The Version of Record of this manuscript has been published in the book *Hunter-Gatherers in a Changing World*, and is available here:

https://doi.org/10.1007/978-3-319-42271-8_13

Chapter 13

Globalized Conflicts, Globalized Responses. Changing Manners of Contestation Among Indigenous Communities

Petra Benyei, Nerea Turreira-Garcia, Martí Orta-Martínez and Mar Cartró-Sabaté

Abstract In a globalized world, environmental conflicts affecting indigenous communities (including hunter-gatherer groups) have intensified and grown in their transnational character. These changes have affected the choice of manners of contestation of these groups, favouring in some cases the emergence of alternative responses based in the use of new technologies and scientifically gathered evidence. In this chapter, we examine these interlinked changes, describing also –through two case studies- an emerging methodology of scientific enquiry that aims to enable indigenous communities to lead scientific activities and confront conflicts through a truly bottom-up approach. The chapter ends discussing how, despite the potential of such new manners of contestation, the power imbalances that currently underpin many indigenous conflicts are first to be addressed.

13.1 Introduction

Globalisation, understood as a process of intensification and integration of world-wide economic and social relations that transcend national spaces, can be seen as a major driver of increasing economic, political and cultural linkages between once distant communities (Kearney 1995; Parks & Roberts 2006). Researchers have argued that globalization is driving the re-scaling of political, social and cultural relations leading to a diversity of economic, cultural, political and socio-ecological changes in many different contexts (Berkes 2007; Cohen 2007; Cerny 1995; Young et al. 2006). Globalization affects even the most remote societies around the globe, including hunter-gatherer societies, often generating many negative impacts. For example, increased interaction between nation-states and indigenous societies has led to forced acculturation, deskilling, and discrimination against cultural minorities (Baker 2007; Gómez-Baggethun & Reyes-García 2013; Stone 2007). Similarly, international economic integration (characterised by the specialisation of productive systems,

Petra Benyei (corresponding author).
Institut de Ciència i Tecnología Ambientals (ICTA)
Universitat Autònoma de Barcelona, Barcelona, Spain
e-mail: Petra.Benyei@uab.cat

Nerea Turreira-Garcia
University of Copenhagen, Denmark

Martí Orta-Martinez
International Institute of Social Studies, Erasmus University Rotterdam, Netherlands

Mar Cartró-Sabaté
Institut de Ciència i Tecnología Ambientals (ICTA)
Universitat Autònoma de Barcelona, Barcelona, Spain

including agriculture) has led to the loss of both economic and food sovereignty of the people subject to externally driven productive agendas (Andrée, Ayres, Bosia, & Mássicotte 2014; Quiggin 2001; Sassen 1996). Furthermore, the intensification of natural resources extraction that occurs in some of the areas inhabited by indigenous groups has been said to contribute to an unequal access to resources and severe environmental degradation, often threatening local livelihoods (Escobar 2006; Muradian, Martinez-Alier & Correa 2003; Obi 1999; Roberts & Thanos 2003).

The negative impact of globalization over indigenous societies has often led to the rise of different sorts of conflicts. While conflicts between indigenous societies and external agents (namely the state and the corporations) are not new, globalization has changed the scale of conflicts blurring the line between the local and the global, both regarding the driver of conflicts and the response to them (Cerny 1995; Edelman 2001). Hence, as traditional hierarchical and state-centred collective action does not seem effective to respond to flexible, dynamic and transnational global conflicts (Cerny 1995), a diversity of alternative manners of contestation has emerged, at times relying on technological inputs brought by the globalization process itself. For instance, information sharing boosted by the use of communication technologies has served to up-scale the responses to certain conflicts and has favoured grassroots movements' organisation (Sandoval-Almazan & Gil-García 2014). This shift in the use of technology (that is progressively being appropriated by lay citizens) is parallel to the shift in the use of scientific evidence (from being used by dominant systems to legitimize their actions, to be adopted by citizens as a manner of contestation; McCormick 2007).

In this chapter, we describe changes in the nature of conflicts and the manners of contestation of indigenous societies linked to globalisation. We first review how conflicts and manners of contestation of indigenous peoples have evolved throughout history, and the role of science in such change. We then present two examples of indigenous communities-led responses to existing environmental conflicts, emphasizing the global nature of both conflicts and responses. Finally, we discuss and compare these initiatives, reflecting both on the potential and limits of participatory citizen science as a tool for indigenous contestation and advocacy in the global world. Although the two studied societies cannot be classified as hunter-gatherers, we consider that the issues presented in this chapter transcend this category and thus can affect a more inclusive range of local communities with indigenous identity while still directly relating to hunter-gatherer societies.

13.2 The Changing Nature of Global Conflicts and Indigenous Responses

Indigenous communities have typically inhabited their territories for thousands of years, displaying a strong sense of place attachment rooted on a long social-ecological interaction history (Cunningham & Stanley 2003). Since colonial times, most indigenous groups have faced struggles against colonising states and other dominant or competing systems (Alfred & Corntassel 2005). Relations with outsiders have taken many forms and have often lead to environmental, social, political and cultural conflicts whose nature has changed through time. The evolution of such conflicts can be understood in the context of changing economic/productive systems and political institutions (Friedman 1999) as well as in the context of political, cultural and social relations that change in scale and intensity (Cerny 1995). Changes in the nature of conflicts are associated with changes in indigenous responses to such conflicts,

including their manners of contestation and their ways of doing advocacy. This section describes such changes.

Conflicts between indigenous societies and national societies can be traced back to colonial times. Colonial nations commonly looked down upon the original populations of the areas in which they established their economic and political rule, sometimes even ignoring the mere previous existence of people in those territories (Buchan 2006). Not acknowledging the existence or the rights of indigenous communities clearly favoured colonial control over indigenous people's and land's, leading to conflicts related to natural resource extraction, cultural imposition, and political repression (Alfred & Corntassel 2005). The fragmentation of colonial powers brought new forms of governance (namely economic and political "empires" funded in expanding control and appropriation processes; Hardt & Negri 2001; van der Ploeg 2009) which substituted colonialism as the main dominance system but that continued oppressing the people living in the economic, political and social periphery until nowadays (Galtung 1971; Wallerstein 2004).

Parallel to the emergence of new forms of governance, indigenous manners of contestation also evolved. Indigenous contestation to colonial domination was commonly done through physical struggle and sabotage in response to a very identifiable dominating force (Schwarz & Ray 2008). During colonial independence, indigenous peoples started organising themselves differently, changing their strategies somehow mimicking the hierarchical and national structures of the newly created nation-states (Corntassel 2008). This was generally done in a quest for institutional recognition (legal rights) and self-determination, yet the process was also imposed by the states, which required these forms of organization in order to grant communities with official representation. However, in recent times, sovereignty is no longer necessarily granted by national powers (due to the change in scale of the socio-political relations towards transnationalism and political integration), leaving indigenous peoples often stripped of their basic human rights (Holden, Nadeau & Jacobson 2011).

This recent intensification and integration of political and economic relations (core to globalisation) has not only resulted in new forms of domination, but also has made more difficult to directly link a conflict to a specific causing institution or agent (Cerny 1995). This has led to the apparition of different, more global and transnational, struggles and manners of contestation (Robinson 2003), a shift that is especially evident in the case of environmental conflicts (Çoban 2004; Martinez-Alier 2001). For example, extraction of raw materials in remote areas raised environmental conflicts in the past, but the relatively recent liberalisation of extractive companies and the organisational engineering of corporations has driven the situation to a point where, increasingly, there are no "doors to be knocked on," so claims need to be addressed to different levels that those of the state or the extractive company (although there is space also for the more "traditional" contestation strategies; e.g. road blocking or litigation; Clark 2002). This situation has led many indigenous peoples' groups and movements in search of other types of recognition, frequently changing their approach to contestation.

New indigenous contestation initiatives vary greatly depending on the region and the conflict (Hall & Fenelon 2015), but have often moved to the supra-national level by means of further transnational organisation and advocacy (Bandy & Smith 2005; Di Chiro 1997; Edelman 2008). For example, indigenous contestation to environmental conflicts try to demonstrate the linkages between local environmental problems and global issues (e.g. deforestation and climate change) to create global awareness and somehow respond to the domination situations leading to conflicts (Doherty & Doyle 2006). Another alternative contestation initiative has been the use of

information communication technologies and organisational tools, paradoxically core to the globalization process, to support indigenous claims (Turner 1992). Finally, and increasingly, another new form of contestation has been the gathering of scientific evidence by indigenous people to prove not only the local consequences of environmental, cultural or political problems but also the linkages between global trends and their associated local impacts (Lewis & Nkuintchua 2012). The growing use of scientific evidence to support indigenous claims is parallel to changes in the roles that indigenous peoples play in scientific projects and can be contextualized in a science democratizing or 'decolonizing' trend that is changing the ways in which the scientific community interacts with citizens in general and indigenous peoples in particular.

The changing relation between scientific and the indigenous communities can also be understood in line with the shifting of mainstream economic, social, political and cultural world visions. As some authors argue (Harding 1992; Jasanoff 2009; Mattli & Büthe 2011), science has been (and continues to be) used by dominant political systems to legitimise their power and actions. For example, during colonial times, scientific evidence was often used to legitimate the oppression of indigenous communities (Baber 1996; Gascoigne 1998; McClellan & Regourd 2000). Following social-Darwinist ideas of civilization and development, indigenous communities were at first studied as 'primitive socio-cultural and economic systems', thus re-enforcing the paternalistic colonial control over these communities (Howard-Wagner 2007). These ideas were progressively refuted as indigenous groups started to contest the oppressing systems and gained self-determination, and thus a less objectified position in the scientific world (Rigney 2001). However, indigenous peoples and their knowledge systems continued to be an object to scientific studies, either as a source of valuable information (both in the scientific and economic sense) or as an element needed to be integrated into scientific accounts of the world's reality (Nadasdy 1999; Watson & Huntington 2014). Although these approaches are still the norm, some exceptional initiatives are emerging progressively changing the agency of indigenous people in scientific projects.

One of such initiatives relates to 'citizen science', broadly understood as scientific activities in which non-professional scientists participate (Cohn 2008), and more specifically to "community science" and "do it yourself science" (Haklay 2013a; Nascimento, Pereira & Ghezzi 2014) or to "volunteered environmental monitoring" and "community-based monitoring", understood as citizen science projects in which local participants engage in natural resource monitoring activities in collaboration with professional non-indigenous scientists (Danielsen et al. 2009; Conrad &Hilchey 2011; Stepenuck & Green 2015). Differently than in "classic" citizen science, in which resources, research questions and research design stay close to the professional scientists and citizens are basically relegated to being a network of observers, "community science" and "do-it-yourself science" promote a bottom-up approach in which the research questions and the implementation are closer to the citizens' side, so citizens are drivers of scientific projects. Such approach, however, is still considered far from being truly bottom-up since the research questions are still closer to the professional scientists' interests. Moreover, its contributions are argued to be limited by issues such as strict project timing and funding or lack of unbiased local engagement, threatening the long term sustainability and meaningful local impacts of such projects (Haklay 2013a).

In response to these issues, a truly bottom-up "extreme" citizen science approach (that we call "participatory monitoring" in the context of this chapter), has been growing rapidly, especially in the context of environmental conflicts. Differently from the

previous citizen science approaches, in extreme citizen science citizens engage actively in all phases of research; from research question to design, implementation and analysis. The implementation of extreme citizen science projects require that tools and technologies which are normally used in scientific contexts and by dominating systems are appropriated by lay users. In most such citizen science projects, information and communication technologies are being used even in very remote areas and by illiterate people to undertake mapping, data sourcing or evaluation activities (Stevens et al. 2014; Ansell & Koenig 2011; Vitos, Lewis, Stevens & Haklay 2013), which can provide valuable evidence to support the communities' claims. These technologies, as well as all the related data management infrastructures, are progressively being made widely accessible not only by means of changing the intellectual property rights associated to datasets, software and hardware, but also by developing innovative solutions that can solve technology access shortages (http://www.cybertracker.org/; https://publiclab.org/).

The results from these types of monitoring activities have been successfully used not necessarily to respond to academic merit driven objectives, but to support many environmental justice claims, in some cases linked to indigenous struggles (Vitos, Lewis, Stevens & Haklay 2013). However, as the following examples will illustrate, a question still remains regarding the extent to which the new contestation will be able to address the power imbalances and other systemic issues that are at the core of the conflicts.

13.3 Indigenous Scientists and Environmental Participatory Monitoring

13.3.1 Community-led oil spill monitoring in the Peruvian Amazon

Our first example of alternative manners of contestation by means of "participatory monitoring" refers to the monitoring of oil impacts in the Peruvian Amazon. Underlying the Peruvian Amazon are large reserves of oil and gas, the exploration and extraction of which is being stimulated by the expanding global oil demand (Finer and Orta-Martínez 2010). Compared to the 7.1% in 2003, in 2009, 48.6% of the Peruvian Amazon was covered by oil and gas concessions, overlapping 17.1% of the Peruvian Amazon protected area system and over half of all titled indigenous lands (Finer and Orta-Martínez 2010).

The first concessions for hydrocarbon extraction in the northern Peruvian Amazon were the Blocks 192 and 8, in the large sedimentary Marañón Basin. After the first productive well was drilled in 1972, this oil project became the most productive in the country, accounting for 65% of national petroleum production at its peak (Orta-Martínez et al. 2007). Its productivity has since then decreased to 5,407.3 MBLS in 2013, representing 23.56% of the whole Peruvian oil production (MINEM 2013). Block 192 was formerly called Block 1AB and was operated by Occidental Petroleum Corporation (OXY) until 2000 and by Pluspetrol Norte until 2015, and it includes 11 central production facilities, 360.3 km of main pipeline routes connected with the North-Peruvian Pipeline, and 250 wells, of which only 112 are currently productive (MINEM 2013). Around 10,000 indigenous people inhabit this area, mainly Achuar and Kichwa communities. Although only nine indigenous settlements are located inside Block 192, other nearby communities depend on the territory inside the oil block to hunt, fish and for subsistence agriculture.

Severe socio-environmental and health impacts related to oil activities in Block 192 have been reported. Orta-Martínez et al. (2007) summarized the official reports issued by Peruvian authorities that described evidences of oil pollution in the study area.

The indigenous communities also denounced “acute cases of poisoning, cancer and other unfamiliar illnesses including allergic skin and eye reactions”, attributing them to oil pollutants (la Torre López & Napolitano 1999 in Orta-Martínez et al. 2007). Other impacts included the overexploitation of forest resources by oil company workers or subcontracting companies, particularly in the form of illegal logging, illegal trafficking of protected animal species, hunting and commercialization of bushmeat (Orta-Martínez et al. 2007). Governmental institutions have also broadcast alarming impacts of oil activities on the ecosystem and on public health. For instance, the Research Institute of the Peruvian Amazon found in local fishes’ tissues concentrations of hexavalent chromium that exceed the safety limits for human consumption (IIAP 1985 in Orta-Martínez et al. 2007), and the previous government agency for natural resources describes the region as “one of the most damaged critical environmental areas in the country” (ONERN 1984). In 2006 the Peruvian Environmental Health Agency reported that the acceptable World Health Organization (WHO) blood level was exceeded in 66.21% of the children for lead and in the 98.65% of the cases for cadmium (DIGESA 2006). Both heavy metals are among the six most toxic metals known for humans (Spadaro & Rabl 2004 in Orta-Martínez 2010). Pushed by such alarming reports, and by the resulting indigenous mobilizations detailed below, recently an Environmental Emergency has been declared by Ministerial Resolution in the Pastaza, Corrientes and Tigre basins (Mayor et al. 2014).

Indigenous peoples have resisted in different ways the impacts generated by oil extraction. During the 1980s and 1990s, they largely concentrated in asking for land titles, as they were confident that this strategy would provide them with the tools for the effective control of their territories. However, when after three decades they finally got small and unrepresentative land titles, indigenous peoples realized that these would not guarantee their territorial rights and much less prevent impacts from oil activities (Orta-Martínez 2010). This led to the diversification of tactics to demand meaningful solutions to oil impacts, which ranged from court cases to institutional meetings with Peruvian state agencies. The publication of health reports by the Environmental Health Agency in 2006 triggered the use of new resistance methods, such as roadblocks and occupation of oil infrastructures, in search for a government response. Such methods turned out to be very effective in improving the oil company’s operational standards as, according to la Torre López & Napolitano (2007), almost none of the numerous recommendations to minimize and mitigate the oil pollution made in the previous official reports were implemented before the indigenous communities paralyzed oil production for two weeks in October 2006.

Simultaneously, in 2006, the indigenous communities started a community-based monitoring programme aiming at mapping and monitoring oil spills (Orta-Martínez 2010). The goal of this programme was to provide irrefutable and striking evidence of the real environmental performance of the oil companies to raise national and international awareness and force the Peruvian state and the oil companies to minimize and mitigate oil-related impacts. The program was born out of the coordinated efforts of the Federation of Native Communities of the Corrientes River (FECONACO) with the support of researchers from the Institut de Ciència i Tecnologia Ambientals at the Universitat Autònoma de Barcelona (ICTA-UAB) and a local NGO (Shinai Serjali). Together, they created a team of local environmental monitors which included one person per community (selected during communal assemblies) and trained by the NGO and the academic partners. Training addressed a diverse range of topics, including oil industry operational practices, oil pollution and their associated effects on the environment, and public health. The monitoring team also had, for their first time,

contact with electronic devices such as Global Positioning Systems (GPS) and digital cameras, which also required a specific training component. The community-based alarm system initially focused on locating and identifying the typology of impacts (oil spills, drilling muds pits, production water outlets, etc.) (Fig. 13.1).

Over the years, monitoring has evolved involving more sophisticated high-tech tools, such as smartphones to improve the management of the data gathered, trap cameras to monitor wildlife behaviour in oil spills, lowcost Do it Yourself (DIY) spectrofluorometer (www.publiclab.org) to measure Polycyclic Aromatic Hydrocarbons, and drones to better map the area covered by oil spills. For example, indigenous communities reported to their scientist partners a new and previously unreported animal behaviour: the ingestion of oil- polluted soil by wild animals (Mayor et al. 2014). To explore the magnitude of this troubling phenomenon, the participatory monitoring program has expanded and now includes an extensive trap camera programme and the analysis of soil and animal tissue samples. At this point the monitoring programme aims to get the collaboration of worldwide online volunteers to analyse the huge amount of videos collected through the camera trap programme. To do so, the UAB is building an online digital citizen science platform that will enable people from around the world to visualise and analyse the impressive images of wildlife licking abandoned oil wells and eating oil polluted soil whist getting a glimpse of the real situation of Amazonian communities and ecosystems and of how local indigenous people are fighting to protect their territories.

Moreover, the monitoring programme has also expanded to the other river basins and has enrolled new partners. Thus, other local indigenous federations (Federación Indígena Quechua del Pastaza - FEDIQUEP; Federación de Comunidades Nativas del Alto Tigre - FECONAT and Asociación Cocama de Desarrollo y Conservación San Pablo de Tipishca - ACODECOSPAT) are now implementing monitoring programs in their lands. Also, different external stakeholders including NGOs, such as Rainforest Foundation, Digital Democracy, alterNativa, Moviment per la Cooperation Internationale, Hivos, and universities (ICTA-UAB and the International Institute of Social Studies, Erasmus University Rotterdam) have supported the programme in many different ways, from the organization of trainings and meetings to economic funding. In 2014, a hackathon was organized in the city of Tarapoto. During a week, indigenous monitors and leaders worked with a group of software and hardware developer volunteers to build up specific tools for the environmental monitoring needs (www.hacktherainforest.org).

INSERT FIG. 13.1 ABOUT HERE

As a result of this monitoring programme, a huge database owned and managed by the indigenous monitors has been created. The analysis of the database has helped uncover several impacts that companies have never reported (hundreds of concealed oil spills, unappropriated and illegal operational practices, etc.; Orta-Martinez 2010) The release of this information has empowered local people and strengthened the role of indigenous leaders in negotiations with the oil companies and the Peruvian state agencies to demand for improved operational standards. These reports have also played a key role in spurring administrative procedures to sanction the oil companies and contributed enormously to the receiving of economic and social compensations by the indigenous communities.

13.3.2 Grassroots monitoring in Prey Long, Cambodia

Our second case study refers to a participatory monitoring case used to contest deforestation of indigenous peoples' forests in Cambodia. Between 2000 and 2012, Cambodia had the world's third highest national deforestation rate due to large-scale acquisitions of land for agro-industrial purposes, such as economic land concessions (ELCs) (Davis et al. 2015, Hansen et al. 2013). These ELCs led to large scale conversion of forest land and to extensive illegal logging operations outside the borders of the officially granted areas, thereby conflicting with the Land Law, Forestry Law, and the Law on Protected Areas. By the end of 2013, 2.6 million hectares of land (14% of the country) had been allocated to ELCs and other types land concessions, mainly to establish rubber plantations. Environmental and Social Impact Assessments (ESIA) are rarely conducted for these concessions and their operations are poorly controlled (Forest Trends 2015). Overall, concessions have resulted in the exhaustion of valuable timber resources and have affected community managed and sacred forests. Moreover, these ELCs negatively affect rural households' total income (Jiao et al. 2015) in a country were about 75% of the population depends on forest resources for their livelihoods (Royal Government of Cambodia 2010).

Prey Long is a forest situated in the central plains of Cambodia (Fig. 13.2) and is the last intact vestige of lowland rainforest in Indochina (McDonald 2004). The Prey Long forest complex covers approximately 360 000 ha and hosts a diverse and unique fauna and flora. Seven vegetation types have been described in Prey Long evergreen, semi-evergreen, and deciduous forests (McDonald 2004, Olsson and Emmett 2007, Theilade et al. 2011). There are around 250 000 people living in 340 villages in the greater Prey Long area. The inhabitants of Prey Long belong to the Kuy and Khmer ethnic groups, who are culturally and spiritually linked to their forests and consider them as sacred. Furthermore, most of the population relies directly on forest natural resources for their livelihoods, resin tapping from Dipterocarp trees being the main source of cash income. Prey Long is also a source of medicines, food, building materials and firewood, essential for the survival of local communities (Olsson and Emmett 2007).

INSERT FIG. 13.2 ABOUT HERE

Despite Prey Long's ecological, social, cultural and religious significance, this forest remains under no special protection in Cambodian legislation and is classified as 'state private land', and consequently under state management. Currently, Prey Long is affected by 53 agro-industrial and mining concessions, which threat the natural resources that the local population need for their biocultural survival. Furthermore illegal timber extraction of precious timber trees in nearby areas, often laundered through the concessions, increases such threats, creating a conflictive situation between those who want to safeguard the forest and those driven by the economic benefits of timber extraction. Furthermore, community chiefs and local authorities often hinder local actions to stop illegal loggers, using verbal and physical threats. As a result of the lack of official protection, and due to the ongoing legal and illegal ELC logging activities, the resin trees and other vital resources for Prey Long's population, as well as the forest biodiversity in general, are under threat (Olsson and Emmett 2007).

As explained by local informants, the villagers living in and around Prey Long have monitored their forests since ancestral times to ensure the protection of their natural resources. In the early 2000s, the increase of ELC-related illegal logging and the lack of protection from the Cambodian State led some of the inhabitants of Prey Long to

organise themselves into forest patrolling groups, forming the Prey Long Community Network (PLCN). The aim was to join forces to combat those large scale illegal logging and land grabbing-activities that destroyed the forest and affected peoples' access to natural resources. Over the years, PLCN has become a well-organised group of indigenous environmental advocates, increasingly recognised both at national and international levels. PLCN has organised forest patrols, public debate, capacity building workshops, peaceful demonstrations, and petitioned their right to be officially recognised in the management of Prey Long. However, so far, the PLCN has not been officially recognised by the Government and their forest patrols are claimed to be illegal by local authorities. In 2015, the PLCN involves roughly 500 members.

Through an innovative partnership between the PLCN, the University of Copenhagen, an IT company, an international faith-based organisation (Danmission) and two Cambodian NGOs (Community Peace-building Network and Peace Bridges Organization), a participatory monitoring programme was developed in 2014. The overall aim of the program was to support rights-based and peace building approaches to natural resource management and to build resilience and capacity of the PLCN to continue their autonomous monitoring. Supported by this partnership, the existing PLCN forest monitoring was upgraded with the use of a smartphone App that can geo-reference, document, and upload information that the communities desire to monitor. The App was designed according to the monitoring needs and priorities of the PLCN and mostly covers illegal activities and natural resources over the evergreen forest of Prey Long. Information collected with the App automatically uploads to a specifically designed database, allowing for a more structured and systematised approach to data collection, analysis and therefore grass-root forest monitoring. The PLCN selected men and women of different ages to participate in the project, ensuring the engagement of younger members who were considered more apt to handle new technologies and better placed to continue monitoring in the future. Additionally, the PLCN is active in the social media, where news and updates regarding the organisation's recent activities are shared. As a result of all these initiatives, the PLCN won the prestigious Equator Prize in 2015 for their efforts to conserve biodiversity and build resilient local communities (go to https://vimeo.com/154774156 to see the video).

An advantage of creating a multi-stakeholder partnership has been that different partners could support the PLCN in areas they would otherwise not be able to cover. Following the PLCN's wishes, representative members of the network were trained in topics such as forest law, indigenous peoples' rights, and peaceful conflict management. They also received training to use the smartphone App. So far, the PLCN members still lack the skills to use computers, analyse the data, and write reports, such work is thus still being conducted by the other project partners. However, the PLCN decides what information should remain confidential (e.g. the exact location of natural resources and names of participants and villages) and revises the content of the monitoring reports before they are published. Local communities have proved to be successful at recording illegal activities using the App. Between February and November 2015, 650 illegal activities were recorded, mainly related to logging (98%). Most submitted entries referred to stumps (480 cases, 74%), followed by transport (128 cases, 20%), and presence of loggers (42 cases, 6%). The location of some 560 timber and non-timber forest products has been recorded; mainly resin trees and luxury timbers (88%), with smaller percentages of reported NTFPs (6%), animals (4%), and sacred resources (2%) (Argyriou et al. 2016).

The monitoring reports are a useful tool to provide proofs of illegal logging and build local ownership of the Prey Long forests. They can also be used by the

communities to notify authorities and guide legal investigations. Finally, the monitoring reports receive massive media attention within Cambodia. For the first time the public is informed about the state of Prey Long based on almost real-time monitoring. Thus, local communities in Prey Long have proven to be able to effectively monitor their forests. Through conflict resolution approaches, the PLCN has been successful in engaging local authorities in some provinces in a peaceful dialogue concerning rights and resources. Although monitoring only is not enough to halt illegal extractive activities, the PLCN hopes to be recognised by the Cambodian government as an official body for forest monitoring and co-management. This would legally enable them to impose graduated sanctions according to the degree of the offence. Furthermore, the PLCN advocates for Prey Long to be catalogued as a protected area and the legal framework for its protection to be enforced and respected by the higher authorities avoiding the location of ELCs and other concessions in it.

13.4 Conclusions

In this chapter, we have presented two examples of how indigenous communities use ICT to gather data with which they can support their claims and protect their territories and resources and thus also their rights. In the case of Block 192 in the Peruvian amazon, the environmental and health consequences of poorly managed oil concessions have generated the contestation of indigenous communities for over four decades. We have described how, while the sources of conflict have remained unchanged over the years (i.e., private companies' negligence overlooked by the state), the intensity of the oil extraction activity in the area has increased in recent years, making more blatant the inaction of the state regarding oil spill control. In the case of Prey Long forest in Cambodia, the environmental and livelihood threats of abusive logging activities have also been long term socio-environmental problems. However, conflicts intensified after the 2000´s due to large-scale acquisitions of lands for agro-industrial purposes (fostered by state permissiveness). In both cases, the manners of contestation have varied greatly (from the search for land rights recognition, to roadblocks, and to participatory monitoring). The shifting scale and intensity of these conflicts, in line with globalisation processes, can be seen as one of the main drivers of these changes in manners of contestation.

The progressive interconnection of distant communities and the increasing use of ICTs have favoured the organisation of grassroots movements that collaborate in networks who also involve other members of the civil society and scientists but who are driven by local monitoring agents that now have access to new technologies. This recent access is possible largely due to research groups partnering up in activist scientific projects. The result of such processes is the design of projects that provide real involvement of local stakeholders in participatory monitoring, which can result in capacity building, knowledge exchange and empowerment. Moreover, in the cases of Block 192 and Prey Long forest, the initiatives contributed to developing an existing "bottom-up" monitoring system by including the monitoring needs and priorities of the local stakeholders in the research design, implementation and use of the results.

The two examples presented here show the potential of participatory citizen science as a tool for indigenous contestation and advocacy (in line with results from other "extreme citizen science" projects; Nascimento, Pereira & Ghezzi, 2014). These innovative highly participatory initiatives are likely to further change the relations between scientists and the public, and have the potential of empowering lay communities of many kinds, including indigenous communities (Ghose 2001; Stevens

et al. 2014). In the case of environmental conflicts attaining indigenous territories, the new approach aims at completely changing the role of indigenous people in scientific projects by listening to their research questions and making science be driven by local interests (Haklay 2013a). In truly participatory monitoring schemes, including the interests of the local communities has -in some cases- shifted the monitoring scope from natural resources to the agents who impact those resources and drive environmental conflicts. By changing the direction of scientific studies, legitimisation and power has the potential to switch sides, from serving dominant systems in their justification of certain actions to serving citizens to confront conflicts. Moreover, this shift in the use of scientific information (and in the ways that locals, not necessarily professional scientists, analyse data trying to answer to their own research questions) can also be considered as a way to claim the validity of alternative and lay knowledge systems (Dunn 2007).

However, considering the existing issues of technology dependence, participation biases, and power imbalances, there is still room for debate about the extent to which these initiatives are really empowering the indigenous peoples and providing effective alternative manners of contestation (Haklay, 2013b; Kyem, 2004). Moreover, the idea that indigenous legitimization in the context of environmental conflicts can be obtained only by means of scientific evidence can also be seen as a contradiction in itself, since it could be reproducing western ethnocentric ideas of scientific knowledge supremacy as opposed to lay knowledge systems (Leach & Fairhead, 2002). In power imbalanced situations such the ones depicted in this chapter, in which big extractive corporations own long-term concessions that are safeguarded by the state, scientific evidence can act as a calibrator of the imbalances. Yet, we must not overestimate the power of scientific evidence and pretend that these new forms of contestation can overcome the traditional ways of responding to conflicts in all cases. Moreover, it is possible that this innovative approach remains unfruitful in terms of its contribution to environmental justice if it fails to first resolve the power imbalances affecting indigenous peoples and derived by political and economic inequality.

Acknowledgements

We are grateful to DANIDA for funding the research in Cambodia. Thanks are due to the PLCN for their brave work conserving the forest and to Ernst Jürgensen, Ida Theilade, Søren Brofeldt, Dimitris Argyriou and Narith Nou for coordinating the project. We would also like to acknowledge the support of the Kichwa and Achuar communities from the Pastaza and Corrientes basins (FEDIQUEP and FECONACO, respectively) and their environmental monitors. The research conducted in Perú was partially supported by the Fundació Autònoma Solidària, IDEAWILD, Rufford Foundation (13621-1), the Spanish Ministry of Innovation and Science through grant AP2004-7103 and project SEJ2006-15219 and the Government of Catalonia through grant FI-DGR 2016. It also benefitted from the Program People (Marie Curie Actions), under the contract REA Nº 289374 - “ENTITLE”.

References

Alfred, T., & Corntassel, J. (2005). Being indigenous: Resurgences against contemporary colonialism. *Government and Opposition*, 40(4), 597-614 (2005). doi:10.1111/j.1477-7053.2005.00166.x.

Andrée, P., Ayres, J., Bosia, M. J., & Mássicotte, M. J. (2014). *Globalization and Food Sovereignty: Global and Local Change in the New Politics of Food*. Toronto: University of Toronto Press.

Ansell, S., & Koenig, J. (2011). CyberTracker: An integral management tool used by rangers in the Djelk Indigenous Protected Area, central Arnhem Land, Australia. *Ecological Management & Restoration*, 12(1), 13-25.

Argyriou, D., Albin, A., Damhus, S., Brofeldt, S., & Turreira-Garcia, N. (2016). *The current status of Prey Lang: 3rd monitoring report with information from PLCN patrolling.* Prey Long: PLCN.

Baber, Z. (1996). *The Science of Empire: Scientific Knowledge, Civilization, and Colonial Rule in India*. New York: State University of New York Press.

Baker, C. (2007). Globalization and the cultural safety of an immigrant Muslim community. *Journal of Advanced Nursing*, 57(3), 296-305. doi:10.1111/j.1365-2648.2006.04104.x.

Bandy, J., & Smith, J. (2005). *Coalitions across borders: Transnational protest and the neoliberal order*. Oxford: Rowman & Littlefield Publishers, Inc.

Berkes, F. (2007). Community-based conservation in a globalized world. *Proceedings of the National Academy of Sciences of the United States of America*, 104(39), 15188-15193. doi:10.1073/pnas.0702098104.

Buchan, B. (2006). Savagery and Civilization: From Terra Nullius to the "Tide of History." *Ethnicities*, 6(1), 5-26. Doi:10.1177/1468796806061077.

Cerny, P.G. (1995). Globalization and the changing logic of collective action. *International Organization*, 49 (4), 595-625. doi:10.1017/S0020818300028459.

Clark, B. (2002). The Indigenous Environmental Movement in the United States: Transcending Borders in Struggles against Mining, Manufacturing, and the Capitalist State. *Organization & Environment*, 15(4), 410–442. doi:10.1177/1086026602238170.

Çoban, A. (2004). Community-based ecological resistance: the Bergama movement in Turkey. *Environmental Politics*, 13(2), 438-460.

Cohn, J.P. (2008). Citizen Science: Can Volunteers Do Real Research? *BioScience*, 58(3), 192-197. doi:10.1641/B580303.

Cohen, R. (2007). Creolization and Cultural Globalization: The Soft Sounds of Fugitive

Power. *Globalizations*, 4(3), 369-384. doi:10.1080/14747730701532492.

Conrad, C.C., & Hilchey, K.G. (2011). A review of citizen science and community-based environmental monitoring: Issues and opportunities. *Environmental Monitoring and Assessment,* 176(1-4), 273-291. doi:10.1007/s10661-010-1582-5.

Corntassel, J. (2008). Toward sustainable self-determination: Rethinking the contemporary Indigenous-rights discourse. *Alternatives*, 33(1), 105-132. doi:10.1177/030437540803300106.

Cunningham, C., & Stanley, F. (2003). Indigenous by definition, experience, or world view. *BMJ (Clinical Research Ed.)*, 327, 403-404. doi:10.1136/bmj.327.7412.403.

Danielsen, F., Burgess, N.D., Balmford, A., Donald, P.F., Funder, M., Jones, J.P.G., Alviola, P., Balete, D.S., Blomley, T., Brashares, J., CHILD, B., Enghoff, M., Fjelsdå, J., Holt, S., Hübertz, H., Jensen, A.E., Jensen, P.M., Massao, J., Mendoza, M.M., Ngaga, Y., Poulsen, M.K., Rueda, R., Moses, S., Skielboe, T., Stuart-Hill, G., Topp-Jørgensen, E., Yonten, D. (2009). Local participation in natural resource monitoring: A characterization of approaches. *Conservation Biology*, 23(1), 31-42. doi:10.1111/j.1523-1739.2008.01063.x.

Davis, K.F., Yu, K., Rulli, M.C., Pichdara, L., & D'Odorico, P. (2015). Accelerated deforestation driven by large-scale land acquisitions in Cambodia. *Nature Geoscience,* 8(10), 772-775. doi:10.1038/ngeo2540.

Di Chiro, G. (1997). Local Actions, Global Visions: Remaking Environmental Expertise. *Frontiers*, 18(2), 203-231.doi:10.2307/3346975.

DIGESA (2006). Evaluación de resultados del monitoreo del río Corrientes y toma de muestras biológicas, en la intervención realizada del 29 de junio al 15 de julio del 2005. In *Informe No-2006/DEPA-APRHI/DIGESA*. Lima: Dirección General de Salud Ambiental, Ministerio de Salud de Perú.

Doherty, B., & Doyle, T. (2006). Beyond borders: Transnational politics, social movements and modern environmentalisms. *Environmental Politics*, 15(5), 697-712.

Dunn, C.E. (2007). Participatory GIS - a people's GIS? *Progress in Human Geography*, 31(5), 616-637. doi:10.1177/0309132507081493.

Edelman, M. (2001). Social Movements: Changing Paradigms and Forms of Politics. *Annual Review of Anthropology*, 30(1), 285-317. doi:10.1146/annurev.anthro.30.1.285.

Edelman, M. (2008). Transnational Organizing in Agrarian Central America: Histories, Challenges, Prospects. *Journal of Agrarian Change*, 8 (2-3), 229-257. doi:10.1111/j.1471-0366.2008.00169.x.

Escobar, A. (2006). Difference and Conflict in the Struggle Over Natural Resources: A political ecology framework. *Development*, 49(3), 6-13.

doi:10.1057/palgrave.development.1100267.

Finer, M., & Orta-Martínez, M., (2010). A second hydrocarbon boom threatens the Peruvian Amazon: trends, projections, and policy implications. *Environmental Research Letters,* 5 (1), 014012 (10pp).

Forest Trends (2015). *Conversion timber, forest monitoring, and land-use governance in Cambodia*. Forest Trends Report Series: Forest Trade and Finance.

Friedman, J. (1999). Indigenous Struggles and The Discreet Charm of the Bourgeoisie. *The Australian Journal of Anthropology*, 10(1), 1-14. doi:10.1111/j.1835-9310.1999.tb00009.x.

Galtung, J. (1971). A Structural Theory of Imperialism. *Journal of Peace Research*, 8(2), 81-117.

Gascoigne, J. (1998). *Science in the Service of Empire: Joseph Banks, the British State and the Uses of Science in the Age of Revolution*. Cambridge: Cambridge University Press.

Ghose, R. (2001). Use of Information Technology for Community Empowerment: Transforming Geographic Information Systems into Community Information Systems. *Transactions in GIS*, 5(2), 141-163. doi:10.1111/1467-9671.00073.

Gómez-Baggethun, E., & Reyes-garcía, V. (2013). Reinterpreting Change in Traditional Ecological Knowledge. *Human Ecology*, 41 (4), 643-647. doi:10.1007/s10745-013-9577-9.

Haklay, M. (2013a). Citizen Science and Volunteered Geographic Information: Overview and Typology of Participation. In D. Sui, S. Elwood, & M. Goodchild (Eds.), *Crowdsourcing Geographic Knowledge: Volunteered Geographic Information (VGI) in Theory and Practice* (pp. 105-122). New York: Springer. doi:10.1007/978-94-007-4587-2.

Haklay, M. (2013b). Neogeography and the delusion of democratisation. *Environment and Planning A,* 45(1), 55-69. doi:org/10.1068/a45184.

Hall, T.D., & Fenelon, J.V. (2015). *Indigenous peoples and globalization: Resistance and revitalization*. New York: Routledge.

Hansen, M.C., Potapov, P.V., Moore, R., Hancher, M., Turubanova, S.A., Tyukavina, A., Thau, D., Stehman, S.V., Goetz, S.J., Loveland, T.R., Kommareddy, A., Egorov, A., Chini, L., Justice, C.O., Townshend, J.R.G. (2013). High-resolution global maps of 21st-century forest cover change. *Science*, 342(6160), 850-853.

Harding, S. (1992). After the Neutrality Ideal: Science, Politics, and "Strong Objectivity." *Social Research*, 59(3), 567-587.

Hardt, M., & Negri, A. (2001). *Empire*. Harvard: Harvard University Press.

Holden, W., Nadeau, K., & Jacobson, R.D. (2011). Exemplifying accumulation by dispossession: mining and indigenous peoples in the Philippines. *Geografiska Annaler: Series B, Human Geography*, 93(2), 141-161.

Howard-Wagner, D. (2007). Colonialism and the Science of Race Difference. In TASA and SAANZ 2007 Joint Conference Refereed Conference Proceedings *Public Sociologies: Lessons and Trans-Tasman Comparisons.* The Australian Sociological Association.

Jasanoff, S. (2009). *The fifth branch: Science advisers as policymakers*. Harvard: Harvard University Press.

Jiao, X., Smith-Hall, C., & Theilade, I. (2015). Rural household incomes and land grabbing in Cambodia. *Land Use Policy* 48, 317- 328.

Kearney, M. (1995). The Local and the Global: The Anthropology of Globalization and Transnationalism. *Annual Review of Anthropology*, 24, 547-565.

Kyem, P. (2004). Power, participation, and inflexible social institutions: an examination of the challenges to community empowerment in participatory GIS applications. *Cartographica,* 38(3-4), 5-17.

la Torre López, L., & Napolitano, D.A. (2007). Cover Essay—English Version: The Achuar and "Production Waters". *EcoHealth*, 4(1), 110-114.

Leach, M., & Fairhead, J. (2002). Manners of contestation: "citizen science" and "indigenous knowledge" in West Africa and the Caribbean. *International Social Science Journal,* 54(173), 299-311.

Lewis, J., & Nkuintchua, T. (2012). Accessible technologies and FPIC: independent monitoring with forest communities in Cameroon. *Participatory Learning and Action*, 65(13), 151-165.

Martinez-Alier, J. (2001). Mining conflicts, environmental justice, and valuation. *Journal of Hazardous Materials,* 86(1), 153-170.

Mattli, W., & Büthe, T. (2011). Setting International Standards: Technological Rationality or Primacy of Power? *World Politics*, 56(01), 1-42. doi:10.1353/wp.2004.0006.

Mayor, P., Rosell, A., Cartró-Sabaté, M. & Orta-Martínez, M. (2014). Actividades petroleras en la Amazonía: ¿Nueva amenaza para las poblaciones de tapir? *Tapir conservation* 23 (32), 26-29.

McClellan, J. E., & Regourd, F. (2000). The Colonial Machine: French Science and Colonization in the Ancien Regime. *Osiris*, 15(2000), 31-50. doi:10.1086/649317.

McCormick, S. (2007). Democratizing Science Movements: A New Framework for Mobilization and Contestation. *Social Studies of Science*, 37(4), 609-623.

doi:10.1177/0306312707076598.

McDonald, J. A. (2004). *Ecological survey of Prey Long, Kampong Thom. A proposal for the conservation of Indochina's last undisturbed lowland rainforest.* University of Texas at Austin.

MINEM (2013). *Anuario Estadístico de Hidrocarburos.* Dirección General de Hidrocarburos, Ministerio de Energía y Minas de Perú.

Muradian, R., Martinez-Alier, J., & Correa, H. (2003). International capital versus local population: The environmental conflict of the Tambogrande mining project, Peru. *Society & Natural Resources*, 16(9), 775-792.

Nadasdy, P. (1999). The Politics of Tek: Power and the "Integration" of Knowledge. *Artic Anthropology*, 36(1-2), 1-18.

Nascimento, S., Pereira, A.G., & Ghezzi, A. (2014). *From Citizen Science to Do It Yourself Science. An annotated account of an on-going movement.* European Commission JRC: Science and Policy Reports.

Obi, C.I. (1999). Globalization and environmental conflict in Africa. *African Journal of Political Science*, 4(1), 40-62. doi:10.4314/ajps.v4i1.27345.

Olsson, A., & Emmett, D. (2007). *A floral and faunal biodiversity assessment of Prey Long. Phnom Penh, Cambodia.* University of Copenhagen, Faculty of Life Sciences, Forest & Landscape.

ONERN (1984). *Inventario y evaluación de recursos naturales de la microregión Pastaza-Tigre.* Lima: Oficina Nacional de Evaluación de Recursos Naturales.

Orta-Martínez, M., Napolitano D.A., MacLennan G.J., O'Callaghan C., Ciborowski S. and Fabregas X. (2007). Impacts of petroleum activities for the Achuar people of the Peruvian Amazon: summary of existing evidence and research gaps. *Environ. Res. Lett.*, 2, 045006.

Orta-Martínez, M. (2010). *Oil frontiers in the Peruvial Amazon. Impacts of oil extraction for the Achuar of Río Corrientes.* Doctoral Thesis. PhD Programme in Environmental Sciences. Universitat Autònoma de Barcelona. Barcelona, Spain.

Orta-Martínez, M., & Finer, M. (2010). Oil frontiers and indigenous resistance in the Peruvian Amazon. *Ecological Economics*, 70, 207-218.

Parks, B.C., & Roberts, J.T. (2006). Globalization, Vulnerability to Climate Change, and Perceived Injustice. *Society & Natural Resources*, 19(4), 337-355. doi:10.1080/08941920500519255.

Quiggin, J. (2001). Globalization and Economic Sovereignty. *Journal of Political Philosophy*, 9(1), 56–80. doi:10.1111/1467-9760.00118.

Rigney, L.I. (2001). A first perspective of Indigenous Australian participation in

science: Framing Indigenous research towards Indigenous Australian intellectual sovereignty. *Kaurna Higher Education Journal, 7*(Aug 2001), 1-13.

Roberts, J.T., & Thanos, N.D. (2003). *Trouble in Paradise: Globalization and Environmental Crises in Latin America*. New York: Routledge.

Robinson, W.I. (2003). *Transnational conflicts: Central America, social change and globalization*. London: Verso.

Royal Government of Cambodia RGC. (2010). *National Forest Programme 2010 - 2029.*

Sandoval-Almazan, R., & Gil-Garcia, J.R. (2014). Towards cyberactivism 2.0? Understanding the use of social media and other information technologies for political activism and social movements. *Government Information Quarterly*, 31(3), 365-378. doi:10.1016/j.giq.2013.10.016.

Sassen, S. (1996). *Losing control?: sovereignty in the age of globalization*. New York: Columbia University Press.

Stepenuck, K.F., & Green, L.T. (2015). Individual- and community-level impacts of volunteer environmental monitoring: a synthesis of peer-reviewed literature, *Ecology and Society,* 20(3). doi:10.5751/ES-07329-200319.

Stevens, M., Vitos, M., Altenbuchner, J., Conquest, G., Lewis, J., Haklay, M. (2014). Taking Participatory Citizen Science to Extremes. *Pervasive Computing, IEEE*, 13(2), 20–29. doi:10.1109/MPRV.2014.37.

Stone, G.D. (2007). Agricultural deskilling and the spread of genetically modified cotton in Warangal. *Current Anthropology*, 48(1), 67-103. doi:10.1086/508689.

Schwarz, H., & Ray, S. (2008). *A companion to postcolonial studies*. John Wiley & Sons.

Theilade, I., Schmidt, L., Chhang, P., & McDonald, J.A. (2011). Evergreen swamp forest in Cambodia: floristic composition, ecological characteristics, and conservation status. *Nordic Journal of Botany*, 29(1), 71–80.

Turner, T. (1992). Defiant images: the Kayapo appropriation of video. *Anthropology Today*, 8(6), 5-16.

van der Ploeg, J.D. (2009). *The new peasantries: struggles for autonomy and sustainability in an era of empire and globalization*. London: Routledge.

Vitos, M., Lewis, J., Stevens, M., & Haklay, M. (2013). *Making local knowledge matter: supporting non-literate people to monitor poaching in Congo*. Proceedings of the 3rd ACM Symposium on Computing for Development. doi:10.1145/2442882.2442884.

Wallerstein, I. (2004). *World-Systems Analysis: An Introduction*. Duke University

Press.

Watson, A., & Huntington, O. (2014). Transgressions of the man on the moon: climate change, Indigenous expertise, and the posthumanist ethics of place and space. *GeoJournal*, 79(6), 721-736. doi:10.1007/s10708-014-9547-9.

Young, O.R., Berkhout, F., Gallopin, G.C., Janssen, M.A., Ostrom, E., van der Leeuw, S. (2006). The globalization of socio-ecological systems: An agenda for scientific research. *Global Environmental Change*, 16(3), 304–316. doi:10.1016/j.gloenvcha.2006.03.004.

Figure Captions

Fig. 13.1 Indigenous environmental monitors installing a trap camera close to an oil spill in the area. Source: FEDIQUEP

Fig. 13.2 Prey Long forest (left) and its location in the Indochinese peninsula (right). Created using Forest Cover map (Open Development Cambodia, 2014) and Natural Earth data in QGIS