Propagating a Sustainable Model for Adaptive Forest Management; and Integration of Indigenous Knowledge Systems

By
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Introduction:

In the debates over climate change, significant issues have brought greater attention to the current lifestyles in many countries, resulting in the promotion of more sustainable livelihoods. These include the use of natural resources around the world, and how much human development depends on them. Additionally, there is the need to help prevent the loss of biodiversity - one of the largest sources being tropical forests.[1] The largest devastation of this resource is the active deforestation done in developing countries.[2] There is a growing call to action for the altering in current forest management systems with a shift to more sustainable methods. This has resulted in a need to look in depth at the indigenous communities which have been living in the forests for thousands of years.

The call for a renewed emphasis on local community knowledge supersedes the current capitalist-driven development and exploitive policies which have contributed to the current changing climate.[3]The loss of important carbon sinks, coupling with the growing loss of biodiversity within tropical forests, has promoted an even greater deal of attention on the need to mediate a change in current practices. However, there are significant limitations on the

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[1] Gordon B. Bonan, "Forests and Climate Change: Forcings, Feedbacks, and the Climate Benefits of Forests", *AAAS Science Magazine* 320 (June, 2008): 1444-49. Accessed September 20, 2015. doi: 10.1126/science.1155121

[2] Ruth DeFries, et. al. "Earth observations for estimating greenhouse gas emissions from deforestation in developing countries." *Environmental Science and Policy* 10 (June, 2007): 385-94. Accessed September 21, 2015. doi: 10.1016/j.envsci.2007.01.010

[3] Naomi Klein. "Capitalism vs. the Climate" *Global Policy Forum.* November 17, 2011. Accessed October 2, 2015. https://www.globalpolicy.org/social-and-economic-policy/the-environment/climate-change/51038-capitalism-vs-the-climate.html?itemid=id#986

actual use of local knowledge. The question is: what factors prevent the use of indigenous knowledge systems of adaptive forest management? In order to begin to answer this we must consider the following three factors: indigenous groups' capability for mobilization, their distance from dominant discourse, and economic disparities. In studying the cases of mobilization, one is able to examine these groups' organizational efforts and the level of activity of their communities within national borders. Since indigenous communities have remained distant from dominant discourse, it is important to analyze the importance of epistemological factors that contribute to the limitations of indigenous knowledge systems (IKS). Seeing as these are typically isolated communities, the exploration of their land and geospatial characteristics need to be studied to see what physical boundaries are placed between them and centers of internationally recognized governance. Lastly, looking into economic disparities and motivations gives a cultural consideration of value (typically monetarily driven), which influences motives for the use of resources.

Since it is widely considered that indigenous groups' knowledge systems and practices are often the most conservative and sustainable, it is important to study the application of their methods.[4] Current media stories litter news outlets with the misfortune of indigenous peoples due to a loss of habitat, a lack of representation, and cultural isolation. Although these all have some truth, this popular discourse to view indigenous groups as victims of global warming, as powerless to influence political decisions, or as agents with limited political rights is misguided. The focus needs to instead be on indigenous knowledge, which could better aid developed and developing countries to sustainably guide their actions - especially in regards to forest

[4] Shengji Pei, et. al. "Application of traditional knowledge in forest management: Ethnobotanical indicators of sustainable forest use", *Forest Ecology and Management* 257 (30 April, 2009): 2017-21. Accessed September 18, 2015. doi: 10.1016/j.foreco.2009.01.003

management. While understanding the value in their knowledge, there is also a need to seek the limitations that do not allow for their techniques to be applied to current forestry practices.

It is significant to change the common discourse to one that utilizes a finite resource in a more effective way that enables it to replenish itself. Essential roles for forests include, but are not limited to, carbon sequestration, medicinal discoveries, and habitats for extremely diverse groups of flora and fauna.[5] Research on conservation and sustainable use of forests, through the renewal of methods such as agroforestry, has resulted in a rekindling of past indigenous knowledge systems on forest management.[6] Initiatives by governments geared towards developing sustainably have to include innovative methods of adaptive co-management. In order to do this there needs to be a utilization of indigenous knowledge.

This is not to argue that the world needs to go back to only using traditional methods of resource management - which is not a viable solution given the length of time and incredible periods of transition towards industrial development that would make it an impossibility - instead there should be a blending of knowledge systems toward adaptive co-management of resources. The overarching goal is to adapt current 'conventional' development occurring globally, towards a more ecological and socially equitable use of resources. In order to do this we have to include indigenous communities as they have shown by example that there are applicable subsistent and sustainable ways of adapting within local ecosystems without degrading them.

The selected case study to explore this research question will involve an in depth look into Mexico, particularly its southern Chiapas region. There will be an emphasis placed on the

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[5] Florencia Montagnini, and Carl F. Jordan. *Tropical Forest Ecology: The Basis for Conservation and Management.* Berlin, Germany: Springer-Verlag Berlin Heidelberg, 2005.

[6] B. Thapa, et. al. "Incorporation of indigenous knowledge and perspectives in agroforestry development" *Agroforestry Systems* 30 (1995): 249-261. Accessed September 20, 2015.

Maya Lacandon management systems,[7] and the traditional ecological knowledge (TEK) education within these indigenous communities.[8] Community forestry and timber smuggling are both elements to highlighting economic disparities as well as cultural values of worth. Particular attention is put on the multiple use strategy of agroforestry as an initiated practice within the Chiapas region; providing new alignments for co-habitation and the ability to combine knowledge systems into the management of forests.[9] It is also important to acknowledge the "indigenous uprising" in the 1990s within the Zapatista Rebellion,[10] to which a historical reference will allow one to measure the accomplishments and failures in mobilization as well as evaluate elements of governance.

The outline for this paper will include an introduction explaining the choice of forest management over other adaptive management varieties - this explanation will link to the impact of climate change and the need to re-evaluate our developmental practices through a promotion of sustainability. This will lead to an introduction of the research question regarding the impacts of indigenous knowledge systems of forest management, as well as the importance of shifting away from the victimization discourse. Following this, a literature review breaking down key concepts and terms related to this paper's topic will be used to explain the barriers IKS face. Selected cases of Indonesia and Mexico will then be used to validate the limitations for the use of indigenous forest management systems which have not been able to be practiced.

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[7] Stewart A. W. Diemont. "Ecosystem Management and Restoration as Practiced by the Indigenous Lacandon Maya of Chiapas, Mexico." PhD diss., Ohio State University, 2006. http://0-search.proquest.com.opac.sfsu.edu/docview/305294927?accountid=13802.

[8] Tomas B. Falkowski, "An Emergy Evaluation of Labor Transformities Incorporating Traditional Ecological Knowledge of Agroforestry in Lacanja Chansayab, Chiapas, Mexico." MA thesis., State University of New York College of Environmental Science and Forestry, 2014.

[9] Lorena Soto-Pinto, et. al. "Carbon sequestration through agroforestry in indigenous communities of Chiapas, Mexico." *Agroforestry Systems* 78 (January 2010): 39-51. Accessed September 17, 2015. doi: 10.1007/s10457-009-9247-5.

[10] David Maybury-Lewis. *Indigenous Peoples, Ethnic Groups, and the State.* Massachusetts: Allyn and Bacon, 2002.

These factors will then be stated with each case followed by a comparison of the two in the analysis. Lastly, a conclusion to sum up the essential findings and an answer to the proposed research question will be given.

Background:

The issue of sustainable development has grown in relevance over the last few decades.[11] Therefore, understanding exactly what sustainable development should characterize is important if there is to be a discussion on adaptive management systems. The most basic fundamental definition of sustainable development came from the Brundtland Report in 1987 from the United Nations stating; "development which meets the needs of the present without compromising the ability of future generations to meet their own needs."[12] Following this is the emphasis placed on the 'three pillars of sustainability' - also referred to as the 'triple bottom line' - they are; economy, ecology, and equity.[13] This particular research question falls most heavily in the importance of ecology - in that of the forest environments - and the social equity components - the indigenous groups' livelihoods and knowledge systems.

The choice in focusing on forest management over other potential resources was strategic in that its literature is not focused on the extreme socio-political conflicts emphasized in other resource managements such as agriculture. The idea was to instead use a resource that would aid in establishing a narrative that focused on the limitations of the incorporation of indigenous knowledge regarding this specific resource. Although still political, it supports case

[11] John Drexhage and Deborah Murphy. "Sustainable Development: From Bundtland to Rio 2012", *United Nations.* September 2010. Accessed September 27, 2015. http://www.un.org/wcm/webdav/site/climatechange/shared/gsp/docs/GSP1-6_Background%20on%20Sustainable%20Devt.pdf
[12] Ibid.
[13] Paulette L. Stenzel. "Sustainability, the Triple Bottom Line, and the Global Reporting Initiative", *Global Edge.* 2010. Accessed September 27, 2015. https://globaledge.msu.edu/content/gbr/gbr4-6.pdf

studies that aim to promote an alternative story that aligned more to the integration of knowledge systems in adaptive co-management, rather than activism and rights focuses.

Knowing that forest ecosystems are vulnerable to the anticipated changes in climate conditions due to global warming, there has been a call for action to occur in the present.[14] Forest adaptation strategies must include adjustments in not only economic systems, but also ecological and social systems.[15] In order to cope with the coming changes, precautionary principles for future climate and forest vulnerability have warranted increased innovation. This must include the incorporation of new and old knowledge from multifaceted groups to develop a dialogue within the forest management community.[16] Introducing and breaking down a newer discourse of understanding local communities value within their "continuous process of adaptation" of forest management,[17] enables a growth in sustainable methods that can potentially be applied to larger contexts. This will not only create a greater sense of community activism, but increase the range of options and evaluation of effectiveness of new sustainable management plans.

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[14] Gian-Reto Walther, et al. "Ecological responses to recent climate change." Nature 416 (28, March 2002): 389-39

Robert B. Stewart, and David L. Spittlehouse. "Climate Change: implications for the boreal forest." In Emerging air issues for the 21st century: the need for multidisciplinary management. Pittsburgh, Pennsylvania: Air and Waste Management Association, 86-101, 1998.

[15] Barry Smit, et al. "An anatomy of adaptation to climate change and variability." Climate Change 45 (2000): 223-251.

Barry Smit and Olga Pilifosova. "Adaptation to climate change in the context of sustainable development and equity." In Climate change 2001: impacts, adaptation, and vulnerability.(2001) New York: IPCC, Cambridge University Press, 876-912

[16] David L. Spittlehouse and Robert B. Stewart. "Adaptation to climate change in forest management." *BC Journal of Ecosystems and Management* 4 (November 1, 2003): 1-11.

[17] Prateep Kumar Nayak. "Building Knowledge and Facilitating Learning through Adaptive Community Forest Management", *International Association for the Study of Common Property* August, 2004. Accessed September 15, 2015.

Literature Review:

The Integration of Knowledge

Managing ecosystem services requires information of complex social-ecological systems so that informed decisions can be made in determining allocations of resources, and monitoring of their availability.[18] Through the literature of co-management and adaptive management, it is fair to conclude that power-sharing, institution and trust building, as well as knowledge generation, is key to the collaboration of problem-solving. This "'co-production of knowledge' [is] working from the premise that knowledge is a dynamic process… [it] opens up the possibility for researchers to establish relationships with indigenous peoples as co-producers of locally relevant knowledge."[19] Building these relationships through the integration of knowledge from different scales has to include typically isolated local communities which have developed generational applied resource management systems. The importance of which was stated in the United Nations Declaration on the Rights of Indigenous Peoples as "recognizing that respect for indigenous knowledge cultures and traditional practices contributes to sustainable and equitable development and proper management of the environment."[20]

Indigenous knowledge systems (IKS)[21], and traditional ecological knowledge (TEK),[22] are both terms that are closely related to each other. They do however differ in that IKS is more of a sociological, all-encompassing term that derives from the specific cultural indigenous groups, and TEK is specifically ecological in that generational knowledge is applied. IKS and

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[18] Fikret Berkes et al., 2003. *Navigating Social–ecological Systems: Building Resilience for Complexity and Change.* Cambridge: University Press 2003.
[19] Ian J. Davidson-Hunt, and Michael O'Flaherty. "Researchers, indigenous peoples and place-based learning communities." *Society and Natural Resources* 20 (2007): 291-305.
[20] *United Nations Declaration on the Rights of Indigenous Peoples.* United Nations: 1-15, March 2008.
[21] B. Rajasekaran, and D. M. Warren. "Indigenous natural-resource management systems for sustainable agricultural development - A global perspective" Journal of International Development 3 (1991): 387-401.
[22] Falkowski, "An Emergy Evaluation of Labor"

TEK will both be used to connect to the practice and study of agroforestry, a method of land management where agricultural practices enable simultaneous conservation and growing of trees.[23]

The integration of TEK means respecting the valuing of forests beyond the political and economic values prescribed with the current resource management systems in most countries. As Neil Byron and Michael Arnold wrote, "for millions of people living in forest environments, the forest forms such a dominant part of their physical, material, economic, and spiritual lives that its importance is not most appropriately described and assessed in terms of the individual products or services that the forest provides."[24] This statement can connect to adaptive strategies aiming to increase human well-being while simultaneously aiding long-term ecological integrity.[25] This in turn connects to the large social component in effective adaptive co-management. Adaptive capacity within social systems is a means to learn from mistakes[26] and garner these experiences to deal with the change that will be brought in coming decades due to climate change. This change in current practices ultimately depends on the ability of individuals and social networks to innovate solutions of anticipated problems of social-ecological systems.[27]

The greater exploration of the types of adaptive communities helps to differentiate levels of mobilization and activity amongst various actors; the three general categories being

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[23] Joseph D. Cornell, "Agroforestry." *The Encyclopedia of Earth*, September 8, 2014. Accessed September 19, 2015. http://www.eoearth.org/view/article/149916/

[24] Neil Byron and Michael Arnold. "What Futures for the People of the Tropical Forests?" *World Development* 27 (1999): 789-805.

[25] Nayak. "Building knowledge and facilitating learning"

[26] Neil Adger. "Social aspects of adaptive capacity." In *Climate change, adaptive capacity and development*. (2003) London, UK: Imperial College Press, 29-49.

[27] Armitage. "Adaptive capacity"

'powerless spectator, 'coping actor', and 'adaptive manager'.[28] Being able to measure levels of mobilization is a critical factor in determining effective roles of organized indigenous groups. Through this analysis, one can pin-point flaws and strengths in actions taken in individual cases that have allowed or prevented a greater promotion of IKS and TEK. The overarching goal is to develop a system of management that enables a horizontal integration of knowledge amongst governance and local communities.

A 'powerless spectator' has both a weak adaptive capacity as well as little to no capacity to govern.[29] Most narratives of indigenous communities place them in this category, [30]although a consistent determining factor in the creation of this powerlessness has been derived from inappropriate outside intervention.[31] Consequently these communities are left without neither financial nor political networks to empower themselves against other influences. Conversely 'coping actors' do not manage their social-ecological systems in a sustainable and adaptive way, even though they have the means to. These include predominantly urbanized areas with the financial capital, infrastructure and technology to deal with changing climate impacts and resource management,[32]who continue, however, to enact responses in the short term "fixes" and contribute to exploitive policies for commercial gain. Therefore, it is not surprising that findings in this particular category have shown a trend of TEK being very well developed for

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[28] Christo Fabricius, et al. "Powerless Spectators, Coping Actors, and Adaptive Co-managers: a Synthesis of the Role of Communities in Ecosystem Management" *Ecology and Society* 12 (2007): 29. Accessed September 18, 2015.
[29] Fabricius, et al. "Powerless Spectators, Coping Actors, and Adaptive Co-managers"
[30] Carl Folke, et al. "Communities, ecosystems and livelihoods." Ecosystems and human well-being: multiscale assessments 4 (2005a): 261-77.

Dawn Chatty and Marcus Colchester. *Conservation and mobile indigenous peoples: displacement, forced settlement and sustainable development*. Oxford, UK: Bergahn Press, 2002.
[31] Fabricius, et al. "Powerless Spectators, Coping Actors, and Adaptive Co-managers"
[32] Reinette Biggs, et al. Nature supporting people: The Southern African Millennium Ecosystem Assessment integrated report. Pretoria, South Africa: CSIR, 2004.

locating and extracting resources in ecologically sound ways, but have not been utilized.[33] Ultimately the goal for these previous two groups is to become 'adaptive co-managers'. This empowered group has "both the capacity to adapt and the governance capacity to sustain and internalize this adaptation in the long term."[34] Long-term investment in resource management stems from communities who not only recognize threats to their ecosystems, but also plan for sustainable action for their present and future well-being.[35]

The Progression to Adaptive Co-Management Systems

Before we are able to study indigenous knowledge systems regarding adaptive forest management there needs to be a coherent understanding of key concepts related to this research question. Co-management is the sharing of power and responsibility between the state governments and local community resource users over natural resources.[36] The importance of collaboration between local and government narratives stems from the sharing of knowledge which benefits all participants. Fikret Berkes writes on the evolution of co-management where he discusses multiple facets of co-management such as; power sharing, institution building, trust and social capital, as a process, problem solving, and governance.[37] The variety of lenses

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[33] Hector Magome and Christo Fabricius. "Reconciling biodiversity conservation with rural development: the holy grail of CBNRM?" In *Rights, resources and rural development: community-based natural resource management in southern Africa*. (2004) London, UK: Earthscan, 93-114.

[34] Fabricius, et al. "Powerless Spectators, Coping Actors, and Adaptive Co-managers"

[35] Per Olsson, et al. "Adaptive comanagement for building resilience in social-ecological systems." *Environmental Management* 34 (2004a): 75-90.

Stephan Barthel, et al. "History and local management of a biodiversity-rich, urban cultural landscape." *Ecology and Society* 10 (2005): 10.

[36] Evelyn Pinkerton. *Co-operative management of local fisheries: New directions for improved management and community development.* Vancouver: UBC Press,1989a.

[37] Fikret Berkes. "Evolution of co-management: Role of knowledge generation, bridging organizations and social learning." *Journal of Environmental Management* 90 (2009): 1692-1702. doi: 10.1016/j.jenvman.2008.12.001.

for this concept shows the complexity of adaptive systems, with numerous perspectives and epistemologies, uncertainties and issues of scale.[38]

While there is an important social-ecological frame of co-management, it is equally prudent to address the emergence of a knowledge partnership. This partnership shows a value to looking beyond the focus of governance as a single driving factor of resource management, and instead to the more complex levels of a public-private-civil society engagement. In order to reach equitable solutions, the initiative of regular building and application of effective dialogue requires an increase in knowledge sharing, and institution building.[39] By doing this, the interaction and feedback between government policy makers and local institutions in congruence with a growth in networking activity, benefits effective co-management through the production of favorable policy environments.[40] With the increase in institution building, the trust between various parties negotiating needs on behalf of their communities as well as the emphasis on social capital grows. As Berkes stated, "trust appears to be a determinant of success in many cases of co-management, as a prelude to building a working relationship".[41] Social capital can be understood as the value of the perceived legitimacy of the parties involved in the practice of co-management.[42] This means to put equitable value on the various actors, organizations, and institutions, working together to meet common goals from independent points of view, which all weigh options that deviate from personal interests and promotes trust in all who participate.

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[38] Fikret Berkes. "Adaptive co-management and complexity: exploring the many faces of co-management," in *Adaptive Co-Management,* Ed. D. Armitage et al (British Columbia Press), 19-37.
[39] Grazia Borrini-Feyerabend et al., *Sharing Power. Learning by doing in co-management of natural resources throughout the world.* Cenesta, Tehran: IIED and IUCN, 2004.
[40] Derek Armitage et al. "Adaptive co-management and the paradox of learning." *Global Environmental Change* 18 (2008): 86–98.
[41] Fikret Berkes. "Evolution of co-management"
[42] Gary Kofinas, et al. "Novel problems require novel solutions: innovation as an outcome of adaptive co-management." in Adaptive Co-Management, ed. D. Armitage et al. (Vancouver: University of British Columbia Press, 2007), 249-267.

The process of sharing management rights and responsibilities emerges from extensive negotiations and is therefore path dependent. This means that there is a constant evolving nature over time due to the influence of history in each case,[43] as well as the changing relationships between local institutions and government policies.[44] Governance involving diverse public and private actors who seek multiple connections across social and political domains, helps promote co-management insofar of increased participation in problem solving with overlapping centers of authority. Local institutions include bridging organizations who act as facilitators between levels of governance and local resource knowledge systems.[45] These organizations can be taken in the form of nongovernmental organizations, or government agencies which act to build trust with involved groups or parties, increasing access to much needed resources, and aligning a common set of shared goals.

An understanding of adaptive management can be used to explain it as a means of developing a strategy for the anticipation of and methodological innovation for resource management.[46] Adaptive management complements co-management, as it requires collaborative processes in order to reach agreements between a multitude of participants. A simplified explanation is to describe it as a process of learning-by-doing.[47] Both management types evolves towards a common ground, since adaptive management without collaboration lacks legitimacy, and co-management without learning-by-doing does not develop the ability to

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[43] Ratana Chuenpagdee, and Svien Jentoft. "Step zero for fisheries co-management: what precedes implementation." *Marine Policy* 31 (2007): 657–668.
[44] Evelyn Pinkerton. "Translating legal rights into management practice: overcoming barriers to the exercise of co-management." *Human Organization* 51 (1992): 330–341.
[45] Carl Folke, et al."Adaptive governance of social- ecological systems." *Annual Review of Environment and Resources* 30 (2005): 441–473.
[46] Kai N. Lee. *Compass and gyroscope: Integrating science and politics for the environment.* Washington, DC: Island Press, 1993.
C. S. Holling. *Adaptive Environmental Assessment and Management.* New York: John Wiley & Sons, 1978.
Carl Walters. *Adaptive Management of Renewable Resources.* New York: Macmillan, 1986
[47] Berkes, "Evolution of co-management,"1692-1702.

address emerging problems. Discussions regarding current management practices often come to the conclusion that they exacerbate impacts from issues on climate change.[48] Adaptive approaches geared towards collective solutions that will avoid the current top-down resource management failures, has elicited a need for collaborative adaptive management.[49] The social learning feature of this learning-by-doing,[50] contributes to an iterative practice of evaluation and modification of actions.[51] Therefore, this learning-as-process narrative combines elements of both adaptive management and co-management practices.

Innovative techniques of co-management and adaptive management are dependent upon a set of facilitating conditions.[52] One must to take into account the role of social networks in promoting new ways of management, while preparing for the potential consequences of both negative and positive interactions with multiple stakeholders and parties negotiating to work together.[53] Innovation within resource management can range from the institutional level to the operational level. Both are dependent on social capital and common interest to work towards a shared goal. Socio-ecological monitoring is a crucial component for any adaptive

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[48] Philip E. Hulme. "Adapting to climate change: is there scope for ecological management in the face of a global threat?" *Journal of Applied Ecology*, 42 (2005): 784-794.
[49] Gary Kofinas, et al. "Novel problems require novel solutions," 249-267.
[50] Carl Folke, et al. "Resilience for sustainable development: building adaptive capacity in a world of transformations." in Rainbow Series 3. International Council for Scientific Unions (ICSU): Paris
Derek Armitage, et al. Adaptive Co-Management: Collaboration, Learning, and Multi-level Governance. Vancouver: University of British Columbia Press (2007)
[51] K.N. Lee. *Compass and gyroscope*, 1993.
C. S. Holling. *Adaptive Environmental Assessment and Management,* 1978.
[52] Evelyn Pinkerton. "Introduction: Attaining better fisheries management through co-management - prospects, problems, and propositions." In Co-operative management of local fisheries: New directions for improved management and community development. Vancouver: UBC Press, 3-33, 1989b.
[53] Everett Rogers. *Diffusion of innovations.* New York: Free Press, 2003.

management program[54] as it builds social networking. This inclusion comprises a societal gathering of local observers, monitors and activists that participate in ecological stewardship.

Adaptive co-management is an innovative process in which "local communities and resource management agencies together generate, implement, and experiment with novel solutions to regional problems".[55] This concept of adaptive collaborative management is to create an approach that constantly adds value from people who agree to work together to prepare, observe, and learn from their resource management plans.[56] The overarching methodology for adaptive co-management is increasing understanding about the management of resources and communities throughout the course of actions which have evolved over time.

Epistemology, Seclusion, and Underrepresentation

The use of indigenous knowledge is prudently needed in order for successful adaptive co-management resource systems, which begs the question of why large parts of the world have decided not to utilize IKS. Even historically there has been literature that depicts collaborative management as partnership arrangements for areas of implementation of indigenous land and resource claims.[57] There have also been specific cases of forest management with community-government partnerships in the 1920s in India[58], and Kenya in the 1930s.[59] Despite these cases however; the co-management of resources between indigenous groups and state government managing bodies are few and far between. The previously studied literature and theory

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[54] Gary Kofinas, et al. "Community contributions to ecological monitoring: Knowledge co-production in the US-Canada Arctic borderlands." In The earth is faster now: Indigenous observations of Arctic environmental change, 54-91. Fairbanks: ARCUS, 2002a.
[55] G.P. Kofinas, et al. "Novel problems require novel solutions," 249-267.
[56] "Adaptive Collaborative Management Can Help Us Cope With Climate Change" *Center for International Forestry Research* 3 (2008): 2.
[57] Fikret Berkes, et al. "Co-management." *Alternatives* 18 (1991): 12-18
[58] Arun Agrawal. *Environmentality: Technologies of Government and the Making of Subjects.* Durham, London: Duke University Press, 2005.
[59] Alfonso Peter Castro and Erik Nielsen. "Indigenous people and co-management: implications for conflict management." Environmental Science and Policy 4 (2001): 229-239

emphasizing the trust between involved parties[60] and social capital,[61] places these factors as important prerequisites for successful adaptive co-management, which is easily applicable to the inclusion of indigenous groups.

The integration of indigenous knowledge to current western driven practices largely follows problematic narratives. As John Briggs states, "western science and indigenous knowledge are represented as two different, competing knowledge systems, characterized by a binary divide, a divide arguably evolving out of the epistemological foundations of the two knowledge systems."[62] For indigenous knowledge, distance from dominant discourse has become a detrimental factor to perceived importance and validity when it comes to determining the use of one epistemological system over the other. Bringing together western science and TEK is challenging due to several reasons. Scientists and government managers typically do not trust local knowledge. This is due to the notion that any inherently factual knowledge needs to be scientifically testable in a formal sense in order for it to be accepted as valid.[63]

The emphasis placed on the need for empirical and recorded proof of applied techniques[64] draws away from a deeper socio-cultural understanding of IKS. Consequently, the implied generational knowledge that is undocumented is seen as too difficult to make

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[60] Sara Singleton. Constructing Cooperation: the Evolution of Institutions of Comanagement. Michigan: University of Michigan Press, 1998
Joan Eamer. "Keep it simple and be relevant: the first ten years of the Arctic Borderlands Ecological Knowledge Co-op." In Bridging Scales and Knowledge Systems. (2006) Washington DC: Millennium Ecosystem Assessment and Island Press, 185-206.

[61] Jules Pretty and Hugh Ward. "Social capital and the environment." World Development 29 (2001): 209-227.
Ryan Plummer and John FitzGibbon. "Connecting adaptive co-management, social learning, and social capital through theory and practice." In Adaptive Co-Management. (2007) Vancouver: University of British Columbia Press, 38-61.

[62] John Briggs. " The use of indigenous knowledge in development: problems and challenges." *Progress in Development Studies* 5 (2005): 99-114.

[63] Ibid.

[64] Ilan Kapoor. "The devil's in the theory: a critical assessment of Robert Chambers' work on participatory development." *Third World Quarterly* 23 (2002): 101-17.

comprehendible to government managers.[65] The ability to build trust and develop mutual respect can take decades[66], and even then does not guarantee success for collaboration.[67] Bridging this gap requires organizations who become facilitators for levels of governance and local resource knowledge systems.[68] As stated previously, these bridging organization's networks not only helps build trust with involved groups, but also increases access to needed resources with alignment of commonly shared goals.

With indigenous groups specifically, knowledge stems from a different worldview than that of western science and therefore has its own distinct set of rules and application processes.[69] The oversimplification of IKS is an additional issue; because indigenous knowledge is not 'problematized' in the sense of internal power relations or unequal distribution (especially concerning gender differences), it is portrayed as a benign and simple knowledge that is waiting to be tapped into.[70] This shows that in order to integrate TEK there has to be a true study of the indigenous knowledge systems with the appropriate amount of time and effort for proper research in understanding its complexities. Without this deeper understanding, IKS would provide useless since it could never be applied as an adaptive integrated knowledge system as that would require a more thorough and accurate iterative process.

The other end of this is the portrayal of indigenous knowledge as closed, narrow in scope, unintellectual, primitive, and emotional.[71]The cultural organization of state management

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[65] Walter Reid, et al. Bridging Scales and Knowledge Systems: Linking Global Science and Local Knowledge in Assessments. Washington DC: Millennium Ecosystem Assessment and Island Press, 2006.
[66] Singleton, *Constructing Cooperation*
Eamer. "Keep it simple and be relevant"
[67] Stella Spak. "The position of indigenous knowledge in Canadian co-management organizations." Anthropologica 47 (2005): 233-246.
[68] Folke, et al. "Resilience for sustainable development"
[69] Fikret Berkes, *Sacred Ecology*
[70] Richard Schroeder. "Community, forestry and conditionality in the Gambia." Africa 69 (1999b): 1-21.
[71] Michael Howes and Robert Chambers. "Indigenous technical knowledge: analysis, implications and issues." IDS Bulletin 10 (1979): 5-11.

agencies has developed a contextual norm limiting the consideration of indigenous knowledge as legitimate sources of information.[72] Conversely, local communities may have the same notion to exclusively rely on their traditional ways and exclude viable scientifically based approaches. The willingness to consider information and ideas across organizational boundaries has been a crucial component of effective adaptive co-management.

Another barrier for the integration of TEK into western knowledge narratives is the general isolation of these groups that has left them secluded from central negotiations.[73] When considering the iterative practice of co-management, there must be an inclusion of agencies and communities that have been isolated from previous negotiations. Romanticization of IKS has created an image of an unchanging, conservative culture that is frozen in time.[74] This occurs due to the fact that many indigenous groups are located in the peripheral parts of states in which they have little to no representation in dominant governance. The failure to address the asymmetries of power and control has enabled the political placement of indigenous groups to be marginalized and secluded.[75] This speaks closer to the issue of political relationships

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Arun Agrawal. "Dismantling the divide between indigenous and scientific knowledge." Development and Change 26 (1995): 413-39.

Roy Ellen and Holly Harris. "Introduction." In Indigenous environmental knowledge and its transformations. Amsterdam: Harwood Academic Publishers, 1-33. 2000.

[72] Robert Pomeroy and Fikret Berkes. "Two to tango: The role of government in fisheries co-management." *Marine Policy* 21: 465-80

[73] *Beyond numbers: the participation of indigenous peoples in parliament* Inter-Parliamentary Union, Survey Report. September, 2014.

[74] Anthony Bebbington. "Modernisation from below: an alternative indigenous development?" *Economic Geography* 69 (1993): 274-92.

Arne Kalland. "Indigenous knowledge: prospects and limitations." In Indigenous environmental knowledge and its transformations. Amsterdam: Harwood Academic Publishers, 1-33. (2000).

[75] Agrawal. "Dismantling the divide" between indigenous and scientific knowledge." Development and Change 26 (1995): 413-39.

governing their management bodies in a way that lacks interaction with local communities. This trend must cease in current practices if co-management is to take place.

A consequence of seclusion is the issue of underrepresentation. This is apparent when indigenous knowledge has been framed in the context of a binary system that does not integrate with other western perspectives. IKS has been increasingly institutionalized[76] in a manner that pressures modernization and cultural homogenization.[77] As supported by Marcus Colchester, "Prejudicial attitudes to indigenous peoples' ways of life are often institutionalized through unjust national laws and government policies which deny indigenous peoples their land rights and rights to manage their resources, and which seek their accelerated assimilation into the national mainstream."[78] Within recent decades, there has been a slow increase in recognizing rights and building partnerships with organizations between state governments and local communities. However, these have yet to show a true attempt to involve legitimate transfers of power[79] which would be crucial for the appropriate power-sharing, knowledge generating adaptive co-management which are now necessary.

More than political isolation and distance from dominant discourse, indigenous peoples find themselves secluded and underrepresented from an economic side. Economic factors tie closely to the topic of forest co-management, since a very large problem for indigenous

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[76] World Bank. *World development report 2000-01: attacking poverty.* Oxford: Oxford University Press for the World Bank, 2000

Briggs. "The use of indigenous knowledge in development"
United Nations Declaration on the Rights of Indigenous Peoples United Nations: 1-15, March 2008.
[77] Agrawal. "Dismantling the divide"
[78] Marcus Colchester. "Indigenous Peoples and Protected Areas: Rights, Principles and Practice." *Nomadic Peoples* 7 (2003): 33-51.
[79] Marcus Colchester. "Beyond Participation: Indigenous Peoples, Biological Diversity Conservation and Protected Area Management." *Unasylva* 47: 33-39.

communities is the exploitive policies in place which use the land in unsustainable ways.[80] The disparities in socio-economic relationships among state management agencies, stakeholders, and local communities, have posed challenges towards breaking through the boundaries of western narratives that do not acknowledge the importance of IKS. The epistemology for this issue will enable a closer study of individual cases of how economic disparities, the lack of mobilization, and the distance from dominant discourse for indigenous communities have limited the use of indigenous knowledge in resource management.

Case Study: Chiapas Mexico

Background

Mexico is the site of several Amerindian civilizations, of which include the Toltec, Aztec and the Maya. As of 2011, agricultural land use was at 54.9%, 41.7% of which is permanent pasture holding, leaving forest at 33.3% and other uses at 11.8%.[81] Currently the government lists deforestation as a national security issue.[82] There are 12.7 million people that make up Mexico's indigenous population, which represents 13% of the national population.[83] The majority of these peoples are located in the southern and south-central region, with 80% of this group living in just eight states, the two most concentrated areas being Oaxaca and Chiapas respectively.[84]

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[80] J. Peter Broslus. "Endangered Forest, Endangered People: Environmentalist Representations of Indigenous Knowledge." *Human Ecology* 25 (1997): 47-69.
[81] "The World Factbook: Mexico" *CIA.gov* October 28, 2015. Accessed November 2, 2015. https://www.cia.gov/library/publications/resources/the-world-factbook/geos/mx.html
[82] Ibid.
[83] "Mexico - Indigenous peoples" *World Directory of Minorities and Indigenous Peoples,* 2015. Accessed November 7, 2015. http://minorityrights.org/minorities/indigenous-peoples-4/
[84] Ibid.

Bordering Guatemala, Chiapas is the southernmost state of Mexico.[85] It was annexed from Guatemala in 1823 to Mexico. It has a humid, tropical climate with rainforest which has been almost completely destroyed due to a dramatic increase in agricultural and ranching practices in the past decades.[86] The capital is Tuxtla Gutiérrez which is the only metropolitan area and the most developed and populated municipality for Chiapas. Predominantly acting as a transportation hub for tourists, the city is mainly business oriented with surrounding government buildings.[87]

Most importantly to this paper, Chiapas is home to one of the largest indigenous populations in Mexico.[88] Having the third largest population of indigenous language speakers; about 25% of the Chiapas 3.9 million people speak one of the Mayan languages.[89] Unlike the northern states of Mexico, the Chiapas were able to maintain their ancient cultures, customs and traditions in a manner that kept their identity as autonomously indigenous.[90] In part to this, is the relative geographical location as well as the political landscapes that created a people who do not identify as mestizo or as Guatemalan.

The importance in studying the Chiapas is the subtropical region that inherently includes intact forests. The Lacandon Jungle is considered a biodiversity hotspot;[91] with

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[85] "Mexico at a Glance" *INEGI,* 2011. Accessed November 7, 2015. http://www.inegi.org.mx/prod_serv/contenidos/espanol/bvinegi/productos/integracion/pais/mexvista/2011/mexatg_2011.pdf

[86] "Facts about Chiapas" *SIPAZ,* 27 March, 2012. Accessed November 7, 2015. http://www.sipaz.org/en/chiapas/facts-about-chiapas/395-ubicacion.html

[87] "City of Tuxtla Gutiérrez" *Mexico: desconcido.* May 29, 2011. Accessed November 7, 2015. http://www.mexicodesconocido.com.mx/tuxtla-gutierrez.html

[88] "Chiapas" *History Channel,* 2015. Accessed November 7, 2015. http://www.history.com/topics/mexico/chiapas

[89] "Chiapas" *Encyclopedia of the Mexican States,* 2015. November 2, 2015. http://www.nationsencyclopedia.com/mexico/Aguascalientes-M-xico/Chiapas.html

[90] John P. Schmal, "Chiapas - Forever Indigenous". *Houston Institute for Culture*. 2004. Accessed November 7, 2015. http://www.houstonculture.org/mexico/chiapas.html

[91] Bill Weinberg. "Mexico: Lacandon Selva conflict grows". *NACLA Report on the Americas* 26 (May–June 2003): 26.

approximately a million hectares, this area provides an ecosystem for 25% of Mexico's total species.[92] Scattered among a dozen villages within this forest, the small isolated groups of the Lacandon Maya lives off of this habitat, their population is estimated to be from 600-1000 people.[93] However, since the 20th century this region has been slowly inhabited by other indigenous communities which have involuntarily altered Lacandon Maya's lifestyles and world-views.[94] Coupled with this issue of encroachment by other migratory indigenous groups, the rate of deforestation within the past decades has been increasingly high. The Lacandon rainforest has been losing over 5% of its remaining forest each year,[95] a large endemic problem spurring this, is the increased human population density that has stressed this environment through demands for agricultural lands.[96] With the likelihood of these areas to continue experiencing population growth and movement[97] there is a correlation that these problems will only increase in the coming years. There have been estimations that only 10% of the virgin rainforest still exists, and despite conservation efforts the remaining forest is still being cut

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[92] Kaity Cheng. "Role of Tao (Beloitia mexicana) in the traditional Lacandon Maya shifting cultivation ecosystem" MS thesis., State University of New York College of Environmental Science and Forestry, 2009.

Carson Brown. "Ruins in the rain forest: An excursion to La Selva Lacandona" *Mexconnect newsletter*. December 1, 2007

[93] Melanie Bidiuk. "The last of the Lacandon" *Online Pioneer Plus*. March 1, 2007.

[94] Margarita Hidalgo. *Contributions to the Sociology of Language: Mexican Indigenous Languages at the Dawn of the Twenty-First Century*. Berlin: Walter de Gruyter & Co. (2006): 106.

[95] Philip Howard and Thomas Homer-Dixon "Environmental Scarcity and Violent Conflict: The Case of Chiapas, Mexico". *American Association for the Advancement of Science, Project on Environment, Population and Security* 3 (1996 January): 1-35.

[96] Rattan Lal "Erosion-crop productivity relationships for soils of Africa". *Soil Science Society of America Journal* 59 (1995): 661-667

N. L. Alvarez and L. Naughton-Treves "Linking national agrarian policy to deforestation in the Peruvian Amazon: a case study of Tambopata, 1986-1997". *Ambio* 32 (2003): 269-274.

[97] R. Ram "Tropics and economic development: An empirical investigation". *World Development* 25 (1997): 1443-1452.

down.[98] One conservation technique has been to designate an ecological reserve within a protected area. An example of such case includes the designation of the Montes Azules Biosphere Reserve in 1979 within the heart of the Lacandon Jungle; it comprises 331,200 hectares which contains about 500 species of trees.[99]

As seen in many histories of indigenous communities, within the Chiapas area there has been a long history of subjugation with occasional rebellions.[100] The most recent rebellion occurred in 1994 with the Zapatista revolt, which has set current trends for the indigenous people's mobilization within Chiapas. With the entrance of Mexico into the North American Free Trade Agreement, the Zapatistia National Liberation Army took up arms and seized three Chiapan towns.[101] The Zapatista movement progressed over a long history of indigenous communities losing control of their historic lands, leaving them marginalized and isolated.[102] Fighting between the Zapatistas and the government's military forces ended with sporadic peace talks and finally the signing of the San Andres Accords in 1996. These agreements that followed directly dealt with autonomy and indigenous rights, but were ultimately failures due to a lack of commitment from federal officials in following through on the implementation of constitutional changes.[103]

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[98] Stewart A W Diemont. "Ecosystem management and restoration as practiced by the indigenous Lacandon Maya of Chiapas, Mexico". PhD thesis., Ohio State University, 2006
[99] "MAB Biosphere Reserve Information" *UNESCO.* August 3, 2011. http://www.unesco.org/mabdb/br/brdir/directory/biores.asp?mode=all&code=MEX+03
[100] "Mexico - Indigenous peoples" *World Directory of Minorities and Indigenous Peoples*
[101] Schmal, "Chiapas - Forever Indigenous"
[102] "Zapatismo" *Mexico Solidarity Network.* Accessed November 7, 2015. http://www.mexicosolidarity.org/programs/alternativeeconomy/zapatismo/en
[103] Ibid.

Agroforestry of the Lacandon Maya

The constant deforestation among the Lacandon Jungle and outskirts of the Biosphere Reserve has resulted primarily due to the agricultural and livestock expansion,[104] which have historically been encouraged by institutional policies from the Mexican government.[105] This is problematic since reported figures of deforestation (although proceeded at different regions within different periods), clearly show that the highest annual rates exceeding 2% are within the colonized and agricultural areas and those with low annual rates (less than 1%) are in the areas that are inhabited by the Maya.[106] From these figures, it is clear that the practices of these indigenous groups within the Lacandon Jungle are more promising in terms of strategizing management policies for sustainable ecological practices and uses.

The Lacandon Maya TEK for agroforestry offers many tools for environmental conservation, which can provide methods to implement resources to local inhabitants as well as regional restoration of tropical forests.[107] For many centuries they have been able to farm the forest while not only preserving it but also regenerating it.[108] The Lacandon Maya do this by practicing a method of agroforestry where the community manages a period for production as well as soil regeneration.[109] Through a course of system cycles between fallow and forestry, they produce raw materials, food, medicines and also regenerate tall secondary forest.[110]

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[104] Edward B. Barbier, and J. C. Burgess. "Economic analysis of deforestation in Mexico". *Environment and Development Economics* 1 (1996): 203–239.
[105] David Barton Bray et al. "The institutional drivers of sustainable landscapes: a case study of the 'Mayan Zone' in Quintana Roo, Mexico" *Land Use Policy* 21 (2004): 333-346.
[106] Bray "Institutional drivers of sustainable landscapes"
[107] Diemont "Lacandon Maya ecosystem management"
[108] Kaity Cheng et al. "Role of Tao (Belotia Mexicana) in the Traditional Lacandon Maya Shifting Cultivation Ecosystem" *Agroforestry Systems* 82 (June 30, 2011): 331-336.
[109] J. D. Nations and R. Nigh "Evolutionary potential of Lacandon Maya sustained-yield tropical forest agriculture". *Journal of Anthropological Research* 36 (1980): 1-30.

R. Jon McGee *Watching Lacandon Maya* Boston: Allyn and Bacon (2002): 194
[110] Diemont "Lacandon Maya ecosystem management"

Meanwhile the primary forest, which neighbors these agricultural spaces, is conserved to maintain a "biodiverse seed bank".[111] This is evident with over 400 sum-plants being recorded within the fallow and primary forests that are useful to the Lacandon community.[112] This is an important aspect of agroforestry, as diversity within plant species is crucial for this method to be successful.

An essential component of this type of adaptive management is the reliance on regenerative capacities of nature obtained from the use of biodiverse species.[113] Contrasting from "modernized and western" practices, agroforestry relies on ecological regeneration that occurs naturally first, with the implementation of human technology as a supplementary method later if necessary.[114] This therefore enables the Lacandon to produce enough materials for their communities, while also demonstrates they are "cognizant of the natural abilities of certain species to fulfill the restoration needs in their systems."[115] Lacandon ecological management techniques enhancement of soil fertility, inconsequently contributes to the restoration and preservation of primary mature forest sites that were previously used for agriculture.[116]

Associating these adaptive management practices on a more global diversified scale would result in the reduction of deforestation throughout the world.[117] This being said, although evaluation of Lacandon Maya agroforestry clearly demonstrates benefits for sustainable adaptive management, there has been very minimal moves to study, integrate nor

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[111] Pedro Francisco Quintana-Ascencio et al. "Soild seed bank and generation of tropical rain forest from milk fields at the Selva Lacandona, Chiapas, Mexico". *Biotropica* 28 (1996): 192-209.
[112] Samuel Israel Levy-Tacher, et al. "How predictive is traditional ecological knowledge? The case of the Lacandon Maya Fallow Enrichment System". Interciencia 27 (2004): 512-520.
[113] Howard T. Odum *Environmental Accounting: Emergy and Environmental Decision Making* New York, USA: Wiley (1996)
[114] Diemont "Lacandon Maya ecosystem management"
[115] Ibid.
[116] Levy-Tacher, et al. "How predictive is traditional ecological knowledge?"
[117] Diemont "Lacandon Maya ecosystem management"

use these techniques of resource management from even the national scale. These barriers of the application of IKS, like the Lacandon Maya TEK, stems from a distance from dominant discourse, economic disparities and lack of mobilization. These factors have contributed to the externalized pressure to change indigenous practices, resulting in a failure to utilize their knowledge and sustainable techniques of resource management.

Distance from Dominant Discourse

The Lacandon, who have been thought to be direct descendants of the ancient Maya,[118] have survived as a culture since the 18th century by living deep within the rainforest without contact with the rest of the world until the 20th century.[119] This isolation was permeated with the migration of other indigenous groups into their areas,[120] as well as the integration of missionary attempts to convert them to Christianity.[121] This speaks to a trend throughout the last few centuries, of the indigenous communities within the Chiapas region being forced to the outskirts of the state, and have had very little cooperative relations with the Mexican government. The powerlessness stems beyond the lack of inclusion in creation of policies, and instead points to the deeper sentiment and belief that these peoples hold very little to contribute to the "modern" society.

Ancient indigenous strategies of use and management of tropical lowland ecosystems has consistently included shifting cultivation practices, of which includes swidden, slash-and-burning, and nomadic agriculture.[122] Despite serving indigenous communities with ample

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[118] Stewart A W. Diemont and Jay F. Martin "Lacandon Maya Ecosystem Management: Sustainable Design for Subsistence and Environmental Restoration". *Ecological Applications* 19 (2009): 254-266
[119] "Lacandon Cultural Heritage Project" *University of Victoria.* October 20, 2004. http://web.uvic.ca/lacandon/
[120] Hidalgo. *Contributions to the Sociology of Language*
[121] "Lacandon Cultural Heritage Project"
[122] Victor Toledo, et al. "The Multiple Use of Tropical Forests by Indigenous Peoples in Mexico: a Case of Adaptive Management". *Conservation Ecology* 7: 9

productivity for subsistent living over centuries, these cultivation practices along with other resource management techniques has been described as wasteful of natural resources, having low productivity and damaging of tropical forests.[123] This biased view stems from the industrialized and fossil-fuel dependent, technologically reliant systems of cultivation being used by the "westernized world" towards the latter half of the 20th century. As further explained, "scientists overlooked indigenous practice and management of ecological processes because they were fixated on an agronomic-centered approach".[124] The pressure for modernization as represented by the agro-industrial model is incredibly controversial when put side by side with agroforestry cultivation practices like those used by the Maya in the Lacandon Jungle. The first is based on the introduction of specialized production of a specific type of crop that is determined exclusively by the market-oriented demands, and simplifies ecological systems.[125] The latter, is a system based on biodiversity, which enables multiple uses through the cultivation of a variety of plants and embraces the complex ecological processes in systematic rotational cycles.[126]

There is a strong sense of cultural identity when studying the practices of resource management from an indigenous group. It is linked to their direct use of historic land that has ancestral knowledge passed through generations, characterizing the communal efforts and sensitivity towards local habitat. This ethnic identity has been increasingly stripped away with the loss of land rights from economic encroachment to violence that has threatened their

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[123] R. F. Watters. *Shifting cultivation in Latin America.* Food and Agriculture Organization of the United Nations (1971)
[124] Toledo, et al. "The Multiple Use of Tropical Forests"
[125] Janice Alcorn and Victor Toledo. "Resilient resource management in Mexico's forest ecosystems: the contribution of property rights" in *Linking social and ecological systems.* Cambridge, UK: Cambridge University Press (1998): 216-249.
[126] Toledo. "The Multiple use of Tropical Forest".

culture and livelihoods.[127] External factors threatening the permanence of indigenous groups include regional plans, actions of development agencies, market forces, and political and technological changes. Internal factors that enable indigenous communities to resist these external influences, includes strong but flexible social organizations and institutions, various controls and strong cultural values.[128] When these external factors become stronger than the internal ones, it results in a change in mentality that contributes to the movement of indigenous peoples into urban areas. As supported by recent trends of political, social, and economic pressures these indigenous populations which have been predominantly rural, are increasingly migrating to urban centers for waged incomes.[129] However, in spite of this movement, whether indigenous groups are located within the urban or rural setting, there is a continued trend of this population lacking efficient health care, education, and government participation.

This pressure to modernize has been coming from the Mexican government which has succumbed to converting their resources towards what benefits capital-driven production. Due to this, policymakers have looked to previously historic lands used by indigenous groups, and created exploitive policies in order to aid the demands of profit-driven businesses which include logging for timber, oil production, and cattle grazing. Globalization as a whole has led to newly identified means of wealth and survival, one to which the Maya have now been either integrated into, or created adaptive practices that still enable them to continue their traditional lifestyle on a varied degree of autonomy and subsistence.

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[127] June Nash. "The reassertion of indigenous identity: Mayan responses to state intervention in Chiapas". *Latin American Research Review* 30 (1995): 7

[128] Toledo. "The Multiple use of Tropical Forest".

[129] "Responses to Information Requests (RIRs)" *Immigration and Refugee Board of Canada.* January 17, 2008. http://www.justice.gov/sites/default/files/eoir/legacy/2013/11/07/MEX102683.E.pdf

Economic Disparities

Historically the isolated state of Chiapas was considered the most backward of Mexico's states, which neglected proper government planning of neither infrastructure nor development of social support systems. In particular the indigenous Indian populations had the poorest of resources with the lowest education and poverty rates.[130] Over the most recent decades there has been an increase of economically motivated migration which links to issues of both social and political discrimination.[131] As the World Directory of Minorities and Indigenous Peoples states:

> indigenous people [...] experience a double form of discrimination - both because of their low economic standing and poor levels of formal education, and also on grounds of [cultural and lifestyle differences]. What little they own is generally insufficient to support them, so many seek waged work from mestizo employers, who generally treat them disrespectfully.[132]

There was a moment in Chiapas history when this level of discrimination and economic disparity was not so severe. The Land Reform Act established in 1917 granted communal lands (known as ejido), thereby allowing a collective base for indigenous groups to pursue cultivation of small plots with surpluses that provided subsistent crops for their community.[133] Ejido land titles were held in perpetuity; in that while communities with individual families controlled plots of land for generations there was no possibility of it being sold, as it is legally held by the

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[130] Schmal, "Chiapas - Forever Indigenous"
[131] Laura Elena Ruiz Meza, "Climate change, poverty and migration processes in Chiapas, Mexico" *International Journal of Labour Research* 2 (2010): 187-210.
[132] "Mexico - Indigenous Peoples" *World Directory of Minorities and Indigenous Peoples*
[133] June Nash, "The Challenge of Trade Liberalization to Cultural Survival on the Southern Frontier of Mexico". *Indian Journal of Global Legal Studies* 1 (Spring 1994): 367-395.

community and not the individual.[134] More so during this time, there was a development of policy for the preservation and support of indigenous culture through bilingual education programs which helped produce a progressive new group of indigenous leaders.[135] Unfortunately this semi-autonomous structure of indigenous communities came to an end with the reform of Article 27 and the beginning process of the government political strides in the 1970s that moved away from programs supporting rural areas and instead favored factory-led industrialization.[136] Without strong ties to the land, new capitalist driven profit-making schemes began to involve the direct exploitation of former communities that used to rely on the ejidos.

With addition to these more recent trends, the continued migration of indigenous groups[137] into the forested Chiapas region and their population growth has increased the demand for land.[138] The current shrinking land distribution was seeing increased competition for use of small-scale shifting cultivation, as well as pastureland for cattle grazing.[139] This caused tension as limited space had been provided for these groups since the reforms in the 1970s and the now protected forests (as determined by the Mexican government and international environmental agencies within the last few decades), are an untouchable space that could have been utilized by these indigenous communities. Ironically there were a lot of cases where for thirty years prior to the reform to Article 27, specific indigenous communities were encouraged by the government to settle within the forest in order to relieve land

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[134] "Zapatismo" *Mexico Solidarity Network*
[135] Nash, "The Challenge of Trade Liberalization to Cultural Survival".
[136] "Zapatismo" *Mexico Solidarity Network*
[137] Hidalgo. *Contributions to the Sociology of Language*
[138] Alvarez and Naughton-Treves "Linking national agrarian policy to deforestation"
[139] Diemont and Martin "Lacandon Maya Ecosystem Management"

pressures in the highlands.[140] These groups instantly became squatters in 1978 with the declaration of the biosphere reserve.[141]

These issues along with the pressure to modernize with increasing outside political and economic influences, has led to a modification of indigenous peoples systems of wealth. Where there was once an ability to provide for their own communities independently through shifting agriculture and agroforestry (like the Lacandon Maya), the lack of available land resources coupled with intervention from outside authorities, has led to a modified economic system. The "progressive" integration of indigenous communities into the national and international market has produced a prominent tourism economic market base for modern financial inclusion.[142] This adaption into a commoditized economy has grown from new sources of income predominantly earned through an intensification of artisan production and a promotion of cash crops.[143]

The changes among the indigenous communities has led further away from subsistence agroforestry and instead towards a "dual economic" system.[144] Market integration has resulted in a transformation and displacement of previous shifting cultivation practices - that had been used before colonialism, and invariably a part of the indigenous communities' identity - towards a specialized practice where all that is produced is market oriented.[145] In a contemporary world that emphasizes a measurement of success through qualitative superiority, the case of

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[140] Bill Weinberg. "Mexico: Lacandon Selva Conflict Grows" *NACLA Report on the Americas 26 (May–June 2003)*: 26-31.
[141] Ibid.
[142] Edward A. Ellis and Luciana Porter-Bolland. "Is community-based forest management more effective than protected areas? A comparison of land use/land cover change in two neighboring study areas of the Central Yucatan Peninsula, Mexico". *Forest Ecology and Management* 256 (2008): 1971-1983 doi:10.1016/j.foreco.2008.07.036
[143] Nash, "The Challenge of Trade Liberalization to Cultural Survival".
[144] Victor M. Toledo, et al. "The Multiple Use of Tropical Forests"
[145] Ibid.

indigenous resource management is a constant struggle between modernization and survival strategies of indigenous people's historical and cultural roots.[146]

Lack of Mobilization

As previously stated, displaced, migrant indigenous groups have adversely affected the ecological stability of the rainforest within this region. These groups typically form cattle pasture[147] or short-term milpa[148] when they manage their land which often leaves the land incapable of production after a very short time. Land devastation from inappropriate use consequently intensifies the need for new lands which then leads to a cycle of further deforestation and social conflict.[149] Such social conflict can either result in fighting amongst individual groups or the mobilized efforts as a collective group to organize against governing bodies. In the case of Chiapas, it was the latter.

The continued ambiguous and contradictory government policies related to settlement rights and exploitation of the Lacandon jungle exacerbated the frustration of the disenfranchised local communities.[150]Of the multiple organized protests, the Zapatista Movement had its biggest global introduction on the eve of the NAFTA agreements

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[146] Victor M. Toledo "Peasantry, agro-industriality, sustainability: the ecological and historical grounds of rural development". *Interamerican Council on Sustainable Agriculture. Working Papers* 3 (1995): 1-27.

Alcorn and Toledo. "Resilient resource management in Mexico's forest ecosystems"

[147] J. Mas and H. Puig, "Deforestation methods in southwestern Campeche (Mexico)". *Canadian Journal of Forest Research* 31 (2001): 1280-1288.

Lettuce Durand and Elena Lazos, "Colonization and tropical deforestation in the Sierra Santa Marta, southern Mexico". *Environmental Conservation* 31 (2004): 11-21.

[148] Karen O'Brien, *Sacrificing the Forest: Environmental and Social Struggles in Chiapas*. Boulder, Colorado: Westview Press (1998)

[149] Howard and Homer-Dixon. "Environmental Scarcity and Violent Conflict"

[150] June Nash. "The reassertion of indigenous identity: Mayan responses to state intervention in Chiapas" *Latin American Research Review* 30 (1995): 7

implementation in Mexico in 1994.[151] The Zapatista Army of National Liberation (EZLN) had the goals of protesting against the political bodies that not only enabled the free trade agreement, but had also created a trend since the 1970s of driving the country's resources for development away from food self-sufficiency and towards foreign market demands in its orientation of production capabilities.[152] Additionally they stated very clear opposition to the indignities faced by indigenous people with their worsening situations, calling for better conditions, protection of communal land, and the end of human rights abuses and government corruption.[153] Beyond the rebellion and political motives, foundations for Zapatista goals included increase access to education, health care and collective development for indigenous local communities. Very importantly pertaining to the issue of collaborative management was the goal of a consistent cooperative model that includes collective action in developing policies within economic or political spheres on all levels.

Consistent mobilization and coordinated political actions in the form of protests, marches, and gatherings from organized indigenous groups clearly demonstrates the potential political influence, (especially when accounting for the diversity of Mayan linguistic groups).[154] The uprising since 1994 has affected the Mexican political process in some degrees, including an agreement to provide economic aid from the president as well as recognition of human rights in the need of provisions for insurgents and supporters.[155] The state and federal governments also promised economic and social improvements to meet the needs of medical

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[151] James D. Nation. "The Ecology of the Zapatista Revolt" *Cultural Survival Quarterly* 18 (Spring 2014) http://www.culturalsurvival.org/publications/cultural-survival-quarterly/mexico/ecology-zapatista-revolt Schmal. "Chiapas - Forever Indigenous"

[152] Georgia A. Collier "Roots of the Rebellion in Chiapas". *Cultural Survival Quarterly* 18 (Spring 1994) http://www.culturalsurvival.org/publications/cultural-survival-quarterly/guatemala/roots-rebellion-chiapas

[153] "Mexico - Indigenous peoples" *World Directory of Minorities and Indigenous Peoples*

[154] Nash. "The reassertion of indigenous identity"

[155] Ibid.

care and schooling to the local indigenous groups.[156] In addition to this success, the mobilization of the Zapatistas brought awareness to the international community on long-standing issues regarding indigenous people's lack of political rights, neglects from basic services, poverty and increasing loss in ties to their land.[157]

Despite these strides, very little has changed for the indigenous communities in the Chiapas region. The signing of the San Andres Accords in 1996, which directly dealt with the autonomy and indigenous rights, was never implemented.[158] The ruling party also failed to address the issue of land redistribution and recognition of titles to indigenous lands that had been encroached on by oil, lumber and cattle enterprises.[159] The lack of commitment from ruling officials to uphold promised policy changes had been doubtful; the former President had unilaterally dismissed the agreements in the Accords based on the belief that these policies "would lead to the Balkanization of the country, with individual states adopting their own form of government and autonomous procedures."[160] This goes to show a deep social-political embedded fear (at least by heresy), of a worldview other than the prescribed western development. Terms of establishing formal recognition for the self determination of indigenous groups and towns, is still unmet with the government initiatives prescribing rights of indigenous people only under a limited pretext of federalist structure that is also consistent with preexisting constitutional mandates.[161]

Although it is clear in this case of the Chiapas state that there is an ability to mobilize and establish modality within a cohesive organized indigenous action, it is simply not enough.

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[156] Ibid.
[157] Schmal. "Chiapas - Forever Indigenous"
[158] "Zapatismo" *Mexico Solidarity Network*
[159] Nash, "Reassertion of indigenous identity"
[160] Linda Lopez. "Advancing Human Rights Policy: Does Grassroots Mobilization and Community Dispute Resolution Matter? Insights from Chiapas, Mexico". *Review of Policy Research* 22 (2005): 77-87
[161] Ibid.

There is still an underlying issue of epistemological differences in worldview, which has seeped into the pressured transformation and integration of the previously subsistent indigenous groups into the profit-driven market. Although a relatively strong case for mobilization, these other underlying factors have made it seemingly difficult to obtain government institutions that are responsive to demands for equality, liberty and autonomy. Without these, it is increasingly unlikely for the creation of a resource management system based on cooperative and inclusive development strategies.

Analysis:

Oaxaca: a case of rights, not the promotion of IKS

Chiapas western neighbor, the southeast state of Oaxaca, has a topography that contains 90% of mountain ranges[162] while also having extensive forests covering 64% of the state's 9.5 million hectares.[163] The majority of the Selva Zoque, the largest intact tropical rainforest in Mexica, is located within this region,[164] which significantly attributes to the state's ranking fourth in the world in overall species richness.[165] Being claimed as the most biologically and culturally diverse state in the country[166], this fifth largest state of Mexico has 16 formally registered indigenous groups, each having their own ancestral traditions, language, and customs.[167] The Zapotecs and Mixtecs have the most numerous influence amongst the various

[162] "Oaxaca Geography" *Explorando Mexico*. 2000-2015. Accessed November 24, 2015. http://www.explorandomexico.com/state/19/Oaxaca/geography/
[163] Gary Martin, et al. "Indigenous and community conserved areas in Oaxaca, Mexico". *Management of Environmental Quality* 22 (2011): 250-266. doi: 10.1108/14777831111113419
[164] "Selva Zoque" *WWF Mexico*. Accessed November 27, 2015. http://www.carlosslim.com/pdf/wwf/fs11-oaxaca-selva-zoque.pdf
[165] Martin, et al. "Indigenous and community conserved areas in Oaxaca, Mexico"
[166] Ibid.
[167] John P. Schmal. "Oaxaca: A Land of Diversity". *Houston Institute for Culture*. 2006. Accessed November 24, 2015. http://www.houstonculture.org/mexico/oaxaca.html

native communities, with historical roots tying them into the early Mesoamerican era of the region, the remaining 14 include the Amuzgos, Chatinos, Chinantecos, Chocho, Chontales, Cuicateco, Huave, Ixcatecos, Mazatecos, Mixes, Popoloco, Tacuates, Trique, Zoque.[168]

Oaxaca has been studied and claimed to be an example of the integration and co-management of resources within indigenous communities and governance. As stated;

> Oaxaca's indigenous and mestizo communities are characterized by an impressive level of internal organization, relative political autonomy, collective institutions and tenurial systems that contribute to resilient resource management and ability to respond to outside conservation and development efforts. The community-based property rights system is supported by the national government, which effectively devolves a degree of political power to culturally diverse communities capable of implementing their own conservation programs.[169]

The driving force behind this relative political autonomy is the distribution of *ejidos*, which are designated communal lands that are were established through the Constitution of 1917 in the established Land Reform Act.[170] Unlike many other regions, Oaxaca's indigenous groups remained their hold on these lands in community self-governance. Since these communities remained both the legal owners and de facto managers of these forests, it has been recognized that their local governance approach could meet important criteria for resource conservation.[171] Local officials coupled with a network of community management institutions that is not only authorized by municipal, but regional and national authorities has become a driving

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[168] Ibid.
[169] Martin, et al. "Indigenous and community conserved areas in Oaxaca, Mexico"
[170] Nash. "The Challenge of Trade Liberalization to Cultural Survival"
[171] Martin. "Indigenous and community conserved areas in Oaxaca, Mexico"

consideration for long-term collective strategies in regards to conservation and the sustainable use of resources.

Despite these successful semi-autonomous plots, the friction between the national government and local indigenous communities has continued especially in lieu of the growing emphasis on conservation. Governance within Mexico has established 173 NPAs (natural protected areas) of the course of 73 years. These have been decreed as "Biosphere Reserves, Flora and Fauna Protection Areas, Natural Monuments, National Parks or Sanctuaries [… covering] over 12 percent of the total surface area of the country".[172] While Oaxaca is looked to as an example in its recognition of 126 indigenous and community conserved areas (ICCAs), the NPAs created through presidential decree does not official recognize ICCAs within their boundaries.[173]

Furthermore, given the complex diversity amongst the numerous indigenous communities and the various topographical features between mountain ranges and forest has made Oaxaca an entirely unique case of indigenous forest management. As supported in a study of community forestry, "Oaxaca has by far the highest percent of forest commonly owned (79.8%) but one of the lowest percents of forest managed (2.6%) […] The low rate of managed forest […] may be due to steep mountain ranges and lack of road access in many parts of state which inhibit commercial extraction".[174] Looking into this issue of commercial extraction, many theorized components for the success of the Oaxaca indigenous communities point to the economic benefit of harvesting lumber from specified locally managed areas; practiced in major forested areas of Oaxaca including La Trinidad, San Andres Yatuni, Santa Maria Yalina, and

[172] Ibid.
[173] Ibid.
[174] James Barsimantov. "What makes community forestry work? A comparative case study in Michoacan and Oaxaca, Mexico". PhD dissertation., University of California Santa Cruz, June 2009.

the San Juan Jaquila Vijanos.[175] La Trinidad is one of the best known forestry communities, and is considered a model of forest management and community governance with extensive support from NGOs and the development of a forestry union.[176]

Extended further, this particular community additionally attained Forest Stewardship Council (FSC) certification and "by all accounts is a model of forest management and community governance".[177] There is a similar storyline in an article published by the New York Times, which looks into the indigenous Zapotec's battle and success in winning the right to communally manage their forest that is in Ixtlán de Juárez, Oaxaca. It explicitly points to the locally built and managed lumber business, while also stating that their newly developed business was in congruence with the study of conserving and protecting the forest.[178] These claims of model forest management and community governance is inherently problematic with regards to the application of IKS towards adaptive co-management policies. The focus on modeled situations being those that comprise of a modified economic system - in this case of timber harvests for capital-driven profits - still results in the loss of communal lands in which traditional ecological knowledge is no longer applied. The loss of these traditional practices undeniably results in the loss of formerly used knowledge due to the newly placed emphasis on job creation and economic stability. Instead of exemplifying the inclusion of two independently equal groups (indigenous communities and national governments); it is representing the factor of economic disparities as being solved through assimilation into the economic system prescribed as successful by the dominant discourse of the west.

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[175] Ibid.
[176] Ibid.
[177] Ibid.
[178] Elisabeth Malkin. "Growing a Forest, and Harvesting Jobs". *New York Times.* November 22, 2010. Accessed November 28, 2015. http://www.nytimes.com/2010/11/23/world/americas/23mexico.html?_r=0

While lessons can be learnt from this region it is not the ideal case study for the proposed research question. Oaxaca can easily be pointed to as a localized phenomenon; there are few places in the world where local groups can control their resources with constitutional and legal protection offered by the national government. Even while looking directly at its neighbor, Chiapas, it is clear that government policies and practices regarding ejidos vary even between states. Furthermore the region is simply too complicated, representing a unique case with diverse topographical conditions as well as numerous indigenous groups that had remained fairly isolated until recent history. Though evident that these communities gain local management and governance over their forests, it is through an extremely well-coordinated effort amongst many parties in an autonomy movement.[179] Even then, this resistance to outside interventions has not created immunity to the effects of neoliberal policies and conservation initiatives.[180] Granted such a case in these different groups to organize would be good evidence for both the factor of mobilization as well as application to theories effective co-management strategies amongst local, state, and international levels, it does not pertain to forest management. In sum, the literature written on Oaxaca's indigenous populations are focused on these groups fight for rights and autonomy with specific emphasis placed on socioeconomic benefits - which leads to a more centered critique of governance rather than the development of resource co-management.

Sustainable exploitation of natural resources has been a driving goal for conservation efforts, and local community management is essential to the small-scale necessary in order to succeed in this. However these cases in Oaxaca quoted to be modeled systems of forest

[179] Catherine Elizabeth Newling. "The Mixe of Oaxaca and the cultural meanings of indigenous autonomy in Mexico: An ethnographic portrait of a social movement". PhD dissertation., University of Pennsylvania, 2001.
[180] Peter R. Wilshusen. "The receiving end of reform: everyday responses to neoliberalisation in southeastern Mexico". *Antipode* 42 (3) 2010: 767-799.

management are problematic when attempting to answer the research question of this paper. This is an issue since the largest factor - distance from dominant discourse - still remains contemptuous for the truly equal inclusion of indigenous communities. The cases in Oaxaca show more of an assimilation to socioeconomic standards that have been predetermined by western epistemology in particular with regards to the monetized value of forest. Despite semi-autonomous governance from Oaxaca's indigenous communities, they still loos the traditional practices and therefore the knowledge of indigenous communities since they completely changed the use of their forests. Instead of establishing adaptive co-management of their resources they were focused on creation of jobs and economic stability and ecological preservation which doesn't actually promote the use of IKS. Although this case study does represent the strong use and inclusion of semi-autonomous indigenous communities, it fails in representation of the use of IKS and TEK.

The fundamental need for IKS in sustainable development

The conventional modernization promoted by dominant discourse is "fundamentally limited in its ability to promote equitable and sustainable development".[181] In the specific case of Mexico, this pressure to modernize has been catastrophic;[182] prompting high deforestation rates and significant reductions of primary forests. With nearly 10% of its original distribution left[183], the devastation of deforestation through the industrialization of the country and community has led to not only the loss of biodiversity but the growing trend of ecological and social equity being considered as low importance.

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[181] Toledo. "The Multiple Use of Tropical Forests by Indigenous Peoples in Mexico"

[182] Fernando Tudela and Rolando Victor García *La Modernización Forzada en el Trópico: El caso de Tabasco.* 1989. El Colegio de México, Mexico City, Mexico.

[183] Toledo. "The Multiple Use of Tropical Forests by Indigenous Peoples in Mexico"
Omar R. Masera et al. "Carbon emissions from Mexican forests: current situation and long- term scenarios." *Climatic Change* 35 (1997):265–295.

This is not unique to Mexico; rural development in the humid tropics globally has resulted in a worldwide deforestation consequently reducing biodiversity and loss of native productive resource management strategies. Cases of indigenous natural resource use however, have clearly shown advantages over 'modern' resource management which has instead propagated simplified and exploitative methodology for the capitally-driven appropriation of nature. Not only have indigenous communities such as the Lacandon Maya, developed stable and subsistence resource use, they have developed a system essential for sustainability in ecological management use. As supported, "the Lacandon are cognizant of the natural abilities of certain species to fulfill the restoration needs in their systems. It demonstrates that Maya agroforestry and local knowledge could contribute to efforts to conserve and restore rainforests, and reduce deforestation by accelerating recovery while maintaining a sustainable productivity".[184] In sum, indigenous knowledge systems of adaptive forest management maintain high levels of biodiversity, remain highly resilient towards naturally-caused environmental change, and create longer periods of use through cyclic rotations and ecological regeneration.

Adaptive capacity is simply, an ability to learn from mistakes - this invariably has a large social component when applied to resource management. Due to the number of stakeholders involved in the interests and use of forests, the need for collaborative management in determining solutions for mistakes and failures in poorly applied management has to include those who have better methods - regardless of the scale they were used on thus far. The distance from dominant discourse has shallowed the value of IKS. Additionally through the pressures of modernization, large economic disparities, and inability to mobilize to promote effective change and accountability towards governing bodies has prevented the use of TEK in

[184] Diemont. "Ecosystem Management and Restoration as Practiced by the Indigenous Lacandon Maya".

almost all national and international resource management. Collaborative adaptive management not only needs to become a forefront towards policymaking decisions, but will not be successful without the inclusion of indigenous groups. As supported, "contemporary scientists, academic institutions, and rural development agencies involved in the search for systems of sustainable management for natural resources in humid tropics of the world must heed the lessons of indigenous [...] social-ecological systems".[185]

Recommendations

The factors preventing the use of IKS in adaptive resource management are no small issues, the fundamental need to restructure current top-down organizational management and the policies made from the motives of capitally driven profit. Instead to favor an inclusive adaptive co-management system must take place when concerning global resource use such as forests, in order to change current unsustainable practices. Certain steps to insure the inclusion of IKS in adaptive co-management can provide solutions to the preventative factors discussed in this paper:

1) *Increase involvement of indigenous groups participation with local governmental municipalities.* The need for horizontal integration of knowledge amongst governance and local communities must be implemented through increased involvement. Steps to include indigenous groups must be made in order for the utilization of their knowledge systems when making resource management policies. In order for successful adaptive collaborative management to occur, there needs to be a mutual trust in association amongst all parties.

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[185] Toledo. "The Multiple Use of Tropical Forests by Indigenous Peoples in Mexico"
C. S. Holling et al. "Science, sustainability and resource management," in *Linking social and ecological systems*, ed. Fikret Berkes and Carl Folke. (Cambridge, UK: Cambridge University Press, 1998), 342-362.
Victor M. Toledo. "Biodiversity and indigenous peoples." In *Encyclopedia of Biodiversity*, ed. S. A. Levin. (San Diego, California, USA: Academic Press, 2001), 330–340.

The inclusion in management decisions will enable recognition of valid indigenous strategies that hold an intrinsic heuristic value.

2) *Increase distribution of communal land for indigenous groups and cease encroachment onto these lands.*

The argument is simple here; the loss of land for indigenous communities means the loss of traditional practices in resource management, which in turns equates to the loss of TEK as a whole. Land Reform Acts such as those made in Mexico in the early 1900s with the recognition of communal lands - ejidos - should be looked to as an example for global policies. As evident in the case study within Mexico, the greatest threat facing indigenous communities within recent decades has been the private sale of ejido land.[186] Therefore it is of crucial importance that once communal lands are available for semi-autonomous indigenous communities to manage, there should active enforcement by national governments to prohibit private sale of any of these lands.

3) *Organize methods to record and study extensively on indigenous communities immediately.*

The likelihood of being able to implement communal land reform policies, and then provide effective protection of these rights towards these lands globally is slim. Based on historic and current trends, indigenous peoples still face severe pressures to modernize and change lifestyles that have resulted in a loss of culture. Although actions to mobilize and organize as collective units has provided some positive response for indigenous groups interests to be heard, the overwhelming trend of isolating and repressing these communities has continued worldwide. Before these communities are completely faded out, there needs to be extensive research and efforts to study IKSs of adaptive resource management - this is so that there is empirical and recorded evidence of these practices that can be more easily

[186] Nash. "Challenge of Trade Liberalization to Cultural Survival"

supplied for government policymakers. This would be a 'label strategy' as it stresses an intellectual construction or plan among indigenous groups who would otherwise – according to western conventional perspectives – be considered backward and without the capacity to manipulate nature in the most productive way.[187]

4) *Create initiatives to avoid further deforestation of biodiversity hotspots without resettling indigenous communities that depend on them.*

   This is a controversial task. The declarations of biosphere reserves and national parks alike, acknowledges the importance of preserving the flora and fauna of these areas, yet still result in the forced movement of indigenous groups that had previously resided in these areas. TEK of these areas has often shown both ecological stewardship as well as community subsistence, and therefore should enable the autonomy of indigenous groups to still reside within their historic land.

5) *Establish horizontal management level meetings between institutions, government bodies, and indigenous groups.*

   Essentially, make certain that indigenous groups are included at all governance levels. This inclusion gives them representation as stakeholders – a right that was stripped away and needs to be given back. In order for the world to use IKS, there has to be an initiative to respect the autonomy and different narratives that these groups hold. Having active stakeholder positions enable accountability unto those who would otherwise demote the legitimate voice of indigenous groups.

[187] Toledo. "The Multiple Use of Tropical Forests by Indigenous Peoples in Mexico"

Conclusion:

The importance of the preservation of forests should include the active ability to recognize those that have lived within them for centuries. Indigenous peoples throughout the world have created methods of adaptive resource management that have allowed them to not only preserve but regenerate these biodiverse areas. Their ability to both utilize this resource as well as maintain it shows clear success in their sustainable capabilities. To not include them in collaborate management is both narrow minded and short sighted. Long term ecological stewardship of forests - and all resources beyond them - will only successfully be promoted on a global scale through the inclusion of IKS. There has been a new recognition of dependence on developing sustainable practices in order to meet future generation's goals of using resources without depleting them. Therefore the need to include the promotion of TEK has a practical importance in the success of creating economic, ecological, and social equity benefits worldwide.

Although the Maya in the southern state of Chiapas, Mexico is just one case of the current challenges faced by indigenous group's inclusion in adaptive co-management systems, it conveys a well-rounded example of preventative factors that decrease the acceptance of IKS in resource management. The need to acknowledge and respect the rights of indigenous groups is not what is in question - and should not be in question at all, as it is a straightforward argument that they inherently should have them - instead the focus on the prevention of application of TEK in resource management is a crucial subset argument for the larger concern in the growth in global sustainable development. This paper has found that of the three factors, the distance from dominant discourse is fundamental in regards to the utilization of IKS when discussing adaptive co-management as it directly connects and influences the other factors of economic disparities and efforts of mobilization.

This huge issue of acceptance of epistemologies derived from other parts of the world that are not linked to the dominant western 'conventional' industrial model of productivity and development is a challenge that has remained a driving factor in the exclusion of indigenous communities. Underestimating the ingenuity and validity of IKS is a fundamental error in modern day's development models. Furthermore, the idea that there is an option to avoid the effects of climate change is naïve and foolish. In order to address the issues facing the altering climate today, there needs to be a collaborative effort to produce adaptive policies with regards to resource management. Sustainable use of forests that produce various products while also allowing natural regenerating processes to occur is entirely possible with the use and application of IKS. Plans to otherwise exclude this dwindling source of knowledge due to a lack of acceptance and appreciation of a different worldview would be a grave mistake and missed opportunity for the current and future management of resources worldwide.

Noora Larson graduated from San Francisco State University in January 2016, earning a BA in International Relations with an emphasis in Environmental Studies. Following travels in Europe and China, she made the decision to focus on gaining diverse work opportunities before entering a master's program focusing on Agriculture and Rural Development and continues to reside in San Francisco, California. Ms. Larson currently works in several organizations as a Program Assistant to the Family Acceptance Project, the Coordinator of the Nursing Alumni Association at SF State University, and a Research Assistant to a tenure faculty professor in the School of Nursing specializing in Public Health. She plans to continue her education in the near future in pursuit of greater knowledge and application of sustainable development in social, political and economic contexts.

Deforestation Map: *http://earthenginepartners.appspot.com/science-2013-global-forest*

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