UNIVERSITÀ DEGLI STUDI DI PADOVA
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'The role of formal institutions in forest decline: exploring institutional failure'

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Abstract

Despite recent global efforts to reduce forest declines i.e. deforestation, degradation and disturbance, forest ecosystems remain as areas subject to competing resource objectives and socio-economic development paradigms. Consensus and fairly unanimous causes of forest decline exist. However, the concept that institutions are failing to secure positive outcomes for forest resources is somewhat new to resource management discourses. It is argued that formal institutions in forest management, acting as both developers and intermediaries between forest policy development, planning and implementation are subject to meso-scale failure and in some circumstances contribute to forest decline. Adopting a mixed-method approach this thesis applied a modified heuristic DPAESMR (Drivers-Policy-Actions-Effects-State Changes-Monitoring and Reporting) derived from the established DPSIR framework. Taking elements from the traditional policy cycle, we suggest a novel policy evaluation analysis or PEA applied to analyze classical literature and empirical experiences across four separate international and geographical case studies. Focus on formal institutions, their forest policy, actions and effects are assessed against more recently reported state changes and respective forest resources, along with gaps in subsequent monitoring and reporting efforts are described. Land-use change and forest exploitation, intentional or not, demonstrate sustained losses in forest area and degradation processes and disturbance. Forest policy definition remains an issue. Forest policy interpreted and derived from acts, laws and norms vary across each case. Similar themes regarding gaps in institutional regulation, enforcement and information, subsequently result in weak forest administration. This thesis gives evidence that although robust, reasonably well covered and incentivized formal forest institutions exist, they have generally failed to address forest decline and some case even induced it. Institutional failure in forestry is highlighted at meso-scale, varies in typology and from case to case. A better understanding of traditional issues such as property rights and path-dependency or re-orientation may succeed in strengthening institutional adaptation to crisis, triggers and abrupt policy changes.

Keywords

Forest decline, Institutional failure, DPSIR, forest management, policy analysis

Astratto - italiano

Nonostante i recenti sforzi globali per ridurre il declino delle foreste (deforestazione, degrado e perturbazione), gli ecosistemi forestali rimangono aree soggette a obiettivi di risorse concorrenti e a paradigmi di sviluppo socioeconomico. Le cause del declino forestale variano, ma sono abbastanza unanimi nella letteratura scientifica. Recentemente sono emersi concetti di istituzioni che non riescono a garantire risultati positivi per le risorse naturali. L'attenzione alla gestione delle foreste, in particolare, è una novità. Si sostiene che le istituzioni formali nella gestione forestale, che agiscono sia come promotori che come intermediari tra lo sviluppo, la legittimazione, la valutazione e l'attuazione della politica forestale, sono soggette a un fallimento su scala meso-scala, in alcune circostanze che contribuiscono al declino delle foreste. Adottando un approccio misto, questa tesi ha applicato una DPAESMR (DPAESMR (Drivers-Policy-Actions-Effects-State Changes-Monitoring and Reporting) modificata, derivata dal framework DPSIR. Combinando elementi del ciclo politico tradizionale, suggeriamo una nuova analisi di valutazione delle politiche o PEA applicata per analizzare la letteratura classica e le esperienze empiriche attraverso quattro distinti casi di studio internazionali e geografici. Le istituzioni formali, la loro politica forestale, le loro azioni e i loro effetti sono valutati a fronte dei cambiamenti di stato più recenti nelle rispettive risorse forestali. Inoltre, vengono descritte le lacune nelle successive attività di monitoraggio e rendicontazione. La politica forestale e le successive decisioni sull'uso del suolo, intenzionali o meno, dimostrano perdite forestali sostenute, degrado e disturbo in tutti i casi. Temi analoghi riguardanti le lacune nella regolamentazione istituzionale, nell'applicazione e nell'informazione hanno successivamente portato a una cattiva amministrazione forestale. Questa tesi dimostra che, sebbene esistano istituzioni forestali formali solide, ragionevolmente ben coperte e incentivate, in genere non sono riuscite ad affrontare il declino forestale e alcuni casi lo hanno addirittura indotto. I fallimenti su scala meso-scala, cioè i fallimenti istituzionali, nella gestione forestale si sono affermati come un'altra causa indiretta del declino forestale, anche se implicita. Una migliore comprensione di questioni tradizionali come il cambiamento/adattamento istituzionale dei diritti di proprietà, la dipendenza dai percorsi/riorientamento può riuscire a rafforzare le istituzioni per rispondere alle crisi, ai fattori scatenanti e ai bruschi cambiamenti politici.
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Parole chiave

Declino forestale, Fallimento istituzionale, DPSIR, Gestione forestale, Analisi politica

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1 Introduction

Despite global, state and regional initiatives for combating forest decline, several insidious processes continue to act directly and indirectly on deforestation, forest degradation and disturbance in both developed and less developed countries. These processes remain as significant drivers for shifting global forest cover (Aronoldo Contreras-Hermosilla 2000). The world bank estimates an approximate decline in forest cover of 0.78% between 1990-2016 *Figure 1*. Keenan *et al.*, (2015), suggest global forest cover loss as approximately 3% between the same period. Several reports from Rayner et al., (2010), D'Annunzio *et al.*, (2015) indicate a continual decrease in forest cover of approximately 0.13-0.06% per annum, if forest decline processes are not adequately addressed. These estimations appear modest in absolute value, however, it equates to millions of hectares lost annually.

Globally, the entity of forest decline is very hard to quantify. Although deforestation estimates vary between approximately 0.06% and 0.13% per year D'Annunzio *et al.*, (2015); Keenan *et al.*, (2015) as suggested above, what of degradation and disturbance? Unfortunately, both forest degradation and disturbance are more problematic, more difficult to measure and require integrated complex responses.

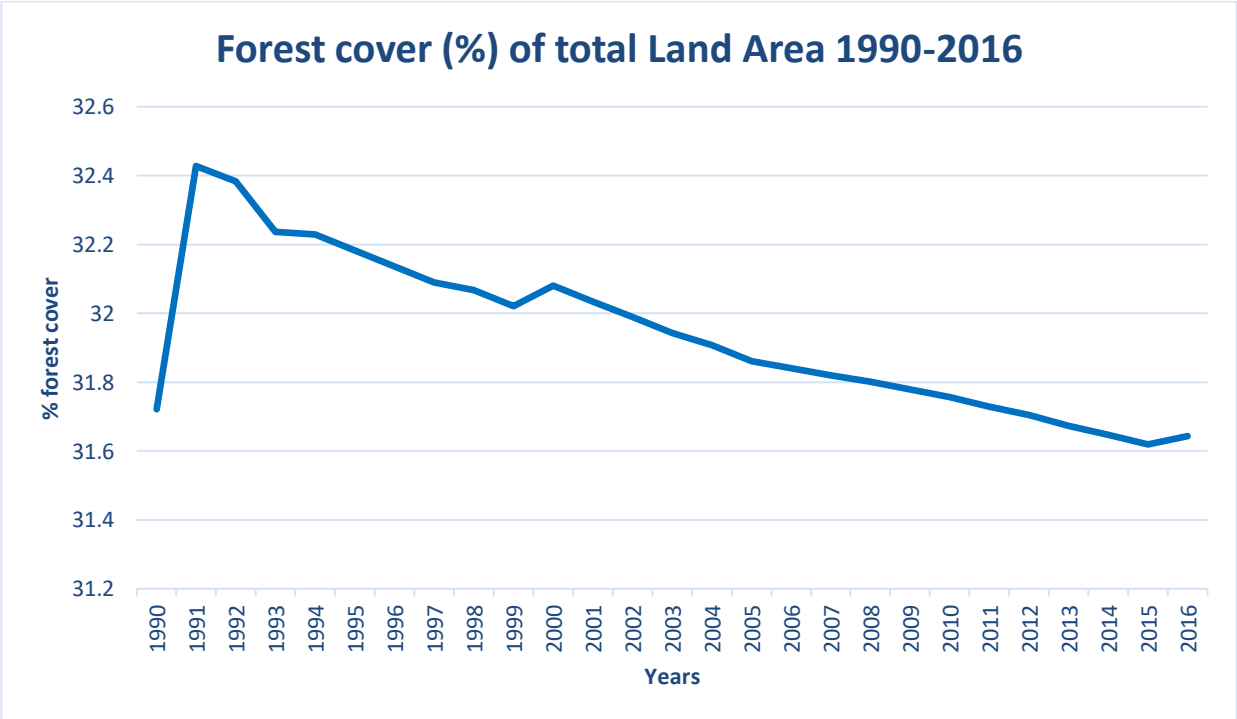


Figure 1: Annual forest cover % of total land area (The World Bank 2014)

Assuming "forest decline" as the common denomination of these global phenomena i.e. forest cover loss, degradation and disturbance (its numerous causes, agents and effects), forest decline is a critical issue and warrants further investigation. Earlier definitions of forest decline state the phenomenon as "*an episodic event characterized by premature, progressive loss of tree and stand vigor and health over a given period without obvious evidence of a single clearly identifiable causal factor such as physical disturbance or attack by an aggressive disease or insect*" (Ciesla and Forest, 1994). The absence of a human element in the above definition must be noted. Anthropogenic or human-induced land-use change arising from resource utility form an integral part of the forest decline discourse. An indirect and partial definition of forest decline can be derived from the analysis of the concept of sustainable forest management (Forest Europe 1993). Forest decline is both the result of and the generator of damage to forest ecosystems when sustainable forest management is not applied, or the capacity to correctly intervene in a particular process not identified or adequately responded to and perhaps more evident in heavily modified landscapes.

In this article, we separate forest decline into three different decline types.

- deforestation: The pre-existing forest ecosystem has evolved into a different ecosystem in which the forest component is minimal or absent. Unless afforestation or reafforestation interventions take place there is a change in land use;
- forest degradation: the ecosystem is in a state of advanced distress due to the simultaneous action of different degradation agents. The resilience capacity of the ecosystem is at its limit, where regulatory, supporting, or provisioning capacity is compromised. Extraordinary and complex interventions are required to counteract the dynamics in progress towards deforestation;
- forest disturbance. The forest ecosystem is affected by processes of various origins which, although important in terms of the resilience of the ecosystem, can respond to these processes if identified and adequately addressed.

A single unanimous definition of forest decline does not appear to exist and may not be achievable, given the contextual differences of the forest condition globally (Damette and Delacote 2012). Most certainly, forest decline, especially anthropogenically induced, is economically wasteful, environmentally degrading, and generally undesirable by society (Arnoldo Contreras-Hermosilla 2000).

Causal mechanisms of forest decline present significant research problems, of which continues to draw attention from researchers in social, environmental and economic disciplines. Increasingly, these are beginning to form new approaches to finding solutions to 'wicked problems' (Moeliono et al. 2014) such as SES (Social-ecological system) models (Armitage et al. 2019) or MCDM (Boungiorno and Gilless 2003).

Souces of forest decline can be biotic, abiotic or anthropological. Within these broad themes, attempts at isolating specific drivers of decline have been explored. For example, Contreras-Hermosilla, (2000), identify direct and underlying (indirect) causes associated with forest decline. Direct mechanisms mentioned are forest disturbances, land-use change and resource over-exploitation. Market failures, mistaken policy interventions, governance weaknesses, broader socioeconomic and political causes are identified as underlying or indirect influences of forest decline *Figure 2*. These have been extensively studied with the focus mainly toward tropical countries more recently (Leblois, Damette, and Wolfersberger 2017; Pendrill et al. 2019). As with most natural resources, forest decline is induced by both direct and indirect causes and as such, intrinsically linked (Aronoldo Contreras-Hermosilla 2000; Evans 2016; Kim, Sexton, and Townshend 2015; Hosonuma et al. 2012; Acheson and McCloskey 2008). Focus on indirect or underlying causes of forest decline is presented in this thesis, although perhaps a less known or studied element, the institution.

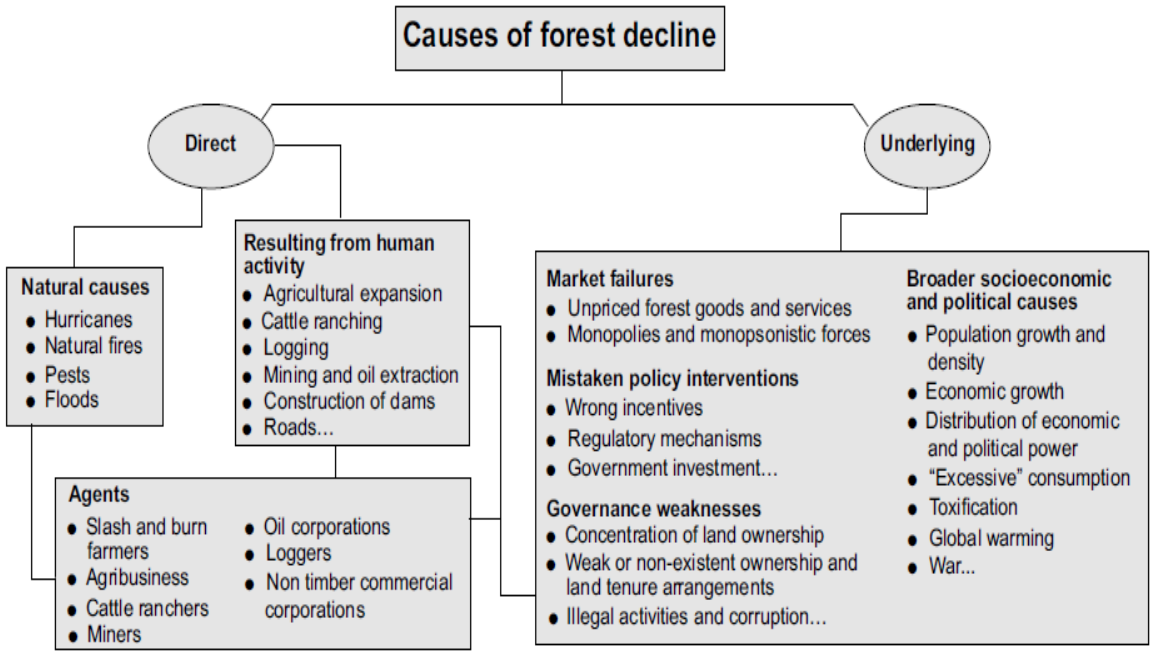


Figure 2: Causes of forest decline (source: Contreras-Hermosilla, 2000 pg. 5-25)

Resource degradation is increasingly being associated with institutions and a distinct discourse and consensus is emerging (Acheson 2006). Formal institutions play a critical role in policy definition, formulation, adoption and implementation (Muller, Domfeh, and Yeboah-Assiamah 2017; Arts and Buizer 2009; Acheson 2006).

Institutions are defined as the set of human-devised behavioral rules and norms that govern and shape human interaction (Jepperson 1991), or a special type of social structure with an acceptance and belief in rules and associated sets of behavior governing political, social, economic and religious arenas, having formal rules and informal constraints (North 1990). Building on North and Jepperson, W. Richard Scott, (2013) explains institutions are formed on three pillars; regulatory, normative and cultural-cognitive. Whereby, these three pillars form the basis, along with associated activities and resources, of stability and meaning to social life. Institutions are therefore considered as both formal and informal. We shall focus in the former rather than the latter. The suggested definitions above, inclusive of civil society, public and private arenas, values, norms and beliefs are far too vast to be entirely inclusive in this article. However, they are essential for navigating forest decline in our context. Because formal institutions in foresty are defined by formal rules and informal constraints, they shape subsequent human interactions with the forest resource through supply and demand.

Institutions play a key role in developing and implementing policies for sustainable forest management, subsequent forest utility and are often overlooked as a source of forest decline (A. R. Poteete and Ostrom 2002). Forest decline, as a continued result irrespective of robust policy and formal institutions is problematic. In this context, formal institutions in forest management are those well-structured organizations having aims, goals, rules, responsibility, competencies, power, resources, and tools in order to implement and achieve forest policy aims. Such as, safeguarding the public interest of forests, to manage directly or indirectly the use of forest resources and influence actions and decision of forest operators (local institutions, forest owners, logging companies, etc.), (Acheson 2006; E. Ostrom and Poteete 2004; Poteete and Ostrom 2002; Zhang 2001). Furthermore, laws, rules and regulations legitimized through state actions.

It has been suggested by previous research that complex interactions between direct and indirect factors associated with socio-economic, political and institutional spheres can lead to forest decline (Arnoldo Contreras-Hermosilla 2000). Operating at different levels, but intrinsically linked, formal and informal institutions (international, national, regional and local) are recognized as linked either indirectly or directly to forest decline. Specifically, this thesis

aims to investigate the role of formal forest institutions and forest decline, determining whether it is an evident case of institutional failure.

Evidence of institutional failure in forest management has been highlighted by FAO, where inadequate institutional structures, capacity and management approaches have often undermined the practical application of policy and laws (FAO 2014). In this thesis, institutional failure is extended to the case of inefficient decisions adopted institution-level and therefore has a direct responsibility on the forest decline registered. Otherwise describe recently as meso-scale failure (Derwort, Jager, and Newig 2019).

To understand forest declines, and in particular those induced by formal forest institutions, it is necessary to reconstruct the path generating it and to indicate the mode in which it is possible to recognize it. Assessment of causality and relationships between human needs, forest resource utility, sustainable forest management and subsequent policy has been assessed by conceptual frameworks in the past (Odermatt, 2006; Sands, 2017; Scriban *et al.*, 2019). Conceptual models are used to collect, visualize and organize information aimed at understanding system complexity where current states and future predictions or trends allow insight into solving problems (Elia and Margherita, 2018). They are organizational diagrams allowing flexibility, and bring together information in a summarized form as (Elliott, Smith, et al. 2016). It is argued they are well suited to resource problems as a means of structuring and analyzing often overlapping and conflicting information within varying resource contexts. They are employed to better inform policy decisions and develop stronger, more effective institutions within respective management spheres (Baxter and Jack 2008). One such conceptual framework, DPSIR Drivers-Pressures-States-Impacts-Responses, has been used to untangle and compartmentalize complex environment resources problems (Elliott 2002; Bradley and Yee 2015; Elia and Margherita 2018; Elliott, Smith, et al. 2016).

1.1 Aim & Objective

This thesis offers a systematic theoretical exploration of the linkage between institutional failure and forest decline. In order to propose a tool for analyzing formal institutions and forest decline, a heuristic conceptual framework has been proposed using a modified version of the DPSIR framework, originally drivers-pressure-state changes-impacts-response (Bell 2012), our DPAESMR Drivers-policy-actions-effects-state changes-monitoring-reporting is combined with a Policy Analysis and renamed as Policy Evaluation Analysis (PEA). The PEA is applied to

four case studies: Indonesia, Australia, Italy and the United States. PEA can be developed by qualitative or quantitative data, in this thesis qualitative analysis have been applied.

This attempt in reasoning appears to be original, especially within the forest management context. We hypothesize that forest decline, which include deforestation, degradation and disturbance, in some cases is at least implicitly linked to the failure of institutions.

Where a combination of mistakes, weakness, misinformation and incompleteness in

- the definition of forest goals and targets adopted in the formal or informal forest policy;
- the implementation of the forest policy;
- the regulation of both forest and non-forest industry in forest areas;
- the management at the *coal face* i.e. operations on the ground;
- the monitoring and reporting of both intervention and non-intervention SFM management effects.

We argue the above mistakes, weaknesses and misinformation lead to decreases in institutional capacity to act as an intermediary between forest policy and forest activities and in some case induce forest decline.

The first tier analysis is aimed at exploring what is the role of formal institutions in each of the four case studies using components of DPAESMR. In the both the PEA and DPAESMR, the agent is a formal institution with competence in the forest sector. Exploring subsequent actions and effects of each policy and an attempt at demonstrating current state changes. Secondly, a comparison of the forest state changes with policy goals and aims adopted from forest institutions are presented as results of the PEA. Monitory and reporting are the outputs submitted to the policy-makers. Thirdly, analysis of each case and current discourses on institutional failure will be highlighted and guided by recent works in this field (Derwort, Jager, and Newig 2019; Neeff and Piazza 2019; Acheson 2006)

1.2 Research plan

Case study methodology has been suggested where one wishes to cover contextual conditions applied to a belief in a relevant phenomenon under study and where boundaries are not clear between the phenomenon and the context (Bartlett and Vavrus 2017; Yin 2014). Adapting the suggested logic case study research process developed by (Yin 2014) (*figure 3),* the following method is applied. 4 global regions are addressed from Europe, Asia, the US and Australia.

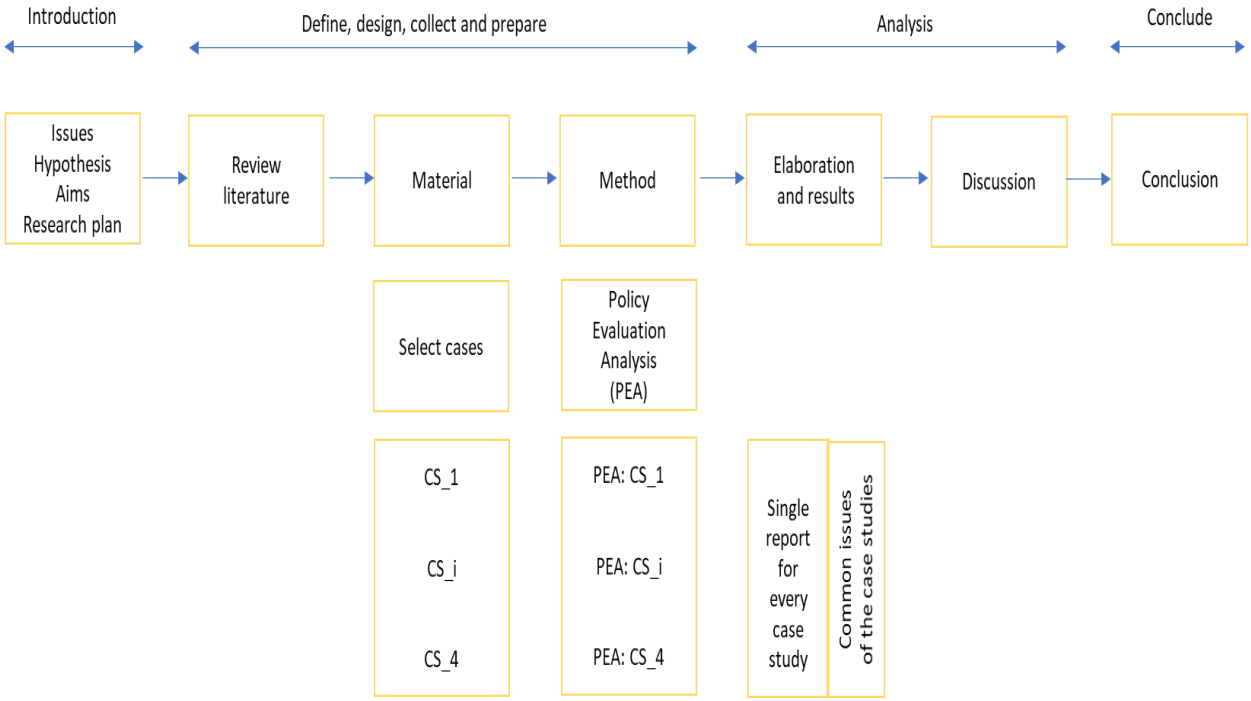


Figure 3: Case study research following logical process design, modified from (Yin, 2014) and adapted to PEA

2 Background

This chapter aims to give a broad narrative on the phenomenon of forest decline, its historical epistemology, the compartmentalized approach to decline and associated difficulties in definition, measurement using sources from classical scientific and social literature. Furthermore, it introduces broad concepts on institutional theory, application to resource and forest management and current discourses on the concept of institutional failure.

2.1 Global Overview

Despite over four decades of global forums, regional and global level initiatives, policy mechanisms and instruments aimed at combating forest decline, the phenomenon remains a significant challenge facing all sectors of forest management and it's institutions. Recent creation and implementation of the mechanisms and instruments such as REDD+, FLEGT (Tegegne, Cramm, and Van Brusselen 2018) and the UNFCCC Paris Agreement and UNFF 2030 (UNFCCC 2015) have ascertained a certain level of collective global cohesion for protecting forests and enhancing forest management (Tegegne, Cramm, and Van Brusselen 2018; Duchelle et al. 2018). Consequently, forests, sustainable forest management and the forestry sector are back on the world stage. The latter two, however, requiring more attention in an attempt to

strengthen institutions further and facilitate more competitive and robust policy-implementation interfaces.

Regardless of the global effort, forest resources continue to be exploited, degraded and converted into other forms of land-use. Furthermore, left completely unmanaged by either chainsaw or without i.e., through efficient and effective strategic monitoring activities (Rasmussen and Jepsen 2018). Agricultural expansion, natural resource utility, disturbance, policy failure, market failure, governance weaknesses and broader socio-economic causes are facilitating forest decline amid shifting political discourses and arenas (Contreras-Hermosilla, 2000).

2.2 Historical epistemology of forest decline

Forest decline, deforestation, degradation and disturbance was described in Germany in the 1970's, where the term *'neuartige Waldsterben'* (new forest deaths) was adopted and replaced by *'neuarige Walschaden'* (new forest damages) assigned to loss in forest health and vigor in mountainous areas and initially linked specifically to atmospheric pollution (Innes 1992). Studies appeared in the late '80s to refute it's assumed intrinsic link to air pollution. Scholars, Holmberg (1989); Innes (1992) began to evaluate forest decline as a symptom of response to changes in environment, short and long term stresses, along with anthropogenic factors causing individual tree mortality and stand-level dieback. Dieback occurs where an individual tree displays symptoms of progressive death of shoots, branches, twigs and roots resulting in loss of crown vigor and possible tree mortality (Mueller-Dombois 1988). Stand-dieback occurs where groups of individuals are displaying the aforementioned symptoms and fragmented stand death. Literature is abundant in this field and has been continually built upon since the term originated. As early as 1918, dieback had been witnessed in Dutch Elm and Ash populations across Europe, Asia and America (Karnosky 1979). Crown dieback in Eucalyptus species in Australia similarly so, although a little later (Landsberg and Wylie 1988).

Response to stand and tree mortality encouraged foresters and ecologists alike, to investigate dieback further and attempt a unified definition (Mueller-Dombois 1988). Assessment of stand structures, stand densities, spatial and temporal dynamics, localized site characteristics, short-term stress conditions and stand life-history began shedding light on dieback processes, thus building the foundation of the ideas of forest decline used presently. As such, forest declines have been explicitly linked to both exogenous and endogenous agents inclusive of

anthropogenic-induced changes in stand spatial and temporal characteristics, pest and disease and climate change irrespective of region or forest type (Aronoldo Contreras-Hermosilla 2000). Abiotic and biotic agents continue to be the focus of research on forest health. Much of the research in this field has furthered the forest decline discourse. This is demonstrated in the more recent definitions of forest decline as described by (Ciesla and Forest 1994), where forest decline is expressed as "*an episodic event characterized by premature, progressive loss of tree and stand vigor and health over a given period without obvious evidence of a single clearly identifiable causal factor such as physical disturbance or attack by an aggressive disease or insect*". Their definition draws on some key points; the often insidious nature of decline and the presence of and persistence of more than one causative agent. Furthermore, it demonstrates the complexity associated with accurate detection, measurement, response and subsequent operationalization of response. Not to mention a unified consensus on a definition. Over the past three to four decades, the forest decline discourse has shifted into two more or less distinct reasoning's. e.g., deforestation and degradation. Galvanizing these reasonings has seen the creation of financial instruments and policy mechanisms at international and national levels. The aforementioned REDD+ mechanism and FLEGT, along with voluntary forest management certification schemes such as FSC (Correia 2010) are examples of growing willingness and response to combat forest decline across political arena, within the scientific community and society in general (Keenan et al. 2015; Tegegne, Cramm, and Van Brusselen 2018; Duchelle et al. 2018). Much as been achieved in this sphere and significant investment and research continues to be pursued.

2.3 Deforestation, degradation and disturbance

Forest decline has more or less been split into two distinct compartments whilst explicitly linked. Compartmentalizing forest decline into deforestation and degradation, it could be argued, has allowed an increase in institutional focus toward addressing the phenomena. Both deforestation and degradation have inspired separate definitions for apparent reasons. Attempts at harmonizing the definitions have been made (Szegedy et al. 2016; Heymell and MacDicken 2011). The UNFAO's description from the most recent *FRA 2015* states deforestation as '*The conversion of forest to other land use or the permanent reduction of the tree canopy cover below the minimum 10 percent threshold*' (FAO 2012). Their definition implies long-term or permanent forest cover loss inclusive of land use alternatives such as pastures, water reservoirs, urban fabric and natural disturbances or were a complete inability for the

land to recover and support forest cover greater than 10% (FAO 2012). It doesn't define, however, a specific temporal scale for forest loss i.e. period of complete canopy loss and furthermore it's prescription of a *minimum 0.5 ha* renders the 10% cover loss definition almost operationally useless, especially in developing countries or regions where small-holder forest tenure and high fragmentation exists (Aronoldo Contreras-Hermosilla 2000). Definition of forest also varies from country to country, take Australia for example where a forest is defined as '*forest and woodland dominated by trees at least 2 m high, with at least 20% canopy cover and a minimum area of 0.2 ha*' (Evans 2016). This definition alone greatly differs from the FAO definition.

What is even more quarrelsome is defining degradation. Again I refer to FAO, 2012,; describes degradation as "*the reduction of the capacity of a forest to provide goods and services*". Degradation implies a reduction in productive capacity; deforestation signifies a complete loss of productive capacity and depletion of all forest ecosystem services. Defining degradation is notoriously difficult because of its insidious nature and the difficulty with which detection and measurement are captured and addressed. An assessment by Heymell and MacDicken, (2011) attempted to harmonize and define a core definition for forest degradation. They state that in general, definitions at the time, were broad or had a particular focus on characteristics of stand biomass, biodiversity and productivity. Whilst these are certainly good indicators, it failed to integrate temporal and spatial scales and inclusively integrate anthropogenic agents. A more focused approach is demonstrated by Thompson *et al.*, (2013) who applies 5 criteria to assess degradation 1.) productive functions 2.) unusual disturbances 3.) biodiversity 4.) protective functions and 5.) carbon storage. Both temporal and spatial scales are included in the authors work.

The issue with a single definition of degradation is a.) perceived losses incapacity to provide goods and services is sometimes a subjective assessment at national and regional levels and very much associated with socio-economic and environmental nuances within the established polity as demonstrated in Indonesia (Ekawati et al. 2019) b.) challenges in defining and measuring temporal and spatial changes in forest structure, canopy cover, land use and even forest type is reliant on accurate and long-term data series; often temporally unaligned with legislative and regulatory mechanisms (Hickey, Innes, and Kozak 2007; Gunn, Ducey, and Belair 2019) c.) Determining trade-offs between forest ecosystem services and economic development is a subjective decision (Acheson 2006) and d.) defining and measuring natural or human-induced degradation, where in most cases they are functioning together, is also

fraught with decision ambiguity (Armitage et al. 2019). Creating a universally accepted global standard will require significant investment, institutional commitment and further advancements in remote sensing. Application of remote sensing techniques have advanced forest decline detection in the past two decades, demonstrating more refined approaches to forest decline detection with assessments of changes in both forest characteristics and more recently socio-economic factors across spatial and temporal horizons (Senf, Seidl, and Hostert 2017).

Figure 4 below, is a simple representation of degradation thresholds, deforestation and intervention opportunities incorporating all FAO, 2012 definitions. It highlights canopy cover as a critical variable in determining classification and illustrates possible intervention opportunities as a function of declining canopy cover (Heymell and MacDicken 2011).

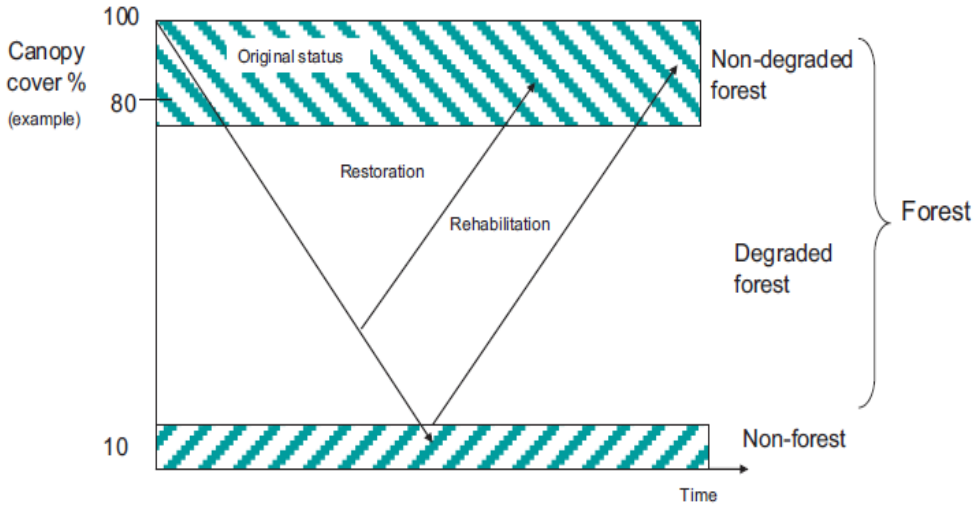


Figure 4: Degradation thresholds adopted from where 100% of canopy cover refers to 100% of the avg. canopy cover of a given forest type. (Heymell and MacDicken, 2011 p.g. 8-99)

2.4 Difficulties in measurement and quantification of forest decline

Various efforts in assessing forest decline globally, remains challenging and substantial. Most recently, *The Global Forest Resource Assessment 2015*, established by the United Nations Food and Agriculture Organization (FAO), suggest a loss of global net forest cover of approximately 1% of total land cover between 1990 and 2015 (MacDicken, Reams, and de Freitas 2015). Regionally, deforestation rates vary across the globe with tropical countries experiencing higher rates historically (Kim, Sexton, and Townshend 2015; Hosonuma et al. 2012). However, hotspots have also been identified in more developed countries such as Queensland, Australia (Simmons et al. 2018). Additionally, Global Forest Watch, a web-based platform, estimates an

approximate loss of 8.4% of total global tree cover since 2000 as of its most recent update, 2017 (Global Forest Watch 2018). Interestingly, they define forest in terms of tree cover as "*canopy closure for all vegetation taller than 5m in height*" and use a data set based on net gains/losses inclusive of disturbance, plantation activity and alternative land use. Acceleration has been measured by Kim, Sexton and Townshend, (2015), who suggest an estimated 62% acceleration of deforestation in the tropics between 1990 and 2015. There is substantial differences in estimations as indicated above most likely attributed to differences in definition, satellite data sources and applied methods. Irrespective of the differences in forest loss/gain estimations, forest decline continues and despite noble institutional responses.

The quantification of forest loss/gain surpasses tree cover and other forest characteristics as critical variables, becoming increasingly inclusive of socio-economic drivers for developing scenarios and future trends. Modeling future forest conditions with projected land-use trends have been made. For example D'Annunzio *et al.*, (2015) modeled losses and gains in forest cover across 91 countries to determine trends in global forest exchanges between alternative land uses, agricultural expansion, afforestation and rural abandonment from 2015 to 2030. Their research suggests repeated but significantly reduced rates of deforestation between 0.13% and 0.06%, driven by a decrease in natural forest loss and gains in the forest plantation area. Although this is promising, industrialized timber plantations are a source of great debate. Whether they are considered as part of the broader land degradation process or not is debatable, especially where the primary forest is replaced by monoculture timber plantations (Kanowski, Catterall, and Wardell-Johnson 2005; Pirard, Dal Secco, and Warman 2016). Another component of decline is disturbance. Whether anthropogenic or natural, disturbances such as mega-fires, flooding events and cyclones are critical to stressed forest ecosystems. Especially those where degradation is established.

Understanding the difference between deforestation, degradation and disturbance is critical. Separating each, although intrinsically linked, further clarifies some of the ambiguity in the terminology. Resolving the differences through examining key driving processes, temporal scales, agents, actors and institutions, of which literature is abundant, illuminates the discussion further. Therefore, the question is, what are the significant drivers of forest decline? A study in 2001 by Contreras-Hermosilla, (2000) thoroughly explored the causes of decline, *figure 2*, recognizing the complexity of the topic and highlighting, implicitly, the different spatial and temporal nature of the issue. Leblois, Damette and Wolfersberger, (2017) examined drivers of deforestation in developing countries to determine potential geographical heterogeneity,

finding economic development, agricultural activity and population pressure as important variables in forest cover loss. Interestingly they found a trade to be a crucial factor. Previous research by Hosonuma *et al.*, (2012), further supports later works as mentioned above, where their analysis of the forest transition theory also indicated strong links with agricultural expansion and population in forest decline. Trade of agricultural and forest commodities, mainly palm oil seed, cattle and development of timber plantations, both increased net-carbon emissions and facilitated forest decline in the tropics between 2010-2014 according to Pendrill *et al.*, (2019). Agricultural expansion and associated corresponding socio-economic exogenous variables influenced forest cover loss in the Caribbean, highlighting improved living standards as one of several important underlying causes of forest decline in the region (Newman, McLaren, and Wilson 2018). Khuc *et al.*, (2018) applied structural and regression models to determine key variables associated with deforestation and degradation in Vietnam. Their study identified higher rates of forest decline correlated with poverty, higher rates of forest decline correlated with population density and positive correlation between provincial competitiveness, i.e. the ability for a province to implement public policy and combat corruption. A key finding from the study, suggests agricultural production did not significantly influence deforestation and degradation. This was attributed to agricultural intensification rather than expansion. Different external and local factors are often operating at once across different spatial scales, making it challenging to pinpoint explicitly what socio-economic variables result in forest cover loss or degradation. This is further demonstrated in Southern European countries such as Italy. Ferrara *et al.*, (2017) established 149 statistical indicators to assess socioeconomic structures of local communities and forest expansion and loss in Italy. Their findings suggest agriculture, income, education and labor market indicators as predictors of forest cover across the country. Spatial relationships between socio-economic indicators and forest expansion and loss were demonstrated. Furthermore, regional polity and socio-economic context, even in a globalized world, remains influential in the forest condition.

Agricultural expansion and population density are subject to resource demand and market conditions, both domestically and internationally. These two factors alone place pressure on forest ecosystems and marginalized land, especially in developing countries. Competing land uses encouraged by increasing population density have noticeably contributed to forest decline, most notably in developing countries of Asia, Latin America and Sub-Saharan Africa predominantly the equatorial belt and tropics (UNFAO 2018).

2.5 Developed vs Developing Countries

Drivers of forest decline are not solely attributed to developing countries or the tropics, where soya crops, mining, palm oil expansion, cattle ranching and illegal logging still remain as significant drivers of deforestation and degradation.(Varsha et al. 2016). Much of the recent attention for forest research has been focused toward tropical nations of the globe (Leblois, Damette, and Wolfersberger 2017; Kim, Sexton, and Townshend 2015; Austin et al. 2019; Newman, McLaren, and Wilson 2018) given accelerated land-use change and forest cover losses in these regions. However, developed countries are not immune and face challenges of forest decline. Pest and disease outbreaks, large scale disturbance events, policy and market failures, inadequate policy interventions, poor networking and collective action dilemmas cause considerable forest damage and incur significant public expenditure (Acheson 2006; Aronoldo Contreras-Hermosilla 2000; de Koning 2014; Hosonuma et al. 2012; Pendrill et al. 2019; Song et al. 2018). Studies linking decline to short-sighted silvicultural management objectives along with the frequency of ownership change and lack of professional forester involvement have been demonstrated in the US (Gunn, Ducey and Belair, 2019). Over-exploitation, colonial conflict, polarized discourses, land tenure disputes and relaxed land clearing laws in Australia, another example (Evans 2016; Kanowski 2017). Although more developed countries have access to larger financial resources and established institutional procedures, they suffer similar breakdowns between policy and operationalization. They are less exposed to corruption than less developed nations and tend to have more safety nets an robust forestry sectors. Institutions in forestry whilst heterogenous by context do share some similarities.

2.6 Institutional background and application to forestry context

Institutions in forest management form a significant component of land management and administration (Zhang 2001). Forest decline is both implicitly and explicitly linked with formal institutions. Formal institutions in forestry have been identified previously as mediators where they influence the interest in collective action (E. Ostrom and Poteete 2004). More commonly they have been identified as institutions governing property rights, markets, organizations and information (Zhang 2001; Elinor Ostrom 2008; Acheson 2006). Well documented, traditional formal forestry institutions have followed command-control systems and top-down hierarchical structures similar to military-style hierarchy structures (Sands 2017). However, the advent of governance has seen a horizontal spreading of administrative responsibilities, a paradigm of decentralization (Secco et al. 2017; Scriban et al. 2019) and subsequent power

delegations from central states to regions (Secco et al. 2017; Sills and Jones 2018; Acheson 2006). Governance itself, requires institutional flexibility and adaptiveness to be effective as described by (Muller, Domfeh, and Yeboah-Assiamah 2017). Evolutions in forest management discourses have been the impetus of a more focused assessment of institutions, their role and outcomes, rather than solely policy an market failures (Poteete and Ostrom 2002). The focus of which is limited to a small but influential number of investigations, for example (Derwort, Jager, and Newig 2019; Newig, Derwort, and Jager 2019; Acheson 2006; Acheson 2000). However, in order to understand forest institutions, one must first understand institutional theory in a broad sense at least.

Institutions represent a social order or pattern attaining a specific state or property and *Institutionalism* denotes the process of such attainment (Jepperson 1991). W. Richard Scott, (2013) defines institutions as '*Institutions comprise regulative, normative, and cultural-cognitive elements that, together with associated activities and resources, provide stability and meaning to social life'* further establishing institutions on three pillars. Or as Jepperson, (1991) eloquently puts it '*Institutions are those social patterns, that when chronically reproduced, owe their survival to relatively self-activating social processes*'. North, (1990) states *'institutions are the rules of the game in society, more formally they are the humanly devised constraints that shape human interaction'*. They have been described as relatively resistant to change and exhibit stabilizing properties and elements both defining and constraining their existence (Scott 2013; Jepperson 1991). Let us consider Scotts (2013) approach in a forestry context. *The regulative pillar* identifies constraints and regulations that shape behavior, i.e. rule-setting, monitoring, sanctioning. In forestry, we can consider, law, access rights, fees/permits and fines as regulative institutions. These institutions are legitimized formalization of the rules of the game (North 1990). *The normative pillar* identifies *Values* and *Norms* whereby institutions are shaped by how things should be done (*Norms*) and conception of the desirable or preferable way things should be conducted or standardized within existing structures (*Values*) (Jepperson 1991). The normative pillar in forestry is represented by the various voluntary accreditation bodies, FSC, and voluntary market instrument *PES*, along with stakeholder perception and institutional culture. The last Pillar discussed by Scott, 2013, is the *cultural-cognitive pillar* which identifies the shared conceptions that constitute the nature of reality by which we frame meaning to our environments. This pillar forms shared definitions of local situations, shapes standard frames and produces patterns of organization. It influences organizational structures and defines belief. Therefore shaping conduct and selected political and economic paradigms (Scott 2013).

Simply, behavior of structured organizations and individuals is a response to their present and past environments and associated form constraints which are derived from both the *regulatory* and *normative* pillars. Between the *cultural-cognitive* and *normative* pillars forest management shares a scale from community-based management activities to transnational industrial plantation companies. For example, in forestry, there is an established hierarchical structure, specified roles, expected behaviors and a myriad of standard operating procedures for conducting operations and planning shaped by both internal and external forces, power structures, expectations and administrative arrangements.

	Regulative	*Normative*	*Cultural-Cognitive*
Basis of compliance	Expedience	Social obligation	Taken-for-grantedness Shared understanding
Basis of order	Regulative rules	Binding expectations	Constitutive schema
Mechanisms	Coercive	Normative	Mimetic
Logic	Instrumentality	Appropriateness	Orthodoxy
Indicators	Rules Laws Sanctions	Certification Accreditation	Common beliefs Shared logics of action Isomorphism
Affect	Fear Guilt/ Innocence	Shame/Honor	Certainty/Confusion
Basis of legitimacy	Legally sanctioned	Morally governed	Comprehensible Recognizable Culturally supported

Figure 5: Three pillars of institutions - Regulatory, Normative and Cultural-Cognitive (Scott 2013 p.g. 60-345)

Forestry institutions are the product of a 'productive system,' an enabling structure, a social program and a performance script, i.e. they all have activity sequences whereby they order or have patterns as determined by social constructs (Scott 2013; Jepperson 1991). This suggests both temporal and spatial components, division of labor and an institutionalization process (Scott 2013). A system of action is said to be institutionalized to the extent that actors in an ongoing relation orient their actions to a common set of normative standards and value patterns (Jepperson 1991). Forestry institutions, associations and organizations, as with other collective based resource systems, respond to societal demands and are shaped by policy in attempts at meeting these demands. Achieved through highly structured and embedded routines and reproductive procedures supporting and sustaining their reproduction (Newig,

Derwort, and Jager 2019). They are systems having multiple levels or orders of organization (primary levels of organization can work as institutions relative to secondary levels of organization (Scott 2013) i.e. the general hierarchical nature of forest management structures and local, regional and state-level management structures. We can treat an object as an institution relative to its centrality as suggested by Jepperson, (1991). For example formal institutions in forest management, i.e. state-based forest management agencies as a core component of administrating policy objectives as a fixed feature of its external environment. The environment, politically, socially and through the market determines its centrality also. An institutions relevance relies on its ability to remain flexible to its context, to societies demands and to surrounding changes in discourse (Koontz et al. 2015; Schlüter 2007; Newig, Derwort, and Jager 2019). These features determine if an institution will rise and fall based on its fundamental role as part of the broader context (Zhang 2001). Subsequently, institutional stability, decline, re-orientation, obsoletion and failure are determined by context, relevance, society and power, as discussed by (Newig, Derwort, and Jager 2019; Acheson 2000; Acheson 2006).

2.7 Institutional failure discourse and current research.

Institutional failure has been addressed outside of natural resource management, for example in the financial sector. Sinclair, (2012), discusses the global financial crisis and associated institutional failure of the rating agencies that lead to the 2008 financial crisis. The author points out, regulation is concerned with the 'rules of the road" not the design of the road itself. This is pertinent statement because institutions are often viewed as having established and legitimized "road designs" given their functional longevity. As such we as society have developed institutional expectations and reliance on their functioning. We as society, define failure based on what our expectations of an institution are, their structure and function (Newig, Derwort, and Jager 2019). Up until recently formal institutions have remained outside of many contextual failure analysis. However, as Derwort, Jager and Newig, (2019) describe, the extensiveness widespread occurrence of failure is now an integral part of the policy process. Formal institutions in forest management are heavily orientated toward centralized command and control structures, self-realizing/maintaining processes and generally defined by elements of the regulatory pillar, *figure 5,* described by (Scott 2013). This is demonstrated by Acheson, (2006) where he identifies formal regulatory institutions such as property rights, transaction costs, and their impacts on collective action dilemmas. Moreover, these institutions are

traditionally not treated as a variable of failure (A. Poteete and Ostrom 2002; Acheson, 2000). The institution itself is subject to our defined definition of what it is. We decide whether an object is an institution based on analytical context, whether we consider an object an institution depends on what we believe to be the analytical problem (Jepperson 1991). Using this logic, the analytical problem is defined as: are formal institutions, *the object,* failing to sustainably administrate forest resources efficiently or effectively as an intermediary between policy and forest management activities, *the context.* What society, the market and politics defines as 'relevant' or 'required', impacts on the supply and demand of these institutions (Zhang 2001; Fleischman and Solorzano 2018) and therefore also impacts institutional adaptation, change and re-orientation (Newig, Derwort, and Jager 2019). As such the main incentive for this study is to treat formal institutions in forest management as a source rather than a component of forest decline. Complex relationships between the forestry sector, it's formal institutions and the "rules of the game" exist and are not necessarily in harmony. Dissecting this relationship is challenging and enlightening.

3 Methodological Background

3.1 *Drivers-Pressures-States-Impacts-Responses (DPSIR)* model and its applications

Understanding the often-complex socio-economic nuances of natural resource management involves disseminating information about various components embedded in a management or policy sphere and determining how those specific components are linked. Conceptual frameworks provide a blueprint to develop a system of concepts, assumptions and rational explanations via visual or written means aimed to expand and examine key factors, concepts and variables across specific contexts via graphical or narrative-based conception (Ruiter 2001). An example of a conceptual framework or *heuristic* applied in resource management is the *Drivers-Pressures-States-Impacts-Responses,* known as the DPSIR framework (Figure 5). It is a logical or systematic approach to structuring and analyzing information in management and decision-making across ecosystems (Elliott, Smith, et al. 2016). The original DPSIR framework recognizes

- *Drivers* - as those factors that motivate human activities to fulfill basic needs from resource utility.
- *Pressures* - as human-induced activities and actions where the functioning of socio-economic activities and driving forces induce changes in the environment.

- *State Changes* as the quality and quantity of the physical, chemical and biological components of the natural and built environment.
- *Impacts* as subsequent socio-economic or environmental components, where adverse effects on the normal functioning and provision of ecosystem services are affected.
- *Responses* as recognition and action by society, institutions or policymakers where undesired impacts and state changes are identified (Bradley and Yee 2015; EEA 1999; Elliott, Söderqvist, et al. 2016; Elliott, Smith, et al. 2016; Kristensen 2004).

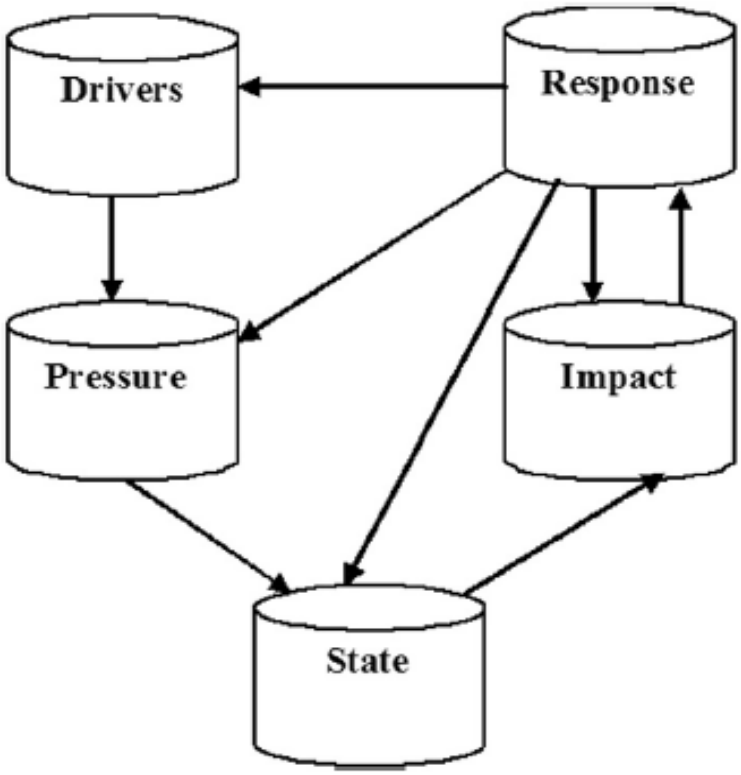


Figure 6: Original DPSIR framework adopted from (Gari, Newton and Icely, 2015 p.g. 64-77)

The European Environmental Agency (EEA) applied the DPSIR framework for standardizing analyzing, monitoring and reporting of the environmental state to the policymakers using a set of typology indicators for evaluating their own progress over time (EEA 1999). Elliott, (2002), used the DPSIR approach to identify causal chains associated with environmental consequences for off-shore wind turbines. Odermatt, (2006), applied the DPSIR approach to study sustainability outcomes in mountain areas using applied sustainability variables in a comparative analysis between developing and industrialized countries. An examination of linkages between climate change pressures and it's consequences for biodiversity, ecosystem services and policy responses was conducted by Omann, Stocker and Jäger, (2009). They used the DPSIR framework in order to better define linkages between climate change and natural

systems. Kagalou *et al.*, (2012) described critical elements for an integrated basin management plan using the DPSIR framework in order to identify management and policy decisions at a basin level scale, highlighting key response measures. In China, a study focused on quantifying socio-economic influences on biodiversity, ecosystem services and human well-being was conducted using the DPSIR approach, combining regional statistical data with each component of the framework in one of few quantitative mixed-studies using the framework (Hou et al. 2014). Another study in China further demonstrates the application of the DPSIR approach to develop a comprehensive indexing system for holistically evaluating overall ecosystem effects of a polluted river and its subsequent restoration attempts (Lu et al. 2019). Further application of the framework is demonstrated by Spanò *et al.*, (2017), who used the DPSIR framework as a tool to support green infrastructure planning in Southern Italy by identifying each component through a stakeholder workshop process guided by the framework.

Application to a specific forest context is limited. Scriban *et al.*, (2019) used DPSIR to asses the forest restitution governance process in Romania and subsequent impacts on resource management outcomes identifying administrative structures for private forests, restitution effects and associated institutional tools in a holistic approach to determine the relationship between the governance of the forest restitution process and forest management outcomes.

The described above are but some examples of many applications of DPSIR. This heuristic tool is establishes a flexible logical scheme to compartmentalize complex resource management problems and establish solutions. Adaptations of the framework with alternative qualitative methods have been demonstrated across the literature

As demonstrated by (Elliott, Smith, et al. 2016), the past 25 years have seen an abundant application and modification of DPSIR across natural resource management sectors. Modifications have been principally focused toward refining and modifying the framework to address some of the criticisms leveled toward it. These criticisms involved the clarification of component analysis and associated ambiguity in the terminology (Gari, Newton, and Icely 2015), also in the compartmentalizing of the framework, as noted by (Elliott, Smith, et al. 2016). Bell, (2012), demonstrates an applied mixed-methodology approach. Here DPSIR framework has been adapted in order to facilitate the public participation within a Systematic Sustainability Analysis.

3.2 Experience of DPSIR in the forest context

Conceptual frameworks continue to be employed as a means of addressing the complex multi-faceted nature of resource management. They have been successful in integrating institutions, their structured organizations and private and public actors which require cohesion and participation (Elia and Margherita 2018). Forests, having heterogeneous services for heterogeneous users (Montgomery 2013) require heuristic approaches for successful assessment and identification of predictors through logically conceptualized frameworks and applied qualitative and/or quantitatively metrics (de Moraes Gonçalves et al. 2014) . The optimal combination of services and functions is attempted and defined through policymakers and formal institutions, however there is often no single solution or 'silver bullet'. Even if policymakers have high expectations, they do not always achieve the desired effects in a coherent manner. Nor a combination to meet the needs of a cohort of service-based commodities driven by human elements. There is no empirical evidence and previous research of applying the DPSIR framework in it's original form to forest resource management. However terrestrial and aquatic ecosystem application has been explored by (Elliott, 2002; Odermatt, 2006; Kagalou *et al.*, 2012; Lu *et al.*, 2019). Adaptations have also been applied to environmental planning (Spanò et al. 2017), socio-economic studies on biodiversity (Hou et al. 2014), forest governance assessments (Scriban et al. 2019), mixed-method analysis (Skondras NA and Karavitis CA 2015; Spangenberg 2017; Barnard and Elliott 2015) and as a subject of systematic review (Elliott, Smith, et al. 2016; Gari, Newton, and Icely 2015).

3.3 From DPSIR to Policy Evaluation Analysis.

The ability to facilitate analysis of relationships between the physical environment and socio-economic components is not novel. Heuristics, such as DPSIR have been applied in many different forms e.g. MCDM (Segura, Ray, and Maroto 2014). The inherent flexibility with which DPSIR may be applied to differing resource management spheres is demonstrated by ample modification and application of the framework since it's initial creation in the 1980's (Elliott, Smith, et al. 2016; Gari, Newton, and Icely 2015). In this study the DPSIR (figure 5) is integrated with forest policy cycle steps (figure 6) for obtaining a new conceptual framework of Policy Evaluation Analysis (PEA) as shown in Figure 7. It is a logical framework for investigating policy effects, that in the thesis have been based on qualitative data.

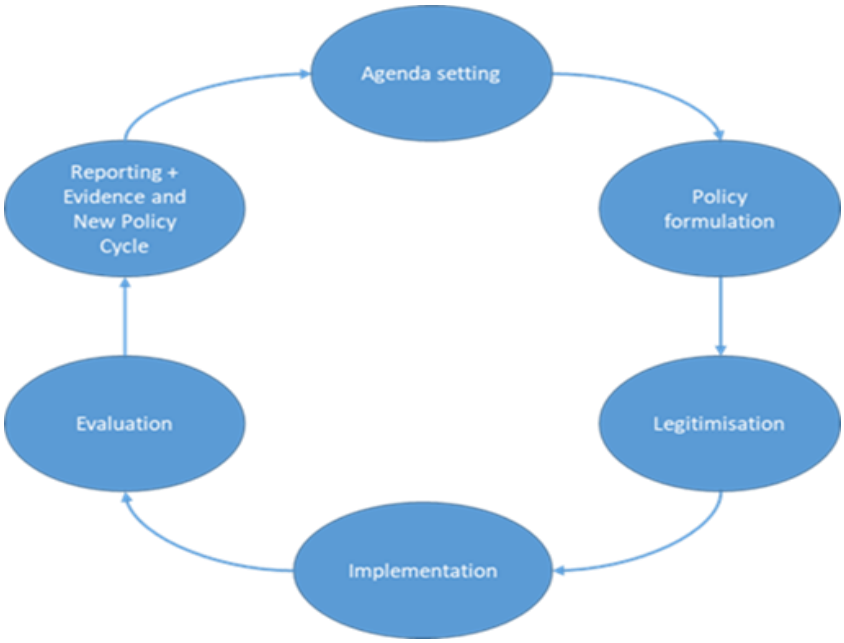


Figure 7: The traditional policy cycle.

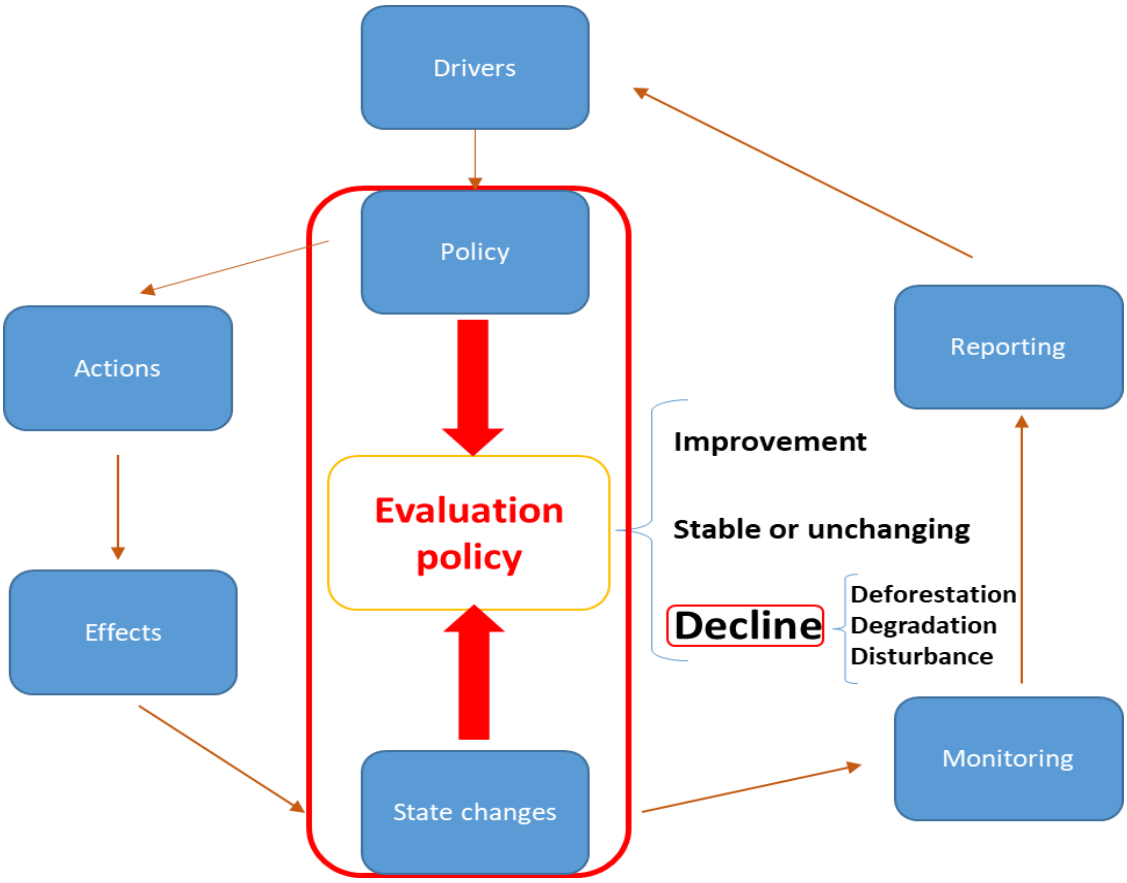


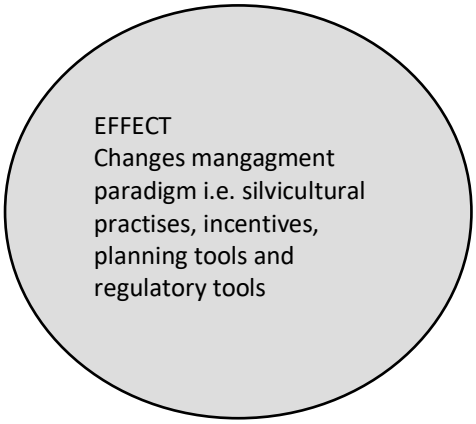
Figure 8: Integrated DPSIR and policy cycle: the policy (Drivers-Policy-Actions-Effects-State Changes-Monitoring-Reporting)

3.3.1 Framework Components

Drivers – formal institutions and other structured organizations within the forest management sphere, having recognized competency in the policy and decision-making apparatus. Operating in the forest sector using policies, acts, laws, regulations, administrative procedure, and other institutional tools. Considered as national regional or local government institutions with mandated responsibility for operational implementation phases forest policy. Also organizations within the forest management sphere, having recognized competency in the policy and decision-making apparatus.

Policy - It includes formal or informal policy sector, produce from institutional government (top-down) or a public participation process (bottom-up) approach. It includes Agenda setting, policy formulation and legitimacy of the policy cycle. Vision, mission, target, aims, resources, timetable are the relevant informations that describes what are the expectation that policy should be achieve.

Actions - Actions (or Implementation) are the initiatives/measures identify in the policy in order to achieve forest policy goals. They reflect what institutions have employed within adopted or mandated policy. Initiatives/measures incorporate the organizational structure bases (human, professional, intellectual and monetary resources) and tools with which an institution intends to operate (legislative, regulatory, administrative, organizational and technical)



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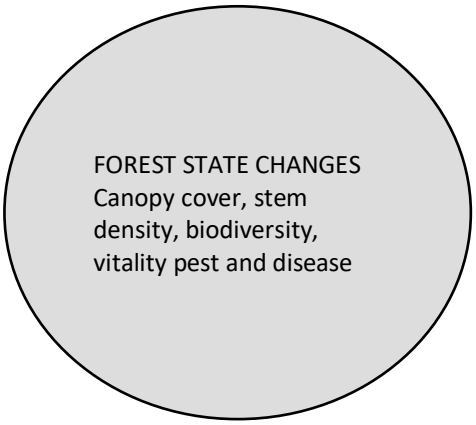
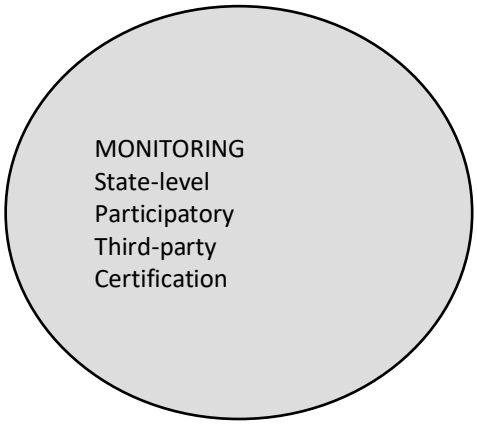
Effects - Actions stimulate *reactions in the forest ecosystem* over both temporal or spatial scales; in the forest ecosystem itself and in the ecosystem management. Effects are those changes at forest level adopted actions.

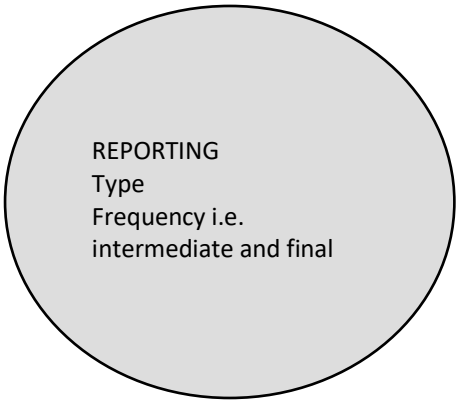
Forest state changes – It describes the forest ecosystem state at the end of policy implementation. The condition observed will be considered for comparing the forest state when the forest policy has been defined (baseline). Variation in terms of forest natural capital, productivity ecosystem functions and services are the variables that should be analyzed.





Monitoring - refers to the technical measurement and collection of forest data. A monitoring plan with a list of indicators at the time of forest policy formulation and implementation. Oversite of policy implementation. Emphasis on monitoring activities in forest management is growing and importance (Rasmussen and Jepsen 2018). Monitoring can be developed through the State, using a participatory approach, or committed to a third-party.

Reporting - Data collection obtained from the monitoring activities, elaborated and aggregated in order to describe effectively the forest ecosystem state. Different type of reporting can be produced: technical report, special report, institutional report, etc.



3.3.2 Main type of PEA results

In this applied context we test the PEA on formal institutions in the forest and forest-related sectors to determine their role and explore institutional failure. We assume formal institutions as the agent responsible for decisions that promote an action which in turn have effects on the forest ecosystem. In the forest policy arena, it is the action with which results achieved (state forest change) are compared with the goals defined in the policy (Krott 2005). It is a critical step in the traditional policy cycle because it affects operational activities and determines the success or failure of policy decisions. As such we have developed an iterative and inductive process to assess the relationships between policy objectives and state changes and hope to highlight the institutional links between the two. As far as we know this is a novel approach. Following a similar approach as described by (Carbone, 2014), the below figure represents possible types of results achieved and expected.

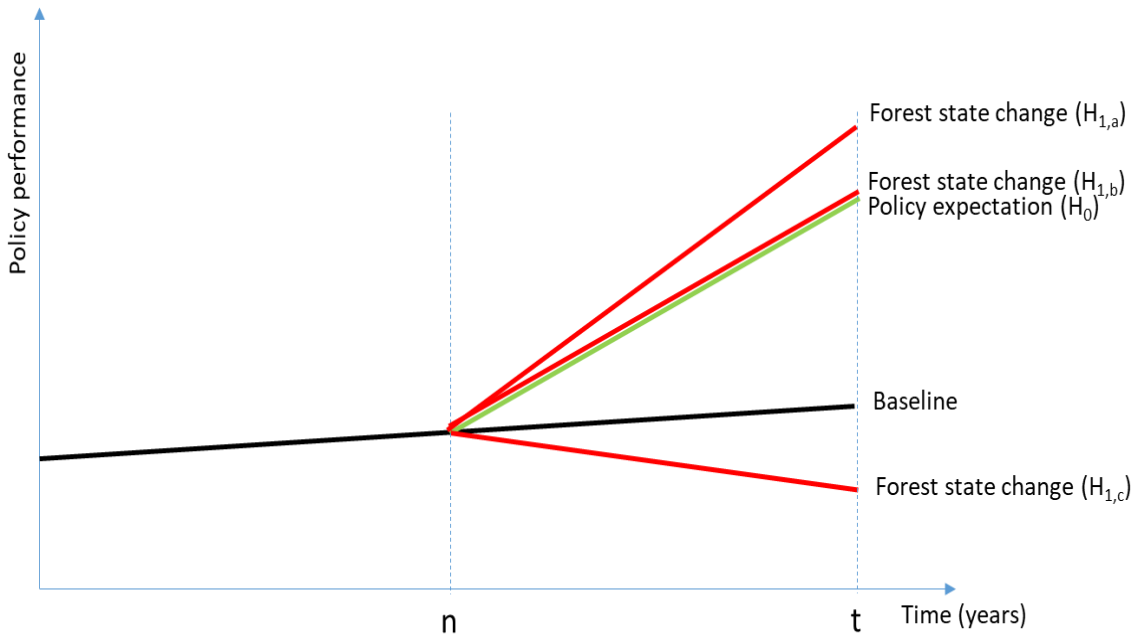


Figure 9: Evaluation pathway adopted from (Carbone, 2014 p.g. 567-589)

- $H_{1,a} > H_0$ refers to situations expressed as *positive or improved*, according to which the forest system has improved more than forest policy expectations. This result highlights that an efficiency forest policy has been adopted, and formal institutions were more than able to satisfy the forest vision adopted;
- $H_{1,b} = H_0$ refers to situations expressed as *coherent.* Forest policy is efficient and the forest policy expectation is aligned with formal institutional goals and implementation representing a level of harmonization between institutional structures, policy and

implementation. Collective well-being have been improved for the expected from the institution;

- $H_{1,c} < H_0$ refers to situations identified as *problematic* especially if an inefficient forest policy has been adopted and the formal institution has been unable to reverse the trend. In this condition *declining forest states* have been registered.

4 Material and Methods

The study was developed following the research process represented in figure 3 of section 1. Identification of 4 case studies sourced in the international scientific literature guided the case study selection process. The selection criterion was to identify those cases in which forest policy decisions adopted by Formal institutions is main factor in forest decline. Case studies were selected through a literature search using Scopus, Science Direct and Google Scholar and guided by a definition and context bounded approach suggested in table 1 as suggested by Bartlett and Vavrus (2017), and Yin (2014). Firstly, an iterative and inductive process focused on forest decline, its causes and a keyword search were applied to gain familiarity i.e. land-use change + deforestation + degradation + drivers + factors +case studies forest policy.

Secondly, a context analysis was applied. It was considered as i) to identify cases where established scenarios demonstrating forest decline were observed ii) To capture a broad regional geographical scope across forest management settings irrespective of policy adopted , and iii) to cover formal institutions across differing policy landscapes with both established and less established forest management structures and institutions: in order to draw similar themes or convergent themes where possible.

The following cases were therefore acquired:

• for Europe, the case of the constraint of relevant vegetational imposed on some forests with the regional law 43/1974 by the Lazio Region

• for Asia, Indonesian Papua relevant policy associated with land-use primarily palm oil crops

• for USA, The Forest Practices act, Maine 1991 (FPA)

• for Australia, The Vegetation Management Act 1999 (VMA)

The different case studies were analyzed following the PEA approach illustrated above.

• for the analysis of individual case studies (Horizontal analysis)

• for the analysis of case studies as a whole (Vertical Analysis)

The horizontal analysis was aimed at answering the following questions

• what was the government institution initiative that determines the forest decline process?
• what was fundamental aims of the decision/s taken?
• what were the effects on the forest ecosystem that resulted from the forest decision implementation?
• what were the mistakes made in making the forest decision implementation?
The aim of the vertical analysis was to identify the common elements that characterized the four case studies, relative to the various steps of the PEA as specified in the following:

- *Drivers* What type of formal institution adopted the decision
- *Policy* Analysis of institutional adhesion to policy if it exists
- *Actions* What type of tools were adopted by the institutions for policy implementation
- *Effects* Analysis of effects produced by decisions taken by formal institution
- *State changes* Deviations from expected policy objectives
- *Monitoring* Level and scope of monitoring activities across each case
- *Reporting* analysis by formal institution

4.1 Data collection protocol and framework application

Informations were collected using a bounded and context approach as suggested by Bartlett and Vavrus (2017), and Yin (2014). Table 1 below demonstrates data selection using context, time and activity. As this thesis is exploratory, secondary sources where forest decline is registered where chosen. Each scenario highlights scholarly works quantifying forest stand conditions, formal institutions and structures linked with drivers of forest decline. Forest policy was assessed through annual or periodic reports, source policy documents and legislative source documents inclusive of state, regional and local institutions, where available, from 1970 until current where applicable. It is realized that this may produce a biased approach. Activities were guided by our adopted PEA framework. The evaluation policy criteria and conceptual framework are essentially a *heuristic*-based approach that is used to explore relationships between each modified concept and the forest management context. As suggested by Bartlett and Vavrus, (2017) comparison provides a powerful mechanism whereby the focus on a few attributes prompts the decomposition of cases into some set components.

Table 1: Bounded and context approach for the case study and data collection.

Context	
Institution	Institutions responsible for policy, decision making and administration of forest resources
Formal institutional arrangement	Demonstrating top-down, horizontal and vertical power and decision making i.e. partnerships, nonstate actors, semi-state actors
Type of forest decline processes	Deforestation, degradation and disturbance
Time	
Forest Policy	Informal and formal, literature search and context focused
State changes	Dependent on policy period identified-Current
Activity	
Actions	Consequent actions from policy
Effects	Effects of actions from policy goals
Monitoring	Types, scale
Reporting	Reporting scope

5 Case study reports

5.1 Case study 1: Forests with high vegetation value in Lazio, Italy

Itay underwent a notorious decentralization process for forest administration during the 1970's , seeing the delegation of power and resources from central forest institutions to regional forest institutions (Secco et al. 2017). Having mixed success, it subsequently aimed at stimulating more regional autonomy and direction over forest management. Only 8 out of the 21 regions across Italy have developed forest policy and strategic plans (F. Carbone and Savelli 2009). In 1974 the Lazio Regional Government adopted the law no. 43 (R.L. 43/1974): *Provisions for the Protection and Development of Forests.* Its main motivation was to protect and enhance the high naturalistic values of forests in the region. Various forest areas and types, predominantly *Quercus spp. coppice* and *Fagus spp.* were protected by this law.

Drivers

Institutions (operative)	Role	Relevant institutions (law, rules regulations) in focus
Lazio Regional Government	Regional institution responsible for regional forest policy setting, regional forestry regulations and planning requirements on public and private lands. Management Plan approval and Sector budgeting, technical assistance and vocational training	No.43/1974, Provisions of the Protection and Development of Forests; Regional Law 28 October 2002, n. 39 Rules on the management of forest resources

Drivers of the decision to introduce the Region Law 43/1974 was the Regional Government, supported by environmentalist associations. Forest reporting was followed although reporting of degradation processes, pest and disease outbreaks were very limited. The area subject to the constraints of R.L. 43/1974 included public forests, municipalities and common forest lands equating to approximately 2,816.79 hectares (Carbone 2011). In 2002, this law was repealed and replaced by R.L. 39/2002 which focused on a more active management approach of the regions forests in line with a sustainable forest management paradigm. It effects have yet to be comprehensively assessed.

Policy

Up until 1973 there didn't exist a regional forest policy or program, nor formal documentation about the future perspective of this initiative (F. Carbone and Savelli 2009). Some forest policy concepts have been reported in the documents produced from regional administration for management objectives for forest land under the regime of R.L. 43/1974. Two main regulatory and financial instruments are highlighted.

- Silviculture and intervention bans for final and intermediate cutting.
- Indemnity payments as compensation for lost revenue based on stumpage prices.

Usually, the forest area under the R.L. 43/1974 law was allocated when it was at an age for which a silvicultural treatment was required (Carbone 2014b).

In 2002 the Lazio Region adopted its first forest law no. *Law 39/2002 Norme in materia di gestione delle risorse forest (1),* subsequently repealing R.L. 43/1974. This law ensured that no more forest areas across the region were allocated under this protective umbrella. However,

the forest areas already under the R.L. 43/974 law are still subject to restrictions on silviculture and remain poorly managed with little formal institutional input or direction.

Actions

The main policy objective for the above-mentioned R.L. 43/1974, aimed toward a hands-off approach that would increase landscape value and provision of ecosystem services by creating *new natural forests* in a heavily anthropogenically modified landscape (Carbone, 2014). Regional Administrators assumed that natural processes and forest successional pathways would eventually return the forest to its former state. The forests in question have had a long tradition of silvicultural management (Carbone 2011) according to local informal rules and institutions. In the process of land forest allocated under the constraint, the National Forest Service played an important role in supporting the regional administration from an operative point of view (Francesco Carbone 2014). The National Forest Service produced reports for each forest submitted under the umbrella of the constraint. However, the forest state's description didn't include evidence about degradation processes, pest and disease outbreaks (Carbone 2011). Given the relevance that forest management revenue had for forest owners, the Regional Administration also introduced indemnity payments that theoretically would cover the amount of money an owner would receive if the stems were in the market (Carbone 2012).

Effects

Regional forests have been placed under severe restrictions in some cases, where zoning and forest delineation has been designated under cadastral land separation rather than systematic forest classification and inventory assessment (Carbone, 2014). Whilst a mapping effort to identify zones under constraints was initiated, it has failed to identify vegetation areas appropriately. Thus active and targeted monitoring are non-existent. In some cases, the rights of single forestry owners to undertake silvicultural management were frozen (Carbone 2012). Silvicultural management on almost all forests of the municipalities in Lazio has been affected by this constraint (Carbone, 2014). Some as early as 1975, leaving them effectively unmanaged for three decades. The absence of silvicultural management has lead to a number of changes in the forest ecosystem in Lazio. Most notably are characteristics of the forest stands themselves. Effects are often varied across each forest area, however, it has been reported that estates have reported various forest decline characteristics including degradation processes, pest and disease outbreaks, high levels of biomass and both under-stocked and over-stocked resources

inducing higher levels of competition and conversely loss in soil protection (Carbone, 2014). In some cases, at higher altitudes, reports of severe stand mortality have been observed, wherein one case 70% of the stand was dead (Carbone, 2014). Although most forest owners received indemnity payments for losses in revenue from the constraint, Carbone, (2014), no information has been included in the formal document produced from the Regional Administration about how the forest should be managed in the future or during the time the constraint has been active. Inconsistency with payments were reported to have placed pressure on local tenure and their financial livelihoods (Carbone, 2014) .

State changes

Determining a baseline for the forest condition for Lazio prior to the implementation of R.L. No. 43/1974 is difficult. Prior to the first comprehensive NFI, 1985 the region of Lazio released reports as the Schema Di Piano Forestale Regionale with forest utilization assessments. These included forest activities and future viability assessments, fire incidents, zoning classifications directed by relevant policy and associated authorities. However, it is evident that pest and disease outbreaks along with other degradation processes were not systematically reported or addressed in these reports (). Recent assessments by Carbone, (2014) highlight increases in degradation processes, most notably the poor management of historic *Quercus spp.* coppice forests. Studies on Quercus dieback across Southern Itay, including Lazio, as early as 1998 demonstrate associations with soil born pathogens such as Phytophthora in overstocked and neglected stands (Sicoli et al. 1998). As described earlier, observations of increased stem density above site carrying capacity and increased biomass have induced higher levels of competition (Carbone, 2014). Volume in some areas has been reported as less than the that of respected baselines which is compelling given the reported levels of stocking. In some instances, supporting and regulating services of Lazio's forests have been reduced with contractions in soil protection due to canopy loss. Public access to forests by locals for NFWP's collection has reduced given poor maintenance of access roads (Carbone, 2014). This is supported in a study conducted in 2011 assessing forest conditions of provinces under indemnity payments, representing some of the forests in the region under R.L. 43/1974 (Carbone 2012). As the table demonstrates almost all forests were under stressed and degradation processes from pest and disease (Carbone 2012). General increases in disturbance susceptibility including pest and disease outbreaks have also been observed along with increased wildfire risk (Sapountzaki et al. 2011). Furthermore, little or no reinvestment into

forest management for the past 3 decades has further compounded forest decline. In contrast, forest extension in Italy and Lazio has actually increased over the past three decades, predominantly due to rural abandonment (Malandra et al. 2018) .

Table 2: Observations of degradation processes by forest type across Lazio region Italy (Carbone 2012 p.g. 119-129)

Community (Province)	Forest Type	Assessment of forest state	Type of degradation
Nettuno (Rome)	Coppice with stems	Deterioration	Diffuse forest disease
Caprarola (Viterbo)	High forest	Improvement	Irrelevant
Roma (Rome)	Coppice with stems	Strong deterioration	High-intensity diffuse forest disease
Manziana (Rome)	High forest	Deterioration	Diffuse forest disease and difficulty for renewal
Bagnoregio (Viterbo)	Young high forest	Light Deterioration	High density, difficulties achieving renewal
Barbarano Romano (Viterbo)	Irregular coppice with stems	Light Deterioration	light forest disease, impacts on hydrological soil stability
Tolfa (Rome)	Coppice with stems	Deterioration	Light forest disease

M*onitoring*

Prior to 2014, forest monitoring was not viewed or integrated as part of the regional formal institutions main objectives. Although attempts to engage local universities have been made more recently. Integration of research in active policy development remains as a problematic issue between formal institutions and operations.

Monitoring is required under 39/2002 stated in article 2 i.e. systematic and knowledge of the forest resource through inventory, monitoring and research should be a goal along with training and updating of the sector and it's personal (Region Council Lazio 2002). Monitoring has been identified as a pillar of sound stewardship by Barbati, Corona and Marchetti, (2007).

The experience of the forests placed under the constraint of the law 43/1974 is characterized by the evident gaps in the activity of data collection and conservation as well as in the monitoring of the state of the forests. A robust and complete dataset is nonexistent even though attempted. Information is fragmented and has been poorly monitored over time (Carbone, 2014).

Reporting

In the thirty years of regional law 43/1974 implementation, reporting activities have been very poor and involved only specific areas. A technical report focused on forests under this constraint was produced in 2003 from a multidisciplinary team of forest science researchers at the University of Tuscia (*La gestione forestale sostenibile di ecosistemi forestali di particolare valore ambientale-Effetti retroeffetti delle politiche forestali)*

Regional adoption of constraints on forests with high vegetation values have produced two main evidences:

- positive effects on high forest when the protection program had been adopted for young stems;
- negative effects have been registered in the forest coppice, especially of Quercus ss.pp..

Pest and diseases affect most of the stands involved, in some areas high percentages of plant mortality have been registered *table 2* above. Emergency silvicultural management has been adopted in many forest areas.

Relevant problems have been registered in the management of the indemnity paid from administration, especially in the coppices affected from pest and disease.

5.2 Case study 2: Palm Oil crop expansion in Indonesian, Papua

Palm oil crop expansion in South East Asia and the Pacific is a continuing and concerning direct cause of deforestation, degradation and disturbance (Chazdon 2003). Over the past 3 decades, Indonesia has experienced palm oil crop expansion in parts of its low land tropic forest areas (Acosta and Curt 2019). Indonesia Papua, a province on the western side of Papua New Guinea supports a significant area of low land sub-tropical rainforest and peatlands (Series 2009). Indonesia, specifically as lost approximately 23% of its forest cover between 1990 and 2015 (Acosta and Curt 2019). Changes in land-use have been endorsed by the Indonesian Government and facilitated by its formal institutions through adopted policy for three decades with focus on more remunerative agricultural activities (Kubitza et al. 2018). However, recent international pressure and significant international investment has been applied in order to curb future forest decline (Meehan, Tacconi, and Budiningsih 2019).

Drivers for the decision to cultivate palm oil crop in Indonesia came from a 'forest crisis' in which the supply of forest resources sharply decreased due to years of overexploitation (Susanti and Maryudi 2016). In addition, ineffective policy, regulation and enforcement saw a downturn in national income form forestry decreasing from 3.5% in 1993 to 0.6% in 2013

(Susanti and Maryudi 2016). This left a hole in the Indonesian economy. One which was readily filled by palm oil crops. According to Susanti and Maryudi, (2016) the palm oil estate expanded from 1.84 million hectares in 1993 to 10.47 million hectares by 2013. Given its financial success the process of land-use conversion from forest to palm oil crop has been a significant driver of tropical forest decline. Decisions for palm oil expansion are directed by a number of formal institutions with conflicting mandates, over-lapping regulations and institutional specific objectives (Setiawan et al. 2016). Each operative institution works within other formal institutions driven by the central authority and are defined in laws, property rights access and regulated by several layers of policy (Erbaugh and Nurrochmat, 2019). Policy is formulated by the Minister of Forestry, approved by the President and relevant ministries, while Operational policy is formulated by Table (3) below and subsequent analysis attempts to highlight Indonesia's federal, state and regional policy as directed through associated formal institutions.

Drivers

Institutions (operative)	**Role**	**Relevant institutions (law, rules regulations)**
Regional Governments	Planning for the development and use of natural resources, land-use policy Issuing Permits, Environmental Impact Assessment/AMDAL, Send Recommendations for forest conversion to the Ministry of Forestry, Send recommendations to the National Land Agency for the issuance of Business Utilization Right (HGU)	Law No. 26/2007 Land Agency Degree 2/1999; Government Regulation Environmental No. 15/2010 Protection Law 32/2009 Plantation Law No. 18/2004
Ministry of Environment and Forestry (MoEF)	Regulate forest conversation, Check the requested area for conversion and issue principal approval Take tax payment and royalties, Issue forest release permits	Law no. 41/1999 Ministerial Decree No. 31/2009 Government Regulation No. 12/2014, PP104/2015

Policy

Indonesia's national forest policy, along with all common development policy, is based on *Pancasila*. The *Pancasila* represents five philosophical principles and directed through the central authority and guided by the Indonesian constitution and Guidelines of State Policy (Nasendi 2000; Alisjahbana and Busch 2017). Briefly the objective of Indonesian foresty policy is to guide forestry activities in supporting development (Nasendi 2000). More recently, forest policy has attempted to shift away from production to more protection and conservation-focused objectives (Erbaugh and Nurrochmat 2019). Reforms have been in response to

international pressure on climate change, trade restrictions and voluntary market incentives for certification (Erbaugh and Nurrochmat, 2019). As of 2011 a Mortioriam on forest concessions, leases, palm oil crop applications and land-use change is in effect (Andrianto, Komarudin, and Pacheco 2019; Alisjahbana and Busch 2017). Forest policies at different levels are developed through different mechanisms such as laws and regulations of which some are described below.

Activities on forest lands are issued through *(GR 34/2002, GR 38/2007, GR 3/2008, Law 32/2009, GR 24/2010, GR 72/2010, GR 61/2012, Law 23/2014, GR 57/2016).* How and by whom forests are monitored, *(Law 32/2009, Law 18/2013, Law 23/2014, PR 16/2015)*, policy that addresses timber trade *(GR 34/2002, GR 6/2007, PR 21/2014)* laws that endorse international commitments *(Law 17/2004, GR 21/2014)* (Erbaugh and Nurrochmat, 2019).

A list of laws and subsequent planning and regulations are briefly explained below.

- Local Government regulations across Papua
    - LGR No 18/2008 supporting community-based economies
    - LGR No 22/2008 based on sustainable forest management
    - LGR No 23/2008 supporting community and village rights
    - LGR No 6/2008 on environmental conservation

(Ekawati et al. 2019)

- Decision making and approval for forest conversion to palm oil crop through Regional Authority
    - Law 26/2007 - Is a spatial law that determines where activities can take place at district level and may be amended to reclassify land (Erbaugh and Nurrochmat 2019).
    - Law No. 22/1999 – Grants Regional Authority to utilize forest resources in generating income for local development (Suwarno, Hein, and Sumarga 2015)
    - Government Regulation Environmental No. 15/2010 – Regional approval and permit issuance through EIS (Environmental impact statements (Setiawan et al. 2016)
    - Protection law 32/2009 – Forest conversion rights and controlled burning (Setiawan et al. 2016)
    - Law 18/2004 – Local government became the license issuing agency for oil palm plantation (Susanti and Maryudi 2016)
    - Law 41/1999 – Basic forest Law (previously BFL No. 5/1967) (Setiawan et al. 2016)

Main Government Regulations regarding Palm Oil and peatland ecosystems.

- Government Regulation 14/2009 Guidance for the utilization of peatland for palm oil cultivation (Uda, Schouten, and Hein 2018)
- Government Regulation No. 17/2014 protection and Management of Peatland ecosystems (Uda, Schouten, and Hein 2018).
- Government Regulation No. 57/2016 prohibition of (a) land clearing for certain tree crops (such as oil palm and acacia) until the clear delineation between forests zoned for conversion and protection had been established; (b) drainage system construction for drying peatland; and (c) setting or allowing fires on peatland (Alisjahbana and Busch 2017).

Actions

Investment for agricultural and infrastructure, driven by distinct development narratives and associated drivers (Susanti and Maryudi 2016), saw forest areas cleared or harvested in order to support socio-economic development (Austin et al. 2019). Pin-pointing what happened in what province is difficult.

Focusing on Papua, transfer of funding from Jakata between 2000 and 2009 was approximately 1300% in nominal terms and 600% in real terms for the period (Acosta and Curt 2019). Primarily aimed at agricultural, mining and infrastructure investment rather than forest protection and conservation (Acosta and Curt 2019). Prior to more recent moratoriums (Austin et al. 2019), targets to increase palm oil crop were mandated by the central government in line with development set out in *Pancasila*. Government concessions and incentives saw 1.7 million ha's of peatland and subtropical rainforest allocated to palm oil in Papua (Brockhaus et al. 2012). Presumably, this process is part of the regional formal administration and regulated by MoEF, Ministry of Environment and Forestry, the senior formal institution in the forestry sector in Indonesia. Of the 40 companies in the region with allocated permits, only 5 have executed their plans amounting to approximately 184, 046 ha's of palm oil crop (Andrianto, Komarudin, and Pacheco 2019). These areas are situated adjacent to peatland and subtropical rainforest which are incurring unforeseen externalities such as illegal logging and subsistence cropping from local minorities (Hergoualc'h et al. 2018). A recent study suggests regional administration is still attracting outside investment for palm oil, contradictory to Indonesia's federal forest policy objectives of sustained yield (Nasendi 2000) and regulations (Andrianto, Komarudin, and Pacheco 2019).

In the past, central government incentives such as the GoI investment scheme in the 90's were used to expand palm oil crops (Suwarno, Hein, and Sumarga 2015). This scheme was repealed with a change in government in (Erbaugh and Nurrochmat 2019). However, a financial instrument known as a *plasma scheme*, driven by foreign investors is still active in Papua. It is used to attract local farmers with financial support to develop their land into palm oil crop selling later production to the parent company (Acosta and Curt 2019).

Management and regulation of forest activities appear to be split equally between the MoEF (Ministry of Environment and Forestry) and Local Governments, however contradicting laws and regulations have created a situation of ineffective formal institutional cohesion and direction (Setiawan et al. 2016). Only recently have actions toward mitigating deforestation and disturbance been of focus for the Indonesian Government. International investment more recently, in the form of REDD+ incentives (Brockhaus et al. 2012)

Effects

The extension of palm oil crop has had numerous effects. Primarily, the clearing of low-land subtropical rainforest on peatland ecosystems (peat swamp forest) as demonstrated in the case of Jayapura Papua (Acosta and Curt 2019). Forest decline remains a significant threat to Indonesia's forest resources. Several direct and indirect causes of forest decline are playing a combined role in forest decline across the country. Across Papua, inclusive of the province of Jayapura, tree loss rapidly increased between 2010 and 2016, where the Moratorium on peatland has been implemented. Illegal logging, corruption and disturbances such as fire have existed well before more recent policy amendments, laws and moratoriums however are still critical issues (Wardojo and Masripatin 2002; Tsujino et al. 2016). The timber boom before the palm oil boom had left most of Indonesia's forest resources in a high state of degradation (Susanti and Maryudi 2016). Prior to clearing, the land was under primary peatland subtropical forest (Acosta and Curt 2019). The clearing of forest for palm oil crop and creation of drainage makes peatlands more susceptible to fire, which when combined with the traditional slash and burn technique, used by villagers, has increase fire incidents including severity (Alisjahbana and Busch 2017). These fires are significant in terms of CO2 emissions certainly but they are also significant for respiratory diseases across Papua (Wicke et al. 2011). Removal of primary forest has also impacted on biodiversity, especially species richness, with fewer organisms registered in palm oil crops compared with primary forests (S. et al. 2014).

On average between 2010 and 2016 47665 ha's of tree loss in the 75% Canopy class was recorded. Approximately 116,216 ha's of tree cover within the 75% Canopy density category were lost between 2000-2010 (Global Forest Watch 2018).

State changes

Focusing on palm oil crop specifically, the state change is clear. Primary forest has been replaced with an alternative land use. Approximately 1.5 million ha's have been already allocated to palm oil in Papua and of these approximately 184,000 ha's have been cleared specifically for the crop (Andrianto, Komarudin, and Pacheco 2019). Although the new Moratorium, Government Regulation No. 57/2016 - partly reflected in the graph below, has effectively halted new concessions for palm oil crop, there is still evidence of villager encroachment and continued forest cover loss in the pursuit of timber and land (Alisjahbana and Busch 2017). Clearing low-land subtropical on peatland ecosystems, which are an important regulator of the water table, has seen a reduction in their hydrological function as a regulator between salt/freshwater transitions (Hergoualc'h et al. 2018). From a socio-economic perspective, tradeoffs between primary forest ecosystem services and palm oil revenue were estimated to be approximately \$3,500 USD $ha^{-1}y^{-1}$ (Forest ES) and \$ 2,150 USD $ha^{-1}y^{-1}$ (PO Rev) respectively by one study in Papua (Acosta and Curt 2019). As demonstrated by Acosta and Curt, (2019), benefits from palm oil revenue are highly lopsided under the plasma scheme, being more lucrative for regional/national income generation than local level re-investment.

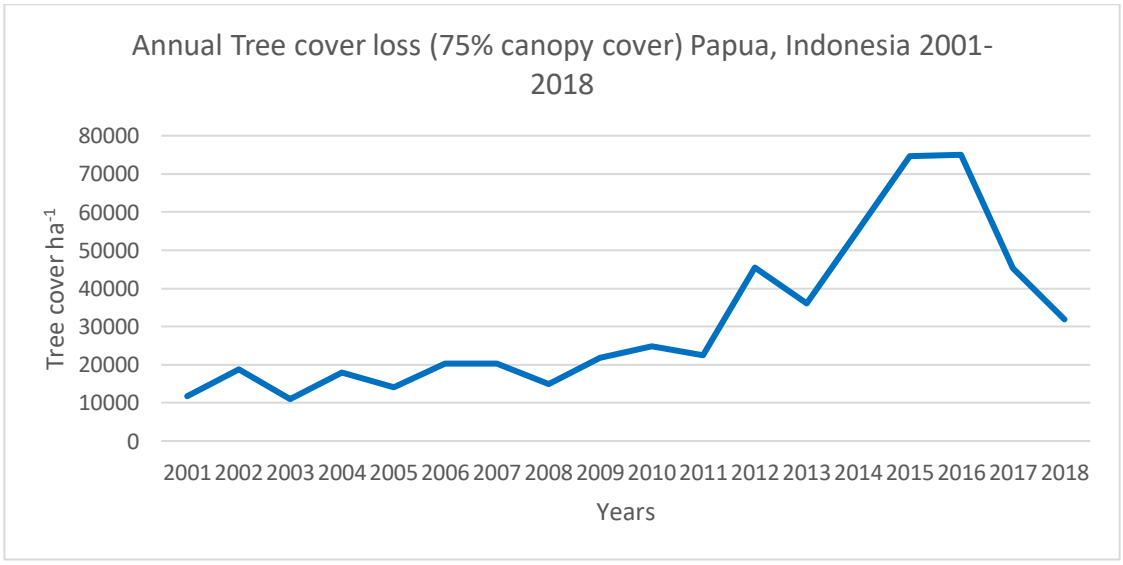


Figure 10: Registered tree cover change for Papua, Indonesia including, plantation harvest, land cover changes, disturbances adopted from (Global Forest Watch 2018).

Monitoring and Reporting

A recent effort by the Indonesian central government is the creation of the *One Map* policy initiative. This initiative aims to create a single 1:50,000 scale geospatial reference map, based on both a single data and single standardized platform map accessible nationally (Ministry of Environment and Forestry 2018). It is a highly commendable act. Furthermore the Indonesian Government as pledged to continue its monitoring programs through the MoEF. Monitoring of the forest resource was conducted on 3-year intervals between 2000 and 2009 using Landsat 4 TM, Landsat 5 TM, Landsat 7 ETM + Landsat 8 OLI and high-resolution satellite images is stated to have occurred (SPOT-6, SPOT-7) (Ministry of Environment and Forestry 2018). The recent reporting through Indonesia's first State of the forest document is important. However, it is difficult to know if this is supported by field inventory or in field checking. It remains to be seen if recent policy amendments will be honored. A study of focus in this case study does not highlight any monitoring or reporting activities for it's reflected project (Acosta and Curt 2019). It does highlight however, the intention of the private palm oil company to obtain certification for its crop. It further suggests an independent standardized checking and monitoring system should be developed and implemented (Acosta and Curt 2019).

5.3 Case study 3: Over-exploitation of forests in Maine USA

Over the past 2 decades, the forests of New Hampshire in the United States North East have seen a shift away from traditional silvicultural treatments to more exploitive short sited treatments focused toward the removal of valuable timber species (Belair and Ducey 2018). A USDA Forest Service funded project to assess productive capacity versus harvest trends found harvesting rates, after the implementation of the FPA, were unsustainable and required action by government institutions in order to adopt a sustainable management for the future (Belair and Ducey 2018).

The state of Maine is the most heavily forested state in North America and also supports the highest percentage of private forest ownership, between 80-90% (Hagan, Irland, and Whitman 2005; McBride et al. 2019). The timber industry has been the main industry in the region since the 19th-century (Acheson and McCloskey 2008). Abrupt policy changes, frequent forest ownership changes and past restrictive silvicultural practices have seen the replacement of pulp and paper firms by private investment Timber Investment Management Organizations (TIMOs), and Real Estate Investment Trusts (REITs) (Hagan, Irland, and Whitman 2005; Correia 2010). These changes have resulted in the over-exploitation and degradation of forest

resources in Maine and are contradictory to mandated policy objectives implemented by both state and federal formal institutions. Forest management decisions and policy development are the responsibility of state formal institutions and linked at federal level as shown below.

Drivers

Institutions (operative)	Role	Relevant Institutions (law, rules regulations)
USDA Forest Service	Federal government institution responsible for policy setting at national and regional levels, forest regulation and legislation, forest planning, monitoring and reporting on public lands, reserves and private lands, scientific publications and regional coordination. Operate at 4 levels (headquarters, Regional administration, National forest administration and Ranger districts) Operates across 10 Regions 154 national forests, 600 ranger districts	National Forest Management Act 1976 2012 Planning Rule Multiple Use Sustained Yield Act of 1960 Chapter II: Forest Service, Department of Agriculture
Maine Forest Service	State regulatory body for silviculture management, codes of practice, annual reporting, forest health and monitoring, wildfire prevention, detection and suppression, technical assistance provider (ten district foresters)	Maine Forest practices Act Forest regeneration and clearcutting standards Forestry rules of Maine 2017

Policy

As with almost all cases presented in this article, a broad suite of forest and environmental policy exists governing forest management in the United States.

- The National Forest Management Act 1976
    - establish sustainable administration of forests with an emphasis on '*analysis of environmental and economic impacts, coordination of multiple-use and sustained yield opportunities as provided in the Multiple-Use, Sustained-Yield Act of 1960 (74 Stat. 215; 16 U.S.C. 528-531), and public participation in the development of the program.*' (*National Forest Management Act* 1976).
- The 2012 Planning Rule
    - A regulatory and legislative tool, establishing planning responsibilities, requirements and administrative responsibilities from federal to district level i.e. National strategic planning, National Forest System unit planning and Project and activity planning (National, System, and Service 2015).
- Maine Forest Practises act 1989
    - Sets out state regulations for forest management and guides the Maine Forest Services standards and guidelines for timber concessions and subsequent management.

- Tree Growth Tax Law 1972
    - Was designed to incentivize forest management for private landowners who signed a contract in commitment to managing their forests with the guidance of a forester to plan and supervise their land parcels (Acheson and McCloskey 2008)

Actions

This study focuses on Maine's Forest Practises Act 1989. It is a formal institutional response to extensive clearcut practices induced by a Spruce Budworm epidemic throughout the 1970's and late 1980's (Acheson and McCloskey 2008; Jin and Sader 2006). Prior to the Forest Practices Act, extensive salvage logging for budworm led to a highly fragmented forest resource. Following public concern about clearcut areas, the Maine State Forest Service introduced regulations on clearcut patch sizes through instruments in the FPA and some minor financial incentives for forest owners affected by the regulative changes (Legaard, Sader, and Simons-Legaard 2015; Acheson and McCloskey 2008). Presently, actions through the Act aim to influence silvicultural management on private land by encouraging sustainable harvesting regimes to avoid clearcutting and further places restrictions on harvesting practises, guidelines for forest management and attempts to integrate the frequent forest ownership issues associated with 'snatch an grab' high-grading. (Belair and Ducey 2018; Maine Forest Service 2017).

Outside of direct formal institutional forest management in the state, a particular important piece of legislation 'The Federal Employee Retirement Income Security Act, 1974' has impacted on management actions in Maine's forest resources. This Act essentially forced traditional investment institutions holding pension plans to search elsewhere for investment (Hagan, Irland, and Whitman 2005). Forests were seen as similar to factories and warehouses where one could preserve capital when markets were down and cut when markets were favorable (Hagan, Irland, and Whitman 2005). Approximately 80% of existing industrial forests in Maine were sold to TIMO's (timber investment and management organizations) and REIT's (real estate investments trusts) between 1994 and 2000 (Jin and Sader 2006). Previously owned by approximately 20 paper and pulp companies and the focus of the FPA regulations in the late 80's (Jin and Sader 2006). In addition to large timber estate purchases investment by TIMO's, small scale wood lot sales from the aforementioned has seen a fragmentation of ownership (Jin and Sader 2006). Hagan, Irland and Whitman, (2005) suggest in Maine alone there has been the '*virtual disappearance of vertically integrated forest products companies as timberland owners in the region'*. This rapid change in ownership along with abrupt policy changes saw a paradigm

of *liquidation harvesting'* emerge (Legaard, Sader, and Simons-Legaard 2015). As such, actions supposedly regulated and incentivized by the state's Forest Practises Act, have unfortunately missed their mark. A shift away from more conservative and traditional silvicultural treatments toward more short-sighted and exploitative high-grading practices has been observed (Gunn, Ducey and Belair, 2019). Although the Act placed heavy restrictions on clearcutting, it does not emphasize baselines for residual stocking, species mixture or structure, nor does it regulate ownership. (Jin and Sader, 2006; Legaard, Sader and Simons-Legaard, 2015; Duveneck and Thompson, 2019; Gunn, Ducey and Belair, 2019). Recent studies by (Belair and Ducey, 2018; Gunn, Ducey and Belair, 2019) suggest actions induced by frequent ownership change and poor institutional regulation are the causes of forest degradation and the continued short-sighted high-grading of Maine's forest ecosystems.

Effects

Prior to the Forest Practises Act (FPA), the state of Maine saw extensive salvage logging and exploitation in response to the Spruce Budworm outbreak in the late 1970's-80's (Hagan, Irland and Whitman, 2005; Jin and Sader, 2006; Acheson and McCloskey, 2008). This left the forest resource in a highly fragmented state (Jin and Sader 2006). The implementation of the FPA, saw the reduction in clearcut patch size. However, this caused disturbance emulation silviculture treatments, <15 ha patch sizes, compounding edge effects and forest fragmentation rather than mitigating it. Ultimately, gap creation silviculture practices caused the further subdivision of intact forest tracts (Legaard, Sader, and Simons-Legaard 2015). This was compounded by the onset of rapid ownership changes in the TIMO's and RIET's which saw both smallscale forest parceling and high-grading of the forest resource and what appears to be poor regulation and enforcement by state institutions (Acheson and McCloskey 2008). Forest cover change in Maine between 2001-2011 is the highest of any state in New England as demonstrated below (Ducey et al. 2016).

	ACRES (1,000s)	PERCENT OF TOTAL LAND AREA	PERCENT OF 2001 FOREST COVER
Connecticut	-26	-0.9	-1.5
Massachusetts	-61	-1.2	-2.3
Maine	-117	-0.6	-0.8
New Hampshire	-111	-1.9	-2.5
New York	-103	-0.3	-0.6
Rhode Island	-6	-0.9	-2.0
Vermont	-35	-0.6	-0.8
Total	**-459**	**-0.7**	**-1.0**

Figure 11: Forest cover change New England USA 2001-2011 adopted from (Ducey et al. 2016 pg. 2-10)

A USDA Forest Service funded project to assess productive capacity versus harvest trends found harvesting rates, after the implementation of the FPA, were unsustainable and required action by state institutions if yields were to be sustainable into the future (Gadzik, Blanck, and Caldwell 1998). In response to continuing forest degradation to voluntary certification schemes were created, the now internationally established FSC (Forest Stewardship Council) in 1993 and SFI in 1995 (Sustainable Forestry Initiative) offering an alternative state regulation of forest resources (Correia 2010). They do not necessarily extend outside of larger timber estates being expensive to participate.

State changes

The baseline for the forest resource in Maine may be taken prior to the implementation of the Forest Practises Act. As stated earlier the FPA was designed to halt large sale clearcutting. However, this led to more destructive harvesting techniques and over-exploitation irrespective of the Act's implementation. A recent assessment of Maine's forest resource suggests approximately 45.1% of the forest resources are classified as degraded within the above classification (Gunn, Ducey and Belair, 2019). Species mixture, merchantable species, relative density and structure have all been impacted through poorly regulated and short-sighted management. This has been supported further by Ducey *et al.*, 2016; Belair and Ducey, (2018), who state many forest areas have been subject to snatch and grab forestry where minimum requirements for residual stocking have not been met. Furthermore, management and planning for privately-held forests under TIMO's and RIET's management generally have shorter

planning horizons compared to previous timber focused industries (Duveneck and Thompson 2019). Many of the TIMO's are certified by either FSC or SFI, however, given Gunn, Ducey and Belair, (2019) resent assessment on Maine's forest it remains dubious if these schemes are effective. However a recent study on regeneration debt demonstrated that forests in Maine were significantly stocked with new seedlings and saplings which may reflect both certification and the Forest Practices Act adoption (Carbone 2012). Forest resources on public lands, managed through the USDA Forest Service appear to be in a better state with better stocking and higher QMD (Gunn, Ducey and Belair, 2019). This not so surprising given public owned lands have been established since 1911 and regulated under strict federal legislation.

Monitoring

Monitoring of the forest resource occurs at National and state level across the US. For example, in 2007, the USDA Forest Service released a comprehensive LMP monitoring and Evaluation document aimed at guiding landscape management an planning it state *"The MET will develop a unified, multi-scale national framework for monitoring progress towards achieving both standard and unique LMP desired conditions and objectives on National Forest System (NFS) lands. This framework will form the foundation for a NFS monitoring and evaluation program within the agency resource information strategy."* (USDA Forest Service 2007). That was some 11 years ago and it is difficult to determine the level of adoption by state and regional agencies. As for Maine, being predominantly privately owned, forest health and monitoring for example is a subsection of the Maine Forest Service. It focuses on invasive species, pests and diseases rather than the structural characteristics of the forest resource. Furthermore and established separate branch for fire detection and suppression operates as part of the state institution. On a separate level, FSC conducts monitoring on estates under its certification across the state (Correia 2010). Monitoring appears significant for the state of Maine, although not entirely effective, given the annual reporting publicly available through the Departments of Agriculture, Conservation and Forestry state website .

Reporting

Reporting efforts both through scientific publications and state forest metrics across Maine are significant. Release of annual budgets, spending allocation and financial return from wood timber products have been reported annually since 2012. Separate reports for silvicultural activities, stumpage reporting, wood processing reports forest conditions are also available

through the state website. Quality of reporting is not a focus of this report, however, the continuing decline of the forest resource indicates possible issues between science, institution and policy dialogues. The University of Maine offers further reporting and publications through its forestry program. An article written in 2006, suggests while reporting and monitoring is effective at sate and regional institutional levels, stakeholder coherence is limited (Hickey, Innes, and Kozak 2007). Annual over reports for forest areas under direct management by the USDA Forest Service are also published along with numerous scientific publications. For example the most recent overview for the state of main has been published and suggests loss in forest area between 2012 and 2017 (Butler 2018).

5.4 Case study 4: Land clearing and deforestation an Australian Story

In the state of Queensland, Australia, forest management has been a highly contested and at times violently fought over issue (Kanowski 2017). Queensland has approximately 39% of Australia's total forest cover equating to 51.8 Mha (ABARES 2018). Forest management across Australia, as with Queensland, is developed, implemented and regulated by various levels of government and formal institutions with a suite of legally binding, regulatory acts, codes and practices (Kanowski 2017). For Queensland, the Vegetation Management Act 1999 or VMA, is a particularly important and controversial piece of legislation governing forest clearing and has been argued to be largely ineffective as a regulatory tool (Evans 2016; Reside et al. 2017). Evidence from recent studies suggest the VMA has been largely ineffective in regulating land clearing, with many landowners clearing their forest areas for alternative land uses such as pasture (Rhodes et al. 2017; Evans 2016)

Drivers

Institutions (operative)	Role	Relevant institutions (law, rules regulations)
Department of Natural Resources, Mines and Energy	State legislator and administration for forestry on leasehold and privately-owned land	Vegetation Management Act 1999 RFA (regional forest agreement) SE Queensland
Department of Agriculture and Fisheries	Responsible for policy development and initiatives at state level, regulatory body for industrial timber plantation and compliance	Forestry Act 1959
Forest Products - Department of Agriculture and Fisheries	Responsible for allocation and sale of state-owned timber, quarry material and other forest products Management of native forest timber production in state forests, timber reserves and other state-controlled lands	Forests Act 1959 Australian Standard Sustainable Forest Management (AS 4708) Forest Harvesting Codes of Practice 2007

Institutions (operative)	Role	Relevant institutions (law, rules regulations)
Queensland Parks and Wildlife Service (QWPS)	Custodial, regulatory and most non-commercial aspects of state forest management including auditing of native forest harvesting.	Code of practice for native forest timber production on the QPWS forest estate 2014

Policy

Decisions on forest management in Queensland developed and administered through various formal institutions at state level.

- The Forestry Act 1959
    - federal legislation for forest management for native forest management and forest plantations in the state.
    - A set of legally binding instruments that facilitates silvicultural management and protection.
    - establishes the regulatory and legal administration of forest resources
- The Vegetation Management Act 1999 or VMA
    - Regulatory tool for management native forestry on private lands for the state of Queensland,
    - Regulates land clearing practices on private lands using a set of self assessable codes for land clearing and development (Department of Natural Resources, Mines and Energy Queensland 2017).
- SE Queensland Regional Forest Agreement 2002
    - Focused on phasing out native timber harvesting by 2024 and restructuring industry toward softwood plantation resources.
- Forest Harvesting Codes of Practise 2007
    - regulates safe harvest practices and harvesting planning for forest operations for private forest owners (Workplave Health and Saftey Queensland, 2007). This regulation is designed for forest owners and harvesting contractors and requires an extensive compilation of harvesting planning and safety regulations before operations commence.
- Code of practice for native forest timber production QWPS 2014.
    - Harvesting practices and codes for conducting harvesting activities on state-owned lands.

The most important forest policy point is the introduction of land clearing practices on private lands using a set of self and soft assessable codes under the Vegetation Management Act 1999 (VMA). In many case this codes has been used for eliminating forest and creating area for agricultural and urban use.

Actions

The actions stemming from forest policy is complex and varied across Australia leading to high leaves of political fatigue at both federal and state-level (Kanowski 2017). Focusing on the Vegetation Management Act 1999, Queensland, is particularly illuminating. The VMA began as a relatively soft tool created by formal institutions in response to extensive land clearing of regrowth permitted on freehold (private) lands. Recognition of high ecosystem and biodiversity values forced the State Government to regulate land clearing across the sate (Evans 2016). Although high-value vegetation was protected, regrowth still qualified for clearing. Between 2004 and 2011 a series of financial tools and third party offset schemes were introduced to curb clearing from private landowners. This also included third party offsets trusts for future re-investment. (McGrath 2007; Evans 2016). Simmons *et al.*, (2018) suggests actions in response to the VMA induced a wave of 'panic clearing' in the 2000's in response to the aforementioned. Landowners thought they were losing valuable future pastoral opportunities. A change in state government saw the VMA relaxed in 2012. Specifically, the Act was amended to reduce the red tape and regulatory burden (Evans 2016). This essentially saw a new simpler vegetation management framework and a set of self assessable codes for landowners and urban development (Evans 2016; Reside et al. 2017). This led to extensive and rapid forest clearing across the state between 2012-2016. The Vegetation Management Act 1999, effectively allowed landowners to set their own thresholds and self-assessment for clearing (Taylor 2015). In addition a more or less poor guideline for thinning was introduced without any robust forest science input leading to obscure thinning treatments by landowners (Taylor 2015). The amendments to the Act in 2012 also enabled the clearing of high-value regrowth for high-value irrigation and agriculture (Evans 2016). Currently, the Act still remains highly problematic and continues to induce large scale clearing. It has also allowed urban development clearing of both regrowth and forests in new developments (McAlpine et al. 2007).

Effects

Between 1972 – 2014, it is estimated that approximately 9.7 million ha's of forest has been cleared across Queensland, of which 3.6 million was primary forest (Evans 2016). Under The Vegetation Act 1999, approximately 1.5 million ha's of forest has been cleared (Evans 2016). Freehold or private tenure lands represent the majority of land class under clearing (deforestation), contributing to 78% of the total cleared area between 1974 – 2014 (Evans 2016). Although changes and amendments have occurred over the span of the VMA, i.e. amended to include remnant vegetation, which prior to 2009 was non-existent (Evans 2016), there is evidence that protected VMA Vegetetation Classes continue to be incrementally cleared and increasing slightly in recent years (Rhodes et al. 2017). Although the Act was supposed to halt broad scale clearing, it has only partly been successful and recent relaxation have caused further clearing and greater forest fragmentation has caused further forest fragmentation (Reside et al. 2017). Fragmentation has impacted on flora and fauna competition promoting aggressive and competitive invasive species such as birds in *Manorina* species, known as minors and the colonization of invasive plant species such as *Lantana* (Thomson et al. 2015). Land clearing hasn't only caused forest fragmentation across Queensland, it has also had effects on stored and released CO_2. For example some 38.5 million tonnes of CO_2 were released in the state between 2013/14 making it likely that the total CO_2 lost since the Act's implementation is much higher (Reside et al. 2017). As stated earlier the VMA uses a set of self assessable vegetation clearing codes and zoned vegetation maps as guides (DNRME Queensland 2017). These are currently under review as of 2019 given continual land clearing trends (DNRME Queensland 2017, 2019). There is evidence of landholders redirecting their clearing to unprotected vegetation classes where remnant zoning is established (Simmons et al. 2018).

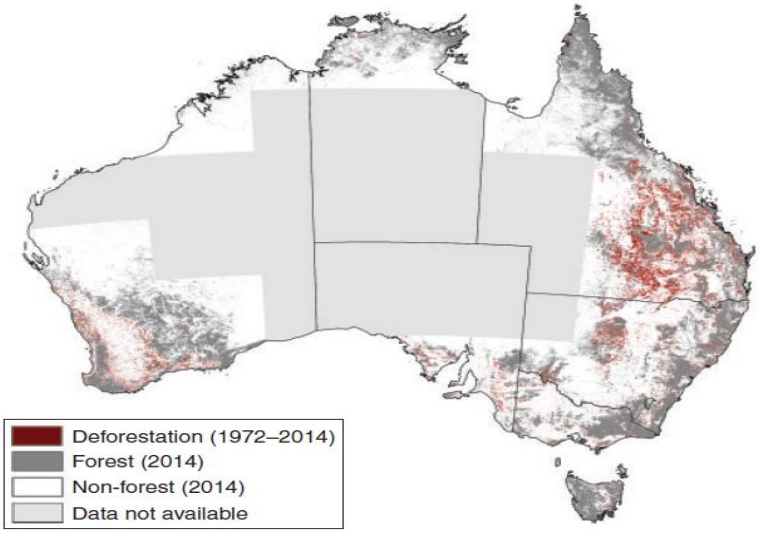


Figure 12: Deforestation across Australia 1972-2014 adopted from (Evans, 2016 pg. 132-150)

State Changes

Forming a baseline to compare the effects of the VMA can be taken before and during the implementation and its subsequent amendments since its inception. It is very complex, as several amendments result from changes in the state government and others from scientific-based lobbying (Simmons et al. 2018; Evans 2016; Reside et al. 2017). Prior to the Act's implementation land clearing for pasture and agriculture had been an age-old tradition and often incentivized and by both federal and state governments (Kanowski 2017). Approximately 4.7 million ha's were cleared between 1980 – 1989 (Evans 2016). Although amendments to the VMA in 2004 were designed to reduce clearing, it still occurred at rate of approximately 400,000 ha per year (Reside et al. 2017). Evans, (2016), suggests between 2013-14 approximately 266, 191 ha were cleared, which is significant given the Act's main purpose is to regulate such activities. More recently, in 2016 a total of 273, 000 ha's of remnant high-value vegetation were placed under notification for clearing using the self assessable codes in the VMA codes (Reside et al. 2017). Looking at the current state of deforestation in Queensland, there is evidence that clearing is continuing despite recent amendments and regulation adjustments (Simmons et al. 2018). One study suggests threatened vegetation continues to be cleared 2.7-2.9 times faster than non-threatened vegetation (Rhodes et al. 2017). The clearing across the state has allowed opportunist invasive species such as foxes and feral cats to prosper (Graham, Maron, and McAlpine 2012). Native mammal declines have been observed as a result. An estimated mortality rate of native mammals in Queensland was reported as 2.1 million per year, being associated with land clearing and invasive predators (Murphy et al. 2019). While land clearing slowed across Queensland with changes in the Act, approximately 0.9 million deaths between 2015-16 have bee reported (Murphy et al. 2019). There remain many gaps with regard to the VMA and its complete outcome. Aggressive invasive plant species such as *Lantana* colonize gaps in fragmented forest ecosystems across Eastern Australia and is a major invasive species for Queensland (Graham, Maron, and McAlpine 2012; Batianoff and Butler 2002).

Monitoring and Reporting

Monitoring at federal level of forest ecosystems across Australia are significant producing 5-year cyclic reports State of the Environment and State of the Forest reports (Kanowski 2017). The State of the Environment Report for example applies a logical process based on the DPSIR described earlier in this thesis and uses a set of socio, economic and environmental variables and indicators for assessment (Department of the Environment and Energy 2018). At state

level, the Department of Agriculture and Fisheries Queensland provides annual reports based on performance indicators for forestry against the states strategic plan. It is on a 5-year rotation and covers strategic risks and opportunities, a set of key performance indicators, cross-government commitments, results, and future priorities (DAF Queensland 2015).

5.5 PEA Synthesis of results from the four case studies

Table 3: Combined qualitative PEA vertical content analysis

Key shared and different elements from PEA	
Drivers	➢ Common formal institutionally driven policy development, decisions, implementation and amendments. ➢ Common elements of the command and control structures and arrangements Formal Government ministries ➢ Commonly formed mandates at federal level for sustainable forest management with state and regional level interpretations such as laws in the case of Lazio and Papua. ➢ Federal level acts separated at state-level into state Acts in Maine and Queensland. ➢ Regulation, codes of practices and planning from forest authorities in Maine, Queensland and Papua, however it's non-existent for Lazio.
Policy	➢ Umbrella SFM principles adopted in each case but supported by weak strategic planning, institutional direction. ➢ In Queensland and Lazio forest policy is difficult to define as it isn't succinctly expressed. ➢ Policy variation between federal and state level in Queensland, Papua and Maine. ➢ Overlapping forest policy with federal (Papua) or state (Queensland and Maine) development policies inducing institutional conflict and policy layering in every case except Lazio. ➢ Frequent policy and Act amendments in Queensland and Papua, less so in Maine and negligible in Lazio. ➢ Direct and updated strategically driven policy for forest management lacking.
Actions	➢ Policy tools are generally regulatory and financial i.e. *'carrots and sticks'*. ➢ In Maine, Queensland and Papua legal instruments are associated with breaches in Acts and Laws. Indemnity payments for profits lost in Lazio. In Maine, financial incentives and in Queensland trust and offsets. ➢ Mixture of hard and soft regulatory tools i.e. strict bans on silvicultural intervention in Lazio and bans on land clearing in Queensland (temporary). ➢ Both Maine and Queensland attempt regulation through codes of practice and standards. In Papua, alternative land-use for agricultural land-use change was in fact mandated by the state.
Effects	➢ Forest resource utility, land-use change and registered effects in general differ both spatially and temporally. ➢ In Papua and Queensland it has been somewhat incentivized. In Papua certainly. ➢ In Queensland and Papua Deforestation is the registered form of decline. ➢ In Lazio and Maine, similarities equal degraded standing resources where disturbance and forest health problems are registered. ➢ Management paradigms across all cases have shifted over the more or less three decades of natural resource discourse. ➢ Ultimately sustainable forests management, for timber or not is lacking scope and application in the policy initiatives and management strategies applied through formal institutions.
State changes	➢ Deviations from Acts, Laws and Policy are evident in all cases where it has been stated. ➢ Degradation process are evident across all cases presently. ➢ Adequate analysis of trade-offs between forest utility and SFM is evident.

	➢ Forest area reductions are registered in all cases. Scales differ. ➢ Degradation through unaccounted externalities is present across all cases. ➢ Varying disturbance regimes registered. ➢ Overall varying severities of forest decline continue despite institutional interventions.
Monitoring	➢ Monitoring efforts in 3/4 case studies. Although strategic direction across institutions appears confused. ➢ Monitoring in Lazio is practically non-existent. ➢ State monitoring of forest health exists in Maine but is either poorly reported or non-existent in Queensland and Papua. ➢ Remote sensing and GIS is frequently applied more recently in all cases expect Lazio. ➢ State-level institutional monitoring initiatives appear under-reported. ➢ State of the forest reports have been released as of 2018 as part of a greater monitoring in3/4 cases ➢ Third-party monitoring exists for privately certified areas in Maine and Qld.
Reporting	➢ Reporting for Maine and Queensland are frequent. Annual and 5 annual cyclic state of the environment and state of the forest reports are produced using statistics derived from each state. ➢ Regional-scale reporting in Queensland seems non-existent for vegetation but robust for tall timber forests. Indonesia recently released its state of the forest report 2018. ➢ Strong scientific literature is present across all cases except Lazio. Integration of reporting and policy seems to be poor.

5.6 Expanded PEA synthesis

Drivers

Each case identified the role of formal forest institutions as drivers of forest policy development and implementation at federal, state and local levels. As demonstrated in An umbrella or set of Acts and legislation exists mainly in the form of command and control and coercive elements as described in the regulatory pillar (Scott 2013). We see in Lazio, that the regional administration created Regional Law 43/1973 in a direct effort to enhance the naturalistic value of some of their forest resources. In Papua, land-clearing for palm oil was a deliberate institutional objective aimed at increasing regional socio-economic development in response to depleted forest resources and in line with their *Pancasila* common-development policy. Maine, in the USA where forestry remains a strong sector, uses the FPA created by the state forest institution to guide and direct forest management on privately owned lands and drafts forest policy in an attempt to regulate forest management activities on private lands. The VMA is driven by the state formal institution for Natural Resources, Energy and Mining in Queensland, similar to Maine, in that is serves as the institution responsible for land management and regulation on private lands. Regulatory formal institutions are attached as either operative institutions across all cases.

Policy

Forest government institutions, in many cases, although having relevant goals, targets and aims for their respective forest heritage e.g. rational forest management or sustainable forest management demonstrate that some policy decisions have, directly or indirectly had negative effect on forests. In almost all cases, state-level formal institutions drive policy development in forestry and are guided by federalized and somewhat ancient Acts. Policy specificity vary across each case, naturally. It is unclear in Lazio what it's strategic forest policy is. This is also the case for the other three case studies where direct forest policies for each state are intwined in-laws and acts and subsequently rather broad. There is evidence of an umbrella-like commitment to sustainable forest management directives in all cases. In Australia, the absence of forest policy related to remnant scrubland is apparent. Although the historical context in Australia is of significance in this case. Policy related to timber production forests is clear cut (Norman et al. 2004) and the VMA does attempt to address levels of clearing but only for a 2 year period (McGrath 2007). This also appears to have been the case for Lazio, where R.L. 43/1974 was used to halt forest management in some areas rather than directed through a regional-specific policy document. In Papua the forest policy is aimed at sustainable yield and hails back to 1966 and the Panacisla (Nasendi 2000). Current forest policy is determined and directed through numerous laws and presidential decrees. Maine does have a forest policy. Again it is based on the principles of SFM and has attempted to regulate the high levels of liquidation harvesting across the state. It is also evident that institutional conflict and policy layering is frequent across each case. Rebranding and amendments to policy are numerous and generally in response to changes in discourse currently, while in the past they appear to be more in response to market opportunities.

Actions

Actions and initiatives for forest policy implementation vary across each case given the natural contextual differences in scales of economy, market forces and political arrangement. In any case they revolve around financial and regulatory based instruments. In the case of Queensland, almost all policies have a legally binding component based on mandatory regulations. As with the USA, all cases each initiative has used a financial instrument at some point along their policy cycle. In Lazio, indemnity payments for private landowners (Francesco Carbone 2012), in Maine state financial incentives for SFM (Cottle and Howard 2012; Farley et al. 2015; Klosowski et al. 2001), in Papua, significant state spending and foreign investment policy (Andrianto,

Komarudin, and Pacheco 2019; Acosta and Curt 2019) and in Queensland offset trusts (Evans 2016). Enforcement for regulation breaches across all cases appear to be insufficient even if clearly stated in public policy in all cases. Between policy development and implementation across all cases, there appears to be a 'carrot' component to incentivize policy implementation, however each case demonstrates problematic long-term validity based on respective outcomes. Strategic planning from the main operative institutions in each case appears lacking. Either broad statements and reporting for strategic planning is focused on broader environmental outcomes or completely non-existent. However, these documents may be only obtainable internally through the ascribed institution.

Effects

Each case highlights different effects from forest policy again attributed to the natural contextual differences in scales of economy, market forces political structures and arrangement. There is a link between shifting forest policy, often abrupt which effects forest utility levels and management paradigms. In Lazio policy initiated strict bans on silvicultural activities. In Indonesia, the market dictated a shift in land use to fill an economic gap. In Maine, changes in legislation saw a restructuring of the entire forest industry and an influx of private forest ownership. In Australia the ambiguity of regulative measures saw continual clearing associated with changes in state governments and frequent amendments despite some years of better regulation. The above has induced forest decline across most case although registered declines are different. In Maine and Lazio, standing resources are suffering from degradation and forest health issues. More importantly, the resource in Maine, which still supports an important forest sector has been depleted and subsequent high-grading has lead to an overstocking of poor quality species. In Queensland and Papua, land-clearing has lead to a change in land-use and deliberate in Papua, poorly regulated in Queensland.

State Changes

Referring back to the various institutional objectives, laws and goals deviations from forest policy is evident across each case. Degradation processes and problems with institutional approaches in developing, implementing responses to forest decline are evident and as such varying secondary degradation processes are present. Focusing on Papua and Queensland, institutional decisions taken over the past three decades have been intentional, however, failed to adequately address trade-offs between regional development and absolute forest value.

Although Lazio's regional administration was able to successfully protect its high-value forests, it failed to address issues associated with highly modified landscapes which subsequently have lead to the degradation of some forest stands and is a direct deviation from the desired outcome. It is apparent that even if robust institutions exist there are varying severities of forest decline and deviations away from institutional objectives. Other than Lazio and Maine, where deforestation is negligible, in Australia and Papua varying levels of deforestation are identified. Disturbance is not presented in all cases; however, fire frequencies and mega-fires have been suggested to be associated to land clearing in both Indonesia and Australia. Fire frequency in Lazio may be increasing.

Monitoring

Monitoring techniques and coverage is varied across each case. In Lazio, it is almost nonexistent nor periodic although attempted in the past (Carbone, 2014). Lazio's most recent monitoring effort was in 2008, executed by the University of Tusica. State-level periodic monitoring efforts are similar for Maine and Queensland. Evidence of strategies using remote sensing techniques to assess forest cover exists in Papua, Queensland an Maine however there does not appear to be a strong coordination between state and regional institutions in any case. Essentially there is very little feedback and integration from field observations, data collection and subsequent policy development.

Reporting

Each case has initiated cyclic reporting across different government ministries and institutions at national levels with differences in scope and timing. State of the Forest Reports have been compiled by all nations addressing various socio, economic and environmental aspects of their forest resources. Scientific reporting is frequent, however there appears to be a lack of absorption of scientific literature in public policy formation across all case. In many cases reporting appears to be a "window dressing' exercise rather than a source of information for future forest policy.

6 Discussion

The discussion chapter explores the adopted PEA in order to link formal institutions to forest decline and begins by establishing some broad observations. Failure typology, as assessed with the PEA is described. The next sections, 6.3-6.5 expand on some key concepts of failure. Causes

of failure at meso-scale (Derwort, Jager, and Newig 2019) are highlighted through an extended synthesis of failures deemed relevant to formal institutions in forest management at meso-scale i.e. property rights, institutional adaptation or change and path-dependency.

6.1 Policy Evaluation Analysis - linking formal institutions to forest decline

The PEA adopted suggests a logical heuristic to examine forest institutions, related policy, acts, laws and regulations and subsequent registered changes in forest resources. Institutional failure, associated with mesco-scale causal mechanisms (Newig, Derwort, and Jager 2019) has been identified as a relevant phenomenon and explored using the PEA. Theoretically, each case study's PEA attempts to give one evaluation a.) positive and coherent with policy expectations b.) coherent or stable and in line with policy expectations c.) problematic and, direct or indirectly, responsible of forest decline processes. The analysis involved four case studies that according to the scientific literature, have registered forest decline. This thesis has categorized each cases as predominantly *problematic*.

Policy outcomes and the role of the institution is fairly recent in international scholarly literature. (Secco *et al.*, 2017; Belair and Ducey, 2018; Simmons *et al.*, 2018; Erbaugh and Nurrochmat, 2019). The assumption that decisions taken from formal institutions in forestry are a priori to sustainable forest management objectives is commonly accepted by governments and society. As shown through the applied PEA, there is very little evidence of effectiveness of intended outcomes when comparison of policy objectives and the forest ecosystem are made. Linking the two explicitly is difficult however. Gaps between, institutional vision, goals and targeted decisions as reported in institutional documents, either informal or formal, surmounting to a large body of synthesis. This is especially noticeable where formal and informal policy amendments span decades. The development of best practises, minimum management standards, standardization, new administrative procedures, hard regulatory tools on land-use change have not been sufficient to ensure future forest heritage or stable yields in these cases (Rhodes et al. 2017; Ellefson, Kilgore, and Granskog 2007; Setiawan et al. 2016; Reside et al. 2017; Varsha et al. 2016). The size of the management areas e.g. Papua, Maine and Queensland and subsequent ability for effective regulation enforcement and institutional coordination is an issue and is associated with institutional capacity. Furthermore, political fatigue and embedded institutional structures/arrangements in forestry combine to undermine change. Strengthening institutional adaptation, capacity and community participation is critical especially at state and regional levels.

Despite changes in global forest management discourses, local and regional needs sometimes take precedence. This is reflected through past actions and policy decisions as those in Papua and Queensland, where decisions from government institutions to increase regional development through land-use change are evident. In Maine, Queensland and Papua, evidence of forest management policy reorientation in an attempt to absorb new forest management and environmental discourses is identified. However, response from forest institutional administrations are much slower and appear to lack the direction, relevance and capacity to respond. In Indonesia amendments and policy repeal have often led to policy layering rather than specifically addressing strategic forest management issues (Erbaugh and Nurrochmat 2019). Amendments to policy and repeal has occurred in Lazio, Maine and Queensland, however, breakdowns between formal institutions and their respective allocated operative branches has occurred. It may be a case of legitimization and institutional harmonization and it is most likely heavily politicized. Strategic planning, focused cross-institutional approaches where forest service heterogeneity is recognized is important.

In Maine and Papua an influx of non-state actors and initiatives reflecting, the participatory and governance paradigms, have resulted in mixed success at coordinating efforts to solve collective action dilemmas associated with property rights (Duchelle et al. 2018; Correia 2010). Property rights issues are visible across all cases. For example radical ownership changes in the late 1990s - early 2000s in the US (Hagan, Irland, and Whitman 2005). These rapid ownership changes from the hands of a few to the hands of the many has seen collective action dilemmas and forest degradation (Gunn, Ducey and Belair, 2019). The inability of the state of Maine to regulate ownership and subsequent impacts on its forest ecosystems is another incident of failure. Conversely land-use change and thus ownership has been intentional and mandated by the Indonesian central government in the past and is still a concern in Papua (Andrianto, Komarudin, and Pacheco 2019).

Forest declines registered from land-use change are simple, however, degradation of standing resources such as in Maine and Lazio are harder to quantify and lack institutional capacity in coordination of monitoring and reporting activities. This combined with relatively weak regulatory property rights institutions causes meso-scale institutional failure (Derwort, Jager, and Newig 2019). This has been compounded by definition and implementation of policy goals which impact on institutional strategic direction.

Measurement requires robust monitoring and reporting. Reporting requires transparency and as such accountability. For this to be established, forest institutions must be directed by clear

and strategic policy. This is lacking in most cases. Less developed countries like Papua are frontiers where central government policy is less likely to be adopted. (Andrianto, Komarudin, and Pacheco 2019). Especially where indigenous populations who rely on the forest for subsistence are under pressure from palm oil companies (Andrianto, Komarudin, and Pacheco 2019; Acosta and Curt 2019). These scenarios require a better understanding of trade-offs between land-use alternatives and direct and indirect benefits derived from a forest ecosystem. Of which is an institutional responsibility and has been found to be wanting.

In more developed countries the role of the state formal institutions for forestry on private land appear to have become somewhat obsolete in planning and strategic roles, playing a seemingly more custodian role rather than strategic direction. This is at least the case for Maine and Queensland. Strategic direction for woodland forests is minimal between formal institutions such as parks and state forest authorities in Queensland. In this case, it is hard to determine which state institutional regulatory and monitoring body is responsible for regulation enforcement. Self-setting regulations and formal institutions designed to enforce best practices have appeared to have failed to achieve their mandates in both Maine and Queensland.

Robust institutions exist but have failed to address the negative externalities of privatization of a resource and short-sighted silvicultural treatments induced by liquidated harvesting paradigms (Belair and Ducey 2018). As with Queensland, state forest institutions are performing the role as custodian for publicly owned resources i.e. state forest and reserves and are effective in many cases (Gunn, Ducey and Belair, 2019). US forest policy is clearly aimed toward sustainable forest management objectives, however the translation from policy to reality is obscured. State regulation and litigation is an ongoing issue (Miner, Malmsheimer, and Keele 2014). Property rights institutions and forest management are in conflict. Unlike the other cases, timber production is still a relevant local income generator for the state and therefore requires significant reassessment and policy revision.

Despite clear contextual differences socially, economically and environmentally across all cases studies, each regions formal institutions in forest management are relatively consistent in their policy mandates, although supported by weak implementation and regulation. Almost all follow command and control structures, with federal policy, state policy and regional policy adopted and developed from the former. (Secco et al. 2017; Setiawan et al. 2016; Kanowski 2017). Each demonstrates and adhesion and inclusion to the “sustainable forest management” paradigm developed out of the RIO convention in 1992 and the Helsinki resolution H1 1993 (Forest Europe 1993). However, this same paradigm has shifted with the ebb and flow of the

conservation discourse where a do-nothing approach, rather than an active management approach has appeared, especially at operational levels.

Finally, for each case, other than Lazio, forest area has declined since 1970 (Evans, 2016; Malandra *et al.*, 2018; Acosta and Curt, 2019; Gunn, Ducey and Belair, 2019; Pendrill *et al.*, 2019). A clear gap between all policy mandates when assessed with state changes through the PEA framework adopted is shown. Furthermore, although robust policy exists surrounding forest administration in all cases, these policies are supported by relatively weak formal institutions. This has been highlighted on an international level, where the same argument has been developed for global forest politics (Arts and Buizer 2009). It is clear across all case studies there are elements of meso-scale institutional failure as defined by (Derwort, Jager, and Newig 2019; Acheson 2006). To shed light on the above more clearly, recent works by (Newig, Derwort, and Jager 2019; Derwort, Jager, and Newig 2019) shall guide concepts of institutional failure in detail.

6.2 Types of Failure

As suggested by (Derwort, Jager, and Newig 2019), institutional failure is not a single clear cut concept. They suggest this concept as an 'umbrella' term for many forms of failure which stem from causes at micro, meso and macro scales. Recent works by Derwort, Jager and Newig, (2019), examine causes of failure at the meso-scale. These include institutional structure weakness, information asymmetries between the public and private sectors, institutional resource and capacity issues for defining policy and enforcing policy, weak regulation i.e. checks and balances and finally insufficient political processes to support socially optimal policy. As demonstrated in all cases studies, there are meso-scale causes associated with failure within each context. Such as:

- Lack of scientific and policy dialogue as demonstrated in the experience of Queensland and Lazio. Ostrom and Poteete, (2004) highlight forest management policies tend to be adopted without first consulting research on factors for successful forest management by national, regional, local governments or local forest groups themselves.
- Lack of institutional capacity and role definition as demonstrated in the case of Queensland, where it is unclear who is regulating land clearing. There is a gap between formal institutional objectives and subsequent operationalization to achieve policy outcomes in most cases.

- Poor monitoring and policy data feedback. Excluding the Lazio Region case study because in the 1970's monitoring wasn't a forest management tool. However it is very common in the other four case studies that this has lead to less than optimal policy implementation and development between formal institutions.
- Weak regulation in enforcing codes of best practice as shown in the Maine and Queensland case studies, although documents suggest robust codes of practice in each case (Department of Natural Resources, Mines and Energy Queensland 2017; Maine Forest Service 2017). Self-regulation and poor oversite appear to be the norm (Simmons et al. 2018; Acheson 2006).
- Institutional structural weaknesses in collaboration between private and public sectors are present, this is especially prevalent in Maine, Papua and Queensland.
- Cross-sectoral coordination and policy harmonization (Derwort, Jager, and Newig 2019). Across Papua, Queensland, Maine and somewhat for Lazio unified forest planning at strategic levels is missing; however it is recognized as key tool for implementing efficient sustainable forest management.

6.3 Traditional formal institutions and forest decline

Acheson, (2006) highlights private property regimes, government-controlled resources and local-level management as key factors for institutional failure. Rivalry in consumption, difficulties in regulation and exclusion impact an institutions ability to maintain both protection and provision of common-pool resources (Bouckaert, Ostrom, and Hess 2013). This is certainly the case in the Maine and Queensland, where private ownership of land is subject to frequent ownership changes, large landholdings, access issues and unstable regulation (Kanowski, 2017; Gunn, Ducey and Belair, 2019; Pendrill *et al.*, 2019). In Papua, conflict often arises between government-endorsed agri-business such as palm oil and restrictions on forest access for indigenous minorities (Acosta and Curt 2019). Although there are robust property rights institutions at state levels in most of the cases, there is a dilemma associated with forest management on privately owned lands. Property rights institutions that issue permits, such as those required in Papua fail to ensure tenure security for marginalized peoples outside of palm oil crop areas. This induces opportunistic agricultural and forest harvesting behaviors (Kubitza et al. 2018). Property rights institutions are also problematic for Maine. Given the high rate of private land tenure and the influx of TIMO's and RIET's, there has been a spree of liquidation harvesting for short term gains focused toward snatch and grab harvesting practices (Correia 2010; Legaard, Sader, and Simons-Legaard 2015; Gunn, Ducey, and Belair 2019). This has

essentially caused a collective action dilemma most likely associated with the 'tragedy of the commons' first proposed by Hardin, in 1968. In Maine, Acheson, 2006, states rules are simply not followed even if in the interest of long-term sustainability. Further implying problems with institutional coordination and sufficient information (Newig, Derwort, and Jager 2019), both recognized as key for institutional stability and self-maintenance. Formal institutions governing forest management appear to have very little relevance in decision making and forest planning for private tenure in both Maine and Queensland. On the other hand, Lazio in Italy, is highly fragmented with small land parcel ownership and tenure. Rural land abandonment is high across most of Italy and land registries are often not well kept making it difficult to establish ownership and thus stimulate collective action (Secco et al. 2017; Secco, Pettenella, and Gatto 2011).

6.4 Change in discourse, abrupt policy changes and institutional adaptation

The study highlights that often changes in forest policy happen abruptly (Legaard, Sader and Simons-Legaard, 2015; Evans, 2016; Maetzke and Cullotta, 2016; Erbaugh and Nurrochmat, 2019). A forest being a renewable but slow responding ecosystem is exposed to abrupt changes in policy and associated actions. Our expectations are that institutions are complex adaptive systems capable of re-orientation, learning and adaptation (Newig, Derwort, and Jager 2019). However, fast-paced and abrupt policy changes can often impede formal institutions especially where periods of long-term hiatus are interrupted by rapid change (Newig, Derwort, and Jager 2019). As shown in this study, relatively abrupt changes in the Queensland VMA 1999, the Maine FPA, the moratoriums in Indonesia and regional policy changes in Lazio R.L. 43/1974 (F.L. 39/2002) have consequently had poor reactions from formal institutions and subsequent forest administration. Institutional stagnation and a poor science/policy interface are evident in Lazio.

Changes in political and environmental discourse more often than not stimulate policy review (Arts and Buizer 2009). However despite review and subsequent changes in policy, institutions are relatively slow to adapt and often have no alternative but a reactionary approach and highly dependant on whether the institutional system is still functioning as desired or obsolete within the discourse (Newig, Derwort, and Jager 2019). We see, despite abrupt changes to institutional regulations in Maine, (Legaard, Sader, and Simons-Legaard 2015) Queensland (McGrath 2007), Papua (Setiawan *et al.*, 2016; Erbaugh and Nurrochmat, 2019) and Lazio (Carbone, 2014), abrupt changes to policy produces a gap in institutional capacity, innovation, subsequent

adoption and implementation (Newig, Derwort, and Jager 2019). Consequently, operational-level planning and management compromised. As demonstrated in Maine, Queensland and Papua it is often unclear *who* is actually regulating the resource, the state, the central government or both (Legaard, Sader and Simons-Legaard, 2015; Susanti and Maryudi, 2016; Rhodes *et al.*, 2017; Simmons *et al.*, 2018; Gunn, Ducey and Belair, 2019). The result here is a big gap between rhetoric and reality (Ashu 2016).

6.5 Path – dependency, political fatigue and institutional change.

The effectiveness and efficiency of a projected policy outcome often depends on the legacy of past actions from decisions taken by institutions and how they respond to externalities arising inside and outside the system (Montgomery 2013). Path dependency is when institutions are bound by these decisions and subsequently'locked' or unable to respond to new challenges or discourses (Rosenbloom, Meadowcroft, and Cashore 2019). We expect formal institutions in forest management to pursue sustainable forest management objectives. Having challenged these institutions with changes in discourse i.e. conservation and climate change, formal institutions are often constrained by legacies of past decisions attempting to guide and restrain current action (Scott 2013). Furthermore, institutional intervention conducted on a forest resource, intentional or not, has temporal ramifications for considerable periods into the future. Therefore short-sighted silvicultural treatments e.g. Maine (Gunn, Ducey, and Belair 2019), past policy interventions e.g. all cases, institutional competition e.g. Papua (Ekawati et al. 2019), land-use change e.g. Queensland and Papua or a hands of approach e.g. Lazio shape the behaviors of institutions, subsequent policy adoption and implementation in the present. Often the status quo may be the most efficient outcome, once costs are considered (Poteete and Ostrom 2002).

Political fatigue associated with forest management as experienced in Australia (Kanowski 2017) is also a prevalent theme in the case studies in this article. Fatigue may manifest itself in by frequent policy creation and layering (Setiawan et al. 2016). It may also be associated with the socio-political arm wrestle between forest conservation and forest production discourses since the 1970's. As stated by Newig, Derwort and Jager, (2019), we perceive institutions to be interlinked, self-sustaining, embedded and linked with the natural environment and judge their sustainability on expectations of their function. In this context, an institutions tend to innovate, adapt, change or become dysfunctional (Newig, Derwort, and Jager 2019). The formal institutions outlined in this thesis reproduce policy to address unsustainable processes but

rarely translate it to substantial impacts at operational levels. Crisis points and triggers for change are not always recognized or absorbed (Newig, Derwort, and Jager 2019), limiting institutional innovation and change. Where forestry institutions have attempted change, where they have been able to re-orient themselves and where the status quo has not been accepted, could stimulate further research to identify adaptive institutional strategies for navigating path-dependency.

6.6 Limitations

There are a number of limitations requiring emphasis in this study. Although a robust assessment of the literature pertaining to each case was completed, all sources are secondary. Furthermore, a more or less negative approach toward formal institutions in forestry has been pursued. There are many instances of successful formal institutional forest administrations and these may highlight further research opportunities. While conceptual frameworks are relatively robust, causality and relationships between key predictors have not been measured. Furthermore, predictors for institutional effectiveness and efficiency are not highlighted here and would be a valuable addition to future research. Linking spatial and temporal forest characteristics with remote sensing and policy objectives would be further illuminating. Monitoring and reporting could be more extensively described.

6.7 Recommendations and future research

This article is very broad in scope and context, as such, future research could be focused towards more vigorous focus on individual case studies and their forest institutions. Furthermore, the institution itself should be better defined, as it is often difficult to understand. It is recommended further research should be focused toward institutional adaptation and response to crisis and triggers and how to direct and strengthen institutions for 'path-reorientation' (Derwort, Jager, and Newig 2019; Newig, Derwort, and Jager 2019) Prevention of failure through constructive pathways should be identified. Successful identification of predictors associated with the above and associated transaction costs should be investigated further. Moreover, can institutions be part of the greater risk assessment discourse?

7 Conclusion

7.1 Primary

Exploring pathways of failure through heuristic models and comparative approaches between *problem* and *context* is the first step of a required greater synthesis. Using the PEA approach this thesis explored the links between formal institutions and forest decline across four case studies. Different forms of decline such as deforestation, degradation and disturbance have been registered and remain sustained. The role of formal institutions, both as the developer and implementor of forest policy may be viewed as an intermediary between successful and not so successful policy implementation. It is not only a problem of institutional decisions but also a problem of implementation and regulation. However, the decision-making process or 'lack thereof' in itself presents challenges. Decisions taken by formal institutions in forestry have been adopted with gaps about knowledge of their resources, conflicting development paradigms, poorly understood variables of temporal and spatial effects associated with hard/soft instruments and the absence of harmonized monitoring and reporting feedback loops. As a result active forest management is either lacking or inducing a lot of the effects registered in each case. A combination of the above are the impetus of institutional failure in forest management at a meso-scale (Derwort, Jager, and Newig 2019). This thesis attempted to establish links between formal institutions and forest decline and succeded, in if only implicitly, at linking formal institutions to forest decline.

7.2 Secondary

Although forest declines are contextually specific, gaps in forest policy and forest administration or operationalization are relatively consistent irrespective of differing social, economic and political factors. It appears the extent and type of forest decline registered is dependant on policy narratives and context-specific land-use paradigms supported by formal institutions that are often in conflict. Despite being of relative new focus in natural resource management, institutions have been identified as critical to the sustainability narrative. Formal institutions, particularly property rights, regulatory and operational, are documented as essential components of a larger sustainability discourse linked with efficiency and effectiveness in forest resource management. As such their role in policy development, implementation and evaluation is considered crucial to the narrative of failure.

7.3 Final

This thesis gives evidence that although robust, reasonably well covered and incentivized formal forest institutions exist, in some circumstances they have failed to address forest decline. In actuality having either directly or indirectly assumed decisions that cause forest decline. Despite positive intentions taken through institutional policy decisions, impacts registered are unfortunately negative over time. Institutional failure, especially in resource management is a relatively new concept. This is supported by recent works from (Derwort, Jager, and Newig 2019) e.g. meso-scale failure traced back to formal government institutions. Using this meso-scale classification we believe, effectively, it is the inability of an institution to act as an intermediary between policy development, legitimization, implementation and monitoring that is a source of forest decline in each case examined. Moreover, where continued 'path re-orientation' is attempted but not successful, where policy amendments, repeals and layering induce negative impacts on forest resources and where institutions become lost in changing discourses they may be in some cases inducing forest decline. Types of failure included are poor policy/science discource and interface, poor instituional role defintion and capacity, poor resource monitoring and data policy feedback, weak regulatory enforcement, instituional strutuctural weakness and poor cross-sectoral and cross-instituional coodination. Further research and investigation requires more rigorous evaluation.

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