Die approbierte Originalversion dieser Diplom-/Masterarbeit ist in der Hauptbibliothek der Technischen Universität Wien aufgestellt und zugänglich.
http://www.ub.tuwien.ac.at

The approved original version of this thesis is available at the main library of the Vienna University of Technology.
http://www.ub.tuwien.ac.at/eng

MSc Program
Environmental Technology & International Affairs

The contribution of Indigenous Peoples' ecosystem management to climate change mitigation actions

A Master's Thesis submitted for the degree of
"Master of Science"

supervised by
Dr. René Kuppe

Oliver Authried

0703532

Vienna, June 2015

Affidavit

I, **OLIVER AUTHRIED**, hereby declare

1. that I am the sole author of the present Master's Thesis, "THE CONTRIBUTION OF INDIGENOUS PEOPLES' ECOSYSTEM MANAGEMENT TO CLIMATE CHANGE MITIGATION ACTIONS", 64 pages, bound, and that I have not used any source or tool other than those referenced or any other illicit aid or tool, and
2. that I have not prior to this date submitted this Master's Thesis as an examination paper in any form in Austria or abroad.

Vienna, 08.06.2015

Signature

Abstract

Indigenous Knowledge has received increased attention during the last decades. This study explores the current application of indigenous knowledge in environmental management systems which would improve climate change mitigation actions

The difficulty in finding appropriate ways on how to integrate indigenous knowledge has been addressed because of the participatory rights that were guaranteed in many international environmental agreements since 1992.

1992 is a key date for climate change mitigation action thank to the Earth summit where all UN member states agreed to comprehensively address environmental issues in an international agreement. Subsequent agreements have seen the integration of indigenous peoples in mostly conservation policies.

Further progress has been made for the evaluation of the rights of indigenous peoples, both on the national and international level. However, their science has long been underestimated. Since 2004, after the devastating tsunami in South East Asia, the interest in the actual content of Indigenous knowledge is rising.

Areas, where indigenous knowledge seems to be superior to any other management are in forest conservation. Thanks to increased efforts in reducing carbon emissions, a field where tropical rainforest were identified as one of the key resources to protect, indigenous peoples provide states with effective strategies to avoid deforestation.

Their potential isn't limited to forest conservation only. Agricultural practices very often proved to be much more suited towards certain environments but more importantly – adaptable to changing climate conditions.

As such, indigenous knowledge, which is inherently connected to a specific area and its people, shows a dynamic system to prepare adaption strategies and help mitigating climate change when their rights are ensured.

Legal aspects of indigenous knowledge are mentioned where needed, the focus was the integration and combination of scientific methods with indigenous knowledge systems. Thus, the comparison of five exemplary projects in South America and Africa is a means to give insight into the various techniques of indigenous peoples worldwide.

Despite promising results those projects show, the need for improving the legal situation worldwide remains. Moreover, science and Indigenous knowledge work complementary, yet too often disregard each other.

Contents

List of Abbreviations 4

1. Introduction 1

1.1. Hypothesis and Research interest 2

1.2. Methods 3

2. What is Indigenous Knowledge? 6

2.1. Definition(s) of Indigenous Knowledge 6

2.2. The long struggle for participation 9

2.3. Inclusion of Indigenous Knowledge 12

3. The Establishment of UN REDD 19

3.1. History of REDD, REDD+ 19

3.2. UN REDD Programme; Functions; goals and policies 21

3.3. Warsaw Framework in REDD-plus 26

4. Indigenous Knowledge in other International Organisations. 28

5. Projects analysis 33

5.1. Malawi 35

5.2. Peru 38

5.3. Panama 40

5.4. Nicaragua 43

5.5. Botswana 46

5.6. Australia 48

6. Combining Science and Indigenous Knowledge 49

7. Conclusion 53

Bibliography 58

List of Figures 64

List of Abbreviations

FAO	Food and Agricultural Organisation
GFCS	Global Framework on Climate Services
IK	Indigenous Knowledge
IKS	Indigenous Knowledge System
NCB	Non Carbon Benefits
REDD	Reduced Emissions from Deforestation and Degradation
UN	United Nations
UNESCO	United Nations Education, Scientific and Cultural Organisation
UNFCCC	United Nations Framework Convention on Climate Change

1. Introduction

Since 1992, the Rio Conference, Climate Change and environmental issues feature more prominently in international conferences and subsequent agreements. When the United Nations Framework Convention on Climate Change first came into existence, there was great enthusiasm by the international community, both in the political sphere, but also within NGOs and other civil stakeholders. Some groups, however, have almost been forgotten, despite their role in the Rio agreements. Those who know best what it means to look after a functioning environment – indigenous peoples.

Subsequent agreements to the UNFCCC have featured participatory rights and the inclusion of indigenous peoples into the decision and policy making process. Their rights, however, seem to be restricted by procedural issues. First and foremost: who are indigenous peoples and what is their "indigenous" or "traditional knowledge"? International law makers seem to have failed taking other science and life concepts into consideration, thus effectively restricting participatory rights. Even if traditional or indigenous knowledge is written into international agreements, the question of where it should be applied remains. Many of them are threatened in their traditional ways of life because increasing pressure is put on natural ecosystems by all economic activity, such as tropical rainforests or the Arctic.

Several international working groups, and other fora in International Organisations, Non-Governmental organisations, and civil society in general have tried to voice their concern ever since the 1992 international environmental agreements. Unfortunately, it seems that the international system has only recently reacted to the claims for improving and, basically, ensuring participatory rights as they had been promised in 1992. What is more important than inclusion and participation is the question whether those alternative practices evade scientific evidence. But there are ways and methods to have indirect parameters in order to properly assess the contribution of indigenous peoples to e.g. forest management, climate change abatement and other environmental issues which are currently featuring prominently in the media and academic writings.

The purpose of this paper is both to examine the requirements to feature in international agreements or environmental policy making and the options which should be included in those agreements to take other approaches to environmental management into account. Indigenous or traditional knowledge doesn't necessarily

prove the scientific evidence our society grasps for but the application can sometimes bring astonishing results. Nonetheless, the need to have some hard 'facts' is there and thus this paper will explore ways on how to best value the contribution of other knowledge concepts to the benefit of international efforts in mitigating climate change and conserving a functioning environment or ecosystem.

1.1. Hypothesis and Research interest

As mentioned already, one of the main issues with inclusion of indigenous peoples is the problem of clear-cut definitions of what traditional knowledge actually is, so it is rarely included in environmental agreements, despite participatory rights of indigenous peoples. As a means to mitigate that problem, are there any ways to explore options on how to assess, evaluate and "prove" the effects of traditional knowledge? One of the key questions of this paper is to look for the right parameters which would indicate such a contribution. Another major question remains, namely the parameters under consideration do they provide sufficient evidence? Climate change alone is complex enough, so if Indigenous Peoples are included in mitigation efforts, what is the exact parameter they contribute to and what are their means to alter or conserve the ecosystem in a way that their contributions can be considered for benefit mechanisms in multilateral environmental agreements. The last and ultimate question which certainly needs clarification is, whether they contribute at all, in order to profit from financial benefits that are included in many international agreements and frameworks, such as UN REDD.

However, the underlying assumption is that traditional knowledge *does* contribute to global mitigation actions, but is rarely considered as traditional knowledge of indigenous peoples, when the techniques are applied in "normal" agriculture or forest management, or other areas. Indigenous peoples' knowledge has thus been made invisible because other farmers, environmental management systems, etc. have utilised the knowledge without either noticing or accepting it as indigenous.

One aspect and method to be applied in this paper will be aimed to look into those techniques or the knowledge and make it visible again. This means to compare similarly arranged project areas under the guidance of Multilateral Environmental agreements and projects without the interference of any such mechanisms, but under the guidance of indigenous peoples' own design.

One area, where indigenous peoples both have influence and apparently knowledge, is environmental management. Forest dependent people are just one example among a variety of different groups that could be subsumed under the umbrella term indigenous peoples. Even though there are numerous definitions of traditional knowledge, indigenous knowledge or indigenous peoples available, the approach in this paper will utilise the definition given by the UN Working Group on Indigenous Populations, which has shaped subsequent definitions. Some of them need to be explored for the purpose of evaluating the quality of participation in international agreements as well as a prerequisite for the selection of the projects. In this paper, however, there is an essential distinction between forest dependent and indigenous, because it has wide legal implications as well as very specific developments that forest dependent people neither made, nor were a part of.

Naturally, not only the definitions and the practice to include indigenous peoples in environmental monitoring or management has been called into question, but also the efficiency of international environmental conservation policies. The criticism goes both ways, either by being too restrictive on indigenous land use practices, or too lenient for including basically any tree to be considered as forest cover. The latter can be reviewed by the definitions of forests and eligible projects for REDD. The framework has been negotiated since approximately 2006, when countries included in the Rainforest coalition called for a framework which would compensate countries and projects that reduce deforestation rates. REDD thus stands for “Reduced Emissions from Deforestation and Forest Degradation”. Projects, which should be compared in this paper have to serve both the REDD definitions and need to have inclusion of indigenous peoples and non-indigenous peoples, too. It should be noted though, that REDD is just one of many examples where indigenous knowledge could be integrated or is being used. The direct involvement of indigenous peoples in the policy making process, at least as observers, is worth mentioning.

1.2. Methods

For this analysis, it is essential to select very specific projects which are similar in size, people involved and the area under protection should be similarly constituted. Otherwise it is almost impossible to clarify whether the improvements have been achieved thanks to traditional land use practices or have some other source. The uncertainty for the final evaluation is whether the results are deduced from other

random parameters or from the “practice” of indigenous knowledge in the analysed area. Nonetheless, it should be possible to identify at least a trend. The number of REDD programmes in partner countries is increasing, because forests have been identified as one of the key areas for climate change mitigation action. Indigenous Peoples are represented in the policy board of REDD, which shows increasing appreciation of indigenous knowledge in international environmental agreements. It serves as a starting point where some of the hypotheses introduced can be explored. REDD is by far not the only international programme trying to integrate indigenous knowledge, but has been endorsed by many partners within a rather short period of time. The importance of REDD or REDD+, the projects that applied for benefits from is financial mechanisms and the expectations by stakeholders are a valuable resource, also considering the contribution by indigenous peoples’ participation.

Finding suitable concepts for evaluating the contribution of alternative science systems that are sometimes restricted to the groups using them, is a massive challenge. The use and perception of these Indigenous Knowledge systems and making them easier to understand, is not a goal of this paper, however. They should serve as a means to showcase the effects of other land use practices or understanding land use practices as a part of a more comprehensive environmental management system. There are various parameters which will serve as benchmarks to get an idea of the contribution of such indigenous groups, without them applying known (natural) science concepts. The strong focus on mainstream science concepts have made some earlier programmes trying to protect forests rather immobile when trying to pursue projects under the tenure of indigenous peoples. Their knowledge, which is a combination of techniques and observatory practice takes the whole ecosystem into account. REDD, which was aimed to serve as a platform for climate change action in combination with a development agenda, improved the integration of non-mainstream science concepts, such as indigenous knowledge (Schielmann, 2013). Other initiatives or agreements, like the Convention on Biological Diversity, identified indigenous knowledge as a source of knowledge for the purpose of the protection and conservation of biodiversity. The shift towards sustainable development despite conservation efforts features more prominently in REDD.

The interest lies in the assessment of the contribution of indigenous knowledge in ecosystem management. Looking at the effects of REDD on ecosystem management

and project implementation is a starting point as well as a basis to compare the various policies. Indigenous knowledge systems can be very difficult to understand, but as a general guidance a quote from Grenier, can be used:

> *"[…] local knowledge existing within and developed around the specific conditions of women and men indigenous to a particular geographic area. (It is acknowledged that nonindigenous people, in particular people living off the land, have their own indigenous or local knowledge, but this topic is not addressed here The development of IK systems, covering all aspects of life, including management of the natural environment, has been a matter of survival to the peoples who generated these systems. Such knowledge systems are cumulative, representing generations of experiences, careful observations, and trial-and-error experiments. […]"* (Grenier, 1998)

One of the problems related to the use of this definition is self-evident, namely the careful selection of examples where the geographical area is limited, otherwise the unknowns are just too many to reasonably exclude them, or extrapolate the contribution of the people living in the area. Improving life quality by indigenous knowledge systems is used more frequently ever since the catastrophic 2004 tsunami in South East Asia. To the surprise of many, the Moken people, an indigenous tribe living off the coast of Thailand and Myanmar survived the disaster almost unscathed, because their age old knowledge made them clear the area before the tsunami unfolded (Hiwasaki et al., 2014).

Setting the boundaries of this paper's projects is obviously one of the main concerns. Other basic definitions will be thoroughly explained and the general principles of the programmes that are assessed here need to be outlined. The general understanding of certain projects may not be sufficient when weighing the arguments and counterarguments. The role of very specific knowledge which is often contained to a region, makes an evaluation of possible contributions of Indigenous Knowledge to mitigation actions impossible. It is very often local, regional and specific to the communities which practice or inherit this knowledge. Thus, the definition of Indigenous Knowledge won't be one to cover them all, but rather to use this generalised approach as knowledge specific to certain regions and peoples. In this particular context, the people attached and part of the project are the reference points for looking in to the knowledge systems.

To overcome this difficulty, it should be noted that the term indigenous is always referring to peoples which are inhabiting an area for centuries, not those people who have become quasi-indigenous. Terms such as “forest-dependent” people will be clearly applied as a distinction between indigenous and those who have become “indigenous” to a region (Sanders, 1989). One aspect which has often been problematic when trying to integrate or even understand indigenous knowledge systems in international agreements was the mere focus on legal terms. The struggle of indigenous peoples to have legal entity in national law systems is an ongoing fight. International efforts like the ones by the United Nations Working Group on Indigenous Populations are among the first to address the issue globally. Regional variations of indigenous peoples, as well as their (legal) protection is an important aspect which has to be included in to the analysis, if needed.

Completely leaving legal issues aside is obviously impossible, especially when analysing the role in pieces of international law. However, a thorough analysis of the legal situation of indigenous peoples in various countries is impossible to include, so problems and shortcomings will be noted if needed for clarification or explanation. Some of the developments in the international system are speaking for themselves anyway. Major milestone international documents, like the United Nations Declaration on the Rights of Indigenous Peoples serve as reference. A part of this paper will be focussing on the international developments of that issue.

2. What is Indigenous Knowledge?

2.1. Definition(s) of Indigenous Knowledge

Much has been said about Indigenous Knowledge or indigenous peoples but little has been done to really benefit and utilise any of that knowledge. To some extent, this is due to its cultural and local context. Too often, modern scientific discourse has excluded indigenous knowledge and people for various reasons. To clarify whether it’s a question of power or because of inaccurate definitions is part of this section. A critical approach to both the methods to acquire Indigenous Knowledge, the efforts to include these concepts into international agreements and the challenge to combine scientific research with Indigenous Knowledge will be addressed. Especially the latter has seen very early resignation amid an increasing number of researchers engaging in the field, e.g. to “measure” indigenous peoples’ environmental management systems.

Indigenous science systems are fundamentally different from modern science concepts, but shouldn't be mistaken for voodoo or only spiritual beliefs systems. There are science concepts which are identified as such, but the use and approach may not meet scientific methods, i.e. academic "objective" science. They still face a challenge to be fully accepted as alternative science-concepts, yet science as understood in multilateral agreements is understood under a strong technological bias, which seems to disregard their indigenous knowledge altogether (Swazo, 2005). In addition, participatory rights for indigenous communities are still faced with that bias, so the best they can do by contributing is to consent to approaches they neither endorse, nor accept (Swazo, 2005). Going back in history would fundamentally change that picture, though. There were many incidents when classification of "newly discovered" plants – at least from a Western science point of view – were completely adopted from former indigenous classification schemes (Nakashima et al., 2012). Even until today, some form of "appreciation" can be found by multinational pharmaceutical companies which copy age old traditional plant uses for medical purpose. The use of so called bush foods has even attracted nutrition scientists to test certain plants observed to be consumed by indigenous tribes (e.g. Radulović et al., 2015). The plants are then brought to laboratories where they are being thoroughly analysed. However, pharmaceutical companies would have rarely been able to identify without the known practices of indigenous peoples, yet these people aren't compensated and sometimes even prohibited from further applying that knowledge, due to protection of intellectual property rights (Anderson, 2015).

A problem of legal recognition of indigenous knowledge is evident. Many initiatives try to improve legal protection, which is sometimes difficult to achieve. In similar fashion to the very region-specific knowledge, its protection varies from state to state, despite international efforts to introduce basic protection (Anderson, 2015; Baez, 2011). The exclusion of indigenous peoples has been standard throughout the past, but even a more liberal approach and appreciation of indigenous peoples seems to have bypassed their knowledge and science concepts. A power discourse shouldn't be overstressed, because the fight for indigenous rights has seen remarkable progress since 2000. The United Nations Declaration on the Rights of Indigenous Peoples, is a high level political recognition, which serves as a reference for government to adapt

their legislation to fully grant those rights. However, the mere acceptance and proper valuation of indigenous knowledge has room to improve (Swazo, 2005).

Researchers have tried to grasp the concepts of indigenous knowledge in various projects all over the world. The settings are different, but many of them – especially in Latin America – have focussed on forest management. Others look at agricultural practices and compare their resilience with non-indigenous agricultural practices. There are even others which compared the practices in agriculture to check whether there was a form of weather forecast. Exactly these forecasts are among rare examples where conventional science could potentially scrutinise the statements indigenous science has issued (Kalanda-Joshua et al., 2011). A project in Malawi has provided an interesting insight. Farmers who utilised Indigenous Knowledge were able to better prepare their fields for upcoming weather events which increased resilience and food security in the mid-term significantly. So farming techniques alone weren't even part of this study undertaken by Kalanda-Joshua et.al. in 2011. The study implied that indigenous knowledge works in strong relation to the whole ecosystem. The study is a valuable contribution to show that traditional farming, environmental management or other activities can be disrupted by small changes either in the ecosystem or in the practice of the people. Nonetheless, the impact of local climate on the farmers' practice could serve as a reference point to value the contribution to climate change adaption. Nonetheless, there are other examples – mentioned in chapters 5 and 6 – which show the potential for climate change mitigation actions.

Some would argue that tropical rainforests hold the key for global mitigation action. Global climate is inevitably depending on the influences from this area. Approximately 300 million people around the globe are considered as forest dependent, 50 million of them are indigenous peoples (Schielmann, 2013). They either populate large areas of forests, or put pressure on small spots in the forest cover. Both are contributing to the health of a forest, in positive and negative ways. So the impact of activities by forest dependent people have to be taken into account, because – as has just been mentioned – the effects could go both ways. Indigenous peoples have lived in symbiosis with forests or other areas of the globe – the Arctic, Savannahs, etc. for centuries. The impact of their low carbon lifestyles on global climate are supposedly minimal. Their contributions to healthy forests mustn't be overseen, though. Studies that show the differences in the handling of farming and ecosystem management in

comparison to people not belonging to indigenous peoples imply that the footprint from e.g. land use change or avoided deforestation is much smaller, thus their carbon emissions smaller (Hayes and Murtinho, 2008; Vergara-Asenjo and Potvin, 2014).

Recent environmental agreements did take them into account, but actual implementation has basically brought deterioration to an otherwise improving legal recognition of indigenous peoples' rights. Critics point out the fact for the sake environmental protection, indigenous peoples have been prohibited in applying their age old forest management practices (Baez, 2011). Considering the long fight for recognition in the international arena this looks like a huge setback, but those cases don't necessarily resemble the otherwise positive development in the last decade.

2.2. The long struggle for participation

It will inevitably take some more time for the international community to accept indigenous peoples as equals in international negotiations. One first step undertaken in 1982 was the establishment of the UN Working Group on Indigenous Populations. As a working group under the Sub-Commission on Prevention of Discrimination and Protection of Minorities it could be considered at the lowest level in the UN system. Any decision to be adopted for the improvement of indigenous peoples would have to go through the Sub-Commission, to the Economic and Social Council, to the Third Committee of the General Assembly and finally to the General Assembly (Sanders, 1989).

Nonetheless, this first step opened the floor for representatives of indigenous peoples to address high diplomatic circles at the United Nations. This first step was a major boost, but the question of who indigenous peoples and thus their knowledge were, remained. A major study finished by Martinez Cobo in 1983 didn't give a final answer to that problem, but made it clear that no final definition is needed for the work in this domain. Whether that finding (UN, 2004)[1] was right, is probably subject to different opinions. However, the working group and its subsequent resolutions which gradually brought indigenous affairs onto higher levels of the international system showed that there was the need to address indigenous peoples' issues on the highest political level and that those early attempts were right in their direct approach.

[1] In PFII/2004/WS.1/3 and E/CN.4/Sub.2/1986/Add.4

Given the initial obstacles for indigenous peoples and their representatives to participate in international negotiations the progress during the following years has been remarkable. Although there still wasn't a universal definition of the people itself, this working definition by Cobo has been used for the design of representatives accredited to those boards, councils and commissions. Their role has been significantly upgraded by the General Assembly in 2000, when the Permanent Forum on Indigenous Issues was established as an advisory body to ECOSOC. This forum, despite serving as an advisory body, was to "be established by the Secretary-General"[2]. This means that indigenous peoples' issues were on the radar of one the highest internationally recognised moral authorities – the Secretary-General of the United Nations.

Given the relatively late establishment of those boards, councils and fora, indigenous peoples didn't feature prominently in the United Nations Framework Convention on Climate Change (UNFCCC). Indigenous living is obviously affected both by Climate Change and by the agreement to tackle the effects of climate change. Growing participatory rights on the political level are not sufficient when it comes to actual project implementation. One of the first to bring up environmental concerns which would severely and irreversibly affect indigenous population was a Norwegian diplomat who spoke in thoughts of the Sami who would have seen their livestock decreased by huge dam projects (Sanders, 1989). This diplomat, Eide, happened to be the first Chairman of the UN Working Group on Indigenous Populations and acknowledged that indigenous peoples had certain rights under international law.

Despite the political support indigenous groups received, it took until 2000, eight years after UNFCCC was agreed, six years after its entry into force, when the international community finally realised the valuable contributions from indigenous groups. Thus their role in climate change questions has seen increasing appreciation, especially in regions they inhabited for centuries and which came under increasing pressure through human activity, e.g. the Arctic and tropical rainforests.

Both areas, especially the latter have drawn a lot of attention from scholars, politicians and NGOs in recent years. Deforestation rates have soared, mainly driven by Brazil and Indonesia. Neither of the two feature prominently in UN REDD nor other related

[2] A/RES/57/191

agreements. Because of Brazil's huge tropical rainforest cover and its handling of indigenous peoples, Brazil has been under scrutiny by indigenous activists and advocates who picture the protection of indigenous rights in those countries particularly poor. It may sound like no surprise that participatory rights in environmental policy making aren't very well implanted, too (Baez, 2011). As has been noted earlier, this is not the general trend in indigenous affairs, but does add to the general problem with defining Indigenous Knowledge: its legal protection is fragmented and porous when it comes to codified policy or decision making.

Some indigenous tribes are hesitant towards being integrated into international agreements. They feel either overwhelmed, some might not have any interest, while others still feel unappreciated by the world they are being introduced to (Swazo, 2005). The last decade has improved the overall dialogue with different indigenous groups. Given, the economic situation of some indigenous tribes, which have been ripped of their livelihood because of discriminatory practices long into the 20th century means that the international community has to make up for lost decades. Many tribes are currently claiming lands that used to be their ancestors (Vergara-Asenjo and Potvin, 2014).

The interest for states to compensate indigenous peoples is there, but is often left on standby to other economic interest (Anseeuw and Bending, 2012; Eligio, 2012). The pressure on land is generally high. Even indigenous territories face the economic pressure to monetise nature, while at the same time protecting or conserving natural habitats. Food and timber production, as well as other economic activities threaten indigenous livelihoods (Anseeuw and Bending, 2012). However, recent developments in international agreements feature topics in which many indigenous peoples have the expertise and get the protection they need. Environmental management, forest management and environmental monitoring are just a few key terms where current negotiations try to explore options on how to best create market based mechanisms (Agrawal et al., 2011). A gold rush like euphoria has made many states adopt environmental management schemes, where indigenous peoples happen to be the best performing of all efforts (Danielsen et al., 2011; Hayes and Murtinho, 2008; Jackson et al., 2014; Vergara-Asenjo and Potvin, 2014).

Participation has to be understood on a large scale. While indigenous peoples care for their land they inhabit, the participation in national programme is – more or less –

subject to a rather passive relation. Indigenous peoples do what they have always done, while states, e.g. Panama, can proudly present reduced deforestation rates (Vergara-Asenjo and Potvin, 2014). What has been improved, however, was the legal protection of indigenous land tenure. Where it was ensured, all those positive effects could be observed. While areas, where indigenous peoples struggle to get land titles, show worse results. The least functioning are areas which are under private ownership (Hayes and Murtinho, 2008; Vergara-Asenjo and Potvin, 2014). Despite claims to practice sustainable forestry or agriculture, these territories have soaring deforestation rates and other poor performing indicators, e.g. resilience towards natural disasters.

Criticism has arose from the early days since the UN Working Group on Indigenous Population was established. Despite cautious steps towards more inclusion, the end of statehood was predicted by some scholars and opponents to indigenous activists agenda. Some concerns brought up by some scholars, e.g. Primeau and Cortassel, the tension which would increase between indigenous groups and states, could be observed in some regions. The situation in regards to indigenous rights is strongly dependent on the state level, which sees different degrees of protection. Thus, the establishment of the Working Group as an advisory body to the Economic and Social Council could have been interpreted as forcing states to speed up their efforts, which in turn would be leading to tensions.

Overall, the situation has improved, nonetheless. The criticism wasn't necessarily constructive, yet indigenous activists avoided no efforts to mitigate the criticism. At least, the situation hasn't deteriorated or stalled the process of furthering participatory rights. At the same time, national policies were set in many countries to either give back or ensure indigenous peoples' land ownership, which will turn out to be a decisive aspect of fighting deforestation. While participatory rights on the international level show a positive trend, i.e. more agreements include indigenous peoples, land grabbing is still a major threat to indigenous land ownership (Anseeuw and Bending, 2012).

2.3. Inclusion of Indigenous Knowledge

One of the most difficult issues are the areas of integration of indigenous knowledge systems. Even if the problems about how or what to integrate are solved, there still is the question on how to measure and quantify it. One option is UN REDD, which is not

the only means available to utilise Indigenous Knowledge systems. As it has been demonstrated already, there is no universal definition of indigenous peoples, nor indigenous knowledge. However, the definition used by the UN working group on Indigenous Populations will be the reference definition in this paper.

Since Indigenous knowledge is very often regionally specialised knowledge, there is a huge difficulty in applying a knowledge system in another setting than the original area where it was created, applied or observed. Thus, the question remains on how to integrate at least that knowledge in a regional context. First, the scientific terms need to be singled out and then areas of where indigenous knowledge systems could be valued need to be singled out, which would be ecosystem service or environmental services. Those two terms are always used as passive consumption of a functioning ecosystem (e.g. Serna-Chavez et al., 2014). However, it would make sense to introduce a concept which works the opposite way, basically meaning that human activity could also contribute to a functioning environment. Most Indigenous Knowledge systems work in harmony with their environment and so it could be deduced that they would provide services that are actually benefitting the environment (Hanna et al., 2014). The primary beneficiary would be the ecosystem, so a human beneficiary needs to be found. One obvious target are the peoples providing those services themselves. Considering the larger frame, i.e. global climate change, the beneficiaries of e.g. forest protection and emission reduction[3] is almost everyone. Obviously, concerning the challenge to put price tags on basically any human activity remains a problem, because the benefit to the world community is hard to estimate, yet even more difficult to calculate.

The terminological problems aren't the dominant problem in the area of ecosystem services. Even though there is a rather straightforward definition of ecosystem services in the case of the European Union in its environmental strategy, the beneficiary is always limited to a very small spatial scale. Global climate action is thus not sufficiently considered as a valuable ecosystem service, even though the beneficiaries are obvious. Non-action in the climate field isn't an option to show that policy makers are wrong in neglecting climate action as ecosystem service. For the protection of biodiversity and its strategy for 2020, the European Union has adopted a plan for

[3] From deforestation and forest degradation, as one of many examples

appreciating ecosystem services. As can easily be seen, this is a specialised in-situ service, meaning the area of protection and the beneficiaries' domain are congruent, whereas protecting tropical rainforests, e.g. is more than just a local improvement (Agrawal et al., 2011; Serna-Chavez et al., 2014). The protection of biodiversity and climate action are both suitable areas to introduce indigenous knowledge as alternative solution to the other technological driven approach by organisations like the European Union and other major international players.

Ecosystem services are increasingly important in conservation and protection frameworks. The definitions are often too broad or incomplete. A dominant question which shows the problems of ecosystem services would be, how to measure biodiversity (Reyers et al., 2013). There is no final conclusions to be drawn from such studies. However, given that protecting biodiversity is one of the areas where indigenous knowledge is most applied a social-ecological rather than a natural sciences approach would be most applicable to observe the practices and also their consequences. Human activity is inevitably contributing to either diminishing or protecting biodiversity. As such, it can be regarded as ecosystem service production (Reyers et al., 2013).

Ecosystem service production is influenced by factors as land use, land use change, protection of soil and so forth. The environment, which isn't only the ecological, but also the social environment, in which those services are produced are negligible for scientific research, yet they set the boundaries in which these services are created (Reyers et al., 2013). When it comes to beneficiaries the problem becomes bigger. There are ways on how to measure the effects of ecosystem service production according to a particular area. Thus, the question who best utilises land, manages the ecosystem can be answered.

Counting indigenous peoples' ecosystem management as an ecosystem service under a sociological approach seems to be e logical step. Policies, which impact either land use, or the way of life of indigenous groups thus have a strong effect on the intended conservation and protection target (Reyers et al., 2013). As such, they contribute to functioning ecosystem services. This could be subsumed under non-carbon benefits. Those non-carbon benefits are of increasing importance for indigenous activists and advocates of REDD+ initiatives (Hvalkof, 2013). Because non-carbon benefits aren't simply one-dimensional approaches to an ecosystem, because the activities in an area –

meaning the social system – are obviously impacting the ecological conditions. The society inhabiting a certain area always has a specific governance of this particular area. So the three fields are inherently intertwined (Hvalkof, 2013), yet they need to be accounted for on the international level.

In the last few years, there have been more studies on indigenous knowledge[4] which aims at environmental protection. Some peoples have been studied in their approach to not only regular weather "forecast" but also disaster response. The 2004 tsunami which devastated coastal areas in the Indian Ocean had little direct effect on indigenous populations living there[5], because they retreated further inland before the gigantic tsunami hit the shores. Many scholars were inspired to integrate that knowledge into plans for disaster risk reduction and to enhance national and international resilience towards natural disasters. The Hyogo Framework for Action 2005 – 2015 introduced and welcomed the integration of indigenous knowledge as part of scientific research to reduce exposure to the strongest catastrophes that would be likely to appear. Thus, there has been further progress in the Indigenous Populations' struggle to have their knowledge accepted by the international community. However, to be included as part of mainstream scientific research doesn't necessarily bring by an appreciation as full science concept. Increasing interest in the topic could be noted, however, from 2004 onwards (Hiwasaki et al., 2014).

The Hyogo Framework for Action was introduced in the aftermath of the tsunami 2004, because of the potential to improve the handling of the disaster response back then. The unpreparedness of the affected countries' governments was a critical issue to be addressed. Thus the inclusion of local, indigenous knowledge was proving to provide strategies in areas where government initiatives are hard to establish or fail altogether (Hiwasaki et al., 2014). Additionally, it has acknowledged the role of indigenous peoples in climate change adaption actions. Despite the focus on mitigation actions in this paper, it should be noted that many indigenous peoples' practices are very well adapted to changing environmental conditions and thus could be well prepared for climate change. Given the local context, on the other hand, means that not all tribes or areas where indigenous knowledge is observed are necessarily well

[4] And regionally specialised knowledge as mentioned earlier
[5] Moken people off the coast of Thailand and Myanmar

prepared. Projects analysed in Malawi and Botswana showed quite the opposite (Kalanda-Joshua et al., 2011; Motsumi et al., 2012).

Given the examples from Africa, which are certainly not only negative it's important to see the potential in combining science and indigenous knowledge. The examples in Malawi showed that by confirming the changed weather patterns by science data, made the farmers adopt new ways of farming. Their sowing, harvesting and soil preparation has been shifted. For inclusion into international agreements, the protection of indigenous peoples themselves is imperative. However, the mere inclusion into international agreements isn't sufficient either, because national policies still vary from region to region. While there is a general positive trend in South America which in turn could be undermined by REDD policies, the latter could contribute to a difficult situation in regards to land titling in many regions of Africa (German et al., 2013). .

It's another major step to have formal appreciation and actual integration of that knowledge. Recalling the difficulties in the general utilisation of the term, there are knowledge systems which are more suited for e.g. REDD+ activities, while indigenous knowledge systems are inherently restricted to the peoples who inherited or created that knowledge. Given the nature of the very regional approach by climate change mitigation actions, especially when it comes to forest conservation, it's rather obvious to look at the regional indigenous knowledge systems in question. There is no need to spread one system to all projects an all areas, which is already done by conventional, modern science. The nature of some Indigenous Knowledge systems isn't necessarily objective or neutral (Jackson et al., 2014), as modern science presumes to be. Many of the practices arise from direct interaction with the local environment, like fire management systems or certain agricultural techniques. This means that there is a personal reason to apply knowledge which is not created in an academic fashion but by learning hands-on.

The situation today is positive. Appreciation of indigenous knowledge has been by and large achieved. Despite political commitments and a general update in regards to inclusion and acceptance of other knowledge systems, there is hardly any debate. However, critics even feel that the situation goes too far. Polemics which would sense a form of indigenous sovereignty and the capitulation of modern science don't

necessarily contribute positively to an improvement in legal concerns (Primeau and Corntassel, 1995).

Critics, similar to Primeau and Corntassel, argue that furthering "indigenous sovereignty", meaning full recognition of land claims, parallel justice systems and even more indigenous self-government would increase tensions between indigenous groups and states (Litfin, 1998). Even long after the turn of the centuries and despite better knowledge, the criticism hasn't seized. Moreover, sceptics of the recent developments would go as far as to call the increasing attention for indigenous peoples – indigenism – as kind of a trendy movement (Corntassel, 2004), instead of a real genuine and sincere attempt to make up for mistakes of the past.

However, it seems as parts of the problems have evaded the observations of the critics. There has been an attempt by the international community to "upgrade" indigenous peoples because of identity awareness. Given that the international community does protect minorities – or does attempt to do so – it's obvious that indigenous peoples must have been noticed at some point in history. The rather late establishment of the UN Working Group of Indigenous affairs can hardly be understood as a "fashionable" trend. If statehood is challenged, as has been argued (Corntassel, 2004; Litfin, 1998; Primeau and Corntassel, 1995), it can hardly be by indigenous tribes who simply call for the protection of their age-old knowledge systems. Additionally, it's still states which grant or withdraw the rights of indigenous peoples or have their practices legally protected.

Nonetheless, the Indigenous Peoples Rights Act did address several issues on a broader scale which would undoubtedly have an impact on national policies towards indigenous peoples. More recently, the debate has again seen new controversies arise. The UN Permanent Forum on Indigenous Affairs sees its participation partially restricted, amid valid international agreements supposedly guaranteeing otherwise (Toensing, 2014). Even more problematic are struggles within the forum when indigenous groups are either expelled, or the leadership of the representatives is challenged. Increasingly pressing issues in regards to people of African descent in South America are unresolved and seem to be not too strongly endorsed by the forum (Díaz, 2015).

Despite the criticism from within the forum and from outside, it's more important to look at the areas where indigenous knowledge has been successfully integrated. This has already been partially covered and thus means that the forum is able to perform its work and improves conditions for millions of indigenous. The concerns, that were raised about the inclusion of people of African descent is indeed a huge problem, which his beyond the scope in this paper. Given the long way indigenous peoples had to come by to get a forum for all their issues, it can be assumed that it would also take at least a few more years to have the other issue sorted. However, the focus on indigenous knowledge, does provide decent results for the groups in question, in the light of the many agreements that were concluded with indigenous knowledge in mind (Danielsen et al., 2011; Litfin, 1998).

The development of indigenous or traditional knowledge systems over generation is comparable to scientific knowledge. Not everybody in a group can use the knowledge or transmit the knowledge, just as in modern science. However, some indigenous knowledge systems are strongly related to age groups (Hanna et al., 2014). When dealing and applying this knowledge the persons who are able to transmit the knowledge must be the ones in charge of actually transmitting it. In some international conventions, the application of traditional knowledge, which can be used as a synonym for indigenous knowledge in this context, it is clearly mentioned as knowledge to be taken into consideration. The Convention on Biodiversity has included provisions to this end, as well as provisions for environmental impact assessment (Hanna et al., 2014). Both areas are inevitably two prominent examples of where the appreciation of indigenous knowledge has been by and large achieved already.

Conservation of biodiversity is an area where indigenous peoples contribute massively by their traditional agricultural practices as well as sustainable forest managements. Several studies on the benefits of indigenous communities in several areas have provided a sound basis to assume that their presence is beneficial. Given that positive impact on environment or at least the contribution to global conservation efforts – a concept itself subject to criticism considering its history – they shouldn't be solely a subject international agreements are talking about, but rather an equal partner in negotiations for environmental agreements. The latter is definitely a challenge both for states of the current international system as well as for indigenous peoples themselves. Some wouldn't bother about any international or even global partnership, as long as

they are left alone in their territories and aren't endangered by the outcome of such agreements. This resignation can be seen as part of the long time it took for states to accept responsibility for failures in the past. Still, land grabbing and exclusion of indigenous peoples and their practices (Moller et al., 2004) occur, despite the much improved legal situation since the turn of the centuries in many countries.

Biodiversity protection, preservation of valuable, even unique species of crops is still a battle against giants. Traditional agricultural practices are often endangered by agreements between states and multinational corporations which exploit the knowledge for commercialisation. Unfortunately, too often the beneficiaries aren't the ones who discovered or nurtured them. That knowledge is made invisible but becomes part of a mainstream discourse, sometimes in sustainable agricultural development discourses. Conservation agencies have often prohibited the use of traditional agricultural practices for the protection of biodiversity, but may have contributed to some form of distrust against scientific methods in areas where customary resource use is common (Moller et al., 2004).

3. The Establishment of UN REDD

3.1. History of REDD, REDD+

The programme's history has a link to UNFCCC in 1992 and subsequent meetings, when Parties to the Convention basically outlined new, innovative ways to cut carbon emissions or at least improve the proper functioning of the current carbon sinks. The uptake of natural carbon sinks is massive and thus forests play an essential role in the fight to achieve a 2°Celsius warming scenario. Increased efforts to tackle these problems need a comprehensive approach which doesn't only look at the forest cover, but also the state of the forests. Degradation significantly reduces the capability of a forest to sequestrate carbon and is only a short delay for complete deforestation. So obviously, the word has spread to policy makers to increase efforts to conserve forests, provide financial assistance to establish environmental management systems and lastly, to provide incentives for states to nationally increase their fights against deforestation and forest degradation.

According to recent estimates, deforestation accounts for a huge part of global greenhouse gas emissions, as well as for historic emissions. In a period from 1850 – 2000, approximately 35% of worldwide carbon emissions originated from

deforestation. Since 2000 land use change is still a huge problem (Pedroni et al., 2009). Slowing deforestation rates in the fastest deforesting areas is an important contribution to global climate change mitigation action. International efforts to institutionalise incentives for conserving forests is imperative, another question to be sorted are compensation mechanisms. Whether they're market based or fund based is important when looking at the policy implementation, but first a closer look at how the programmes itself developed is important.

The Copenhagen 2009 summit started with high expectations, but the outcome was mixed. There was progress in some areas, i.e. parties agreed to establish the REDD+ framework, but left some questions about what should be included open. It was neither the first choice nor the optimum solution for limiting future climate change, but it should have provided a market based mechanism under the Clean Development Mechanism to compensate for avoided carbon emissions by preserving forests (Agrawal et al., 2011). Newly introduced were mechanisms not only for states, but for sub-state actors to benefit from funds that are made available through the financial instruments, some of them which are still being established[6]. Thus, the euphoria to have a mechanism which actually pays for forest conservation led to a mild form of a "gold rush" in some countries. Unfortunately, also big international companies have sensed an area of profit which in turn led to an implementation which is a far cry of what was originally envisaged in 2009 (e.g. Baez, 2011).

Going back to the roots of REDD, which stretch back a few more years than the Conference of the Parties in Copenhagen 2009. Already as soon as 2005 in Montreal, the 11th Conference of the Parties the Coalition of Rainforest Nations proposed that mechanism called Reducing Emissions from Deforestation in Developing Countries (RED) through economic and financial incentives. Avoided deforestation wasn't new to the international agenda in 2005 so soon forest degradation was also added to the original proposal and so RED became REDD at the COP13 in Bali, 2007 (Agrawal et al., 2011). More has been added to improve the conditions of carbon stocks, i.e. forests which sequestrate carbon dioxide and thus add to the reduction carbon emissions. Deforestation is a major driver of carbon emissions, so avoided deforestation is obviously a logical step to prevent severe hazards of future climate change.

[6] At least until the time of writing in May 2015

The development of the current international programme has seen several steps. At the beginning the collation of rainforest nations introduced RED, which were Reduced emissions from deforestation which would be monitored internationally and provide financial incentives for countries with large rainforest covers to increase protection measures. Only at the next COP meeting in 2007, degradation was added which then became REDD. Another year later, at COP14 in Poznan, 2008, the plus was added for any other activities that would enhance sustainable management of forests or other natural habitats. The original forest conservation still plays a major role, but REDD+ is clearly opening towards other possible climate change mitigation actions, or activities for nature conservation (Agrawal et al., 2011).

The terms in use shouldn't be scrutinised per se. Generally, the distinction between the two is negligible for analysing ecosystems, but for the financial benefits scheme it does play a major role. REDD+ enables more donor countries to participate. Thus REDD+ financing contributes significantly to more initiatives to protect forests, ecosystems and tackle climate change. According to a voluntary database set up by the Food and Agricultural Organisation, REDD+ financing has exceeded 4 billion US-Dollars so far (FAO, 2014)[7]. It has thus by far exceeded the importance of the UN REDD programme, which is still in place, but focuses on its original objectives – forest conservation. Still, there are overlaps and the boundary between the two is subsequently vanishing.

3.2. UN REDD Programme; Functions; goals and policies

The UN REDD programme was officially launched in 2008 and was geared towards facilitating financial benefits to countries, regions or project stakeholders contributing to the overall goal, which is the reduction of emissions from deforestation. Forests, are an integral part of carbon dioxide sequestration in the atmosphere and thus are huge natural carbon sinks, so basically they have a carbon dioxide reducing effect. REDD does take carbon sinks into account as a contribution to international efforts to mitigate climate change (Agrawal et al., 2011). It was established under the United Nations Framework Convention on Climate Change and is an innovative initiative to combine not only the efforts of the international community, but also to utilise the

[7] http://www.fao.org/forestry/vrd/by/funders#introduction

best available international organisations which have some expertise in environmental issues, climate change and related areas.

The Food and Agricultural Organisation, the United Nations Environment Programme both contribute expertise and data to the verification of REDD and REDD+ activities. Their big databases which accumulated data over decades can give a very good overview of the envisaged improvements by REDD+ activities.

Originally the programme was designed to have a multi layered implementation process on the international level, state level and community level. Even though there is a high number of levels and partners involved, there have been 36 countries which received support in the year 2014. Almost half of those countries don't have national programmes, while the majority, namely 19 countries, have implemented national programmes. The differences between a targeted country without national programme and including national programmes doesn't make much difference. There are many projects which have only applied after its establishment. REDD and REDD+, as its short history above should have demonstrated, is a collection of any activities in that particular field to curb carbon emissions. Financial benefits, however, have to undergo certain procedures and are subject to monitoring and verification mechanisms (Agrawal et al., 2011).

In order to achieve its goal, the programme established a Multi-Partner Trust Fund Gateway, where significantly more countries or basically any donor, could participate in order to ensure effective implementation and compensation. Including even more international organisations, the programme can be seen as a major platform to share and exchange views, expertise and best practice examples. Roughly 200 million dollars have been made available through that fund. This sum has to be put into perspective, thus the focus will be laid on some of the projects that have been financed or have benefitted from these funds. What REDD should provide, originally, was to create incentives for states to protect rainforest or other forest cover at the national level (Pedroni et al., 2009). Just like any other international agreement, REDD relies on the national implementation of the policy. So the different activities that can benefit from the financial instruments have to be safeguarded by national authorities. As such, REDD or REDD+ is just a framework to basically verify state-level actions. Differences in participation of sub-state actors can be noted, though.

Interestingly, many countries shared monitoring and verification duties with local communities, sometimes even NGOs (e.g. Maraseni et al., 2014).

Given the variety of REDD programmes and the legal situation in the partner countries, it's difficult to evaluate the general participation of indigenous peoples. While there are many forest conservation efforts in South America, the situation in e.g. Sub-Saharan Africa looks quite different. There are REDD projects implemented, but while the projects themselves are nationwide programmes, the role of indigenous tribes is sometimes restricted to community monitoring. Despite the observer status of indigenous peoples in the Policy Board of REDD+, this doesn't entail automatic participation in the national REDD programmes. A look into each partner country would be necessary to allow conclusions in this regard.

The inclusion of sub-state actors for the implementation and policy making process – indigenous peoples have representatives in the Policy Board of UN REDD – is a major step forward for indigenous peoples international recognition and reputation alike. One representative is selected by the Permanent Forum on Indigenous Issues, while the other one is selected by civil society.

The national implementation, however, reflects many of the problems associated with the protection of indigenous rights. There is no guarantee that even though representatives of Indigenous Peoples have a word in the policy making process, as advisers, not necessarily decision makers, their rights in the project implementation is ensured later on. Thus the picture of UN REDD is heavily dependent on the regions where projects have been implemented. Some countries which are known to have poor legal protection of indigenous land rights are now threatening the age old practices of e.g. shifting cultivation. Neither the scientific community nor international organisations can prove that shifting cultivation is a major driver of carbon emissions, yet it is increasingly targeted by states receiving REDD assistance (IWGIA, 2012; Lyster, 2011). In order to look in particular at activities by indigenous communities and their legal protection, the gathering of data needs to be ensured. REDD is one of the first international policy frameworks to address deforestation globally. Indigenous peoples can hardly be regarded as deforesting tropical rainforest. Problems associated with cultivation shifting remains, but REDD, in its current form, cannot account for member states' problem in developing appropriate forest protection schemes.

Cynics would argue that the improvement of REDD brought the right for indigenous peoples to restrict their own traditional ways of life. However, the problem is adamant in countries with high deforestation rates, such as Malaysia and Indonesia, which makes the situation even more absurd. For the sake of climate action huge areas of natural rainforests are cleared for the production of biofuels and palm oil. Neither of the two can replace the original forests and its capacities to sequestrate carbon. Sustainable forest management wouldn't include the clearing of thousands of acres of rainforests for agricultural production. Yet, under the paradigm of sustainable development and less fossil fuel use in e.g. transportation, huge areas of mature rainforest cover are victims of a new "sustainable" biofuels boom (Adams, 2009). Cultivation shifts as practiced by indigenous communities in the area but also in other regions. In contrast to large scale palm oil production it cannot be reasonably argued that cultivation shifting has more effect than those – as counterintuitive as it sounds – activities for global climate protection (IWGIA, 2012). Even worse, in some areas land grabbing has occurred for protecting the environment. Forests have been cleared or cultivated land has been taken away from indigenous communities to produce clean energy.

Another problem of the current international climate protection regime, which is basically UNFCCC and subsequent protocols, is the rather secondary role of Land use and land use change, while biomass burning is actually favoured in the protocols (Ellison et al., 2014). The assumption of the immediate burning of harvested wood products means that any tree is immediately oxidised and thus wouldn't have further impact on the carbon dioxide balance. However, the accumulation of forest products for biomass burning can have significant more impact than in the calculations which assume immediate combustion (Ellison et al., 2014).

In 2010, an updated decision envisaged that any projects under REDD+ would have to ensure safeguards in respect to indigenous rights. Their knowledge and land tenure must be recognised and taken into account. REDD+ needs to provide transparency and effective national forest governance (Lyster, 2011). Rio Principle 22 clearly states that indigenous peoples and local communities must be appreciated for their role in sustainable development[8]. Reiterating the Declaration on the Rights of Indigenous

[8] Rio Declaration, Principle 22

Peoples in the build-up to REDD+ is another indicator not only of the importance, but also of some of the shortcomings REDD+ wanted to amend. For the further implementation of REDD and REDD+ projects it is imperative to improve national legislation. Furthermore a shift in the science community is another major contributor which would help to ensure those safeguards more easily.

SBSTA is the one international body which dominates the technical part of UNFCCC, subsequent protocols and also UNREDD. The mandate of SBSTA is rather straightforward, the strong emphasis on technological solutions is obvious. If more projects showcase how innovative Indigenous Knowledge could contribute to the improvement of communities (not only indigenous peoples) it would certainly have to be considered among the three objectives of SBSTA (UNFCCC, 1992)[9]. Reducing Emissions from deforestation certainly is an area that has long been neglected, thus to establish a financial benefits scheme for activities that would reduce carbon emissions and conserve the capacity to absorb carbon dioxide was a logical, valuable contribution from the international community. The 2010 safeguards brought more political weight to the implementation and further appreciation of indigenous knowledge. At the same time there have been more initiatives to embed that knowledge in new schemes and frameworks, of which some will be described.

Implementing REDD or REDD+ in national context and according to national capacities is a major asset of the initiative. The combination of scientific data from remote sensing and social science data to account for changing land use practices on the ground mustn't be neglected. Planning ahead may be an advantage in ecosystem management, but remote sensing data are actually pictures from the past. So social sciences must provide the missing link between remote sensing data and developments that may still happen (de Sassi et al., 2015). Such an integrated monitoring approach is envisaged under the agreement which opens participation opportunities to indigenous peoples, without prejudging or disregarding their knowledge systems. A problem connected to the integration is the need to upscale those ground observations to use them on larger scales (de Sassi et al., 2015), which is hardly possible with knowledge in a local context.

[9] UNFCCC, Article 9

The Subsidiary Body for Scientific and Technological Advice (SBSTA) has already initiated a discussion and negotiation process to not only include avoided deforestation into international benefit systems, but also LULUCF – Land Use, Land Use Change. A challenge to the more prominent acceptance of REDD or REDD+ in general would be an endorsement by the European Union, which doesn't recognise any reduced (or avoided) emissions in their carbon trade mechanisms (Ellison et al., 2014). Any avoided emissions from land use or land use change are part of the climate policy framework of the European Union, but its member states may not trade any certificates which would have been earned through the Clean Development Mechanism when financing or developing project in the LULUCF sector. Land use change is also an area where projects can be easily analysed. But the rewards are little, because of the limitation to incentivise national governments to protect the areas. Big international donors like the European Union are limited in their acceptance of REDD+ because of the EU's climate policy framework.

LULUCF alone has been on the agenda of some policy developers for some years now, but haven't entered a prominent inclusion into new environmental agreements, yet. This has changed with the Warsaw Framework on REDD+, which addresses LULUCF among other problems, such as finance.

3.3. Warsaw Framework in REDD-plus

The Warsaw Framework on REDD+ is basically a call and attempt to build up a carbon finance system for financing reduced emissions from deforestation as it is the original plan for REDD. On the COP19 in November 2013, parties agreed to the "results-based finance" and should come from "a variety of sources, public and private, bilateral and multilateral, including alternative sources" (FCCC/CP/2013/10/Add.1). In addition, COP19 reiterated the importance to assist the implementation of Climate mitigation actions in developing countries. Still, there is no carbon financing for avoided deforestation by the European Union, which makes the Warsaw Framework just another example of unfinished, half-hearted attempts to improve the adoption of measures against deforestation.

While LULUCF and activities for forest protection remain on low-level appreciation in international financing systems, the cost effective, innovative land tenure systems of indigenous communities could provide a solution for a market based approach.

REDD+ has provided large sums to countries for protecting natural habitats in its current forms, so the question of the finance alone shouldn't be restricted to economic issues alone. As the original idea of REDD was to combine climate change mitigation action with some developmental aspect, the pure economisation is short-sighted. In addition, economic incentives to protect forests are again endangering indigenous land use practices (Baez, 2011) or even lead to absurd projects like clearance of forest areas for wind energy production, or the construction of hydropower dams to reduce emissions from otherwise fossil fuel combustion.

Non-carbon benefits are an area, where indigenous livelihoods show positive developments (Hvalkof, 2013). The REDD+ safeguards, which were reinforced in the Warsaw framework in REDD plus, include environmental governance and social aspects, such as sustainable livelihoods. In regards to the environmental component, it does include much more than just carbon sequestration and carbon storage. The whole ecosystem protection is considered, as well as the protection of ecosystem services (Hvalkof, 2013).

Considering the goals of UN REDD one key question remains: is it a suitable framework for reducing carbon emissions? Despite all positive developments in regards to the inclusion of indigenous and local knowledge, the key aim may not be fully achieved. While much debate focusses on conserving carbon stocks, the potential to actively reduce emissions would be strongly related to afforestation projects. The latter aren't fully recognised by REDD+ so all activities seem to head towards measurable "progress" that can be compensated by international donors. Thus, the framework has limited effect if its compensation mechanisms focus too strictly on financial aspects. While financial incentives are inevitably important, the dominant thinking should shift onto discourses where low carbon economies become the norm. As of now, the low carbon lifestyle by indigenous peoples isn't considered an alternative for most of the world and there is no financial incentive to turn away from a carbon intensive economy. Missing political and economic will to change to a low carbon economy cannot be blamed on REDD. However, the framework will lose relevance, if the changes in policy take too long to endorse alternative, yet innovative approaches.

4. Indigenous Knowledge in other International Organisations.

Keeping in mind, that UN REDD isn't the only international programme which tries to include not only participatory rights but also takes the application of indigenous knowledge into consideration, but there are several frameworks established by a number of international organisations or other networks. Among them is the World Meteorological Organisation which established the Global Framework on Climate Services. The name alone would be a good way to endorse indigenous practices and give them a prominent role in global actions against climate change.

Climate services are, however, understood as a service provided to better understand climate. So at best, indigenous knowledge would contribute to enhance climate services. Strictly speaking, the current situation wouldn't allow anything else apart from more accurate weather predictions and observations. Climate or ecosystem services, as it has been mentioned above, isn't developed yet and isn't envisaged to be used as an active service to the ecosystem.

The Hyogo Framework for Action has been another milestone international document in the appreciation of indigenous knowledge, without going into detail or substance. Particularly the cultural heritage has been noted as a form of valuable information system in knowledge exchange for disaster identification:

> *"(a) Provide easily understandable information on disaster risks and protection options, especially to citizens in high-risk areas, to encourage and enable people to take action to reduce risks and build resilience. The information should incorporate relevant traditional and indigenous knowledge and culture heritage and be tailored to different target audiences, taking into account cultural and social factors."* [10]

Resilience has been singled out as an area where indigenous knowledge could be applied. Thus, the problems of conventional science is revealed. Very often, measurement, monitoring or pre-warning systems are very expensive and inapplicable to low-income areas. Infrastructure plays another role, which is a problem when relying on technological solutions which inevitably require e.g. electricity. Remote sensing is a viable option for regions with limited infrastructural development, but is

[10] Hyogo Framework for Action 2005 - 2015

even more expensive and needs very specific knowledge to operate. Using existing knowledge system in the area in question may sound like a much more sensible option and also sensitive option, when taking power relations again into account (Swazo, 2005).

Ecosystem services are defined in a very restrictive way. The Global Framework on Climate Services is a provider of information of weather data to better prepare people, states and organisations. Comparing the term as outlined by the GFCS, it is active in comparison to the passive use of the e.g. European Union (Serna-Chavez et al., 2014). What's important about the question if you can either consume or provide ecosystem services is essential for current or future debates on how to integrate indigenous knowledge. Especially, when it comes to question of climate change mitigation action. Sometimes, as will be demonstrated, the application of certain knowledge can be unaware of the effects. Integrating that kind of knowledge certainly needs outside observers to duly note the practices.

Another provision in ecosystem services could be the low-carbon lifestyle. As technological solutions are difficult to apply in regions with weak or no infrastructure, other ways of problem solving need to be explored. Those are essentially the lifestyles of many indigenous peoples. The economic situation often corresponds to less carbon emissions, but shouldn't be seen as a pure economic question. The traditional practices don't rely on technology which is commonly known in Europe, USA, etc. The focus could be set on techniques, as they are being used in agriculture or environmental management, or even Monitoring, Review and Verification systems (Danielsen et al., 2011). Despite the fact, that some indigenous peoples don't necessarily describe the practices they apply, the accumulation of their activities is part of a broader ecosystem management.

The evaluation and appreciation of ecosystem services can be found predominantly in the Non Carbon Benefit discourse. Ecosystems services are produced in a specific region, where the effects can be easily measured. So e.g. if a specific area has increased water levels, better forest covers, etc. they would count as functioning ecosystem services. Indirectly, however, they could be deduced from the more sustainable practices by indigenous tribes. That's precisely an area where the International Work Group on Indigenous Affairs calls for more support in order to

have those indirect services acknowledged, but also refunded when it comes to financial benefit sharing (IWGIA, 2014).

Many projects which aim at curbing carbon emissions in combination with some developmental aspect, necessarily introduce some ecosystem management practices. Taking feedback mechanisms of one ecosystem into account, assuming an impact by human activities and trying to mitigate for that problem is a practice which is essentially performed by many indigenous peoples. Most of their knowledge is always in combination with the region, thus their environment. It would be natural to assume that indigenous peoples inhabiting natural areas would care for their immediate environment in the best possible way. In situ approaches therefore aren't selfish or a sign for isolation, but can be seen as a valuable contribution to the wellbeing of an ecosystem, such as a forest. Thus, UNESCO has initiated under MOST, which stands for Management of Social Transformations Programme, a selection of Best Practices of Indigenous Knowledge (Boven and Morohashi, 2002).

MOST, established in 1994, enables UNESCO to engage in interdisciplinary and intercultural research. As the cultural and scientific organisation of the United Nations, this is an interesting initiative for international cooperation in basically any area of expertise. Thus, indigenous knowledge was again mentioned to be a valuable source for information on very specific issues (Boven and Morohashi, 2002). Even though it was one of the first to prominently feature indigenous knowledge which can in some regards be understood as indigenous technology (Boven and Morohashi, 2002), it doesn't particularly identify that knowledge as potential for activities in climate change mitigation actions. The analysis was a general overview of technologies applied by indigenous tribes and didn't aim at climate change mitigation. It is true, that some indigenous knowledge systems are not suited to integrate into bigger schemes for mitigation, but shouldn't only be seen as potential adaption strategies. Nonetheless, the establishment of an international database of best practice indigenous knowledge is a sign of greater acceptance. A huge study by UNESCO further shed light on how to best evaluate and use indigenous knowledge.

"Weathering uncertainty" is a summary of many different aspects of indigenous knowledge. Definitions, the history and the influence on conventional science has been demonstrated. Especially in plant identification, species and natural practices, indigenous knowledge has played a major role. The phrase "Every Eskimo is a

scientist" (Nakashima et al., 2012, p. 32) is a catch phrase, which shows how much could be learnt from indigenous peoples. Understanding weather systems is one of the oldest known examples of indigenous knowledge, which correlates in impressive detail with scientific knowledge (Nakashima et al., 2012). Attempts to analyse exactly that have been conducted. An ambitious research project in Southern Malawi tried to grasp how indigenous peoples adapted to changing weather systems (Kalanda-Joshua et al., 2011; Nkomwa et al., 2014). They also tried to understand the perception of those phenomena by the people of the community. This qualitative approach gives valuable insight into the thinking of one of many indigenous knowledge systems.

Considering the manifold forms of indigenous knowledge, it's important to note that assessment of climate change lies well within the capacities of some indigenous communities. This is acknowledged by UNESCO, so more international organisations could have learnt from that appreciation (Nakashima et al., 2012). Under Non-carbon-benefits, which NGOs demand to be taken into consideration for REDD+ mechanisms, are contested for their effects. In 2014, a lot has been addressed at the Conference of the Parties to adopt mechanisms which would safeguard the consideration of NCBs. SBSTA has adopted NCBs together with the general REDD+ safeguards, which show respect for the knowledge and rights of indigenous peoples (UNFCCC, 2014).

The climate debate and the role of tropical rainforests seem to have superimposed an international imperative to utilise all available criteria for the best of climate protection. Biodiversity, however, is a field of expertise for indigenous peoples which sees a much longer rise than any actions related to climate action. In the convention on Biodiversity, indigenous knowledge is explicitly mentioned for benefitting the protection of the ecosystem (Zerbe, 2005).

The convention on Biological Diversity was established together with the United Nations Framework Convention on Climate Change at the summit in Rio 1992. What has been integrated was not only indigenous knowledge, but has created a framework in which indigenous knowledge can be used both to conserve and to learn from. It has three major goals and objectives, which are the "conservation of biological diversity, sustainable use of its components and fair and equitable sharing of benefits arising from genetic resources." (CBD, 1992). Despite its dimension, it hasn't received as much attention as has UNFCCC. The use of the components is a key area where

indigenous knowledge can demonstrate what plants its custodians use for all kind of purpose.

The objectives of the Convention serve to protect not only the habitat of certain species, but indirectly affects indigenous peoples. Their knowledge might be appreciated on the international level, but similar o REDD, sees varying degrees of implementation. Some areas need to have increased legal protection, e.g. in Africa (Zerbe, 2005), but shows a similar development as indigenous rights under REDD activities in Africa. On a more general level, the protection of biodiversity could be regarded as value-added to REDD practices, but are under different policy frameworks. The one includes indigenous peoples in its policy making process, while the Convention on Biological Diversity particularly protects and respects the lifestyle of indigenous peoples, too (CBD: Article 7 [j], 1992).

In this article, the role of indigenous peoples is in monitoring and identification capacity. Thus, the appreciation of indigenous knowledge as contributing to an intended conservation policy is already well established. The same isn't always the case in other agreements, despite similar wording. However, the problem is much more complex than just land rights, which would improve e.g. forest conservation (e.g. Vergara-Asenjo and Potvin, 2014). Intellectual property rights sometimes abuse the original "inventor", who is very often a member of indigenous tribes who was observed using certain plants for medical applications (Swazo, 2005).

This strong conservation and protection narrative has received remarkable attention. Even though it produces some unwanted by-products, protection of forests is fashionable. If you can cover more areas than merely the forest cover, but the forest quality, biodiversity seems to be a good area which needs protection, even though it might have an age-old imbalanced power relation between people "asked" to protect and the people who want to protect (Swazo, 2005). Among the most elaborated cooperation of indigenous groups with multilateral environmental agreements – whatever their target may be – the protection of biodiversity is most elaborated when it comes to participatory rights and appreciation of indigenous knowledge in the field. Moreover, they are included in the policy development under the agreement from the very beginning.

Climate change, on the other hand, seems to be building up momentum during the last few years. Especially with Paris 2015[11] on the horizon, states, activists, NGOs and UN bodies work hard to have their agenda included. Indigenous knowledge is on the agenda once again and some of the studies introduced in the following chapter can shed light on the actual contribution of indigenous knowledge. Activists for indigenous rights urged the international community for years to take measures. Thanks to observations in different regions, the effects of climate change were brought forth by representatives of indigenous peoples. Also, they were addressed at the various international fora for indigenous issues, etc., so indigenous knowledge played an active role. Representatives voiced concern over the international community's inability to move for a new agreement that would reduce greenhouse gas emissions.

5. Projects analysis

Across many countries, which have a share of tropical rainforests, projects to protect them are spreading all over the area. The motivation to develop any project in community forest monitoring, afforestation, biodiversity protection etc. isn't always easy to single out. The donors behind those projects need to be closely looked at, but are sometimes hard to find. In any case, the actual implementation of the project which has a benefit for environment doesn't necessarily need a background check on the donor. As has been mentioned earlier, in some cases, where the implementation was poor or geared towards revenue creating businesses the actual benefits were clearly not for the people inhabiting the area. What shouldn't be forgotten is the fact that all those projects aiming at ecological sustainability always mean the utilisation of natural resources, whether it's for production or just self-sustaining activities. This means that the projects should ensure environmental sustainability along with some positive developmental impact on the population inhabiting the areas. Yet, the importance for global climate mustn't be neglected either, so the balance between those two interests is difficult to find.

Projects developed by the German Development Cooperation Association in the forestry sector diligently consider this balance in their projects (e.g. Schielmann, 2013). Globally 300 million people are dependent on forests for economic or self-

[11] The Climate Conference will be held in Paris, December 2015. There are high hopes placed on this agreement to produce a successor agreement to the Kyoto Protocol.

sustaining activities, 50 million of them are indigenous peoples as defined by the very general terms by the UN Working Group on Indigenous Populations. Thus, to accommodate the economic development of not only 50 million people, but of 300 million people together with the protection of the world climate is important to combine. Leaving or excluding 300 million people would be a huge poverty disaster – despite the problem that many of those forest dependent are actually poor (Schielmann, 2013).

So theoretically, no project is used merely for the benefit of global climate, but always in combination with other interest. The economic and financial interests, shouldn't impair the best implementation of environmental protection. Vice versa in order to protect environment, people's economic interests are refuted or simply not satisfied by stalling projects. Indigenous peoples in particular very often face prohibition of land use practices and sometimes their own habitat is destroyed by for other interests. Looking at several dam projects in natural rainforest areas where hectares of forests were cleared or inundated – triggering carbon emissions and reducing the forest's carbon uptake capacity – in the name of economic development. Thousands of indigenous were relocated in e.g. the Iguacu dam project which in theory produces clean energy. Environmental impacts were addressed and the ecosystem suffered lasting damage, despite hydropower producing zero-carbon electricity.

Considering the conflicting interests and the imposition of projects which completely ignored the affected population, projects in the 21st century should have learned from these experiences. Not only has the legal situation of indigenous peoples improved since, new agreements have a more low-level participation, i.e. community inclusion in the decision making process, to ensure that local customs, cultural practices and indigenous knowledge can flow into the projects. Low level participation is a double-edged legacy, however. While it may ensure participation where indigenous people are already well protected, they can't upgrade an otherwise flawed legislation. As it has been noted earlier that there are some examples for poor implementation, which basically prohibited indigenous land use practices, but this shouldn't discourage scholars who have started to fuse indigenous knowledge systems with scientific practices. Such efforts are priceless for future research to get alternative systems on an equal basis with otherwise technology laden solutions.

Technology and indigenous knowledge mustn’t be considered as antonyms. In the projects to be analysed they work very well as complementary solution. If indigenous peoples – from a point of view of European reasonableness – fail to reason their findings, technology can help to examine whether there was an effect or not. Vice versa could indigenous knowledge serve as a research interest for scholars who otherwise wouldn’t have even thought about possible interactions of any kind (Hiwasaki et al., 2014; Kalanda-Joshua et al., 2011).

5.1. Malawi

An area in Malawi where farmers relied heavily on varying seasonal rainfall patterns challenged indigenous knowledge in a way because their forecasts and adaption techniques proved insufficient due to increasing effects of global climate change. In this case rainfall patterns were significantly altered, so the local traditional knowledge which was used to rather constant season was less reliable and led to higher stress on agricultural production. Thus, the combination of indigenous knowledge and modern knowledge managed to calculate the deviations of the rainfall patterns and improved the otherwise insufficient traditional forecasts (Kalanda-Joshua et al., 2011).

This study combined a social science approach with meteorological data to test traditional weather forecasts, or rather indicators. Those indicators were used for helping crop selection and thus soil preparation. An early mango bloom would mean dry weather in the next season, so farmers used to those traditional indicators would prepare for more drought resistant crops instead of mango. More importantly farmers relied more on those indicators than on the meteorological data

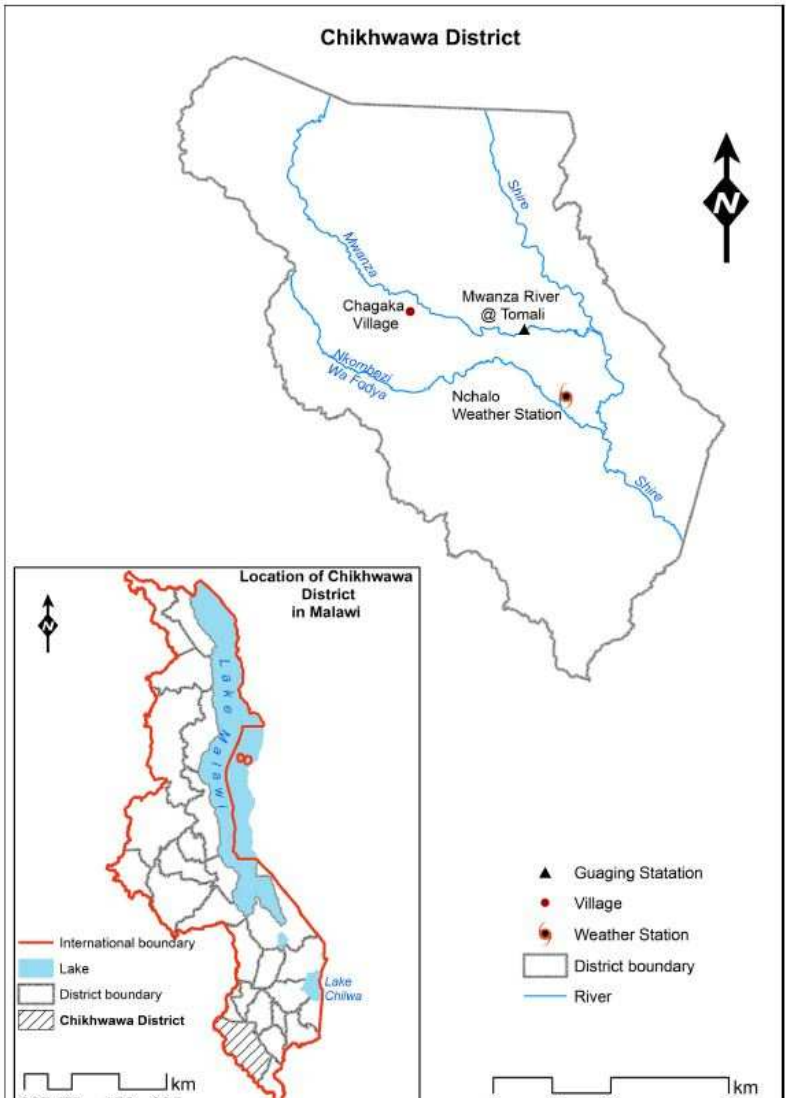

Figure 1 – Map of Chikhwawa District in Southern Malawi (Nkomwa et al., 2014)

provided by the national Department of Climate Change and Meteorological Services (Kalanda-Joshua et al., 2011). Thus, one problem is already displayed here, namely trust. If local farmers, people, tribes or any others don't really endorse the suggested projects, they won't be running for long.

While many villagers in the analysed area were completely aware of the changing weather events, they weren't calling it climate change, but perceived it as more frequent weather variations. In any case, science data totally backed up the observations by the local villagers who wouldn't have been expected to adapt according to their experiences. However, Indigenous Knowledge in this case has not only provided better and more understandable results for the local villagers, but has demonstrated its dynamics (Kalanda-Joshua et al., 2011). The elderly of the village

who held the knowledge and the youth of the village wouldn't clash about dissenting opinions, but would rather learn from both, almost like trial and error. This could be seen as a basic science concept where you adapt your theories to your observations.

This project is an example for adaption to climate change, which definitely is important to improve food security, resilience to natural disasters by subsistence communities. Integrating weather data from the region to better prepare and help indigenous knowledge systems to adapt to those new findings is important from a development point of view. The communities can sustain themselves and are less exposed to famine or other impacts from natural disasters or extreme weather events (Nkomwa et al., 2014). The project has only been established recently, which makes an impact analysis impossible. The study authors have provided a table of either natural disaster events or weather events which lead to an impact on the communities inhabiting the area. It's not entirely safe to claim that since 2000 famines have decreased, even though they don't show up in the events table (Nkomwa et al., 2014). The analysis of the rainfall patterns in the region were analysed and local farmers started to prepare the soils either earlier, or later, according to the best time for a particular crop.

This project in the agricultural sector showed how local, indigenous knowledge could interact with modern science concept to improve the situation of the people of a particular area. It does, however, also show the exposure of indigenous peoples to climate change. The changing rainfall patterns have severely impacted the societies in that valley which were aware of the problem and started to adapt to that new situation. Climate scientists have backed up the changing rainfall patterns and observed the changing crop planting times. However, it should be further explored how indigenous peoples contribute not only to adaption, but mitigation action. Agriculture is an important means to ensure food supplies and increase resilience towards natural disasters. If it's not for carbon intensive crops, however, the impact on mitigation of climate change is minimal.

Forest management systems, especially in tropical rainforests, however, are an essential part, if not the key for global mitigation action. Deforestation in South East Asia, Africa and South America limit the capacity of Earth's rainforest to sequestrate carbon. The carbon stock in natural rainforest is enormous. Thus, the focus of REDD and REDD+ was obvious. Therefore, a project where indigenous peoples contributed

with their knowledge in sustainable forest management should be analysed. A project in Panama is ideal for that purpose, because indigenous peoples forest tenure was included in the national forest conservation programme (Vergara-Asenjo and Potvin, 2014). The situation in some Latin and Central American countries is very good when it comes to integration of indigenous peoples into state projects, especially in forest tenure. Before going to Central America, there is an interesting tribe in the Peruvian Amazonas territory who showed remarkable success in avoiding deforestation, while being able to grow cash crops for export.

5.2. Peru

In Peru's Amazonas territories an indigenous people called the Ashénika inhabit an area, the Gran Pajonal, which is known for its huge terrace like structures. This mixture of forest and agricultural land is home to the Ashénika tribe as well as mestizo farmers. The international work group for Indigenous Affairs has lead a study in the area to analyse the agricultural production, protection of forests and tried to display the socioeconomic consequences for the people living there. So areas of similar population densities, forest cover and agricultural land were compared (IWGIA, 2014).

A brief description of the Ashénika's techniques gives an insight into how sensitive they are towards their environment. The crops planted by the tribe are always season dependent, which makes it easier to harvest several times within one year. Several cycles of crops are employed to ensure that the soil is properly prepared but still in use. So despite having fields where cropping and harvesting take place it hasn't produced any negative (observable) impact yet (IWGIA, 2014). Interestingly though, the people there plant coffee in one of the cycles for export. Without any negative consequences for food security they were able to integrate export crops into their age olds cycles, but neither increased deforestation, nor altered their practices.

In comparison are the mestizo farmers, who also grow coffee in a climatically comparable area, with similar soil conditions, weather patterns and so forth. However, their results show much worse results then the Ashénika tribe. Food security is worse, the forest cover less and overall, the settlers were hardly able to create income, while at the same time, the Ashénika improved all the three. This area, approximately 3800 km² large, has been observed for a period of over 50 years. Over this period, the Ashénika increased forest cover from 87% of their areas to 91%, while maintaining a

stable population, economy and area of grasslands. The extensive cattle farming practices of the settlers are showing signs in the completely opposite direction. Forest cover has decreased by almost half, from initial 87% as in the Ashénika territories, while other parameters also show worse results, i.e. population growth, stagnating economy (IWGIA, 2014). Several other studies produce very similar results and imply that indigenous environmental monitoring is a much more accurate process than the conservation practices of modern science (Danielsen et al., 2011).

In similar examples a strong correlation of a strong legal framework ensured indigenous land tenure. In turn, forest areas were either afforesting or decreased significantly less than in other areas. Even though public natural protection wasn't measured in this example, this project can be repeated in similar environments. A glimpse into several areas across Middle America and South America, as well as Africa should provide a better picture of how indigenous land tenure produces less deforestation than any other conservation regimes. The correlation is significant and the example above shows how much diligence flows into indigenous land use.

5.3. Panama

Panama is a prime[12] example of the combination of international programmes, legal protection of indigenous practices and national plans to reduce deforestation as well as contribute to mitigate climate change. In a study conducted by Vergara-Asenjo and Catherine Potvin in 2013, published 2014, all territories under indigenous tenure, claimed by indigenous peoples or those which are currently transferred into indigenous care, were analysed for their forest cover. The highest carbon stocks of natural rainforests are local in Latin America and Central America. Panama, which is the connecting element of land between South and North America is an ideal location for analysing different forest patterns. Additionally, Panama has established a forest tenure regime which enables the researchers to differentiate different tenure regimes. The basic assumption was that areas under indigenous tenure would deforest much slower than other territories, even under natural protection. In Panama, the legal status of the different regions is difficult to sort. Thus, the tenure and land practices may vary even within designated protection areas, because in some of them legally recognised indigenous lands are located which are under different tenure practices than the surrounding areas.

Given the different localised approaches it can be regarded a major challenge for researchers and policy developers in national ministries to combine legal protection of indigenous (land) rights, conserving natural protection areas – basically forests – and ensuring effective management of these areas to benefit from REDD+ mechanisms. Areas of sought improvement had to be negotiated with REDD+ and the problem areas of Panama had to be clearly mentioned. They include poor urban planning, thus uncontrolled urbanisation, extensive ranching and other factors contributing to deforestation (Vergara-Asenjo and Potvin, 2014). They have been made parameters for all tenure regimes, in order to have an objective picture of the differences. Obviously, the problem with the regional distribution of urban centres has to be taken into account, but the authors have accounted for that.

[12] In this context it is a prime example. In this paper it cannot be comprehensively argued if the legal situation is sufficient, but for the purpose of the analysis of international stakeholders, state-level protection and application of indigenous knowledge it can be considered a prime example

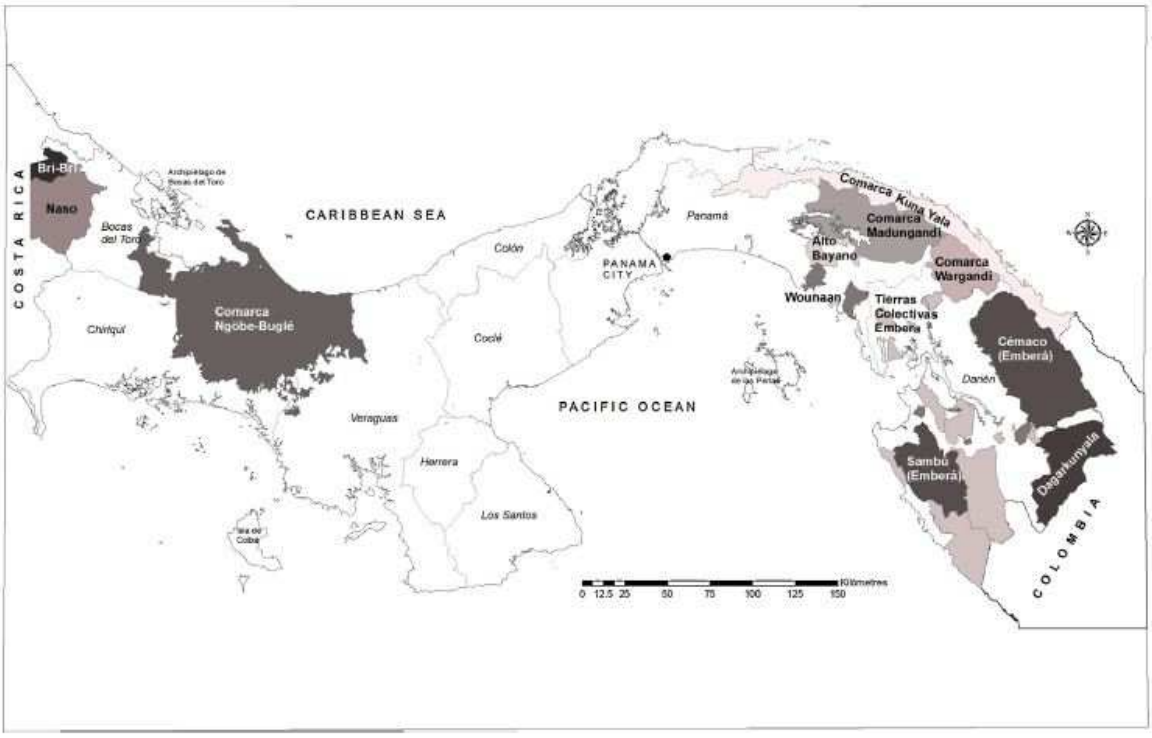

Figure 2 – Indigenous territories and claimed lands (Vergara-Asenjo and Potvin, 2014)

The method was to use a geographic information system to map the areas under indigenous tenure, or lands claimed by indigenous groups and groups without any indigenous participation. Thus, they had a great chance to see the effects of different practices on the conservation of natural carbon stocks. It should be noted, that 54% of natural forest cover in Panama lie within indigenous areas in 2008. The lower deforestation rates in those areas significantly contribute to the slowing average deforestation rates of all Panama. Some of the forest territories overlap with protected areas. Nonetheless, similar to the problem with a different distribution of urban areas, this can also be take into consideration when evaluating the overall forest areas under investigation. Remarkably, all analysed territories under indigenous tenure or claimed lands showed significantly better results than all the other areas, especially the non-protected areas (Vergara-Asenjo and Potvin, 2014).

All areas were compared in the same way. They took remote areas as samples. All land images were compared pixel by pixel. Most claimed land areas were closer to roads and at lower elevations than any other areas. So urbanisation alone, which could be considered as a factor contributing to deforestation in non-protected areas, isn't the main driver for the much worse results in those areas. Some claimed lands even had more areas closer to roads and cities than others, yet the deforestation rate was slower,

for a period from 2000-2008. Despite those good results the relation between Panamas' indigenous peoples and REDD+ isn't the best. Before, however, the general proof that forest tenure can contribute massively to avoided deforestation is delivered. Forest tenure regimes seem to be a footnote of REDD+ or readiness projects for REDD+.

Difficulties in accounting for preserved forests instead of avoided deforestation is one of the main problems when it comes to the example of Panama and REDD+. The different tenure regimes in this study show that conservation of forests, despite falling under the criteria for REDD or REDD-readiness projects, aren't prominently featured in other areas. All data collected by that study have one key feature missing. They only show the results instead of accounting for the differences in land tenure. A defining aspect for the difference in the tenure regimes should have been mentioned, otherwise the study is exposed to criticism that only correlations are implied, while there could be none. Key questions would need further clarification, whether the analysed indigenous areas share the same forest tenure regime. Furthermore, the differences between the indigenous areas and the protected areas should have been outlined in order to identify the indigenous forest tenure practices as the decisive element for the results.

For an international scheme like REDD+, which has a rather fixed catalogue of what could work and what shouldn't work, it's rather difficult to reward forest protection by merely presenting numbers. It's a problem of international agreements, as has been noted earlier, that its immobile character often prevents dynamic and innovative concepts. Just looking at the history of REDD and REDD+, which was expanded over a few years by just two terms, namely degradation and eventually the plus, means that even more complex questions about the mechanisms of the programme itself is likely to take an even longer period of negotiations. Assuming that no other study has had a closer look at the different tenure regime, it wouldn't be possible to take those practices into benefit and compensation mechanisms, as no actual proof of any activities has been given. However, the example given shows how the legal situation of a country significantly affects the intentions of an international framework. Panama has slowed its deforestation rate and would formally fulfil REDD criteria. Whether forest management will be part of financial benefit sharing, isn't conclusively decided yet.

Getting a better picture of what indigenous land or forest tenure could mean, a closer look at other projects can resolve that puzzle. This study was a large scale project analysis instead of a qualitative approach which has been introduced in the first description at how indigenous knowledge could be used for improving agricultural yield in Southern Malawi. Similarly, there are research projects which provide similar insight into forest tenure practices of indigenous peoples. They may, however, differ from the one introduced in Panama, both in extent and in their end results. One small attempt to address that problem was undertaken for the Kafa biosphere, which implemented community monitoring procedures to verify data obtained from remote sensing (DeVries et al., 2012). This particular example showed how different types of forest are taken into account for the analysis, which is something provided by the communities included into the monitoring regime. In its motivation and objective, the research focuses on completely different aspects than the one in Panama. The focus lies on the inclusion of local communities and how their role in monitoring deforestation could be valued, which is a potential application of indigenous knowledge, too. In contrast to the first two studies, the one conducted by DeVries clearly set the frame for community inclusion into international REDD+ processes.

Furthermore, DeVries' study is a good example of how science and communities can complement each other. While changes in remote sensing data need longer re-evaluation time, community monitoring can "lend" the data and observations to actually improve the data gathered by satellites (DeVries et al., 2012). Inevitably, the combination of science and local concepts has been achieved. Similarly, indigenous knowledge could be seen as another source, wherever similar problems occur. Monitoring and Verification is also partially included in forest tenure, as you need to control the development of what is under the tenure of a certain group, community or even ministries.

5.4. Nicaragua

Similar to Panama, Nicaragua has established territories under indigenous land tenure. In addition, there was another chance to directly evaluate government protected areas, with indigenous tenure and also mixed zones. Basically, those were buffer zones between the areas under government protection and indigenous territories where indigenous peoples were residing. A direct comparison was possible for the researchers and authors of the study (Hayes and Murtinho, 2008). More interestingly,

this research was conducted before the establishment of REDD+ mechanisms and also before the study in Panama.

The distinction between different types of tenure regimes is important and also how they are being monitored. There are forest guards, which patrol the territories, participation from the local indigenous tribe is ensured. Thus they play vital role in the monitoring process as well as the observation of indigenous resource use (Hayes and Murtinho, 2008). In contrast to the study in Panama, qualitative methods were applied in the course of the study, which is important in disclosing the difference in practices that may lead to an improved conservation regime in contrast to non-indigenous forest conservation management. Available satellite imagery was used to determine the land use change in the different areas to basically observe the changes over a certain period of time. The design was specifically targeted for estimating land use change subject to population growth. In this point, the study differs from the one conducted in Panama. The valuable insight into different land use practices thanks to the qualitative approach is essential. The average Miskitu household used much less land area than the aver mestizo household. Only a fraction of available land was used for pastures, while mestizo communities used up double the area for pastures in contrast to crops. So crop farming was the primary form of agricultural activities in Miskitu communities, while cattle seems to be dominating in non-indigenous areas (Hayes and Murtinho, 2008).

Deforestation would rise under the assumed population growth in all the areas. Feeding the data into simulations of land use change under a certain population growth, it has produced similar results as in Panama a few years later. Miskitu territories had a very strict distribution of different land zones, consisting of forests and agricultural zones, which are hardly changing. Two simulations supported the current observations and assumptions that slow change in land patterns will continue. Pessimistic assumptions for the simulations showed a faster retreat of the forest areas. Wherever indigenous property rights were kept and upheld, the change would take place in time spans of 40-50 years, whereas mestizo communities would only take 7 years, assuming no change in agricultural practices (Hayes and Murtinho, 2008). A clear trend can be deduced from the study in Nicaragua: because of the less cattle intensive agriculture of indigenous communities in the area, forest protection is much stronger in those areas than in any other territory, even those under environmental protection schemes of the Nicaraguan government.

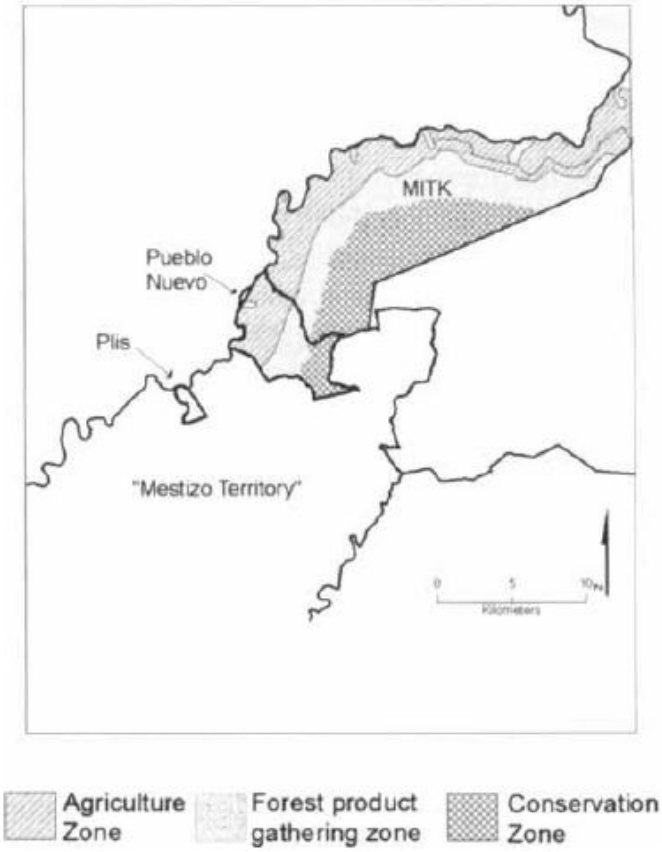

Figure 3 – zone plan of indigenous territories in analysed areas (Hayes and Murtinho, 2008)

Land tenure status can effectively influence results of deforestation rates and other parameters. Private land use is more connected to deforestation than e.g. protected areas. Even better results are produced by regions with indigenous land tenure. Whether the actual practices or the legal title itself are the decisive element isn't exhaustively answered with any of the studies (Robinson et al., 2014). Nonetheless, forest cover protection under indigenous lands and those claimed by indigenous lands are better protected than any other types of forests. These results are repeating all over

the place, especially in South America. The statistical correlation between better forest protections in public areas, which implies a restriction on natural resources use, clearly has the advantage over private land ownership (Robinson et al., 2014). Land titles for indigenous groups work even better, and wouldn't work in a traditional public / private contrast. Legal protection of indigenous land titles is another difficult area, but their contribution to forest protection is consistent within any data sets acquired.

Legal frameworks are among the most important aspect of effective forest protection. Implementing international agreements without a strong policy on the national level would mean an ineffective handling of natural resources. Supported by the study of Robinson et al. in 2014, the approach by REDD is thus a strong signal by the international community (Pedroni et al., 2009). In addition, the financial benefits can be harnessed by state players – at least indirectly.

5.5. Botswana

Another example of the application of indigenous knowledge which was extensively measured and observed over longer periods of time lies in the Okavango Delta in Botswana. Land use policy was analysed in order to look into the effects of national policy on local farming, land use and conservation efforts. Also, the application of indigenous knowledge was important to account for inundations and other recurring natural phenomena. The dependence on flood recession farming in that area was one of the factors to analyse the policy which eventually marginalised the practice. Indigenous farming practices are subject to long and detailed observation of the local vegetation. Thus, farmers knew well where to plough, when to sow seeds and knew the quality of their soils well (Motsumi et al., 2012).

Mainly, the problem was that land use policy by national authorities pretended to include indigenous knowledge in *molapo* farming for conservation purpose. The actual plans, however, completely ignored the traditional practice and even prohibited farmers to follow their generation-old practices (Motsumi et al., 2012). Essentially, their farming relied on the receding – recurring – floods to harvest the nutrients and use the moisture for their crops. However, because of national plans for flood protection, all fields had to be move from an area much further away than the farmer usually went to. Thus, the practice has been illegalised, food security endangered and indigenous knowledge completely disregarded. But because of the (former) flexibility

in applying the agricultural practices, *molapo* farming could be taken as an example for adaption strategies in the wake of climate change. Weather variability has led the government of Botswana to adopt the land use policy, which should have taken the practice into account. Yet, the response didn't account for that and thus actively marginalised indigenous knowledge, despite other efforts to increase the respect and appreciation for it.

Even worse, *molapo* farming was associated with some livelihood income in an area stuck in poverty and little other economic activity. Even though farmers had little other option but to take government funds when there was no harvest, the whole practice was an essential part of the whole ecosystem. Farmers diligently prepared the soil, selected crops and planted them accordingly to have the highest possible efficiency. The care for the growing plants was labour intensive. Neither fertilizers were applied, nor were any other chemical means to fight pests used. A systems of taboos – i.e. no eating in the fields – and other measures tried to ensure the least possible attraction of pests like birds, which would eat away the seedlings. Arising from agriculture, the societal system is strongly bound to the whole practice and natural cycle together with plant growth (Motsumi et al., 2012). The ecosystem was cared for. If flood recession farming wouldn't produce enough, parts of the land was used for livestock farming. This ranged in the region of 10-15% of land. Similar to the example in Nicaragua, it means a less livestock intensive agriculture, despite a significant higher usage in Botswana. The land in questions, however, is the defining difference for that. Because of changing dry and wet conditions and Savannah lands as opposed to tropical rainforest, this practice wouldn't even allow other than livestock farming to produce enough food.

Even though this example showed many negative aspects, one positive trend is the adaptability to changing environmental conditions. As one of the most defining aspects of indigenous knowledge, it shows again its dynamic character and the close relations to environmental conditions. Drastic changes in environmental conditions may not only endanger the existence of certain indigenous peoples, but also their traditional livelihood. Sometimes, it requires more time for that adaption to take place, just as modern societies aren't well suited for immediate change. Thus this example was clearly at showing the adaption capacity by people practicing indigenous knowledge and shows the need for climate action to slow the current natural processes.

5.6. Australia

Australia has recently – amid international pressure – started an ambitious programme which would essentially explore options of where indigenous knowledge would be best for protection initiatives (Ens et al., 2015). Indigenous, ecological knowledge is always about the interconnectedness between human beings and the environment, which is comparable to Western Ecological science. The interactions of the different parts of environment are key in understanding ecology.

The study compared territories where active indigenous peoples were practicing their ecological knowledge and compared it within Australia. One of the driving questions was its temporal and spatial extent. Some regions haven't had any records of indigenous biological knowledge, whereas others had more. The connection was that more hotspots of indigenous biological knowledge would mean a healthy amount of species in an area. The less accounts of indigenous knowledge there were, the less biodiversity could be observed (Ens et al., 2015).

Given the various types of landscapes Australia inherits, the comparison over time is important. With disappearing indigenous tribes, the number of species observed, also in cross cultural surveys, declined. Thus, the correlation of the benefits of indigenous bio-cultural knowledge and management to the conservation of biodiversity has been demonstrated. More importantly, however, was the existence of those oral reports by indigenous tribes. They turned out to be a source for "Western" biologists to discover "new" species (Ens et al., 2015). Interestingly enough, this study managed to show the difference in the approach towards ecology. While the custodians of the biological knowledge in a specific area inherit the knowledge "automatically" (Ens et al., 2015), biologists would need long studies to produce similar results, i.e. the account of certain species.

All kind of projects could be analysed in order to show the effects of indigenous peoples. One essential question, however, remains. What are the actual practices that make it so fundamentally different? What is so unique about that knowledge that it can produce astonishing results, but only in limited way show the actual procedure of how that knowledge is created? One major problem lies within the production of the knowledge itself. It's orally passed on to the next generation, which is both essential to its survival, as to the survival of the ones getting the knowledge. Reversely, the loss of

people practicing the knowledge means the disappearance of this knowledge altogether. This is what the study of the Australian government basically discovered, or reinforced. Decreasing accounts of indigenous peoples' knowledge means less biodiversity in an area (Ens et al., 2015). Consequently the protection or conservation that was intended when establishing national parks and other territories was ineffective due to the weak or inexistent protection of indigenous peoples. The stronger their territories and land rights are protected, the better the conservation of biodiversity works. Australia in particular had a long history of discrimination against aborigines. This policy was gradually abandoned, but the consequences are still visible today, i.e. increased mortality, poor health and other social problems within aboriginal communities (Lea, 2005).

6. Combining Science and Indigenous Knowledge

Many initiatives have thoroughly weighed options on where to best combine scientific and indigenous knowledge. The projects described above are considered as examples to showcase the contribution and differences in practices for the benefit of preservation. But active research can be assisted by indigenous knowledge, too. Often, indigenous monitoring is imprecise and qualitative, but has long periods of observations which are still a valuable source for scientists (Moller et al., 2004). Especially in monitoring wildlife populations, indigenous knowledge has been widely used as complementary to scientific research. In those remote areas, bringing in the necessary equipment for technological monitoring is often expensive and inefficient, so science can benefit from local, yet imprecise knowledge, nonetheless.

Biodiversity is definitely a good example where the both concepts work well together. Climate change is much more difficult. Despite internalising weather patterns and adapting to changing environmental conditions (Hiwasaki et al., 2014; Nkomwa et al., 2014) the only real field where indigenous knowledge systems can be applied is forest tenure and land use change. Given the examples from Panama and Nicaragua, it can be easily assumed that further studies in this area would produce similar results. Studies which imply that strong land tenure rights for indigenous peoples help slowing deforestation rights, are increasing in numbers (Robinson et al., 2014), but need to face the reality checks which are sometimes less positive than the actual results (Baez, 2011).

Many studies have indicated that indigenous knowledge can provide similar data and conclusions as modern scientists can, at a much cheaper cost and less efforts invested. Even though they might not use the same terms for biomass stock or other important aspects of forests, they are still able to describe and estimate them with high detail. This data doesn't necessarily reflect the findings of modern scientists, but wouldn't completely deviate from the results. However, the simple techniques in contrast to very expensive remote sensing data, this is significant (Danielsen et al., 2011, UNFCCC Submission 408). What seems to be missing is an appreciation of non-western-sciences. Despite the fact that highly trained (natural) scientists, who undoubtedly produce amazing results in all kind of fields, require long training and often sensitive equipment to produce only slightly better results than knowledgeable indigenous persons to a certain region, the appreciation of Indigenous Peoples hasn't been improved. Social scientists, however, managed to show strong correlations between findings of scientists and the findings of indigenous Peoples (Danielsen et al., 2011).

Science concepts are a major part in any international agreement. Most intergovernmental organisations basically rely on those concepts, while indigenous knowledge is just considered another source which can be used for certain scientific practice. The framework convention on climate change, SBSTA in particular, is responsible for the development of global policies to combat climate change. Similarly, multilateral environmental agreements, e.g. the Convention on Biodiversity also have a science bias which utilises indigenous knowledge as a means to achieve the goals of the agreement. While the policy development, or the objectives of those agreements, have been fixed in the negotiations, the scope of the potential application of indigenous knowledge is only allowed for suiting those objectives. Indigenous peoples do have some voice, but mostly on advisory basis. Usually, they become a part of an agreement but have little influence in actually framing the agreement itself. Instead of actually contributing to the development, the conservation imperative – which is undoubtedly positive in e.g. climate change – limits them to have a say on what they could contribute, without actually being part of the initial problem. Carbon emissions can hardly be attributed to the lifestyle of many indigenous communities (IWGIA, 2012).

The projects above show that sometimes science and indigenous knowledge aren't hard to combine. Especially when you don't analyse actual practices, but rather the results. Knowledge, specific to a region or ecosystem is even further complicated by the fact that indigenous peoples' knowledge is subject to age group, gender and rank within a society. There are differences within the various indigenous population groups, but as a general problem, it has to be considered who is responsible for certain activities (Cámara-Leret et al., 2014). Natural sciences aren't helpful in this regard, because it wouldn't make any difference for the end result.

However, methods to measure the benefits of indigenous peoples land use practices are within other disciplines, like sociology. Having combined the sociological analysis to the end results, e.g. the ones in Panama or Nicaragua, show a positive correlation between indigenous ecosystem management and improved forest cover. The intention of forest conservation, or ecosystem conservation is to mitigate climate change. Altering land use scenarios like in, e.g. mestizo communities who inhabit the same area like indigenous groups show that potential that lies within the protection of those indigenous land practices. The whole potential could include countless further examples on what the positive effects were. If the ecosystem management is considered a holistic, societal endeavour, then the indicators which can be used to show the positive effects rise in numbers. Not only the reduced deforestation rates are important, but the improvement of the plant life, leading to increased water quality (Reyers et al., 2013) or other unforeseen but beneficial outcomes.

The combination and highly positive impact on conservation policies under the Convention on Biological Diversity is a field where conventional science has learnt a lot from indigenous peoples, especially in medicine. The relation of traditional medicine and the protection of biodiversity is inevitable. Indigenous tribes practice their knowledge by conserving nature around them and benefit from plants used for healing purpose. In this regard, indigenous knowledge is endangered in its application of those plants, because of development in the intellectual property rights field (Timmermans, 2003). Traditional medicine, which utilises certain plants and has basically been part of any society which started to use local plants for healing purpose, may have significant contribution to cheap health care systems (Cordell, 2014). The analysis of the practice can directly relate to science, as the chemical analysis of the plants and its effective substances could give an overview of the active components.

Thus the contribution to medicine is obvious and presents a field for conventional scientists, in which they can still find potentially unknown positive effects on health.

Market based mechanisms to tackle environmental programs have been a fashion of late. While traditional knowledge is regarded as a valuable source of knowledge for the conservation of species and biodiversity, it's not considered as fully marketable. Considering the practice some pharmaceuticals are following, which has become known as biopiracy, it would seem fair to apply market mechanisms for protected species or similar. The example of Australia has clearly demonstrated a correlation of accounts of different species and the presence of custodians of indigenous knowledge. The fewer reports about indigenous knowledge, the fewer species Western scientists were able to find. Thus, the conclusion that aboriginal tribes in Australia provide a strong conservation practice which is superior to other attempts to "save" species, is logical. So the question would be how should they be compensated? Unfortunately, there is still a need to not only respect, but incorporate the contribution of indigenous knowledge into financial benefit mechanisms. Conservation of biodiversity shows great potential, but lacks legal protection the same would account for market based mechanisms in the climate regime. The possibilities for indigenous tribes to apply for international programmes at all is limited through national legislation. This paper stressed the importance of national legislation for mitigating that problem sufficiently and there is no exception for the problems that would come with a discussion about market based mechanisms. What could be demonstrated, though, was that despite all economic rationale, sustainable forestry – which would live up to the expectation of sustainability – *only* occurs in indigenous inhabited lands.

Market based mechanisms, which inevitably provide incentives for a monetised economy, aren't necessarily suited for alternative live concepts. Even worse, they may endanger the implementation and usage of traditional knowledge. The incentive to protect a forest to gain tradable certificates could trigger a conservation regime which is too strict. The problems of some indigenous peoples in Brazil who were prohibited from logging single trees (Baez, 2011), is inevitably proof for activists who admonish that market based mechanisms would again benefit the rich and powerful.

7. Conclusion

Indigenous knowledge is difficult to demonstrate, even more so to quantify or measure. Many initiatives in international organisations and non-governmental organisations have spent decades on the basic work. The fact that people write about indigenous knowledge is thanks to an increasing appreciation of the same. The not-too-distant history has seen many indigenous tribes forced into re-education programmes, their practices prohibited or even prevented. As if things couldn't get any worse, indigenous peoples have been driven off their traditional lands and are now gradually getting back what was originally theirs. Legally, there has been significant improvement ever since the UN Working Group on Indigenous Populations was established. From that time onwards, activists, indigenous peoples and anybody interested in the field had someone to go, when addressing new issues.

The United Nations Declaration on the Rights of Indigenous Peoples can be regarded as a climax of a political atmosphere trying to overcome century old prejudice and stereotypes. So the political landscapes has seen more participation of indigenous peoples in almost every aspect, also in questions of climate change. The "right" framework for the inclusion of indigenous knowledge hasn't been found yet, which opens up one problem. During research the question of the effects of indigenous knowledge has been answered by scientific criteria only. In order to include IK into international agreements this is arguably important. Participatory rights are included to a varying degree among many international agreements. There isn't, however, the possibility to generalise whether they're beneficial or detrimental to the affairs of indigenous peoples.

One aspect, which hasn't been a target of this paper, is biodiversity. The Convention on Biodiversity has paragraphs which strongly endorse the role of indigenous peoples in the conservation of multiple species. Agriculture, especially indigenous agriculture, is a key contribution to species conservation (Zerbe, 2005) without expensive monitoring systems. Despite ambiguities in definitions of indigenous peoples, the limits were set in this paper. A rather straightforward term was used, basically the one employed the one by the UN Working Group on Indigenous Populations.

This particular episode of history about indigenous peoples is massively important. It proved to be a turning point in international politics in regards to appreciation of

indigenous knowledge. Indigenous peoples in general had a history which shared one aspect – violence and discrimination. This hasn't started necessarily with the journeys of Christopher Columbus, there were already known indigenous groups in the Arctic and other regions. When Columbus landed in South America, people inhabiting South America were quickly eradicated or significantly decimated. The situation for them hasn't improved much for several centuries. Only in the second half of the 20th century indigenous people were increasingly appreciated, sometimes compensated for the stripping of their former territories, practices and the exercise of their own culture. Human rights activists were the first to address the situation, which eventually was brought into the general racial discrimination discourse, which was highly unsatisfying for indigenous peoples. They never wanted to be considered racially abused, nor discriminated against. Their issue was special and one that wasn't down to skin colour, but to a belief and society system that was apparently impossible in the modern world.

So when the UN Working Group on Indigenous Populations addressed all those issues in questions, gradually improved recognition of land claimed by indigenous groups, sometimes compensation payments by governments that wanted to make up for former crimes and eventually led to the UN Declaration on the Rights of Indigenous Peoples. Since then they feature prominently in many environmental protection agreements because natural science and social science alike started to interest what was so special about them. What was so unique to indigenous peoples that wouldn't be possible to subsume under a general discrimination discourse?

Whatever it may be, the question should rather be what the systems they subsequently build up which seems to make forest protection look easy are. They are capable of producing impressive results as has been shown in the project analysis. Whichever example employed, the practice they applied was positive in almost all the cases. Despite the limited number of cases analysed, the nature of each of them allows to conclude that indigenous knowledge is beneficial to environment and does contribute significantly to climate change mitigation actions.

This brings up more questions, indeed, which have been addressed above. The positive results alone are subject of ongoing international negotiations. Activists for indigenous affairs are submitting proposals to international bodies, in this context mainly to UNFCCC in order to have the knowledge appreciated. International agreements seem to lack the dynamic to integrate new findings quickly. Looking at the different

submissions and decisions adopted by the Conference of the parties in regards to REDD and REDD+, it took the parties more than five years to come up with a programme (Agrawal et al., 2011). It shouldn't be assumed that those five years were lost. Many projects were already well underway parallel to the negotiations without actually expecting a later financial reward.

Conservation policy is a major driver for the international community to streamline efforts to protect natural rainforests which hold the key to climate change mitigation action (Hayes and Murtinho, 2008). Given the major impact on the world climate deforestation of tropical rainforest have, it's no surprise that it's an area which needs attention and improvement. REDD is among the first environmental agreements that address forests as a vital part of the global ecosystem. The Framework Convention on Climate Change in 1992 didn't account for that. Negotiations took a long path from an original idea to the actual scheme, which still isn't finished (den Besten et al., 2014; Jackson et al., 2014).

The REDD+ framework is particularly suited for the analysis in this subject. Its policy board has indigenous groups integrated into policy development – yet in limited form – and in the actual implementation of any projects that would contribute to the improvement and conservation of natural forests. More so, afforestation and improved environmental management systems could fall under REDD+ even though the latter is a difficult area for financial incentives. At least states are not yet willing to pay for results only without having a clear visible practice, which is sometimes the case in many studies aiming at proving the value of indigenous knowledge. Forest protection and forest conservation is an essential contribution to keep carbon removal mechanisms intact. Furthermore, avoided deforestation is key for contributing to climate change mitigation actions. However, for the conservation and protection purpose alone, indigenous practices mustn't be prohibited.

Some areas where indigenous land tenure is hardly guaranteed and where internationally active multinational corporations have sensed a new kind of gold rush, because of the envisaged certificates from avoided carbon emissions have led to practices like forest police forces in e.g. Brazil, where they fine indigenous inhabitants for cutting a single tree (Baez, 2011). Several wrong assumptions are the basis for the misinterpretation of protection. First, indigenous peoples aren't doing it for economic benefits. Second, protection and conservation doesn't mean that no trees must be

lodged. Protection should aim at sustainable forest management and keep practices going, where they should significantly better results than any other efforts to protect tropical rainforests.

The examples from Panama and Nicaragua show quite remarkably what indigenous peoples land tenure can contribute to reforestation or how effective they are in avoiding deforestation. Ecosystem management is an integral part of almost any indigenous knowledge system, because of long-term observations and the dependence on the ecosystem. Despite best efforts to manage sustainably but still follow an economic interest, resource use is much higher in areas which aren't under indigenous tenure. The diligent care for soils, acres, forests but also livestock means that indigenous land use could be made visible by analysing the area in which they are produced and estimate the beneficiaries (Reyers et al., 2013).

So the questions which motivated to research this paper are partially answered. The most basic question, whether Indigenous Knowledge can be seen at all is easily answered. Certainly yes. Panama's rainforest cover analysis, Nicaragua's similarly organised study have proved that areas under indigenous tenure or claimed by them have much denser and higher forest covers than others. The techniques underlying this positive influence have been shown in the other examples. Weather forecast in combination with scientific backup improved agriculture. Peru showed that even without any interference of modern technologies, the traditional land use practices lead to more forest cover, improve agricultural production and most importantly, sustain a significant amount of people. The parameters to look for, which was the intention of this paper, are basically statistical analysis over longer periods of time. There are ways to look into detail whether the soil is better when prepared in e.g. Botswana. Chemical analysis and data to show whether more or less is produced would be another example on how to complement science and indigenous knowledge.

Last, but certainly not least is the question to how to integrate them into environmental agreements. First, it has to be said that they are indeed part of many agreements. What some of them share is the mistake to make them subjects or "servants of conservation". Indigenous peoples aren't a vehicle for modern science or the international community to offload mitigation actions onto their shoulders. Unfortunately, the situation wouldn't even allow that. There is improved respect for those indigenous knowledge systems, but still not enough to trust them and include

them into the financial reward schemes – or at least in limited fashion. Some indigenous tribes certainly don't have any interest in gaining money from their activities they do for a daily living and to sustain them but in order to have a fair compensation regime it would at least be a symbolic gesture to formally accept such contributions. Very often, highly complicated mechanisms in the international system prevent payments because of "certainty" issues, or "responsibility" issues. Despite all reliance on data, the objective data provided by researchers is hesitantly taken up and reviewed over and over again.

More studies shouldn't be conducted to put more hurdles into the path of fully accepting indigenous knowledge. They should rather focus on explaining in a scientific way on how to best utilise the lessons learnt for all people.

Numbers, data, statistics, they're all undoubtedly important. Studies demonstrating the beneficial impacts of indigenous knowledge produce similar results over and over again, but still it is argued that more research is needed. The situation can still be improved, yet a good basis has been created. If the international community is sincere in its attempt to tackle climate change, then indigenous peoples shouldn't be made "servants" for conservation, but rather teachers…

Bibliography

Adams, W.M., 2009. Green development: environment and sustainability in a developing world, 3rd ed. ed. Routledge, London ; New York.

Agrawal, A., Nepstad, D., Chhatre, A., 2011. Reducing Emissions from Deforestation and Forest Degradation. Annu. Rev. Environ. Resour. 36, 373–396. doi:10.1146/annurev-environ-042009-094508

Anderson, J.E., 2015. Indigenous Knowledge and Intellectual Property Rights, in: International Encyclopedia of the Social & Behavioral Sciences. Elsevier, pp. 769–778.

Anseeuw, W., Bending, T., 2012. Land rights and the rush for land: findings of the global commercial pressures on land research project. ILC, Rome.

Baez, S., 2011. Right REDD Framework: National Laws That Best Protect Indigenous Rights in a Global REDD Regime, The. Fordham Rev 80, 821.

Boven, K., Morohashi, J., 2002. Best practices using indigenous knowledge. Nuffic ; UNESCO/MOST, The Hague; Paris.

Cámara-Leret, R., Paniagua-Zambrana, N., Balslev, H., Barfod, A., Copete, J.C., Macía, M.J., 2014. Ecological community traits and traditional knowledge shape palm ecosystem services in northwestern South America. For. Ecol. Manag. 334, 28–42. doi:10.1016/j.foreco.2014.08.019

Cordell, G.A., 2014. Phytochemistry and traditional medicine—The revolution continues. Phytochem. Lett. 10, xxviii–xl. doi:10.1016/j.phytol.2014.06.002

Corntassel, J.J., 2004. The Origins of Indigenism: Human Rights and the Politics of Identity. Soc. Sci. J. 41, 507–509. doi:10.1016/j.soscij.2004.04.017

Danielsen, F., Skutsch, M., Burgess, N.D., Jensen, P.M., Andrianandrasana, H., Karky, B., Lewis, R., Lovett, J.C., Massao, J., Ngaga, Y., Phartiyal, P., Poulsen, M.K., Singh, S.P., Solis, S., Sørensen, M., Tewari, A., Young, R., Zahabu, E., 2011. At the heart of REDD+: a role for local people in monitoring forests?: Local REDD+ monitoring: reliability and cost. Conserv. Lett. 4, 158–167. doi:10.1111/j.1755-263X.2010.00159.x

Díaz, Diogenes, 2015. People of African Descent in Latin America: A one-way-ticket. Equal Times. http://www.equaltimes.org/people-of-african-descent-in-latin?lang=en. (accessed June 10, 2015)

Den Besten, J.W., Arts, B., Verkooijen, P., 2014. The evolution of REDD+: An analysis of discursive-institutional dynamics. Environ. Sci. Policy 35, 40–48. doi:10.1016/j.envsci.2013.03.009

De Sassi, C., Joseph, S., Bos, A.B., Duchelle, A.E., Ravikumar, A., Herold, M., 2015. Towards integrated monitoring of REDD+. Curr. Opin. Environ. Sustain. 14, 93–100. doi:10.1016/j.cosust.2015.04.003

DeVries, B., Avitabile, V., Kooistra, L., Herold, M., 2012. Monitoring the impact of REDD+ implementation in the UNESCO Kafa biosphere reserve Ethiopia. Sens. Chang. World.

Eligio, A.M.J.E., 2012. Communication imperatives for indigenous peoples' representation in policy making: Lessons from the IPRA (Indigenous Peoples Rights Act) experience. Telemat. Inform. 29, 324–334. doi:10.1016/j.tele.2011.10.004

Ellison, D., Lundblad, M., Petersson, H., 2014. Reforming the EU approach to LULUCF and the climate policy framework. Environ. Sci. Policy 40, 1–15. doi:10.1016/j.envsci.2014.03.004

Ens, E.J., Pert, P., Clarke, P.A., Budden, M., Clubb, L., Doran, B., Douras, C., Gaikwad, J., Gott, B., Leonard, S., Locke, J., Packer, J., Turpin, G., Wason, S., 2015. Indigenous biocultural knowledge in ecosystem science and management: Review and insight from Australia. Biol. Conserv. 181, 133–149. doi:10.1016/j.biocon.2014.11.008

Food and Agricultural Organisation, 2014. Voluntary Redd+ Database. http://www.fao.org/forestry/vrd/by/funders#introduction (Accessed June 7, 2015)

German, L., Schoneveld, G., Mwangi, E., 2013. Contemporary Processes of Large-Scale Land Acquisition in Sub-Saharan Africa: Legal Deficiency or Elite Capture of the Rule of Law? World Dev. 48, 1–18. doi:10.1016/j.worlddev.2013.03.006

Grenier, L., 1998. Working with indigenous knowledge: A guide for researchers. IDRC.

Hanna, P., Vanclay, F., Langdon, E.J., Arts, J., 2014. Improving the effectiveness of impact assessment pertaining to Indigenous peoples in the Brazilian environmental licensing procedure. Environ. Impact Assess. Rev. 46, 58–67. doi:10.1016/j.eiar.2014.01.005

Hayes, T.M., Murtinho, F., 2008. Are indigenous forest reserves sustainable? An analysis of present and future land-use trends in Bosawas, Nicaragua. Int. J. Sustain. Dev. World Ecol. 15, 497–511. doi:10.1080/13504500809469845

Hiwasaki, L., Luna, E., Syamsidik, Shaw, R., 2014. Process for integrating local and indigenous knowledge with science for hydro-meteorological disaster risk reduction and climate change adaptation in coastal and small island communities. Int. J. Disaster Risk Reduct. 10, 15–27. doi:10.1016/j.ijdrr.2014.07.007

Hvalkof, S., 2013. Imperatives for REDD+ Sustainability. Non-Carbon Benefits, local and indigenous peoples. International Work Group for Indigenous Affairs, Copenhagen.

IWGIA, 2014. Case Study on non-carbon benefits and indigenous- and local community practices - Titling of Indigenous Territories protects and increases tropical forest cover in the Peruvian Amazon. International Work Group for Indigenous Affairs, Copenhagen.

IWGIA, 2012. Drivers of Deforestation? Facts to be considered regarding the impact of shifting cultivation in Asia. International Work Group for Indigenous Affairs, Copenhagen.

Jackson, S., Finn, M., Scheepers, K., 2014. The use of replacement cost method to assess and manage the impacts of water resource development on Australian indigenous customary economies. J. Environ. Manage. 135, 100–109. doi:10.1016/j.jenvman.2014.01.018

Kalanda-Joshua, M., Ngongondo, C., Chipeta, L., Mpembeka, F., 2011. Integrating indigenous knowledge with conventional science: Enhancing localised climate and weather forecasts in Nessa, Mulanje, Malawi. Phys. Chem. Earth Parts ABC 36, 996–1003. doi:10.1016/j.pce.2011.08.001

Lea, T., 2005. The work of forgetting: Germs, aborigines and postcolonial expertise in the Northern Territory of Australia. Soc. Sci. Med. 61, 1310–1319. doi:10.1016/j.socscimed.2005.01.020

Litfin, K. (Ed.), 1998. The greening of sovereignty in world politics, Global environmental accord. MIT Press, Cambridge, Mass.

Lyster, R., 2011. REDD+, transparency, participation and resource rights: the role of law. Environ. Sci. Policy 14, 118–126. doi:10.1016/j.envsci.2010.11.008

Maraseni, T.N., Neupane, P.R., Lopez-Casero, F., Cadman, T., 2014. An assessment of the impacts of the REDD+ pilot project on community forests user groups (CFUGs) and their community forests in Nepal. J. Environ. Manage. 136, 37–46. doi:10.1016/j.jenvman.2014.01.011

Moller, H., Berkes, F., Lyver, P.O., Kislalioglu, M., 2004. Combining science and traditional ecological knowledge: monitoring populations for co-management. Ecol. Soc. 9, 2.

Motsumi, S., Magole, L., Kgathi, D., 2012. Indigenous knowledge and land use policy: Implications for livelihoods of flood recession farming communities in the Okavango Delta, Botswana. Phys. Chem. Earth Parts ABC 50-52, 185–195. doi:10.1016/j.pce.2012.09.013

Nakashima, D.J., United Nations University, Traditional Knowledge Initiative, Unesco, 2012. Weathering uncertainity: traditional knowledge for climate change assessment and adaptation. UNESCO ; UNU-IAS, Paris; Darwin.

Nkomwa, E.C., Joshua, M.K., Ngongondo, C., Monjerezi, M., Chipungu, F., 2014. Assessing indigenous knowledge systems and climate change adaptation strategies in agriculture: A case study of Chagaka Village, Chikhwawa, Southern Malawi. Phys. Chem. Earth Parts ABC 67-69, 164–172. doi:10.1016/j.pce.2013.10.002

Pedroni, L., Dutschke, M., Streck, C., PorrúA, M.E., 2009. Creating incentives for avoiding further deforestation: the nested approach. Clim. Policy 9, 207–220. doi:10.3763/cpol.2008.0522

Primeau, T.H., Corntassel, J., 1995. Indigenous“ Sovereignty” and International Law: Revised Strategies for Pursuing“ Self-Determination.” Hum. Rights Q. 17, 343–365.

Radulović, N.S., Randjelović, P.J., Stojanović, N.M., Cakić, N.D., Bogdanović, G.A., Živanović, A.V., 2015. Aboriginal bush foods: A major phloroglucinol from Crimson Bottlebrush flowers (Callistemon citrinus, Myrtaceae) displays strong antinociceptive and anti-inflammatory activity. Food Res. Int. doi:10.1016/j.foodres.2015.02.023

Reyers, B., Biggs, R., Cumming, G.S., Elmqvist, T., Hejnowicz, A.P., Polasky, S., 2013. Getting the measure of ecosystem services: a social–ecological approach. Front. Ecol. Environ. 11, 268–273. doi:10.1890/120144

Robinson, B.E., Holland, M.B., Naughton-Treves, L., 2014. Does secure land tenure save forests? A meta-analysis of the relationship between land tenure and tropical deforestation. Glob. Environ. Change 29, 281–293. doi:10.1016/j.gloenvcha.2013.05.012

Sanders, D., 1989. The UN Working Group on Indigenous Populations. Hum. Rights Q. 11, 406. doi:10.2307/762100

Schielmann, S., 2013. Waldschutzvorhaben im Rahmen der Klimapolitik und die Rechte indigener Völker. Institut für Ökologie und Aktions-Ethnologie, Köln.

Serna-Chavez, H.M., Schulp, C.J.E., van Bodegom, P.M., Bouten, W., Verburg, P.H., Davidson, M.D., 2014. A quantitative framework for assessing spatial flows of ecosystem services. Ecol. Indic. 39, 24–33. doi:10.1016/j.ecolind.2013.11.024

Swazo, N.K., 2005. Research integrity and rights of indigenous peoples: appropriating Foucault's critique of knowledge/power. Stud. Hist. Philos. Sci. Part C Stud. Hist. Philos. Biol. Biomed. Sci. 36, 568–584. doi:10.1016/j.shpsc.2005.07.006

Timmermans, K., 2003. Intellectual property rights and traditional medicine: policy dilemmas at the interface. Soc. Sci. Med. 57, 745–756.

Toensing, G.J., World Conference Controversy at UN Permanent Forum. Indian Country - Today Media Network.com. http://indiancountrytodaymedianetwork.com/2014/05/09/world-conference-controversy-continues-un-permanent-forum-154807?page=0%2C1 (accessed June 10, 2015)

UNFCCC 2014. Submission by the International Work Group for Indigenous Affairs. http://unfccc.int/resource/docs/2014/smsn/ngo/405.pdf (accessed June 7, 2015)

UNFCCC, 1992. United Nations Framework Convention on Climate Change

United Nations Department of Economic and Social Affairs, 2004. The concept of Indigenous Peoples. PFII/2004/WS.1/3 and E/CN.4/Sub.2/1986/Add.4

United Nations General Assembly, 2002. Permanent Forum on Indigenous Issues. A/RES/57/191

Vergara-Asenjo, G., Potvin, C., 2014. Forest protection and tenure status: The key role of indigenous peoples and protected areas in Panama. Glob. Environ. Change 28, 205–215. doi:10.1016/j.gloenvcha.2014.07.002

Zerbe, N., 2005. Biodiversity, ownership, and indigenous knowledge: Exploring legal frameworks for community, farmers, and intellectual property rights in Africa. Ecol. Econ. 53, 493–506. doi:10.1016/j.ecolecon.2004.10.015

List of Figures

Figure 1 – Map of Chikhwawa District in Southern Malawi (Nkomwa et al., 2014) .. 36
Figure 2 – Indigenous territories and claimed lands (Vergara-Asenjo and Potvin, 2014) 41
Figure 4 – zone plan of indigenous territories in analysed areas (Hayes and Murtinho, 2008) 45