has mentioned the dragging effect. This means that, in terms of the environment, there are impacts due to the transport system, soil erosion and agricultural chemicals effects. Socially, these impacts are the eviction of people that formally used to live in rural areas that have been replaced by soybean croplands, which implies lack of food production to local consumers. Also, the Government has invested on soybean production instead of allocating financial resources in education, health and activities that generate more jobs than mechanized crops of soy (Fearnside, 2001).

The economic development in Amazon results in forest fragmentation surrounded by pastures and periodic burnings, increasing the number of forest edge relate and non-edge related fire risk (Cochrane et al., 2002; Cochrane & Laurance, 2002; Laurance & Curran, 2008). The research of Costa et al. (2015) underlined a progressive fragmentation of native forest in the municipalities of Corumbiara and

Buritis perceived by the increase of number of fragments and decrease of fragments' connectivity.

As stated by an interviewee, soy plantation and reforestation with non-native species increase, large holdings are occupying the space of small holdings:

> In my land there are cattle activity, soybean plantations and management plan of eucalyptus, *aroeira* (*Schinus terebinthifolius*) and *cuibano* pine (*Schizolobium parahyba var. Amazonicum*). We do not commercialize timber already. Although people are talking about supports and incentives, actually there are not guarantees of returns. Here the big farmers, which are meat cattle and soybean producer, were swallowing the small ones (Anderson, Rolim de Moura, 2015).

There are no big industries related to timber processing in Rondônia. The reforestation with non-autoctonous species started spontaneously in the south of Rondônia. Interviews *in locu* helped to understand the issue:

> In 2005 we thought about eucalyptus for rural construction and fences. In Rondônia there are already two autoclaves, one in Vilhena and another in Jaru. From pines we collected the resin to export to Portuguese, Chinese and North American markets. Due to the climate of Rondônia it is harvested all year, the production is 3 tons/hectare per year (Donadoni, Vilhena, 2015).
>
> The reforestation in Vilhena is not for the environment, it is to make a profit. The pine resin is exported to the Netherlands, and eucalyptus is used for firewood used by regional agro-industries. The lack of the title of land property is an obstacle to get funding for planting of eucalyptus, nowadays it is very expensive to plant in sandy soils, so that is the reason why today we spend a lot of money on soil correction (Antônio, Vilhena, 2015).
>
> Before, the forest was cleared. Even today there are people who clear although it is forbidden. There are eucalyptus plantations to support own exploitation. And there is pine resin exportation and reforestation, as they can enter into the management plan (Madalena, 40, Vilhena, 2015).
>
> In Pimenta Bueno I was the first to plant eucalyptus on my own initiative. I have planted 90 hectares. Its growth here is very good. What I am worried about is the wind. Neither there are enough options for sale. If the incentive for planting increases, the cellulose companies will come. What happens is that they are only installed when there is at least 2 million hectares planted. In Vilhena there is the autoclave factory producing fences (Edson, Pimenta Bueno, 2015).
>
> In our settlement we have the idea to plant eucalyptus. We have tested a few tree seedlings and it worked out well. We have reforested the permanent protection area with eucalyptus and as soon as the Rondon II thermoelectric plant is in operation, they will need eucalyptus (Maria, Pimenta Bueno, 2015).

As seen through various fragments of the interviews, the non-autochthonous reforestation is associated with the exportation of resin, the rural construction, the generation of biomass for energy production and the expectations of future installation of paper industry. The reforestation can also be seen as something related to the meta-power of innovation in Rondônia. The forestry department of EMBRAPA in Rondônia developed researches, simultaneously, with the recuperation of native forest and also with commercial forestry of fast-growing species. The experimental network of the *pinnus* genetic improvement program of the EMBRAPA forest sector, tested the species suitable for tropical and subtropical climate and the ones with potential for economic

exploitation of timber and resin, especially *P. caribaea var. Hondurensis, P. caribaea var. Bahamensis, P. tecunumani, Pinus kesiya* (Aguiar et al., 2011).

Besides, in 2011 the government of Rondônia created the "Planted Forest" project coordinated by the State Secretary for the Environment (Sedam) which provided mechanisms to facilitate timber commercialization. The coordinator of the project explained the main goals of reforestation:

> There are 3 project objectives: 1) reduce the pressure on native forests, 2) promote economic alternatives for loggers and timber producers and 3) provide environmental services (CO2 sequestration, water management area, climate change policy, non-reimbursable funds) (Edgar, Sedam, Porto Velho, 2015).

The project generated opposing opinions among officials of different environmental bodies acting within the state:

> The planted forest does not create risks because it is being implemented in regions that are not suitable for agricultural projects and reduces the pressure on the native forest (José Neuton, Sedam 60 years old, Vilhena, 2015)

> In the Planted Forest program all species are from outside. They are promoting flammable species for the substitution of the original not burning Amazonian forest (Wilhan, Icmbio, Porto Velho, 2015).

There are also projects of non-native species reforestation that seek to provide raw material for the furniture industry:

> In Rondônia the forest was burned for grazing and for agriculture. A lot of wood has been lost here, only the mahogany and the cherry tree (*amburana acreana*) were used. We began with the reforestation of teak for commercial production in 1993. Today there is still native forest, but its commercialization is more bureaucratic and its market value is the same (Luiz, Pimenta Bueno, 53 years, 2015).

There are small furniture's industries in Rondônia, but the interviewee mentioned that teak plantation is to provide raw material to the furniture industry in the south or southeast regions of Brazil.

With ecological purposes, national programs, laws and non-governmental organizations (NGO's) actions are also attempting to promote reforestation with autochthonous species. The Brazilian Forest Code provides that individual properties must have 50 % of native forest in the Amazon. Due to the intense deforestation in Rondônia, reforestation is required in many individual lands. There is a special credit for replenishment of forest, as the official regional environment department illustrated:

> Who has available area for reforestation obtains a reforestation credit by the electronic system called the Forest Origin Document (FOD). Another owner who has 20% of his property has to reforest or buy the credit of the FOD system (Elen, Porto Velho, 2015).

The interviewee refers to an electronic tool that integrates federal and state forest transport documents to monitor and control the exploitation, transformation, commercialization, transportation and storage of forest resources. She explained that if a

landowner has not the 50% of native forest, he/she has two options: 1) start reforestation; 2) buy the credit of another landowner who has more than 50% of native forest in his/her land.

There are reforestation projects based on the use of autochthonous species. During the field work, the NGOs projects of reforestation Ecoporé and the Forest Carbon developed by Suruí indigenous people, were visited and observed. As well, the entry of the Suruí into the markets for environmental services via carbon sequestration reflects the mobilization of some social groups in the search of a new development perspective in Rondônia. The land of Suruí people (*Sete de Setembro*) is located in a region characterized by high anthropic pressure, close to the settlements of agrarian reform. This made Suruí lands susceptible to forest degradation by fires, illegal logging and clearcutting for agriculture and ranching. This mobilization towards the environmental market is strongly related to national indigenous social movements interacting with international NGOs. They incorporate the perspective of the use and commercialization of environmental services through the REDD ++ mechanism (Reduction of Emissions from deforestation and environmental degradation). According to the interview realized with Gasodá Suruí, the incomes from this activity are invested in satisfaction of collective needs, by building schools or collective goods. In 2012, the project obtained the *VCS (Verified Carbon Standard)* and *CCB (Climate, Community and Biodiversity)* certification stamps which stimulate this type of dynamics in the state and influence other indigenous groups for their incorporation to this kind of service and market.

The results of Graça et al. (2012) showed a total area of 4187 hectares of forest were affected by fire in the indigenous land, what corresponds to 1.7% of the total reserved area. Among the reasons for the fires, there is the conversion of forests for agricultural and livestock activities in function of the decline in logging activity. Compensation of environmental services is criticized by these authors in the sense that events such as forest fires, that cause loss of part of the carbon *stock*, reduce the climatic benefits of forest, so that the quantification of wildfires is essential for accounting and fair awards for environmental services such as the Suruí Carbon (Graça et al., 2012). An indigenous from the ethnic group Gavião, clarified that in their land people continue to carry out pasture burnings, a practice left by their colonists. These burnings eventually escape to the forest.

The use of fire by indigenous people changes according to the scale of interaction between indigenous and indigenous peoples. In regions characterized by high anthropic pressure, the agrarian practices of the colonists are progressively incorporated among indigenous people. Thus, depending on the type and degree of interaction between indigenous and non-indigenous people, wildfires might be used as in the past or as hybrid of these indigenous and non-indigenous interactions.

Rondônia is also considered the latest frontier due to the infrastructure projects recently developed. Since 2000, the increase in demand for national energy and the expansion of infrastructures in Brazil generated a new wave of dam's construction. The program Growth Aceleration Project (PAC - *Programa de Acelaração do Crescimento*), initially called "*Avança Brasi"*, further stimulated the advancement of the agrobusiness frontier. The complex *Madeira* is a great infrastructure project that covers a river transport network and four hydroelectric dams: two in Brazilian areas, one in international waters, one in Bolivian areas and one electric transmission line (Antenas,

2008). In Rondônia, as an action of PAC *Santo Antônio* and Jirau dams started to be built in 2007. The impacts of these infrastructures transpire even before their implementation by generating employment expectations, boosting real estate speculation, and investing in civil construction (Cavalcante et al., 2011). Throughout the dam's construction, there were 26,000 workers in Jirau and 26,000 in Santo Antônio, not counting the subcontracted labor force (over 10,000). This led to an abrupt demand for consumer goods and an addition of new neighborhoods in urban areas to accommodate both environmental refugees from flooded areas and workers' families (Urzúa, 2015).

Reservoir construction has significant impacts on the socio-ecological systems, not only because workers migration, but also other negative effects. The Madeiras' dam inundated part of Madeira-Mamoré railway, affected the ecologic station *Três Irmãos* and the conservation unity Jaci-Paraná with losses in fishing and wet croplands. It, indirectly, affected the Karitiana indigenous land, once logging activities advance towards their lands (Cavalcante et al., 2011). Thus, the construction of the dams generated new conflicts with the rural population and indigenous communities both directly or indirectly affected by the construction. A Karipuna indigenous said, in an interview, that his community is not satisfied with the compensations offered by the construction companies:

> For me, the Santo Antônio's dam was the worst situation that has occurred in our lives because it inundated the indigenous land, houses, schools and health facilities. The reparations were not done correctly as we wanted. All of us are migrating to the city, where people don't work or study. In our land, there are not lots of wildfires, but there are a lot of hidden loggers that rob our wood (Angélica Karipuna, Porto Velho, 2015).

In regards to settlements during the agrarian reform, the dam's construction represented a third of spatial displacement. People who came from other regions of Brazil were firstly settled through projects of agrarian reform. Due to the dam's construction, many resettlement areas were inundated. Thus, the affected population was replaced to other areas and received environmental compensations. That is the case of one interviewee who lives in the new settlement *Riacho Azul*. He describes part of his experience:

> In our previous settlement, our house was next to the river, which helped us to plant crops while other used it for pasture, but it is all inundated now. In the new settlement, I have planted fruits and vegetables. Economically, it was good for us. I have never seen so much money in my life, but still I would have preferred to stay in our last settlement if it was a possibility. I used to see the fish in the river from the door of my house (Isabel, Porto Velho, 2015).

The *Riacho Azul* resident's experience has highlighted the compulsory adaption to new conditions. The dams' construction marks another change in the settlement pattern typical of the Amazon based on river, wetland, and forest. The dams have negatively affected the life of other *ribeirinho* people who had not been relocated. The installed infrastructure (such as bridges and roads) made it easier the farming advancements in the riverside region. An account of a flooding in 2014 in Porto Velho area allows a glimpse at the interrelation between the flood risks and *queimada* risks.

> The flood killed everything: the species that we had planted, the hens. It damaged the electric wires. We have been living without electricity for one year now, and the children haven't gone to school. We don't know if what we plant we will be able to harvest due to the water flooding again. The first time we saw fire was after the floods, because the floods killed the shrub. Someone lit a fire that spread throughout the town. Nobody has the means to call the fire department. Firstly, our neighbors don't know what it is and secondly because there is no way to call since there is no telephone. We live in the Stone Age (Miracy, Porto Velho, 2015).

The notion of flood risk is old among riverside populations, but the notion of the wildfire risk is a new element that emerges in the universe of meanings. Besides, new risks emerge unaccompanied by mechanisms that can provide these communities with the minimum conditions of mitigation or preparedness, once the interviewee revealed that they do not even have telephone.

The amount of investments and actions to promote productive activities demonstrate that the wildfire drivers are engendered without available institutional mechanisms to cope with risks. In other words, there is neither preventive mitigation nor reactive mitigation of forest fire risk. Wildfire risk governance in Rondônia is only possible if it takes into account the complex relationship among indigenous people, riverside population, rubber-tappers, settlers, governmental and non-governmental institutions (at different levels) and private companies.

2.4. Evolution of wildfire context in Galicia

2.4.1. Traditional fires

The contemporary landscapes of Galicia are an imprint of the transformations occurred through the centuries of human and environmental interacting processes. Galician farming practices, collective use of land, cultural and linguistic features dates back to very old times. The traditional settlement pattern is historically rural and scattered, with a large proliferation of small population entities or small hamlets, whose economic base was agriculture and subsistence farming (Dubert, 2012; Balsa-Barreiro and Hermosilla, 2013). Elements such as well-known boundaries, the antiquity of the ordination of the space, the density of human occupation in many areas in the XIX and XX centuries, suggest that the disperse settlement in Galicia has existed for long time, probably in the centuries V and X (Pardo, 2010).

Other significant characteristic is the existence of smallholder farming in Galicia. Smallholders managed to survive by means of subsistence farming supported by complementary activities in a mixed-crop subsistence farming (Saavedra and Villares, 1985). The ownership structure is explained by both geographical and cultural limitations – historical reasons, which date from medieval times and alienation of agricultural holdings by large landowners including the Catholic Church (Villares, 1990). This led to a prominence of smallholder and hamlets which explain the multiplicative growth that took place in Galicia since the modern time, as highlighted the author. The actual high degree of land fragmentation (mean cadastral parcel smaller than 0.25 ha) is explained by a high population density, a large number of scattered settlements, a dominant traditional agricultural economy and, mainly, a historical

tradition of property inheritance by sub-division within families (Ónega-Lopez et al., 2010).

An important feature of the ancient Galicia is the tradition of slash-and-burn practices. In fact, European countries have a long culture of fire use, by which human deeply modified the landscape (Tedim et al., 2015). Thus, fire taking place on European landscapes have been historically shaped by human activities by using "slash-and-burn" to change forest into arable land (Zennaro et al., 2015; and Tedim et al., 2016). Fire was an outstanding element of the long-term human interaction with ecosystems based on local patterns. The main purpose of "slash- and- burn" in Galicia was to obtain a complementary harvest of cereals and depending on the soil quality a second harvest of oats (Bouhier, 1979; Balboa, 1990; Soto et al., 1995). It consisted of using fire to renew gorse and broom bushes in order to prepare crop land by using ashes as fertilizer (Cabana, 2009). These practices used to take place in the marginal arable lands, where less demanding crops were planted, such as wheat and rye. In the agrarian system, there were lands of ordinary use on collective private property referred to as neighbourhood-owned commons (Lana, 2016) or peasant commons (Seijo, 2005). These community-owned lands were considered the support or motor of the traditional agricultural system, which was exploited continually and systematically until the industrialization of agriculture in the 1960s (Bouhier, 1979; Balboa, 1990). Other basic functions of these lands varied from providing firewood and wood to the maintenance of livestock (Cabana, 2009b; Soto-Fernández, 2016).

Another outstanding characteristic was the use of shrub (*ulex europeus*) as a natural fertilizer. This practice – which is known as *esquilmo* – consisted of using shrub as bedding for cattle, as feed in extensive grazing pasture lands and as fertilizer for cultivated fields (Seijo, 2005). This practice – which was an important priority for the economy of the families – was intensified throughout the XIX century due to the demographic pressure over land (Balboa, 1990; Lage Picos, 2003).

The high population in Galicia is an outstanding characteristic, as can be noticeable in the Figure 13.

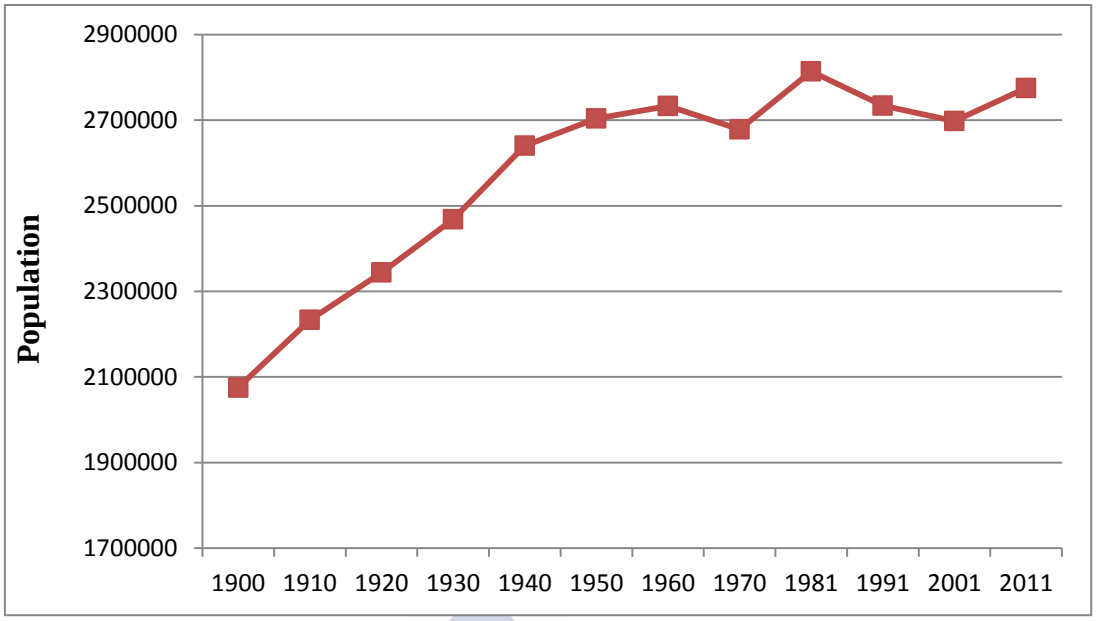


Figure 13. Population Evolution in Galicia (number of inhabitants)Source: Elaborated with information from IGE, 2016.

The continuous production of shrub was greatly possible because of slash and burn, once it permitted the regeneration of shrub when the land was totally exploited and ended its vegetative cycle (Balboa, 1990). The complexity and dynamicity of traditional farming systems reveals that rational decisions were present in these social-ecological systems. The fact that people avoided practicing *estivadas* in sloped areas or aridity conditions (Bouhier, 1979; Balboa, 1990) corroborates that fire was a product of rational decisions among neighbor communities. Findings of Soto et al. (1995) illustrate that slash-and-burn provoked immediate increase in nutrient availability, but after the first year, the amounts of nutrients contents dropped to a level similar to those existing prior to burning, and over this period there was an increasing loss of nutrients. Neighbor's concerns about the area where fire should take place demonstrate that slash and burn was not product of ignorance. Those times are still present in the oral discourse, as it can be seen in the fragments of interviews:

> The neighbor villagers used to produce wheat in the community-owned land, each farmer had one parcel where high quality wheat was produced, but it was physically demanding. Nowadays if people had to do it they would prefer to die. In 1948 pine trees were planted, I do not remember major questioning. Pine trees and chestnut trees were profitable, but nowadays they are not. Now, eucalyptus is profitable, in fifteen years you can log. The community-owned land would be interesting if one could plant on his own (Albeal, Saldanxe, 2014).

> Before land consolidation, 30 years ago, the neighbors used to raffle quadrants of community-owned land, people used to clear and burning their own area (Luis, Xinzo de Limia, 2015).

Villagers were able to report the profound changes that impacted on their lifestyle. These memories highlight that the use of fire was a dynamic part of the social

fabric, and that both society and fire evolved throughout the centuries. Nevertheless, changes in the socio-economic and political scenario triggered consequences to the agrarian system, and therefore, to the meanings, purposes and consequences of using fire.

Many processes in a non-linear relationship help to understand the problem. The agrarian system has been affected by labor shortages due to the rural flight in the second half of the XX century. Galician workers migrated to Central Europe and industrialized areas of Spain, which was a fact accompanied by aging process and falling birth rate (Beiras and López, 1999; Marey, 2013). Parallel, from the 1950 to 1970 there was a gradual change in the productive strategies of dairy cattle farmers (Cardesín, 1992). In the 1970s, traditional holdings coexisted with market oriented holdings, in which milk specialization was accompanied by technologic changes in a system that common and rustic lands are transformed in providers of pastures and silage (Marey, 2013).

The afforestation process evolves in this scenario of changes in the Galician agrarian system. In the process interventions of Franco dictatorship, the State Forestry Trust (*Patrimonio Forestal Español*) - an independent public agency - was created in 1935 to accomplish the purpose of producing forestry raw materials for industry at the service of the policy of autarchy (Seijo, 2005; Lana, 2016). The Spanish forestall strategy was designed in 1941 with strong regulation or prohibition of pasture and wood fire gathering ignoring the neighbor social use of common lands (Cabana et al., 2011). Throughout the 1940s the afforestation process was decelerated until 1952 when it started to increase abruptly (Rico-Boquete, 1995). This author mentions that land afforestation reached, in 1964, the amount of 270,000 ha.

In conjunct with the afforestation process, Land Consolidation (LC) was an initiative by the State in Galicia in the Francoist period. Following the ideology of "peasantry sovereignty", Franco policies equated the problem of *latifundium* to the small landownership, which justified developing activities in Galicia (Pérez Rubio, 1995). The LC was the goal to be achieved by two institutions, the National Agency of economy and the agency of Social Reform of Land (*Servicio Nacional de reforma Económica y Social de la Tierra*) and Nation Institute of Colonization (INC- *Instituto Nacional de Colonización*) (Liss, 1987). The INC developed actions in various areas of Galicia, as the interventions in the lagoon Antela en la Limia (Ourense) in 1958, in the expropriation of Ons island (Pontevedra). However only in the Galician region "Terra Cha", the colonization settlements were developed between 1954 and 1968 (Cabana, 2008). The process was explained by a resident of this settlement:

> The colonization settlement Project of Arneiro was implemented in 1972 during the Franco's dictatorship. Before it was a common land that Government expropriated and parceled. People were settled there for many reasons, such as dam's implementations, having many siblings in the same house or do not having house. It was a Government policy in order to modernize agriculture in which was offered 16 hectares. My family has two pieces of land, with 8 hectares each. The credit received was paid each year. It was very expensive, what had cost the land you could pay an apartment in Lugo city. The soil was very bad to establish a cropland, it did not produce anything. With the parcel, beneficiaries received scrubland, one white house, a cowshed, two silos, one mare, two cows, fertilizing and irrigation to produce (José Angel, Vilalba, 2014).

The colonization settlement project was also justified by other interventions, such as dam's construction, as highlighted by the interviewee. Likewise, the land consolidation, the rationalization of agriculture, the afforestation process and the creation of the national pulp factory (ENCE) in Pontevedra in 1963 demonstrate that a set of actions attempted to enhance the growth by modernization.

In this scenario, the private social use of common lands starts to be clearly threatened. The community-owned land received the first legal treatment suitable to the Galicean reality by the law 181/1968. Nevertheless, this law provided that community-owned land should be managed by the municipality. The restoration of the right of use of commons lands to resident neighbors was possible only by law 35/1989. Those lands constitute an enduring feature of the past in the present. Figure 14 illustrates spatial positioning of these lands in Galicia.

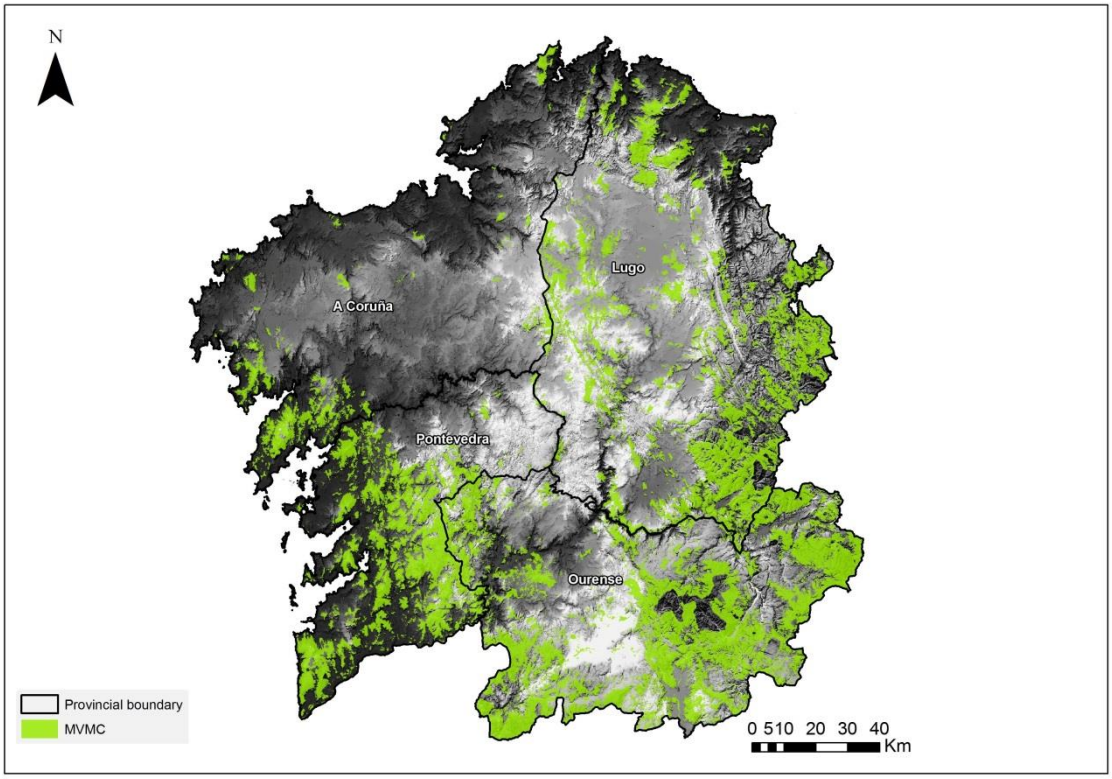


Figure 14. MVMC in Galicia. Source: elaborated with information from Consellería de Medio Rural (2008.)

Based on the ancient and customary social use of common lands, land property rights were reestablished to neighbors. However, it occurred when the importance of the community-owned land was not the same due to the fast and profound changes in these social-ecological systems, which are discussed in the next subsection.

2.4.2. Wildfires in the context of fast changes

Since the 1960s, Galicia rural society has been progressively transformed in an urbanized society and service-based economy. According to Marey (2013), joining the European Community (EC) in 1986, has led to the final collapse of the traditional Galician model. The accelerated disappearance of a large number of small farms was accompanied by afforestation process (Guimarey and Corbelle, 2012). This change is noticed by an interviewee who lives in a rural area:

> In the past there were two or three bovine animals in each house. Nowadays few people have around 200 dairy cattle. CAP supports them giving money to plant corn (Victorino, Saldanxe, 2014).

The interviewee has reported, in his own words, the specialization process stablished via Common Agricultural Policy (CAP). This policy was initially based on price support, but from the mid-1980s it is progressively based on income support due to the budget pressure on reducing agricultural surpluses (López Iglesias, 2000). The 1992 CAP reform introduced three accompanying measures: agri-environmental, early retirement and afforestation of agricultural lands (Garcia and Perez, 2001). The measure of afforestation of agricultural lands had an important role in the evolution of the wildfire risk scenario of Galicia. A controversy can be identified in its objectives, which fluttered from increasing supplies for forestry products accompanying market changes to mitigate the greenhouse effect and absorb carbon dioxide (Council Regulation – EEC, No. 2080/92). Two important factors are fundamental to understand the impact of this measure on Galicia reality: fast-growing species were subsidized and the fact that European regulation did not establish a minimum area to be planted, giving this decision to state legislators. In Galicia until 1998, there were not stablished limits regarding the minimum area to be afforested. Compared to the other Spanish regions, Galicia was the first in the ranking submitted applications, which most of them were applied for fast growing species (García and Pérez, 2001). Considering that the Galician settlement pattern is scattered and the fact that most of the agrarian lands had lost the agricultural use since 1960, the inexistence of a minimum area to be afforested represented consequences on the evolution of wildfire risk scenario. The landowners of unproductive lands were encouraged to afforest even small lands. Nevertheless, the amount of 44,747 hectares, in the period 1992-1998, was afforested by received subventions (Marey, 2013). This amount in the author's opinion was irrelevant. Most part of afforestation of agrarian lands was made by private inversions (Marey, 2004).

The afforestation of agricultural lands not only contributed with the loss of utilizable agricultural area (López Iglesias, 2000; Corbelle and Crecente, 2009), but also facilitated scattering even more the forestall use in the landscape.

Regarding the institutional framework of wildfire management, important national changes are noticeable over time. The Spanish national decree 407/1992 established basic civil defense standards; the Council of Ministers Agreement dated 18 March 1993 provided the directive for the planning of civil protection against wildfires, then the Council of Ministers Agreement dated 31 March 1995 established the national plan of wildfires emergency. The elaboration of wildfire emergency plans is the legitimization of the reactive perspective of managing wildfires. This plan only came to be updated by the Decree 893/2013, which emphasizes action in the scenario of fires of

wild land-urban interface, but the current guideline maintains the same general structure of planning of 1995.

The reactive wildfire management is also noticeable in the regional Government. The creation of an agency of mitigation of wildfires by the early 1990s was encouraged by wildfire increasing crises (Pérez-Vilariño, 1992). In fact, 1989 was a year marked by great wildfires crisis, which affected 198,643.1 ha in Galicia (MAGRAMA, 1990). This corresponds to around 6,71% of total area. As a parameter to understand the magnitude of the wildfire crises of 1989, the conspicuous wildfire crises of 2006 affected 95,947.38 ha (MAGRAMA, 2012). More than 100,000 ha less than in 1989. It was also the first time that it became a subject of electoral campaigns (Marey, 2013).

This can be interpreted as a feature of rigid model of governance of Regional Administration. As long as no surprises occur, or circumstances do not change, this type of governance is likely to maximize stability while lacking flexibility vis-à-vis changing circumstances (Duit and Galaz, 2008). In fact, in governance there is a tension between flexibility and stability. Institutions and norms are stablished by humans in order to achieve predictability, stability, and low costs for social interactions (North, 2005). The problem emerges when the needed stability is transformed in rigidity, which seems to be a characteristic of the regional wildfire governance. New regional legislative change occurred only after wildfire crises of 2006. The law 3/2007 recognizes the increasing occurrence of fire in wildland urban interface and proposes that preventive strategies should be the fundamental aspect of fire management system in Galicia. This reflects a trend, at least legislatively, in advance governance towards a more precautionary[10] approach. However, this law also provided the obligatory elaboration of plan of prevention and defense against forest fires in Galicia (PLADIGA - *Plan de prevención e defensa contra os incendios forestais de Galicia*) annually.

The existence of PLADIGA corroborates Beck's et al. (1994) perspective that institutions become the producers and legitimators of threats that they cannot control. The innovation is rhetorically introduced, but the technical know-how of a classical model of fire management is the instrument chosen to handle the negative effects of wildfires rather than choosing the precautionary approach. This classical approach gives a uniform solution to a complex problem. It does not take into account the different types of wildfires risk situations, mainly considering the deep differences between eastern and western.The eastern Galicia presents high rates of population aging, and low capacity to embody a generational shift and the absence of economic activities based on innovation (Ferrás, 2011). The western, or Atlantic axis as dynamic area, presents industrial building surrounding main roads (see the Figures 15 and 16), in a consolidated axial model of localization of industrial activity with increasingly densification in terms of flows such as productivity, techniques, demographics and of social relationships (Alonso and Lois, 1997).

[10] According to Gregory and Long (2009) The precautionary principle is famously stated in the U.N. 1992 Rio Declaration on Environment and Development: "Lack of full scientific certainty should not be used as a reason for postponing costeffective measures to prevent environmental degradations.".

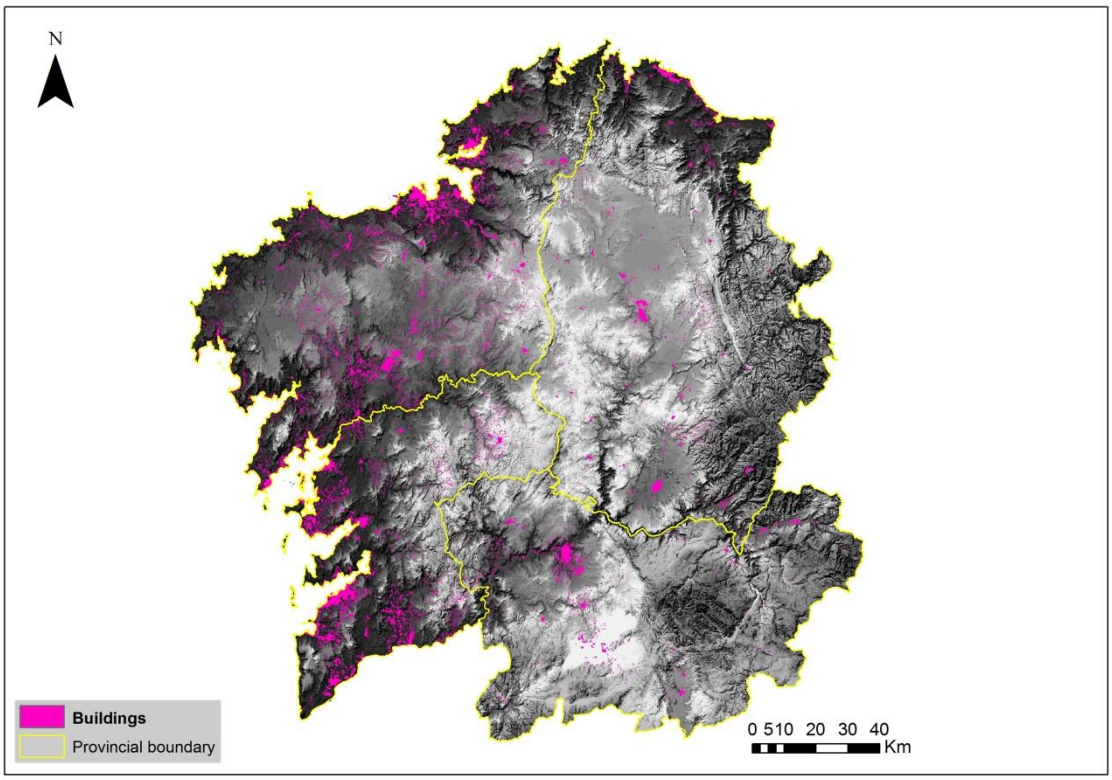


Figure 15. Buildings spots in Galicia. Source: elaborated with information from Catastro, 2016.

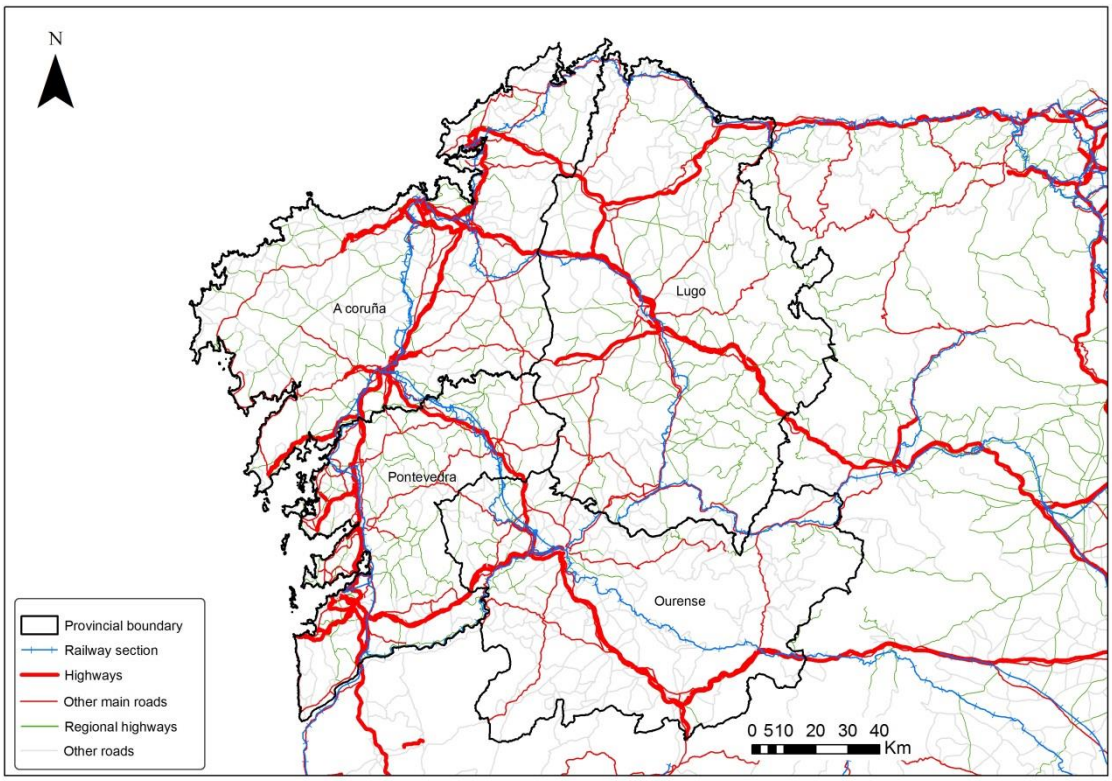


Figure 16. Main communication routes of Galicia. Source: elaborated with information from IGN, 2016.

Wildfires risk context in the eastern Galicia - distinguished by aged people, abandoned houses and the spread of scrub in the scrubland in landscapes –is different from the Atlantic Axis, but both contexts deserve equal attention in risk governance. The Figure 17 illustrate, for instance, that wildfires in 2005 (before the crisis of 2006) have affected an important amount of areas in the eastern Galicia, mainly in Ourense.

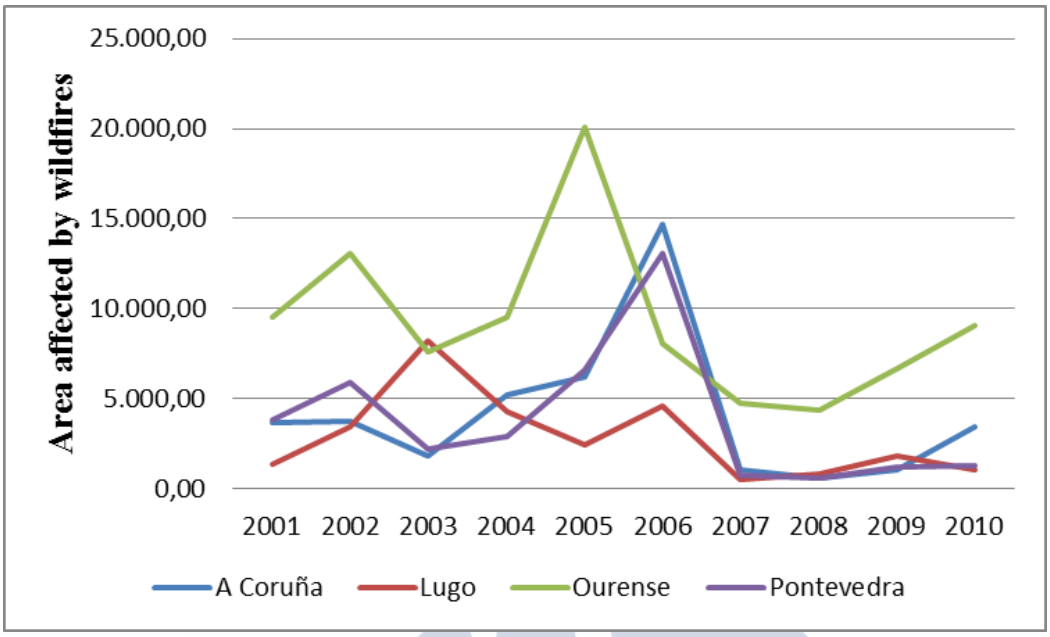


Figure 17. Evolution area affected by wildfires (in hectares) in the period 2001-2010 in each province of Galicia. Source: elaborated with data from Magrama (2012) in "Incendios forestales de españa decenio 2001-2010".

The change in the framework has given more attention to the wildland urban interface, which, although very important, should not neglect the much-need attention to the other interfaces of the problem, such as the contradictory dynamic in different areas of Galicia. In this way, Chas-Amil et al. (2013) findings reveal that WUI in Galicia represents 8,3% of total area of Galicia, with a higher concentration along the Atlantic coast and in the southwest due to the density of buildings. Their findings illustrate that more than half of the built area is situated in the WUI, and that fire ignition is approximately twice as frequent in WUI as in non-WUI areas. This illustrate that areas of interface should imply in strategies of interface among institutions.

Main findings of Calviño-Cancela et al. (2016) suggests that the highest increase in ignition risk in WUI compared to non-WUI areas occurs due to the interaction WUI and forestry plantations, while native forests and agricultural areas have the lowest ignition risk. Agricultural areas showed the smallest difference in fire size between WUI and non-WUI areas, while scrublands showed much larger fires outside WUIs.

Thus, different risk situations pose challenges to the wildfire risk governance, which should go beyond the simplistic solution of reactive wildfire mitigation. Although wildfires in eastern Galicia is a hot topic widely associated with the abandonment of agricultural use, the existence of fires in wildland urban interfaces also

demonstrates that the land abandonment takes place in urban areas. This reveals the lack of anticipatory planning in which urban, rural and forestall sectors negotiate and make rational decisions regarding the land use and potential risks.

Wildfire crisis in 2006 has also triggered National institutional change, which is the activation of Emergency Military Unit. The head of wildfire management department of the national ministry for environment, food and rural affairs reported this change:

> The wildfires crises of 2006 produced a change because the military unit of Emergencies of Spanish army was created. They are not forestry professionals, every four years they are displaced, which is not very professional. Other problem is that they are not placed in the most complicated areas (Elsa Enriquez, Madrid, 2015).

This further reinforces that ability to change in this model of governance is strongly conditioned by the previous know- how of classical models of governance. The novelty introduced is mechanism deterrence, once the military presence is re-introduced. In this sense, certain elements of the Franco dictatorial past revives.

In the classical model, the aspiration of decreasing burnt area justifies the high economic inversion in fire suppression (Marey, 2013). This model encourages the construction and dependence of a private sector of fire mitigation. Suppressing fire implies inversion in means of fire suppression and temporary contracts of wildfire brigade's. That is the reason why wildfire is a double-edged sword, once overcoming the classical model implies the destabilization of other societal sectors.

The role of industry cannot be neglected when considering the changes in the wildfire scenario Galicia. In the early 1990s, celluloses prices increased because of competitive demand by two paper industries placed in Pontevedra (Galicia) and Navia (Asturias) until they made a fusion (Feo Parrondo, 2002; Marey, 2013). The rising price of pulp has been an additional encouragement for afforestation of unproductive lands. In 1999, ENCE has had revenues 62% higher than the average of the previous four years due to the higher sales volume, higher productivity, decrease in energy costs, and a significant increase in the price of pulp (Feo Parrondo, 2002). In the 2000s *Eucalyptus nitens* are introduced with lower production compared to *Eucaliptus globulus*, but more resistant to frosts (Marey, 2013).

Summarizing, reforestation of agrarian land, the land abandonment, population aging in rural areas, weakness of primary sector which led to the urbanization and growing second and third sector, new legislative changes are intervening new factors determinants to understand wildfires evolution in Galicia. Those process overlap and evolve towards intermingling fires accompanied by rigid governance, which is not able to handle uncertainties to make rational decisions.

2.5. Conclusions

The transformation of the meaning, purposes and consequences of fire employment in Rondônia and in Galicia reflects, mainly after 1960, an increase of complexity of these socio-ecological systems. Anthropogenic action, fire, and notion of hazard co-evolved in complex way.

In current Rondônia, traditional fires still occur synchronically together with wildfires resultant of complex socio-economic processes. The soybean and beef production processes reveal that Rondônia is periphery of core countries. The national demand of energy -which triggered infra-structure construction, new displacement of people - demonstrates that Rondônia is also periphery of core Brazilian states, the industrialized ones. These dynamics coexist with the Amazon style of life, which distinguished features are the *forest-wetland-river* in the case of the riverside, the indigenous and the traditional populations such as the rubber tappers. These lifestyles are progressively in threat due to the advancement of agribusiness and infrastructure frontier. At the same time, the enduring existence (resistance) of these actors reveals that learning with their experience is one of various ways to create a real governance process. It is even more urgent in this context in which private activities and transnational agencies assume the role of *quasi*-states, using Beck's (2002) perspective. In this model, transitional power when promoting *quasi*-political decisions relegates the role of the role of these actors.

These social actors are forgotten in the decision-making process as well wildfires are not considered a risk problem. There are two reasons why it can be affirmed that there is no risk governance in Rondônia, even though there are institutions responsible for fire management. True risk governance should recognize the complex nature of the risk on hand and the wide range of actors in the disaster scene.

Differently from Rondônia, Galician experience of modernization meant a breakdown from the ancient dynamics that were prevalent for centuries (Bouhier, 1979). Fire is no longer an agricultural acceptable tool since Franco dictatorship. As well fire parallels the contradictory transformation of rural societies towards urban and, at the same time, abandoned areas. In this context, wildfires are considered a risk which deserves attention from the decision-makers, the responsible for creating laws, reactive plans and strategies. Galician reactive risk management validates Beck's (1994) perspective that institutions become the producers and legitimators of threats that they cannot control. Wildfires in Galicia are weakly accompanied by the emergent challenges of risk governance, which implies the adoption of precautionary approach and abandoning rigidity.

The similarities observed in both realities is that omitting risk decisions as occurs in Rondônia or making up actions as risk decisions as occurs in Galicia is an attempt to obscure elements that are engendering risk. Those elements are complexly interrelated as shown through the chapter, but efforts should be done to handle the wildfire risk as a complex problem in the social-ecological systems.

Complexity is, in this way, an interpretation introduced by the observer. The trajectories of rubber-tappers in the Amazon are an illustration of this statement. They were displaced to the Amazon due to the rubber boom, and represented the first major population disturbance in these socio-ecological systems. Years later, the policies of

creation of conservation units started to consider the certain types of human presence and certain use of natural resources, such as gathering or fishing, as a component of ecosystem's equilibrium. In this way, what was considered a disturbance becomes considered a factor of equilibrium. On the other hand, the increasing situations of risk caused by rational decisions are not an interpretation of the observer. By contrast, future possible damages constitute a clear sign that complexity involving wildfire is increasing.

The key starting point for a truly risk governance in both areas is envisioning future risks by taking advantage of outstanding enduring features of their social-ecological systems. The features of ancient style of development are noticeable in Rondônia by the indigenous, riverside and rubber-tappers population while in Galicia it can be seen by the existence of community-owned lands. Social sources of adaptability - which has been present in the various process of change in the couple social-ecological systems - can be reinforced, but with contrary objectives, in order to create more sustainable dynamics. The design of the wildfire risk governance model should be transversal to all formal and informal institutions and to the diversity of relationships that are part of socioecological systems.

References

Abi-Eçab, P. C. (2012). Principais ameaças ao meio ambiente em terras indígenas. *Planeta Amazônia. Revista Internacional de Direito Ambiental e Políticas Públicas*, 3, 1-17.

Aguiar, A. V., de Sousa, V. A., Fritzsons, E., & Junior, J. E. (2011). *Programa de melhoramento de pinus da Embrapa Florestas*. Documento 233, Embrapa Florestas.

Allison, H. E. (2015). Understanding and Conceptualizing Risk in Large-Scale Social-Ecological Systems. In U. Fra. Paleo (Ed.). *Risk Governance: The Articulation of Hazard, Politics and Ecology*. New York-London: Springer, 99-115

Alonso, M. P.L., & Lois, R. C.G. (1997). Proceso de industrialización y organización del espacio en un territorio periférico: Galicia. Boletín de la Asociación de Geógrafos Españoles, (24), 147-168.

Antenas, J. M. (2008). El complejo del Rio Madera: resistencias e impacto socioambiental. *Ecología Política*, 34, 107-109.

Armitage, D. R., Plummer, R., Berkes, F., Arthur, R. I., Charles, A. T., Davidson-Hunt, I. J. & McConney, P. (2008). Adaptive co-management for social–ecological complexity. Frontiers in Ecology and the Environment, 7(2), 95-102.

Arruzzo, R. C. (2012). Construindo e desfazendo territórios: as relações territoriais entre os Paresi e os não-índios na segunda metade do século XX. *Scripta Nova: revista eletrónica de geografía y ciencias sociales*, 16, 48.

Balboa, X.L. (1990). *O monte en Galicia*. Vigo: Edicións Xerais.

Balsa-Barreiro, J., & Hermosilla, T. (2013). Socio-geographic analysis of wildland fires: causes of the 2006's wildfires in Galicia (Spain). *Forest systems*, 22(3), 497-509.

Barham, B. L., & Coomes, O. T. (1994). Reinterpreting the Amazon rubber boom investment, the state, and Dutch disease. *Latin American Research Review*, 29(2), 73-109.

Batistella, M., & Moran, E. F. (2005). Dimensões humanas do uso e cobertura das terras na Amazônia: uma contribuição do LBA. Acta Amazonica, 35(2), 239-247.

Beck, U. (1992). *Risk society: Towards a new modernity*. Vol. 17. Sage.

Beck, U. (2002). Power in the global age: A new global political economy. Polity Press

Beck, U., Lash, S., & Giddens, A. (1994). *Modernización reflexiva: política, tradición y estética en el orden social moderno*. Alianza Editorial.

Beck, U. (2006). *Cosmopolitan vision*. Polity Press

Becker, B. K. (1991). *Amazônia* (2nd ed.). São Paulo: Ática.

Becker, B. (2004). *Amazônia: geopolítica na virada do III milênio*. Rio de Janeiro: Garamond.

Beiras, X. M., & López, A. (1999). *A poboación galega no século XX*. Santiago de Compostela: Edicións Laiovento.

Boswell, T., & Chase-Dunn, C. K. (2000). *The spiral of capitalism and socialism: Toward global democracy*. Lynne Rienner Publishers.

Bouhier, A. (1979). *La Galice*. Essai géographique d'analyse et d'interpretation d'un vieux complexe agraire.

Bowman, D. M., Balch, J., Artaxo, P., Bond, W. J., Cochrane, M. A., D'antonio, C. M. & Kull, C. A. (2011). The human dimension of fire regimes on Earth. Journal of biogeography, 38(12), 2223-2236.

Bowman, I. (1913). *Geographical Aspects of the New Madeira-Mamore Railroad*. Bulletin of the American Geographical Society, 45(4), 275-281.

Braudel, F. (1974). *La Historia y las Ciencias Sociales*. Madrid: Alianza Editorial.

Browder, J. O. (1994). Surviving in Rondonia: The dynamics of colonist farming strategies in Brazil's Northwest frontier. *Studies in Comparative International Development*, 29(3), 45-69. 21.

Brown, J. C., & Purcell, M. (2005). There's nothing inherent about scale: Political ecology, the local trap, and the politics of development in the Brazilian Amazon. *Geoforum*, 36(5), 607-624.

Burns, T. J., Kentor, J. D., & Jorgenson, A. (2003). Trade dependence, pollution, and infant mortality in less-developed countries. *Contributions in Economics and Economic History*, 1, 14-28.

Cabana, A. (2008). Lo que queda de las agras. La evolución del paisaje agrario en Galicia: A Terra Chá (1954-1968). AGER. *Revista de Estudios sobre Despoblación y Desarrollo Rural*, 7, 35-58.

Cabana, A. (2009a) A cultura do lume e os montes galegos. Aproximación a unha relación histórica. Recursos Rurais - *revista oficial do Instituto de Biodiversidade Agraria e Desenvolvemento Rural* (IBADER), (5), 101-106.

Cabana, A. (2009b). Incendiarios de las repoblaciones del Patrimonio Forestal (1940-1975). Algunas notas para su caracterización. Actas de la III Reuniòn sobre

Historia Forestal. *Cuadernos de la Sociedad Española de Ciencias Forestales.* 30: 203-208.

Cabana, A. (2011). De imposible consenso. Actitudes de consentimiento hacia el franquismo en el mundo rural (1940-1960). *Historia social*, (71), 89-106.

Calviño-Cancela, M., Chas-Amil, M. L., García-Martínez, E. D., & Touza, J. (2016). Wildfire risk associated with different vegetation types within and outside wildland-urban interfaces. *Forest ecology and management*, 372, 1-9.

Cardesín, J. M. (1992) Tierra, trabajo y reproducción social en una aldea gallega (s. XVIII-XX): muerte de unos, vida de otros. Madrid, ES: *Ministerio de Agricultura, Pesca y Alimentación.*

Cavalcante, M. M. D. A., Nunes, D. D., Silva, R. G. D. C., & Lobato, L. C. H. (2011). Políticas Territoriais e Mobilidade Populacional na Amazônia: contribuições sobre a área de influência das Hidrelétricas no Rio Madeira (Rondônia/Brasil). *Confins* [online], 11.

Chas-Amil, M. L., Touza, J., & García-Martínez, E. (2013). Forest fires in the wildland–urban interface: a spatial analysis of forest fragmentation and human impacts. *Applied Geography*, 43, 127-137.

Cochrane, M. A., & Laurance, W. F. (2002). Fire as a large-scale edge effect in Amazonian Forests. *Journal of Tropical Ecology*, 18(3), pp. 311-325. doi:http://dx.doi.org/10.1017/S0266467402002237 25.

Cochrane M. A., Skole, D.L., Matricardi, E.A.T., Chomentowski, W.H. (2002). *Interaction and synergy between selective logging, forest fragmentation and fire disturbance in tropical forests*: Case study Mato Grosso, Brazil. OGCEO Research Advances 03-02/W. East Lansing, Michigan USA. 26.

Cochrane, M., Skole, D. L., Matricardi, E. A., Barber, C., & Chomentowski, W. H. (2004). Selective logging, forest fragmentation, and fire disturbance. *Working forests in the Neotropics: conservation through sustainable management*, 310-324.

Collins, T. W. (2008). The political ecology of hazard vulnerability: marginalization, facilitation and the production of differential risk to urban wildfires in Arizona's White Mountains. *Journal of Political Ecology*, *15*(1), 21-43.

Corbelle Rico, E., & Crecente Maseda, R. (2008). Land abandonment: concept and consequences. *Revista Galega de Economia*, *17*(2).

Corbelle E. y Crecente, R. (2009). Evolución histórica de la Superficie Agrícola Utilizada en Galicia (1962-2006). Integración de fuentes cartográficas y Estadísticas. *Economía Agraria y Recursos Naturales*, 9(2) 183-192.

Costa, G., Silva, G., Brambilla, C., Lobato, L., Cunha, L., Teles, V. & Cavalcante, M. (2015). Ocupações ilegais em unidades de conservação na Amazônia: o caso da Floresta Nacional do Bom Futuro no Estado de Rondônia/Brasil. GOT, *Revista de Geografia e Ordenamento do* Território, 8, 33-49.

Council *regulation* (EEC) No 2080/92 instituting a Community aid scheme for forestry measures in agriculture. 20.6.1992.

Coy, M. (1988). Desenvolvimento regional na periferia amazônica. Organização do espaço, conflitos de interesses e programas de planejamento dentro de uma

região de" fronteira": o caso de Rondônia. In: Aubertin, C. (Ed.). *Fronteiras*. UnB/Paris: Editora Universidade de Brasília/ORSTOM, 167-194.

Cunha, M. C. D., & De Almeida, M. W. (2000). Indigenous people, traditional people, and conservation in the Amazon. *Daedalus*, 129(2), 315-338.

Dean, W. (1987). *Brazil and the struggle for rubber:* a study in environmental history. Cambridge University Press.

Decree 407/1992. Basic Civil Defence Standards, 24 April 1992.

Decree 893/2013. Directive for the planning of civil protection against wildfires, 15 November, 2016.

Dewey, J., & Ramos, S. (1949). *El arte como experiencia*. México D. F: Fondo de cultura económica.

Dewey, J. (1958*). Experience and nature* (Vol. 1). Courier Corporation.

Dubert, I. (2012). Elderly, Family, and Age Support in Rural Galicia at the End of the Ancien Régime. *Journal of Family History*, 37(2), 175-196.

Duit, A., & Galaz, V. (2008). Governance and complexity—emerging issues for governance theory. *Governance*, 21(3), 311-335.

Duit, A., Galaz, V., Eckerberg, K., & Ebbesson, J. (2010). Governance, complexity, and resilience. *Global environmental change*, 20(3), 363-368.

Fearnside, P. M. (2001). Soybean cultivation as a threat to the environment in Brazil. *Environmental Conservation*, 28(01), 23-38.

Fearnside, P. M. (2005). Desmatamento na Amazônia brasileira: história, índices e conseqüências. *Megadiversidade*, 1(1), 113-123.

Fenske, J. (2014). The battle for rubber in Benin. *The Economic History Review*,67(4), 1012-1034.

Feo Parrondo, F. (2002). Industria forestal en Asturias: el ejemplo de ENCE. *Nimbus*, 9(10), 57-70.

Ferrás, C. S. (2011). Da aldea ao suburbio: cambios demográficos e territoriais en Galicia, 1990. *Revista Galega de Economía*, 20(2), 11-30.

Folke, C., Hahn, T., Olsson, P., & Norberg, J. (2005). Adaptive governance of social-ecological systems. *Annu. Rev. Environ. Resour.*, *30*, 441-473.

Folke, C. (2006). Resilience: The emergence of a perspective for social–ecological systems analyses. *Global environmental change*, 16(3), 253-267.

Folke, C (2008). *Synthesis: resilience and adptative capacity in social – ecological systems.* In: Berkes, F., Colding, J., & Folke, C. (Eds.). (2008). Navigating social-ecological systems: building resilience for complexity and change. Cambridge University Press.

Folke, C. (2007). Social–ecological systems and adaptive governance of the commons. Ecology and Economics. *Ecol Res* (2007) 22: 14–15.

Folke, C., Hahn, T., Olsson, P., & Norberg, J. (2005). Adaptive governance of social-ecological systems. *Annu. Rev. Environ. Resour.*, 30, 441-473.

Fraser, J. A. (2010). Amazonian dark earths and caboclo subsistence on the middle Madeira River, Brazil (Doctoral dissertation, University of Sussex).

Fujisaka, S., Bell, W., Thomas, N., Hurtado, L., & Crawford, E. (1996). Slash-and-burn agriculture, conversion to pasture, and deforestation in two Brazilian Amazon colonies. *Agriculture, Ecosystems & Environment*, 59(1), 115-130.

Fujisaka, S. & White, D. (1998). Pasture or permanent crops after slash-and-burn cultivation? Land-use choice in three Amazon colonies. *Agroforestry Systems*, 42(1), 45-59.

García, A. & Pérez, M. (2001). Análise e evolución da aplicación em Galicia do Programa de Axudas á forestación de terras agrarias. *Revista Galega de Economía*, 10(1), 151-176.

García P. J. (2001). En el corazón de las tinieblas…del Putumayo, 1890-1932. Fronteras, caucho, mano de obra indígena y misiones católicas en la nacionalización de la Amazonia. *Revista de Indias*, 61(223): 591-617.

Goldammer, J. G. (2001). *FRA Global forest fire assessment 1990-2000*. Rome: Food and Agriculture Organization, 30-37, Forest Resources Assessment Programme, Working Paper 55.

Gomes, C. V. A. (2009). *Twenty years after Chico Mendes*: extractive reserves' expansion, cattle adoption and evolving self-definition among rubber tappers in the Brazilian Amazon (Doctoral dissertation, University of Florida, Florida, USA).

Goudsblom, J. (1992). *Fire and civilization*. Harmondsworth: Penguin

Graça, P. M. L., Vitel, C. S. M. N., & Fearnside, P. M. (2012). Detecção de cicatrizes de incêndios florestais utilizando a técnica de análise por vetor de mudança na terra indígena sete de setembro-Rondônia. *Ambiência*, 8, 512-521

Gregory, R., & Long, G. (2009). Using structured decision making to help implement a precautionary approach to endangered species management. *Risk Analysis*, 29(4), 518-532.

Guimarey, B.; & Corbelle, E. (2012). Caracterización dos procesos de repoboación forestal posteriores á entrada de Galicia na Unión Europea. In: Crecente Maseda, R. & Fra Paleo, U. (Eds.). *Territorios a examen*: trabajos de ordenación territorial Santiago de Compostela: Servizo de Publicacións e Intercambio Científico, 41-56.

Gunderson, L. H.; and Holling, C. S. editors. (2002). *Panarchy*: understanding transformations in human and natural systems. Island Press, Washington, D.C., USA.

Harrison, J. (1980). Spanish economic history: From the restoration to the Franco regime. *The Economic History Review*, 33(2), 259-275.

Holling, C. S. (2001). Understanding the complexity of economic, ecological and social systems. *Ecosystems* 4:390-405.

Holling, C. S. (2006). Foreword: The backloop to sustainability. *In*: Berkes, F., Colding, J., & Folke, C. (Eds.). (2008). *Navigating social-ecological systems: building resilience for complexity and change*. Cambridge University Press.

IGN – Censos de población y viviendas 2001 y 2011 Elaboración de IGN a partir dos ficheiros proporcionados polo INE. Accessed 15 March 2016

INPE – Instituto Nacional de Pesquisas Espaciais (2016). Portal do Monitoramento de Queimadas e Incêndios. Available in: http://www.inpe.br/queimadas. Accessed 17 January 2017.

Jones, D. W., Dale, V. H., Beauchamp, J. J., Pedlowski, M. A., & O'Neill, R. V. (1995). Farming in Rondonia. *Resource and energy economics*, *17*(2), 155-188.

Krug, T. (1999). Tecnologia espacial como suporte à gestão dos recursos naturais. *Parcerias Estratégicas*, 4(7), 211-226.

Lage Picos, X. A. (2003). El monte, el cambio social y la cultura forestal en Galicia. *RIPS: Revista de Investigaciones Políticas y Sociológicas*, 2(1-2), 109-124.

Lana, J. M. (2016). From privatisation to governed nature. Old and new approaches to rural commons in Spain. Ländliche Gemeingüter: Kollektive Ressourcennutzung in der europäischen Agrarwirtschaft= *Rural commons: collective use of resources in the European agrarian economy*/Niels Grüne, Jonas Hübner, Gerhard Siegl (Hg.), 12-26.

Laurance W. F., Curran T.J. (2008). Impacts of wind disturbance on fragmented tropical forests: a review and synthesis. *Austral Ecology*; 33(4): 399-408.

Law 3/2007. Prevention and mitigation of wildfires in Galicia. Accessed 9 April 2007.

Leroy, J. P. (2005). *Política ambiental do governo Lula para a Amazônia*. In: [Coll.] Direitos Humanos no Brasil. Relatório da Rede Social de Justiça Social e Direitos Humanos.

Liss, C. C. (1987). Evolución y estado actual de la concentración parcelaria en España. *Revista de Estudios Agrosociales*, (139), 31-66.

López Iglesias, E. (2000): O sector agrario galego ás portas do século XXI: balance das súas transformacións recentes. *Revista Galega de Economía*, 9(1):167-196

Luhmann, N. (1993). *Communication and social order*: risk: a sociological theory. Transaction Publishers.

Luhmann, N. (1996). Modern society shocked by its risks. *Social sciences research centre ocasional paper 17*. The University of Hong Kong.

MAGRAMA (1990). *Los Incendios Forestales en España*. Año 1989. Ministerio de Agricultura, Alimentación y Medio Ambiente: Madrid.

MAGRAMA (2012*). Los Incendios Forestales en España*. Decenio 2001-2010. Ministerio de Agricultura, Alimentación y Medio Ambiente: Madrid.

Marey, M. F. (2013). Da cultura agraria á industria do lume. *Grial: Revista Galega de Cultura*, (198), 69-77.

Marey, M. F.; Crecente, R.; Rodriguez, V. (2004). Claves para comprender los usos del monte en Galicia (España) en el siglo XX. In: *II Simposio Iberoamericano de gestión y Economía Ambiental*. Barcelona, 18-20.

Marichal, C. (2006). The Spanish-American silver peso: Export commodity and global money of the Ancien Regime, 1550-1800. In: Topik, S., Marichal, C. & Frank, Z. *From Silver to Cocaine*, 25-52.Durham/London: Duke University Press.

Mello, L. C. (2014). *Os outros lados da fronteira: la historia del alto Madeira en el siglo XVIII desde el estudio de sus relaciones interétnicas*. (Masters' dissertation, University Pablo de Olavide, Sevilla.

Mello, L. C. (2016). From the fortified plaza to social arena: The Amazonian fortress of Príncipe da Beira and some considerations on the social interpretation of materiality. *In the Trenches. Archaeological review from Cambridge*, 31(1), 38-61.

Minc, C. (1985). *A reconquista da Terra: Estatuto da Terra, lutas no campo e reforma agrária*. Rio de Janeiro: Jorge Zahar.

Muñoz, R. V. (1991). Los incendios forestales y la política forestal. *Revista de estudios agrosociales*, (158), 83-105.

Nascimento, M. G. (1998). Migrações nordestinas para Amazônia. *Revista Educação, Cultura e Meio Ambiente*, II(12), 1-13.

Nascimento, S. M. (2013) Real Forte Príncipe da Beira: Histórias e estórias do Imaginário popular no Vale do Guaporé. *Revista Labirinto*, XIII(18), 113-124

Nepstad, D. C., Lefebvre, P., Lopes da Silva, U., Tomasella, J., Schlesinger, P., Solorzano, L. & Guerreira Benito, J. (2004). Amazon drought and its implications for forest flammability and tree growth: A basin-wide analysis. *Global Change Biology*, *10*(5), 704-717.

North, D. C. (2005). Institutions and the process of economic change. *Management International*, *9*(3), 1.

Oliveira, A. U. (2006). A Amazônia e a nova geografia da produção da soja. *Terra Livre*, 1(26), 13-43.

Ónega-López, F. J., Puppim de Oliveira, J. A., & Crecente-Maseda, R. (2010). Planning innovations in land management and governance in fragmented rural areas: Two examples from Galicia (Spain). *European Planning Studies*, *18*(5), 755-773.

Ott, A. M. T. (2002). Dos projetos de desenvolvimento ao desenvolvimento dos projetos: o PLANAFLORO em Rondônia. (Doctoral dissertation, Federal University of Santa Catarina, Florianópolis).

Pardo, J. C. S. (2010). Poblamiento rural tardorromano y altomedieval en Galicia (ss. VX).: Una revisión Arqueológica. *Archeologia medievale*, (37), 285-306.

PARMSRN (2010). *Plano de ação participativo para o desenvolvimento de uma economia racional e de manejo sustentável dos recursos naturais da Terra Indígena Sete de Setembro*,Metareilá, Cacoal.

Parrondo, F. F. (2002). Industria forestal en Asturias: el ejemplo de Ence. *Nimbus: Revista de climatología, meteorología y paisaje*, (9), 57-70.

Pausas, J. G. (2012). *Incendios forestales. Una visión desde la ecología*. Consejo Superior de Investigaciones Científicas (España).

Pedlowski, M. A. (1997). *An Emerging Partnership in Regional Economic Development: Non-Governmental Organizations (NGOs), Local State and the World Bank. A Case Study of Planafloro, Rondônia, Brazil*. Doctoral dissertation, Virginia Polytechnic Institute and State University, Virginia, USA.

Pereira, M. F. V., & Kahil, S. P. (2010). A lógica corporativa do uso do território em Rondônia: o agronegócio da soja na região de Vilhena. *Campo-Território: revista de Geografia Agrária*, 5(10), 288-311.

Pérez Rubio, J.A. (1995): *Yunteros, braceros y colonos*. La política agraria en Extremadura (1940-1975). Madrid, MAPA.

Pérez Vilariño, J.P. (1992). Cultura forestal y diferenciación profesional. *REIS: Revista Española de Investigaciones Sociológicas*, (59), 89-119.

PLADIGA – Plan de prevención e defensa contra os incendios forestais de Galicia (2016). Xunta de Galicia. Consellería de Medio Rural. Dirección Xeral de Montes, Santiago de Compostela, Spain Available in: http://mediorural.xunta.gal/fileadmin/arquivos/forestal/pladiga/2016/MEMORIA.pdf Accesed 16/07/2016.

Popa, F., Guillermin, M., & Dedeurwaerdere, T. (2015). A pragmatist approach to transdisciplinarity in sustainability research: From complex systems theory to reflexive science. *Futures*, *65*, 45-56.

Prado, E. E. D., Hiromoto, D. M., Godinho, V. D. P. C., Utumi, M. M., & Ramalho, A. R. (2001). Adaptabilidade e estabilidade de cultivares de soja em cinco épocas de plantio no cerrado de Rondônia. *Pesquisa Agropecuária Brasileira*, *36*(4), 625-635.

Pyne, S. J. (1997). *Vestal fire: an environmental history, told through fire, of Europe and Europe's encounter with the world*. University of Washington Press.

Pyne, S. J. (2012). *World fire: the culture of fire on earth*. London: Reaktion Books.

Ramos-Neto, M. B., & Pivello, V. R. (2000). Lightning fires in a Brazilian savanna National Park: rethinking management strategies. *Environmental management*, *26*(6), 675-684.

Ribeiro, D. (1958). Cândido Mariano da Silva Rondon. *Revista de Antropologia*, 6(2), 97-103.

Rich, B. M. (1985). The multilateral development banks, environmental policy and the United States. *Ecology Law Quarterly*, 12, 681–745

Rico-Boquete, E. (1995). *Política forestal e repoboacións en Galicia, 1941-1971*. Universidade de Santiago de Compostela.

Rodrigues, F. S. (2010). História e fronteiras: o Estado Brasileiro e a intervenção no Sertão Norte (1889-1930). *Revista Brasileira de Estudos Estratégicos*, 1(3), 133-156.

Rondon, M.S. (1916). *Missão Rondon: apontamentos sobre os trabalhos realizados pela Commissão de Linhas Telegraphicas Estrategicas de Matto-Grosso ao Amazonas (sob a direcção do coronel de engenharia Candido Mariana da Silva Rondon de 1907 a 1915)*. Rio de Janeiro: Typ. do Jornal do Commercio.

Rothstein, H. (2006). The institutional origins of risk: A new agenda for risk research. *Health, risk & society*, *8*(3), 215-221.

Saavedra, P., & Villares, R. (1985). *Galicia en el Antiguo Régimen: la fortaleza de una sociedad tradicional*. Crítica, 434-50.

Santos Rodrigues, J. R. (2010). La construcción del ferrocarril Madeira-Mamoré y el Caribe inglés: la primera inmigración negra libre para Brasil. *Vegueta: Anuario de la Facultad de Geografía e Historia*, (11), 89-100.

Saraiva, O. F. S., & Leite, R. D. C. (2008). *Resultados de pesquisa da Embrapa Soja 2005*. Documentos 296. Londrina, PR: Embrapa Soja.

Schlindwein, J. A., Marcolan, A. L., Fioreli-Perira, E. C., Pequeno, P. L. D. L., & Militão, J. S. T. L. (2012). Solos de Rondônia: usos e perspectivas. *Revista Brasileira de Ciências da Amazônia*, 1(1), 213-231.

Seijo, F. (2005). The politics of fire: Spanish forest policy and ritual resistance in Galicia, Spain. *Environmental Politics*, *14*(3), 380-402.

Silva, R. G. C. (2007). Agronegócio e novas dinâmicas territoriais em Rondônia. In:*X Simpósio Nacional de Geografia Urbana – Trajetórias da Geografia Urbana no Brasil: tradicoes e perspectivas*, (pp. 1-16). Florianópolis.

Silva, R. G. C. (2014). Espaço, sociedade e natureza em Rondônia. *Revista GeoAmazônia*, 1(02), 144-165.

Silva, R. G. D. C. (2015). Amazônia globalizada: da fronteira agrícola ao território do agronegócio–o exemplo de Rondônia. *Confins. Revue franco-brésilienne de géographie/Revista franco-brasilera de geografia*, (23).

Silva, N. T.C., & Ferreira Neto, J. A. (2014). Actividades económicas en tierras indígenas en la Amazonía Brasileña: Perspectivas y contradicciones para el desarrollo rural. *Spanish Journal of Rural Development*, *5*(2).

Singh, S. J., Haberl, H., Chertow, M., Mirtl, M., & Schmid, M. (Eds.). (2013). Long term socio-ecological research: Studies in society-nature interactions across spatial and temporal scales (Vol. 2). Springer Science & Business Media.

Smeraldi, R., & Millikan, B. (1997). *Planafloro - Um Ano Depois - Análise Crítica da Implementação do Plano Agropecuário e Florestal de Rondônia Um Ano após o Acordo para a sua Reformulação*. Amigos da Terra Internacional - Programa Amazônia e Oxfam, São Paulo/Porto Velho, August. Manuscript.

Soto, B., Basanta, R., Perez, R., & Diaz-Fierros, F. (1995). An experimental study of the influence of traditional slash-and-burn practices on soil erosion. *Catena*, *24*(1), 13-23.

Soto-Fernández, D. (2016). De la multifuncionalidad a la especialización, la irrelevancia y la reinvención: los montes de Galicia durante la transición socio-ecológica (1960-2012). Encontro Rural Report. XV Congreso de historia agraria

Souza, M. M. O., & Grossi, S. R. (2010). A regionalização do espaço amazônico: o caso de Rondônia. Revista da Católica, Uberlândia, 2 (3), 126-145.

Souza, M. M. O., & Pessôa, V. L. S. (2009). A contra-reforma agrária em Rondônia: colonização agrícola, expropriação e violência. V Encontro de Grupos de Pesquisa "Agricultura, Desenvolvimento regional e transformações socioespaciais. UFSM.

Souza, V.A. (2011). *Rondônia: Uma memória em disputa*. (Doctoral dissertation, Paulista State University "Júlio de Mesquita Filho", Assis, SP).

Tedim, F., Xanthopoulos, G., & Leone, V. (2015). Forest Fires In Europe: Facts And Challenges. *Wildfire: hazards, risks and disasters'.(Eds D Paton, PT Buergelt, S McCaffrey, F Tedim)* , USA: Elsevier, 77–99

Tedim, F., Leone, V., & Xanthopoulos, G. (2016). A wildfire risk management concept based on a social-ecological approach in the European Union: Fire Smart Territory. *International Journal of Disaster Risk Reduction*, *18*, 138-153.

Teixeira, L. S. (2015). *Dinâmicas territoriais em Rondônia: conflitos fundiários entorno do Projeto Integrado de Colonização Sidney Girão (1970-2004).* (Masters dissertation, Pontifical Catholic University of Rio Grande do Sul, Porto Alegre).

Théry, H. (2012). *Rondônia: mutações de um Território Federal na Amazônia brasileira*. Porto Velho: SK Editora.

Urzúa, J. P. P. (2015). Integración regional e hidroelectricidad: geopolítica del alto río Madeira entre frontera y cooperación. Estudos Internacionais: Revista de Relações Internacionais, 3(2), 181-201.

Muñoz, R. V. (1999). El período 1848-1947 en la defensa contra incendios forestales en España. In *Incendios históricos: una aproximación multidisciplinar*. Universidad Internacional de Andalucía, p. 13-33.

Vergara, M. R. (2015). Franz Keller-Leuzinger's Exploration of the Amazon and Madeira Rivers During the Brazilian Empire: Press and Nation. *History Research*, 3(5), 54-64.

Villares, R. (1990). La agricultura gallega contemporanea (1850/1936) permanencias y cambios. *Areas. Revista Internacional de Ciencias Sociales*, (12), 137-143.

Wallerstein, I. (1979). *The capitalist world-economy* (Vol. 2). Cambridge University Press.

Wilkinson, X. V. (2009). *Tapping the Amazon for Victory: Brazil's "Battle for Rubber" of World War II*. (Doctoral dissertation, Georgetown University, Washington D.C.)

Wynne, B. (1996). A reflexive view of the expert-lay knowledge divide. *Risk, environment and modernity: Towards a new ecology*, *40*, 44.

Zennaro, P., Kehrwald, N., Marlon, J., Ruddiman, W. F., Brücher, T., Agostinelli, C. & Barbante, C. (2015). Europe on fire three thousand years ago: Arson or climate? *Geophysical Research Letters*, *42*(12), 5023-2033.

3. Wildfire risk communication in Rondônia and Galicia

3.1. Introduction

Risk communication is a central part of risk governance (Kasperson, 2015; Renn, 2015), once it helps societal actors to understand the rationale of risk results and to make decisions regarding risks. In addition, risk communication raises tolerance for conflicting viewpoints and provides the basis for their resolution, creating trust in the institutional means for assessing and managing risk and related concerns (Renn, 2009).

However, the ultimate goal of risk communication cannot be limited tothe actors' trust in institutional means. The diverse and conflicting interests can represent sources of learning about the governance processesin a certain area.

Kasperson (2015) highlighted that the experience of risk is linked to communication processes by which groups and individuals learn to acquire or create interpretations of risk and risk frames[11] (Kasperson, 2015). In this way, risk communication also holds a wide range of actors and different ways of flowing information, direct or indirectly related to risks.

Three approaches are noticeable regarding the conceptualization of risk communication: one-way, two-way communication and social learning.In the one-way risk communication, risk information is conveyed from experts or authorities to lay citizens, being implict the superiority of knowledge of experts and inferior knowledge of lay citizen (De Marchi, 2015). In this sense, experts are considered the legitimated actors to construct risk analysis. The public is considered passive agents who must receive information from experts .The crucial purpose of risk communication, in this approach, is to diminish public ignorance.

The emergence of two-way communication brings the possibility for feedback from the public. The two-way information flow by near-instantaneous feedback is able to clarify and rectify the broadcast of disaster information (Sood, 1987).

Nevertheless, the one-way communication has not been abandoned en detriment of two-way communication. In fact, Jönsson's et al. (2016) findings have shown that research about risk communication -in the array of cross-national environmental risks - still focuses on a traditional and obsolete notion of communication as a linear process, which might be successful but could also fail.

In practice, these approaches co-exist and overlap.The one-way and two-way risk communication have been developed as an attempt to build a communicative bridge between official channels and the public. Studies about risk communication during wildfire crisis usually differentiate information by its relationship with risk management stages: preparedness, response, mitigation, and recovery (Tang et al., 2015). Social media applications are hot topic in the approach of two-way communication. In wildfires risks, social media applications have been considered as bridges between first

[11] Frame is used in the perspective of Goffman. It is an interpretive framework that helps individuals to process information (Goffman 1974)

responders, the population exposed and the citizens who offer help (Brengarth, 2016). In this way, Sutton et al. (2008) has suggested that the increasing two-way communication during disaster management should be supported by public officials. These authors have called for a new conceptualization of the information production and dissemination functions for disaster response.

Although these approaches represent a support to disasters mitigation, the disaster experience is necessarily associated with actors directly exposed to risks. Disasters are also a subject of the media when framing risk and communicating risk information through news. Ironically, the role of media, in many contexts, can be the most effective form of transmiting risk information in the one-way approach or even in two-way approaches.

The mass media focus on disasters, according to Dunwoody (1992) usually ends up in bias, sensationalism, inaccuracy, and in being simplistic and polarized in risk coverage. Similar point is made by Adams (1992) who stated that journalists tend to ignore risk and report on larger hazards and their negative consequences. In some cases it might be true, mainly in contexts where there is no effective dialogue between media and official channels. A bridge between these channels can be seen as a possibility to promote education about some potential or future risks. Besides, journal reports are not the result of deliberate distortion or incompetence of journalists, but they are an outcome of media's institutional and organizational values, by acting as gatekeepers or filters of the large volume of information to make it manageable for the audience (Quarantelli, 2002). This corroborates Dijk's (1983) statement that news (in general, not only disasters ones) are not merely an incomplete description of the facts, but a specific kind of (re) construction of reality according to the norms and values of that society. In other words, the media can influence and it can be influenced by societal actors. In this way, the corpus of disaster news stories is, according to Sood et al. (1987), a product of complex and contingent relationships in the news process that affect not merely the public perception but also the coverage of, and policy toward, future events that the media define as disasters.

Values of societal actors or hot topics in the socio-economic and political agenda are framed by the media to achieve desired rates of news' sale, once the elemental goal of mass media is to transform information in a catching and profitable message. In this way, the spectacle - understood as the transformation of life events in a representation - aims to reinforce the choices made in the capitalist manner of production (Debord, 2008). However, there are, as well, non-private purposes in disseminating risk information. This role is usually played by organized civil society, local or transnational, which seeks to form an opinion on what it is considered by these groups as an adequate treatment of the risk issues.

Although their interests are not – or not strictly – commercial, it does not obscure the possibility that risks are also transformed in spectacles. The spectacle in this chapter is a Debord's (2008) concept that helps the examination of risk communication in Rondônia and Galicia. The logic of the spectacle limits actor's understanding of risks. This logic contradicts the third approach of risk communication, which is the learning process. The learning process among various actors – in a multi-directional and interactive way- focus on obtaining a negotiated and non-hierarquical construction of risk knowledge rather than finding a simplistic explanation for risks, as seen in the spectacle logic.

Hence, this chapter seeks to examine how wildfire risk is communicated by different actors, via media (local printed media and international online articles) or public official channels and at communitarian level, among neighbors or rural villagers. This can give clues to better understand the governance conditions in each context. Wildfires' frames by the media and civil society (local and transnational), and also the degree of interaction among official means of risk communication and the public are analytical unities used to understand the wildfire risk arena of interests in Rondônia and in Galicia.

3.2. Methods

This study uses qualitative content-textual analysis of wildfire risk communication in Rondônia and in Galicia. Analysis of local printed media was aimed at exploring the nature of risk information transmitted in both places. News articles dealing with wildfires published in the mainstream printed media in 2015 in Rondônia (*Diário da Amazônia*) and Galicia (*El Progreso*) were used. Since the Amazonia catches world attention regarding the environmental issues, an analysis of on-line news articles on wildfires in Rondônia in 2015 has been performed. Thus, this analysis focuses on the role of media as an actor (among others) in collecting, interpreting and communicating wildfire information. The existing channels of risk communication, the types of generated information, and how it is communicated have been examined in order to understand the dominant approach of risk communication in Rondônia and Galicia. In addition, bibliography review and informant interviews in locu were examined in order to support the analysis.

The media's discourse is understood as a manifestation of a complex process in which knowledge, beliefs, and opinions are matched with existing or incoming information about events, the social context of news production, and representations of the public (Dijk, 1983). Therefore, the analysis of article newsreporting wildfires shows elements that help to understandthe current conditions of risk governance and risk communication in studied areas. Besides, it helps to explore the role of different actors, and social, economic and political elements that are intrinsically linked to the disaster risk.

The content analysis opens the door to a rich repertoire of social-scientific constructs by which texts may become meaningful (Krippendorff, 1989). Regarding the content analysis of news, Semetko and Valkenburg (2000) have called for the development of a set of analytical indicators in order to explore similarities and differences in the way politics and topics of national and international importance are framed in the news in different countries.

Three elements were chosen to develop the content analysis in this study: surface structure; rhetoric variations; and text/context that allows the discovery of the related macrostructures covering wildfires in both areas. The surface structures are related to the semantic level of the discourse as a whole; the rhetoric variations are parallelisms, metaphors, ironies and alliterations; the text and context consist of the dimension of an action in which a discourse is seen, as a promise, threat, question, congratulation (Dijk, 1983) or blame, for instance.

Both the headlines and the news were considered important in the analysis. The

content of news in daily press is organized by the principle of importance, along a dimension of decreasing prominence with respect to the macrostructure, so that reading headlines means processing the most important information (Dijk, 1983).

The content analysis here is aimed at understanding the wildfire risk arena and discourses of interface with the main subject, which can give clues about the major context in which wildfires take place.

3.3. Results and discussion

3.3.1. Wildfires in Rondônia: The role of local media

Using the criteria of 'adopted approaches' or 'major salience given', the printed news articles of local printed media in Rondônia about wildfire were classified in three types of subjects: 1) the existent reactive and non-scientific nature wildfire management; 2) the negative effects of fire to the ecosystem, the infrastructures and individuals' health affected by the smoke; 3) the hardship identification of fire-starters. So, those articles open an avenue to discuss the following aspects: health problems caused by fire as one sign of a sick planet, land property as an old and current problem, the requirement of environmental rural registration and the ambiguities in the law interpretation about criminal fires.

Table 1. Articles about wildfires published in Diário da Amazônia, Porto Velho, 2015.

	Title (in Portuguese and English translation)	**Date**
1	Balorixá prevê grande incêndio Balorixá predicts great wildfire	1 January
2	Sobe para 16,7% casos de queimadas urbanas em Porto Velho 16,7% increase in cases of urban clearing fires in Porto Velho	4 July
3	Estudo aponta para focos de queimadas Study indicates clearing fire hotspots	21 July
4	Estado mobilizado contra queimadas State mobilized against clearing fires	24 July
5	Rondônia respira fumaça (titlepage) Rondônia breathes smoke	7 August
6	Incêndio queima vegetação no cemitério Wildfire burns vegetation in the cemetery	7 August
7	Queimadas: 53 focos em Ariquemes Clearing fires: 53 hotspots in Ariquemes	7 August

8	Incêndio atinge terreno da Base aérea de Porto Velho Wildfire affects the Air Base land in Porto Velho	8 August
9	Porto Velho no topo de queimadas urbanas (title page) Porto Velho in the list of top urban clearing fires	12 August
10	Porto Velho lidera em ranking de queimadas urbanas e rurais Porto Velho leads the ranking of urban and rural clearing fires	12 August
11	Queimadas: Fogo volta a atingir área e mata animais (title Page) Clearing fires: Fires affect region again and kills animals	15 August
12	Queimada volta a atingir terreno da base aérea Clearing fires affect again the Air Base	15 August
13	Clima seco faz avançar focos de queimadas em Cacoal. (title Page) Dry climate causes clearing fire hotspots to advance in Cacoal	16 August
14	Com clima seco, queimada avança e dificulta controle With dry climate, clearing fires advance and become difficult to be controlled	16 August
15	Show de fumaça Smoke spectacle	20 August
16	Sedam busca identificar autores de incêndios (title Page) SEDAM tries to identify wildfire-starters	21 August
17	Sedam quer identificar incendiários SEDAM wants to identify fire-starters	21 August
18	Ditos mil focos de calor só registrados na cidade One Thousand hotspots registered in the city alone	22 August
19	Blitz alerta contra queimadas urbanas Campaigns alert against urban clearing fires	22 August
20	Fumaça causa problema nas cidades (title Page) Smoke causes problems in cities	23 August
21	Forte fumaça prejudica meio ambiente Strong smoke impacts the environment	23 August
22	Cacoal Focos de incêndios podem ser criminosos, afirma bombeiros Cacoal: Fire hotspots may be criminal, affirm firefighters	25 August

23	Clima seco: A nuvem de fumaça sobre a capital e Ji-Paraná enfrenta problema (title Page) Dry climate: Smoke cloud above the capital and Ji-Paraná faces problem	26 August
24	SEMEIA registra aumento de índice de queimadas SEMEIA registers an increase in clearing fire index	26 August
25	SIPAM prevê mais um dia quente em Rondônia (title Page) SIPAM predicts another hot day in Rondônia	27 August
26	Ji-Paraná registra aumento de número de focos de incêndios Ji-Paraná registers an increase in the number of fire hotspots	27 August
27	Ji-Paraná: Fumaça e calor superlotam as unidades de saúde (title Page) Ji-Paraná: Smoke and heat lead health centers to be crowded	30 August
28	Fumaça e calor levam crianças ao Hospital Municipal Smoke and heat lead children to the Municipal Hospital	30 August
29	Fogo atinge área próxima ao Parque Ecológico da Capital Fire affects area near the capital Ecological Park	11 September

Data collected in: 28 December 2015, Porto Velho.

The lack of a scientific approach towards the disaster is easily identifiable in new article 1 that illustrates a fire and flood forecast by a guru (so-called Balorixá), which denotes the use of misbelieves as a way to find meanings to risk disaster. This seems to be ironically accompanied by the institutional lack of a precautionary approach. The absence of prevention is the target of criticism in the op-ed 15 (Table 1) and is indirectly found in new article 4 (Table 1), that describes the (late) first meeting of the Fire Prevention Committee12on July 23, although it was emphasized, that in June 1,5 thousand hotspots were registered already.

The meeting of the Committees took place in the peak period of the drought and fires in Rondônia, which demonstrates the reactive characteristic of fire management in Rondônia. In that sense, participants of this committee expose:

> The committee is the most concrete inter-institutional initiative in existence; however, it just works in the peak of fire period, it does not explore the prevention and education side. Embrapa, without institutional partnership,

[12] Composed by those institutions: Ministério Público (Prosecuter), IBAMA (Environmental federal institution - Brazilian
Institute of the Environment) EMATER (Rural Extension), CBMRO (Fire Department), UNIR (Rondônia's University, FETAGRO (Federation of rural labor union), SEAGRI (Agricultural Secretary), IDARON (defense agro health department), SEDAM (Environmental Institution of the state), CEPLAC (executive committee of the cocoa crop), FAPERON (private university), Caerd (Water distribution company), AROM (Municipalities Association), CPPT Cuniã (Research Group of Traditional People), SIPAM (System of Amazon Protection), INCRA (Federal Land Institute), BAPV(Air Base of Porto Velho), SFA (Federal Agriculture Institution), BPA (Environmental Military Police), SEMA (Environmental Municipal Departamenr), ICMbio (Conservation Unities Federal Departament), FUNAI (Indigenous Federal Department), EMBRAPA (Rural Science and Technology Department- agricultural research).

> develops research related to alternatives to contesting slash and burn. There is much militarism in fire management, such as Military Firefighters Corps, and military police. The uniform represents the oversight; the curtailment and not the aim to transmit information. My concern is bringing those words to action. There is no concern regarding the use of a friendlier language. (Embrapa's researcher A, Porto Velho, 2015).
>
> It is a group that meets tardily in the peak of the dry season to plan activities to handle the most susceptible period of fires. It is a group to put out the fire. EMBRAPA develops a work in a continuous process. EMBRAPA formed partly by a national group in 2002-2003, that set up a schedule of eight-hour-courses. These courses consisted of information to raise awareness about the use of alternative technology to replace the use of fire. Most of degraded grasslands is due to the fact that small farmers consider fire the cheapest option (Embrapa's researcher B, Porto Velho, 2015).
>
> The Committee's meeting happens when there is a critical situation. We don't have a partnership with Embrapa. (Ibama's worker, 2015).
>
> There is no risk governance. Just an instituted Committee (Sedam's worker, Porto Velho, 2015).

In those discourses interviewees make it clear that fire management in Rondônia is characterized by the reactive approach and the reminiscent presence of military approach. The fact that the committee's meetings are prompt during the critical period of wildfires allows the analysis that the Committee's existence is not translated into strong ties in social networks. As the stronger are the ties to networks, individuals are more likely to make more consistent decisions (Granovetter, 1973). Thus, the existence of the committee to mitigate fire damages is not translated in a real process of interinstitutional risk communication.

The environmental damages were only pointed out in the articles 13 and 26 (Table 1), emphasizing respectively fire effects to flora and fauna in protected areas. The health damage is more emphasized than the environmental harm, once fire and illness are linked in many articles: the inhalation problems in articles 5, 21, 23, 27, 28 (Table 1). This in parts reinforces Adams' (1992) idea that journalists tend to focus on the negative consequences of hazards. Nevertheless, local news in Rondonian illustrates that health damages are more highlighted than ecological ones.

In this way, the sick planet is the perspective used to see that society as a whole concretely re-created the world as the environment and decor of its illness, in which the negative effects of pollution and the need to combat it led to a certain union of different social classes (Debord, 2006). Hence, the negative effects of wildfires give evidence to the productive –economic model adopted in Rondônia, which made the environment more hazardous for all society. In addition, the consequences of fire over infra-structure were also highlighted, such as in airports restricting the landing of aircraft. The threatening of houses, phone towers and cemetery is stressed in articles 6, 14, 21 and 23, revealing the fire of wildland urban interface in Porto Velho, the most populated[13] municipality of Rondônia.

[13]According to IBGE (2010) data, the population of Porto Velho is of 428, 527 inhabitants. The population density of 12,57 inhabitants per square kilometre.

The discussion of fire found in the scientific literature of wildfire of Amazon relies in the deforestation fire and roads construction. Nevertheless, the approaches do not give evidence to this emerging situation, which deserves attention by different institutions responsible for land planning.

News articles 16 and 22 (Table 1) expose a contradiction of existing multiple criminal fires, it also accentuates the hardship identification of fire-starter. This subject has been directly linked to the historical problem of registration land in Rondônia. Théry (2012) has concluded that the major barrier in the 1970s to Rondônia's development was to obtain the land title in the period when it was a federal territory. According to the interviews, land registration represents a problem in Rondônia, mainly in the identification of fire-starters:

> The problem regarding the INCRA is that they do fail to complete the settlement. INCRA has no control of the illegal land market and of environmental offense. INCRA is unable to identify the fire-starters. (Sedam's worker A, Porto Velho, 2015).
>
> There are real obstacles to apply criminal sanctions which result in impunity. The fines are expensive, but they are not effective because the lands usually have no formal owner (Environmental Police, Candeias do Jamari, 2015).
>
> It is complicated to call upon offenders because they are not to be found. The rural environmental registration helps us. It plays the coordinates and makes the tax assessment. However, the number of unregistered land is high, which is made by SEDAM, up to 240 hectares are without costs (Sedam's worker B, Porto Velho, 2015).

The rural environmental registration is the most recent attempt to solve the problem of land registration. It consists of a requirement of the New Brazilian Forest Code of 2012 (law 12.651of 25 may 2012), which has extended the deadline for farmers until December 2015todo the land registration. This is mentioned in Diário da Amazônia – a local newspaper- many times14, which demonstrates the importance of

[14]February 6th: Governo quer acelerar adesão de produtores ao Cadastro Ambiental
Government wants to accelerate farmers adhesion to rural environmental registration
February 10th: Rondônia no ranking do Cadastro Ambiental Rural
Rondônia in the rural environmental registration ranking
May 7th: Adesão ao CAR deve subir após prorrogação
Adhesion to rural environmental registration might increase after the deadline extension
March 24th: Acir cobra prorrogação do Cadastro Ambiental
Acir asks to postpone the rural environmental registration
March 29th: Cadastro Rural atende 20% das propriedades
Rural environmental registration serves 20% of properties
April 8th: Prazo para fazer o CAR termina em um mês
Deadline for rural environmental registration is a month from now
April 15th: Prazo para inscrição no CAR termina em maio
Deadline for rural environmental registration is in May
April 21th: Migração de cadastros rurais ultrapassa 50 mil
Rural Registration Migration reaches over 50 thousand
September 7th: Senador vota favorável à prorrogação do CAR
Senator votes in favor of postponing deadline for rural environmental registration
October 7th: Cadastro Ambiental Rural é reforçado com entrega de veículos
rural environmental registration reinforced with delivery of vehicles
October 27th: Conheça importância do Cadastro Ambiental
Get to Know the importance of rural environmental registration
October 31th: Produtores alertados para o Cadastro Rural
Farmers warned about rural environmental registration

this subject in the current scenario in Rondônia. Actually, fires are mentioned in the New Brazilian Forest Code that states in article 38 that the use of fire on vegetation is forbidden, with few exceptions15. Apart from that, Article 40 regulates that the federal government should establish a National Policy and Management Fires Control, Prevention and Combat of Forest Fires.

In the state environmental ordinance 068 of 2011 it is established that the use of fire in all its forms is forbidden, including controlled burning in agro-pastoral and forestry practices. The ordinance 211 of 2012, in turn, grants authorization to controlled burning, which should include the guidelines[16].

The criminal fire is an issue that divides opinions among institutional actors in Rondônia, as it can be seen in the following fragments of informant interviews:

> All fires are illegal. They are not allowed (Justice Promoter, 58 years old, Porto Velho, 2015).
>
> The small agriculture has no viable alternative use of technology. Farmers cut down and clean forests by using fire. Although wildfire is prohibited this practice still occurs (IBAMA's worker, Porto Velho, 2015).
>
> Controlled burning is permitted if the producer has had the rural environment registration in anthropic areas since 2008 (Sedam's worker, Pimenta Bueno, 2015).
>
> There is a SEDAM's ordinance authorizing the controlled burning since 2012. It depends on the political pressure (ICMbio's worker, Porto Velho, 2015).

The perspective of a small farmer is interesting as well:

> The fines are applied to the wretches who have no money to pay. I even got a fine of R$ 105,000 because I am the president of the association and when you do not find the owner of the property, the president receives the fine. Okay then, we will never pay. The soybean farmers are the ones who should pay fines because of the pesticides they use (Small farmer, Vilhena, 2015).

In the last fragment, the small farmer calls attention to different punishments, which usually fall upon small farmers because of the use of fire. This fragment illustrates that, according to the farmer's point of view, there are other risks being created by big farmers that lack punishment such as the use of pesticides.

November 7th: Governo investe na emissão do CAR
Government invests in emission of rural environmental registration

[15]The exceptions are: 1) in places or regions where peculiarities justify the use of fire in agro pastoral and forestry practices with the approval of the environmental state agency, the competent Sisnama for each rural property or on a regional basis, which would establish the criteria for monitoring and control; 2) use of controlled burning in protected areas, in accordance with its management plan and upon approval of the governing body of Unit Conservation, aiming at conservation management of native vegetation whose ecological characteristics are evolutionarily related to the occurrence of the fire; 3) Scientific research activities linked to the research project properly approved by the competent authorities and carried out by a research institution recognized by prior approval of the competent environmental agency's Sisnama.

[16] Conditions for controlled burning: 1) warn the neighbors with three working days in advance of the place, day and time scheduled for the beginning of the burning; 2) make a firebreak around the area to be burned with a minimum width of three meters; and 3) promote windrowing waste vegetation in order to limit the action of fire

The prohibition of fires is interpreted by institutional actors in different ways. In any case, the allowed burning would occur with permission that depends on the land tenure or compliance with environmental requirements. In this sense, in current days, most of numerous fire – if not all fires - in that region are not allowed, as it is explained in following fragments:

> Before the 70s the region lived from extractive activities, capitalist exploitation was residual. From 1970 to 1995 there was a massive occupation developing agriculture. And in the last 20 years we have introduced soybeans for the production of commodities causing deforestation. The logic of the colonizer is that there is no shame in clearing or burning (UNIR's Professor B, Porto Velho, 2015).

> The Public Ministry does not have a satisfactory performance because the prosecutor only had knowledge of environmental law, unaware of the environmental and social issues. They just follow what is written in the law, and make inconsiderate decisions (Environmental Prosecutor, Porto Velho, 2015).

The negative consequences of wildfires are addressed in the news without a parallel discussion about the reasons behind the risk. However, many elements are neglected, such as the use of fire with purposes of logging, cattle, farming, grazing or for fuel wood and foraging. Contrariwise, those agribusiness practices are highlighted by associating the economic returns and political prominence to the representation of Rondônia as the land of progress, as seen in articles 19, 24 and 25 (Table 2).

Table 2.News articles indirectly related to wildfires in Rondônia, 2015.

	Title (in Portuguese and English translation)	**Date**
1	Cresce produtividade de área de soja no Estado Productivity increases in soy areas in the State	3 January
2	Área de soja cresce 20% em Rondônia Soy area increases 20% in Rondônia	3 February
3	Soja e boi empurram o progresso de Rondônia Soy and oxen push progress in Rondônia	15 February
4	Floresta se torna nova fonte de renda em Rondônia (Title Page) Forest becomes new source of income in Rondônia	22 March
5	Nova fonte econômica em Rondônia New economic source in Rondônia	22 March

6	Rondônia exporta mais alimentos para a China (Title Page) Rondônia exports more foods to China	27 April
7	Iguarias de Rondônia são exportadas para a China Delicacy of Rondônia are exported to China	27 April
8	Rondônia é destaque no extrativismo para Exportação Rondônia stands out in gathering for exportation	27 April
9	Exportação de carne aumenta 243% Meat exportation increases 243%	28 April
10	Assegurada instalação da Zona de Processamento de Exportação de Rondônia de Porto Velho Assured installation of Export Processing Area of Rondônia in Porto Velho	28 April
11	Garimpo ilegal ameaça os Cinta Larga Illegal artisanal mining threatens the Cinta Larga	28 April
12	A mega ferrovia Norte Sul Mega railroad North South	6 June
13	Chineses discutem ferrovia em Rondônia The Chinese discuss railroad in Rondônia	9 June 2015
14	Ferrovia da Soja é indispensável para Rondônia Soy railroad is indispensable for Rondônia	14 June
15	Carne de Rondônia para os Estados Unidos Rondônia's meat for United States	1 July
16	Grupo indiano conhece café e soja de Rondônia Indian Group gets to know coffee and soy of Rondônia	28 July
17	Projeto da Ferrovia da Soja entregue neste mês	13 August

	Soy Railroad Project presented this month	
18	Desmatamento zero na Agenda Brasil Zero Deforestation in Brazil Agenda	6 September
19	O tripé do crescimento de Rondônia Rondônia's Tripod of growth	19 September
20	Acordos abrem mercado para carne de Rondônia Agreements open Rondônia's meat market	11 October
21	A BR-319 na rota do crescimento The BR-319 on the route of growth	17 October
22	Exportações de carne se mantêm em outubro Meat Exportation steady in October	11 November
23	Acir inclui ferrovia e BR-364 no PPA 2016/19 Acir includes railroad and BR364 in PPA 2016/19	13 November
24	A vocação de Rondônia é para o agronegócio Rondônia's vocation is agribusiness	16 November
25	Superávit de R$ 21,9 milhões na agropecuária Surplus of 21,9 million in agribusiness	21 November
26	Evento visa integração econômica Event aims the economic integration	22 November
27	A nova Zona de Exportação de Porto Velho New Exportation Zone in Porto Velho	24 December

Data collected in: 28 December 2015, Porto Velho.

The emphasis on the importance of the meat market is found in articles 3, 6, 7, 9, 15, 19 and 22 (Table 2), and soybean in articles 1, 2, 3,14,16,17, 19 (Table 2). Other articles illustrate that the fish farming and wood market are increasing areas. (4 and 5 Table 2). There are marginal concerns about nut gathering (8-Table 2), illegal mining on indigenous lands (11-Table 2) and policies to reduce deforestation (18-Table 2).

The railroads' construction is a subject highlighted as an element that will allow the growth of agribusiness in the region, including 'the soybean railway'. It is the transcontinental railroad Brazil-Peru (Atlantic-Pacific EF-354) mentioned in articles 12, 13, 14 and 17 (Table 2). The international interests are demonstrated by China (13), India (16) and the United States (15), Table 2.

In addition, the construction of the highway BR-319 with government inversion is discussed in article 21 (Table 2). Although the roads are shown as a synonym of prosperity in the articles, there is an international discussion linking roads and deforestation fires and the need to protect areas in Rondônia, once there were more deforestation fires in regions with high human impact than in those with low human impact (Adeney, 2009).

The news listed in Table 2 give clues about the field in which wildfires take place. According to Bourdieu (1996), field is a setting in which social actors and their positions are located. Actors take part of a particular field not by means of explicit contract, but by their practical acknowledgement of the stakes, implicit in the "playing of the game". This approach highlights the fact that in the investment of time and, money, work is needed in order to generate and maintain an Ilusio that is the interest that agents have in participating in the game. So, when the economic and political importance of agribusiness is highlighted, the Ilusio of progress comes alive. The trajectories of the colonizer agents are translated in dispositions to participate in this social process; which the greatest interest is to transform Rondônia in an economically promising land.

However, what is forgotten in local discourses is brought to light by the international community, a subject discussed in the next subsection.

3.3.2. Conspicuous fires: The projection of Amazon wildfires in the international media

When international media refers to the Amazon and its environmental problems, the global dimension and repercussion of the problem is often highlighted. In fact, Amazonian fires erupted into a global prominence in 1988 after being connected by global media to the extensive fires in Yellowstone National Park, and becoming a sign of a forthcoming environmental apocalypse (Pyne, 2012). Not only the repercussion of Yellowstone's, but also the Rio 1992 Conference on Environment and Development can be cited as another example that helped to consolidate the role of transnational civil society embodying environmental initiative. The role of the movements of global civil society is associated with the rise of local and global awareness of values by sparkling public outrage and generating public indignation over norms violations (Beck, 2002).

The approaches adopted by the international media to talk about wildfires in Rondônia transmit the message of Rondônia as the counterexample in conservation

discussion, appealing to the discourse of blame and finding, in a theatrical perspective, the prosecuted as responsible agents for environmental crimes, the villains and the good guys.

Table 3.Coverage by international media of wildfires in Rondônia, 2015

	Title	Date	Available in:
1	Deforestation Alerts Rise Over 90% in Brazil's Amazônia	15 January	http://riotimesonline.com/brazil-news/rio-politics/deforestation-alerts-rise-over-90-in-brazils-amazonia/
2	Brazilian Amazon nears deforestation threshold past which wildlife may crash, says study	1 March	http://news.mongabay.com/2015/05/brazilian-amazon-nears-deforestation-threshold-past-which-wildlife-may-crash-says-study/
3	Roads to ruin: the G20's ecocidal infrastructure rampage	16 March	http://www.theecologist.org/News/news_analysis/2789309/roads_to_ruin_the_g20s_ecocidal_infrastructure_rampage.html
4	15 before-and-after images that show how we're transforming the planet	7 April	http://www.vox.com/2015/4/7/8352381/anthropocene-NASA-images
5	Mais fogo e menos água More fire and less water	31July	http://amazonia.org.br/2015/07/mais-fogo-e-menos-%C3%A1gua/
6	Amazon fire risk differs across east-west divide in 2015	5 August	http://phys.org/news/2015-08-amazon-differs-east-west.html
7	Brazil's Amazon Region to Register More Wildfires in 2015	5 August	http://riotimesonline.com/brazil-news/rio-politics/brazils-amazon-region-to-register-more-wildfires-in-2015/#
8	Image: Deforestation in the state of Rondônia in western Brazil, from orbit	16 October	http://phys.org/news/2014-10-image-deforestation-state-rondnia-western.html#nRlv
9	Deep In The Amazon, An Unseen Battle Over The Most Valuable Trees	4 November	http://www.npr.org/2015/11/04/452555878/deep-in-the-amazon-an-unseen-battle-over-the-most-valuable-trees
10	Brazil has battled for decades to halt the Amazon's destruction	5 November	http://www.reuters.com/article/us-climatechange-summit-earthprints-braz-idUSKCN0SU1D520151105
11	In The Amazon's Fire Season, 'You Either Burn Or You Starve'	5 November	http://knpr.org/npr/2015-11/amazons-fire-season-you-either-burn-or-you-starve
12	The Claims Are Rosy, But Brazil's Rain Forest Is Still Disappearing	6 November	http://www.npr.org/2015/11/06/454735786/the-claims-are-rosy-but-brazils-rain-forest-is-still-disappearing
13	You were taught in school that the rain forest is like the lungs of our planet. It's not that simple.	12Novembr	http://apps.npr.org/lookatthis/posts/brazil/

14	The rain forest was here: The Amazon, As It Looks To A Man Who Made His Fortune There	10 November	http://www.npr.org/sections/parallels/2015/11/10/453512623/the-amazon-as-it-looks-to-a-man-who-made-his-fortune-there
15	Amazon tree species face threat of extinction	23 November	http://www.ibtimes.com.au/amazon-tree-species-face-threat-extinction-1485453
16	It's Not Just Coal and Oil: Forests Are Key to Climate	24 November	http://news.nationalgeographic.com/2015/11/151124-paris-climate-talks-forest-carbon-amazon-congo/
17	Brazil's vanishing jungle: Haunting images from the Amazon shed light on ongoing destruction of world's largest intact rainforest	27 November	lymail.co.uk/news/article-3335766/Destruction-Brazils-Amazon-forest-jumps-16-pct-2015.html
18	Destruction of Brazil's Amazon forest jumps 16 pct in 2015	27 November	http://news.trust.org//item/20151127002658-9lo9v
19	Deforestation in Brazil's Amazon Region Increases 16 Percent	27 November	http://riotimesonline.com/brazil-news/rio-politics/deforestation-in-brazils-amazon-region-increases/#sthash.BX1p3noa.dpuf
20	Protecting forests must become the norm in supply chains - prince	1 December	http://news.trust.org//item/20151201182451-22gnj/
21	Earth has lost 30% of its food-producing land from erosion, may potentially lead to food shortage	3 December	http://www.ibtimes.com.au/earth-has-lost-30-its-food-producing-land-erosion-may-potentially-lead-food-shortage-1489068
22	What's The Best Way To Protect Forests? That's A Big Question At The Paris Climate Talks	4 December	http://europe.newsweek.com/whats-best-way-protect-forests-thats-big-question-paris-climate-talks-400923?rm=eu
23	Sharp rise in wildfires in the Brazilian Amazon over the past 16 years	9 December	http://news.mongabay.com/2015/12/sharp-rise-in-wildfires-in-the-brazilian-amazon-over-the-past-16-years/
24	Brazil fiddles in Paris while the Amazon burns	10 December	theconversation.com/brazil-fiddles-in-paris-while-the-amazon-burns-52033
25	Brazil in focus at Paris climate talks: Is stopping deforestation the best solution?	15 December	http://latincorrespondent.com/2015/12/brazil-in-focus-at-paris-climate-talks-is-stopping-deforestation-the-best-solution/

Consulted in: January 15th 2016.

News articles 2 and 3 (Table 3) highlight the pair inextricably linked, deforestation and fire while the recent growth of deforestation rates in Rondônia is the subject of the news articles 1, 5 and 7 (Table 3).

Taking into account that the spectacle comprises a social relationship between people that is mediated by images (Debord, 2008), many NASA images and data are used in news articles 4, 6, 8 and 12 (Table 3) to illustrate effects of deforestation fires. In addition, photos of burnt areas in Bom Futuro National Forest near Porto Velho are

used in articles 10, 15, 17and 22 (Table 3).

According to Beck (2009), the ecological images and symbols are culturally perceived, constructed and mediatized in order to generate pressure for action; they are part of the social knowledge 'fabric', with all of its contradictions and conflicts, as mentioned by the author. Images framing the fire in the Amazon forest are a strategy to make the catastrophic consequences of human activities over the environment more visible. This aims to generate pressure for actions capable to set limits to these activities. Often international media employs the discourse of blame[17] to refer to the fires and deforestation in Rondônia, as seen in article 17 which emphasizes that Brazil´s jungle is vanishing, and article 18 that uses the expression 'Destruction of Brazil's Amazon'.

Comparable to a drama, the report of disasters catch people's imagination and make it possible for the emotional identification to occur (Sood and Stockdale; 1987). In articles 9, 10, 11 and 14 (Table 3) the theatrical[18] metaphor of social life as a stage performance with different kinds of characters is identified. In articles 9 and 24, the "good guys" are represented by the rubber tappers and ingenuous people described as "Guardians of the Forest". Fire as spectacle is usually used in parallel as the battlefield, language found in Article 10 which title is "Brazil has battled for decades to halt the Amazon's destruction". Article 11 pointed out that fire is part of the culture of Rondônia, emphasizing that people believe the ash from the burned trees is the only way to make the land fertile, and making it clear that subsistence farmers burn their land to survive, therefore they would not be villains. In this spectacle, the subsistence farmers assume the victim perspective. As in the theater, each drama piece must have its villain; he appears in the article 14, a very influential Politician of Rondônia known as the founding father of deforestation, in a spectacle titled as 'the rain forest was here'.

For each discourse counter-discursive mechanisms can be developed. Although it is to perceive the discourse of blame, the counter discourse emerges by mentioning the Politician's words: "*Is it fair to ask Brazil to do all the conservation when the United States made the mess to begin with? That's very hypocritical of the Americans. The same rules have to be applied for everyone or for no one. Are we supposed to be the slaves of other countries? Are we supposed to be the lungs of the United States? Are we supposed to be the lungs of other countries? Even though they send us only a pittance to pay for conservation? I won't accept it. No. If the Amazon is the lungs of the world, the world will have to pay Brazil to breathe*".

Article 14 finally draws attention to the fact that whatever deal is reached at the United Nation's Climate Conference in Paris (COP 21), it will have to be implemented by politicians like the mentioned influential Politician. In fact, the discussion of Rondônia fires and deforestation rates also took an important place in the Paris conference. Those discussions are stressed in articles 10, 17, 19, 22, 24 and 25 (Table 3), highlighting finger-pointing debates, mechanisms to reduce carbon emission and difficulty to enforce the law to eliminate fire and illegal deforestation in remote corners.

The discussions in Paris and the repercussion of the news about Rondônia reveal

[17] In this type of this discourse Brazil (Government or economical dynamics) appears as the promoter of destruction of the forest. Another example of this type discourse: http://phys.org/news/2010-01-farmers-blame-deforestation-amazon.html#nRlv

[18] The metaphor of theatrical action in social sciences is presented by Goffman in the book

that the agribusiness frontier runs their course without an appropriate institutional effort to cope with human-induced hazards.

3.3.3. Predicted fires: Government channels' role

The fact of fire formal predictions are not conveyed in printed local media in Rondônia, but this does not mean that there is no information available. The Brazilian Department of Spatial Research (*Instituto Nacional de Pesquisas Espaciais-INPE*), by the wildfires monitoring program[19],informs every day the wildfire risk observed and predicted to all Brazilian states, they provide reports for National Environmental Department (*Instituto Brasileiro de Meio Ambiente e Recursos Naturais –IBAMA*) and for Department responsible for protected areas (I*nstituto Chico Mendes de Conservação e Biodiversidade –ICMbio*). In addition, the manager and operational institute of the Amazon Protection System (*Centro Gestor e Operacional do Sistema de Proteçao da Amazônia –CENSIPAM*) is responsible for the production of information, data and knowledge up to date in the Amazon, contributing to the public policy of protection and sustainable development of the region. One of its products is a Synthetic Aperture Radar[20] allowing the identification of environmental offenders. Data are shared with National Environmental Department (*Instituto Brasileiro de Meio Ambiente e Recursos Naturais –IBAMA*) and INPE. Those centralized source of information, called "czar information", reduces the possibility of public panic concerning disaster and facilitates communication (Sood et al., 1987).

All of the departments and institutes mentioned above have twitter accounts, which represent a possibility for two-way communication. However, in the rural areas in Rondônia the access to internet is not common, therefore people do not use the resource where the information is available. As a matter of fact, rural interviewees pointed out how they become aware of the wildfire ignition and propagation:

> We see the smoke, there are no official warning (Isabel, Porto Velho, 2015).
>
> We become aware of wildfire occurrence because we see it happening in our land, burning everything. Nobody warns us (Maria, Porto Velho, 2015).
>
> On television we see urban fires, but in rural areas we have not seen (Pedro, Ji-Paraná, 2015).
>
> People start rumors when they go to the city and see the wildfires along the road (João, Pimenta Bueno, 2015).
>
> People warn that it is burning. When there is a risk of fire advancing to determined area, people usually call to warn the land owner (Marli, Pimenta Bueno, 2015)
>
> We see the burning areas everywhere we go (Antônio, Porto Velho, 2015)
>
> We often see the smoke in the forest (Miracy, Porto Velho, 2015).

It reveals a gap between information available and information accessed, which demands efforts of cooperation between official sources and available sources

[19] http://www.inpe.br/queimadas/abasFogo.php
[20] http://sosamazonia.sipam.gov.br/sosmanaus/

information that rural people in Rondônia could be informed of the wildfire risks existence.

3.3.4. Wildfires in Galicia: The role of local media

Compared to Rondônia, Galicia can be seen as reverse frontier, a term coined by Pyne (2012) to refer to wildfire waves that take place in many long cultivated landscapes where suddenly shed tyrannical governments entered the modern market and the rural population left the countryside for the cities. These resemble, in the author's point of view, a plague less than a degenerative disease (Pyne, 2012). Interestingly, the local media in Galicia usually employs the expression plague to refer to their fire.

The news articles about wildfire in Galicia and the subjects it tangents are numerous. They open an avenue to discuss: the risk governance and civil society action; how media frames and uses wildfire as metaphors; the intentionality and criminal fires categorization; parties and economic disputes that dichotomize prevention versus mitigation; the emphasis in the mitigations means; and the effects of fire on conservation areas.

Table 4.News articles about forest fires published in El Progreso, Galicia, 2015.

	Title (In Spanish or Galician and English translation)	**Date**
1	Un pirómano que causó diez incendios pagará 48.648 euros por su extinción. Arsonist that caused 10 fires will pay 48,648€ for its extinction	2 June
2	Greepeace detecta casi 30 puntos negros en el mapa medio ambiental de Galicia Greenpeace detects almost 30 black points on the environmental map of Galicia	4 June
3	El fuego dio un respiro a la mitad de las parroquias de especial vigilancia Fire gives a break to half of towns under special vigilance	6 June
4	El primer incendio de verano calcina cinco hectáreas de monte en A Conchada (Title Page) First fire of summer scorches five hectares of vegetation in A Conchada	26 June
5	Quiroga, primer municipio en sufrir un incendio forestal Quiroga, first county to suffer forest fire	26 June
6	Un incendio forestal amenaza varios pueblos de Soberenla zona de Anllo Forest fire threatens several towns of Sober in the Anllo region	30 June

7	La plaga (Opinion by Lóstregos por Fruíme) The plague	1 July
8	Os incendiarios executan os nosos bosques. Se vês um incêndio chama ao 085. (Advertisement Xunta de Galicia) Arsonists destroy our forests. If you see a fire, call 085	4 July
9	Un incêndio calcia 800m de matorral dado de las casas de Vilela, en Xove Fire scorches 800m of bushes near houses in Vilela, Xove	9 July
10	Un incendio forestal calcina cinco hectáreas de monte bajo em Toldaos, em Pantón Forest fire scorches five hectares of vegetation in Toldaos, Pantón	11 July
11	Ocho aviones para apagar um gran incendio en Sober Eight planes to put out great fire in Sober	12 July
12	El incendio forestal de Láncara quedó controlado tras quemar 20 hectareas Láncara's forestfire under control after burning 20 hectares	15 July
13	Los equipos de extinción trabajan duro en Boborás, Padrón, Muxía y Randín Fire extinguishing teams work hard in Boborás, Padrón, Muxía, and Randín	16 July
14	Controlado el incendio de Calvos do Randín tras quemar 130 hectáreas y activo otro en Xinzo. The fire in Calvos do Randín is now under control after burning 130 hectares and another is still active in Xinzo	17 July
15	Controlado un conato de incendio en Piñera con la ayuda de medios aéreos An attempt of fire in Piñera is under control with the help of air assets	18 July
16	Um rayo, posible origen de un incendio en el Monte Clodio Lightning is a possible reason of fire in Monte Clodio	19 July
17	Guntín sufrió tres incendios a la vez y uno de ellos amenazó varias casas Guntín suffered three fires at once and one of them threatened several houses	24 July

18	Un voraz incendio quema 160 hectáreas en Navia y amenaza viviendas (Title Page) Voracious fire burns 160 hectares in Navia and threatens homes	26 July
19	Un incendio calcinó más de 160 hectareas en Navia y amenazó casas Fire scorched over 160 hectares in Navia and threatened houses	26 July
20	Dos fuegos devastan en Navia y O Courel la Red Natura (Title Page) Two fires devastate the Natural Network in Navia and O Courel	27 July
21	El fuego arrasa en 24 horas unas 630 hectareas de terreno de la Red Natura en Navia y O Courel Fire destroys, in 24 hours, 630 hectares of land in the Natural Network in Navia and O Courel	27 July
22	Una amenaza (Opinion by Lóstregos de por Fruíme) A threat	27 July
23	Desolación en la zona cero de Navia (Title Page) Desolation in ground zero of Navia	28 July
24	Un tesoro reducido a cenizas A treasure reduced to ashes	28 July
25	Los fuegos de A Fonsagrada y O Courel bajo control tras calcinar 223 hectareas Fires in A Fonsagrada and O Courel under control after scorching 223 hectares	28 July
26	La Xunta asegura que los fuegos se iniciaron a la vez y cuando anochece La Xunta assures that the fires started simultaneously and at dusk	28 July
27	Un incendio forestal quemó 0.4 hectareas en Ourol Forest fire burnt 0.4 hectares in Ourol	29 July
28	Libertadcon cargas para el acusado de quemar 230 hectáreasenPalmés Freedom with charges for a man accused of burning 230 hectares in Palmés	30 July
29	Un incêndio amenazó varias casas de laparroquiavilalbesa de Sancovarde	03 August

	Fire threatened multiple houses in the Sancovardevillage	
30	Reflorestar montes, mantener huertos y jardines (OpinionbyLóstregos de por Fruíme) Replant vegetation, maintain orchards and gardens	03 August
31	Os incendiários executan os nosos bosques. Se ves um incêndio chama ao 085. (AdvertisementXunta de Galicia) Arsonists destroy our forests. If you see a fire, call 085	5 August
32	Co lume acendido, cara á nada (OpinionbyLuisCelero) With fire ascending, facing nothingness	5 August
33	Um fuego arrasa el monte em Belasar y se acerca a las viviendas Fire destroys vegetation in Belasar and gets close to housing	7 August
34	El incêndio de Belesar quemó trece hectáreas y movilizó numerosos médios Fire in Belesar burnt 13 hectares and mobilized numerous means	8 August
35	Co lume acendido (Opinion by Luis Celero) With the fire ascending	8 August
36	Arde un pinar contiguo a unas viviendas em Donalbi, em Begonte Pine forest burns near housing in Donalbi, Begonte	9 August
37	Um fuego arrasa 160 hectareas de Rede Natura em Toques y outro amenza Teo Fire destroys 160 hectares of the Natural Network in Toques and threatens Teo	10 August
38	La Xunta ve intencionada la oleada de 90 incendios en día y medio en montes gallegos (Title Page) The regional governanment (Xunta de Galicia) believes that the wave of 90 fires in one day and a half in Galician forests were intentional	11 August
39	Un incendio calcina más de 10 hectáreas próximas al Hila y a una urbanización Fire scorches more than 10 hectares near Hila and a residential area	11 August
40	Medio Rural ve intencionalidade tras noventa incendios en apenas 36 horas	11 August

	Rural Environment believes the 90 fires in 36 hours were intentional	
41	La lluvia contribuirá hoy a mitigar los fuegos, que se cebaron con la provincia de Ourense Rain will contribute to alleviating the fires that ravaged the province of Ourense	12 August
42	Los incendios dan un respiro pero los rescoldos queman el terreno político Fires give a break but embers burn political terrain	13 August
43	Nueve imputados en Galicia por la oleada de incendios (Title Page) Nine charged in Galicia for the wave of fires	14 August
44	Nueve imputados por provocar incendios durante la devastadora ola ya finalizada Nine charged for starting fires during the devastating wildfires crises, which suppressed.	14 August
45	Árdeme o monte The mountain is burning	21 August
46	El fuego arrasa 30 hectáreas en Carballeda de Valdeorras y deja un operario herido Fire destroys 30 hectares in Carballeda de Valdeorras and leaves a worker injured	23 August
47	Previr e concienciar, claves contra o lume Prevention and awareness are the key factors against fire.	23 August
48	Toda medida de precaución é pouca nos meses de verán All the precautionary measures are not enough in the summer months	23 August
49	A protección da terra queimada é fundamental para rexenerar os ecossistemas Protecting burned lands is essential to regenerate the ecosystems	23 August
50	Campos de ceniza (Opinionby Jorge de Vivero) Fields of ashes	25 August

51	Un incêndio com tres focos arrasa 20 hectáreas de monte em A Pontenova Fire with three outbreaks of wildfires devastate 20 hectares of forest in A Pontenova	27 August
52	"Tiene que llover a cántaros" 'It must rain buckets'	27 August
53	Una avioneta se accidenta en Castro Caldelas y el piloto sufre heridas leves Small plane has accident in Castro Caldelas and pilot suffers minor injuries	28 August
54	Lumes (Opinion – Letters) Fires	28 August
55	Un incendio se acercó a varias viviendas a las afueras de Ourense Fire gets close to multiple houses in the suburbs of Ourense	30 August
56	Desalojos por un fuego que arrasa en Cualedro más de de 2.000 hectareas Evacuation due to a fire destroying over 2,000 hectares in Cualedro	31 August
57	Las llamas de Cualedro avivan el viejo debate sobre la política antiincendios The flames of Cualedro trigger the old debate about anti-fire policies	1 September
58	Controladas las llamas en Cualedro después de tres dias de tensión y desolación Flames of Cualedro are now under control after 3 days of tension and desolation	2 September
59	Siete artefactos incendiarios desataron el infierno de Cualedroen 25 minutos Seven arsonist devices unleashed hell inCualedro in 25 minutes	3 September
60	Incendios: Vias pendientes (Opinion by Lóstregos por Fruíme) Fires: Pending roads	3 September
61	Libre con cargos el autor del incendio en Cualedro, un vecino de 83 años The responsible for the fire in Cualedro is released with charges, a neighbor of 83years old	5 September
62	Lume contra os beneficiarios dos incendios (Opinion by Tito Diéguez)	9 September

	Fire against the beneficiaries of fires	
63	Un incêndio de um almacén de hierba seca causa alarma em Castroverde Fire in a dry grass storage causes alarm in Castroverde	10 September
64	La caída de un árbol tumba una línea eléctrica en Viveiro y causa un fuego y corte de luz Tree falling knocks over an electric line in Viveiro and causes fire and power outages	11 September
65	Os incendiarios executan os nosos bosques. Se ves um incêndio chama ao 085. (Merchandising Xunta de Galicia) Arsonists destroy our forests. If you see a fire, call 085	12 September
66	Un incendio en Asturias incomonicó cuatro horas el Principado y A Mariña Fire in Austrias leaves the Principado and the Marina areas isolated for four hours	20 December
67	Fuegos forestales Forest fires	28 December
68	Sargadelos sufre un tercer incendio en seis días que alarma a la población Sargadelos suffers third fire in 6 days alarming population	29 December
69	Otro incendio en A Mariña calcina 20 hectareas de monte en A Pontenova Another fire in A Mariña burns 20 hectares of forest in A Pontenova	31 December

Data collected in 2015, Lugo.

The action[21] of an international NGOs is illustrated in article 2 (Table 4) stressing the effect of fires on Galicia's landscape. The mobilization of civil organized society and their discourse has been gaining space in the printed media. As a matter of fact, risk governance in the European Union presents a constant flourishing of bottom-up initiatives in which citizens' literacy, education, willingness were translated in the capacity to express preferences and opinions through the channels offered by representative democracy, as well as other forms of participation and protesting(De Marchi, 2003). Here it is possible to understand an important difference between social movements in Rondônia and in Galicia. In Europe, it is said to be bottom-up actions while in Rondônia is also a notion brought by the international actors.

[21] More discourses of fire by this NGO could be encountered in: http://www.greenpeace.org/espana/Global/espana/report/bosques/incendios-forestales-el-fin.pdf

Many parallelism are employed to refer to fires in Galicia, as plague, chronic diseases, domestic apocalypses, ecological terrorism – hell, respectively in the op.eds 7 and 22 and news articles 80 and 59 (Table 4). Considering participants and observers of a given situation share frames (Debord, 2006), the employment of those fire metaphors reflects the people's subjective elements of what is considered real for each person.

The use of the term pyromaniac (article - 1 Table 4) is another parallel that shows neurotic sickness associated with fire as a result of this sick society.

> In the urban areas, those who provoke forest fires are part of the most unprivileged social classes. In the rural regions, there could have been a negative selection once the ones who were more of the entrepreneurs types of the village were the first ones to leave the place. Whoever stayed, felt like a castaway, and believed to be authorized to burn the land, a process of destruction. (Professor UVigo, Pontevedra, 2015).

The intentionality of fire is also discussed in the news articles 26, 28, 32, 35, 38, 40 and 44, (Table 4). Some of them highlighted that intentional fires are identified when started at night when the mitigation team is off duty.

The institutional advertisements of Regional Administration provide the message about zero tolerance strategy in punishing fire starters, which appeals to the discourse that emphasizes the criminality of wildfires. They appeared in the newspaper just three times during the year, in July (article 8), in August (article 31) and in September (article 65), in the entire summer period.

Besides, the op.eds state that policy makers insist on the intentionality of the fire and there is the captive carbonized and obscured discourse. News articles 28, 44, and 61 (Table 4) highlight that the strategy of the Regional Administration consists of blaming others in order not to be blamed by the opposition. Little progress has marked the action of police information, or the arrest of perpetrators, or judicial condemnation. In fact, op-ed. 62 (Table 4) affirms that the government knows who puts out the fires, what suggests that most fires occur with a prosaic purpose, while it is more profitable to put out a fire than to avoid it, the wildfires will continue. The critics towards the dependence on the private sector of wildfires mitigation reveal that this issue divides opinions.

Regarding the legal approach of fires, the law 3/2007 that regulates the prevention and defense against forest fires in Galicia establishes that the main criteria in punishing fire-starters are: burned surface, intentionality, and risk situation to persons or property damages. After the reform of the Spanish Penal Code, the penalty for incendiary activity can range from 3 to 6 years in prison and forfeit of 18 to 24 months (MAGRAMA[22], 2015).

About prevention, articles 47, 48 and 49 (Table 4) mention the action of the Regional Administration that consists of establishing limitation of the territory use, personal to mitigate and prohibition of bonfire in the high-risk period. The article 57 (Table 4) mentions a party dispute in the denominated political use of fire. In this sense, the interviewee pointed out that:

[22]Ministerio de Agricultura, Alimentación y Medio Ambiente. In english, Agriculture, Food and Environmental Ministery of Spain.

> The forestry policies are clearly marked by the presence of fires, by political interest. There is professionalization, but they have left things about Forestry Policies that do not involve fires. They are dichotomized: Forest culture *versus* Prevention. The economy of fire is about guaranteeing that these parties are maintained every year. The information about fires is not public, so it is a political problem. They do not publish for example, the burned territories, which in theory should not have a building permit in 30 years. They do not do projects that don´t have to do with fires. There has to be a functional separation between forestry and fires departments. Right now, one is absorbing the other. For example, the director of the hospital cannot be the director of the emergency room (Professor of UVigo, Pontevedra, 2015).

> Political parties use the topic of wildfires. There needs to be a unit like there was against ETA (terrorist group). Zero tolerance against arsonists (Lourizan Researcher, 50, 2015).

Article 38 illustrated the controversial discussion in Galicia about the focus on mitigation action instead of a prevention policy of wildfire. Regarding the existence of only the wildfire reactive mitigation[23]as Forestry Policy Forest, interviewees accused Regional Administration of overinvesting in fire suppression:

> The forestry policy is based on the extinction more than on prevention. To take another path to solve the problem is difficult; it is necessary a change of habits. In a hypothetical situation in which the administration allocate more resources for prevention, and fires wildfires still occur, this flaw will be used as a political weapon. Therefore, removing money from extinction resources to prevention is risky (Silvanus President, Santiago de Compostela, 2015).

> The forestry policy focuses on the extinction and not on the prevention. Prevention isn´t just cleaning treatments, it´s related with the value put on wood (Forest Technician -CONFEMADERA, Santiago de Compostela, 2015).

> There needs to be more investment in prevention, in education since it is a social problem. Sega is not so professional (Member of Verdegaia, Santiago de Compostela 2015).

Besides, many articles (11, 13, 15 and 34 of Table 4) underline mitigation means such as airplanes, helicopters, land brigades, motor pumps and displaced shovel. The actors described in the wildfire scene are technical y forest agents; Guardia civil, Regional police and civil defense. The terms ‘firefighting’ or ‘brigade team work’ suggest that those figures are comparable to heroes, transmitting the message that society is safe due to their action. In this sense, the "struggle against pollution" at first creates new specializations, ministerial services, jobs [and] bureaucratic advancement and its efficacy will be completely determined by such means (Debord, 2006). This statement is very suitable to the Galician context where many actors are involved in mitigation: private contracts of mitigation means, employers associated with wildfires mitigation (brigades), investigation or deterrence by different policy bodies and also by the regional administration.

The article 53 communicates a crash in a small plane of wildfire mitigation and that the pilot suffered minor injuries, which exposes a case in which one risk gave rise to another.

[23] Fire fighting in the expression used by Institutions in Spain, as the same way in Rondônia is used fire combat. Actually, it refers to the fire mitigation actions.

Fire in protected areas is approached in the news articles 20, 21, 23, 24 and 37 (Table 4). Although they report the fact that fire affected high natural interest areas, the population exposure is more emphasized than the environmental damages. In this sense, op-ed. 50 exposed that the news lies when it indicates that there is no victimless wildfire, once other no human beings are as well alive. News articles in Table 4 (6,17,18,19,28,32,35,39,20,55,56) emphasize that fires threaten the houses even causing some displacement. The interviewees reveal that urban wild land interface is an important element of fires management in Galicia:

> It is necessary to make it clear that ecosystems need fire. We do not expect to take the fire out of forest ecosystems and ¨to know how far it must go. The urban wild land interface presents the problem of putting houses where they don´t belong (Leader of the Department for defense against wildfires– Magrama, Madrid, 2015).
>
> In Galicia the infrastructure is very scattered in the forest environment. (Technician of the Department for defense against wildfires – Magrama, Madrid, 2015).
>
> People made their houses in the middle of the mountain, and then they defend the mountain in case of fires. It went from being an indifference to a cause for social alarm. (Professor of UVigo, Pontevedra, 2015).

The op-ed.52 illustrated that after the month of September citizens usually forget the problem of wildfires. Ironically, it was an unwise forecast, once in December there were winter wildfires, as described in news 66, 67, 68 and 69 (Table 5). This reinforces the need of a preventive and continuous fire management.

In Galicia the wildfires indirectly related to other issues which are illustrated in the table below.

Table 5. News articles indirectly related to wildfires in Galicia,2015

	Title	**Date**
1	Las guerras de la madera The wars of wood	2 May
2	Dos empresas de pellets adquieren los 90.000 metros del puerto seco Two pellets companies acquired the 90,000 meters of Puerto seco	14 May
3	Los ganaderos, en guerra por los contratos que les imponen las lácteas Cattle Ranchers in war because of contracts that impose on their milk	16 April
4	La asociación de productores de madera de Viveiro entregará este año a Ence 35.000 toneladas The wood producers' association of Viveiro will deliver35,000 tons to Ence this year	29 April

5	Propietarios forestales expondrán modelo de organización en Irlanda Forest owners will present organizational model in Ireland	30 April
6	A fábrica de Návia pasará a poder producir 40.000 toneladas mais cada ano. The Navia's wood factory will be able to produce 40.000 tons more each year.	30 April
7	La cuota láctea es historia mientras la incertidumbre hace mella en el sector The milk quota is history as uncertainty takes its toll on the sector	1 April
8	Amigos da Terra denuncia una tala masiva en suelo protegido del cañon del Sil Amigos da Terra report mass cut down on protected land of Sil Canyon	1 April
9	Ence primará la venta de madera en cotos redondos Ence prevail timber sales in round preserves	2 July
10	Empresarios de la madera piden un desbroce a fondo de la burocracia forestal Wood businessmen call for a thorough clearing of the forest bureaucracy	4 July
11	El eucalipto ocupa en Lugo el 50% del aprovechamiento total de la madera Eucalyptus in Lugo occupies 50% of the total timber harvesting	16 July
12	Ence ganó 22 millones en el primer semestre y redujoun 78% su nivel de deuda Ence gained 22 million in the first semester and reduced in 78% its debt	23 July
13	La lei do solo diseña el rural del futuro The land law designed rural future	1 August
14	La marea ganadera mantiene su pulso en Lugo pese las explicaciones de Quintana The cattle ranchers wave maintains its pulse in Lugo despite the explanations of Quintana	5 September
15	Productores en Viveiro venderán 75.000 toneladas de madera a Ence en un año Viveiro producers are going to sell 75,000 tons of wood to Ence in a year	9 September
16	El sector forestal genera la mitad de empleo de los concellos del interior The forest sector generates half of employment of interior municipalities	13 September
17	Promavi se une a un grupo de trabajo gallego que busca mejoras en el sector forestal Promavi joins a group of Galician workers that seeks improvements in the forestry sector	19 October
18	El abandono que ha vaciado más de 1.600 aldeas de Galicia amenaza a otras 2.000 The abandonment that has emptied more than 1,600 villages in Galicia threatens other 2,000	25 October
19	Detenidas doscientas personas en la marcha por el clima de Paris	30 October

	Detained two hundred people in the Paris march for the climate	
20	Dictaduras del calentamiento Dictatorships of global warming	30 October

Data collected in Lugo, 2015.

News articles (2, 4, 5, 6, 9, 11, 12, 15, 16 and 17 – Table 5) classify as outstanding the economic development of the forestry sector in Galicia. The economic development of the forestry sector – mainly the eucalyptus and paper industry's role - in Galicia is highlighted in the news articles 2,4, 5,6,9,11,12,15,16 and 17 (Table 5). In these news, the *Ilusio* is operating when the forestry potential is shown as lucrative and as a jobs generator, although the conflicts of that sector in Galicia are also accentuated in the news article 1 (Table 5). Articles 3 and 7 (Table 5) demonstrate the crises in the milk sector, subsequently in the rural economy, in which the forestation process is associated with.

Studies have linked the fire occurrence and abandoned lands (Guimarey and Corbelle, 2012, Corbelle and Crecente, 2009), but, via local printed media, the rural abandonment is handled only in article 18 (Table 5).

Also, an important institutional aspect was highlighted in the new land law in Galicia and the possible consequent changes are illustrated in article 13 (Table 5). Finally, articles 19, 20 are about the Paris COP21 conference, which indicates a local journalistic concern in connecting the news to those discussions.

3.3.5. Predicted fires: Government channels' role

In Galicia the wildfire prediction data are available in the Spanish Agency of Meteorology (AgenciaEstatal de Meteorología – AEMET[24]), and in the Rural Galician Department (Consellería de Medio Rural[25]) that measure the wildfire daily risk index. The Regional Agency of Meteorology (Meteogalicia) provides alert services[26]. The fact that media routinely cover prescheduled or anticipated events (Sood and Rogers, 1987) is true in Galicia where TV news on summer conveys wildfire predictions.

Meteogalicia, Consellería de Medio Rural, AEMET have account in twitter, where it is possible to find, as well, collective groups providing wildfire information as Professional association for forest rangers and Environmental Galicia @aprafoga or non- official accounts as @info_incendios.

The citizens who were interviewed reported aspects of wildfire risk communication that are relevant in their context:

> Television tells the truth (Albeal, Vilalba, 2014).
>
> The people that extinguish the fire and causes fire are the same. I hear the news and rumors (José, Vilalba, 2014).
>
> If there is a wildfire here, I would escape and call the fire department. Nobody has explained how to proceed in a wildfire crisis (Luz, Saldanxe, 2014).
>
> The people of the villages are awaiting the fire alert (José, Trives,2014).
>
> In the past, the neighbors used to ring church bells, now we see the fire warns on TV and or listen to it on the radio (Nemesia, Trives, 2014)

Thus, it is perceived that television, radio, phone calls and the neighborhood are sources used by rural people in Galicia, demonstrating cooperation between official sources and news conveyed. The rumor, as unconfirmed messages that pass from person to person generating contradictory conclusions about risks (Douglas, 1985), also play a role in Galicia mainly considering the social repercussion of extinguish inversions.

3.4. Conclusions

News in printed and online media provide one view of reality, which can also represent - in greater or lesser extent- economic groups, politic interests and civil society demands. The symbolic construction promoted by the media framing has a great impact on other societal actors and it is a key component in understanding the nature of risk communication in studied areas.

[24] http://www.aemet.es/es/eltiempo/prediccion/incendios
[25] http://mediorural.xunta.gal/nc/es/areas/forestal/incendios_forestales/irdi/
[26] http://www.meteogalicia.es/web/adversos/adversosIndex.action?request_locale=gl

When a language is repeatedly used it may become normal and incorporated to common language, then still stimulates that ideology unconsciously in the brains of citizens and journalists (Lakoff, 2010). Hence, the approaches that give salience to criminality of fires in Rondônia and Galicia as well, the emphasizes in the agribusiness activities in Rondônia as synonymous of progress, or the illustration of the economic benefits of forestation in Galicia, are encouraging ideologies and forms of interpreting the wildfire problem in those societies. Considering that societal diffusion of information about risk can qualitatively and quantitatively increase or diminish the risk and its consequences (Kasperson, 2015), the poor focus on wildfire prevention and appeal to the fire criminalization discourse in media both in Rondônia and Galicia is marking its priorities in both governance systems. It is perceived in Rondônia by means of the inexistent translation of scientific predictions of fire to the citizens. In Galicia, although there is collaboration among media and official channels, informant interviews have shown the preponderant role of the media announcement of wildfire as spectacle.

The debate about wildfire risk presents dissimilarities due to the particularities of Rondonian and Galician context. In Rondônia the debate around wildfire is associated with the dilemma regarding deforestation fires and sustainability while in Galicia the duality between prevention and reactive mitigation. Nevertheless, harmonies, in terms of risk communication, were identified, such as the appeal for the fire criminalization and the lack of precautionary discourse. The role of the channels related to risk communication in both areas is not characterized as part of precautionary strategies coordinated with government sources, mass media, social media and populations feedbacks.

In fact, this chapter has shown that wildfires turn into spectacle when news emphasize extinguishing means in Galicia, or international media using theatrical metaphors to convey the message that Amazon wildfires are a sign of environmental destruction. Actually, the different nature of the focus given to wildfire in Rondônia by local and international media does not reflect a coherent interpretation of the problem. The finger pointing debate accuses the lack of Government control, but neglects the role of the dynamic of global markets, as another societal actor to be considered in the wildfire risk.

The problem regarding of spectacle's contemplation is the development of alienation (Debord, 2008). Therefore, while wildfires remain mostly as an element mediated by spectacle in those societies, it will continue promoting misbelieves of risks or biased interpretation of the problem. That is the reason why social learning is needed in order to construct negotiated risk governance. This subject is discussed in the next chapter.

References

Adams, W. C. (1992). The role of media relations in risk communication. *Public Relations Quarterly*, *37*(4), 28.

Adeney, J. M., Christensen Jr, N. L., & Pimm, S. L. (2009). Reserves protect against deforestation fires in the Amazon. *PLos one*, *4*(4), e5014.

Beck, U.; Giddens, A.; Lash, S. (1994). *Reflexive modernization*. Cambridge: Polity Press.

Beck, U. (1996). World risk society as cosmopolitan society? Ecological questions in a framework of manufactured uncertainties. *Theory, culture & society*, *13*(4), 1-32.

Beck, U. (2005). *Power in the global age*. Cambridge UK: Polity

Beck, U. (2009). *World at risk*. Polity.

Becker, B. K. (2005). Geopolítica da amazônia. *Estudos avançados*, *19*(53), 71-86.

Brengarth, L. B., & Mujkic, E. (2016). WEB 2.0: How social media applicationsleveragenonprofit responses during a wildfirecrisis. *Computers in Human Behavior*, 54, 589-596.

Bourdieu, P. (1996). *Razões práticas: sobre a teoria da ação*. 10° Ed. Campinas: Papirus.

Corbelle E. y Crecente, R. (2009). Evolución histórica de la Superficie Agrícola Utilizada en Galicia (1962-2006). Integración de fuentes cartográficas y Estadísticas. *Economía Agraria y Recursos Naturales*, 9(2) 183-192.

Debord, G. (2006). *El planeta enfermo*. Translated by Luis Andrés Bredlow. Barcelona: Anagrama.

Debord, G. (2008). *La sociedad del espetáculo*. Translated by José Luis Pardo. Valencia: Pre-Textos. Fourth reprint (second edition).

De Marchi, B. (2003). Public participation and risk governance. *Science & Public Policy (SPP)*, *30*(3), 171–176.

De Marchi, B. (2015). Risk Governance and the Integration of Different Types of Knowledge. In U. Fra.Paleo (Ed.). *Risk Governance: The Articulation of Hazard, Politics and Ecology*.New York-London: Springer, 149-165.

Dijk, T. A. (1983). Discourse analysis: Its development and application to the structure of news. *Journal of communication*, *33*(2), 20-43.

Dunwoody, S. (1992). The media and public perceptions of risk: How journalists frame risk stories. In *The social response to environmental risk*, 75-100. Springer Netherlands.

Feldman, D., Contreras, S., Karlin, B., Basolo, V., Matthew, R., Sanders, B. & Serrano, K. (2016). Communicating flood risk: Looking back and forward at traditional and social media outlets. *International Journal of Disaster Risk Reduction*, 15, 43-51.

García, A. I., & Pérez, M. (2001). Análise e evolución da aplicación en Galicia do programa de axudas a forestación de terras agrarias (Règ. CEE 2080/92). *Revista galega de economía*, *10*(1), 151-176.

Goffman, E. (1959). *The presentation of self in everyday life*. Garden City, NY, Doubleday.

Goffman, E. (1974). *Frame Analysis: An Essay on the Organization of Experience*. New York, NY et al.: Harper & Row

Granovetter, M. S. (1973). The strength of weak ties. *American journal of sociology*, *78*(6), 1360-1380.

Granovetter, M. (1983). The strength of weak ties: A network theory revisited. *Sociological theory*, 201-233.

Grawitz, M. (1984). *Métodos y técnicas de las ciencias sociales*. Tomo I. Trad. Enrique MuñozLatorre. Mexico-Barcelona. Editia mexicana.

Governo do Estado de Rondônia. Secretaria de Estado do Desenvolvimento Ambiental Gabinete Da Secretária. Portaria nº 068GAB/ SEDAM. 04 May 2011.

Governo do Estado de Rondônia. Secretaria de Estado do Desenvolvimento Ambiental Gabinete Da Secretária. Portaria nº 211/GAB/ SEDAM Porto Velho - RO, 03August 2012.

Guimarey, B.; & Corbelle, E. (2012). Caracterización dos procesos de repoboación forestal posteriores á entrada de Galicia na Unión Europea. In: Crecente Maseda, R. & Fra Paleo, U. (Eds.). *Territorios a examen*: trabajos de ordenación territorial Santiago de Compostela: Servizo de Publicacións e Intercambio Científico, 41-56.

Jönsson, A. M., Boström, M., Dreyer, M., & Söderström, S. (2016). Risk Communication and the Role of the Public: Towards Inclusive Environmental Governance of the Baltic Sea?. In *Environmental Governance of the Baltic Sea.* 205-227.

Kasperson, R. (2015). Risk Governance and the Social Amplification of Risk: A commentary. In: Fra.Paleo, U. (editor). *Risk Governance: The articulation of Hazard, Politics and Ecology*. Springer Dordrecht Heidelberg New York London.

Krippendorf, K. (1989). Content Analysis. In: E. Barnouw, G,Gerbner, W.Schramm, T.L.Worth, & L. Gross (Eds), *International encyclopedia of communication* (Vol.1, pp.403-407). New York, NY: Oxford University Press. Available in: http://repository.upenn.edu/asc_papers/226. Accessed 31 March 2015.

Lakoff, G. (2010). Why it matters how we frame the environment. *Environmental Communication*, *4*(1), 70-81.

Ministério de Agricultura, Alimentación y Medio Ambiente. 27 March 2015. Nota de Prensa: El nuevo Código Penal endurece las penas por los relativos alosincendiosforestales.

Pimenta, T; Rabello, A. (2010). Agentes políticos e o seu olhar sobre o desenvolvimento regional. *Revista Labirinto*, *13*, 149-166.

Presidência da República. (2009). Decreto 7008 de 12 de novembro de 2009. http://www.planalto.gov.br/ccivil_03/_Ato2007-2010/2009/Decreto/D7008.htm

Pyne, S. J. (1996). *Introduction to wildland fire*. New York : John Wiley and Sons, 2nd edition revised

Pyne, S. J. (2012*). Fire: nature and culture*. London: Reaktion Books.

Quarantelli, E. L. (2002). The role of the mass communication system in natural and technological disasters and possible extrapolation to terrorism situations. *Risk Management*, *4*(4), 7-21.

Renn, O. (2009). *White Paper on risk governance: Towards and integrative approach*. International Risk Governance Council (IRGC).

Renn, O. (2015). Stakeholder and public involvement in risk governance. *International Journal of Disaster Risk Science*, *6*(1), 8-20.

Semetko, H. A., & Valkenburg, P. M. (2000). Framing European politics: A content analysis of press and television news. *Journal of communication*, *50*(2), 93-109.

Senado Federal. (2008). Operação Arco do Fogo. Available in: http://www.senado.leg.br/comissoes/CRA/AP/AP20081028_Alvaro_Palharini.pdf. Accessed 25 January 2015.

Steelman, T. A., McCaffrey, S. M., Velez, A. L. K., & Briefel, J. A. (2015). What information do people use, trust, and find useful during a disaster? Evidencefromfivelargewildfires. *Natural Hazards*, 76(1), 615-634.

Souza, M; Grossi, S. (2010). A regionalização do espaço amazônico: O caso de Rondônia. *Revista Católica*, Uberlândia, 2 (3), 126-235.

Souza, M; Pessôa, V. (2009). A contra-reforma agrária em Rondônia: colonização agrícola, expropriação e violência. V Encontro de grupos de pesquisa "Agricultura, Desenvolvimento Regional e Transformaçoessócio-espaciais. Available in: http://w3.ufsm.br/gpet/engrup/vengrup/anais/1/Murilo%20Mendonca_NEAT-UFU.pdf. Accessed 16 May 2016.

Sood, R; Stockdale, G; Rogers, E. (1987). How the News Media Operate in Natural Disasters. *Journal of Communication*. Volume 37, Issue 3, pages 27–41.

Sutton, J., Palen, L., & Shklovski, I. (2008). *Backchannels on the front lines: Emergent uses of social media in the 2007 southern California wildfires*. In Proceedings of the 5th International ISCRAM Conference, 624-632. Washington, DC.

Tang, Z., Zhang, L., Xu, F., & Vo, H. (2015). Examining the role of social media in California's drought risk management in 2014. *Natural Hazards*, 79(1), 171-193.

Théry, H. Rondônia. (2012). *Mutações de um Território Federal na Amazônia brasileira*, SK. Translated by Evelyne Mainbourg

Xunta de Galicia. Ley 3/2007, de 9 de abril, de prevención y defensa contra losincendios forestales de Galicia. Available in: http://www.medioruralemar.xunta.es/fileadmin/arquivos/publicacions/2013/LeiDeIncendios/cast/Ley_03-07_de_prevenc_y_defensa_contra_los_incend__castellano_.pdf Accessed 16 May 2016.

4. Participatory research and its contribution to disaster risk governance in Rondônia and Galicia

4.1. Introduction

The main purpose of this chapter is to understand which learning, through a pluralistic consideration of societal values and perspectives, and awareness on disaster risk can derived from participatory research. Data collected with participatory instruments and interactive construction of actors' knowledge—interviews, actor mapping, and focus groups— were employed in order to analyze governance conditions and challenges in the study areas.

The link learning process and disaster is discussed by Fra Paleo (2015) who states that, disasters trigger a learning gain which could be incorporated into local environmental knowledge and governments. Besides that, one of the biggest current challenges in risk governance is the coordination between a range of different stakeholders in a multifaceted and a multi-actor risk process, and the need to consider contextual factors, such as institutional arrangements and political culture (Van Asselt, and Renn (2011). Thus, in the learning processes, both actors' negotiation and their outputs are considered beneficial to understand and analyze contextual factors.

Social learning is also addressed in approaches that call for novel governance, which in turn, posits that group decision making should be able to accommodate diverse views, shared learning, and the social sources of adaptability, renewal, and transformation (Folke et al., 2005; Armitage et al., 2008.) In this way, the experiential dimension of learning, as a current challenge, presupposes the creation of a shared understanding of the consequences of actions in order to make possible positive change (Armitage et al., 2008). These positive changes and adaptive governance are commonly used by these authors to refer to sustainability challenges in the social-ecological systems.

Regarding the participatory research, many authors are calling for an integrative scientific approach, which consists in engaging actors in order to make permeable the boundary among research, actors and policy arena as it is integrated into policy-making (Bracken et al.2014; Simon and Schiemer, 2015; Popa et al. 2015). Besides, recent findings suggest that projects can achieve mutual benefits when focusing on early processes of knowledge exchange and on stakeholder engagement (Bracken et al., 2014).

Research of this kind has shifted the focus towards the extended co-production of knowledge by scientific and extra-scientific actors. In this way, the reflexive dimension encourages the process of critical assessment and social learning from the background values and assumptions guiding research, and from the socio-institutional structures supporting particular norms and practices (Popa et al., 2015). The endeavor to include a pluralityof actors in risk governance should go beyond the mere inclusion of public in legislation and policies. The thesis presented here is that engaging the actors in the knowledge generation is one step to advance wildfire risk governance. This research allows actors to frame and assess a risk problem in an integrative way.

Sharing participation's definition as a process where individuals, groups and organisations choose to take an active role in making decisions that affect them, authors prefer to use stakeholder participation rather than broader public participation (Reed, 2008).The International Risk Governance Council (IRGC) defines stakeholders as socially organized groups that are or will be affected by the outcome of the event or the activity from which the risk originates and/or by the risk management options taken to counter the risk, including groups as diverse as the media, cultural elites and opinion leaders, the non-organized affected public and the non-organized observing public (Renn, 2005). In risk governance, the named stakeholder involvement is required in order to integrate knowledge, values and interests into risk policy making and also so as to disseminate the result of governance process, offering opportunities by taking an active role in the resolution of conflicting expectation via a process that identifies overarching common values without compromisingthe vision of the others (Renn, 2015). This argument shall be considered even more reliable, in this research, if the term 'stakeholder' is replaced by 'societal actors'. Stakeholder analysis is essential to the domain of strategic management (Mitroff,1983; Freeman, 1984), but risk governance cannot be limited to the strategic management sphere. Societal actors, in turn, are those who process information and strategise in their dealings with various local actors, as well as outside institutions (Long, 2003). The institutions, that are formal and informal (North, 1990; Ostrom, 1990), should be taken into account, since they guide the behaviour, perceptions and interactions among actors. Institutions are associated with the individual's decision making by indicating which choice is adequate and determining which rules and behavior are socialized into a given society (Ahlstrom and Bruton, 2002).

Considering that the way in which institutions are intertwined and sustained has consequences in the various scenarios (Ostrom, 2013), societal actors is the term employed, in this study, to refer to those [individuals or groups in formal and informal institutions] that are in some way associated with wildfire risk governance in studied areas, and subsequentely linked to any of the multiple social, environmental, economic, cultural, or technological processes in which a multitude of actors/players occur.

One of the strategies that most promotes connection between environmental experts, decision makers, and the wider range of actors points to the necessity of involving participants jointly in a participatory process of social learning and adaptive co-management (Hermans, 2008). Thus, using the term societal actors is a way to advance in how we can learn and co-generate knowledge based on the lived experiences of actors, and thereby, prepare for the participatory process and facilitate social learning not only on the management level, but on the knowledge construction level.

The illustration of method and results is preceded by a short conceptual discussion about public participation in risk governance; and the engagement of societal actors in the scientific production and in a risk integrated approach. Subsequently, pros and cons of combining interactive data collection as well as a few thoughts on how such data may be out to good use, are debated in the method.

4.1.1. Public participation in risk governance

Public participation is the practice of consulting and involving members and also entailing initiatives of the public in the agenda-setting, decision-making, and policy-forming activities of organizations responsible for policy development (Rowe and Frewer, 2004). Over the past few decades, there has been growing debate about the role of the public in determining policy regarding issues of science and technology, particularly in health and environmental risk management (Rowe and Frewer, 2000). Nevertheless, the popularity associated with public participation obscures the challenge of putting this into practice effectively and efficiently (Renn, 1999). As matter of fact, in the discussion about effectiveness of public participation a tension exists regarding the process and outcome criteria. As an attempt to alleviate this tension, Rowe and Frewer (2004) have pointed out that effectiveness of a group meeting in arriving at a solution to a particular problem should be measured by the number and quality of ideas generated, so that if the process is good the outcomes are likely to be good.

When linking public participation to discussion about risks, people-centered approach shave been addressed as a way to involve people in risk decisions, empower them, and encourage ownership, responsibility and participation. This approach has emerged as one of the consequences of the 1994 Yokohama Strategy. This strategy has been the incorporation of integrated prevention, mitigation and preparedness measures into the risk framework of effective disaster reduction, which opened up the possibility of a people-centered approach by including of a wide variety of stakeholders, from within the government and without, from the private sector, from abroad, and from civil society (Scolobig et al., 2015).Involving stakeholders has been the main requirement for effective, efficient and fair risk governance (Renn, 2015). This author has pointed out that it is necessary to the integration of the knowledge, values, and interests of people into the risk policy making process, and provides a way of recognizing themes important agents for facilitating outreach throughout of the governance process.

The inclusion of these agents though participatory processes is also associated with the discussion of bottom-up or top-down policies. The participation gap –the disparity between societies' demands and perceptions and the implemented policies – is usually associated with top-down approaches. At the same time that institutions open themselves up to participation, there emerges a bottom-up development in the new social movements on a global scale, such as the recent phenomenon of the online petitions, which combines the effectiveness of non-violence with the opportunities offered by the Internet and the media (De Marchi, 2003). However, Scolobig et al. (2015) clarify that top-down approaches should not be considered obsolete, but the mix of approaches must reflect contexts, situations and circumstances, meaning that disaster risk managers must be flexible and adaptive, and ought to be integrated only insofar as the characteristics of the system would permit.

Although the outcomes of this research have not been directly applied to decision making, the way participatory instruments were combined provide elements that governments, scholars and civil society can take advantage of when thinking about risk governance conditions in the study areas.

4.1.2. Engaging actors in the scientific production

Involving societal actors in the scientific production is explored by different fields, such as civic science, research action and knowing in action and transdisciplinarty. All these frameworks, directly or indirectly, handle the concept of reflexivity, which is defined as a multi-lateral process of acknowledgement, critical deliberation and mutual exchange of values and assumptions and understanding that enables the generation of new meanings, heuristics, and actors' identities (Lenoble and Maesschalck, 2010). This encourages critical analysis and social education on background values and assumption that shape scientific research

Civic science suggests that in democratic societies citizen participation is included in the production, validation and application of scientific knowledge (Backstrand, 2003). This approach gives salience to the experience. Understanding the essences of reality are the broad terms in action research, the main goal of which is the generation of new ways of thinking, seeing and acting (McIntosh, 2010).

The action research and reflexive approach are not validated by eradication of the problem or degree of change. It supports the rationalization of them by means of voluntary participation and co-operation in debates and attempts aimed at achieving a temporal consensus about their standpoints (Waterman, 1998).

Knowing in action presupposes different practices and their learning/knowing outcomes, especially in the dynamics of innovation and of interactive knowledge creation (Amin and Roberts, 2008). Knowledge, in turn, in the form of skills and competencies can be transferred from one person to another through interaction (Al-Hawamdeh, 2002). As all types of knowledge originate from actors' experience, they are equally important, then, they should be considered non-hierarchically. In this way, knowledge of different types, such as local, indigenous, practical, tacit, lay and expert, scientific, technical, explicit, or codified knowledge, at certain times may match and support the identification of gaps or new questions (Fra Paleo, 2015).

Therefore, engaging actors can only be a fruitful task if it is consistently updated to deal with the very changing dynamics of society. In this way, reductionism and disciplinary isolation limit the understanding of a world characterized by surprises and discontinuities (Levin, 1999). That is the reason why the discussion regarding multi-inter-transdisciplinarity is also outstanding in the context of knowledge organization and production.

Multidisciplinarity connotes an additive and individual function to producing knowledge; interdisciplinarity presupposes interaction among disciplines; and transdisciplinarity research is focused on societally relevant problems, enables mutual learning among participants from various disciplines and actors, and tries to create solution-oriented knowledge and often involves stakeholders in the co-production (Gall et al., 2015).

If the dominant discourse on interdisciplinary in the 1980s and 1990s had mainly focused on articulating the contributions of different disciplines into a coherent framework, the more recent analyses of transdisciplinarity have shifted the focus towards the extended co-production of knowledge and the importance of 'unsettling' established assumptions (Popa et al., 2015).

Transdisciplinarity, by contrast, has been shown as a way to explore the challenges inherent to socio-ecological social-ecological and complex system research. The problem is that this kind of research stem from the entrenched persistence of the intellectual, epistemological and methodological boundaries between natural and social scientific disciplines (Petts et al., 2008; Wesselink et al., 2009; Simon and Schiemer, 2015).

This criticism is also valid to the disaster risk research. Key-findings of Gall et al. (2015) have highlighted that the majority of research displays multidisciplinary characteristics, involving just two or three different fields. What is more, transdisciplinary research transcends the boundaries among disciplines, but also those that separate academia from other

In this context, transdisciplinarity can be characterized as a support for the actor's reflexivity through their participation in tangible and temporal problem-solving, social experimentation, and the learning process. For this reason, transdisciplinarity is implicit in every participatory method that makes exercise and negotiation of reflexivity possible among societal actors.

4.1.3. Risk-integrated approach

Conventional knowledge, produced exclusively by experts, is not currently considered sufficient to handle the kinds of new challenges that result from changing and complex scenarios. This fact requires new approaches in which actors' participation becomes a tool to construct collective risk understanding and governance.

Although risks are conceived technically as things that can be expressed quantitatively, they cannot be fully understood or managed using only traditional risk assessment tools (De Marchi, 2015). This author advocates that handling uncertainty and assessing risks cannot be restricted to the arena of experts. While technical expertise is necessary, it is not enough to make prudent decisions in risk management, once impact of risk decisions on human values, preferences and lifestyles (Renn, 2015). This argumentation demonstrates the necessity of integration between analytic-deliberative approaches to participation.

Combining scientific perspectives (quantifiable risk probabilities) with those of lay participants (qualitative-based values) at the governance stages is possibility also contemplated in the *risk communication* and *public participation* framework (Leiss, 2004). Thus, learning process – understood in the novel approach of risk communication - can be achieved as actors' inputs are incorporated into all stages of risk governance. However, a situation in which the public's knowledge is more emphasized than the scientific knowledge is not desirable either. This is justified by the fact that public opinion has often driven political and governmental choices about allocating budgets, even when public opinion contradicts scientific research (Rowe and Frewer, 2000).

In Renn's (2015) words, the input of stakeholders ought to strengthen the role in scientific analysisin risk governance. Thus, the role of participation in the management of risk policies is far from insignificant. However, there has been less progress in co-generation of knowledge (De Marchi, 2003). So, integrated disaster risk research has

emerged in the discussion of risk as an approach composed of multiple levels (local to global), stakeholders (experts, professionals, officials, etc.), knowledge (scientific and local), disciplines, methodological approaches, areas of application (planning, sustainable development, policy, etc.) (Gall et al., 2015) and actors' experiences.

Integrating actors into risk assessments seems to incorporate peoples' concerns that science unattended is not capable of addressing. In this way, lay risk assessment can be complex, situationally sensitive expressions of a person's value system, lay perceptions of risk must be understood and evaluated on their own terms, not treated as deviations from scientific facts (Hansen et al., 2003). Integrated assessment focus groups citizens' juries, consensus conferences, and participatory multi-criteria analysis are examples of approaches that promote this kind of dialogue. These approaches have come to recognize all knowledge as situated and contingent, have served as a means of building lay/non-scientific knowledges, values, meanings, and framings into science-policy processes, and thereby, enhancing social intelligence (Chilvers, 2008).

In conclusion, participatory science can contribute to wildfire risk governance in a process by which societal actors are better able, through reflexive behavior, to contribute insight to the current risk governance conditions and challenges of each study area.

4.2. Methods

Existing means of encouraging participation are diverse. They range from more tradition approaches, such as public meetings, or surveys which participants are allowed to answer in privacy, to more novel forms of participation, such as consensus conferences, or focus groups, stakeholders' workshops, participatory expert workshops which foster deliberative interaction.

Participatory approaches are an essential element of governance, and have been designed implemented and analyzed in various contexts (Van den Hove, 2006). Studies have attempted to evaluate exercises using a variety of instruments that have proved helpful in the triangulation of findings and the validity of the measurements (Kathlene and Martin, 1991; Rowe and Frewer, 2004). Other discussions have shown that combining a variety of methods or variants of standardized procedures is the most efficient mechanism for engaging public (Rowe and Frewer, 2000). Hence, flexibility needs to be built into research design and methods in order to incorporate the knowledge of stakeholders throughout the research process (Bracken et al., 2015).

The most appropriate techniques for public participation are likely to be a hybridized reformulation of more traditional methods. A variety of contextual and environmental factors might interact with a given method as to determine the method's true effectiveness (Rowe and Frewer, 2000).

Considering that finding the right and appropriate combination of participatory instruments is not a simple task, Renn (2015) posits that the suitability of a given set of instruments depends on the complexity, uncertainty and ambiguity level of the risk problem in question. Besides, the choice of instruments and its sequence depend upon the risk issue, the context and regulatory structure and culture of country or state in which such a process is planned (Renn, 2015).

Thus, the fact that wildfires in both contexts are problems that involve many factors and actors in complex interactions is the reason why it was once thought that the combination of a broad array of participatory instruments would boost understanding of the problem in all its dimensions, in that the act of combining would necessarily involve an inclusion of agreements, but also, conflictive aspects of those risk arenas.

For this research, the three mutually reinforcing interactive data collection/production were used, as illustrated in the figure below.

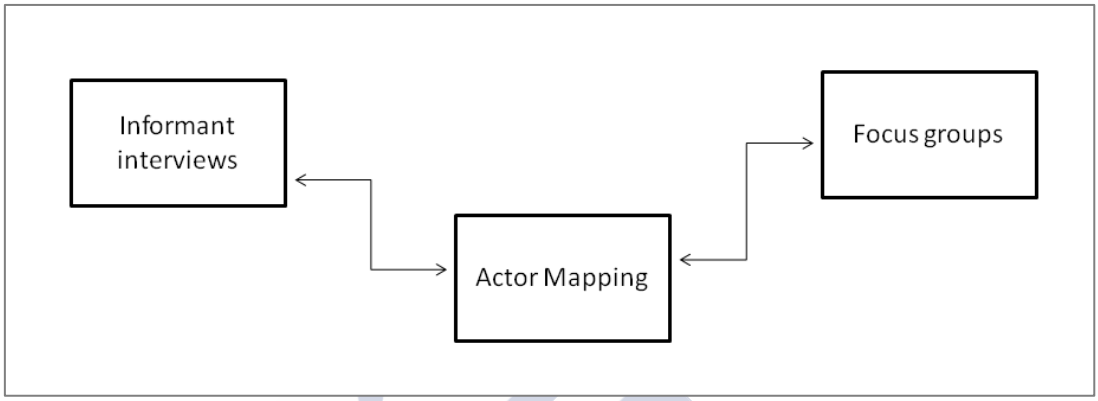


Figure 18. Combination of techniques of data collection

Actor mapping was used to decide which actors should be interviewed in each territory. It was also scientifically expedient to identify correspondent, similar or inexistent institutions/organizations in Rondônia and in Galicia, organizing the actors around their purposes in their perspectives territories. The interviews generated feedback that could be employed in constructing the actor's map and allowed for the identification of the main discourses that reveal contradictions or dilemmas associated with the wildfire risk. Although isolated discourses form a mosaic with multiple views regarding governance, it is not enough simply to understand how studied societies are opened to create common values, assessments and collectively agree upon which risk factors are more determinant in future scenarios. That is the reason why focus group sessions were convened in order to discuss, negotiate and determine provisional consensus about which intervening factors are determinant to constructing future wildfire risk scenarios. The map of actors also served to decide which actors should be invited to participate in focus groups. In the following sections, I will provide an explanation and discussion of each instrument used.

4.2.1. Actor mapping

In this study, actor mapping was the basis of all participatory instruments employed. Actor analysis supports the identification of key-actors and their interests, influence and importance, providing an analytical apparatus for support for proactive approaches (Grimble, 1998; Hermans et al., 2006).

Firstly, similar, different or inexistent institutions or groups were identified, along with correspondent policies and strategies that were/are in some way related to wildfires in the different study areas. In order to identify and organize actors, attributive variables were employed according to the sector and action scope. According to the

sectors, five groups of sectors were identified: public sector, private sector, academy and civil society organizations. According to the action scope, each area presents a different configuration not only administratively, but in the interrelationships that reveal dynamic actors in different scales. In Rondônia, the action scope is reflected on global, national, regional, state and local levels. In Galicia, the action scope is European, national, regional and local.

4.2.2. Interviews

The goal of qualitative interviewing is an exploration of the ways in which participants experience and construct their lives (Ritchie et al., 2014).The purpose of using informant interviews in this research is to frame actors' experiences related the subject of wildfires as a way to increase the knowledge of intervening factors.

Interviewing actors helped to clarify and to contrast the various views on the role of actors in the wildfire risk arenas. Moreover, interviews allowed examining the intervening risk factors identified as well as the social, cultural, natural, economic and technological processes recognized by the actors. Finally, interviews can provide knowledge about conflictive and strategic discourses; discourses unveil the conflicts on, concerns or consensuses about the governance model and the social, cultural, and economic context.

4.2.3. Focus groups

While interviews and actor maps furnish the detailed evidence for values and points of view, focus groups enable an examination of how knowledge and ideas operate within a given cultural context (Kitzinger and Barbour, 1999).As discussions proceed (forward and backwards), individual positions are refined, and move to a deeper and more considered discursive level (Ritchie et al., 2003). These authors have stated that the language that participants use, the emphasis they give and their general framework of understanding emerges spontaneously from discussion within the group.

Hence, the distinguishing feature of focus groups is the use of interaction to generate information when participants talk to one another: asking questions, commenting on their own and each other's experiences, viewpoints, interests and concerns.

This technique also enables researchers to examine participant perspectives as they operate within a confined social network or social context. As contexts vary, flexibility is an essential to use the technique. One reason for the contemporary extended use of focus groups in social research is the flexibility with which they respond to quantitative techniques (Wilkinson, 2004).

The recommended number of participants is between 8 and 12 (Stewart and Shamdasani 1990, Krueger 1994), but for other scholars a lower number (5-6) is preferred since the dominant concern is less statistical representativeness (Kitzinger and Barbour, 1999), than stratification, and representativeness in a more general sense aimed at reflecting the diversity within a given group.

None the less, a problem persistent in the shaping of focus groups is the determination regarding homogeneity or heterogeneity among group participants. According to Hermans et al. (2006), on the one hand, local knowledge is essential to eliciting values, and also to identifying historic trends, avoiding repetition of past failures and ensuring a match with local conditions and institutions. On the other hand, experts should contribute their specific expertise and bring forward certain information related to the subject that is not grounded locally. There are reasons why analytical tools to combine stakeholder and scientific knowledge in order to support stakeholder judgments with scientific inputs are suitable and indispensable (Hermans et al., 2006).

Barriers might be faced when attempting to combine different types of knowledge. Collaborations involving experts entail considerable autonomy, and also worth, given their individual skills, experiences and reputation (Amin and Roberts, 2008). If this evidence is true in most contexts, education must change in order to accommodate and conciliate the various knowledges in societies.

Bringing together people on the basis of some shared experience is often most productive; however, differences between participants are often illuminating (Kitzinger and Barbour, 1999).

In the risk field, dialogue within the focus group should be facilitated in such a way that the various actors are encouraged to contribute in those areas in which they feel they are competent and can offer something to improve the quality of the final product (Renn, 2005). This instrument provides more data about people's positions and concerns and as a measure of strength and social resonance of each argument vis-à-vis the issue at hand, and appears in the pool of instruments for coping with the ambiguity that arises, that arises over the issue of social and moral justification of a risky activity, of distributional inequities and environmental justice, and the selection of the right management options (Renn, 2015).

Although the output of focus groups tends to be more explicit, it generally has a marginal final impact on policy, and their actual value lies in clarifying bases of agreement and disagreement and identifying values that underlie opinions, rather than setting a clear direction for policy makers (Rowe and Frewer, 2000). The argument presented here is that participative forms of interactions are essential to understand the conditions of risk governance, what might represent a possibility of creating a space of dialogue among actors, including as one actor more, the policy-makers. This can enact pluralistic processes of decision-making.

Participation in focus groups aimed at discussion of future wildfire scenarios can be interpreted as a measure of the commitment and openness of actors and institutions to engage in participatory processes. Four focus group sessions were conducted in Rondônia, compared to three in Galicia.

As regards to the recruitment, participants were invited by e-mail and phone calls. Although scholars suggest stipend or compensation for participant's travel expenses (Kitzinger and Barbour, 1999), research funding made impractical any compensation. Porto Velho (Rondônia's capital) and Santiago de Compostela (Galicia's capital) were chosen as the venue places with highest accessibility for participants.

The first session started with an invitation for participants to brainstorm on the problem: What are the wildfire risk factors in Rondônia/Galicia, and how do you foresee them interacting over the next 10 years? In this fashion, participants thought, discussed, negotiated which possible factors were determinant to the future risk scenarios. The point was to discover and to hammer out an agreement about anything that might, over time, influence the generation, increase or decrease of wildfire risk in the study areas.

No limit was placed on the maximum number of factors, although an effort was made, through a process of negotiation, to pinpoint those factors that were most relevant and suitable. Subsequently, for each factor, the possible future configurations or hypothetical futures were chosen. The next steps, denominated synthesis process, consisted in examining the existing interdependences between influencing configurations as to establish alternative scenarios, by asking participants about the possibility of two configurations existing harmoniously and at the same time

This chapter gives attention to the actor's identification and negotiation rather than to future scenarios, which discussion is subject of Chapter five. Moreover, the main purpose of the focus groups was not but a gathering of qualitative insight to facilitate discussion of governance conditions in different circumstances.

4.3. Results and discussion

4.3.1. Actors in Rondônia, Brazil

The actor's map in Rondônia (Figure 19) made possible to visualize five scales of decision making (global, national, regional, state and local), by which an important question still remains whether wildfires in the state of Rondônia are a Rondônia, Amazonian, Brazilian or global problem.

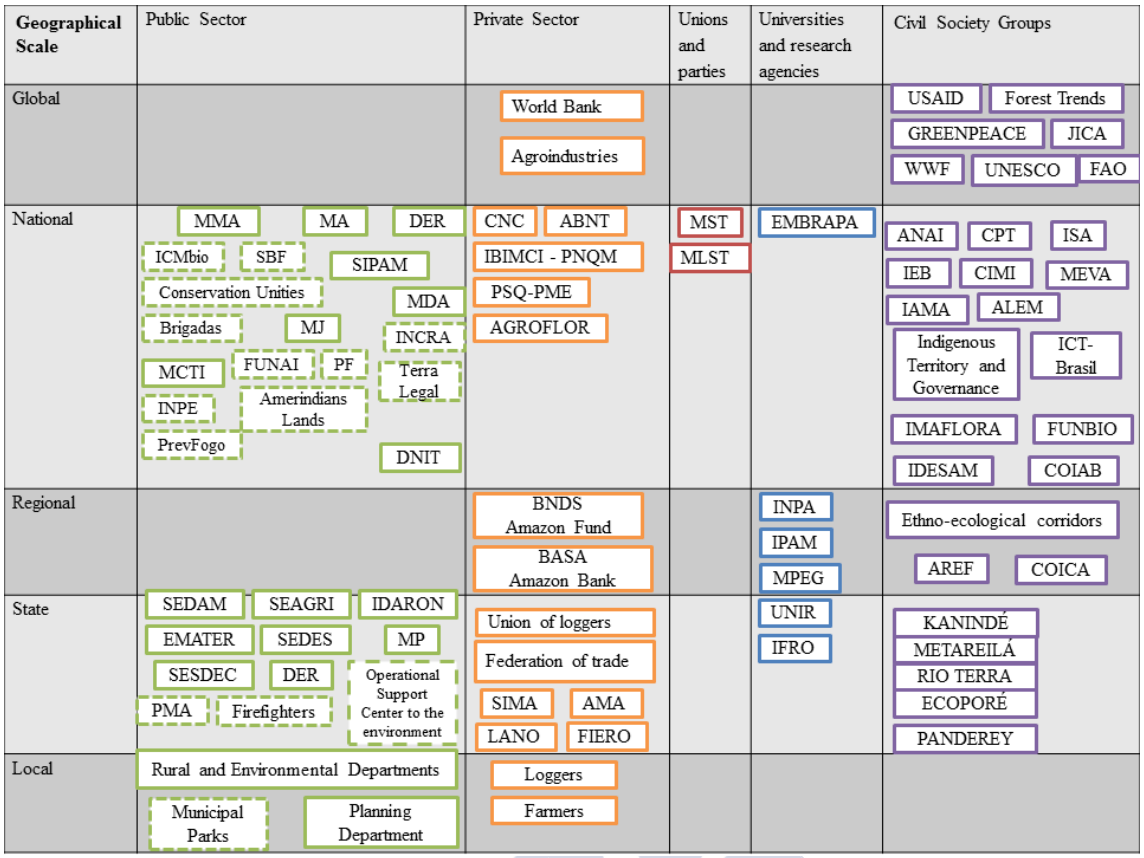


Figure 19. Actors' map in the wildfire risk scenario of Rondônia

Regarding the global level, it is possible to identify corporations of the agro-industrial sector, mainly the soy and meat industries. Additionally, the influential actions of the World Bank (WB) have flopped in what this institution has considered sustainable development goals in their projects. In fact, the process of global environmental change is a result of a vast number of multi-level, multi-sector and multi-actor governance failures (Boyd and Folke, 2012).

The POLONOROESTE (Northwest Region Development Program) encouraged migration and deforestation by financing the paving of Rondônia's main highway – BR 364. The WB´s program named Natural Resource Management Project (PLANAFLORO) had the purpose of protecting biodiversity and it has contributed towards the promotion of high levels of environmental degradation occurring in the region and also developing sustainable systems of utilization of the existing natural resources (Pedlowski et al., 1997). However, the planned goals collided with the antagonic interests of different local actors involved in its implementation, which made it impossible for the program to reach any ecological goals (Ott, 2002).

The creation of the Amazonian Protected Areas Program-ARPA(*Programa de Áreas Protegidas da Amazônia*), in 1998 was possible due to a collaboration among the Brazilian government, the WB and the World Wide Fund to nature (WWF) in order to increase the level of protected areas in the Brazilian rainforest in a governmental and non-governmental joint action (MMA, s/d). According to Beck's (2002), this kind of action can be interpreted as globalization from above, which occurs through international treatied and institutions in a process that usually take into account the

international development agendas concerning sustainability or local groups. Although this project is aimed at mitigating non-sustainable practices, the way it is engendered falls upon in the top down approach.

On the other hand, there are organizations in the market mechanisms for environmental services[27], environmental NGOs supporting ecological conservation. NGOs concerned about indigenous rights and inequality are examples of international actors interacting and influencing local practices. By means of a program aimed at carbon sequestration coined as *Projeto de Carbono Florestal Suruí*[28], the Metareilá NGO, which is the local organization that represents Suruí indigenous people, interacts with international NGOs such as Forest Trend and national ones such as Funbio (*Fundo Brasileiro para a Biodiversidade*). In addition, many international agreements about environmental issues were achieved because of the emergence of a global public opinion, what is defined by Beck (2002) as globalization from below, which addresses the action of new international actors that challenge established political organizations and interest groups.

In spite of successive actions that resulted in an unsustainable use of resources in these social-ecological systems, a lesson that can be learned from the experience of actions of transnational agencies is that the existent dynamic in the local-level is determinant to the development of any process of instututional decision-making, as seen in the PLANAFLORO policy. This example draws attention to the necessity of formal and informal decisions made at the local level. As a matter of fact, the local-level is characterized by a range of decision-making processes that can vary from the individual choices - such as farmers' decision to use fire - to local environmental and rural policies as for instance local natural resources management or wildfire mitigation plans.

In relation to the national level,the state enact environmental law, ratify international environmental agreements, design environmental institutions, devise environmental policies, allocate resourses and manage natural resources (Duit, 2012). In this way, the evolution of wildfire management in Brazil reflects international institutional cooperation.The powerful international request for actions to face the environment problems in the Amazon triggered the development of a national Brazilian wildfire Programme in the vast territory (Pyne, 1996). On the other hand, it can not be said that Brazilian policies were created only by international pressure as suggested by Pyne, mainly considering that National environmental policy-making does not take place in isolation but it is greatly interconnected with neighbouring policy arenas (Duit, 2012). Thus, agricultural policies, as one example of a neighbouring policy arena, give evidence to the outstanding role of the National government legitimating productive actitivies. The antagonistic interests in the decision making processes exist mainly because of the various local actors (indigenous and traditional populations, small and landowners) who interact differently with global processes legitimated by the National government.

The table below gives an idea of the policies developed regarding wildfires

[27] Market mechanisms for forest environmental services are an approach for conservation, focused on four fields: carbon sequestration, watershed protection, biodiversity benefits, and landscape beauty (Grieg-gran et al., 2005).
[28] http://www.idesam.org.br/projetos/carbono-surui/

Table 6. Evolution of wildfire management in Brazil from 1989 to current days

Year	ActionProgramme	Description
1989	NosaNaturaleza	Program of environmental reform,developed by the Federal Government and managed by the Brazilian Department of Environment IBAMA (*Instituto Brasileiro do Meio Ambiente*),which controlsdeforestation fires over national parks and forests.
1989	PREVFogo	Department of IBAMAresponsible for the promotion, support, coordination and implementation of education, research, monitoring, prevention and firesupression of forest fires throughout the country
1989	NOAA	The National Institute for Space Research INPE (Instituto Nacional de Pesquisas Espaciais) eveloped satellite (named as NOAA) to monitor fire, producing risk reports daily
1991	IBAMA and U.S Forest Service	Intergovernmental agreement for cooperation in fire science management
2002	Centro Gestor e Operacional do Sistema de Proteção da Amazônia	A wide network of protection of the Amazon was createdwith a focus on the development and establishment of technology, intelligence analysis, integration between federal, state and municipal agencies.
2007	Queimadas website - INPE	Geographical database of fire outbreaks and forest fires detected by satellite and modelling of vegetation fire risk

Sources: IBAMA, (2015); Pyne, (1996); INPE,(2015); Ministério do Meio Ambiente (2015).

PrevFogo has existed since 1989, but the national repercussion of fire was evident after the great fires of El Niño in the period of 1997-1998 in Amazon, which stimulated, in 1998, the creation of the Amazon emergency fire prevention and control project - PROARCO (*Programa Integrado de Monitoramento, Prevenção e Controle do Desmatamento*) in a cooperation between IBAMA and the World Bank (Schroeder et al., 2009). As an attempt to respond and overturn illegal activities such as fire and deforestation, the "Arco Verde" (Green Arc) was an action plan from the Terra Legal program (Brasil, 2009), whose goals consist of mitigating those activities, and regulating land tenure and property rights and environmental compliance (Brasil, 2009).

When constructing the actors' map, the existence of various offices of national institutions in Rondônia placed in different municipalities in the state were an eye-catching element. National institutions were determinant in the process of occupation of the state, which becames a federal territory until 1981. Two institutions played a major role in this scenario: the Brazilian Department of Environment - IBAMA (*InstitutoBrasileiro do MeioAmbiente*) and the National Institution of Colonization and Agrarian Reform -INCRA (*Instituto Nacional de Colonização e Reforma Agrária*).

The cooperation among national, regional and local institutions regarding environmental issues has been encouraged by the National law 140 of December 2011. However, during research conducted in the fieldwork, it was noticeable that the most concrete initiatives regarding wildfire management was developed only by National institutions such as by IBAMA through the PrevFogo and ICMbio in the conservation units. In 2007, the ICMbio was created to manage exclusively the conservation unities in Brazil.[29]

When organizing the actors, formal institutions were identified the regional or Amazonian level, which is a not an administrative sector, but were different actors are noticeable. At this scale of decision-making, there are multiple ethnic corridors that

[29] http://www.icmbio.gov.br/portal/nossascompetencias

connect indigenous communities sharing cultural values such as costumes, language and social organization. In Rondônia, the Corridor Tupi Mondé [30]is an example of a level of decision making among indigenous that share the same language features, Tupi Mondé. Indigenous land and the belt of protected areas lead to the realistic possibility of an existence of ecological connectivity given the presence of effective efforts to protect these areas from the agribusiness frontier (Gontijo, 2011).The idea of the belt of forested areas and the ethnic corridors derives from the discussion of increasing forest fragmentation due to the advancement of economic activities in Amazon. These actors such as indigenous and rubber tappers populations connected in the Amazonian level have their own rules and points of views; they make individual and collective decisions. For this reason, considering the perspective and demands of these actors is an essential step to advance in risk governance which should be able to promote a communicative-deliberative process among various actors involved in the wildfire scene.

In the Amazonian level, there are also research centers dedicated to generate scientific knowledge about various Amazonian issues, such as the National Institute of Research about Amazon - INPA (*Instituto Nacional de Pesquisas da Amazônia*), or Institute of Environmental Research about Amazon- IPAM (*Instituto de Pesquisa Ambiental da Amazônia*). In addition, there are banks such as the Amazon Bank - BASA (*Banco da Amazônia*) and financial resources such as the Amazon Found – "*Fundo Amazonia*" managed by the National Bank of Economic and Social Development - BNDES (*Banco Nacional de Desenvolvimento Econômico e Social*), which aim to support development projects in the Amazon. Thus, the regional (or Amazonian) scale of decision making illustrates the existence of not only financial and research institutions, but also institutional social- ecological connectivity, such as indigenous and traditional populations living in conservation units. This is an arena in which there is a diversity of actors and institutions that are interconnected by common or/and conflictive interests and worldviews regarding the development of the Amazon.

Regarding the state (or statewide) scale, once the state of Rondônia was established in 1981, it was expected that the state government would be able to assume more political responsibilities and power. However, as mentioned previously in chapter two, the role the state plays allows and encourages the quasi-political decisions of global markets in Rondônia. Moreover, the state power is weakened by corruption and lack of innovation capacity, once the statewide level just replicates the global dynamics.

At the state scale, the Department of Environmental Development - SEDAM (*Secretaria Estadual do Desenvolvimento Ambiental em Rondônia*), the Public Prosecutor's Office - MPRO (*Ministerio Público do Governo de Rondônia*) and the Environmental Police are institutions responsible for dealing with the environmental irregularities in Rondônia. Through interviews, a SEDAM's worker stated that there is no fire management at state level because of scarce financial resources. In the protected areas from the ICMbio, there are brigades to mitigate fires just in the conservation unities.

At the local sphere of decision-making, interviews with local people and representatives of rural and environmental public agencies revealed that towns and municipalities do not have enough financial resources to manage wildfires and to tackle

[30] http://www.kaninde.org.br/corredor-tupi-monde-e-lancado-pelo-consorcio-garah-itxa-juntos-pela-floresta-durante-a-rio-20/

deforestations rates. Besides, municipalities have an outstanding political role in managing the rapid process of urbanization and urban growth from villages to towns (Becker, 2005). In other words, the increase of population exposure to wildfires and the increasing generation of wildland-urban interface might be a process legitimated by municipalities. That is the reason why local administration cannot be analyzed just considering its constraints that enable investment in preventive mitigation of wildfires. The point is how these constraints are used as a mechanism to promote a disorderly territorial occupation, which has consequences to the evolution of the wildfire risk.

There are municipally protected areas managed locally as well, which means that the local administration has been receiving more responsibilities regarding environmental aspects, but it lacks a capacity to promote disaster management.

4.3.2. Actors in Galicia, Spain

In Galicia, four geographical scales of policy making have been identified, from the European to the local level (Figure 20).

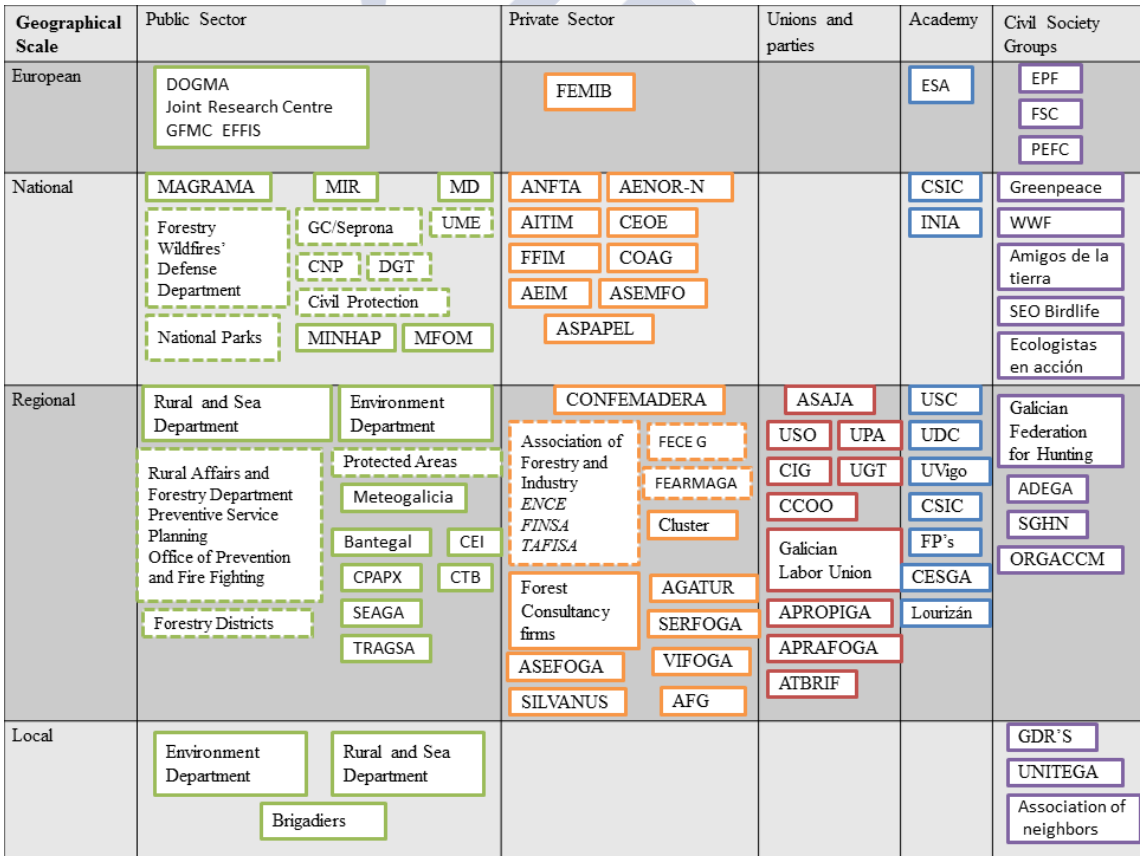


Figure 20. Actors' map in the wildfire risk scenario of Galicia

Regarding the European level, as a state member of the European Union (EU) since 1986, the political processes in Spain are inescapably determined by the EU policies in different areas. As exposed in chapter two, the afforestation of agrarian lands was one of the processes associated with the role of EU in the current wildfire scenario.

Besides, there is the European Forest Strategy, adopted in 1998 and reformed in 2013, which consists of the framework which should also guide the forest sector in Galicia. The European Commission emphasized the precautionary approach to deal with the process of afforestation in many European areas (European Communities, 2003).

The preventative or precautionary approaches have been introduced in the recent year's formal discourses of EU. Although this represents, at least in theory, an increase of awareness in relation to handling risks from decision-makers, there are obstacles in the implementation of the precautionary approach. In 2000, the EU formally expressed in a white paper the principle of prevention in disaster management, which implementation had implications for regulatory decisions in the international trade affecting mainly the food industry (Kinkle and Renn, 2002). The adoption of the precautionary principle in Europe was intended in order to avoid some of the environmental problems associated with the use of pesticides, and it was also an attempt to encourage public acceptance of alternative and new technology. However, it has failed to achieve either of these aims due to the disparity between the industry interests and ethical or value-based responses to risk issues (Tait, 2001). The essential role of global markets is parallel with a critical discussion about the private decision-making process that increases risk situations.

In the private sector of European scale of decision making, the FEMIB[31] (Federation of the European Building Joinery Associations) is an association of the manufacturers of the building joinery industry. This type of organization is present in the EU parliament as lobbyists. This illustrates that the existence of agreements and critical discussion regarding risk does not obscure the role of private organizations in this field. When a decision is more influenced by certain actors' groups than other actors, the contradictions of governance might emerge.

Regarding research, the European Space Agency provides scientific findings and fire operational services which represent an attempt of scientific debate about wildfire risk among European countries. Finally, at the European level, there are groups promoting forest certification, which is progressively affecting the forest sector in Galicia. In Galicia, the certification process is conducted by the Forest Stewardship Council (FSC) or by the Program for the Endorsement of Forest Certification Schemes (PEFC). The challenge of these processes in Galicia is certifying and managing private smallholdings, which is enabled by grouping and choosing the modalities of Small and Low Intensity Managed Forests in the case of FSC or regional in the case of PEFC, both aim to make the certification of small forest holdings a simpler and easier process (Alboreca-Rojo, 2015). The certification solution can be interpreted as a global form of governance or "non-state market driven", as discussed by Cashore (2002). This discussion is associated with the shift from government to governance, characterized by privatization, state transformation, joint public and private authority and cooperative partnerships complementing authoritative top-down regulation (Gulbrandsen, 2004). On the other hand, this author argued that it is not an opposition to intergovernmental cooperation on forests, but actually a supplement to the global forest regime. Public-private partnership is also an element of risk governance. Although disaster planning is an activity more often performed by the state, the public-private partnership can work as an ally of the disaster risk reduction can represent a step towards the adaptive governance (Tompkins and Hurlson, 2012). Besides, as illustrated in the map, effective

[31] https://www.femib.eu/aboutfemib.html

risk governance should also take into account parties and unions as well as the academy and the social civil society in their different levels of action. Knowing the actors involved does not only give the dimension of the complexity of the risk problem, but the actors' position can give insights on collective ways to solve this problem.

Regarding the national level, the first point would be to the need to consider the decentralization process of governments in Spain. According to Moreno (2002),this process was associated with the disappearance of the dictator General Franco and the spontaneous inclination and demands for autonomy to the Spanish regions.

At the national level, the role of the Wildfire Department of the Spanish Department of Agriculture, Food and Environment Ministry (MAGRAMA - *Ministerio de Agricultura, Alimentación y Medio Ambiente*) is to provide additional means of wildfire management just when the autonomous regional government is not able to cope with large wildfire crisis. Also, the fire data gathered locally are all sent to the national database about wildfires. The coordinator of the Spanish wildfire department, during an interview for this research, clarified that Regional Government has the main role in the risk governance, followed by the local Government. The informant also stated that one of the challenges of the Spanish Department is to stimulate the Regional Government to invest, not just on extinguishing fire, but also on prevention activities. This means that, institutionally, at the different levels of wildfire management, there are different perspectives towards the wildfire problem. On the other hand, in practice, when national mitigation means are displayed for emergency cases of wildfire crises in the Autonomous Regions - as it occurs every year - the national wildfire management is legitimating the reactive approach.

About the private sector in the national levels, companies associated with wood transformations are highlighted in the map. In the academic sector, outstanding research institutions were identified as having an important part playing the role of generating and sharing knowledge about the fires and related subjects. In the civil society, many national NGOs or global NGO's that develop activities in Spain are highlighted because of constant pressure on Governments to make decisions considering the dimension of sustainability. The amount of NGOs in the national and also regional level is an indicative that the emergence of a global public opinion (globalization from below) is accompanied by the emergence of national, regional and local public opinion.

Regarding the regional-Galician level, there are noticeable differences compared to Rondônia. In the same year of 1981, Rondônia started the transition from federal territory to state as well Galicia, which acquired legal character by approbation of autonomic status. However, observing the map of actor's map in Galicia, it is noticeable that there are more institutions spread among all sectors of the regional level. This is probably due to the fact that the decentralization process, described by Moreno (2002) as an Europeanization process which is a symptom of the general desire to leave behind the long stagnation of the Franco era as well as the wish to develop a new form of cosmopolitan localism (Moreno, 1999). In other words, if in Rondônia the decentralization process was strongly conducted by the military government accompanied by WB's investments; in Galicia the decentralization process was demanded by the society in order to overcome the effects of the military period.

The point is that, although the political decentralization has occurred at the same period in Galicia, local institutions were able to assume the main responsibilities in their

sector policies, and therefore, to cope with wildfires. Not only did the public institution actually assumed responsibilities, but it was also noticeable the stronger presence of local NGO's in Galicia when compared to Rondônia. The NGO's have an outstanding role in putting pressure on the use of natural the resources, criticizing the fast-growing reforestation and also the excessive focus that regional government put on extinguishing wildfires in Galicia. When contacting people to make informant interviews, it was noticeable that many actors of this NGO's were part of the academy sector. This indicates that the social demands are parallel to the level of formal education.

This does not prevent the fact that all researchers are demanding a preventive wildfire approach; neither the fact that many researches are being conducted to generate innovation in the approach of reactive wildfire management.

At the local level, there are municipal brigades and services created associated with wildfires. The community-owned land are also set at the local level, which indicates, at least in theory, the local management of common areas.

4.4. Social dimensions of wildfires

In this section, actors' discourses identified through informant interviews illustrate some relevant aspects of the arena in which wildfire risk discussion takes place in Rondônia and Galicia.

Understanding social dimensions in the local practices of management of ecosystems, in the framework of adaptive governance is the goal when examining how local groups, often embedded in multi-level governance, manage resources and engage adaptive governance (Armitage et al., 2008). Consequently, daily basis experience of the local actors dealing with practical dynamics related to wildfires represents an opportunity to learn from below. The concept 'learning from below' is associated to considering different points of view, values, and cultural norms of formal and informal institutions. This learning process should precede every participation process, once it helps to have an idea not only about factors related to the risk, but also the polarization of the actors in deliberative processes.

This study aimed to identify wildfires' factors and at identifying some controversial points in this arena. Involving different actors at different levels is implicit within the concept of risk governance. Hence, knowing their positions and dilemmas of the wildfire arena makes it possible to think about limits and possibilities of governance towards more integrative and adaptive approaches through actors' engagement.

4.4.1. Discourses and controversial points in Rondônia, Brazil

The discourses regarding wildfire risk reflect a dilemma about sustainability and the real dynamic existent in Rondônia. A polemic issue in Rondônia is the role of agribusiness. The government focus on agribusiness is perceived by some actors as the only via for the economic development of Rondônia, as illustrated in the fragment below:

> The agricultural and cattle sector are the focus of Rondônia. We have eleven times more cattle unities than people. Deforestation was necessary for the development of the state. How will we achieve the development goals with only forests? In 1984, we used to see a lot of *queimadas*, now the laws prohibit human causing fires and there is also the fact that the entire place is already deforested (Director of local Rural Department, Ji–Paraná, 2015).
>
> Rondônia has one of the most profitable conditions in livestock. The simplest and cheapest way to renew pasture is put fire on it (ICMbio's environmental analyst, Porto Velho, 2015).

In the first fragment, development is illustrated as a synonym of deforestation while forest is described as an element that prevents the development processes. The second fragment, in turn, recognizes that the dynamics of fire is the necessary condition for profitable breeding of cattle.

The position found in the first fragment is compatible to the sector from which this actor represents: the local rural sector. On the other hand, the second fragment is from a public servant of an institution whose aim is to develop more sustainable dynamics in these social-ecological systems of Rondônia. This means that the perspective of local actors is not always conditioned to the aims or ideology of the institution that they represent.

In this way, three types of discourse associated with dilemma regarding the sustainable and farming activities in Rondônia were identified:

1) Highlighting the familiar agriculture, independently of the activity, as more sustainable than the agribusiness:

> The familiar agriculture is concerned about the forest while the agribusiness is not. From 1970 to 1995 there was a huge occupation that developed the cattle. In the last 20 years the soy was introduced to product commodities, causing the deforestation fires. The colonizer logic is that there is no embarrassment in deforest and burn (Professor of Geography department Unir, Porto Velho, 2015).

2) Highlighting the agribusiness (producing and processing grains) practices as more professional and sustainable than the pioneer farmer:

> The pioneer is different from the farmer. The pioneer [colonist] deforests and burns while the farmer is coming now to Rondônia (Incra'sCordinator, Ji-Paraná, 2015).
>
> The farmer has the mechanism to use tractor to clear the forest. The cattle rising farmer does deforest, burns areas and grass seed on top of the ashes, he also uses fire as pest control method. There is a lack of governmental policy in Brazil. There is not a public policy with compensation to encourage the farmer to invest on maintenance of tree species and carbon sequestration, (Professor of Agronomy Department –UNIR, Rolim de Moura, 2015).

3) Highlighting cattle rising as a sustainable practice:

> Initially, the fire in Rondônia was used to promote deforestation; it was the cheapest practice worldwide. The order was to give a use to the land. In the late 80's, it was the main practice. At first, it consisted of shorter cycle practices, rice, beans, and manioc. In the '90s it also turned into pasture as another way to prevent deforestation fires. Today the farmer is aware that fire reduces the soil production capacity. Thus, cattle rising triggers wildfires' decline (Forestry Engineer ofSedam, Vilhena, 2015).

Those discourses illustrate the actors' social construction about causes and drivers of wildfires in Rondônia which vary depending on the connection or empathy with certain sector or actors.

As discussed in chapter two, some contradictions about sustainability and the productive dynamics in Rondônia were engendered by international agencies, such as the role of the World Bank. Locally, the actors evaluate differently the role of these actions.

> In Rondônia, the environment is not a priority. The Conservation Units have been proposed by the World Bank, but have not been implemented. Regarding wildfire crimes, there are many actions in public prosecution against the state and against the farmers. There is no policy directed to the environment at the state level, only to small initiative of environmental projects (Environmental Prosecutor, Porto Velho, 2015).
>
> The first state special planning was done in 1988/87because the international organizations, especially the World Bank, realized that the POLONOROESTE offered the condition for human settlement, with roads, rural and urban nucleus. So the Planafloro in 1991 was implemented in order to increase the territorial organization, finding the best land and disciplining the use of it. On one hand, the agriculture entered into decadence, on the other hand cattle raised. The economic ecological planning created by Planafloro brought greater control in the occupation of productive space in Rondônia, it strengthens the model of production. (Coordinator of the sector planted trees of Sedam, 2015).
>
> Planafloro encouraged the introduction of teak plantations and eucalyptus in the 90s, ironically, the project aimed to achieve biodiversity (Kanindé's Coordinator, 2015).

The first and the second fragments illustrate WB in a positive as a result of two main reasons. Firstly, WB is presented as one actor, different from local actors that attempt to engender sustainable dynamics in Rondônia. Secondly, WB actions are considered positive due to the development of roads, cities and agrarian activities. The elements highlighted as positive in the second fragment coincides with the main critiques that authors, as illustrated in chapter two, has made to the WB actions in Rondônia. Just the third fragment of one informant, a leader of a local NGO with conservation purposes, classified these actions as negative.

However, through interviews it was possible to perceive a local resistance towards the international NGO's interference. The international appeal for more sustainable patterns in Rondônia is understood by a couple of actors as a limitation of agents' freedom in managing resources:

> The forest management limits the exploitation of native forest. Rondônia is under constant pressure from Greenpeace (Planning and agro forestall development consultant, 67 years old, 2015).
>
> Sustainability is an international appeal, but if you go to Acre, you will see that the people are hungry, there is a lot of poverty there (Ownership of a Furniture Artisanal Industry, 55 years old, 2015).

To contextualize the last discourse, Acre is a state which borders Rondônia. The model of development chosen in that state attempts to balance traditional populations,

biodiversity and economic activities. The local government in Rondônia, on the other hand, has chosen the rural productive model. Introducing a comparison with Acre, this discourse attempts to highlight that although the sustainability is an international appeal, it is not generating wellbeing for people settled in the Amazon areas, once they are still in conditions of misery.

The contradictions regarding sustainability and productive activities are also evident by the role of national agencies, as it is illustrated in the following narratives:

> INCRA encouraged the deforestation, but at the same time IBAMA prohibited deforestation and fires (Incra's Coordinator in Pimenta Bueno, 2015).

> It was an occupation based on trial and error, the fire was intended in order to produce food. INCRA just deposited people and abandoned migrants without guidance. My grandfather tried to develop crops here as he used to do in the south of Brazil. In the first and second years, he worked on crops of corn, then cocoa. In the third year, he was already searching for new areas (Director of Ji-Paraná's Environmental Department, 2015).

INCRA, as an organ responsible for the colonization, encouraged the development of rural activities at the expense of great deforestation fires. As mentioned in the second fragment of the narrative, the colonization was based on a trial and error approach. On the other hand, the environmental department- IBAMA, was present in Rondônia since the colonization process.The persistence of deforestation and wildfires seems to question the capacity of this department to promote its institutional objectives, which, at least in theory, are intended to protect rainforest and biodiversity and to control the negative effects of human induced changes.

According to the point of view of one interviewed, IBAMA is unable to suppress fire in the state:

> Prevfogo (IBAMA) has 20 people to suppress wildfire in the entire state. The environmental laws are not implemented in Rondônia (Kanindé's Coordinator, 55 years old, 2015).

Through observations of the work field, consisting of visiting local rural and environmental agencies, it was proven that IBAMA's suppression actions in Rondônia are not accompanied by a suppression service in the municipalities.

Besides, actors' perception illustrates a lack of wildfire monitoring in the years when there are electoral processes, as seen in the following interviews' fragments:

> Fires usually take place during the election year. The agencies do not monitor, because managers run as candidates in the elections (Agronomist of Rural Environmental Department of Pimenta Bueno, 2015).

> In the presidential election year there are more fires (Professor of Geography department UNIR, Porto Velho, 2015).

These fragments give evidence to the lessening of environmental restrictions in the electoral processes in order to obtain more votes of local actors. The variety of values, points of view and cultural norms about wildfire risk has illustrated the need of an understanding of practical challenges and obstacles of sustainability to advance risk

governance in Rondônia. Sustainability is a concept and a goal of some national and international policies or initiatives which does not match with the trajectories of most actors who moved to Rondônia seeking a more promising future.

Until sustainable alternatives do not represent a socio-economic possibility for local actors' livelihoods, sustainability or wildfires will continue to be ignored and not seen as a socially perceived problem for most actors in Rondônia. The major obstacles to real wildfire risk governance are associated with the complex interplay between changes in the social-ecological systems in its different levels, which engenders these dilemmas related to sustainability and production dynamics.

4.4.2. Discourses and controversial points in Galicia, Spain

In this section, discourses identified by interviews with actors illustrate the arena of discussion regarding wildfire risk Galicia.

The role of EU in the wildfire scenario is interpreted in different manners by actors. Many discourses pointed out the need of an increasing European control towards forestry and protected spaces in Spain. This control might represent, according to the interviewed people, a decrease of wildfires in Galicia:

> The forest policy consists of mitigating fire, creating business associated with extinguishing fire or companies that manufacture mitigating means such as airplanes or helicopter. The influence of the European Union should be greater, with subsidies and greater control (Environmental agent, Xinzo de Limia, 2015).

> Regarding the forest politic, it is based just on fire reactive mitigation. If there are investment in forestry activities, wildfires would not exist. There´s little influence of the European Union in the forestry sector. It establishes some basic limits through the European Forest Strategy (Member of ADEGA, Lugo, 2015)

> Galicia´s forestry policy is coordinated with that one of the European Union. There is not a common forestry policy, and this prevents the rural development in Europe. In the Rural Development Programme, there are forestry development policies. However, they are not as strong as the CAP (Researcher Lourizan, Pontevedra, 2015).

Nevertheless, another interview points out the importance of the role played by the EU which enabled a fast growing in the reforestation of Galicia. That is one reason why this collective argue for leaving the UE:

> I am against being part of the EU. One of the reasons is because it is almost impossible to reach consensuses. Therefore I support the majority´s role. The forestry production in Galicia comprehends mainly the pulp and paper industries. Europe decided that the focus of Galicia would be on the primary, secondary and tertiary sectors. It is a broken policy. Every six years they mark lines. The forest is encouraged to be used as pulp for paper and trituration. Galicia is a biodiesel zone, reconfiguration of the primary sector to the secondary sector (National secretary of the union CIG, Santiago de Compostela, 2015).

This discourse seems to come closer to Wallerstein's (1979) discussion about the periphery of core countries. Although Spain is considered a developed country, the discourse of this interviewed considers existent differences among European regions. Besides, the individual interviewed considers that belonging to the EU means accepting the Galician condition of periphery in relation to other European countries.

Another topic highlighted in the interviews is the institutional overlap in the investigation of wildfire causes. Informants pointed out a conflict of legitimacy in the investigation of wildfires between the national Environmental Protection Service (SEPRONA- *Servicio de Protección de la Naturaleza*) and investigator agent of wildfire of the Regional Government so-called Xunta de Galicia:

> SEPRONA copied our work. There is duplicity. SEPRONA is the military, the state, and we are from the Xunta (Galician government) (Environmental agent, Xinzo de Limia, 2015).

> My job consists of administrative police which is the same function as SEPRONA who investigates crimes against the Environment. The Office of Rural Environments investigates all issues related to forests and fires. And the Environmental Office has of ensuring the environmental conservation, investigating crimes against faun and, the nature network. We have the same responsibilities, we investigate wildfires' causes, but we have different bosses (Fire Investigation Brigade, Pontevedra, 2015).

These fragments have highlighting uncoordinated measuresregarding wildfires' investigations. These interpretations of reality illustrate ideological institutional tensions in wildfire risk governance. They are a kind of micro-conflicts that formally that do not appear in the formal discourses of the organizations where interviewed work. Nevertheless, the micro-conflicts exist and guide the understanding of the role developed by the actors that in practice of investigating wildfires meet each other and dispute ideologically the legitimacy for the role played by these actors.

The battle for legitimacy is a sign that wildfire risk assessments and management lacks of inter-institutional communication processes able produce dialogue among actors that share responsibilities regarding wildfires.

These legitimacy tensions exist also between public and private spheres. Recently, a conflict emerged between representatives of the Galician wood products industry (CONFEMADERA -*Confederación de Empresas de la Madera de Galicia*) and regional government. "Mesa da Madera" is a deliberative conference, promoted by regional government. The participants of "Mesa da Madera" are actors of different institutions that meet in order to approve the plan of prevention and defense against forest fires (PLADIGA). The conflict came to light when CONFEMADERA left the organization accusing the regional government of overinvesting in fire suppression at the expense of scarce investments and empowering the wood market. [32]

> We want a forestry policy that enables holding all the stakeholders, to into operation the forestall plan improvements that have been created only on paper not in action. The forestall plan is being revised, but the regional administration should be able to put it into practice (Forestry Technician de CONFEMADERA,Santiago de Compostela , 2015).

[32]http://www.lavozdegalicia.es/noticia/economia/2015/04/10/sector-forestal-rompe-xunta/0003142867348612536549 3.htm
http://www.europapress.es/galicia/agro-00246/noticia-patronal-madera-deja-grupos-xunta-desatencion-20150410174125.html

From that conflictive situation it emerged a divergence: Many associated companies of CONFEMADERA disagreed with the decision to move away from "mesa da madeira"[33], highlighting that it was a decision that did not reflect the desire of all members. The fragment highlighted below is from an actor who disagreed with the idea that leaving this group would be the only one initiative of governance:

> " It [mesa da madeira] is the best of the worst that we have" (ProfesorUVigo, Vigo, 2015)

In his perspective, leaving this group is not promoting ways to solve the problem. Before CONFEMADERA abandoned the Mesa da Madeira, there were other institutional conflicts:

> Galician Wood Cluster dissociated itself from CONFEMADERA because of the functions overlap and because CONFEMADERA's actions would put an end in Cluster activities, in a phagocytosis process (Leader of Galician Wood Cluster, Santiago de Compostela, 2015)

This fragment gives us a glimpse about the existent disputes among private sectors of forestalls industry in Galicia. These different ways of understanding the institutional role have repercussion on the wildfires' risk understanding. The leader of Galician Wood Cluster has emphasized in the interview that wildfires are not a subject of the cluster. He highlighted that CONFEMADERA is the actor who focused on the discussion based on the political agenda items.

Regarding wildfire mitigation, interviewed people highlighted that municipal and regional brigades sometimes overlap:

> Salaries for the same job are different; the paperwork with four companies is complicated. In Lugo, the municipal brigadewas prohibited to mitigate fire in certain places, because there is overlapping with other brigades(Municipal brigade member of As Nogais, Santiago de Compostela, 2015).

> It is a sector that needs more professionalization. The campaigns and brigade members are not organized. They are just businesses (Reginal brigade of SEAGA, Trives, 2015).

The perspective illustrated by the actors in Galicia inevitably falls upon the classical approach of reactive wildfire management. Consequently, the initiative towards integrative governance such as "mesa da madeira" is threatened by that dilemma. Nevertheless, risk governance processes cannot be limited dualities. On the contrary, handling the problem by considering complexities is one condition to advance risk governance, which is better when capable to engage actors in their adaptive processes. This was attempted in this study through a collective construction of wildfire risk scenario, which is discussed in the next subsection.

[33]http://www.lavozdegalicia.es/noticia/economia/2015/04/12/madereros-lugo-desmarcan-patronal-romper-xunta/0003_201504G12P38991.htm
http://www.economiadigital.es/gles/notices/2014/10/golpe_a_la_unidad_del_sector_forestal_los_empresarios_de_lugo_rompen_la_patronal_gallega_39985.php

4.5. Focus groups to discuss and identify wildfire factors

As mentioned, focus groups were developed as deliberative sessions in which participants thought, discussed, and negotiated which possible factorswere determinant to the future risk scenarios. The point was to discover and to hammer out an agreement about anything that might, over time, influence the generation, increase or decrease of wildfire risk in the study areas.

In Renn's (2015) perspective, the stakeholder engagement during the risk pre-assessment phase is advantageous because it allows the initial framing of the problem, defining boundary conditions and applicable scientific, political and social conventions.

The argument presented here is that the negotiation among actors about wildfire risk factors is needed in order to stimulate actors' reflection about risk governance considering the complex interplay among factors and actors in wildfire scenarios.

Indeed, recent disaster experience and research have illustrated that relationships among technical knowledge, social processes, political pressures, and the resulting behavioral outcomes (both individual and institutional) are not as simple and straightforward as the top-down approach might suppose (Scolobig et al., 2015). That is the reason why engaging societal actors in framing the problem is a necessary instrument to expand actors' understanding through multi-directional learning process.

Based on the focus group experience, Bracken et al. (2015) found that negotiating and working iteratively helps to expand participants' knowledge about an issue and understand each other's views on it. In addition, it helps the achievement of common understanding between academics, non-academics and local actors.

This supposes an advance towards the integrated approach, which poses the need to understand interactions between the biophysical processes, social issues and socio/political economic processes (Gall et al., 2015). This approach allows the problem framing according to the practical experiences together with science perspective.

Other important aspect to take into account is that different countries have diverse traditions and different preferences when it comes to deliberative processes, thus the format choice should reflect specific requirements of the regulatory system and political culture of each country (Renn, 2015). For this reason, the same combination of participatory instruments triggers not only different outcomes but can also trigger discussions about different styles of participation.

Is this study, all actors were considered important in the participation process, so that the absence of any actor could imply that their views were not represented in the interpretation of fire risk scenarios. Underrepresentation of actors in the problem-analysis occurs particularly with the poor and vulnerable groups, who are not usually included in traditional institutions and do not have the resources needed to attend participatory processes (Hermans et al., 2006). Following the concerns of inclusiveness, a great effort was made to include local representatives of indigenous groups in Brazil and local actors Galicia, such as representative of community-owned land.

Pros and cons resulting from the experience with heterogeneous groups are discussed in the table below.

Table 7. Advantages and disadvantages of heterogeneous actors in the focus group sessions

Advantages	Disadvantages
Sharing different meanings in order to build common learning	Less cohesion
Problem is seen from different perspectives and this is understood as logical by participants	Clashing understanding of the problem may lead to conflict
Possibility of starting inter institutional dialogue or include additional stakeholders	It is likely that a "white elephant" may try to attract the group to his/her position
Giving voice to all participants, assuming that everyone has a particular view of the problem	Different backgrounds may discourage involvement in the dialogue
As dialogue advances productively it encourages participation	

Despite efforts made inviting several people from different sectors of societies, not all groups were interested or available to participate. Risk assessment can be compromised if important stakeholders are excluded from the process which could reduce reliance on the results and weaken the legitimacy of subsequent policy decisions (IRCG, 2010). On the other societal actors' availability to participate is an uncontrollable element in this research, once to participate or not is a subjective decision taken by individuals or formal institution. Besides, actors who managed to participate of the sessions presented good illustrations of which institutions are willing to move to integrative governance.

The Figures 21 and 22 illustrate which actors were present in the sessions in both areas:

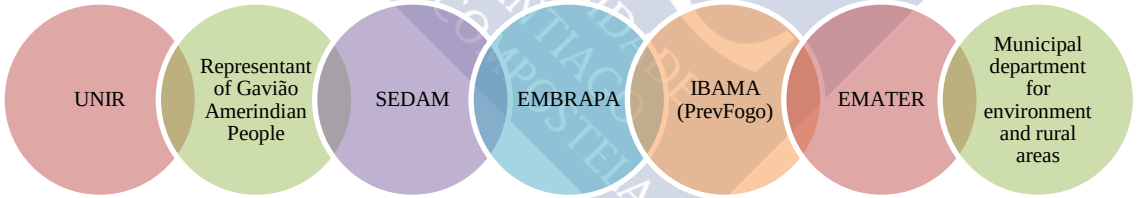


Figure 21. Actors' attendance to the focus group sessions in Rondônia

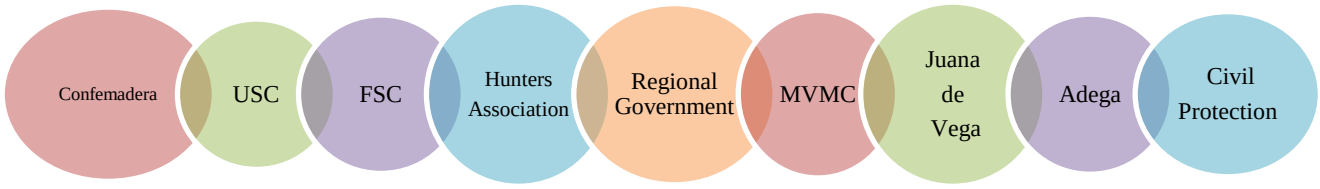


Figure 22. Actors' attendance to the focus group sessions in Galicia

Attendance to the sessions in Rondônia was lower when compared to Galicia. The difference in terms of scales and the need of long hours commuting in Rondônia constitute factors that partially explain the difference. Although local NGO's were invited in Rondônia, they did not attend the meetings. Just one NGO participated in the Galicia sessions.

The presence of actors from NGOs, in both contexts, was not as significant as expected. In Rondônia no NGO representative attended the meetings while in Galicia one representative attended some sessions.Actors representing the private sector did not attended sessions in Rondônia while CONFEMADERA in Galicia were present in focus group discussion. The presence of academy, by means professors and research groups, and also Government institutions and local collectives as Amerindian people in Rondônia and a representative of one of community-owned land in Galicia were very advantageous for the quality of discussions.

4.5.1. Controversial points: the negotiation process

After risk factors were identified in the first session, they were analyzed and adjusted through a negotiation process attempted to reduce, as much as possible any bias, misinformation or disagreements. The dialectal process, which involves theory, research and practice, increases the understanding and abstraction of ideas alongside and between improvements in the real world (Winter, 1987), was attempted through negotiated understanding of wildfire risk factors.

The allusion to the dialectal process does not necessarily go back to the easy solution of agreement, consensus, and cooperation proposed by Habermas (1983).On the contrary, participation processes are not free from conflicts, biases or myopia. Honeth (2003) has argued that constant social conflicts are able to raise an action that seeks to establish relations of mutual recognition or to develop them at a higher educational level. In other words, conflicts are also a source of learning. In this way, Fra Paleo (2015) affirms that heterogeneity and discordance should not be used as an argument to avoid interaction, mainly considering that different points of views concerning risk could be converted into an arena to confront the various and opposed interests, concerns, and individual and collective choices..It leads to recognition of conflict as an inescapable dimension of life in society. Besides, conflicts can be seen as a driver for creative decision-making through participatory learning processes rather than as a justification for mere zero-sum bargaining (Van Den Hove, 2006).

Negotiation of conflictive points of view among participants can be an ally of transparency and reduction of manipulation among actors. A transparent procedure for balancing arguments and a debate about the relative weight of arguments are essential elements to gain legitimacy in the deliberative process of risk governance (Renn, 2012). For this reason, controversial points which merged in the focus group discussion are highlighted, as a way to better understand which problems are regarded to the risk governance challenges in both areas.

In the negotiation process, although the synthesis of ideas and practice will provide innovative and more rational understandings and behaviors, contradictions or irrationalities may emerge because of other ambiguities and poorly justified areas of work (Waterman, 1998). This explains why participatory processes are endless and

offer only temporary answers to the problem. It is a process that is constantly awaiting feedbacks. In the subsequent items, the most controversial points are presented in the proposed focus groups.

4.5.2. Controversial points in the focus groups in Rondônia

The discussion about two risk factors was highly controversial in the focus group dialogue: territorial and environmental policies, and population growth.

1) Territorial and environmental policies

Territorial and environmental policies were chosen as a wildfire risk factor understood by participants as the set of rules, programs and plans that affect the use of land and environmental resources. In the discussion, most participants agreed that environmental laws lose their power over time, especially when considering its coexistence and overlapping with other livestock agro and mining policies. The majority of participants pointed that the softening of environmental laws occurs especially because of the action of the rural members of the national congress who defend the interest of agribusiness in detriment of sustainable issues and traditional lifestyles in the Amazon. An indigenous representative, for instance, described the potential impact of a legislative proposal, Act PEC 215/2000[34], to indigenous lands. In summary, the goal of the regulation is to change the process of recognition of indigenous lands, traditional lands and the units of conservations and make it easier for farming development towards those lands. The discussion became controversial when a participant, a representative of a municipal rural department, pointed out the increasing environmental regulations that raised the barriers to farming. The discussion was essential to consider other possible dimensions of this factor and also to understand that the statements from both the indigenous and the rural department representatives are reasonable in their daily experiences. This allowed framing hypothetical futures that take into account both representatives logics.

2) Population growth

As a risk factor, population growth is mentioned in literature as a key factor for land use changes in Rondônia, considering past government policies that aimed to resettle population through colonization projects (Becker, 2005; Thèry, 2012). Also, population was identified in the interviews as a main factor of deforestation and, ultimately, linked to forest fires:

> In the 80's there was a great deforestation due to the increase of population in the state (PrevFogo Coordinator in Rondônia-IBAMA, 52 years old, 2015).

> Rondônia was considered a demographic void, if introduced livestock and crops, the government gave the area the chain saw and gasoline to validate the land ownership title (ICMbio Environmental Analyst, responsible for the National Park Mapinguari in Rondônia, 30 years old, 2015).

[34]In this link it is possible access the drafting of the law: http://www.camara.gov.br/proposicoesWeb/fichadetramitacao?idProposicao=14562. Accessed 02 March 2016.

> In the 70s, Rondônia suffered an intense process of external migration, Firstly, it was established settlements based on subsistence farming. Later, livestock appeared as larger enterprises. Loggers and sawmills were part of a long primary process, causing the depletion of wood, stimulating internal migration, selling the most expensive land to raise the price of cheaper land (Coordinator of the sector planted trees of Sedam, 69 years old, 2015).

Although population growth was an element identified in both the scientific literature review and also in the informant interviews, the participants of the first focus group session did not identify this element as a risk factor. Even though the moderator introduced population growth as a factor for discussion, the group did not contemplate a direct relation between population and increased wildfire risk, arguing that in the last 20 years the rural population in Rondônia remained constant. It is important to note that the group assumed this discourse largely influenced by the opinion of a researcher who felt legitimate to assert his point of view. The key argument proposed by this participant was that agriculture is very diverse, coexisting with small farmers and soy big farms. In these diverse rural dynamic, new *latifundia* are being created at expense of the advancement of smallholdings' occupation of new areas, threating the native forest areas. The viewpoint of this participant was that the amount rural population remains stable in this dynamic. So a key question was presented as a counterargument in the moderation: can we disregard the future processes of colonization and immigration from other parts of Brazil?

Just so the group took the potential future demographic changes into consideration. At the same time, participants acknowledged the role of rural-urban migration and rural-rural migration (the development of new areas) as dimensions of this factor. Thus, participants also were to consider emergent types of vulnerability by wildfires due to population growth.

4.5.3. Controversial points in focus groups in Galicia

The most controversial issues in the focus group were related to four risk factors. After discussion, two of them were reformulated and two others were eliminated.

1) From "Non-pyrophitic" to " native species forest"

The term *pyrophytic*, commonly used in local media and in actors' informal discourse, was used to refer to fast-growth planted species and their role as fuel which makes forests more prone to catch fire. The participants' argument was that the fact of being native or not is not decisive in future wildfire risk, but the fact that certain species are *pyrophytic*is is the prevailing feature that increases possibilities of fire propagation. However, in the moderation process it was exposed that the use of the term non-*pyrophytic*relates to a forest productivity perspective, in which biodiversity and ecosystem conservation are not taken into consideration. In the second session, after a new discussion, the group decided to adopt the term "native" and "non- native" forest species attending to conservation, landscape and production concerns.

2) Social capital

The term social capital was initially suggested as a factor to consider the actions of land owners and other societal actors who organize themselves as a result of fires,

both in mitigation and suppression. After discussions in the second focus group session, it was suggested that this factor could also hold the possibility of public participation in decision making regarding wildfires.

3) Connection to the land

Participants linked wildfire risk to farm land abandonment, arguing that living in rural areas is not a decisive factor to decrease the risk. For them, developing some land activity is determinant to connect people to a real activity over the land and therefore avoid fire. However, in the negotiation process, participants highlighted that that connection to the land refers to personal predisposition to maintain activities in rural areas. After discussions, participants agreed that this factor was reflected more objectively in 2 factors previously identified, such as suburbanization and mosaic of land uses.

4) Conflict and competing land uses and interests

Conflict was initially framed as a factor that consists of two aspects: 1) Wildfires are used as an objection against the creation of protected spaces or spatial planning; 2) Wildfires also emerge as result of micro conflicts regarding land use change.

In subsequent discussions, participants agreed that wildfires are more considered as an unsolvable problem, which raises concerns only in summer when wildfires mostly occur. When the critical period of forest fires ends, this discussion loses its strength. Besides, the discussion also contemplated that fire as a protest can be seen as a symptom of other micro-conflicts such as urbanism, environmental, fishing, infrastructure polices. Therefore, conflict was not considered a constant element and does not represent a decisive factor to the wildfires risk.

4.6. Conclusions

Learning by means of a pluralistic consideration of societal values and perspectives through the combination of participatory instruments yielded clues about actors' traditions and contradictory institutional arrangements of each of each area. In Rondônia, for instance, part of the contradiction between sustainability and rural productive activities were engendered by formal institutions of different bodies, such as INCRA which stimulated changes in modes of land use, and IBAMA that, at least in its rhetoric discourse, aimed to protect ecological diversity as well as prevent against unsustainable activities. In Galicia, the popularity of wildfires as a topic of discussion reflects different institutional ways of seeing and tackling the problem, marked by an institutional overlap of the mitigation and investigation of wildfires or non-communicated ways of conceiving the problem that might have resulted in institutional ruptures, in the style of, say, the rupture between the CONFEMADERA and the regional government.

The main thesis presented in this chapter is that bringing together actors is a way to establish the communication process and to promote innovative modes of thinking through interaction to co-generating knowledge regarding wildfire risk.

In any country public participation and stakeholder involvement can transform the scientific discourse by leading the discussion towards classifying knowledge claims, characterizing uncertainties, exploring the range of explanations and acknowledging the limits of systematic knowledge in many risk arenas (Renn, 2015). This statement does not omit the fact that each region has its own social traditions and specific institutional arrangements, which determine the nuances of participatory process and its outcomes. In fact, the variety of contextual and environmental factors will interact with the components of a method to determine its effectiveness (Rowe and Fewer, 2000).

About the leaning process in Rondônia, the sessions were the first time, according to participants, that they were invited to engage in inter-institutional work to disclose their position regarding wildfire risk. In Galicia, in turn, the longstanding debate about wildfire risk, usually marked by the dichotomy between suppression and prevention, had taken on a new significance as a result of discussion

Participants in Galicia pointed out that the focus group sessions were fruitful and helped them to break with more usual partisan debates. In both places the focus group sessions, represented an opportunity – considering their range possibilities and limitations – to 'think about how best to include societal actors in the co-management in risk disaster policies in the role of agents equipped to handle wildfire as a problem of certain complexity involving multiple interrelated factors.

In both areas, participants also stated that the discussion and negotiation processes opened their minds about the complex and interconnected nature of wildfire risk. Negotiation within the focus group in Rondônia and Galicia triggered a process of social learning in which the emergence of conflicting viewpoints was not considered a barrier, but a valuable resource to gain diversity for the construction of future wildfire risk scenarios.

According to Renn (2015) the transformation of the risk arena into a well-structured and professionally moderated analytic-deliberative discourse depends on the reconciliation of scientific expertise, rational decision making and publi value. The empirical experiences with the engagement of societal actors in risk research in Rondônia and Galicia illustrate that it is indeed possible to achieve a shared understanding of wildfire risk and construct future scenarios, which is the topic of the next chapter.

References

Ahlstrom, D. & Bruton, G. D. (2002). An institutional perspective on the role of culture in shaping strategic actions by technology-focused entrepreneurial firms in China. *Entrepreneurship Theory and Practice*, 26(4), 53–70.

Al-Hawamdeh, S. (2002). Knowledge management: re-thinking information management and facing the challenge of managing tacit knowledge. *Information research*, *8*(1), 8-1.

Alboreca-Rojo, A. (2015). El reto de la ordenación de los montes privados en España.*Cuadernos de la Sociedad Española de Ciencias Forestales*, (39), 275-297.

Allison, H. E. (2015). Understanding and Conceptualizing Risk in Large-Scale Social-Ecological Systems. In: U. Fra. Paleo (Ed.) *Risk Governance: The Articulation of Hazard, Politics and Ecology*. New York-London: Springer, 99-115.

Amin, A., & Roberts, J. (2008). Knowing in action: Beyond communities of practice. *Research policy*, 37(2), 353-369.

Armitage, D. R., Plummer, R., Berkes, F., Arthur, R. I., Charles, A. T., Davidson-Hunt, I. J. & McConney, P. (2008). Adaptive co-management for social-ecological complexity. *Frontiers in Ecology and the Environment*, 7(2), 95-102.

Bäckstrand, K. (2003). Civic science for sustainability: reframing the role of experts, policy-makers and citizens in environmental governance. *Global Environmental Politics*, *3*(4), 24-41.

Barbour, R.S.; Kitzinger, J. (1999*). Politics, Theory and Practice*. London: Sage Publications

Beck, U. (2002). *Power in the global age: A new global political economy*. Polity Press

Becker, B. K. (2005).Geopolítica da Amazônia. Conferência do Mês do Instituto de Estudos Avançados da USP proferida pela autora em27 de abril de 2004. São Paulo: *Estudos avançados*, 19 (53)

Bonet, J. (2006). La vulnerabilidad relacional: Análisis del fenómeno y pautas de intervención. *Redes: revista hispana para el análisis de redes sociales*, *11*, 4.

Boyd, E. & Folke, C. (Eds.). (2012). *Adaptinginstitutions: Governance, complexityand social-ecologicalresilience*. Cambridge University Press.

Bracken, L. J., Bulkeley, H. A., & Whitman, G. (2015). Transdisciplinary research: understanding the stakeholder perspective. *Journal of Environmental Planning and Management*, 58(7), 1291-1308.

Brasil (2009). Decree nº 7.008, 12 November 2009. Available in: http://www.planalto.gov.br/ccivil_03/_Ato2007-2010/2009/Decreto/D7008.htm. Accesssed 8 March 2015.

Bryson, J. M. (2004). What to do when stakeholder matter. Stakeholder identification and analysis techniques. Public Management Review 6 (1), 21–53.

Bryson, J. & Crosby, B. (1992). Leadershfipo r the CommonG ood: TacklinaP ublicP roblemsin a SharedP ower World,San Francisco,. CA: Jossey-Bass.

Cashore, B. (2002). Legitimacy and the privatization of environmental governance: How non–statemarket–driven (NSMD) governance systems gain rule–making authority. *Governance*, *15*(4), 503-529.

Chilvers, J. (2008). Environmental risk, uncertainty, and participation: mapping an emergent epistemic community. *Environment and Planning A*, 40(12), 2990-3008.

Coy, M. (1987). Rondônia: Frente Pioneira e Programa POLONOROESTE: O Processo de Diferenciação Sócio-Econômica na Periferia e os Limites do Planejamento Público,in: G. Kohlepp, A. Schraeder (Eds.), Homem e Natureza na Amazônia, Simpósio Internacional e Interdisciplinar, ADLAF, Tübingen Geographische Studien, Blauberen, 253–270

De Marchi, B. (2003). Public participation and risk governance. *Science & Public Policy (SPP)*, *30*(3), 171–176.

De Marchi, B. (2015). Risk Governance and Integration od Different Types of Knowledge. In: Fra Paleo, U (editor). *Risk Governance: The Articulation of Hazard, Politics and Ecology*. New York-London: Springer,149-165.

Duit, A. (2012). Adaptive capacity and the ecostate. *Adapting Institutions: Governance, Complexity and Social-Ecological Resilience*, 127-147.

European Comunities. (2003). Sustainable forestry and the European Union: Initiatives of the European Commission. Luxembourg: Office for Official Publications of the European Communities.

European Union (2014). Forest strategy: conclusions adopted by the Council. Brussels. (online) available in http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/agricult/142685.pdf. Accesed february 19 2015.

Fairclough, N. (2001b). The Dialectics Of Discourse. InTextus XIV.2 2001a pp.231-242. Available in: https://www.sfu.ca/cmns/courses/2012/801/1-Readings/Fairclough%20Dialectics%20of%20Discourse%20Analysis.pdf. Accessed 19 January 2016.

Fearnside, P. M. (2005). Brazil's Samuel Dam: Lessons for hydroelectric development policy and the environment in Amazonia. *Environmental Management*, *35*(1), 1-19.

Folke, C., Hahn, T., Olsson, P., & Norberg, J. (2005). Adaptive governance of social-ecological systems. *Annu. Rev. Environ. Resour*., 30, 441-473

Fra.Paleo, U. (2015). Structure, Process and Agency in the Evaluation of Risk-Governance. In: Fra Paleo, U (editor). *Risk Governance: The Articulation of Hazard, Politics and Ecology*. New York-London: Springer, 237-273.

Freeman, R.E. (1984). *Strategic management. A Stakeholder Approach*. Boston: Pitman Publishing, Marshfield, MA.

Frewe, L.J; Salter, B. (2002). Public Attitudes, Scientific Advice and the Politics of Regulatory Policy: The Case of BSE. Science and Public Policy 29(2)

Gall, M., Nguyen, K. H., & Cutter, S. L. (2015). Integrated research on disaster risk: is it really integrated?. *International journal of disaster risk reduction*, *12*, 255-267.

Gontijo, B. M. (2011). Cinturão de áreas protegidas em Rondônia/Brasil: Corredores de paisagem para salvaguarda do bioma amazônico. *Revista Geográfica de América Central*, 2(47E).

Grieg-Gran, M., Porras, I., & Wunder, S. (2005). How can market mechanisms for forest environmental services help the poor? Preliminary lessons from Latin America. *World development*, *33*(9), 1511-1527.

Grimble, R. (1998). Stakeholder methodologies in natural resource management. Socioeconomic methodologies. Best practice guidelines. *Chatham: Natural Resources Institute*.

Gulbrandsen, L. H. (2004). Overlapping public and private governance: Can forest certification fill the gaps in the global forest regime? *Global Environmental Politics*, *4* (2), 75-99.

Habermas, J. (1983). *Moralbewußtsein und kommunikatives Handeln* (Vol. 422). Frankfurt: Suhrkamp.Brazilian editionConsciência moral e ação comunicativa. Rio de Janeiro: Tempo Brasileiro, 1989

Hansen, J., Holm, L., Frewer, L., Robinson, P., & Sandøe, P. (2003). Beyond the knowledge deficit: recent research into lay and expert attitudes to food risks. *Appetite*, *41*(2), 111-121.

Hermans, L; Renaul,D; Emerton, L; Perrot-Maître, D; Nguyen-Khoa, S; Smith, L (2006). Stakeholder-oriented valuation to support water resources management processes: Confrontinh concepts with local practice. FAO Water Reports30, Rome.

Hermans, L. (2008). Exploring the promise of actor analysis for environmental policy analysis: lessons from four cases in water resources management. *Ecology and Society*, *13*(1).

Honneth, A. (2003) *Luta por reconhecimento. A gramática moral dos conflitos sociais*. São Paulo: Editora 34.

Horlick-Jones, T., Rowe, G., & Walls, J. (2007). Citizen engagement processes as information systems: the role of knowledge and the concept of translation quality. Public understanding of science, 16(3), 259-278.

IRGC (International Risk Governance Cuncil) (2010). Risk Governance Deficits: An analysis and illustration of the mostcommon deficits in risk governance. Report

Jones, D. W., Dale, V. H., Beauchamp, J. J., Pedlowski, M. A., & O'Neill, R. V. (1995). Farming in Rondonia. Resource and energy economics, 17(2), 155-188.

Jönsson, A. M.; Boström, M.; Dreyer, M.; Söderström, S. (2016). Risk Communication and the Role of the Public: Towards Inclusive Environmental Governance of the Baltic Sea? *Environmental Governance of the Baltic Sea*. Springer International Publishing, 205-227.

Kathlene, L., & Martin, J. A. (1991). Enhancing citizen participation: Panel designs, perspectives, and policy formation. *Journal of Policy Analysis and Management*, *10*(1), 46-63.

Klinke, A., & Renn, O. (2002). A new approach to risk evaluation and management: risk-based, precaution-based, and discourse-based strategies. *Risk analysis*, *22*(6), 1071-1094.

Kitzinger, J., & Barbour, R. (Eds.). (1999). *Developing focus group research: politics, theory and practice*. Sage.

Knauth, D.; Meinrez, N. (2015). Reflections on sharing data from healthcare anthropological studies. *Ciência e Saúde Coletiva*, 20(9):2659-2666.

Krueger, R. A. (1994). *Focus Groups: A Practical Guide for Applied Research* 2nd edn. Sage, Thousand Oaks, California.

Kvale, S. (2007). Doing interviews. London: Sage Publications

Lages Picos, J. A. (2001). La construcción social del bosque y la cultura forestal en Galicia. Tesis Doctoral. Universidad de Santiago de Compostela.

Leiss, W. (2004). Effective risk communication practice. *Toxicology Letters*, *149*(1), 399-404.

Lenoble, J., & Maesschalck, M. (2010). Renewing the theory of public interest: the quest for a reflexive and learning-based approach to governance. *Reflexive governance: redefining the public interest in a pluralistic world. Hart Publishing, Oxford*, 3-21.

Levin, S. A. (1999). *Fragile dominion: complexity and the commons*. Reading, MA: Perseus Books.

Long, N. (2003). *Development sociology: actor perspectives*. Routledge.

McIntosh, P. (2010). Action research and reflective practice: creative and visual methods to facilitate reflection and learning. Routledge

Mikulsen, M., & Diduck, A. P. (2016). Towards an integrated approach to disaster management and food safety governance. International Journal of Disaster Risk Reduction

Mitroff, I. I. (1983). *Stakeholders of the organizational mind*. Toward a New View of Organizational Policy Making. Jossey-Bass Publishers, San Francisco.

McIntosh, P. (2010). *Action research and reflective practice: Creative and visual methods to facilitate reflection and learning*. Routledge

Moreno, L. (1999) Local and global: mesogovernments and territorial identities, *Nationalism & Ethnic Politics 6(3&4)*, 61–75.

Moreno, L. (2002). Decentralization in Spain. *Regional Studies*, *36*(4), 399-408.

Myers, G., & Macnaghten, P. (1999). Developing focus group research. In: Barbour, R.S.; Kitzinger, J. (Editors). *Politics, Theory and Practice*. London: Sage Publications.

North, D. C. (1990). *Institutions, institutional change and economic performance*. Cambridge university press.

Ostrom, E. (1990). *Governing the commons*. Cambridge university press.

Ostrom, E. (2013). *Comprender la diversidad institucional*. España: Editorial KRK Ediciones.

Ott, A. (2002). *Dos grandes projetos de desenvolvimento ao desenvolvimento de projetos: o PLANAFLORO em Rondônia*. Tese (Doutorado em Interdisciplinar em Ciências Humanas) – Universidade Federal de Santa Catarina, Florianópolis, 2002.

Palarini, A (2008). Comissoes da Operaçao Arco do Fogo. Senado. Available in: http://www.senado.leg.br/comissoes/CRA/AP/AP20081028_Alvaro_Palharini.pdf. Consulted in: 10th July of 2015.

Palacio, D. (2015). *Redes, actores y gobernanza desde un enfoque relacional*. Colección hojas de ruta: Guías para el estudio socioecológico de la alta montaña en Colombia, libro 2 -- Bogotá: Instituto de Investigación de Recursos Biológicos Alexander von Humboldt.

Pedlowski, M. A., Dale, V. H., Matricardi, E. A., & da Silva Filho, E. P. (1997). Patterns and impacts of deforestation in Rondônia, Brazil. Landscape and Urban Planning, 38(3), 149-157.

Petts, J., Owens, S. and Bulkeley, H. (2008). "Crossing boundaries: Interdisciplinarity in the context of urban environments" *Geoforum* 39(2): 593-601.

Popa, F., Guillermin, M., & Dedeurwaerdere, T. (2015). A pragmatist approach to transdisciplinarity in sustainability research: From complex systems theory to reflexive science. *Futures*, 65, 45-56.

Pyne, S. J. (1996). *Introduction to wildland fire*. New York : John Wiley and Sons, 2nd edition revised

Pyne, Stephen J. (2012). *Fire: nature and culture*. London: Reaktion Books.

Phillipson, J., Lowe, P., Proctor, A., & Ruto, E. (2012). Stakeholder engagement and knowledge exchange in environmental research. *Journal of Environmental management*, 95(1), 56-65

Radeloff, V.C.; Hammer, R.B.; Stewart, S.I.; Fried, J.S; Holcomb, S.S; McKeefry, J.F. (2005). The wildland-urban interface in the United States. *Ecological Applications*, 15(3), pp.799-805.

Reed, M. S. (2008). Stakeholder participation for environmental management: a literature review. *Biological conservation*, 141(10), 2417-2431.

Renn, O. (1999). A model for an analytic− deliberative process in risk management. *Environmental Science & Technology*, *33*(18), 3049-3055.

Renn, O. (2005). Risk Governance: Towards an integrative approach. *International Risk Governance Council.* Geneva. white paper no. 1

Renn, O. (2008). *Risk governance: coping with uncertainty in a complex world*. Earthscan.

Renn, O. (2015). Stakeholder and public involvement in risk governance. *International Journal of Disaster Risk Science*, *6*(1), 8-20.

Renn, O; Kinle, A. (2015). Risk Governance and Resilience: New Approaches to Cope with Uncertainty and Ambiguity. In: Fra Paleo, U (editor). *Risk Governance: The Articulation of Hazard, Politics and Ecology*. New York-London: Springer, 19-41.

Ritchie, J; Lewis, J; Nichols, C; Ormston, R. (2003). *Qualitative Research Practice: A guide for a social science students and researches*. London: Sage Publications

Rowe, G., & Frewer, L. J. (2000). Public participation methods: A framework for evaluation. *Science, technology & human values*, 25(1), 3-29.

Rowe, G., & Frewer, L. J. (2004). Evaluating public-participation exercises: a research agenda. *Science, technology & human values*, *29*(4), 512-556.

Scolobig, A., Prior, T., Schröter, D., Jörin, J., & Patt, A. (2015). Towards people-centred approaches for effective disaster risk management: Balancing rhetoric with reality. *International journal of disaster risk reduction*, *12*, 202-212

Schroeder, W., Alencar, A., Arima, E., & Setzer, A. (2009). The spatial distribution and interannual variability of fire in Amazonia. *Amazonia and Global Change*, 43-60.

Simon, D., & Schiemer, F. (2015). Crossing boundaries: complex systems, transdisciplinarity and applied impact agendas. *Current Opinion in Environmental Sustainability*, *12*, 6-11.

Silverman, D. (2011). Interpreting qualitative data: A guide to the principles of qualitative research. London: SAGE.

Stern, P. C., & Fineberg, H. V. (Eds.). (1996). Understanding risk: Informing decisions in a democratic society. National Academies Press.

Stewart D.W.; Shamdasani P. N.(1990). Focus Groups: Theory and Practice. Sage, Newbury Park, California.

Stonehouse, J. M.; Mumford, J. D. (1994*). Science, Risk Analysis and Environmental Policy Decisions*. Geneva, Switzerland, Publisher: Environment and Trade, UNEP

Tait, J. (2001). More Faust than Frankenstein: the European debate about the precautionary principle and risk regulation for genetically modified crops. *Journal of Risk Research*, 4(2), 175-189.

Thèry, H. (2012). *Rondônia: Mutações de um Território Federal na Amazônia brasileira*, SK Ed.

Tompkins, E.,&Hurlston, L. A. (2012). Public-privatepartnerships in theprovisionofenvironmentalgovernance: a caseofdisaster management. In: Boyd, E.,&Folke, C. (Eds.). (2012). *Adaptinginstitutions: Governance, complexityand social-ecologicalresilience*. Cambridge University Press.

Trimble, M.; Berkes, F. (2013). Participatory research towards co-management: Lessons from artisanal fisheries in coastal Uruguay. Journal of Environmental Management 123, 768-778.

Ulrich, B. (1999). World risk society. Cambridge, UK: Polity.

Van Den Hove, S. (2006). Between consensus and compromise: acknowledging the negotiation dimension in participatory approaches. *Land Use Policy*, 23(1), 10-17

Van Asselt, M. B., & Renn, O. (2011). Risk governance. *Journal of Risk Research*, *14*(4), 43

Wallerstein, I. (1979). *The capitalist world-economy* (Vol. 2). Cambridge University Press.

Wasserman, S; Faust, K. (1994). *Social Network Analyses: Methods and applications*. Cambridge: Cambridge University Press.

Waterman, H. (1998). Embracing ambiguities and valuing ourselves: issues of validity in action research. *Journal of advanced nursing*, 28(1), 101-105.

Wesselink, A., Paavola, J., Fritsch, O., and Renn, O. (2011). Rationales for public participation in environmental policy and governance: practitioners' perspectives. *Environment and Planning-Part* A 43(11): 2688.

Wilkinson, S. Focus group research. (2004). In: Silverman, D. (Editor) *Qualitative Research: Theory, Method and Practice* (2nd ed.). London: Sage Publications.

Williams, T., & Hardison, P. (2013). Culture, law, risk and governance: contexts of traditional knowledge in climate change adaptation. Climatic Change, 120(3), 531-544.

Winter, R. (1987). *Action-research and the nature of social inquiry: Professional innovation and educational work*. Ashgate Publishing Company.

5. Constructing wildfire risk scenarios: Brazilian Amazon and Northeast of Spain in a comparative perspective

5.1. Introduction

Among the various purposes of risk governance and scenario building, they share a common purpose consisting of dealing with uncertainty and exploring its consequences. Frequently, uncertainty lies within reasonable limits and humans make their way in an uncertain and changing world where existing knowledge and experience suffice as a guide to future expectations, but where highly complex systems with extensive interactions or where novel problems or technology limit experience, risk governance is essential (Kasperson, 2015).

Scenario building, in turn, is a disciplined method for imagining and describing possible future developments, as well as exploring the consequences or joint impact of uncertainties and complexities (Schoemaker, 1995; Chermack et al., 2000; Van Notten and Rotmans, 2001; Duinker and Greig, 2007, Kosow and Gabner, 2008; Nguyen and Dunn, 2009). Scenario building has also been considered a powerful tool to deal with the unpredictability of future events in the context of complex interactions among economic, environmental, technological, or socio-political sectors of society (O'Brian, 2002; Habegger, 2010; Amer et al., 2013; Luis et al., 2016).

The last few decades have witnessed a growing worldwide interest towards the development of risk scenarios (Kazantzidou-Firtinidou et al., 2016). Furthermore, Koivisto's et al. (2009) study has demanded a more holistic approach towards the strong association between foresight and risk analysis. However, key findings of Gall et al. (2015) have suggested that traditional assessment approaches using quantitative methods to generate scenarios predominate in risk research. These authors concluded that mixed-method approaches combinaning technical analytics with participatory approaches are limited and implementation gaps between research and practice persist.

In adittion, it is noticeable in risk research the interest in the development of methodologies able to produce reliable damage scenarios. This is increasing in order to support the decision process within policies of disaster prevention and emergency management (Del Gaudio et al., 2016). These damage scenarios are mostly related to seismic risk and risks derived from climate change.

Nowadays, seismic risk models are highly demanded for emergency response and for risk mitigation (Calvi et al., 2006). Recent advances in the development of seismic risk scenarios promoted the integration of seismic vulnerability and hazard assessmentat (Kazantzidou-Firtinidou et al., 2016); as the study of Medel-Vera and Ji (2016) which has assessed probabilistic relationships between seismic risk and nuclear power plants in the UK or as the study of Torres et al. (2016) which has provided more realistic estimates of earthquakes based on damage scenarios in Haiti. These recent examples illustrate that seismic damage scenarios remains on traditional approaches.

Wilfires and flooding risks, endangered wildlife, water or forestry management are often highlighted as secundary stresses when the subject is climate change scenarios.

According to EM-DAT (2016), the main categories of climatological disasters are wildfires, extreme temperature, drought, flood and storm. Studies using global scenarios for climate change have been developed in recent years (IPCC, 2007) in order to design models of long-term adaptation strategies. That is the case of Ferreira's et al. (2014) study which, using fire occurrence and damage scenarios, have developed an stochastic approach about the optimal rotation age and number of fuel treatments. Tarancón et al. (2014) also pointed out the importance of post-fire predictions for forest recovery under future climate change and management actions for adaptive forest management. These are a few brief examples that suggest that wildfire risk knowledge production, even when aimed at anticipating future risks, falls upon more technical approaches and lacks participatory research.

Wildfire scenarios established by probabilistic models, which in turn, are based on ecologic and technologic interface have been emphazised in many studies. In order to develop a set of future property risk scenarios due to wildfires in California, Bryanta and Westerling (2014) have explored interactions among global emissions scenarios, climate models, spatially explicit population growth scenarios, and a range of parameters defining properties' vulnerability to loss in a probabilistic model.

Liu's et al. (2013) wildfire fire risk projection attempted to build relations between historical fire properties and fire weather indices based on projected future climate (Liu et al., 2013). Cane et al. (2013), in turn, assessed the behaviour wildfire regimes in future scenarios with the multimodel quantitative techniques. In a similar study, burning scenarios were built for a Wildland Urban Interface (WUI) area in the eastern Mediterranean in order to produce fire risk maps to be used as valuable components of judicial short- and long-term wildland fire prevention and management (Mitsopoulos et al., 2015). Based on greenhouse-gas emission scenarios, Lehtonen et al. (2013) have evaluated potential wildfires by the end of the current century in Finland using the fire weather index system. Once again, these analyses has focused on wildfire anticipation that used only technical parameters.

Although the majority of studies in risk scenario building focus on either probalistic models or the evoution of ecological patterns, other factors such as social, institutional or political have been recently considered, such as in the studies of Jacito et al. (2013), Koivisto et al. (2009) and Luis et al. (2016). In the context of long term adaptation strategy for climate change, Jacito et al. (2013) stated that water use scenarios - considering population, land use, technological developments, increases in efficiency, climate changes, or political and behavioural change scenarios - are useful frameworks for thinking about the future, in order to contribute to the reduction of vulnerability of distinctive future societies and to decrease the probability of decision failures. Although these authors include socio-economic parameters, it does not mean an advance in integrating people in their analysis, as suggested by risk integrated approach.

After concluding that foresighting risks are already an emerging innovation process, Koivisto et al. (2009) have firstly pointed out that there are possible synergies between risk and future assessments. These synergies constits of people's openness to new future possibilities by changing mind-sets, the construction of trust among actors and the progress of preparedness for the change, and the creation and sharing in networks.After criticizing the fact that cenario planning has been applied to singular issues such climate change, Luis et al. (2016) presented an approach which integrates

risk and future assesment in the context of water governance. They have proceeded a morphological analysis involving the risk experts, whose results allowed recognized threats and opportunities to be identified and enabled strategies for master plans to be devised. Although this study advances in using participatory approach, the authors just consider experts in their analysis. This occurs also within Devisscher's et al. (2016) research, who adopted a participatory approach to involve local actors in the anticipation of wildfire risk in the Bolivian Amazon. They combined informant interviews (with indigenous communities, private cattle ranchers, local authorities and regional experts) and focus groups. The point is that local actors were only considered for the interviews while the focus groups´ participants were experts. They did not create a space for multi-actor debate.

As seen in chapter four, risk governance demands not only an expert assesment but also an integrative approach able to take into account societal actors in the process of building knowledge participatively. In fact, scenario analysis has been accompanied with participatory exercises in the field of sustainability. New participatory and problem-oriented approaches have been presented with a powerful tool to integrate knowledge by scanning the future in an organized way and internalizing human choice into sustainability science (Swart, et al., 2004; Duinker and Greig, 2007). In the field of risks, the idea of integrated disaster risk research has been paving the way to involve multiple scales from local to global; various societal actors or stakeholders such as experts, professionals, officials; integration of scientific knowledge to real world experiences; and to also engage different disciplines, methodological approaches, and areas of application (Schneider and Lane, 2005; Wisner, 2011; Gall et al., 2015).

Thus, in the threshold of integrated disaster risk research, this study seeks to contribute to the discussion of risk governance by providing the outcomes of scenarios built participatively and encouraging the exploration of interfaces between personal experiences associated with wildfire risk in studied areas.

5.2. Methods

There are three dominant schools of scenario building: intuitive-logic, La Prospective and probabilistic modified trend models. In the intuitive-logic model, the output of the exercise is qualitative, and all scenarios must be equally probable and plausible. In La Prospective Models, the the outputs are quantitative and qualitative so that probabilities are associated to scenarios, which are organized according to plausibility (Bradfield et al., 2005). La Prospective Models cannot be dissociated from strategic propective, because it emphasizes the importance of long-range and alternative thinking in the strategic decision-making process so that rational and heuristic schools of scenario planning are complementary (Godet, 2000). Finally, in the probabilistic modified trend, the outputs are quantitative so scenarios present conditional probabilities (Bradfield et al., 2005).

The distinction between quantitative and qualitative traditions of scenario analysis is not irrelevant. Quantitative analysis has higher accuracy in forecasting in the short run (Swart et al., 2004; Duinker and Greig, 2007; Amer et al., 2013). In fact, forecasting methods may be more applicable because of the higher degree of predictability in short-term (up to 5 years as maximum) futures analysis (Kaivo-oja, 2001).

Nevertheless, as complexity rises and the time horizon of interest lengthens, the power of prediction reduces (Swart et al., 2004). That is the reason why rigorously quantitative methods are often criticized, because these methods depend exclusively on historical data and assume that same trends will prevail in the future (Gordon et al., 1974) or they usually simulate well-understood systems (Swart et al., 2004).

The most frequent scenario planning quantitative approaches are labeled as Cross Impact Simulation, Interactive Future Simulations, Trend Impact Analysis and Fuzzy Cognitive Mapping (Amer et al., 2013).

On the other hand, qualitative methods such as surveys, workshops and Delphi for data generation are judged as suitable for projects having a large scope and long time horizon (Börjeson et al., 2006). If the goal is to assess the long-term future when state conditions are uncertain, causal interactions are poorly understood and non-quantifiable factors become significant. Instead, it should be combined with qualitative scenario analysis (Swart et al., 2004) because when qualitative and quantitative approaches are used together, they build off of each other (Amer et al., 2013).

The main methodological problem with developing future scenarios is that the intrinsic uncertainties in complex problems are in principle non-reducible, and often cannot be completely described. The concrete process by which conclusions are drawn in such studies is often difficult to trace, making its reproducibility difficult (Ritchey, 1998a).

In this study, the scenario analysis was developed with the support of the software DSTO Scenario Analysis Tool Suite v1.6, which combines methods in order to provide possible alternative scenarios by synthetizing quantitative and qualitative information in three basic stages (Nguyen and Dunn, 2009). They are described in the figure below.

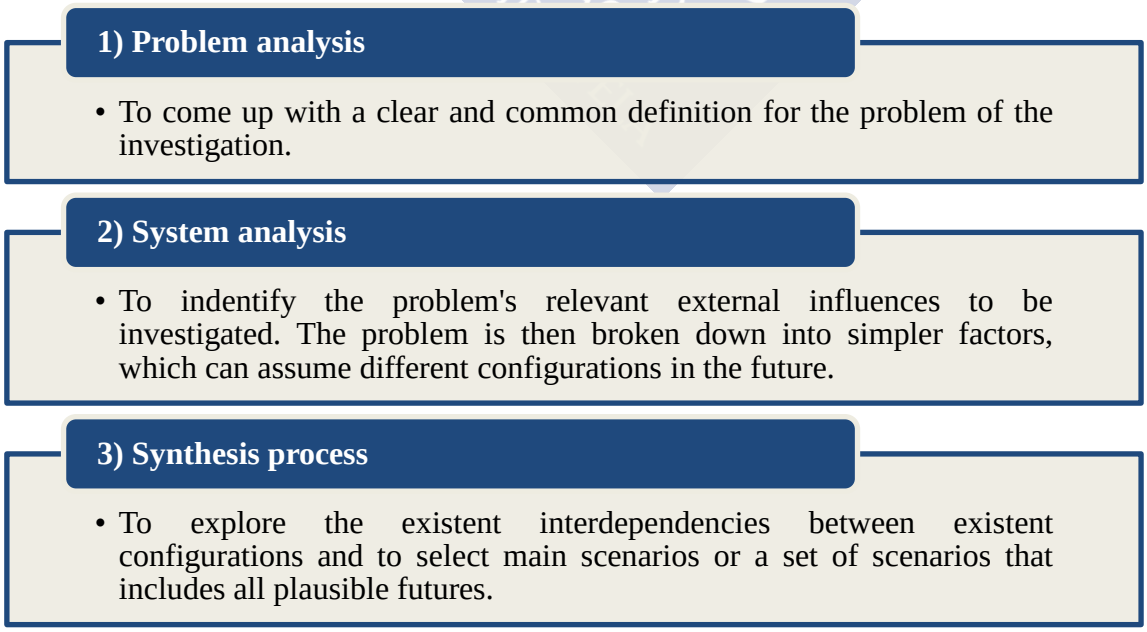


Figure 23. Stages of scenario analysis

According to Nguyen and Dunn (2009), a variety of methods can be employed in each stage. The possible useful methods in scenario analysis are described in the figure illustrated below:

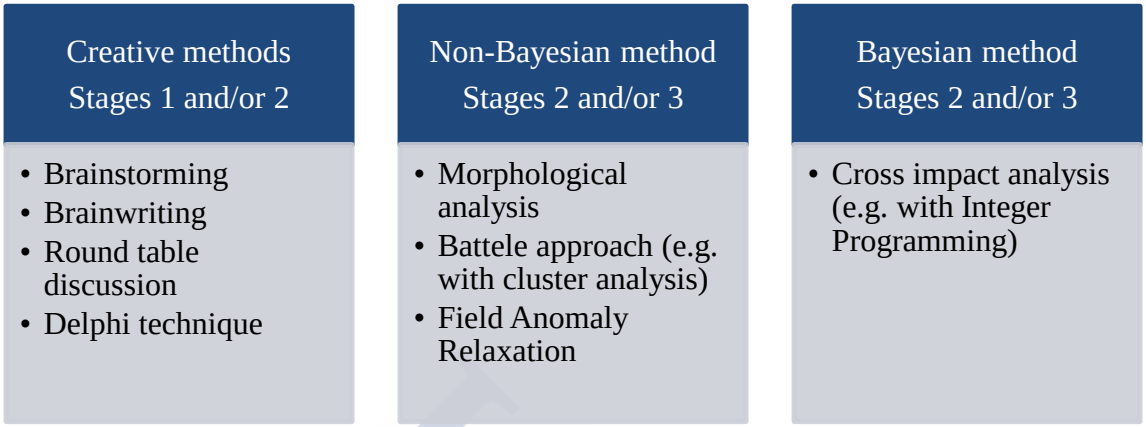


Figure 24. The possible useful methods in scenario construction

The software, DSTO Scenario Analysis Tool Suite v1.6, was used in the analysis of wildfire risk scenarios in Lugo (González and Fra-Paleo, 2012) and in coastal flood risk scenarios in A Coruña (Loureiro and Fra-Paleo, 2012), both municipalities of Galicia. These researchers used interviews with experts and societal actors in the first and second stages of scenario analysis. Tagarev and Ivanova (2013) also used this software to build scenarios and identify possible new roles within the European Union in security planning with the interactive participation of experts.

This thesis, in turn, attempted to develop the scenario analysis in a participatory framework by combining different tools and methods. The software automatically processed the non-Bayesian and Bayesian methods. Non-Bayesian methods do not take into consideration the probabilities of influencing factors, while Bayesian methods require marginal and conditional probabilities as pairs of input factors (Nguyen and Dunn, 2009). The participative instruments supported the obtainment of the incomes needed to the scenario's projection. The Figure 25 summarizes the combination of those instruments, which are explained in further detail in the following subsections.

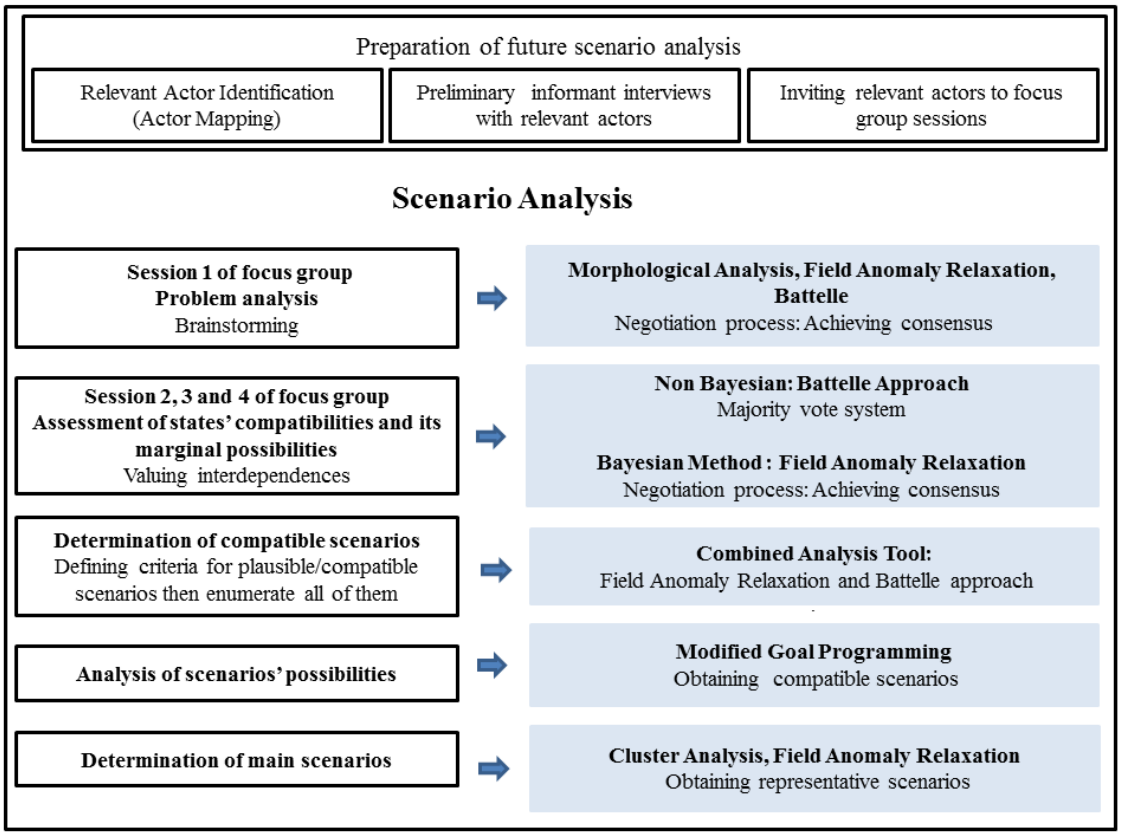


Figure 25. Stages of data collection techniques and methodological approachs for future wildfire risk scenarios construction

The scenario analysis was preceded by a preparation that, as discussed in chapter four, consisted of identifying relevant societal actors (individuals or collective) that somehow associated with wildfires risk. The map of societal actors was the base to discern who would be interviewed and invited to the focus group sessions, which in turn, was the instrument chosen to engage relevant societal actors in the scenario building.

The combination of participatory instruments and scenario building followed the stages mentioned before, which are further explained in subsequent subsections:

5.2.1. Problem analysis

Problem analysis, as the first stage of scenario analysis, requires a clear identification of the issue that will be explored in order to help the participants achieve a common understanding of the problem at hand (Nguyen et al., 2008).

In the first focus group session in the studied areas, participants received a short presentation about risk governance and the necessary stages of scenario building. Then, brainstorming was proposed as the creative method to analyze the problem.

The question posed to the participants was "Which are, and how do the wildfire risk factors interact in Rondônia/Galicia in the next 10 years?" which triggered a series of discussions. After clarifying the participants' doubts, it was possible to move forward with the second stage of scenario analysis, which was the system analysis.

5.2.2. System analysis

When dealing with intricate uncertainty, a large number of interrelated elements may require the problem to be broken down into simpler parts (Borches, 2005). The system analysis expresses the problem as a system of inter-related dynamics factors (or subsystems), with the system itself linked to its external environment (Nguyen and Dunn, 2009).

Each factor can assume several hypothetical future states. A given scenario is characterized by the choice of a specific configuration for each factor (Nguyen and Dunn, 2009). In the focus group sessions, participants by means of a debate reached an agreement about wildfire risk factors and its future hypothesized states (a number of representative elements relevant to the problem).

There are as many possible scenarios as there are combinations of configurations. All these combinations represent the field of possibilities, the so-called morphological space (Nguyen and Dunn, 2009). In the focus group session, a maximum number of factors and states were not established, but efforts were made to keep them under control since a short increase in the number of factors sharply increases the time and effort participants need to invest in the assessment (Tagarev and Ivanova, 2013). The outcomes of this discussion provided accessible data to develop the morphological analysis, which is a non-Bayesian method for investigating the set of possible relationships or configurations contained in a specified complex/multidimensional problem (Nguyen and Dunn, 2009). This method, conceived by Fritz Zwicky, allows structuring and investigating the total set of relationships contained in a multi-dimensional and non-quantifiable problem complex (Zwicky, 1969; Ritchey, 2009).

Morphological analysis enables the structuring of the group's thinking on the strategic response profiles (Godet, 2000). The selected factors need to be comprehensive enough to reflect all relevant concerns about the future and be thoroughly defined (Nguyen and Dunn, 2009). All factors and their possible states are organized in a box, also known as Zwicky box, which is illustrative because it provides a complete picture of the dimensions of the problem. This facilitates the identification and investigation of the boundary conditions with the limits and extremes of different problems (Ritchey, 1998b). After Zwicky, Rhyne (1995) and Coyle and McGlone (1995), have been applied to morphological analysis.

In this study, the morphological box was expanded to the study areas by allocating the wildfire factors and its hypothetical future states.

5.2.3. Synthesis process

The following sections of the focus group were dedicated to the synthesis process, which consists of examining the compatibility or interdependencies among all the configurations by asking the participants about the level of coexistence between each pair of configurations (Nguyen and Dunn, 2009). Participants of the focus group valued the current interdependences between existing configurations. The matrix of pairs was the first filter applied to compose scenarios. It displays all the possible configuration pairs, where each cell of the matrix represents a pair. In each pair, the question formulated is: 'Can we think of a pattern within which these two

configurations might coexist?'(Rhyne, 1995, p.667). This author also pointed out that the process of collectively scoring may trigger a transdisciplinary mode of discourse; after hours of working together, an outsider cannot tell which team member is the engineer or which is the economist of philosophy.

As the assessments of all the configurations require a long time, the majority vote system was chosen in order to make the process more efficient. Participants could contribute their personal assessment about the compatibility/plausibility of each outcome pair. Participants rank, from 1 to 5, the compatibly of occurrence. Following the Battelle, a compatibility rating of 5 suggests two possible occurrences (or a configuration) are very compatible, while a rating of 1 indicates they are not likely to occur concurrently (Nguyen, 2008).

The highest number of the states' compatibilities in the same assessment was chosen.

It is important to point out that when participants chose a configuration least likely to occur it meant a temporal decision, since further discussion can start if anyone on the team could visualize a different future condition containing that pair (Rhyne, 1995). In the event of a tie in valuing compatibilities, the focus group participants discussed and negotiated the possible future configurations. After debating, new assessments of that compatibility were prepared in order to make sure an agreement was reached.

With the synthesis process, participants also assessed, via consensus, the marginal probabilities of occurrence of each state as part of field anomaly relaxation. Field anomaly relaxation is a non-Bayesian method that allows the development of a range of plausible scenarios and an understanding of their evolution (Stephens, 2006). Some configurations should be discarded, as they are not plausible in real life. In the filtering process, the relaxation of anomalies reduces the range of future developments (Nguyen and Dunn, 2009) and guides the identification of main scenarios. The assigned marginal probabilities of each state's factor amounts to 1, which was an important input in the cross impact analysis.

The additional steps of the synthesis process were carried out by the software, which firstly determined the compatible scenarios then enumerated all of them. This was necessary because the number of scenarios grows exponentially with an increasing number of factors. Some configurations may not represent plausible scenarios. Thus, in order to decrease computation efforts while representing real situations, the final number of scenarios are predetermined (Nguyen, 2008).

Field anomaly relaxation and the Battelle approach were combined when applying the default criteria:

• U: Maximum number of rating 2

• L: Minimum average of compatibility rate

Nguyen and Dunn (2009) recommend that a compatibility rating between any two configurations (U) in a scenario should be different to 1 (not likely to occur together) and should be below half the number of the sectors in a scenario. They also

suggest that the average individual compatibilities between the factors in each scenario is greater than or equal to a lower limit L that, in turn, should be chosen to assure that the remaining scenarios had average scenario compatibility above a neutral compatibility, which is above a 3.

Then, by means of modified goal programming, the software provided the analysis of the scenarios' possibilities, which consisted of obtaining the likelihood for the compatible scenarios and further prune scenarios based on this The modified goal programming (GP) approach was used to recognize possible inconsistency between the estimates of the conditional probabilities and the marginal probabilities. Then, the arithmetic mean of these probabilities is calculated (Nguyen et al, 2008; Nguyen and Dunn, 2009).

For the realization of this step the program uses the statistical package R. The determination for main scenarios was achieved by combining the cluster analysis supported by the R program. Cluster analysis allows the grouping of similar scenarios by families of future scenarios according to the level of representability (Nguyen et al., 2008).

The remaining task is to compose the scenarios with the surviving field of configurations positioned on the tree, where nodes represent possible future states and branches represent transitions from one configuration to the next (Nguyen and Dunn, 2009). The Faustian tree represents the conceivable evolution of future scenarios and the transitions between states' factors that give rise to these changes (Stephens, 2006).

5.3. Results and discussion

A fundamental element in projecting future scenarios is the context with which it is in, which in turn, is nested to the social field. The task consists of, according to (Rhyne, 1995), composing a set of scenarios for a given world region (e.g. Europe or Latin America) keyed to (and therefore contingent on) each of the particular scenario lines. After that, focus on social fields nested within those regions.

Although many social variables are difficult to measure, Allison (2015) has made known that recent attempts are being made to include them as important variables within the context, emphasizing that every measurement is a subjective selection based on the worldview. Thus, taking into account societal actors to frame wildfire risk factors is a way to measure based on different experiences and worldviews which will provide outcome risk factors and therefore scenarios which are truly valued by society.

That is the reason why projecting future scenarios in Rondônia and Galicia consists of considering contextual factors. Many risk factors recognized are similar in Rondônia and Galicia by different focus groups´ composition, although with different nuances, such as social movements in Rondônia and social capital in Galicia. This demonstrates that public participation has different connotations in different contexts. On one hand, social movements as a factor refers to the social demands from historically marginalized groups such as indigenous, landless family farmers. On the other hand, in Galicia, social capital as a factor has two meanings: 1) self-organizing groups depending on the wildfire, and 2) public participation in decision making

associated with wildfires.

Different nuances are also perceived in fragmentation of land use. An example of a chosen factor in Rondônia is their attempt to capture the coexistent process in which some farms are becoming even bigger, mainly where there is soybean production. Simultaneously, small farmers are occupying new areas through deforestation fires and sometimes threating the conservation unities and indigenous land. In Galicia, in turn, participants chose distribution of uses as a manner to contemplate in the hypothetical states the tendency of mosaic usage or to the concentration process.

The term Native forests were used as a factor that also presents different connotations in these contexts. Talking about native forest in Rondônia is less complex than in Galicia, where the ancient occupation generates a discussion from the ecology point of view on which species are actually native. Comparing commercial forest use, it is the oldest practice in Galicia in contrast to Rondônia. During the first periods of colonization in Rondônia, the forests were cut down and burned because of interest in transforming it into agricultural land without logging. For a second time, artisanal wood industrials were installed very close to the logging roads, initiating an illegal trade in native woods. Nowadays, this group is collectively organized as a sector, but in practice these associations are not active, as verified in the research in locu.

Different nuances are also apparent in framing accessibility. In Rondônia, the discussion of roads' aperture is associated with the establishment of new settlements, and therefore is correlated to deforestation fires. In Galicia, in turn, the density of roads is due to the dispersion of the population and the fragmentation of ownership (smallholding) that is indirectly associated with the possibility of suppressing wildfires, which are scattered throughout the territory.

The discussion about climate change also emerged in both areas' focus groups, but only the Galician participants were able to associate the human-decision factor to the subject. In Galicia, it was framed in terms of human adaptation to the climate change. In Rondônia, participants attempted to assess the degree of warming during a time span of 10 years. Nevertheless, the climate change factor was not considered valid since there were no experts or indices in the focus group able to measure this factor scientifically. This means that, depending on the heterogeneous composition of the group, participation processes can have bounds. This did not eliminate the legitimacy of the other factors, which reflects actors' negotiated experiences and points of view.

Other factors are related to regional specificities, which are perceived and framed according to the existent local and common meaning about the subject. In Rondônia, the discussion of wildfires cannot be dissociated from the conservation of protected areas (indigenous land and conservation unities), the cattle culture, and agriculture factors. This received a lot of discussion from participants. In the same way, the social movements factor attempts to show the historical process of many classes (landless, indigenous people, dam affected people) asserting their rights and social recognition.

Secondarily, some factors received less concern from participants, such as the emergence of environmental market services (e.g. carbon sequestration) and forestry, which is socially framed in Rondônia as planted forest with exotic species.

Distinctly, participants used the term 'pyrophyites' forest in Galicia. This term is commonly used to frame the plantation of fast growing species, which is a subject profoundly taken into account by the civil society when discussing wildfires and also as an element of pressuring governments and the private sector towards more development patterns.

The outcomes of scenario building are displayed in following subsections.

5.3.1. Rondônia

The morphological box is presented in the Table 8 of the wildfire system analysis in Rondônia.

Table 8. Morphological box of wildfire risk in Rondônia with factors and their states

A. Cattle culture	B. Agriculture	C. Native forest	D. Fragmentation of land use	E. Planted forest	F. Access ways	G. Environmental and territorial policies
A1. Increases	B1. Increases	C1. Increases	D1. Increases	E1. Increases	F1. Increases	G1. Law implementation
A2. Decreases	B2. Decreases	C2. Decreases	D2. Decreases	E2. Decreases	F2. Remains constant	G2. Blocking the law implementation
A3. Remains constant	B3. Remains constant	C3. Remains constant	D3. Remains constant	E3. Remains constant		
H. Conservation of protected areas	I. Social movements	J. Environmental market services	K. Prevention Strategies	L. Population	M. Degree of risk perception	M. Reactive Mitigation policies
H1. Increases	I1. Tendency to joint	J1. Increase	K1. Increase	L1. Urban population increase and rural population decrease	M1. Increases	N1. Increase
H2. Decreases	I2. Weakening trend	J2. Remain constant	K2. Remain constant	L2. Urban population increase and rural population remain constant	M2. Remains constant	N2. Remain constant
H3. Remains constant	I3. Remain constant		K3. Decrease	L2. Urban population and rural population increase		N3. Decrease

The morphological space of wildfire risk in Rondônia contains 1,259,712 (2x3x3x3x3x3x2x2x2x3x2x3x3x2x3) possible configurations, which are represented in the morphological space (Figure 26).

	A1	A2	A3	B1	B2	B3	C1	C2	C3	D1	D2	D3	E1	E2	E3	F1	F2	G1	G2	H1	H2	H3	I1	I2	J1	J2	K1	K2	K3	L1	L2	L3	M1	M2	M3	N1	N2	N3
A1	1	1	1																																			
A2	1	1	1																																			
A3	1	1	1																																			
B1	3	3	4	1	1	1																																
B2	3	2	2	1	1	1																																
B3	3	3	2	1	1	1																																
C1	2	2	2	3	2	2	1	1	1																													
C2	3	2	2	2	2	2	1	1	1																													
C3	2	3	1	3	2	2	1	1	1																													
D1	3	2	3	3	2	3	3	3	2	1	1	1																										
D2	3	3	2	2	2	2	2	3	2	1	1	1																										
D3	2	2	2	2	3	2	2	3	3	1	1	1																										
E1	3	2	3	4	2	3	3	3	4	4	3	3	1	1	1																							
E2	3	2	2	2	2	2	2	1	2	2	2	2	1	1	1																							
E3	2	3	2	3	2	2	2	2	3	3	2	2	1	1	1																							
F1	3	2	3	4	2	3	2	4	3	4	4	3	4	2	3	1	1																					
F2	2	2	2	3	2	2	2	2	2	3	3	2	3	2	2	1	1																					
G1	3	2	2	3	2	2	4	2	3	4	3	3	4	3	3	4	3	1	1																			
G2	3	2	2	2	2	2	3	3	2	2	2	2	2	2	2	2	2	1	1																			
H1	3	2	2	2	2	2	3	3	3	3	2	2	3	2	2	3	2	3	2	1	1	1																
H2	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1																
H3	3	3	2	4	2	2	3	3	2	3	3	3	3	2	3	4	3	3	3	1	1	1																
I1	3	3	3	3	2	3	4	3	3	4	3	3	4	2	3	4	3	4	3	3	3	3	1	1														
I2	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1														
J1	3	3	3	3	2	3	4	2	4	3	3	2	4	2	3	4	3	4	2	2	3	3	3	2	1	1												
J2	2	2	2	2	2	2	3	2	3	3	3	3	3	2	2	3	3	3	3	3	2	3	2	3	1	1												
K1	3	3	4	2	2	2	5	4	3	4	3	3	4	3	3	4	3	4	2	3	3	3	4	2	4	3	1	1	1									
K2	3	2	2	3	2	2	3	2	3	3	3	3	3	2	2	3	3	3	2	3	2	3	3	2	3	2	1	1	1									
K3	2	1	2	2	1	2	2	2	2	2	2	2	2	1	2	2	2	2	2	2	2	2	2	1	2	2	1	1	1									
L1	4	2	3	3	2	2	3	3	4	3	4	3	4	2	3	4	3	3	2	3	2	3	3	2	4	3	4	3	3	1	1	1						
L2	3	2	2	3	2	3	3	3	3	2	3	2	3	2	3	4	3	3	3	3	2	3	3	2	3	3	3	3	2	1	1	1						
L3	2	2	3	3	2	2	2	2	2	2	2	2	2	2	3	2	3	2	2	2	2	2	2	1	2	2	2	2	1	1	1	1						
M1	3	3	3	4	2	3	3	3	2	4	3	3	4	2	2	4	3	4	3	4	3	3	4	2	4	3	4	3	3	4	3	3	1	1	1			
M2	2	1	2	3	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	3	2	2	2	3	3	2	2	1	1	1			
M3	3	2	3	3	2	3	3	3	3	3	3	3	3	2	3	3	2	3	3	3	3	3	3	3	3	3	3	3	2	3	3	2	1	1	1			
N1	4	2	3	5	2	3	4	3	3	3	4	3	4	3	3	4	3	4	2	3	3	3	4	2	4	3	4	3	2	4	3	4	5	2	3	1	1	1
N2	3	2	2	3	2	3	3	2	3	3	3	2	3	2	3	3	2	3	2	2	2	3	3	3	3	3	3	3	2	3	3	3	4	2	3	1	1	1
N3	3	1	2	2	1	2	2	2	2	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	1	2	1	1	1

	A1	A2	A3	B1	B2	B3	C1	C2	C3	D1	D2	D3	E1	E2	E3	F1	F2	G1	G2	H1	H2	H3	I1	I2	J1	J2	K1	K2	K3	L1	L2	L3	M1	M2	M3	N1	N2	N3
	0.3	0.1	0.6	0.3	0.1	0.6	0.2	0.2	0.6	0.5	0.4	0.1	0.3	0.1	0.6	0.3	0.7	0.3	0.7	0.2	0.2	0.6	0.4	0.6	0.7	0.3	0.6	0.3	0.1	0.65	0.3	0.05	0.3	0.1	0.6	0.3	0.5	0.2

Figure 26. Matrix of configuration pairs with their compatibility rating, and marginal probabilities of states (below).

In the synthesis process, the application of criteria was needed to filter in order to obtain a manageable number of scenarios. Following the Battelle approach, the two criteria used to filter reduced the number of possible configurations. They can be selected in the software as complementary (AND) or exclusive (OR) to obtain manageable scenarios. As recommended by Nguyen and Dunn (2009), it used both criteria (AND) in filtering scenarios in order to find more of the main or more realistic scenarios. The authors also pointed out that a compatibility rating between any two configurations (U) should be below half the number of factors. That is one of the reasons why the threshold 'U= 5' was applied, which is lower than half of the 14 chosen factors.

In addition, authors recommended that 'L' should be above 3, which is considered a neutral compatibility. This made it necessary to find suitable thresholds complying with the recommendation of the authors, but also compatible with the participative outcomes. Filtering scenarios has demonstrated that this process is very dependent on the behavior of the group when evaluating configurations of future scenarios. In Rondônia, participants had the tendency to rank the compatibly of occurrence with extreme values, 1 or 5, when they were very sure about the future configuration.

The fact that the focus group participants ranked configurations with such

extreme values represented an automatic decrease in the range of plausible scenarios, so it was critical to not be very restrictive in the filtering process. It was necessary to find thresholds that did not eliminate or significantly reduce the set of plausible scenarios (Table 9).

Table 9. Criteria and thresholds used to filter scenarios

Criteria	Threshold	Plausible scenarios
U: Maximum number of rating 2	5	6
AND		
L: Minimum average compatibility value	3.5	

After applying these criterias, the software through the Modified Goal Programming, allocates conditional probabilities to each scenario while rejecting scenarios with a 0 probablity and transferring them to the next analysis. In the case of the Rondônia, all scenarios had an associated probability, so the software remained with the set of 6 plausible scenarios.

The last step consisted of the software automatically arranging the cluster analysis by the use of the R program, which groups scenarios based on similarities that are defined by a distance between scenario pairs (Nguyen and Dunn, 2009). This analysis makes achieving the group of representative scenarios possible, which would support strategic planning (Nguyen et al., 2008).

The representative scenarios may not wholly correspond to possible real scenarios. This is the reason why they would be used as end-state scenarios and why others in their clusters as transition scenarios, because the clusters might represent different branches in a scenario tree (Nguyen and Dunn, 2009).

In following tables, four classifications of clusters which are organized by the program are illustrated.

Table 10. Future scenarios for Rondônia using two clusters

Cluster	Scenario	Average compability value	Probability	Representative vcenario
1	1,3,4,5 y 6	3.527	88.9	A1B1C1D1E1F1G1H3I1J1K1L1M1N1
2	2	3.571	11.1	A1B1C1D1E1F1G1H3I1J1K1L1M1N1

Table 11. Future scenarios for Rondônia using three clusters

Cluster	Scenario	Average compability value	Probability	Representative vcenario
1	1,3	3.527	22.2	A1B1C1D1E1F1G1H2I1J1K1L1M1N1
2	2	3.571	11.1	A1B1C1D1E1F1G1H3I1J1K1L1M1N1
3	4, 5,6	3.527	66.7	A1B1C2D1E1F1G1H3I1J1K1L1M1N1

Table 12. Future scenarios for Rondônia using four clusters

Cluster	Scenario	Average Compability Value	Probability	Representative Scenario
1	1,3	3.527	22.2	A1B1C1D1E1F1G1H2I1J1K1L1M1N1
2	2	3.571	11.1	A1B1C1D1E1F1G1H3I1J1K1L1M1N1
3	4,5	3.516	55.6	A1B1C2D1E1F1G1H3I1J1K1L1M1N1
4	6	3.549	11.1	A3B1C1D1E1F1G1H3I1J1K1L1M1N1

Table 13. Future scenarios for Rondônia using five clusters

Cluster	Scenario	Average Compability Value	Probability	Representative Scenario
1	1	3,538	11.1	A1B1C1D1E1F1G1H1I1J1K1L1M1N1
2	2	3,571	11.1	A1B1C1D1E1F1G1H3I1J1K1L1M1N1
3	3	3,516	11.1	A1B1C1D2E1F1G1H3I1J1K1L1M1N1
4	4,5	3,516	55.6	A1B1C2D1E1F1G1H3I1J1K1L1M1N1
5	6	3,549	11.1	A3B1C1D1E1F1G1H3I1J1K1L1M1N1

By handling these four solutions, it was possible to manually build a tree that displays the possible evolution of future scenarios for Rondônia (see Figure 27). Constructing the tree is thought-provoking, because it arranges a set of scenarios connected in line with transitions into a plausible history that marks out how a future world could evolve from the present (Duczynski and Willians, 2000).

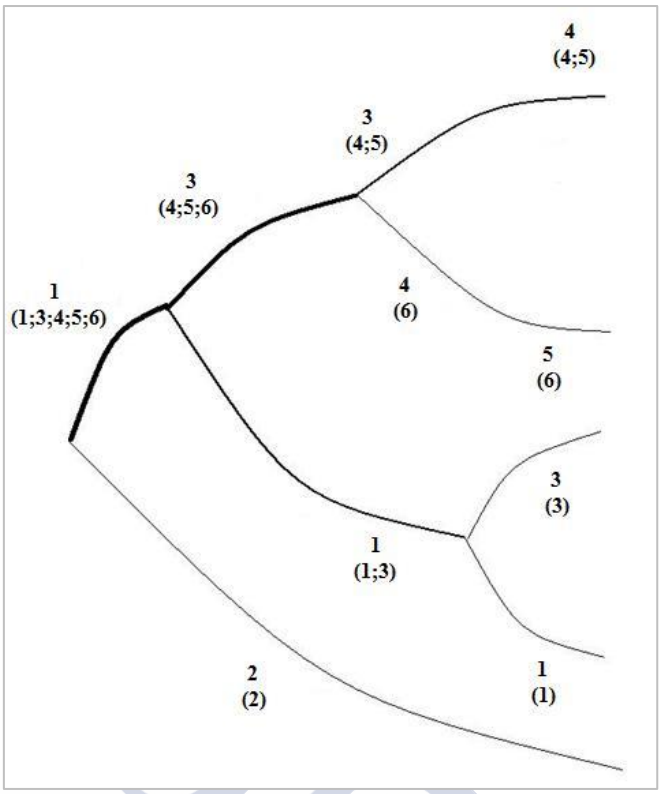


Figure 27. Tree representing the evolution of the multiple scenarios in Rondônia.

In examining the transitions in the tree, it is clear that the representative of a cluster scenario, A1B1C2D1E1F1G1H3I1J1K1L1M1N1, is the most plausible. This representative scenario is defined by the conditions illustrated in the table below.

Table 14. Configuration of the most plausible representative scenario for Rondônia

A. Cattle culture	B. Agriculture	C. Native forest	D. Fragmentation of land use	E. Planted forest	F. Access ways	G. Environmental and territorial policies
A1. Increases	B1. Increases	C2. Decreases	D1. Increases	E1. Increases	F1. Increases	G1. Law implementation
H. Conservation of protected areas	I. Social movements	J. Environmental market services	K. Prevention Strategies	L. Population	M. Degree of risk perception	M. Reactive Mitigation policies
H3. Remains constant	I1. Tendency to joint	J1. Increase	K1. Increase	L1. Urban population increase and rural population decrease	M1. Increases	N1. Increase

This scenario states a progressive reduction in the native forest and a stabilization of protected areas, which means that forest loss will mainly occur in private property and not in protected areas, which is a factor named in the focus group to refer to the conservation unities and indigenous land. In addition, this scenario markets for an expansion of environmental services, becoming an ally of conservation within the protected units. However, the decrease in native forest coverage is accompanied by an expansion of farming, forestry, road construction, urbanization and a declining rural population. In this context, it looks like the "deforestation fire" will continue as a common practice. Moreover, the expansion of forestation and afforestation represents an increase of biomass and higher wildfire risk. Interestingly, the scenario foresees an improvement of both preventative and reactive strategies of wildfire mitigation, which are supported by an increasing risk awareness and expansion of social movements with further action from governments. In this scenario, the economic rural activities -which presume cross-scale interactions - will remain supported by the state policy as of today. From the socio-environmental point of view, social mobilizations supported by higher risk awareness are forces that may balance the dominant neoliberal rationality in economic planning that have wildfire as one externality.

The second plausible scenario is represented by the configuration, A1B1C1D1E1F1G1H2I1J1K1L1M1N1. This representative scenario is defined by the conditions illustrated in the table below.

Table 15. Configuration of the second plausible representative scenario for Rondônia

A. Cattle culture	B. Agriculture	C. Native forest	D. Fragmentation of land use	E. Planted forest	F. Access ways	G. Environmental and territorial policies
A1. Increases	B1. Increases	C1. Increases	D1. Increases	E1. Increases	F1. Increases	G1. Law implementation
H. Conservation of protected areas	I. Social movements	J. Environmental market services	K. Prevention Strategies	L. Population	M. Degree of risk perception	M. Reactive Mitigation policies
H2. Decreases	I1. Tendency to joint	J1. Increase	K1. Increase	L1. Urban population increase and rural population decrease	M1. Increases	N1. Increase

Regarding the most plausible scenario described above, this future scenario is not contradictory with it, but transitional. Most factors have the same states. The main differences are the tendency to increase the native forests and to decrease the conservation of protected areas, which indicates that the native forest is protected in private lands. This is probably due to the implementation of environmental laws, once other factors such as agriculture, planted forest, and roads remain as progressive trends. In this scenario, economic processes in the state of Rondônia reclaim other uses of protected areas by demanding more efficient control mechanisms from the bodies responsible for their protection.

The least plausible scenario has both the lowest average compatibility and probability. This scenario is described as follows; A1B1C1D1E1F1G1H3I1J1K1L1M1N1.This representative scenario is defined by the conditions illustrated in the table below.

Table 16. Configuration of the least plausible representative scenario for Rondônia

A. Cattle culture	B. Agriculture	C. Native forest	D. Fragmentation of land use	E. Planted forest	F. Access ways	G. Environmental and territorial policies
A1. Increases	B1. Increases	C1. Increases	D1. Increases	E1. Increases	F1. Increases	G1. Law implementation
H. Conservation of protected areas	I. Social movements	J. Environmental market services	K. Prevention Strategies	L. Population	M. Degree of risk perception	M. Reactive Mitigation policies
H3. Remains constant	I1. Tendency to joint	J1. Increase	K1. Increase	L1. Urban population increase and rural population decrease	M1. Increases	N1. Increase

Designated conservation areas remain constant over time, and there is a tendency to generally increase native forest. The growing trend of factors such as agriculture, planted forest, roads, and urban population growing against a declining rural population is the reason why there is not a change in economic and productive dynamics in Rondônia. Therefore, the growing trend of native forest can only be explained by the strong tendency of the implementation of environmental laws.

5.3.2. Galicia

The morphological box is presented in the Table 17.

Table 17. Morphological space of wildfire risk for Galicia with factors and their states

A. Public policies	B. Population structure	C. Forest management	D. Preventative mitigation policies	E. Reactive mitigation policies	F. Area of farming and animal husbandry	G. Spatial distribution of uses
A1. Greater efficiency and integration of sectoral policies	B1. Aging	C1. Improving good forestry practice	D1. Increase	E1. Increase	F1. Increase	G1. Tendency towards mosaic
A2. Minor efficiency and integration of sectoral policies	B2. Rejuvenation	C2. Worsening good forestry practice	D2. Decrease	E2. Decrease	F2. Decrease	G2. Tendency towards concentration
A3. Remain constant	B3. Remains constant	C3. Remains constant	D3. Remain constant	E3. Remain constant	F3. Remains constant	G3. Remains constant
H. *Pyrophytes* forest cover	**I. Native forest cover**	**J. Degree of risk perception**	**K. Infrastructure and communication**	**L. Climate change**	**M. Social capital**	**N. Spatial pattern of population**
H1. Increase in pyrophytes forest cover	I1. Increase in native forest cover	J1. Increases	K1. Increasing accessibility	L1. Greater adaption	M1. Increases	N1. Maintenance of spatial dispersion and rural population
H2. Decrease in pyrophytes forest cover	I2. Decrease in native forest cover	J2. Decreases	K2. Decreasing accessibility	L2. Minor adaption	M2. Decreases	N2. Trend towards urban bundling and peri-urban growth
H3. Remains constant	I3. Remains constant	J3. Remains constant	K3. Remains constant	L2. Remains constant	M3. Remains constant	N3. Trend towards urban reunification and compact urban growth

This morphological space contains 4.782.969 (3x3x3x3x3x3x3x3x3x3x3x3x3x3) possible configurations, a number much larger than in Rondônia. Although, the focus group participants chose the same number of factors (fourteen) in both places. Though in Galicia, participants allocated more states to the existent factor, which considerably increases the morphological space (Figure 28).

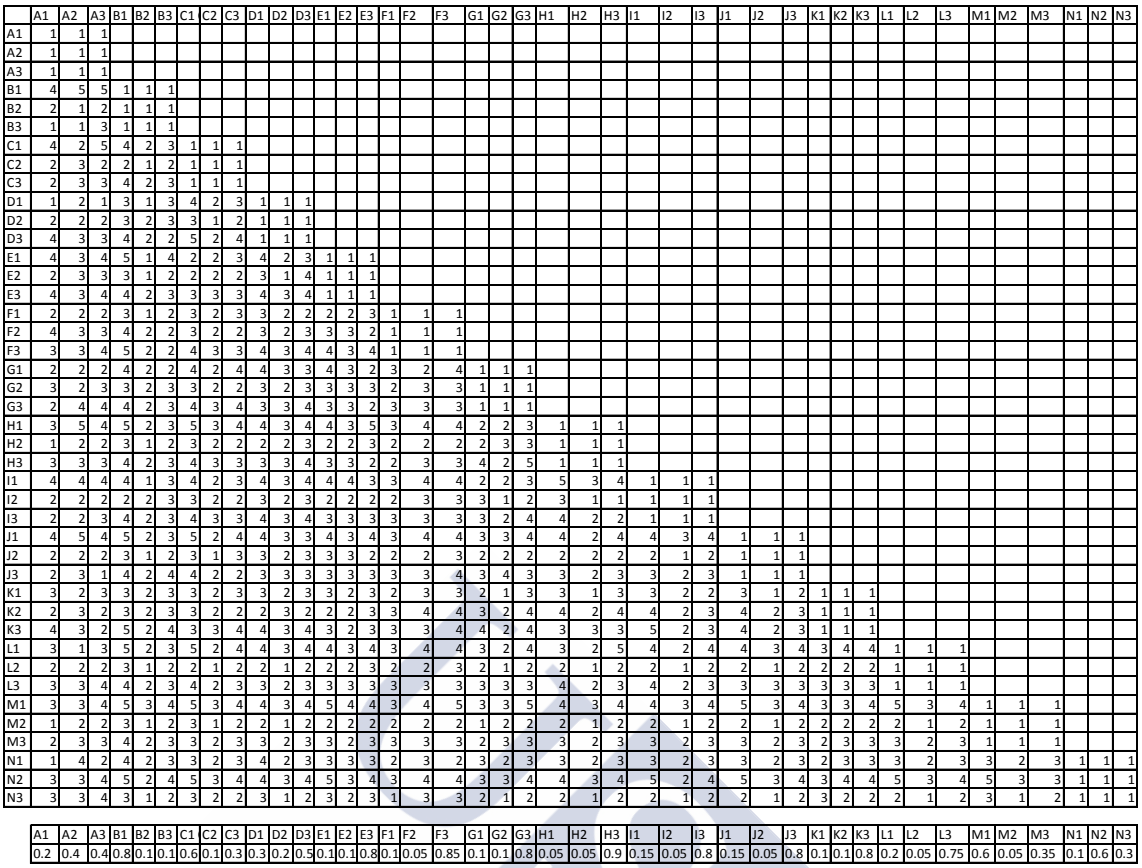


Figure 28. Matrix of configuration pairs with their compatibility rating, and marginal probabilities of states

The next step of the synthesis process consists of applying criteria to obtain a manageable number of scenarios. Following the Battelle approach and also recommendations provided by Nguyen and Dunn (2009), the two criteria that filter and reduce the number of possible configurations were selected in the software complementarily (AND).

The threshold U= 6, which is below half of the factors (7 factors), was applied as recommended by authors. The process of participative evaluation for future configurations in Galicia was different when compared to Rondônia, which results in choosing suitable filtering for the behavior of the group. Not only did the participants allocate more states to factors, but they also did not contemplate with extremes values as with Rondônia. This meant a bigger set of scenarios should be filtered in the attempt to finally find the main or more realistic ones. In addition, following the authors' recommendation, L should be above 3. Thus, L=4.055 was chosen and justified by the fact that the higher the L value, the more restrictive the average scenario compatibility, which in turn reduced the number of more realistic scenarios (Table 18).

Table 18. Criteria and thresholds used to filter scenarios

Criteria	Threshold	Plausible scenarios
U: Maximum number of rating 2	6	12
AND		
L: Minimum average compatibility value	4,055	

After these criterias are applied, the scenarios with probablity equal to zero are eliminated by the Modified Goal Programming. In the case of Galicia, all scenarios had an associated probability, so the software remained with the set of 12 plausible scenarios. After applying these criterias, by Bayesian method Modified Goal Programming, scenarios in the next step conceived to eliminate scenarios with probablity. In the case of the scenarios of Galicia, all scenarios had an associated probability, so the software remained with the set of 12 plausible scenarios.

The last step consisted of cluster analysis, which groups scenarios based on similarities that are defined by the software as the distance between pairs of scenarios (Nguyen and Dunn, 2009).

In following tables, four classifications of clusters organized by the program are illustrated to better understand the clusters as transition scenarios, and find the ranking of plausibility.

Table 19. Future scenarios for Galicia using two clusters

Cluster	Scenario	Average Compability Value	Probability	Representative Scenario
1	1,2,3,4,5,7,8,9,10, 11,12	4.071	96.6	A3B1C1D3E1F3G3H1I1J1K3L1M1N2
2	6	4.132	3.4	A3B1C1D3E1F3G3H1H1J1K3L1M1N2

Table 20. Future scenarios for Galicia using three clusters

Cluster	Scenario	Average Compability Value	Probability	Representative Scenario
1	1,2,3,4,5,7,9, 10,11,12	4.067	75.9	A3B1C1D3E2F3G3H1I1J1K3L1M1N2
2	6	4.132	3.4	A3B1C1D3E1F3G3H1I1J1K3L1M1N2
3	8	4.11	20.7	A3B1C1D3E1F3G3H3I1J1K3L1M1N2

Table 21. Future scenarios for Galicia using four clusters

Cluster	Scenario	Average Compability Value	Probability	Representative Scenario
1	1,2,3,4,5,7,9,11,12	4.062	72.4	A3B1C1D3E1F3G3H1I1J1K3L1M1N2
2	6	4.132	3.4	A3B1C1D3E1F3G3H1I1J1K3L1M1N2
3	8	4.11	20.7	A3B1C1D3E1F3G3H3I1J1K3L1M1N2
4	10	4.11	3.4	A3B1C1D3E3F3G3H1I1J1K3L1M1N2

Table 22. Future scenarios for Galicia using five clusters

Cluster	Scenario	Average Compability Value	Probability	Representative Scenario
1	1,2,3,4,5,7,9,11	4.062	51.7	A3B1C1D3E1F3G3H1I1J1K3L1M1N2
2	6	4.132	3.4	A3B1C1D3E1F3G3H1I1J1K3L1M1N2
3	8	4.11	20.7	A3B1C1D3E1F3G3H3I1J1K3L1M1N2
4	10	4.11	3.4	A3B1C1D3E3F3G3H1I1J1K3L1M1N2
5	12	4.066	20.7	A3B1C1D3E3F3G3H3I1J1K3L1M1N2

By handling these four solutions, it was possible to manually build a tree that displays the possible evolution of future scenarios for Galicia (Figure 29).

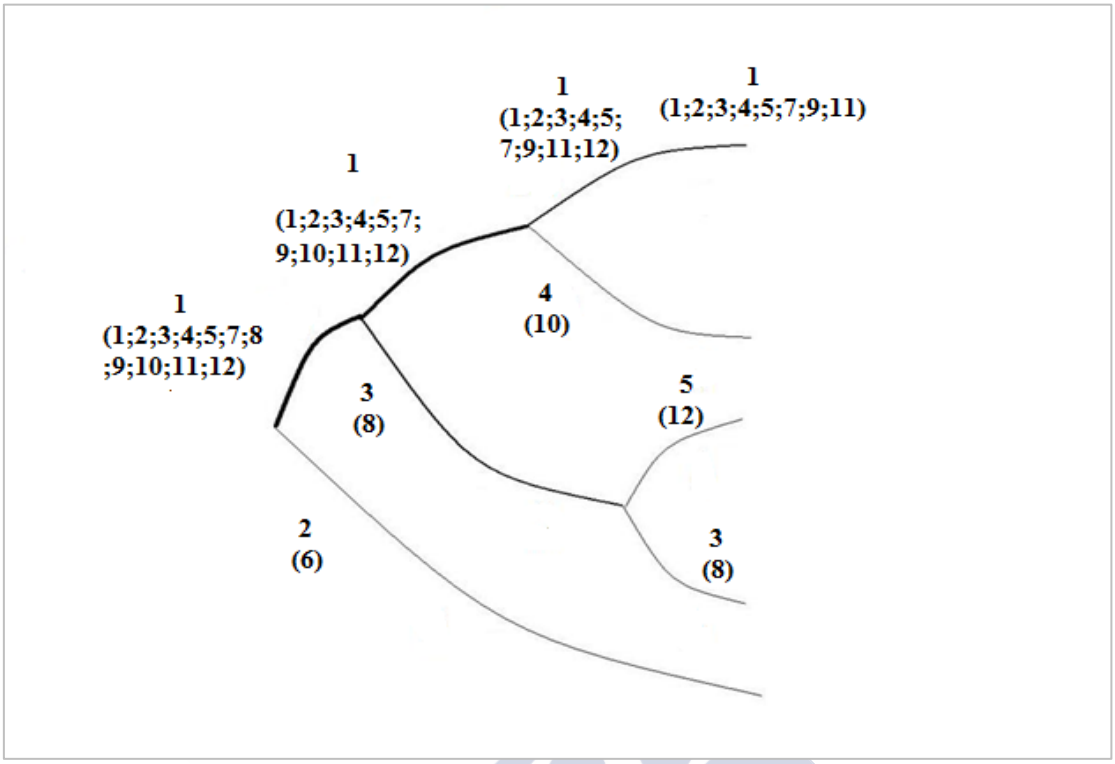


Figure 29. Tree representing the evolution of the multiple scenarios for Galicia

The most plausible scenario presents the configuration, A3B1C1D3E1F3G3H1I1J1K3L1M1N2.

This representative scenario is defined by the conditions illustrated in the table below.

Table 23. Configuration of the most plausible representative scenario for Galicia

A. Public policies	B. Population structure	C. Forest management	D. Preventative mitigation policies	E. Reactive mitigation policies	F. Area of farming and animal husbandry	G. Spatial distribution of uses
A3. Remain constant	B1. Aging	C1. Improving good forestry practice	D3. Remain constant	E1. Increase	F3. Remains constant	G3. Remains constant
H. *Pyrophytes* forest cover	**I. Native forest cover**	**J. Degree of risk perception**	**K. Infrastructure and communication**	**L. Climate change**	**M. Social capital**	**N. Spatial pattern of population**
H1. Increase in pyrophytes forest cover	I1. Increase in native forest cover	J1. Increases	K3. Remains constant	L1. Greater adaption	M1. Increases	N2. Trend towards urban bundling and peri-urban growth

The future resembles the present in many states, such as farming and animal husbandry remaining in a constant area, the uses of spatial distribution, the development of communication infrastructures, and the level of efficiency and integration of sectoral policies. This representative scenario anticipates the expansion of fast growing forest species, termed as pyrophytes by the focus group, and seen as the key expansion factor of wildfires throughout the region. On the other hand, there is an increase in native forest land and an improvement in forest management practices. An aging population also continues to be a concern. Regarding spatial pattern population, there is a trend pattern towards urban bundling and peri-urban growth, which can increase fires in wildland urban interface. This is more disquieting when considering that preventative mitigation policy remains as it is in the present moment. Nevertheless, other forms of prevention are noticeable in growing trend factors such as risk perception degree, by strengthening of social capital, which solidifies the role of social actors in public policies. However, it coexists with the persistence of reactive policies in mitigation. Perhaps because raising awareness is not sufficient to shift the perspective of traditional policies that remain operative in this scenario.

The second plausible scenario is A3B1C1D3E1F3G3H3I1J1K3L1M1N2. This representative scenario is defined by the conditions illustrated in the table below.

Table 24. Configuration of the second plausible representative scenario for Galicia

A. Public policies	B. Population structure	C. Forest management	D. Preventive mitigation policies	E. Reactive mitigation policies	F. Area of farming and animal husbandry	G. Spatial distribution of uses
A3. Remain constant	B1. Aging	C1. Improving good forestry practice	D3. Remain constant	E1. Increase	F3. Remains constant	G3. Remains constant
H. *Pyrophytes* forest cover	I. Native forest cover	J. Degree of risk perception	K. Infrastructure and communication	L. Climate change	M. Social capital	N. Spatial pattern of population
H3. Remains constant	I1. Increase in native forest cover	J1. Increases	K3. Remains constant	L1. Greater adaption	M1. Increases	N2. Trend towards urban bundling and peri-urban growth

The only significant difference between the second and the most plausible scenario is shown by the factor: Pyrophytes forest cover. The most plausible scenario presented a tendency to increase in Pyrophytes forest cover, while the second plausible representative scenario remained constant. In this case, the forest cover accompanies the stabilization tendency of many other factors such as area of farming and animal husbandry, uses of spatial distribution, infrastructure, communication, and the level of efficiency and integration of sectoral policies. On the other hand, reactive mitigation policies are strengthened, showing that stabilization is not always followed by institutional change. It can be also justified by the spatial pattern of population which presents a trend towards urban bundling and peri-urban growth, suggesting that mitigation fire will also take place wildland urban interface.

The least plausible scenario is represented by this configuration: A3B1C1D3E3F3G3H1I1J1K3L1M1N2. This representative scenario is defined by the conditions illustrated in the table below.

Table 25. Configuration of the least plausible representative scenario for Galicia

A. Public policies	B. Population structure	C. Forest management	D. Preventative mitigation policies	E. Reactive mitigation policies	F. Area of farming and animal husbandry	G. Spatial distribution of uses
A3. Remain constant	B1. Aging	C1. Improving good forestry practice	D3. Remain constant	E3. Remain constant	F3. Remains constant	G3. Remains constant
H. *Pyrophytes* forest cover	I. Native forest cover	J. Degree of risk perception	K. Infrastructure and communication	L. Climate change	M. Social capital	N. Spatial pattern of population
H1. Increase in pyrophytes forest cover	I1. Increase in native forest cover	J1. Increases	K3. Remains constant	L1. Greater adaption	M1. Increases	N2. Trend towards urban bundling and peri-urban growth

This scenario presents two different configurations compared to the previously shown. These differences are noticeable in the reactive mitigation policies factor, which remains constant in this representative scenario and also in the factor Pyrophytes forest cover, which presents the tendency to increase the Pyrophytes forest cover. It seems to be the most chaotic scenario since there is no institutional change in mitigating wildfire forefront, and there is an increase in Pyrophytes forest cover factor, which suggests a greater presence of wildfires. This is most likely the reason why it was presented as the least plausible scenario, mainly considering that it is quite unlikely that decision makers invest the same funds in mitigation when wildfires are increasing.

5.4. Conclusions

Participatory construction of wildfire risk scenarios, in this study, has proven to be a means of empowering different societal actors as legitimate agents able to handle emergent uncertainties in social-ecological systems as well as theorize on possible future developments through a consideration of the complexities attached to wildfire risk in their regions. This has demonstrated itself to be a real opportunity for rethinking the issue through the study of previously overlooked aspects of wildfire risk with participants of distinct social groups offering distinct types of knowledge, and thereby, enabling the integration of contrasting viewpoints, gaining more diversity in the identification of distinct key factors inherent to wildfire risk, which can then be incorporated into the construction of future scenarios.

Although the field of public policy surpasses the limits of this research, this study pays close attention to what role societal actors can play as proactive agents in the evolution of policy. Throughout the process of generating future wildfire risk scenarios, participating actors are encouraged to reckon with the importance of society's current

decisions. These actors "plan and act according to the satisfaction of their needs and wants, supporting, opposing or deflecting public policies, or as actors who continuously interfere with and modify the extant risk conditions" (Fra Paleo, 2015, p.5). Hence, societal actors do determine future developments by means of political, economic and social processes. Actors' participation can reduce the implementation gap among research, practice and decision making because when heterogeneous actors handle changes and uncertainties, the richness of their experiences and a wide range of possibilities is captured in these future scenarios.

The same process of scenario building implemented in different contexts – Rondônia and Galicia ─ supports the identification of the forces as well as traditions and trends that are determinant in the current and in the potential risk governance model in the study areas. Each scenario poses a different set of strategic challenges and demands with regard to core capabilities (Schoemaker, 1995). Temporarily bracketing the most plausible scenario on hand, policies and plans should be elaborated and provisionally accepted with suitable hedges (Rhyne, 1995), bearing in mind that most appropriate responses can be thought under different circumstances (Duinker and Greig, 2007). Therefore, the manner in which actors judge certain responses to be appropriate in potential circumstances can also be incorporated in readjustment of risk strategies.

The most plausible scenario in Rondônia suggests that "deforestation fire" will continue to be a reality due to the growing trend factors associated with rural productive activities. Nevertheless, there is a growing acknowledgement of the emergent demand from markets for environmental services, which could facilitate conservation purposes within the protected areas. Also, increasing risk awareness and expansion of social movements may be viewed as opportunities for enacting change towards more sustainable scenarios, which should be supported by state policy, as to confront the growing trend in the factors associated to the agribusiness activities.

In Galicia, the most plausible scenario demonstrates the tendency toward more stable factors. This scenario illustrates the expansion of fast-growing forest species, and consequently, the growing possibility of wildfires. This calls for special attention to the trend pattern towards urban bundling and peri-urban growth, which increase the risk of fire in wild land urban interface. What is problematic is the fact that preventative mitigation remains as is. The capabilities and opportunities of this scenario is perceived as an improvement in forest management practices, increasing risk awareness and strengthening social capital, which points to a translation of perception into collective action, mobilization and a stronger role for social actors in public policies.

The main scenario plausible for both regions demonstrated an increase in social participation, but this is not accompanied by a change in productive dynamics. Thus, efforts should be made to integrate demands of different societal actors and economic players. In this way, it reflects the truth of Fra Paleo's (2015) critique that the action of these societal actors and economic players has been considered as a marginal behavioral issue that increases the complexity of governance. They not only increase complexity in risk governance, but also their demands are treated differently in processes of decision-making, since political sensitivities to the economic players and to the lobbies is not the same to the other actors of civil societies, as for instance indigenous populations or small farmers.

Since the contexts differ, the task of finding more realistic scenarios should be accomplished by means of bibliographical recommendations and should also take into account how participants contemplate their configurations. Particularities of the context

where participatory sessions took place have influenced a number of sessions, and ultimately the way scenarios were filtered. The fact that the participants in Rondônia had the tendency to weigh configurations with very extreme values, when they were certain about the future development of a factor, suggests that there is probably a hierarchy among factors, which was not considered in the software used. Thus, this study opens the way for further research that aims to connect integrated risk with scenario building framework.

This study has shown that it is possible to take advantage of existent tools such as these creative and formal methods, even with scarce financial resources, in integrating technical-scientific and sociological perspective of environmental risks. However, it does not rule out the possibility of creating more suitable software to achieve scenarios that are more compatible to the specificities of the region, risk and styles of participation.

Participatory construction of scenarios corroborates Rhyne's (1995) viewpoint that when participants chose a configuration least likely to occur it meant a temporal decision, since further discussion can start if anyone on the team could visualize a different future condition containing that pair (Rhyne, 1995). Therefore, participatory construction of scenarios demands flexible strategies with constant evaluation (feedbacks) in accordance with the changing perceptions of actors. These feedbacks are even more important if considering a persistent dilemma in decision-making, illustrated by Schoemaker (1995), regarding under-prediction and over-prediction. Once again, a pluralistic consideration of societal values and perspectives through participatory forms can aid the achievement of this this right balance.

Overall, the combination of participatory techniques adapted to the construction of wildfire risk scenarios has shown how a tool suite may be employed to engage different actors in risk governance in different areas as long as a great effort is made in order to know the historic evolution of the problem and conceptualize it from within its specific context. This combination might also be suitable for the study of other with a high frequency of interaction among human actions, political decisions and natural processes, such as, to cite but one example, flood risk.

References:

Allison, H. E. (2015). Understanding and Conceptualizing Risk in Large-Scale Social-Ecological Systems. In U. Fra. Paleo (Ed.). *Risk Governance: The Articulation of Hazard, Politics and Ecology*. New York-London: Springer, 99-115.

Amer, M., Daim, T. U., & Jetter, A. (2013). A review of scenario planning. *Futures*, 46, 23-40.

Borchers, J. G. (2005). Accepting uncertainty, assessing risk: decision quality in managing wildfire, forest resource values, and new technology. *Forest Ecology and Management*, *211*(1), 36-46.

Börjeson, L., Höjer, M., Dreborg, K. H., Ekvall, T., & Finnveden, G. (2006). Scenario types and techniques: towards a user's guide. *Futures*, *38*(7), 723-739.

Bradfield, R., Wright, G., Burt, G., Cairns, G., & Van Der Heijden, K. (2005). The origins and evolution of scenario techniques in long range business planning. *Futures*, *37*(8), 795-812.

Bryant, B. P., & Westerling, A. L. (2014). Scenarios for future wildfire risk in California: links between changing demography, land use, climate, and wildfire. *Environmetrics*, 25(6), 454-471.

Budiyono, Y., Aerts, J. C. J. H., Tollenaar, D., & Ward, P. (2015). River flood risk in Jakarta under scenarios of future change. *Natural Hazards and Earth System Sciences Discussions*, 3, 4435-4478.

Bytnerowicz, A., Fenn, M., McNulty, S., Yuan, F., Pourmokhtarian, A., Driscoll, C., & Meixner, T. (2013). Interactive Effects of Air Pollution and Climate Change on Forest Ecosystems in the United States: Current Understanding and Future Scenarios.

Bytnerowicz, A., Fenn, M., McNulty, S., Yuan, F., Pourmokhtarian, A., Driscoll, C., Meixner, T., 2013. Interactive effects of air pollution and climate change on forest ecosystems in the United States – current understanding and future scenarios. In: Matyssek, R., Clarke, N., Cudlin, P., Mikkelsen, T., Tuovinen, J.P., Weiser, G., Paoletti, E. (Eds.), *Climate Change, Air Pollution and Global Challenges: Understanding and Solutions from Forest Research*. Dev. Environ. Sci. 13. Elsevier, Netherlands, 333–369.

Calvi, G. M., Pinho, R., Magenes, G., Bommer, J. J., Restrepo-Vélez, L. F., & Crowley, H. (2006). Development of seismic vulnerability assessment methodologies over the past 30 years. *ISET journal of Earthquake Technology*, *43*(3), 75-104.

Cane, D., Wastl, C., Barbarino, S., Renier, L. A., Schunk, C., & Menzel, A. (2013). Projection of fire potential to future climate scenarios in the Alpine area: some methodological considerations. *Climatic change*, 119(3-4), 733-746.

Coyle, R. G., & McGlone, G. R. (1995). Projecting scenarios for South-east Asia and the South-west Pacific. *Futures*, *27*(1), 65-79.

Chermack, T. J. (2004). Improving decision-making with scenario planning. *Futures*, 36(3), 295-309.

Del Gaudio, C., Ricci, P., Verderame, G. M., & Manfredi, G. (2016). Observed and predicted earthquake damage scenarios: the case study of Pettino (L'Aquila) after the 6th April 2009 event. *Bulletin of Earthquake Engineering*, *14*(10), 2643-2678.

Dellasala, DA, Williams JE, Williams CD, Franklin JF. (2004). Beyond smoke and mirrors: a synthesis of fire policy and science. *Conservation Biology* 18: 976–986.

Devisscher, T., Boyd, E., & Malhi, Y. (2016). Anticipating future risk in social-ecological systems using fuzzy cognitive mapping: the case of wildfire in the Chiquitania, Bolivia. *Ecology and Society*, *21*(4).

Duczynski, G., & Williams, M. C. (2000). Creating Futures Scenarios To Aid In Military Planning: The Use Of The Field Anomaly Relaxation Systems Approach. In *I International Conference on Systems Thinking Management*. Available in: http://ftp.informatik.rwth-aachen.de/Publications/CEUR-WS/Vol-72/024%20Duczinski%20Military.pdf Accessed 07 March 2015.

Duinker, P. N., & Greig, L. A. (2007). Scenario analysis in environmental impact assessment: Improving explorations of the future. *Environmental impact assessment review*, 27(3), 206-219.

EM-DAT: The OFDA/CRED International Disaster Database. Available online at www.em-dat.net. Accessed 14 September 2016.

Ferreira, L., Constantino, M., & Borges, J. G. (2014). A stochastic approach to optimize Maritime pine (Pinus pinaster Ait.) stand management scheduling under fire risk. An application in Portugal. Annals of Operations Research,219(1), 359-377.

Fra.Paleo, U. (2015). Structure, Process and Agency in the Evaluation of Risk-Governance. In: Fra Paleo, U (editor). *Risk Governance: The Articulation of Hazard, Politics and Ecology*. New York-London: Springer, 237, 273.

Gall, M., Nguyen, K. H., & Cutter, S. L. (2015). Integrated research on disaster risk: Is it really integrated?. *International journal of disaster risk reduction*, 12, 255-267.

Godet, M. (2000). The art of scenarios and strategic planning: tools and pitfalls. *Technological forecasting and social change*, *65*(1), 3-22.

Gordon, T. J., Becker, H. S., & Gerjuoy, H. (1974). Trend impact analysis: a new forecasting tool. *Futures Group*.

González, I; Fra.Paleo,U. (2012). Escenarios de riesgo de incendio actuales y potenciales en el Municipio de Lugo. In: Crecente, R; Fra.Paleo, U. *Territorios a examen.* Universidade de Santiago de Compostela. Servizo de Publicacións e Intercambio cientifico: Santiago de Compostela.

Habegger, B. (2010). Strategic foresight in public policy: Reviewing the experiences of the UK, Singapore, and the Netherlands. *Futures*, volume 42, 49–58.

IPPC - Intergovernmental Panel on Climate Change (2007). Report about Climate Change 2007: Impacts, Adaptation and Vulnerability. Available in: http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_wg2_report_impacts_adaptation_and_vulnerability.htm. Accessed 07 March 2016.

M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson (eds)

Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Jacinto, R., Cruz, M. J., & Santos, F. D. (2013). Development of water use scenarios as a tool for adaptation to climate change. Drinking Water *Engineering and Science*, 6(1), 61-68.

Kaivo-oja, J. (2001). Scenario learning and potential sustainable development processes in spatial contexts: Towards risk society or ecological modernization scenarios?. *Futures Research Quarterly*, 17(2), 33-56.

Kasperson, R. (2015). Risk Governance and the Social Amplification of Risk: A commentary. In: Fra Paleo, U (editor). *Risk Governance: The Articulation of Hazard, Politics and Ecology*. New York-London: Springer, 485-487.

Kazantzidou-Firtinidou, D., Kassaras, I., Ganas, A., Tsimi, C., Sakellariou, N., Mourloukos, S. & Giannaraki, G. (2016). *Seismic damage scenarios in Kalamata* (S. Greece). Bulletin of the Geological Society of Greece, 50.

Koivisto, R., Wessberg, N., Eerola, A., Ahlqvist, T., Kivisaari, S., Myllyoja, J., & Halonen, M. (2009). Integrating future-oriented technology analysis and risk assessment methodologies. *Technological Forecasting and Social Change*, *76*(9), 1163-1176.

Kosow, H., & Gaßner, R. (2008). *Methods of future and scenario analysis*. DIE. Research Project "Development Policy: Questions for the Future". – Berlin: Institut für Zukunftsstudien und Technologiebewertung.

Lehtonen, I., Ruosteenoja, K., Venäläinen, A., & Gregow, H. (2014). The projected 21st century forest-fire risk in Finland under different greenhouse gas scenarios. *Boreal Environ. Res*, 19, 127-139.

Liu, Y., Goodrick, S. L., & Stanturf, J. A. (2013). Future US wildfire potential trends projected using a dynamically downscaled climate change scenario. *Forest Ecology and Management*, 294, 120-135.

Loureiro, X; Fra.Paleo,U. (2012). Escenarios actuais e potenciais de risco de inundación costeira na área metropolitana de A Coruña. In: Crecente, R; Fra.Paleo, U. *Territorios a examen*. Universidade de Santiago de Compostela. Servizo de Publicacións e Intercambio cientifico: Santiago de Compostela.

Luís, A., Lickorish, F., & Pollard, S. (2016). Evolution of strategic risks under future scenarios for improved utility master plans. *Water Research*, 88, 719-727.

Medel-Vera, C., & Ji, T. (2016). Seismic probabilistic risk analysis based on stochastic simulation of accelerograms for nuclear power plants in the UK. *Progress in Nuclear Energy*, 91, 373-388.

Mitsopoulos, I., Mallinis, G., & Arianoutsou, M. (2015). Wildfire risk assessment in a typical Mediterranean wildland–urban interface of Greece. *Environmental management*, 55(4), 900-915.

Nguyen, M. T., Beck, J., Dilek, C., Dunn, M., & Newbold, G. (2008). Strategic planning tool suite: an approach of combining scenario analysis methods. *Australian Society for Operations Research Bulletin*, 27(3), 2-11.

Nguyen, M. T., & Dunn, M. (2009). *Some Methods for Scenario Analysis in Defence Strategic Planning*. (No. DSTO-TR-2242). Defence science and technology organisation (Australia) joint operations division.

O'Brien, F. A. (2004). Scenario planning–lessons for practice from teaching and learning. *European Journal of Operational Research*, volume 152, 709–722.

Renn, O.; Kinle, A. (2015). Risk Governance and Resilience: New Approaches to Cope with Uncertainty and Ambiguity. In: Fra.Paleo, U. (editor). *Risk Governance: The Articulation of Hazard, Politics and Ecology*. New York-London: Springer, 19-41.

Rhyne, R. (1995). Field anomaly relaxation: the arts of usage. *Futures*, 27(6), 657-674.

Ritchey, T. (1998a). General Morphological Analysis: A general method for non-quantified modeling. In: *16th Euro Conference on Operational Analysis, Brussels.*

Ritchey, T. (1998b). Fritz Zwicky, morphologie and policy analysis. In *16th Euro conference on operational analysis*, Brussels.

Schneider, S., & Lane, J. (2005). Integrated assessment modeling of global climate change: much has been learned—still a long and bumpy road ahead. *Integrated Assessment*, 5(1), 42-75.

Schoemaker, P. J. (1995). Scenario planning: a tool for strategic thinking. *Sloan management review*, *36*(2), 25-40.

Stephens, A. K. (2006). *Future urban states: a field anomaly relaxation study* (No. DSTO-TR-1910). Defence science and technology organisation salisbury (australia) systems sciences lab.

Swart, R. J., Raskin, P., & Robinson, J. (2004). The problem of the future: sustainability science and scenario analysis. *Global environmental change*, 14(2), 137-146

Tagarev, T., & Ivanova, P. (2013). Analytical support to foresighting EU roles as a Global Security Actor. *Information & Security: An International Journal*, *29*(1), 21-33.

Tarancón, A. A., Fulé, P. Z., Shive, K. L., Sieg, C. H., Meador, A. S., & Strom, B. (2014). Simulating post-wildfire forest trajectories under alternative climate and management scenarios. *Ecological Applications*, *24*(7), 1626-1637.

Torres, Y., Molina, S., Martínez-Cuevas, S., Navarro, M., Martínez-Díaz, J. J., Benito, B. & Belizaire, D. (2016). A first approach to earthquake damage estimation in Haiti: advices to minimize the seismic risk. *Bulletin of Earthquake Engineering*, 14(1), 39-58.

Van Notten, P., & Rotmans, J. (2001). The future of scenarios. *Scenario and Strategy Planning*, *3*(1), 4-9.

Wisner, B. (2011). Are we there yet? Reflections on integrated disaster risk management after ten years. *IDRiM Journal*, 1(1), 1-14.

Zwicky, F. (1969). *Discovery, Invention, Research – Though the Morphological Approach*. New York: The Macmillan Company.

6. Conclusions

Any development, even supported by a well-elaborated plan, with the necessary resources and an adequate budget, goes through readjustment. On some occasions adjustments are so profound that they may even result in a process of deconstruction. At other times, when the goal was finally achieved, the original ideas and values that instigated it have shifted. The truth behind this statement is evident in the examples discussed in this dissertation.

In the early twentieth century, Rondônia was connected by a railway, a project interrupted by the harsh conditions of the rainforest, where workers had to confront tropical diseases and continuous attacks by the indigenous peoples. The railway was constructed to satisfy the demand for natural rubber in the international market. However, by that time, most of the production had already been displaced to Asia, where the resource could be harvested more efficiently, rendering the railway obsolete. Similarly, after longstanding social claims, property rights of community-owned land in Galicia were returned to their members in 1986. Claims were based on the customary continued and farm-integrated use of these lands by the local community until the industrialization of agriculture in the 1960s (Bouhier, 1979; Balboa, 1990). Once the rights were returned to the legitimate owners, the members of the community no longer needed the land or used farming practices as they had (or the previous generation had) in the past.

These two examples suggest that the true value of any development does not necessarily lie in the object itself, but in the associated learning process. The argument presented here is that learning is not simply a process, but an outcome as well. This has been the central focus of this dissertation, which is aimed at understanding wildfire risk governance in the Brazilian Amazon and in Galicia by exploring learning with societal actors participating in the research.

The past experiences of those actors became valuable resources to learn about the changes occurred in the social-ecological systems where they live. Changes in the use of fire and the cultural interpretation of fire as hazard in each area are accompanied by the contradictory transformation of models and notions that have guided societies. In the leap from a wild land to a rural society in Rondônia, and from a rural to an urbanized society in Galicia, new formal institutions emerged to directly or indirectly deal with wildfire risk. Formal instruments, such as policies and regulations, changed over time rhetorically assimilating preventative mitigation and sustainability. Nevertheless, formal institutions were not able to go along the dynamism of informal institutions. These informal institutions hold different values, knowledge and viewpoints regarding the range of societal actors involved in wildfire risk. That is why the wildfire risk governance model should should integrate formal and informal institutions, and be inclusive in terms of actors, to address the diversity and complexity of social-ecological systems.

Reconciliation between the various societal processes around wildfire risk falls upon risk communication. Wildfire risk is communicated differently by the various actors, via culture, mass media, social media, or government channels.

The incoordination among means (formal or informal) of risk communication

usually results in simplistic or fuzzy understanding of actors regarding the drivers or elements associated with wildfire risk. That is the reason why it is the necessary to construct negotiated risk governance between societal actors, and advance to an integrated risk approach. This approach emerged to accommodate the complexity of multiple levels (local to global), stakeholders (experts, private sector, officials, community members), knowledge (scientific and local), disciplines, methodological approaches, areas of application (planning, sustainable development, policy, etc.) (Gall et al., 2015) and actors' experiences.

Negotiation among actors was performed by using participatory methods. The fact that wildfires in involve factors and actors in complex interactions was the argument for the combination of participatory instruments to boost understanding of all the dimensions of the problem, to reach agreements but also to identify the conflictive aspects.

The argument proposed in this dissertation coincides with the contribution of Honeth (2003), who underlines that the social system and its instrumental logic face constant conflict. According to this author, conflict gives rise to actions that seek to establish relations of mutual recognition or to develop them at a higher educational level. In other words, conflict should be also understood as a form of learning. In this way, Fra.Paleo (2015) has stated that heterogeneity and discordance should not be used as an argument to elude interaction, arguing that different views of society concerning risk could be converted into an arena for confronting the various and opposed interests, concerns, and individual and collective choices. Thus, conflict as an inescapable dimension of social life is also an inescapable dimension of risk governance. In this way, Van Den Hove (2006) has called for the use of conflict as a driver for creative decision-making through participatory learning processes rather than as a justification for mere zero-sum bargaining.

The participatory sessions throughout the research process, aimed at constructing future wildfire scenarios, made emerge conflicting ways of understanding the problem, and occasionally participants even attempted to manipulate each other's perceptions. Stimulating debate and negotiation among participants has proven to be an aid to increase transparency and helped mitigate efforts of manipulation. Throughout the process, both negotiation between actors and outputs—future scenarios—are beneficial to understanding and analyzing contextual factors of wildfire risks. Therefore, learning –in the context of risk communication - should be reflected into all processes of risk governance.

The same process of scenario building implemented in different contexts – Rondônia and Galicia — has supported the identification of the forces as well as traditions and trends that are determinant in the current and in the potential risk governance model in the study areas. This illustrate that contextual factors nested within those regions should be considered in composing a set of scenarios.

Ultimately, this study sought to focus on the role of participatory methods in research and in enhancing public participation in governance and gives clues as to how to incorporate actors in processes of decision-making and the construction of scenarios. Moving from forecasting to strategic action involves debate plus awareness of the responsibility of society toward future generations (Godet, 2000). Thus, an important finding is that the process of generating possible future scenarios by social actors prompts thinking about the importance of current decisions, since they determine future

development. Each scenario poses a different set of strategic challenges and demands with regard to core capabilities (Schoemaker, 1995). Temporarily bracketing the most plausible scenario on hand, policies and plans should be elaborated and provisionally accepted with suitable hedges (Rhyne, 1995), bearing in mind that most appropriate responses can be thought under different circumstances (Duinker and Greig, 2007). Therefore, the manner in which actors judge certain responses to be appropriate in potential circumstances can also be incorporated in risk strategies, which further validates the argument presented here that actors are agents who can play a proactive role in the evolution of risk policy.

Additionally, considering possible future scenarios is a way of dealing with the 'uncertainty monster', to use De Marchi's (2015) expression, who posits that handling uncertainty and assessing risk cannot be restricted to the expert arena. In her view, risks are conceived technically as things that can be expressed quantitatively, but they cannot be fully understood or managed using only traditional risk assessment tools.

In the integrated risk approach, future scenarios are the outcome of social negotiation. In addition, scenario construction raises risk awareness in actors who did not participate in the construction, be they decision makers, scholars, members of civil society or private sector. They can discuss not only about the process of construction, but also about the outcomes and readjust future participatory sessions. Participation calls for and makes sense when it is set within a continuing process, once people's values, knowledges, and ideas change, will the way they conceive of risk become changeable as well, adaptive to contexts and scenarios that are themselves ever-changing.

References:

Balboa, X.L. (1990). *O monte en Galicia*. Vigo: Edicións Xerais.

Bouhier, A. (1979). *La Galice*. Essai géographique d'analyse et d'interpretation d'un vieux complexe agraire.

De Marchi, B. (2015). Risk Governance and the Integration of Different Types of Knowledge. In U. Fra.Paleo (Ed.). *Risk Governance: The Articulation of Hazard, Politics and Ecology*. New York-London: Springer, 149-165.

Duinker, P. N., & Greig, L. A. (2007). Scenario analysis in environmental impact assessment: Improving explorations of the future. Environmental impact assessment review, 27(3), 206-219.

Fra.Paleo, U. (Ed.) (2015). *Risk Governance: The Articulation of Hazard, Politics and Ecology*. New York-London: Springer.

Gall, M., Nguyen, K. H., & Cutter, S. L. (2015). Integrated research on disaster risk: is it really integrated?. *International journal of disaster risk reduction*, *12*, 255-267.

Godet, M. (2000). The art of scenarios and strategic planning: tools and pitfalls. *Technological forecasting and social change*, *65*(1), 3-22.

Honneth, A. (2003) *Luta por reconhecimento. A gramática moral dos conflitos sociais*. São Paulo: Editora 34.

Rhyne, R. (1995). Field anomaly relaxation: the arts of usage. *Futures*, 27(6), 657-674.

Schoemaker, P. J. (1995). Scenario planning: a tool for strategic thinking. *Sloan management review*, *36*(2), 25-40.

Van Den Hove, S. (2006). Between consensus and compromise: acknowledging the negotiation dimension in participatory approaches. *Land Use Policy*, 23(1), 10-17

Appendix. Interview scripts in Portugue and Spanish

Nome:	Idade:
Ocupação/Cargo:	Local da entrevista:
Data:	

Bloco 1: Percepção dos cidadãos sobre as transformações no território

1) Desde quando você mora aqui?

2) O (A) senhor (a) poderia me descrever as principais mudanças que aconteceram nesta região nos últimos anos?

MUDANÇAS		
Componentes	**Sentido (o que mudou, como era e como é)**	**Motivos (Por quê?)**
Usos do solo/Paisagem	Vias de comunicação (+ ou -)	É maisfácil viajar agora?
	Cultivos agrícolas (+ ou -)	Existem diferentes plantações comparado ao passado?
	Exploração florestal (+ o -)	Mudaram as espéciesflorestais?
	Pastos/Gado (+ o -)	

	Fragmentação ou Concentração da propriedade (+ o -)	Mudou o tamanho das parcelas? Qual o papel dos assentamentos de reforma agrária?
	Casas (+ o -)	Se existem mais casas, estão dispersas (separadas) ou agrupadas (juntas)?
Transformações populacionais	Vive mais ou menos gente aqui? Por quê?	
	Tem mais velhos/jovens que antes?	
Propriedade	A atividade que você desenvolve é suficiente para viver ou tem/teve que abandoná-la? Quando você se aposentar alguém vai continuar com as atividades? A sua propriedade tem terra suficiente? O governo está apoiando as atividades agrícolas florestais? Quais mudanças você crê que vão acontecer no futuro?	

Atividade industrial e de serviços	Tem mais ou menos atividade industrial? Tem mais ou menos comercialização ?	

3) Quais são os principais problemas destes municípios (região)?

Bloco 2: Memória, Percepção, Atores, Atitude, Propostas de Mitigação

4) Houve incêndios florestais nesta região?

5) Quais áreas foram queimadas? Mato, pasto, floresta?

6) Ocorreram sempre nas mesmas áreas? Por quê?

7) Quais prejuizos causaram?

8) Afetou as casas/áreas de moradia?

9) Como o fogo foi apagado?

10) O (A) senhor (a) acredita que os incêndios prejudicam a natureza? Por quê?

11) Qual é o último incêndio florestal que o(a) senhor(a)se lembra?

12) Qual é uma data marcante em termos de incêndios florestais em Rondônia? Produziram alguma mudança?

Percepção

13) Quais são as causas dos incêndios na sua opinião?

14) Tem mais incêndios agora ou no passado?

15) O que influenciou para que existam mais/menos incêndios?

16) Os incêndios são maiores ou menores?

17) O que influenciou para que agora sejam maiores ou menores?

18) Em qual época se produzem os principais incêndios?

Perguntas de Mitigação e Atores

19) Quem é responsável para apagar os incêndios?

20) O governo deve ser o único responsável?

21) O que o(a) senhor (a) faria em caso de incêndio?

22) O(a) senhor(a) já ouviu alguma explicação sobre o que deve fazer em caso de incêndio?

23) Os moradores se organizam para apagar os incêndios? De que forma?

24) O que os moradores podem fazer para ajudar a extinguir os incêndios?

Quem intervém no risco de incêndios em Rondônia (para apagar ou reduzir o risco)?

Instituições/Organizações Quem?	**Que é o seu papel?**	**Sua atuação é satisfatória?**	**Se não, por quê?**

20) Quem deveria intervir também?

21) O que os proprietários devem fazer para evitar os incêndios?

22) O(a) senhor (a) identifica algum tipo de atuação ou mobilização de moradores relacionado ao risco de incêndios florestais?

23) Quais trabalhos de prevenção existem? Quais deveriam existir?

24) O que pode ser feito na época que não tem incêndios para que evitar incêndios em outro período? O que pode ser feito na época em que não ocorrem incêndios para evitá-los no período de seca?

25) São promovidas reuniões para tratar do assunto de incêndios?

26) Como se organizam?

27) De que maneira você fica sabendo sobre os incêndios na região? Você está pendente dos alertas de incêndios?

Interconexões entre a gestão em comum da terra e o risco de incêndios

28) Ocorrem incêndios nas terras indígenas e reservas extrativistas?

29) Os tipos de usos/aproveitamentos da TI/reservas facilitam ou impedem a ocorrência dos incêndios?

30) As práticas das TI's/reservas extrativistas (queimas, formação de pastagens, bovinocultura, agricultura) facilitam ou impedem a ocorrência dos incêndios?

31) Quais usos e práticas deveriam ser realizados para prevenir os incêndios?

32) Na sua opinião, a gestão (tomada de decisões) das TIs e reservas ajuda a prevenir/aumentar os incêndios?

33) Deveriam modificar a forma de gestão para prevenir aos incêndios?

Nombre:	Edad:
Donde se sitúa la propiedad rural:	Local de la entrevista:
Fecha:	

Bloque 1 percepción de los ciudadanos sobre los cambios en el territorio

1) ¿Cuánto tiempo hace que vives aquí?
2) ¿Me puedes describir los principales cambios que han ocurrido en esta zona en los últimos años?

CAMBIOS		
Componentes	**Sentido (qué ha cambiado, cómo era y como es)**	**Motivos (Por qué?)**
Usos del suelo/Paisaje	Vías de comunicación (+ o -)	¿Es más fácil desplazarse ahora?
	Cultivos agrícolas (+ o -)	¿Hay distintos cultivos que en el pasado?
	Explotación forestal (+ o -)	¿Las ayudas de reforestación de tierras agrarias como está afectando? ¿Han cambiado las especies forestales? ¿Hay más o menos matorral?

	Pastos/Explotac. ganadera (+ o -)	8) ¿Qué papel juegan las ayudas de la PAC? ¿Es necesario desbrozar zonas de matorral? ¿para qué?
	Fragmentación de la propiedad (+ o -)	¿Ha cambiado el tamaño de las parcelas? ¿Ha habido concentración parcelaria? ¿Qué papel juega la concentración parcelaria en este contexto?
	Casas (+ o -)	Si hay más casas ¿están agrupadas o dispersas? ¿se están abandonando las casas?
Cambios Poblacionales	¿Vive más o menos gente aquí? ¿Por qué?	
	¿ Hay más viejos/jóvenes que antes?	
Explotación	¿La actividad que desarrollas te da para vivir o tendrás que dejarla? ¿Va a continuar alguien con tu explotación cuando te jubiles? 7) 9) La explotación tiene tierras suficientes? ¿Está apoyando la administración las actividades agrícolas o	

	forestales? ¿Qué cambios piensas que se van a producir en el futuro?	
Actividad industrial y de servicios	¿Hay más o menos actividad industrial? ¿Hay más o menos negocios?	

3) ¿Cuáles son los tres principales problemas de estos pueblos?

Información: Galicia ha pasado por un incremento de la masa forestal de 18,1% de la superficie forestal productora de 1985 a 2005.

4) ¿Sabes por qué está pasando? (Pregunta de validación)

Bloque 2: Memoria, Percepción, Actores, Actitud, Propuestas de Mitigación

Preguntas de Memoria

5) ¿Hubo alguna vez incendios forestales en esta zona?

6) ¿Qué zonas se quemaron? ¿Matorral, pastos, bosque?

7) ¿Cómo se apagó el fuego?

8) ¿Qué daños se produjeron?

9) ¿Afectó a las casas?

10) ¿Se queman siempre las mismas zonas? ¿Por qué?

11) ¿Crees que los incendios fastillan la naturaleza? Por qué?

12) ¿Cuál es último incendio forestal que recuerdas?

13) ¿Hubo incendios en 2006? ¿y en 1995?

Preguntas de Percepción:

14) ¿Cuáles crees que son las causas de los incendios?

15) ¿Hay más incendios ahora o en el pasado?

16) ¿ Qué ha influido para que haya más/menos incendios?

17) ¿Los incendios son más o menos extensos?

18) ¿Qué ha influido para que ahora sean más/menos extensos?

19) ¿En qué época se producen los principales incendios?

Preguntas de mitigación y actores

20) ¿Quienes intervienen para apagar los incendios?

21) ¿Debe ser sólo la administración la única responsable?

22) ¿Qué harías en caso de incendio?

23) ¿Alguien te ha explicado cómo actuar en caso de incendio?

24) ¿Qué pueden hacer los vecinos para ayudar a extinguir los incendios?

25) ¿Se organizan los vecinos para apagar los incendios? De qué forma?

Instituciones/Organizaciones ¿Quién?	**¿Qué papel juegan?**	**¿Su actuación es satisfactoria?**	**Si no, ¿por qué?**

26) ¿Quiénes intervienen para reducir el riesgo de incendio?

27) Quiénes deberían intervenir también?

28) ¿Que deben hacer los propietarios para evitar los incendios?

29) ¿Qué se puede hacer en la época en la que no hay incendios para que no se produzcan en la época de incendios?

30) ¿Se hacen reuniones para tratar del tema de los incendios?

31) ¿Y cómo se organizan?

32) ¿Estás pendiente de las alertas de incendios?

33) ¿Hubo algún cambio después de 2006?

Interconexiones entre la gestión común de la tierra y el riesgo de incendio

34) ¿Se producen incendios en los MVMC/TI?

35) ¿Los usos de los MVMC/TI facilitan o impiden la extensión de los incendios?

36) ¿Las prácticas en los MVMC/TI (quemas, pastoreo...) facilitan o impiden la extensión de los incendios?

37) ¿Qué usos/prácticas deberían realizarse para prevenir los incendios?

38) ¿Crees que la gestión (toma de decisiones) de los MVMC/TI ayuda a prevenir/incrementar los incendios?

39) ¿Se debería cambiar la forma de gestión para ayudar a prevenir los incendios?

Roteiro de entrevistas com atores institucionais/sociedade civil organizada | 2015

Nome:	Idade:
Ocupação/Cargo:	Local da entrevista:
Data:	

Elementos físicos e sociais que influenciam o risco de incêndios em Rondônia

Quais foram as transformações (usos do solo, populacionais, nas propriedades e de infra-estrutura) que, ao longo do tempo, influenciaram o risco de incêndios (queimadas) em Rondônia?

1) Quais fatores físicos incidem na ocorrência de incêndios florestais em Rondônia?

2) Quais elementos sociais interferemno risco de incêndios?

3) Existe uma política florestal direcionada para incêndios em Rondônia? Quais são as suas fortalezas e fraquezas?

4) Qual a influência do novo código florestal (2012) na política agroflorestal de Rondônia?

5) Quais são os fatores que propiciaram o desmatamento/decrescimento da massa florestal em Rondônia?

6) Os incentivos à constituição de assentamentos de Reforma Agrária (os PICs) como afetaram ou seguem afetando o risco de queimadas/incêndios?

7) Houve alguma mudança nas espécies florestais? Quando? A partir de que?

Memória:

9) Qual é o último incêndio florestal que você se lembra?

10)Quais são as áreas geralmente queimadas? Mato, pasto, floresta? São sempre as mesmas áreas? Por que?

11)Houve algum incêndio que tenha marcado a história de Rondônia?e quais tipos de mudanças esse incêndio trouxe?

12) A morte de Chico Mendes, em 1988, foi um fator determinante em termos de mudanças nas políticas de Rondônia?

13) Qual tipo de danos são produzidos? A partir de que?

Percepção

13) Quais são as causas dos incêndios na sua opinião?

14) Tem mais incêndios agora ou no passado?

15) Quais fatores influenciaram para que existam mais/menos incêndios?

16) Os incêndios são mais ou menos extensos atualmente?

17) O que influenciou para que agora sejam mais/menos extensos?

Mitigação e atores

18) Quem intervém no risco de incêndios em Rondônia (para apagar ou reduzir o risco)?

Instituições/Organizações Quem?	**Que papel jogam?como/onde atuam?**	**Sua atuação é satisfatória?**	**Se não, por quê?**

19)O governo deve ser o único responsável pela diminuição do risco de incêndios?

20) Quem deveria intervir também?

21) O que os proprietários devem fazer para evitar os incêndios?

22) O(a) senhor (a) identifica algum tipo de atuação ou mobilização de vizinhos relacionada ao risco de incêndios florestais?

23) Quais trabalhos de prevenção existem? Quais deveriam existir?

Participação

24) Qual é a participação dos proprietários florestais na gestão de incêndios em Rondônia?

25)Como qualificaria o efeito das comunidades indígenas e reservas extrativistas na incidência de incêndios em Rondônia? Acredita que a gestão (tomada de decisões) nas reservas e nas terras indígenas ajuda a prevenir ou aumentar aos incêndios?

26) Quais características têm a produção de madeira em Rondônia?

27)Existe influência da indústria moveleira e de papel na decisão dos proprietários florestais? De que tipo?

Governança de risco

28) A quem afeta a governança de risco de incêndios florestais em Rondônia?

29) Como conseguir uma articulaçãoentre atores sociais, políticos e empresariais para diminuir o risco de incêndios?

Nombre:	Edad:
Ocupación/Cargo:	Local de la entrevista:
Fecha:	

Elementos físicos y sociales que influyen en el riesgo de incendios en Galicia.

1) ¿Cuáles cambios (usos de suelo, poblacionales, en las explotaciones o de infraestructura) al largo del tiempo han influido en el riesgo de incendios en Galicia?

2) ¿Qué factores físicos inciden en la ocurrencia de incendios forestales en Galicia?

3) ¿Qué elementos sociales intervienen en el riesgo de incendios?

4) ¿Cuál es la política forestal en el ámbito de incendios en Galicia? ¿Cuáles son sus fortalezas y debilidades a la hora de implementarlas?

5) ¿Cuál es la influencia de la Unión Europea en la política forestal de España?

6) ¿Cuáles son los factores que conllevan al incremento de la masa forestal en Galicia (una vez que Galicia ha pasado por un incremento de la masa forestal de 18,1% de la superficie forestal productora de 1985 a 2005)?

7) ¿Las ayudas de Reforestación de Tierras Agrarias como están afectando/afectaron?

8) ¿Han cambiado las especies forestales?

Memória:

9)¿Cuál es el último incendio forestal que recuerdas?

10)¿Sé queman siempre las mismas zonas? ¿Matorral, pastos, bosque? ¿Por qué?

11) ¿Hubo incendios en 2006 y 1995? Alguna otra fecha importante? ¿Qué cambios produjeron?

12) ¿Qué tipo de daños se suelen producir?

Percepción

13) ¿Cuáles crees que son las causas de los incendios?

14) ¿Hay más incendios ahora o en el pasado?

15) ¿ Qué ha influido para que haya más/menos incendios?

16)¿Los incendios son más o menos extensos?

17) ¿Qué ha influido para que ahora sean más/menos extensos?

Mitigación y actores

¿Quienes intervienen en el riesgo de incendios en Galicia (quienes para apagar y quienes para reducir el riesgo)?

Instituciones/Organizaciones ¿Quién?	**¿Qué papel juegan?**	**¿Su actuación es satisfactoria?**	**Si no, ¿por qué?**

¿Debe ser sólo la administración la única responsable?

¿Quiénes deberían intervenir también?

¿Que deben hacer los propietarios para evitar los incendios?

¿Identificas algún tipo de actuación de vecinos o movilización social relacionada al riesgo de incendios?

¿Qué labores de prevención existen?¿ Y cuáles deberían existir?

Participación

¿Cuál es la participación de los propietarios forestales en la gestión de incendios en Galicia?

¿Cómo calificarías el efecto de los Montes Vecinales de Mano Común en la incidencia de incendios? ¿Crees que la gestión (toma de decisiones) de los MVMC/TI ayuda a prevenir/incrementar los incendios?

¿Qué características tienen los aprovechamientos maderables en Galicia?

¿Cuál es la influencia de la industria papelera en las decisiones de los propietarios forestales?

Gobernanza del riesgo

¿Quiénes a su consideración tienen repercusiones en la gobernanza del riesgo de incendios forestales?

¿Cómo lograr una vinculación entre los actores sociales, políticos y empresariales para disminuir el riesgo de incendio?