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Determining forest conflict hotspots according to academic and environmental groups

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ABSTRACT

Conflicts regarding natural resource management are ubiquitous. The present paper aims to present ways to analyse the location of forest conflicts, based on systematic screening and location of cases, and examines the focus of academic research as well as ENGOs regarding forest conflicts. A large sample of 300 identified forest conflicts are located, categorised according to conflict type and analysed using kernel associations. The results revealed a high concentration of forest conflicts (hotspots) in richly ecological regions of South-East Asia, Central Africa and several areas of South America. Additional areas in Central Europe and North America were also identified. Concerning the focus areas, there were important differences in the areas covered by the ENGOs and the academic literature, in terms of location, as well as conflict type. Although more cases are possibly needed to get more solid conclusions, the methods and results of this paper can serve as a basis of further research, in order, for example, to identify common socio-economical factors that can be linked with the conflicts.

1. Introduction

Conflict in forest management is inevitable (e.g. Hildyard et al., 1998; Walker and Daniels, 1997) and ubiquitous (e.g. Buckles and Rusnack, 1999; Yasmi, 2007). This is understandable considering the differing, and often competing, interests and values regarding forest management (Gritten et al., 2009). The potential negative outcomes of a forest conflict, which according to Buckles and Rusnack (1999: 3) "often lead to chaotic and wasteful deployment of human capacities and the depletion of the very natural resources on which livelihoods, economies, and societies are based" underline the need to further develop the understanding of the subject area (e.g. Hellström, 2001; Yasmi, 2007).

The global nature of forest conflicts has not been studied in detail, with the majority of forest conflict research being qualitative in focus, for example: on individual conflicts or conflicts within one country (e.g. Yasmi et al., 2006; Gritten and Kant, 2007), or in a few case studies (Hellström, 2001). Additionally, academic research, according to Hellström (2001), has tended to focus on countries with high public attention to forestry issues, for example the USA, rather than countries with mild conflict or little public attention to forestry. This is pertinent considering the important role that academic research plays in the development of conflict management tools. Additionally, little work has been done to determine the focus of environmental non-governmental organisations' (ENGOs) campaigns regarding forests, which is relevant considering that the media's focus often follows actions by ENGOs (Rose, 2005).

Forest conflicts have an obvious geographical component, as they do not appear randomly (Yasmi et al., 2006). Their distribution is likely not only based just on forest area, but also related to the social and political context. Given a broad enough sample, it is possible to identify the areas with a higher occurrence of forest conflicts, which can be defined as conflict hotspots, by using kernel analysis (Silverman, 1986). In this approach, with a given set of locations (i.e. identified forest conflicts), it is possible to estimate the spatial distribution of probabilities of occurrence, which permits showing the relative likelihood that a conflict will be associated with that area, based on the location of previous conflicts. Therefore, this method can be used to map the location of the forest conflicts by associating a probability of occurrence, and analyse the areas where the highest concentration of forest conflicts are located. At the same time, it is possible to use this approach to map the areas where the academic literature or the ENGOs are most likely focusing their studies.

Kernel analysis has been used previously in hotspot identification in, among others, medicine, for example regarding outbreaks of illnesses (e.g. Moreno et al., 2008), and crime analysis, for example regarding areas with high levels of burglary (e.g. Savoie, 2008). The identification of conflict hotspots has implications on an academic and practical level: e.g. understanding why conflicts are grouped in a certain location, as well as developing location specific tools regarding intervention. Also, its relevance is highlighted by the apparent

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increase in conflict related to natural resources, including forest management (de Koning et al., 2008).

This study focuses on the analysis of the distribution and concentration patterns of forest conflicts around the world, according to the main source of data, whether academic or ENGO. The specific aims of the study are the application of a kernel methodology for the identification of forest conflict hotspots and to examine the focus of the two sources cited according to the conflict type and the geographical scope.

2. Material and methods

2.1. Theoretical concepts

The nature of forests, and therefore related conflicts, entails that the actual definition of a forest conflict is often vague (Hellström, 2001; Yasmi, 2007). According to FAO (2000) conflicts, regarding natural resource management, occur when there are disagreements and disputes regarding access and management of natural resources. Using Glasl's (1999) terminology, these disputes and disagreements constitute being a conflict when one group is impairing the activities of another, for example, restricting their access to the resource or excluding them from the decision making process (e.g. Yasmi et al., 2007).

The ubiquity of forest conflicts naturally entails that it affects many areas of forests, and their management (Walker and Daniels, 1997), resulting in numerous types of forest conflicts. There have, however, been a few attempts at categorising the types of conflicts (e.g. Chandrasekharan, 1996; Hellström, 2001), and these tend to be quite abstract, geographically limited, or simply too few (a view supported by Hellström (2001)). For this work conflict type is defined as the issue at the centre of the conflict, as defined by the source (i.e. academic, ENGO or international forestry organisation). The aim of categorising the conflicts into type is the fact that it facilitates the investigation of conflicts according to different variables, such as location. Therefore, the categorisation needs to be based on a practical system, reflecting reality (Table 1). The selection of the categories was done based on an initial analysis of the conflicts identified in academic, ENGO and international forest organisation publications.

In cases of possible overlapping (for example, a conflict involving a pulp and paper company in Indonesia) the decision was made according to the main focus of the different reports and papers associated with the conflict. For academic papers the titles, keywords and abstract, in that order, were used to identify the conflict type, while in the ENGO reports the title, summary or abstract (if available) and the article itself was used. In a couple of these cases, where there were more than one source, there was still an overlap in the classifying of the conflict, with one source, for example, defining the conflict as being centred on forest industry, while the other source sees the conflict as being centred on plantations. In these few cases the categorisation was based on a content analysis of each of the articles in question. The content analysis included the examination of, in order, the titles, keywords (when available), abstract/summary (when available), first paragraph of the text, and remainder of the text. The number of times each category was used determined the categorisation of the conflict. Titles ($\times 10$) were given more weighting, than keywords ($\times 5$), and keywords more than abstract ($\times 3$).

2.2. Compilation of data

A database was constructed including all possible forest conflicts, according to the source of information, whether academic or ENGOs. For the analysis of the academic literature, the data came mostly from peer reviewed journals, using academic search engines such as Google Scholar and Science Direct. The search for relevant cases was based on the use of keywords (i.e. forest conflict, forest conflicts and additional combinations) as a search term.

A similar search was carried out for data provided by ENGOs. In this case, the search was based on general search engines such as Google. The same terms and keywords were used, in addition to the names of international ENGOs. The ENGOs included in the search were the major international groups (e.g. WWF, Greenpeace and Friends of the Earth). Finally, a search based on the same methods was performed for conflicts reported by international organisations (e.g. FAO and Centre for International Forestry Research (CIFOR)). All searches were performed during 2008.

Initially, the search resulted in about 400 individual cases from academic sources and international organisations, and over 2000 from ENGOs. After the removal of duplications, as well as irrelevant pages, the conflicts were subject to a content analysis; whereby the results were then individually analysed in order to verify their validity. The content analysis was done by comparing each conflict with Glasl's (1999) definition of conflict as being based on impairment. The content analysis that we employed, based on Glasl's (1999) definition, was similar to the one utilised by Yasmi (2007) in his quantitative research into conflicts in natural resource management. The analysis centred on the identification of sources of impairment, which proved to be a valid additional tool in the content analysis: 1. Forcing (objective) — for example, regarding enforcement of a conservation agenda, 2. Restriction (access) — for example, removal of local people for establishment of plantation, 3. Degrading (environment) — for example, pollution of river as a result of pulp mill operations, 4.

Table 1
Categorisation of conflict based on source material (publications from academic, ENGO and international forest organisation sources).

Conflict type	Explanation
1. Agriculture	Conflict centred on agriculture impacting on forest usage (e.g. clearing of forest to allow grazing by cattle)
2. Bioenergy plantations	Conflict centred on the establishment and/or management of bioenergy plantations (e.g. establishment of oil palm plantations)
3. Conservation	Conflict centred on arising from conservation efforts (e.g. establishment of nature reserve which inhibits local communities' forest usage)
4. Deforestation	Conflict centred on the results of deforestation (various reasons may be the cause)
5. Genetically modified material	Conflict centred on use of genetically modified (GM) material (e.g. establishment of GM trials)
6. Illegal logging	Conflict centred on the results of illegal logging (actors conducting illegal logging may include local communities, but also forest industry)
7. Indigenous rights	Conflict centred on indigenous rights being restricted by activities of organisations (e.g. by a private company, or a government institution)
8. Forest industry	Conflict centred on the operations of forest industry (e.g. where various aspects of a forest company's operations result in conflict)
9. Plantations (other than bioenergy plantations)	Conflict arising from the establishment and management of plantations (e.g. fibre plantations for pulp and paper industry), excluding those included in category 2
10. Population resettlement	Conflict centred on results of population resettlement (relocation is forced as well as voluntary e.g. as a result of war, or government policy) resulting in increasing pressure on forest resource
11. Resource extraction	Conflict centred on resource extraction (e.g. establishment and operation of a coal mine) and its resulting impact on the surrounding forest resource
12. Stakeholder conflict	Conflict between stakeholders over forest usage (e.g. where two or more stakeholders are conflicting over management of forest).
13. Urban forestry	Conflicts involving urban forestry (e.g. conflicting recreational use in a forest)

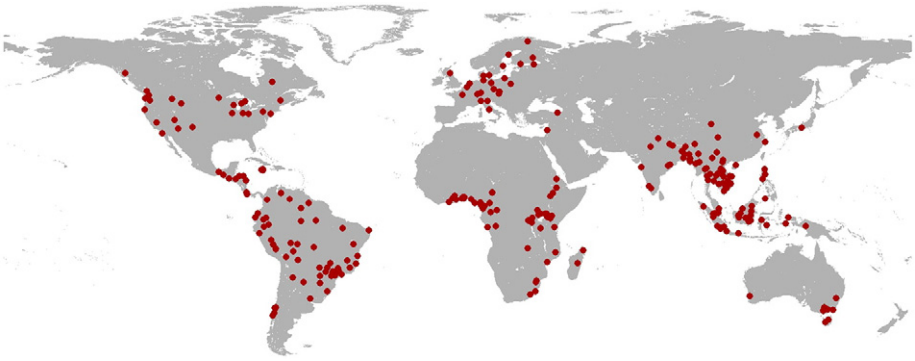

Fig. 1. Location of the forest conflicts analysed (N = 300).

Abusing (authority) — including, corruption in allocation of logging licences.

In some cases, the same conflict was reported by a wide range of documents, both by academic and ENGOs sources. The resulting conflict cases were then classified in categories as presented above. Finally, each conflict included was located geographically (Fig. 1). In most of the other cases, the specific area of the conflict could be easily identified, and the coordinates were extracted. In unclear cases, the closest city to the conflict or the capital of the district was used to locate the position.

2.3. Methods to identify conflict areas

The conflict locations were analysed using a geo-statistical methodology based on hotspot associations. The method aimed to identify areas where forest conflicts are concentrated. This approach allows the estimation of the spatial distribution of probabilities for a forest conflict, based on a pool of observed events, extracted from the database of forest conflicts. For a spatial region a continuous grid was first created, and the probability of occurrence of a forest conflict was calculated by creating a density function (kernel function). The density function was based on a normal bi-variate distribution curve, where the variables analysed were the coordinates of the forest conflicts. The kernel function was then calculated for all the points on the grid, which resulted in a continuous distribution of the frequencies for all the territory.

The bandwidth used in the kernel function referred to a parameter based on Worton (1989, 1995) which served as a smoothing factor. The smoothing factor allowed working at different levels of detail in the calculations. The final calculations used variance standardisation and variable kernels, where the bandwidth parameter is not fixed along the locations, being lower in areas with low concentration of forest conflicts, which prevented the over-representation of isolated conflicts.

The application of this method resulted in maps with standardised isopleths, based on percent volume contours (PVC), in order to compare areas with high occurrence of forest conflicts. The PVCs represent a defined percentage of conflicts in the smallest possible area. For instance, the isopleths containing the 10th percentile area shows the areas with the highest occurrence of conflicts, since it

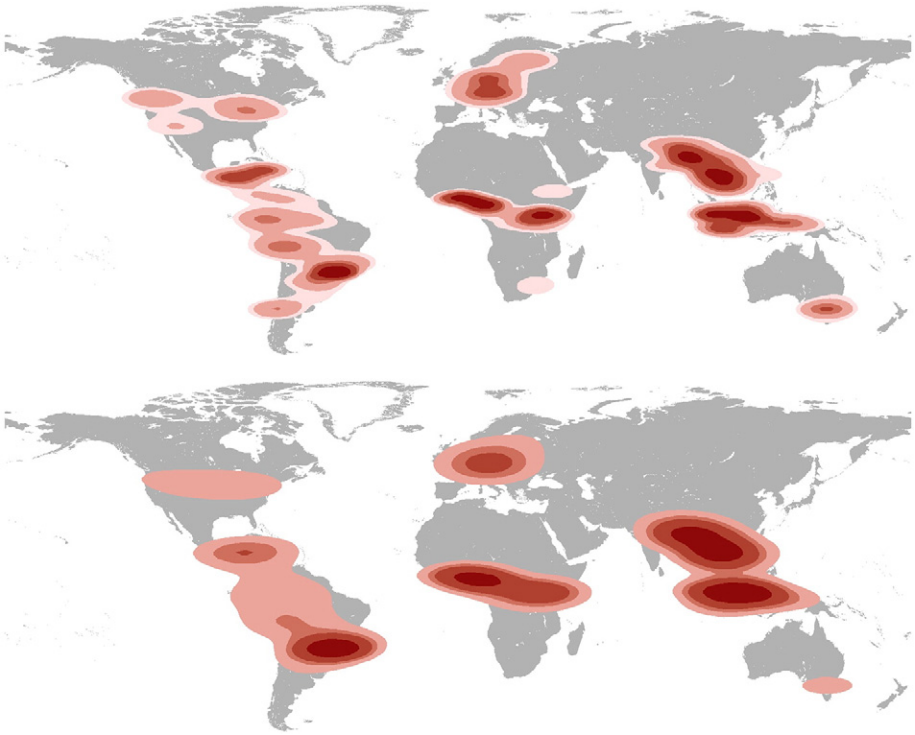

Fig. 2. Location of the conflict areas for two levels of detail, corresponding to a 20% (up) and 40% (bottom) of the reference parameter. Whereas the use of 20% is more flexible and identifies local hotspots, the use of 40% is better to show general areas.

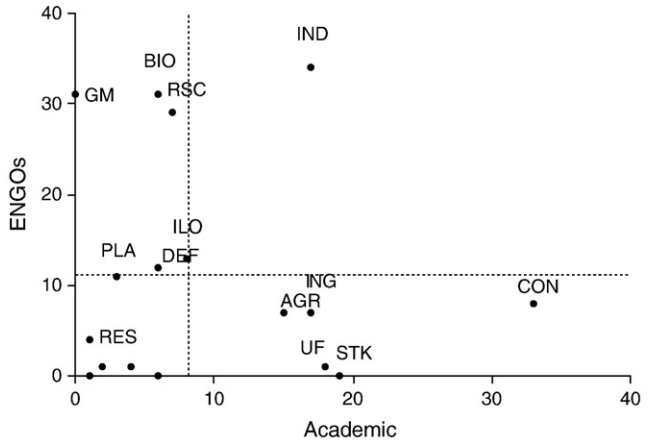

Fig. 3. Number of conflicts according to the topic and source: academic and UN/FAO articles versus ENGOs reports. The same conflict could be simultaneously reported by both groups. AGR: Agricultural uses, BIO: Bioenergy, CON: Conservation, DEF: Deforestation, GM: Genetically modified material, ILO: Illegal logging, ING: Indigenous rights, IND: Forest Industry, PLA: Plantations, RES: Resettlement, RSC: Resource extraction (e.g. mining activities), STK: Stakeholders, UF: Urban forest. Discontinuous lines mark the averages for both groups.

represents the smallest possible area to contain 10% of all the conflicts documented. On the other hand, the 90th percentile area, contains almost all the conflicts, and therefore defines the areas covered by the study.

This methodology was also applied to analyse the conflict locations attending to the sources by groups: academic literature and ENGOs reports. In this case, the hotspots illustrate the areas where each of these groups are focusing attention, given the data available. This allowed identifying divergences between academics and ENGOs in their geographical coverage. In addition, the classification of the conflicts was used in order to identify possible divergences in the nature of the conflicts covered.

3. Results

Overall, conflicts were identified in almost all the forested areas, with the exception of Russia. Regarding the source of the conflicts, 136 were reported in academic literature, 20 in international forest organisations (i.e. FAO, UN), and 182 in ENGOs reports. It should be noted that some of the conflicts had more than one source; as a result the final identified conflicts numbered 300 across the globe.

The reference parameter (Worton, 1989) was 0.386 for all conflicts included, after variance standardisation. The use of 20% and 40% of the reference parameter seemed to be adequate for the identification of the hotspots. These revealed a high frequency of forest conflicts in highly biodiverse regions of South-East Asia as well as in central Africa, central and north Europe, several areas of South America, and the border area of USA and Canada (Fig. 2).

The analysis of the data showed important differences in the main focus areas between the academic community and the international ENGOs (Fig. 3). Whereas many of the conflicts reported in scientific journals focused on conservation (e.g. nature reserve creation in Thailand) and urban forestry (e.g. in Europe), the ENGOs clearly reported most of the conflicts related to the use of genetically modified material (main focus in Brazil and Europe), bioenergy (e.g. oil palm plantations in central Africa, and South-East Asia) and resource extraction (mostly mines in Asia and some in South America). Conflicts linked to forest industries seem to be more balanced between both sources.

The application of the hotspot analysis to the conflicts reported by academic publications and ENGOs also showed different geographical focuses (Fig. 4). Both groups seem to focus on South-East Asia and South America. However, the results show that the academic community paid bigger attention to Europe, Australia and North America, whereas international ENGOs focus relatively more in central Africa.

4. Discussion

This study primarily focuses on the analysis of the location of forest conflicts, based on a large number of cases reported by scientific

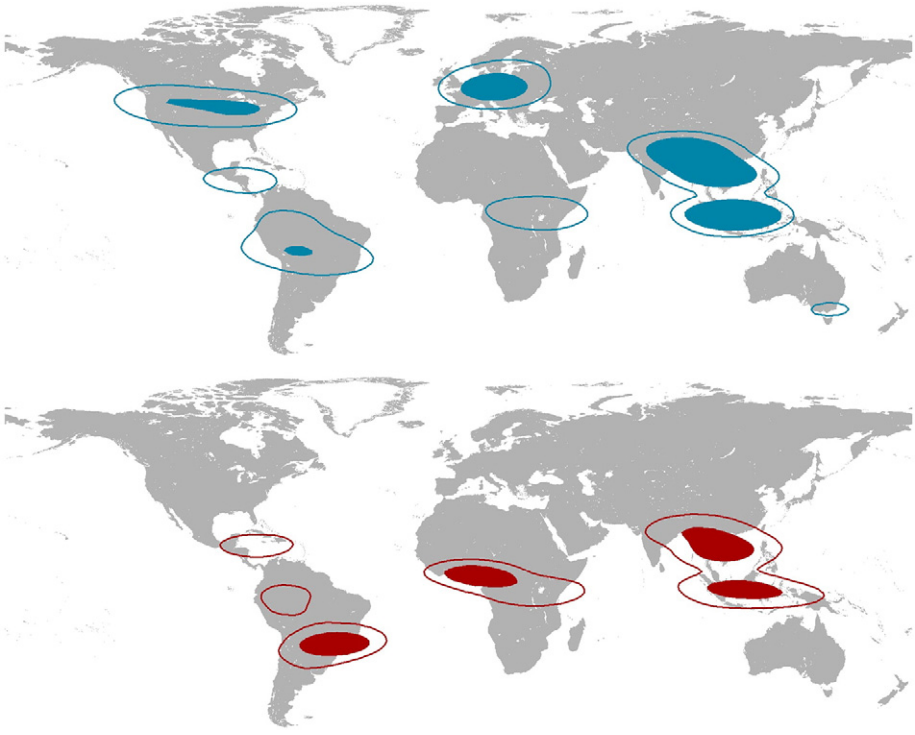

Fig. 4. Conflict areas using forest conflicts from academic publications (up) and from ENGOs reports (bottom). The hotspots have been identified using a kernel analysis (40% of the reference values). Dark areas show the higher concentration of forest conflicts reported. Lines comprise about 60% of the forest conflicts reported by each group.

literature, international organisations and ENGOs. Although the calculations and analysis aimed at being as exhaustive as possible, access to data concerning forest conflicts presented several obvious limitations. These included the fact that despite the main language of scientific reports being English, there are several linguistic barriers that have prevented access to some possible conflicts, for example, those published in local reports. Additionally there is a temporal limitation to the search as a result of it being restricted to publications available on the internet (i.e. reducing the inclusion of a number of conflicts taking place before the mid-1990s). The number and use of keywords used during the searches cannot be exhaustive and, therefore, also result in the exclusion of some possible conflicts.

These limitations inevitably result in biases of the analyses provided, as it is extremely difficult to access all possible forest conflicts in the world. Furthermore, it must be taken into account that the data reflects conflicts investigated and already reported, and cannot include conflicts that have not garnered the attention of the ENGO and scientific communities. However, although many forest conflicts may have been excluded from the analysis, the database included a large sample of forest conflicts, which provides a solid ground for the results. The total number of conflicts investigated is similar to previous studies conducted in quantitative research regarding forest conflicts (Yasmi, 2007). His search of scientific articles for forest conflicts produced 118 results. From a methodological point of view the use of Glasl's (1999) categorisation of conflict as being based on impairment, despite being developed for inter-individual conflict, was highly valid in this work. Yasmi (2007) also found Glasl's (1999) impairment categorisation to be highly suitable in the content analysis.

The obvious central factor in the location of forest conflicts is forest areas, which partially explains the concentration in areas with large forest cover. This can be seen in South-East Asia, Central Africa and central South America; however, the lack of forest conflicts in the extensive forested areas of Russia was noteworthy. This can reflect a possible lack of attention paid to areas of central Asia by the international academic community or the ENGOs. An advantage of the methodology used is that the implementation of the kernel analysis allows for different levels of detail in the definition of hotspots, which provides with both regional and local estimates. This permits the identification of different conflict areas in similarly forested regions.

The results also illustrate that there is not a uniformity in the geographical focus regarding forest conflicts, a finding supported by Hellström (2001). Concerning the focus areas, there were differences in the areas covered by the ENGOs and the academic literature, in terms of location, as well as conflict type. This may partly be explained by funding; as ENGOs must operate with funding in mind, this can determine their focus (McAdam et al., 1996). This focus is in both geographical terms and issues that they campaign on, as suggested by Gritten (2009). In other words, they are unlikely to campaign on issues, for example, that will not garner media coverage (Gamson, 2004). Certain issues lend themselves to campaigns by ENGOs, such as the operations of multinational forestry companies considering such issues as media coverage and its impact on funding and membership, and campaign partners. This should be considered in the context of the fact that their ability to influence policy makers is partially determined by the level of financial support (Kau and Rubin, 1982) and size of membership (Riddel, 2003). Additional factors may include, among others, the ENGOs' links to the region, and whether they have campaigned there previously (Gritten, 2009), which should be taken in the context of the fact that international ENGOs have stronger presence (i.e. country offices, partner organisations) in certain locations. For example, Greenpeace opened its South Africa office only in 2008.

According to Hammersley (1995), academics, like ENGOs, have factors that determine their focus; also including funding. Additionally other issues need to be considered including the number of academic publications per country, as well as levels of academic cooperation (Beerkens, 2004), which will impact on the geographical and conflict type focus. A couple of possible explanations, and areas of potential future research, could be the nationality and research home of the authors of the academic articles (i.e. researchers may be more likely to focus research on conflicts closer to home). Additional areas of interest for future research, regarding the differences in focus between ENGOs and academics, could also cover sources of funding, as well as the media coverage of the conflicts identified from academic and ENGO sources, including whether there is correlation between the media coverage (e.g. scale and location) and funding.

The significance in the differences in the focus of the ENGOs and academics is significant when taken in the context of a particular conflict's nature, as well as conflict management in general. There has been extensive work by academics on the development of environmental conflict management tools (e.g. Caton-Campbell, 2003), this is noteworthy considering the focus, both geographical and regarding conflict type, of the academic work. In other words the conflict management tools are therefore likely to be location specific and conflict type specific to a certain degree. While the academic focus is particularly important regarding numerous issues, including the fact that the ENGOs have become increasingly important in setting the agenda and determining policies on both governmental and corporate levels (Jasanoff, 1997; Murphy and Bendell, 1997; Betsill and Corell, 2001).

The quantitative nature of the data necessitates caution when conducting further analysis. Each conflict is unique in intensity, protagonists involved and geographical scale (Buckles and Rusnack, 1999; Hellström, 2001). Therefore one must consider the different elements involved in a forest conflict, whether in terms of biodiversity, to the conflict forest being a livelihood source for a large number of people. For example, comparing a conflict such as ones involving plantations or forest industry in Indonesia with a conflict regarding an urban forest in South Korea could be viewed as having very differing levels of impact e.g. forestry share of GDP, employment in forestry) and intensity (e.g. demonstrations, violence). In addition, some conflicts can be very geographically localised (e.g. location of mining activities), whereas others can be over a large area (e.g. extensive plantations). Future studies can incorporate these factors by adding weighting factors in the calculations associated with the impact intensity and area coverage of the conflicts, thus providing with higher accuracy to the resulting estimates.

From the results the omnipresent nature of forest conflicts is quite clear, despite the aforementioned limitations on the data gathering. Conflicts do not occur in a vacuum, as there will be social and political drivers (Yasmi et al., 2006). The hotspots are clearly identified in South-East Asia (centred on Indonesia), South America (Brazil) and Central Africa and the gulf of Guinea, areas with social and political instability in comparison to Europe and North America. This gives a pointer for an additional area of further research, namely the identification of common issues in the hotspot areas.

Future efforts to enlarge the database can use the same methodological approach in order to identify new focus areas of conflict, through an expansion of the search terms. It must be taken into account that this type of research is by nature very dynamic, and new focus areas can appear within a brief period of time (e.g. oil palm plantations).

This also leads to further development and applications of the hotspots. With the potential destructive nature of forest conflicts there is a continuing need to address the various dimensions to the subject (Ayling and Kelly, 1997; Walker and Daniels, 1997; Yasmi, 2007). This includes examining its global aspects, including their location, and within that the types of conflicts. This work is a small step in the process of investigating the global dimensions of forest conflicts.

5. Conclusions

This is the first study, to the authors' knowledge, that analyses the location of forest conflicts on a global scale based on a large sample of data. The use of hotspot methods based on kernel associations is an innovative tool that provides solid ground for the analysis of the location of forest conflicts. There are areas with high concentration of forest conflicts that can be quantified and studied in further detail in future studies. Despite its limitations, the methods and data provided show the different focus by the academic literature and the ENGOs when studying the complex subject of the forest conflicts.

Although more cases are needed to develop the findings and their implications, the methods and results of this paper can serve as a basis of further research, in order to identify common socio-economical factors that can be interlinked with the conflicts. A better understanding of the processes and geographical factors involved in forest conflicts can contribute to conflict resolution, as well as having direct policy and educational applications.

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