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The Role of Institutions in the Adaptation Discourse

Results from Social Network Analysis in Tabasco, Mexico

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Acronyms

CCC= Climate Change Council

CCGSS= Centre for Global Change and Sustainability in the South-East

CDI= National Commission for the Development of Indigenous Populations

CFE= Federal Commission for Electricity

CGDRPE= General Coordination for Regional Development and Strategic Projects

CICC= Interministerial Commission on Climate Change

Colpos= College of Postgraduates

COMESFOR= State Commission on Forestry (Tabasco)

CONABIO = National Commission for the Knowledge and Use of Biodiversity

CONAFOR= National Commission on Forestry

CONAGUA= National Commission on Water

CONANP= National Commission for Natural Protected Areas

CONAPESCA= National Commission for Aquaculture and Fishing

CPM= Carmen-Pajonal-Machona

Ecosur= The College of the South Border

ENCC= National Strategy on Climate Change

GHG= Greenhouse Gases

HDI= Human Development Index

IEM= State Women Institute (Tabasco)

INAFED= National Institute for Federalism and Municipal Development

INECC= National Institute for Ecology and Climate Change

INEGI= National Institute of Statistics and Geography

INMUJERES = National Women's Institute

IPCC= Intergovernmental Panel on Climate Change

ITS= Superior Technical Institute

LAERFTE= Law for Renewable Energies Consumption and Financing to Energy Transition

LASE= Law for Sustainable Energy Use

LGCC= General Law on Climate Change

LGEEPA= General Law of Ecologic Equilibrium and Environmental Protection

LGPGIR= General Law for the Prevention and Integral Management of Residuals

LGVS= General Wildlife Law

PA= Public Administration

PADAC= Program for the support of Agro-Industrial Development and Commercialization

PEACC=State Program of Action against Climate Change

PEAER= Special Program for the Consumption of Renewable Energies

PECC= Special Climate Change Program

Pemex= Petróleos Mexicanos

PROFEPA= Federal Attorney for Environmental Protection

PRONASE= National Program for the Sustainable Consumption of Energy

SAGARPA= Secretariat of Agriculture, Livestock, Rural Development, Fisheries and Food

SALUD Tabasco = Secretariat of Health (Tabasco)

SCT= Secretariat of Communications and Transportation

SDET= Secretariat of Economic Development and Tourism (Tabasco)

SDS= Secretariat of Social Development (Tabasco)

SE= Secretariat of Economy

SECTUR= Secretariat of Tourism

SEDAFOP= Secretariat for Agropecuary, Forests and Fisheries Development (Tabasco)

SEDATU= Secretariat of Agricultural, Territorial and Urban Development

SEDESOL= Secretariat for Social Development

SEGOB= Secretariat of the Government

SEMAR= Secretariat of the Navy

SEMARNAT= Secretariat of Environment and Natural Resources

SENER= Secretariat of Energy

SEP= Secretariat of Public Education

SERNAPAM= Secretariat of Energy, Natural Resources and Environmental Protection

SETAB= Secretariat of Education (Tabasco)

SGPA= Sub-Secretariat of Environmental Protection Management

SHCP= Secretariat of Finance and Public Credit

SINACC= National Climate Change System

SNA= Social Network Analysis

SOTOP= Secretariat on Territorial Organization and Public Work (Tabasco)

SPF= Secretariat of Planning and Finance

SSP= Secretariat of Public Security (Tabasco)

UJAT= Juárez Autonomous University of Tabasco

UNAM= National Autonomous University of Mexico

UTTAB= Technologic University of Tabasco

Sintesi

I. Introduzione

L'idea di partenza per lo svolgimento del presente lavoro di Tesi scaturisce dalla partecipazione dell'autrice al progetto *Plan of Adaptation Measures to reduce Vulnerability of Lagoon System Carmen-Pajonal-Machona, Tabasco, to Impacts created by Climate Change and Human Activities*, volto all'ideazione e implementazione di misure di adattamento per contrastare gli impatti dei cambiamenti climatici nel sistema lagunare sopracitato. Tale iniziativa è parte del macro-progetto *Proyecto de Adaptación de Humedales Costeros del Golfo de México ante los Impactos del Cambio Climático*, finanziato dalla Banca Mondiale e conclusosi il 31 ottobre 2015 (Zuleta, Martínez Fernández, Gómez Patiño, & Contreras Alcaraz, 2011). La collaborazione ha avuto luogo durante il periodo di tirocinio svolto dalla sottoscritta presso il Centro Euro-Mediterraneo sui Cambiamenti Climatici di Venezia (CMCC).

Rispetto al progetto, la Tesi si configura come un approfondimento della dimensione istituzionale dell'adattamento, alla luce della sua rilevanza nella creazione e nello sviluppo della capacità di adattamento delle società in risposta ai cambiamenti climatici. Le istituzioni contribuiscono infatti a ridurre la vulnerabilità e promuovere la resilienza (B. Smit & Pilifosova, 2001), obiettivi considerati essenziali all'interno del discorso climatico, come è stato ribadito anche nel recentissimo Accordo di Parigi firmato dai delegati di 195 paesi lo scorso dicembre in occasione della COP 21 (United Nations, 2015).

Nel contesto dell'adattamento, le istituzioni giocano un ruolo essenziale: determinano le vulnerabilità delle società cui appartengono, distribuendo le risorse e la tecnologia esistenti e determinando dunque le distinte risposte ai diversi impatti (A. Agrawal, 2008). A livello locale, le istituzioni si collocano inoltre come mediatori tra le comunità e gli agenti esterni che forniscono aiuto e supporto (A. Agrawal, 2010). Data la loro particolare rilevanza, le istituzioni sono state incluse dall'IPCC tra le determinanti della capacità di adattamento delle società, accanto ad altri fattori come la ricchezza economica, la tecnologia, l'informazione, le infrastrutture e l'equità (B. Smit & Pilifosova, 2001).

Ad una prima analisi, le istituzioni si rivelano subito come entità complesse, difficili da incasellare in una definizione. In effetti, il dibattito tra gli studiosi in questo senso è ancora molto vivo (si veda Hodgson, 2006).

Il presente Studio prende a riferimento la definizione di istituzioni offertaci da Ostrom (1990), poiché questa cattura efficacemente la loro natura duale. Da un lato vengono infatti identificate come l'insieme di procedure, leggi e regole formali e tangibili; dall'altro lato però, viene esplicitata anche la loro dimensione soggettiva - e dunque più sfuggevole - che le riconosce come l'insieme di valori, norme, tradizioni, condotte e codici taciti ed informali che danno forma alle aspettative e guidano le azioni degli individui e delle organizzazioni, configurandosi dunque come manifestazioni delle istituzioni (Ostrom, 1990).

È importante notare che le due dimensioni sopra descritte sono strettamente interconnesse: affinché qualsiasi tipo di norma o regola venga implementata efficacemente, è necessario che essa sia generalmente compresa ed accettata, e dunque legittimata dalla comunità (A. Agrawal, 2008).

Nonostante la letteratura esistente sulla capacità di adattamento delle istituzioni sia tutt'altro che vasta e unanime, troviamo generale accordo su alcune caratteristiche che rendono un'istituzione ricettiva ai cambiamenti climatici (B. Smit & Pilifosova, 2001). Tra queste, la dimensione della *cooperazione istituzionale,* a livello verticale quanto orizzontale, ricopre un ruolo essenziale: grazie all'integrazione di più esperienze e idee diverse, è infatti possibile rispondere alle sfide climatiche con prospettive ad ampio raggio che portino a soluzioni differenziate. *Cooperare* significa condividere e diffondere conoscenza e distinte esperienze, evitando così la duplicazione e favorendo la creazione di politiche di più ampio respiro e meglio articolate (A. Agrawal, 2010). Particolarmente nel contesto locale, in cui le istituzioni fanno da mediatori tra le comunità e le risorse esterne, una visione multisettoriale dell'adattamento è senz'altro necessaria.

L'importanza della cooperazione inter-istituzionale è stata riconosciuta anche dall'IPCC, che l'ha inclusa tra i fattori determinanti la capacità di adattamento istituzionale nel suo quinto Assessment Report (Noble et al., 2014).

II. Caso-studio

Il sistema lagunare Carmen-Pajonal-Machona (CPM) è stato scelto come caso-studio per la presente analisi istituzionale a causa del suo alto livello di vulnerabilità agli impatti causati dai cambiamenti climatici. Infatti, essendo una zona costiera, è altamente sensibile alle molteplici conseguenze derivanti dall'innalzamento dei livelli del mare: inondazioni, tempeste, erosione e insabbiamento per citare solamente i fenomeni più rilevanti (Buenfil Friedman, 2009). Inoltre, il sistema CPM rivela profonde criticità nel settore socio-economico, con livelli di povertà ed emarginazione molto alti, che contribuiscono ad innalzare i livelli di vulnerabilità della regione (Carraro & Mazzai, 2015; IPCC, 2014; Oxfam, 2010). Nel 2010, il 57.3% della popolazione di Tabasco viveva in uno stato di povertà, di cui il 13% si trovava in condizioni di povertà estrema (Gobierno del Estado de Tabasco, 2013).

Gli alti livelli di vulnerabilità della zona hanno costretto il governo federale del Messico ad includerla tra i siti pilota del progetto internazionale per la creazione e l'implementazione di misure di adattamento ai cambiamenti climatici al quale l'autrice del presente lavoro di Tesi ha collaborato (CMCC, 2014). In particolare, il diagnostico delle vulnerabilità redatto nella prima parte del progetto (Ramieri et al., 2015) ha rivelato cinque aree tematiche che risultano particolarmente problematiche per il caso-studio: pesca, equità di genere, uso sostenibile del capitale naturale, sviluppo di capacità per l'uso e la gestione efficaci dell'ambiente ed efficienza energetica.

Il presente Studio ha dunque lo scopo di comprendere con più chiarezza i meccanismi retrostanti i processi decisionali e l'implementazione di strategie di adattamento in una regione ad alta vulnerabilità come è il sistema lagunare Carmen-Pajonal-Machona, con un focus particolare sulle cinque aree tematiche risultate maggiormente sensibili. La dimensione istituzionale dell'adattamento, con i suoi limiti e le sue qualità, viene letta ed analizzata attraverso la lente della cooperazione istituzionale.

III. Materiali e metodi

La metodologia utilizzata per investigare il livello di cooperazione istituzionale è quella della Social Network Analysis (SNA) (Passmore, 2011), una tecnica dotata di una vasta applicabilità che l'ha resa adeguata all'utilizzo in varie e distinte discipline, dalla matematica alla sociologia. La SNA consiste nella rilevazione e riproduzione

grafica delle reti di relazioni (networks) esistenti tra vari attori sociali, che possono essere singoli individui, stati o organizzazioni - come nel presente caso. Lo scopo è quello di esplorare l'esistenza, la quantità e la qualità delle relazioni tra attori sociali per meglio comprendere i meccanismi di influenza esistenti tra di essi.

Una volta individuati gli elementi sulle cui relazioni s'intende focalizzare l'analisi, si procede alla redazione e alla distribuzione di un questionario o alla realizzazione di interviste, i cui risultati verranno poi sistematizzati in grafici per facilitarne la visualizzazione. Tali grafici, consistenti in segmenti che uniscono un attore all'altro, rappresentati come punti, possono essere *diretti* o *indiretti* a seconda che l'analisi delle relazioni si svolga in forma unilaterale o multilaterale. Nel presente caso i grafici sono unilaterali, ed i segmenti si convertono quindi in frecce per mostrare con più chiarezza da che prospettiva si analizzano le varie relazioni.

Per facilitare l'individuazione degli attori da includere nella SNA sono state realizzate ricerche puntuali a livello legislativo e di pianificazione federale e statale, che hanno permesso anche una maggiore comprensione del quadro normativo di riferimento per ciascuna tematica selezionata.

In seguito alla prima fase di ricerca, è emerso che la *Secretaría de Energía, Recursos Naturales y Protección Ambiental* dello stato di Tabasco (SERNAPAM)(SERNAPAM, 2015f), settorializzata in otto Direzioni, è designata normativamente come la principale istituzione operativa nel paese in materia di cambiamenti climatici: è infatti responsabile dell'implementazione delle norme federali e statali e della protezione e conservazione dell'ambiente, nonché dell'ideazione, creazione ed implementazione di politiche e strategie di adattamento che riflettano quanto espresso a livello federale nello stato di Tabasco, con una speciale attenzione all'inclusione trasversale della dimensione di genere.

Gli altri attori normativamente riconosciuti come rilevanti nei vari ambiti sono stati sistematizzati in tabelle, escluso il caso riguardante il tema dell'uso e gestione efficaci dell'ambiente, per il quale non sono state riscontrate normative che indicassero specificamente gli attori istituzionali ritenuti responsabili dell'implementazione a livello locale oltre alla SERNAPAM.

Successivamente, è stata svolta una fase di ricerca sui progetti e le iniziative attualmente esistenti a Tabasco e nella zona CPM, mantenendo il focus sulle cinque tematiche scelte, con lo scopo di verificare ed eventualmente integrare quanto espresso a livello normativo evidenziando eventuali discordanze tra le leggi e la

situazione effettiva, e prendendo nota di eventuali nuovi attori rilevanti non previsti dal quadro normativo.

Una volta ottenuti i risultati, si sono sommati gli attori rilevanti a quelli precedentemente identificati e si è proceduto a raggruppare le otto Direzioni di SERNAPAM secondo le aree di appartenenza.

Nella maggior parte dei casi, si è deciso di analizzare al contempo più di una Direzione per lo stesso tema, per sottolineare l'importanza di una visione congiunta da più prospettive delle questioni trattate, nel contesto dell'ideazione di strategie di adattamento efficaci.

Infine, si è passati alla redazione del questionario. Come menzionato sopra, per garantire l'efficace ed immediata comprensione dei suoi risultati, la SNA si avvale di una componente grafica: esistono diversi software di visualizzazione appositi ai quali si affida il compito di sistematizzare in grafici i dati ottenuti. Il software utilizzato in questa analisi è *NodeXL* (D. L. Hansen, Shneiderman, & Smith, 2011), una componente aggiuntiva del programma *Microsoft Excel 2007* per il sistema operativo *Windows*.

Il questionario del presente Studio presenta una struttura bipartita, che affianca aspetti *qualitativi*, comprendenti una serie di domande aperte alle quali i rispondenti possano dare le risposte che ritengano più opportune senza limiti di spazio, ad una parte più squisitamente *quantitativa*. La scelta è stata fatta a seguito di una revisione degli studi condotti finora (Bharwani et al., 2013; Edwards, 2010; Lange, Agneessens, & Waege, 2004). La prima parte del questionario è volta a ricreare un quadro preciso delle funzioni e dell'organizzazione delle varie direzioni in oggetto. La seconda, più specifica, si propone di valutare l'intensità e la frequenza delle relazioni mantenute dall'attore preso in considerazione con gli altri attori elencati. L'intervistato può definire i suoi contatti su una base di quattro livelli: "nessun contatto", "scambio d'informazioni", "coordinazione", "cooperazione" per quanto riguarda l'intensità; "mai", "a volte", "frequentemente" e "molto frequentemente" per quanto riguarda la frequenza.

L'idea iniziale era quella di distribuire i questionari attraverso Qualtrics[1], una piattaforma on-line per ricerca e creazione di questionari da computer o dispositivi mobili; tuttavia, dato lo scarso numero di risposte ricevuto in un primo momento, si

[1] http://www.qualtrics.com, ultimo accesso Ottobre 2015.

è proceduto a somministrare i rimanenti questionari per via telefonica, tramite colloqui diretti con i rispondenti. I colloqui telefonici si sono rivelati i contatti più proficui, fornendo risultati fruttuosi grazie all'immediatezza caratteristica del dialogo dal vivo e alla possibilità di ottenere informazioni esulanti le domande originarie, tramite l'utilizzo della tecnica d'intervista semi-strutturata.

IV. Risultati

Ciò che è emerso dalla prima parte dell'analisi, comprendente la ricerca normativa generale, quelle specifiche per macro-area e quelle progettuali, è in generale un vasto e ben strutturato quadro legislativo e di pianificazione tanto al livello federale quanto a quello locale. La cooperazione istituzionale viene promossa e raccomandata in maniera costante, così come l'inclusione e la partecipazione della sfera sociale nei processi decisionali per favorire la creazione di strategie di adattamento efficaci.

Tuttavia, si è riscontrata una profonda criticità rispetto all'implementazione a livello locale delle misure e dei principi prescritti. I risultati della SNA dimostrano uno scarso livello generale di cooperazione tra le varie istituzioni, avvalorando così l'ipotesi che la questione ambientale, e specificamente l'adattamento agli impatti generati dai cambiamenti climatici, non ricopra a tutt'oggi un ruolo prioritario all'interno dell'agenda dei governi e delle istituzioni locali, come invece appare ai livelli più alti di governance.

Inoltre, unendo ai risultati del questionario le informazioni aggiuntive ottenute durante i colloqui telefonici, è emersa la pressante presenza a Tabasco di problematiche con connotazioni sociali, che appaiono come gravi ostacoli all'implementazione delle misure e delle leggi esistenti. In particolare, i livelli di fiducia delle comunità locali nelle istituzioni locali e federali si sono rivelati criticamente bassi.

V. Raccomandazioni strategiche

Dal lavoro svolto sono scaturite alcune possibili raccomandazioni riguardanti future politiche da implementare nella regione CPM.

In primo luogo, sarebbe opportuno vigilare più rigorosamente sull'esistente applicazione dei quadri normativi esistenti, che si dimostrano vasti e ben strutturati, fertili dunque per l'attuazione di un processo di adattamento efficace. Per migliorare

l'attuale situazione, sarebbe perciò utile che le istituzioni formalmente incaricate eseguissero in maniera più completa ed efficace quanto espresso nei loro mandati.

In secondo luogo, l'approccio settoriale che è apparso come un elemento costante fra le istituzioni analizzate potrebbe essere ridotto attraverso una più stretta collaborazione tra i vari attori e la ricerca di maggiore trasversalità in politiche e progetti. In particolare, si rivela necessario integrare in maniera efficace la dimensione sociale, soprattutto alla luce del suo ruolo particolarmente significativo nell'attuale situazione del socio-ecosistema della zona CPM. Integrare tematiche con connotazioni sociali all'interno del discorso sull'adattamento permetterebbe alle comunità locali di capire, accettare e dunque legittimare le strategie proposte. L'obiettivo dunque dovrebbe essere quello di accompagnare le comunità locali verso la capacità di adattamento passo dopo passo, sensibilizzandole alle questioni riguardanti il clima, il loro ecosistema ed in ultima analisi il loro benessere. Azioni in questo senso potrebbero inoltre contribuire a colmare quel vuoto di fiducia nelle istituzioni riscontrato con la SNA.

Infine, le istituzioni dovrebbero promuovere con più efficacia la coscienza ambientale in tutti i settori sociali. A questo scopo, sarebbe opportuno instaurare una più vasta e attiva cooperazione con le università ed i centri di ricerca, con lo scopo di creare progetti ed iniziative che promuovano la cultura ambientale soprattutto tra i giovani.

Bisogna tenere sempre presente il ruolo essenziale che ricoprono le istituzioni nel favorire o sfavorire la capacità di adattamento delle società in cui operano: nessun processo di adattamento può avvenire all'interno di un vuoto istituzionale (A. Agrawal, 2008).

VI. Possibili direzioni per una futura ricerca

Visto l'interesse non prioritario riscontrato fra le istituzioni di Tabasco nei confronti delle problematiche ambientali e degli impatti generati dai cambiamenti climatici sui sistemi sociale ed ecologico, sarebbe interessante tentare di indagarne le cause principali. L'identificazione delle principali barriere all'adattamento potrebbe avvenire attraverso un'analisi più approfondita delle ragioni retrostanti la scarsa presenza di una coscienza climatica tra le istituzioni pubbliche. Per quanto riguarda la scarsa implementazione di progetti ed iniziative, sappiamo che le problematiche che interessano il tessuto sociale della zona CPM giocano un ruolo determinante come fattori di limitazione. Diventa dunque interessante quanto utile ricercare

opzioni concrete e *ad hoc* per la tutela e l'inclusione delle comunità locali all'interno del processo decisionale in ambito di adattamento. La via da seguire si configura come un processo di "capacitazione", letto nell'accezione del *Capability Approach* di Sen (1980), che permetta alle comunità di appropriarsi dei concetti base e delle buone abitudini legati ad una visione sostenibile dello sviluppo ambientale e sociale. L'obiettivo deve essere quello di offrire alla società gli strumenti necessari per dare vita ad un processo di adattamento efficace a fronte delle molteplici e multiformi sfide posteci dal riscaldamento globale.

Introduction

The importance of enhancing societies' adaptive capacities in the face of climate change has been highlighted in many occasions. Most notably, the recently adopted Paris Agreement identifies strengthening resilience and reducing vulnerability as crucial factors for the deployment of effective adaptation strategies, contributing also to the achievement of sustainable development (United Nations, 2015).

In this context, institutions are recognized as having an essential role to play. Acting both as limiting and enabling factors, they determine societies' vulnerabilities by shaping the way they will be affected by short and long-term impacts, and the ways they will respond to them. In particular, local institutions provide and allocate resources, determining who is going to benefit from the most recent and advanced technology to respond to climate change impacts (A. Agrawal, 2008). Moreover, they also act as bridges between communities and the external actors providing aid and support (A. Agrawal, 2010).

Given their particular relevance in the adaptation discourse, institutions have been included among the determinants of countries' adaptive capacity by the IPCC, along with other factors such as economic wealth, technology, information and skills, infrastructures and equity (B. Smit & Pilifosova, 2001).

However, institutions are not easy to define and therefore evaluate because of their complex and dual nature. On the one hand they appear in their formal dimension, consisting in the laws, rules and norms of society; on the other hand however, they are characterized by an informal level made up of habits, traditions, social norms and behaviours (Ostrom, 1990), which are equally crucial although more difficult to detect.

Given such intrinsic complexity, the institutional dimension of adaptation has not been explored much: the majority of studies define countries' adaptive capacity on the basis of more tangible proxies, such as economic wealth, often identified with countries' GDP (Grothmann, Grecksch, Winges, & Siebenhüner, 2013; Hinkel et al., 2013), leaving the role of institutions in the adaptation discourse poorly explored.

However, especially at the local level institutions play a pivotal role in producing and sharing information, mobilizing and allocating resources, developing skills and

capacity building, providing leadership, and most importantly *establishing networks* with other institutions (A. Agrawal, 2008). Institutional cooperation is indeed a crucial factor for the deployment of effective adaptation actions (IPCC, 2014a): by promoting both the sharing and dissemination of knowledge and experiences, it avoids duplication and favours the creation of better articulated policies (A. Agrawal, 2010). Especially in the local context, where institutions are the main mediators between local communities and external resources, a multi-sectorial vision is essential.

Consistently, the present work of Thesis investigates the level of institutional cooperation currently existing in the socio-ecosystem of the Carmen-Pajonal-Machona (CPM) lagoon system in Tabasco, Mexico. The location has been selected in light of the author's collaboration to the project *Plan of Adaptation Measures to reduce Vulnerability of Lagoon System Carmen-Pajonal-Machona, Tabasco, to Impacts created by Climate Change and Human Activities* (CMCC, 2014), which took place during the internship at the Euro-Mediterranean Centre on Climate Change (July-October 2015).

In order to assess the quantity and quality of the relations existing among the different institutions dealing with climate change and environmental protection in Tabasco and the CPM lagoon system, a Social Network Analysis methodology (SNA) was employed. The SNA allows for the reproduction, evaluation and graphic representation of the social relations connecting different actors, highlighting the different mechanisms of influence lying behind decision-making processes.

The present Dissertation is organized as follows. The First Chapter consists in an introduction to the role of institutions in the climate change context, focussing in particular on the concepts of adaptation, and adaptive capacity, and highlighting in particular the feature of institutional cooperation as a key determinant of adaptive capacity.
The Second Chapter presents the case-study and addresses its main socio-economic and environmental vulnerabilities, with a special focus on climate change-related issues, in order to provide the reader with the specific context of the area considered.

The Third Chapter presents the methods and materials used to carry out the institutional analysis. Firstly, a review on legislative and planning tools both at national and state levels is carried out to understand the main institutional actors formally recognized as in charge of implementation. Additionally, a research on the presence of projects on climate change adaptation practices in the CPM area is undertaken with the aim of identifying eventual discrepancies and other actors involved in the implementation process. The institutional actors identified are then clustered around five thematic areas, pointed out as the most problematic by the vulnerability assessment carried out in the first phase of the project (Ramieri et al., 2015). The areas are: fishery, gender empowerment, sustainable use of the natural capital, capacity development for environmental use and management and energy efficiency.

Finally, a Social Network Analysis is then performed to investigate the different degrees of cooperation existing among the actors selected.

The Fourth Chapter presents the results of the analysis. In particular, results from SNAs are systematized with the aid of the visualization software *NodeXL*, an extension of Microsoft Excel 2007 (D. L. Hansen et al., 2011), analysed and combined with the results of the normative review.

While the Fifth Chapter is devoted to the discussion of the results, Chapter Six provides the conclusions along with some recommendations followed by some possible future research pathways to continue investigating the institutional dimension of adaptation in the Carmen-Pajonal-Machona lagoon system.

1 The institutional dimension of adaptation

1.1 Adaptation, vulnerability and adaptive capacity

From a purely biological point of view, adaptation refers to the *ability* of an organism to respond to its surrounding environment (Darwin, 2005). A definition of a successful adaptation in the climate change context is provided by the IPCC in its Fifth Assessment Report (AR5), which describes it as "*transitioning* from a phase of awareness to the construction of actual strategies and plans in societies" (Mimura et al., 2014, p. 871). In this view, adaptation is seen as a *process* resulting in a specific outcome, which brings modifications to the natural or human systems in response to climate change (B. Smit & Pilifosova, 2001; IPCC, 2007, 2014a). Such definition of adaptation to climate change reveals its complex and context-specific nature, resulting in a heterogeneity of adaptation planning methods (Mimura et al., 2014). Such complexity stems from the fact that the defining elements of the adaptation concept are subjective and variable over time: socio-economic, cultural and political contexts, values, needs and perceptions of them change continuously among and within societies (Barnett & O'Neill, 2010; B. Smit & Pilifosova, 2001).

Human beings can perform two types of adaptation (Engle, 2011): the so-called *autonomous* or *reactive* adaptation takes place in response to stresses that already occurred. Experience revealed that this type of adaptation is the one usually taking place in the climate change context, due to the difficulties in predicting future climate developments (Barnett & O'Neill, 2010; Tompkins & Neil Adger, 2005). Such difficulties concern especially the global dimension of the problem, the lack of scientific certainties, and the sometimes very long periods of time needed for impacts to become visible (Tompkins & Neil Adger, 2005).

The other form of adaptation is *anticipatory* or *planned* adaptation, which conveys both an understanding of what future may bring, and the ability to learn from past experiences, to predict future impacts (Barnett & O'Neill, 2010; B. Smit & Pilifosova, 2001).

An effective adaptation process should convey abilities to both learn from past experiences and use the lessons learnt to face future challenges, included

unexpected ones (Brooks & Adger, 2004).

Adaptation is inherently connected to the concepts of vulnerability and adaptive capacity (Barry Smit & Wandel, 2006). The vulnerability of a human or ecologic system can be understood as the "propensity or predisposition to be adversely affected", as a result of a system's "sensitivity or susceptibility to harm and lack of capacity to cope and adapt" (IPCC, 2014b, p. 5). More in detail, adaptive capacity has been defined by Engle (2011) as the ability of a social system to overcome and mitigate the damages and to cope with the consequences of climate change impacts, trying to transform potential risks into opportunities through the mobilization of scarce resources. For the same reasons concerning adaptation, this concept as well is very context-specific and therefore difficult to identify and quantify (Barry Smit & Wandel, 2006): if indeed adaptation refers to the successful outcome of a process, adaptive capacity indicates the *potential* to carry out such process, without however guaranteeing that effective adaptation will take place (Noble et al., 2014). In this sense, we can define it as a *prerequisite* to any successful adaptation process.

1.1.1 Institutional determinants of adaptive capacity

Literature on adaptive capacity in the climate change field is not vast nor unanimous. However, we find general consensus on the inclusion of institutions among the discriminant factors of societies' adaptive capacities, along with other elements such as economic wealth, technology, information and skills, infrastructures and equity (B. Smit & Pilifosova, 2001).

Even though institutions provide the *enabling environment* for the successful creation and development of adaptive capacities, their role as potential enabler or barriers has not received much attention until the last years. Indeed, past researches have focused mainly on tangible economic assets, using proxies such as national GDPs to appreciate countries' levels of adaptive capacity (Aarjan Dixit, Gonzales, & Desmond, 2012; Hinkel et al., 2013; World Resources Institute, 2009). In doing so, they somehow left the institutional dimension of the adaptive process aside. However, to gain a better understanding of the institutional dimension is crucial to advance and give impulse to the adaptation process through the identification of adaptation needs, the appraisal of adaptation options and the planning and

implementation of adaptation measures. Moreover, it is also key to understand what may be the barriers preventing adaptation to take place.

To fully understand the institutional dimension of adaptation, we first need to explore more in depth what an institution is commonly conceptualized as. This demonstrated to be a relatively difficult task: according to Hodgson (2006), a consensual and unanimous definition among social scientists is still lacking, and even experts often prefer to get down to practical approaches to differentiate institutions from organizations, failing to be unanimous in their theoretical definitions (Hodgson, 2006).

For the sake of clarity, I will adhere here to the definition of institutions provided by Ostrom (1990): institutions are "tangible formal procedures, laws and regulations and tacit informal values, norms, traditions, codes, and conducts that shape expectations and guide actions among actors and organizations, serving as manifestations of institutions". This definition is very precise and useful in that it highlights the twofold nature of institutions: on the one hand, we have a *formal* set of rules, fixed and binding; on the other hand, we find a whole different dimension including all those *informal* structures, namely common and shared behaviours, traditions and other non-written, so-called *social* rules (A. Agrawal, 2008). These are clearly more difficult to detect, and yet they play a crucial role in the adaptation process.

Institutions appear therefore to be the "rules of the game" of decision-making processes, conveying both formal and informal dimensions. Anyway, as Hodgson points out, the two dimensions are intertwined and indissolubly linked, as legitimation of binding rules and norms is provided by society through an acceptance at the cultural and behavioural level (Hodgson, 2006).

The lack of sure data on how nature will react to shifts in levels of GHG emissions makes the work of institutions hard: probability-based decision-making frameworks are often not applicable, due to the scarce predictability of phenomena (Tompkins & Neil Adger, 2005). To tackle such difficulties, formal and informal institutions need to cooperate and build networks to permit adaptation in the socio-institutional system to take place (Pelling, High, Dearing, & Smith, 2008).

1.1.2 The local dimension

Given that adaptation is generally identified as a local process (Agrawal, McSweeney, & Perrin, 2008; Brooks & Adger, 2004), local institutions in particular represent a pivotal factor in determining which social groups are going to achieve adaptive capacity to climate change, and which ones will be excluded from assets and resources. Indeed, adaptation never takes place in an "institutional vacuum" (A. Agrawal 2008, p. 24).

According to Agrawal (2008), the types of local institutions which are relevant within the adaptation discourse are public, private and civil ones, both in their formal and informal dimensions. Their main roles in enhancing society's adaptive capacity include: "(1) shaping the impact of climate change on rural communities; (2) shaping the ways in which rural communities respond to climate change; and (3) acting as the intermediaries for external support to local climate adaptation" (Wang, Brown, & Agrawal, 2013, p. 1674).

Local institutions have therefore the ability to increase or diminish the effects of climate change on communities by keeping up to date with the technologies and providing them to the communities. Moreover, they improve societies' ability to respond by providing access to infrastructures and capital; and finally, their role as mediators and mainstreamers of the external interventions is pivotal to the effectiveness of local adaptation. Successful institutions in rural environments produce and share information, mobilize and allocate resources, develop skills and capacity building, provide leadership, and most importantly they *establish networks* with other institutions (A. Agrawal, 2008).

1.1.3 The importance of institutional cooperation

Only a limited number of studies provide us with criteria to assess institutional adaptive capacity: most of the literature refers exclusively to steps to be taken in order to obtain improvements in this sense, instead of focusing on criteria to be met (Gupta et al., 2010).

However, there is general consensus on the fact that to provide the *enabling environment* for adaptive capacity to develop within societies, institutions must provide different characteristics (Noble et al., 2014). Among those, *inter-*

institutional communication, *coordination* and *cooperation* are key. Indeed, to cooperate is to share and disseminate knowledge and diverse experiences, avoiding therefore duplication and favouring the creation of better articulated policies (A. Agrawal, 2010). Particularly in the local adaptation context, where institutions are the main mediators between local communities and external resources, it is essential to maintain a multi-spectrum perspective.

The concept of cooperation has a dual nature: on the one hand we find *vertical, multi-level cooperation* among institutions from the federal, national, and local levels. A successful cooperation framework should give the same space to both national and local initiatives, being thus a good mix of the top-down and bottom-up approaches often found in current socio-institutional environments (Mimura et al., 2014). Indeed, it is certainly positive for the national level to provide effective guidelines to local actors; however, excessive interventions by the national sphere could hamper local institutions' initiatives, leading to a system of dependence (Hinkel et al., 2013; Mimura et al., 2014; Pettengell, 2010).

The second type of cooperation is *horizontal, inter-institutional cooperation,* concerning different agencies and departments operating at the same level, which is valuable for avoiding duplication in policies and for building successful adaptation actions (A. Agrawal, 2010).

In addition to vertical and inter-institutional cooperation, it is important to stress that cooperation between institutions and *civil society* is also crucial. Indeed, the social dimension represents an absolutely pivotal factor in the adaptation process: adaptive capacity has been conceptualized as a *social-learning* and therefore *relational* process (Pelling et al., 2008). Helping communities get out of poverty is not enough to provide their adaptive capacity, while teaching them how to gain proactive adaptation is more important than the establishment of any specific adaptation measure (Pelling et al., 2008; Pettengell, 2010).

Particularly in the coastal zones case, approaches based on social learning through inclusive and participative institutions are considered essential to convey the social willingness to change that - along with the availability of an efficient technology - would lead to a successful adaptation process (Soriani, Buono, Tonino, & Camuffo, 2015; Tompkins & Neil Adger, 2005). Despite conveying a longer and more reflexed-upon process for decision makers, who need to continually test and re-discuss their

achievements, this learning-by-doing approach has indeed demonstrated to be more effective for successful adaptation outcomes (Olsen, Tobey, & Hale, 1998; White, 1994).

Regulations or norms imposed without pursuing to stimulate the abovementioned social willingness to change are bound to have little or no success at all. Social, cultural and economic environments where individuals live and develop their abilities are not less important than the normative framework governing them (Tompkins & Neil Adger, 2005).

2 The case-study

2.1 The state of Tabasco and the CPM area: geographical features

Tabasco (in green in Figure 1) is a federative entity of the United States of Mexico, located in the southeast and bordering the states of Campeche to the northeast, Veracruz to the west and Chiapas to the south, and the Petén department of Guatemala to the southeast. It has a coastline to the north with the Gulf of Mexico. The soil is characterized by low and humid plains with fluvial origins, mainly composed by clay, favouring the creation of numerous lagoons (SEMARNAT, 2006b).

Figure 1: The state of Tabasco. Source: Google images. Accessed on November 23rd 2015.

Figure 2 represents the CPM lagoon system. As can be noticed, the system is composed by three lagoons: the El Carmen and La Machona lagoons are located at the left of the Mezcalapa river and are connected by the little one El Pajonal. They lie on a plain formed by the delta of the rivers Mezcalapa, Grijalva and Usumacinta, and are separated from the Gulf of Mexico by a very narrow coastal bar (Buenfil Friedman, 2009b).

Figure 2: The Carmen-Pajonal-Machona lagoon system. Source: Google earth. Accessed on November 23rd 2015.

From an administrative point of view, the state of Tabasco is divided into eighteen municipalities, as presented in Figure 3. As can be noticed, the three municipalities nearest to the CPM lagoon system are those of Cárdenas, Comalcalco and Paraíso, all of which present socio-economic and environmental criticalities which will be addressed in the following pages.

Figure 3: Political division of the state of Tabasco. Source: Google images. Accessed on November 23rd 2015.

2.2 Vulnerabilities of the socio-ecosystem

The human and ecologic realities are highly interdependent in the CPM lagoon system: most of the issues affecting economy and human welfare have indeed implications reflected in similarly serious damages to the environment and the ecosystem's life, and vice versa. The next paragraphs will therefore address the main economic, social and environmental issues affecting the area.

2.2.1 Economic and social challenges

To the present day, the most important contribution to Tabasco's GDP still belongs to the secondary sector (mining, construction and electricity sectors, water and gas and manufactory industry), dominated by the production of oil and gas (Secretaría de Economía, 2015). However, despite the "petrolization" of its economy, Tabasco still plays an important role in the production of agricultural and livestock products, keeping its position as first national producer of cacao and edible yucca (CEPAL, 2012).

Since the 1960s, the whole state of Tabasco experienced some drastic changes concerning its economic and productive structure. The following paragraphs will provide a review of the main challenges undergone by the socio-economic system, with a special focus on the three municipalities belonging to the CPM area.

2.2.1.1 Agriculture

Agriculture, along with the livestock and forestry sectors, is the most vulnerable field when it comes to climate change impacts in Tabasco. Indeed, the Agriculture, Livestock and Forestry Census carried out by INEGI in 2007 (INEGI, 2012) shows that the most relevant issues concerning Tabasco's productive units are climatic: inundations, frosts, droughts, strong winds, hails, erosion and salinity are just some of the most relevant. Moreover, 97.9% of the agricultural surface is depending totally or partially on rains for the growth of cultivations, which is another factor improving the climate vulnerability of the area (INEGI, 2012). The expansion of cattle industry, developed mainly between the 1950s and the 1970s, also had a relevant role in the progressive contraction of the agricultural surface, converting one million cultivated hectares into ranches (Vidal, Morales, & Arturo, 2014).

The municipality of Cárdenas, the biggest among the three surrounding the CPM lagoon system, represents the headquarters of the so-called "*Chontalpa Plan*" (1965), an economic project created by the federal government involving the Chontalpa sub-region, composed by the municipalities of Cunduacán, Cárdenas, Comalcalco, Huimanguillo and Paraíso (INAFED, 2015). The aim of the Plan was to improve state economy through the moving of rural communities towards more urbanized areas, and the use of rural lands for the promotion and implementation of the region's agropecuary development through the production of corn, cocoa, rice, banana and citrus cultivations. The project, still in process, has xsencountered some difficulties in its implementation (Pinkus-Rendón & Contreras-Sánchez, 2012): on the one hand, some cultivations did not develop as well as predicted and expected; on the other, rural communities, despite beneficiating of important improvements in their lifestyles (Pinkus-Rendón & Contreras-Sánchez, 2012), all at once saw their traditional demographic organization completely altered. From being based on typical settlements such as small ranches, where extended families used to live together, the new clusters are indeed lacking effective mechanisms for social integration of the new inhabitants and this has led to an atmosphere of reciprocal distrust and hostility, decreasing overall social welfare (Arrieta Fernández, 1994).

2.2.1.2 The mining sector

The second profound change experienced by Tabasco's socio-economic system started at the end of the 1970s: in those years, a remarkable development process began, stemming from the boom of the oil industry related to the discovery of wide oil fields in the area among the town of Reforma y Juárez (Chiapas) and the municipalities of Cunduacán, Cárdenas and Comalcalco (Tabasco) (Beltrán, 1988).
The rapidly acquired primacy of the mining sector gradually altered the productive structure – dominated until then by the primary sector – and further boosted the urbanization process, contributing to the phenomenon of the abandonment of fields promoted by the Chontalpa Plan. In 1940, agricultural products represented 70% of the GDP, whereas in 1970 their contribute was only 14%, and in 1980 they constituted only 3.6% of total Tabasco's GDP (Campos, 1996). Today, the economic aggregate value of the three municipalities of Cárdenas, Comalcalco and Paraíso is almost totally provided by the mining sector and oil extracting activities, reflecting

the situation of Tabasco, in which the mining industry represented 67% of the GDP in 2013 (Secretaría de Economía, 2015).

In the context of the mining sector, the most relevant and almost unique actor present in Tabasco is the multinational oil extracting firm *Petróleos Mexicanos* (Pemex), performing activities of exploration, exploitation, refining, and storage. Created by the Mexican government as a public institution in 1938 (Gobierno Mexicano, 1971), it started its activities in Tabasco in 1975, as soon as oilfields started to be discovered in the area. Its installation in the zone provoked a wave of social protests among local farmers and fishers, who reported damages to their own welfare and that of land and water. Such movements led in 1976 to the foundation of the *Pacto Ribereño* (Coastal Dwellers' Agreement), strongly demanding the cessation of oil explorations and pretending compensations for the damages allegedly suffered (Coerver, Pasztor, & Buffington, 2004).

We can therefore say that since its settlement in the area, the relations between Pemex and local communities proved to be problematic. However, in the 1980s the situation badly worsened as Pemex gained more and more authorizations by the federal government for the use of extracting machineries, to the detriment of fishers, who were forced to migrate from their original fishing locations and testified an increasing degree of pollution in the water which additionally hindered the quality and quantity of fishing.

In 1992 there was a breakdown: the fishers' community called upon Mexico's National Commission on Human Rights to report human rights violations by Pemex, and the Commission emitted a recommendation for the Director of the oil firm (Comisión Nacional de los Derechos Humanos de México, 1992). The main points included: reparations for the damages caused to the fishers and other locals' properties; an in-depth investigation on the negligent actions that brought about the accidents with the identification of the responsibilities; a commitment to prevent future damages and regenerate and protect the natural resources of the state of Tabasco in the areas where extracting activities are carried out. However, no additional measures were subsequently taken in this direction.

Since its integration in Tabasco's territories, Pemex has been entertaining strong relations with the government and some municipalities (Arias Rodríguez & Ireta

Guzmán, 2009), and also with some universities in the area, signing contracts that have often been criticized by local NGOs and the public opinion due to their alleged lack of transparency (Arias Rodríguez & Ireta Guzmán, 2008).

2.2.1.3 Fishery

With regards to fishery, Tabasco is today the main provider of ribbonfish, flag fish and sea bass (CEPAL, 2012). This sector is particularly developed in Paraíso, specialized in the breeding of tilapia fish and cultivation of oysters' seeds. Cárdenas instead relies principally on traditional fishing (Sánchez, Vidal Fócil, Morales Méndez, & Méndez Olán, 2014). Oyster production in Cárdenas decreased dramatically in the last years, due to the ecologic changes in the area, among which an increase of the sedimentation and salinization rates and changes in hydrodynamic conditions.

2.2.1.4 Human Development

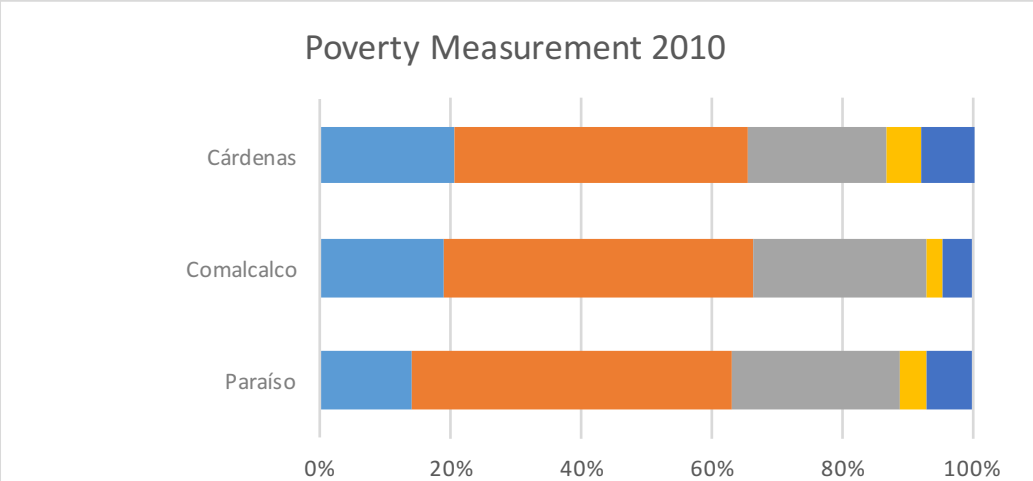
Even though the oil sector allowed Tabasco to reach a relatively stable economy, such stability did not reach the social sphere: in 2010, 57.3% of the population of Tabasco lived in a state of poverty, a higher rate than the national average of 46.3%, and even more significant if we think that 13.6% of that percentage of population was experiencing extreme poverty conditions (Gobierno del Estado de Tabasco, 2013b).

If we take into account other indicators of human development, Tabasco is still under the national average. In 2012 it was 17th out of the 32 federative entities of Mexico according to the United Nations' Human Development Index (HDI) (United Nations Development Program, 2015).

Among the three dimensions considered by the HDI (health, education and income), the lowest value can be found in the income proxy, referring to the access to resources for a decent life. In 2012, Tabasco was 20th, slightly under the national average (United Nations Development Program, 2015).

Considering the poverty indicators, Graph 2-1 illustrates the percentage of people in Cárdenas, Comalcalco and Paraíso suffering an extreme or moderate state of poverty, or who are susceptible to experiment some type of social or income deficiency. As can be noticed, the total number of people living above the minimum level of poverty and social vulnerability is extremely low. Among the three municipalities, Paraíso relies on the best situation, while Comalcalco records the

highest poverty rate, with a cumulative value of 66.1%. The rate of social issues affecting the communities is also notably high, similarly affecting more than 20% of the population in all three municipalities considered.



	Paraíso	Comalcalco	Cárdenas
Extreme Poverty	13,9	18,9	20,4
Moderate Poverty	49,3	47,2	44,9
Vulnerable for social issues	25,5	26,6	21,5
Vulnerable for income	4,2	2,8	5,3
No poor and no vulnerable	7	4,5	8

Graph 2-1. Poverty Measurement in Cárdenas, Comalcalco and Paraíso (2010). Own elaboration with data from: CONEVAL, 2010.

2.2.2 Environmental challenges

2.2.2.1 The Gulf of Mexico wetlands and the CPM lagoon system

The Gulf of Mexico is considered as one of the broadest, most productive and richest ecosystems of the planet, hosting more than 75% of all Mexico's coastal wetlands (Day, Díaz de León, González Sansón, Moreno- Casasola, & Yañez-Arancibia, 2004). Most of the national fishing products are from there, and mangroves cover a total area that exceeds 450 square miles, being considered the characteristic vegetation of the area (Buenfil Friedman, 2009b).

The wetlands ecosystem is particularly delicate: it consists in a transitional area between water and land environments, and is considered a dynamic and indivisible system (Buenfil Friedman, 2009a). Wetlands are extremely important thanks to the

environmental services they provide, among which the production of fish, fruits, clean water and wood, representing the sustenance for millions of Mexican citizens (Buenfil Friedman, 2009a).

Wetlands are also the habitat of diversified wild and water fauna: many endangered species find their shelter in them, and Tabasco in particular is home to a variety of migratory birds (CONABIO, 2013a).

However, the Gulf of Mexico's coastal zone is characterized by the occurrence of a high number of extreme climatic events, such as hurricanes and droughts, which classify it among the most vulnerable zones to climate change (Buenfil Friedman, 2009a).

Most of the vulnerability factors stem from human activities: among the most relevant we find deforestation due to the expansion of cattle industry; overfishing; tourism and contamination caused by oil extracting activities (Buenfil Friedman, 2009a), which brought about severe modifications in the hydrologic system, in addition to general environmental degradation (Gobierno del Estado de Tabasco, 2013b).

Figure 4: Aerial view of the Carmen-Pajonal-Machona lagoon system. Source: Google images. Accessed on November 23rd 2015.

Figure 4 represents a panoramic of the CPM lagoon system. As can be noticed, the coastal bar separating the three lagoons from the Gulf is very narrow (35 kilometres

long and from 300 to 600 meters wide) (Buenfil Friedman, 2009b), increasing the lagoon system's vulnerability to floods. The lagoon system has been declared priority land, marine and hydrologic region by the National Commission for the Knowledge and Use of Biodiversity (CONABIO) (CONABIO, 2008b, 2008c, 2008d), and is currently in process to be recognized as a protected area by the National Commission for Protected Natural Areas (CONANP). Both the high vulnerability of the CPM ecosystem and its being host to a great variety of protected species (Buenfil Friedman, 2009a) set out as the main reasons for these choices. The vegetation surrounding the system is characterized by tropical woods of mangroves up to 4 meters high, the distribution of which is determined by tide, sweet water availability, sunlight, temperature and type of sediments (Gutiérrez Estrada & Galavíz Solís, 1983). In the southern part, the mangroves grow scarcely due to their exposure to the erosion caused by the train of waves.

The lagoon system communicates with the Gulf of Mexico through two inlets: the first one is Boca Santana, of natural origins, located at the north-west of El Carmen lagoon. Its current main vulnerability is silting. The second inlet, Boca de Panteones, lies at the north-east of La Machona lagoon. Created artificially in 1975, it has a key role in enhancing the ecosystem's vulnerability: it caused great amounts of water to invade roughly 60.000 hectares of land, and salinity brought about a series of phenomena that had repercussions in Tabasco and possibly the whole country of Mexico (Gutiérrez Estrada & Galavíz Solís, 1983). Among them, considerable changes in the hydrologic regime, disappearance of oyster banks - to the detriment of fishers -, salinization of land apt for cattle breeding and overall raise of extreme sea events appear as the most relevant (Buenfil Friedman, 2009b). Moreover, it is now suffering a high degree of erosion (Rivillas-Ospina et al., 2014).

Contamination by hydrocarbons due to Pemex' activities in the Dos Bocas port is also a very urgent problem affecting the area, along with the alteration of the physical-chemical characteristics of the lagoon bodies and their inundation zones due to the Boca de Panteones opening (Buenfil Friedman, 2009b).

Contamination of water does not belong exclusively to the mining sector: urban and industrial centres' waste pollutes rivers and streams and has become a serious problem, as the velocity of the rivers' flow has diminished concentrating all residuals in open-air dumps (Buenfil Friedman, 2009b).

Another problem affecting the CPM lagoon system is represented by the deforestation of mangroves, due especially to the expansion of cattle industry land and unregulated tree cutting that makes the zone more vulnerable to flooding and inundations (Buenfil Friedman, 2009b).

3 Methods and material

3.1 Structure of the analysis

The Study on formal institutions dealing with climate change and environmental protection in Tabasco was carried out through:

- An analysis of the legal and planning instruments at Mexico's *federal* and *state* level with reference to five thematic areas of primary importance for the socio-ecosystem;
- A research on the presence of concrete projects and initiatives in the CPM area and in Tabasco for each topic; and
- Eight Social Network Analyses (SNA) among the relevant actors, clustered according to the five themes selected.

3.2 Methodology

The following lines delineate the different methodologies used to analyse Tabasco's formal institutions.

Given the fragilities and vulnerabilities of the socio-ecosystem presented in Chapter 2 and identified in the Diagnostic of the CMCC project (Ramieri et al., 2015), the institutional analysis will be focused on the following five themes: fishery, women's empowerment, sustainable use of natural capital, capacity development for environmental use and management and renewable energies. A wider description of each thematic-area and their relevance for the case-study is provided in the homonymous paragraphs in Chapter 4 (4.2.1, 4.3.1, 4.4.1, 4.5.1, 4.6.1).

As to the normative analyses, they consist in a review of different documental sources, especially of legislative character, dealing with climate change and environmental protection, with a specific focus on the five themes considered. A synthetic-analytic process on federal and state laws, strategies, plans and programs is carried out, with the aim of identifying the institutions *formally* recognized as relevant in each field.

Subsequent to the normative analyses is the research on projects active in the CPM area, carried out with the specific objective of evaluating the presence of synergy between what mandated at the normative level and its reflection in local implementation, highlighting eventual contrasts and identifying additional actors

carrying out activities locally.
Once identified the relevant actors, their social relations are then analysed through the Social Network Analysis method, to which the next paragraphs are dedicated.

3.2.1 Social Network Analysis: definition and brief history

Social Network Analysis has been exhaustively described by Wetherell, Plakans and Wellman (1994) as a strategy which:

- Conceptualizes social structure as a network with ties connecting members and channelling resources;
- Focuses on the characteristics of ties rather than on the characteristics of the individual members; and
- Views communities as personal communities, that is, as networks of individual relations that people foster, maintain, and use in the course of their daily lives (Wetherell et al., 1994, p. 645).

SNA aims therefore at exploring the types of relations existing between different actors: their *networks*. To do so, it relies on oral interviews or questionnaires directly distributed to the respondents, to obtain the information that will subsequently be systematized through the appropriate visual software (Edwards, 2010).

Even though some authors recognize the birth of SNA even before the thirteenth century (Freeman, 2011), its conceptual development from mathematical graph theory and sociometry is considered to belong to the 1930s, with Moreno as a pioneer in this sense (Edwards, 2010). After him, Barnes is generally considered to be the first one to systematize and practically apply SNA in social sciences in 1954, using the term to indicate the patterns of ties constituting the social environment of a community living in a Norwegian island (Lucas & Mayne, 2013; Passmore, 2011).

SNA has since been used for a variety of purposes and in a wide range of disciplines and areas of research including economy, psychology, mathematics, health and social security (Lucas & Mayne, 2013; Stephen P. Borgatti, Ajay Mehra, Daniel J. Brass, 2009), and has become increasingly popular in the last decade both in physical and social sciences (Stephen P. Borgatti, Ajay Mehra, Daniel J. Brass, 2009).

Particularly relevant is one of SNA's most recent uses, belonging to the environmental sustainability field, which sees it as playing a pivotal role in the adaptation process: in particular, it has been used to assess social and institutional networks (individuals, organizations, interest groups) and their interconnections, identifying the contexts and influences behind decision-making (Bharwani et al., 2013).

SNA in the adaptation context departs from the notion that some social and institutional barriers to adaptation do exist, and tries to reveal and defeat them. To do so, it maps the levels of influence among institutions, investigating the exchange of information and the coordination among them (Bharwani et al., 2013).

SNA has been differentiated into two types (Bharwani et al., 2013; Lucas & Mayne, 2013) ,quantitative and qualitative. They differ principally in that the first relies on a higher number of sample and to be reliable it often needs to be repeated over time, while the second is characterized by a lower quantity of samples and by being ego-centric, meaning that it is based on the perception of just one actor (ego) (Bharwani et al., 2013).

3.2.2 Terminology

Social network analysis and its various types of visualization software rely on a specific terminology to address the elements represented and their different relations. The most relevant for this Study are explained below, following the systematization by Lucas and Mayne (Lucas & Mayne, 2013).

First of all, an *actor* is any social entity: it can either be represented by one individual, a corporation or an organization, as in the case considered in this Study. The actor may also be referred to as a *node* or a *vertex* when visually represented. The main actor within a social network is called *ego*, meaning that it is the actor from which all the data to reproduce the social network are gathered. It is therefore the key respondent of the questionnaire or interview.

Secondly, the threads connecting one actor to the other and representing the different types of relations are usually called *ties* or *edges*. They can represent

different types of relations, such as information interchange, coordination or national relations.

Moreover, the graph representing the different relations may be *directed* or *undirected*. In the second case, to which this analysis pertains, the edges are added an *arrow* at one end, signalling that relations are considered unilaterally from the ego's point of view.

Finally, *degree centrality* represents the feature according to which one node is more or less "popular": it measures indeed the number of links incident upon a node. In the case of an undirected graph, such feature is divided into two: *in-degree* centrality and *out-degree* centrality. The first one depends on the number of ties *directed to* a node, whereas the second one to the number of ties *departing from* the node. Given that our analyses are directed, only out-degree centrality was relevant for this Study.

3.2.3 Identifying the actors

3.2.3.1 The "ego"

The *Secretariat on Natural Resources and Environmental Protection* (SERNAPAM) is Tabasco's main institution in charge with the promotion and fostering of environmental protection and conservation in respect of cultural diversities, native communities and fostering gender equality, in coordination with the three levels of government and civil society (SERNAPAM, 2015f).

As stated by *Tabasco's Organic Law on the Executive Power* (Gobierno del Estado de Tabasco, 2002, art. 38 bis), SERNAPAM is the responsible actor for the application of environmental policy in Tabasco. For this reason, it is entitled for the application of the normative framework referring to environmental protection.

Moreover, as mandated in its Internal Regulations, SERNAPAM should promote, execute and evaluate programs, policies, actions and strategies for sustainable development and environmental protection in the state, and foster social reappraisal of natural resources and the environment (Gobierno del Estado de Tabasco, 2013c).

Concerning climate change, the Secretariat is also in charge with activities related to normativity and design of public policy tools, along with the evaluation of areas considered to convey social, economic and environmental impacts. Moreover, it

should also be providing actions to raise awareness and strengthen adaptation and mitigation efforts (Gobierno del Estado de Tabasco, 2013c).
From the operational point of view, SERNAPAM actively designed Tabasco's *State Program of Action against Climate Change* (PEACC) (Gobierno del Estado de Tabasco, 2011c), and is currently designing the new *State Strategy for Climate Change* (COMESFOR & SEDAFOP, 2011), both normative and planning instruments that will be addressed in the Results Chapter (4).

In light of its pivotal role in the creation of Tabasco's main normative tools on climate change and environment, along with its functions designated by law, SERNAPAM was selected to be the ego of the present analysis. At the graphic level, SERNAPAM's role is translated into the presence of arrows at one end of the threads connecting it with the other actors, signalling the perspective from which the relation is analysed.

The Secretariat is divided into four Subsecretariats; the analysis will be limited to three of them, in light of their particular relevance with regards to the five themes considered: the first one is the *Subsecretariat for the Promotion of Environmental Policy*, in which we find the *Direction for Climate Change Policies* and the *Direction for Environmental Culture.*
The second one is the *Subsecretariat for Sustainable Development,* which includes the *Direction for Communitarian Development*, the one for *Social Involvement* and the one for the *Use and Management of Natural Resources*.
The third organ considered is the *General Direction on Energy*, which is the youngest among SERNAPAM's organs, seeing the light only in 2012. The General Direction itself is composed by three Directions, each of which deals with energy from a different perspective: *Energy Development*, *Energy Efficiency and Responsible Consumption* and *Research and Technology of Sustainable Energy*.

3.2.3.2 The other actors

While the identification of the main actor (ego) relied exclusively on *a priori* research, the other actors were identified in two ways: in addition to the legislative reviews and the projects research, the so-called *name-generator* or *snowball*

technique (D. L. Hansen et al., 2011; M. Kowald & Arentze, 2010; Matthias Kowald & Axhausen, 2012; Passmore, 2011) was used. Such method consists in asking the first respondent if he or she would like to add some names to the already given list of actors, and then including them in the new list for the following respondents. This technique demonstrated to be quite satisfactory and useful in terms of results, beyond being quite time-effective.

Once the most relevant actors for the analysis were identified, the SNA questionnaire was created and distributed.

3.2.4 The questionnaire

Given the positive results previously obtained by mixing quantitative and qualitative methods in SNA data collection (Edwards, 2010), this approach was followed in the redaction of the questionnaire for this SNA (Annex).

The first part – qualitative – presents a semi-structured section composed of five open questions aimed at identifying the main functions of each Direction, their involvement in the CPM lagoon system reality and their relationship with local communities.

The second part – quantitative – consists in a section in which the names of the relevant institutions at the local and federal level are listed. Institutions are clustered into three groups, following partially the division proposed by Bhagavan and Virgin (2004). The third category, civil society organizations, was indeed substituted by that of *State government entities*, due to the limited presence of NGOs and similar entities in the area.

- *Knowledge-generating institutions*: Universities and departments, research institutes or centres within and outside the university system, etc. (Bhagavan & Virgin, 2004, p. 3)
- *Federal Government entities*: Ministerial departments, policy-making authorities, regulatory authorities, environment protection agencies, science and technology commissions, national research councils, etc. (Bhagavan & Virgin, 2004, p. 3)
- *State Government entities*

Subsequently, the respondents were asked to evaluate the strength of their relationships with the actors on the basis of two indicators, the so-called matrices: the *quality* of the relations and their *frequency*. Such differentiation was made to provide more precise and detailed outcomes, that reflect as faithfully as possible the current institutional network operating in Tabasco. Indeed, the two dimensions are deeply intertwined in the definition of a relationship: intensity alone does not tell us anything about how often two institutions cooperate; on the other hand, the frequency matrix alone does not mean that the actors are actually cooperating, concretely contributing to the adaptation process.

The answers for the first matrix – intensity – could be given according to the following four-degree range:

0= no contact

1= interchange of information

2= coordination

3=cooperation

For the second matrix – frequency – the four levels were:

0= never

1= sometimes

2= often

3= quite often

Such four-degree range was chosen in light of the results of the study conducted by Lange, Agneessens, and Waege (2004), which highlighted the importance of *asking the right questions* to minimize the phenomenon of *non-response*. With this regard, *factual* and *direct* questions are to be preferred to hypothetical ones, because of their capacity to provide more detailed information. By including the "no contact" and "never" answers respectively in the intensity and the frequency questions, it was therefore possible to distinguish a missing answer from the absence of a relation, as exemplified also by Lange et al. (2004).

3.2.5 Challenges encountered

The most challenging aspect of the editing and distribution of the questionnaire was the phenomenon of *non-response.* Indeed, the questionnaire was supposed to be administered entirely by "Qualtrics"[2], an on-line platform for research and creation of surveys by computers or mobile devices. However, despite the easy procedure to access the questionnaire (the direct link was sent by e-mail), many respondents did not fill in the questions. Due to the initial scarcity of responses, the majority of the questionnaires was then distributed through direct phone calls.
Despite some initial pessimism linked to an apparent lack of interest in the project, the cases in which direct communications were made turned out to be the most interesting and useful, because they allowed the opportunity to get personalized information that often lied outside the original questions posed.

An important issue to keep in mind when structuring a questionnaire is that questions perceived as particularly sensitive or privacy-invading are usually the ones with the highest number of non-respondents (Lange et al., 2004). Interestingly, in the present case the most "embarrassing" question, which was often responded to vaguely or partially, was the one aimed at exploring the relationships existing between the Directions and local communities living within the CPM area (Annex, question 4.1). This aspect, particularly visible in the fishery context, will be considered in the Results Chapter (4.2.5).

3.2.6 Analysis and visualization of data: *NodeXL*

Once obtained the data, these were systematized and graphically represented through the *NodeXL* software, a Microsoft Excel 2007 complement which permits to visualize and analyse networks through graphs (D. Hansen, Shneiderman, & Smith, 2011). The two parameters used to evaluate the relations were represented as follows: a range of colours starting from light orange up to dark blue represent the three grades of *intensity* of the relations (for the sake of clarity and immediacy, those actors whose relations were found to be null were not included in the graphs: there are therefore just three levels). On the other hand, the three levels of *frequency* are represented by the thickness of the thread linking the two institutions.

[2] http://www.qualtrics.com, last accessed October 2015.

The two matrices are then combined creating different combinations of colour and thickness that can accurately define the relation. As an example, a lilac, thin thread will therefore indicate that the contact between the two institutions considered is relatively intense, and yet does not occur on a frequent basis.

In each graph, the nodes are going to be represented as *circles* when they belong to the federal level; as *triangles* when they belong to the state or local level and as *squares* when they belong to the academic and research sector. The egos are going to be represented by black disks, whose dimension varies according to their *out-degree centrality*. Labels indicating the actors' name are placed next to each of them. In some cases, the names have been substituted with acronyms: this will be adequately underlined beforehand, and has been done to avoid too long names to interfere with a proper visualization of the graphs. As previously mentioned, the graphs representing this SNA are *directed*; the edges terminate therefore with an arrow signalling that the relation is judged taking into consideration uniquely the *ego*'s point of view.

The eight different Directions were clustered according to the theme(s) they appeared to be most involved in. For the sake of clarity and to favour explanation, each graph will be followed by another version representing only the relations of coordination and cooperation. Simple interchange of information is indeed seen as less relevant for the creation of adaptive capacity. At the beginning of each SNA, specific reasons will be provided to justify the combination of the different Directions.

To appreciate the level of *internal* cooperation among the different Directions of SERNAPAM, the ones not acting as egos in each graph were also included among the actors: under the label "SERNAPAM" are thus considered each time all SERNAPAM's Directions except the one acting as ego in the graph considered. It was possible to cluster all the different Directions under an individual edge because the responses were almost always univocal. In the only case in which they were not, it will be explicitly mentioned in the relative SNA, and extra threads will appear representing the different relations, followed by a label with the actors' name.

4 Results

This Chapter is divided into two main sections. The first one presents the normative framework on climate change and environmental protection at the federal and state (Tabasco) levels, from which the majority of laws and programs stem from. The twofold aim is to both highlight how inter-institutional cooperation is fostered at the different levels of governance, and to analyse and discuss the reception of norms and strategies from federal to state levels of governance.

After the insight on the normative framework, the second section is divided into five parts, each of which aims at exploring the normative framework and the levels of institutional cooperation within the thematic areas constituting the focus of this Study. The macro-thematic areas include: fishery, gender empowerment, sustainable use of natural capital, capacity development for environmental use and management and renewable energies. Their relevance for the case study is outlined in the introductory paragraph of each section. Introductions are followed by an insight on the normative and planning framework at the federal level, carried out with the aim of understanding the relevance of the issue in federal governance, and revealing the institutional actors officially in charge of implementation. Subsequently, a second paragraph substantiates the results with an investigation on their reception and synergy at Tabasco's state level. A third paragraph investigates the presence of supporting projects dealing with the areas considered and involving the CPM area, identifying other relevant actors. Finally, the last paragraph of each section presents the results of the SNAs performed to investigate institutional cooperation among the institutions considered.

4.1 The normative framework

4.1.1 The General Law on Climate Change (LGCC)

The *General Law on Climate Change*, adopted in 2012, aims at providing a legal framework for the regulation of the mitigation and adaptation policies among the different levels of government and promoting the transition to a competitive low-carbon economy (Gobierno Mexicano, 2012b).

Interestingly, the LGCC is one of the first climate laws in the world, and the first one created by a developing country (Climate Action Tracker Partners, 2014).

The LGCC is particularly relevant in that it renewed Mexico's institutional architecture on climate change (Figure 5) through the creation of the *National System for Climate Change* (SINACC). SINACC is a platform of action supposed to work as a permanent mechanism of concurrency, communication, collaboration and coordination on federal climate change policy. Its main objective is to promote the transversal application of measures in the brief, medium and long term, through all the three levels of government.

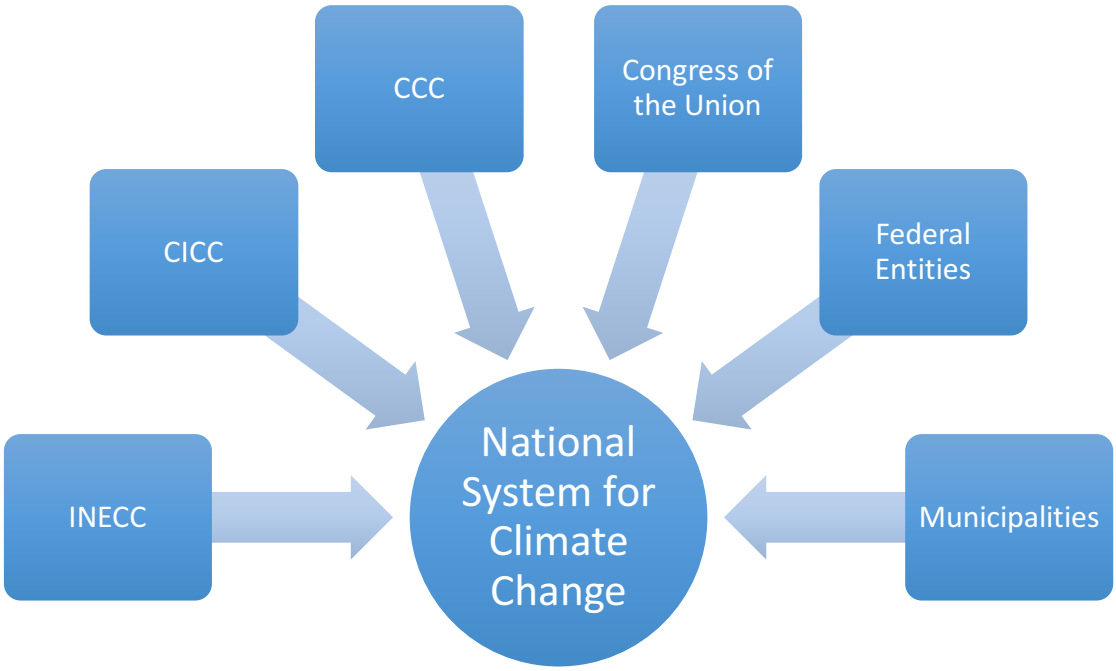


Figure 3: Mexico's National System for Climate Change (Source: ENCC 2013. Own elaboration).

The SINACC is composed by six elements (Figure 3). The INECC (Institute for Ecology and Climate Change) is a decentralized organ of the PA in charge of investigation on biosecurity, sustainable development, environmental protection, preservation and restoration of the ecologic equilibrium, and conservation of the ecosystems (Gobierno Mexicano, 2012b). It operates with consultants from different sectors of society: academic, scientific, technical and industrial. The head of INECC forms part of the Evaluation Commission, which periodically evaluates the country's achievements in terms of emissions reduction and policy implementation.

With the abrogation of the *Agreement on the Creation of the Intersecretarial Commission on Climate Change*, signed in 2005 (Gobierno Mexicano, 2005), the LGCC reformed the previous *Interministerial Commission on Climate Change* (CICC). The

new Commission is now composed by the members of the main institutions working within the climate change field: SEMARNAT, SAGARPA, SALUD, SCT, SE, SECTUR, SEDESOL, SEGOB, SEMAR, SENER, SEP, SHCP, SER and SEDATU (see Acronyms). The Commission is articulated into different working teams, whose most relevant new functions include the promotion of coordination within the actions of the public administration.

Like its predecessor, the CICC counts on a permanent consulting body: the *Climate Change Council* (CCC). With the objective of integrating the different actors working or interested in collaborating with climate change issues, the CCC is composed by at least fifteen members of the private, social and academic sectors, who are elected by the President of CICC (Gobierno Mexicano, 2012, Title 5 Chap. III).

The Congress of the Union, the governments of the federal entities and the association of municipal authorities also form part of SINACC, contributing to widen up the regulatory and planning frameworks.

Finally, in its article 58 the LGCC considers as additional planning instruments the *National Strategy on Climate Change* (ENCC), the *Special Climate Change Program* (PECC) and state and local programs of the federal entities (PEACCs).

The following paragraphs provide an overview of the two planning instruments mandated by LGCC, as they offer a useful insight on the institutional network in charge of the adaptation strategies in the different sectors.

4.1.2 The National Strategy on Climate Change (ENCC)

The strategy, currently at its second edition, sets out to be the main instrument of the national long and medium-term policy. Its main objective is to bring Mexico to a sustainable, low-carbon economy and to provide the lines of action for the three levels of government to reach this goal. Concerning adaptation, the ENCC aims at reducing vulnerability to climate change in the social sector, in the strategic infrastructure and in the productive systems. Moreover, it pursues to increase their resilience and the preservation and sustainable use of the ecosystems (Gobierno Mexicano, 2013a). It is subordinated to the approval of the CICC.

Due to its medium and long-term focuses, the ENCC does not set as its objective to indicate concrete actions in response to climate change, nor to identify the actors responsible for their implementation: indeed, as disposed in the LGCC, the PECC is the instrument supposed to define the six-year objectives at the federal level, while at the local level this function belongs to state and local programs (Gobierno Mexicano, 2012b).

To achieve the designated goals, the Strategy highlights the importance of a strong and solid policy, indicating in particular six pillars to strengthen national governance on climate change (Gobierno Mexicano, 2013a):

1. Transversal, articulated, coordinated and inclusive policies;
2. Fiscal policies and economic and financial tools with a focus on climate;
3. Adaptation of climate technologies and strengthening of institutional capacities;
4. Promotion of a climate culture;
5. Creation of measuring, report, verification, monitoring and evaluation mechanisms.
6. Strengthening of strategic cooperation and international leadership

As to point 1, 3 and 6, Mexico's government by means of the ENCC explicitly highlights the importance of enhancing institutional capacity through cooperation, and to improve the level of coordination and cooperation through all the levels of government, perfectly in accordance with what stated in the IPCC's AR5 (Mimura et al., 2014). Point 4 takes into account the importance of stimulating and creating a climate culture, to create and gather the information necessary to increase overall awareness and thus give impulse to the adaptation process.

4.1.3 Special Climate Change Program (PECC)

In light of Mexico's commitment to follow the United Nations' Framework Convention on Climate Change (UNFCCC) (UNFCCC, 2014b), the Mexican government in collaboration with CICC elaborated in 2009 the first edition of the *Special Climate Change Program* (PECC), which covers a period of four years and is

currently at its second edition (2014-2018). The PECC, subject to the periodical evaluation by the head of INECC, sets out as the main instrument of the PA to contribute to national goals and to the building of a new legal and institutional framework at the national level (Gobierno Mexicano, 2014d).

The latest PECC develops five main objectives, among which three focus in particular on the topic of adaptation and institutional capacity development (Gobierno Mexicano, 2014d):

1. Reduce vulnerability of population and productive sectors and improve their resilience and the resistance of the strategic infrastructure;
2. Preserve, re-establish and sustainably manage the ecosystems guaranteeing their environmental services for mitigation and adaptation to climate change;
3. Strengthen national policy on climate change through effective instruments, and with a high level of coordination among federative entities, municipalities, legislative power and society.

The last point is the most relevant for this Study: indeed, as well as the ENCC (Gobierno Mexicano, 2013a), it remarks clearly the importance of transversal cooperation through all the levels of government and the sectors of society.

In conformity with the last point, both editions of the PECC highlight the importance of their own convergence and coherence with the national goals, exhaustively expressed in their relative *National Development Plans*, disposed by art. 26 of the Mexican Constitution (Gobierno Mexicano, 2014a) and respectively concerning the periods 2007-2012 and 2013-2018 (Gobierno Mexicano, 2007, 2013f).

4.1.4 The PEACC (Tabasco)

Tabasco developed its *State Plan of Action against Climate Change* (PEACC) in 2011 (Gobierno del Estado de Tabasco, 2011c), following what mandated by the LGCC (Gobierno Mexicano, 2012b).

The PEACC sets out as the result of the *State Strategy against Climate Change*, designed by SERNAPAM in collaboration with the *Universidad Juárez Autónoma de*

Tabasco (UJAT), *El Colegio de la Frontera Sur* (Ecosur) and *Colegio de Postgraduados* (Colpos) the same year. Among their main objectives we find the urge to identify physical, socio-economic and environmental impacts, along with actual and future vulnerability to climate change in the state of Tabasco. Once identified the vulnerabilities, the second step is to develop climate change adaptation options at the state level (Gobierno del Estado de Tabasco, 2011c).

4.1.5 Environmental Protection Law of the State of Tabasco

Effective since 2013, the *Environmental Protection Law of the state of Tabasco* provides a general normative framework for the protection of the environment (Gobierno del Estado de Tabasco, 2013a).

In particular, the Law identifies two organs in charge of implementation and evaluation of the adaptation and mitigation measures, promoting a transversal and collaborative focus: the first one is the *Intersecretarial Commission on Climate Change of the state of Tabasco*, appearing as a support and consulting body for the planning and execution of public policies in coordination with state executive power; the second is the *Interinstitutional Committee on Climate Change of the state of Tabasco*, aimed at achieving transversality in public policy involving the three levels of government, the academic, enterprise and productive sectors, ONGs and society (Gobierno del Estado de Tabasco, 2013a, art. 31). To this regard, it is necessary to mention that the abovementioned organs apparently do not function properly. The Commission, established in 2011 (Gobierno del Estado de Tabasco, 2011a) held just one meeting, in the occasion of the definition of its working program (never realized). It met again in 2013, as a group of 16 members chaired by the Secretary of SERNAPAM (SERNAPAM, 2013). In this case as well, no concrete activity was carried out. The Committee had no different destiny: it was established in 2008, proposing the elaboration of Tabasco's PEACC as one of the first points on its agenda. Nevertheless, after a meeting in 2010 it did not meet again (Colpos, 2012).

4.2 *Fishery* in Tabasco

Figure 4: Fishers fishing in Tabasco's coastal area. Retrieved from http://www.elcorreodetabasco.com.mx/2013/12/06/por-lluvias-cae-produccion-pesquera-un-15-por-ciento/. Accessed on November 23rd 2015.

4.2.1 An introduction

Fishery is the economic motor of Gulf of Mexico's coastal zone, being however very fragile due to its dependence on the changes in the wetlands' ecosystems (Buenfil Friedman, 2009a). In the CPM lagoon system, fishery consists mainly in oyster gathering. Indeed, the mangroves growing along the coast provide a perfect habitat and alimentation for these species.

Oyster peeling is one of the most popular activities among women in the CPM lagoon system and they involve principally product treating, both for selling and family use (SERNAPAM & Ecosur, 2011). Female workers can dedicate to this activity up to 12 hours per day (Aldana Aranda, 2008a).

Usually, the women engaged in this job are wives or relatives of the fishers who catch the oysters; however, these women are not usually organized into regularized cooperatives, so that their job is often not well-remunerated nor recognized by society (Aldana Aranda, 2008b).

As we saw in Chapter 2, the most relevant obstacle for successful fishing activities in the CPM lagoon system is represented by Pemex' oil extracting activities. The heart of the decades-long controversy stems from the claim by local communities that the activities practiced by Pemex are dangerous and harmful both for the human and the ecologic systems. Such claims have been supported by scientific data obtained through a research conducted by some local organizations (Arias Rodríguez & Ireta Guzmán, 2008). The results showed how the coastal ecosystem

has been dramatically modified by Pemex' activities, causing a general deterioration of the fishing conditions, due among other causes to contamination, the use of disturbing equipment and the constant passage of vessels (Arias Rodríguez & Ireta Guzmán, 2009).

In October 2013, a huge explosion involved the deep well *Tierra 123* owned by Pemex, located in the community of Oxiacaque, in the town of Nacajuca, Tabasco. The collapse generated a fire that lasted 55 days, and fishing had to be forbidden for water contamination (Gobierno Mexicano, 2014b). Since the first days, contestations took place about the responsibility of the accident, and despite warranties by Pemex that the firm would take care of the damages and give compensations to the affected citizens, no indemnities were received by local communities so far. This generated another wave of protests and manifestations and mined the feeling of trust in institutions among the local communities, who felt their interests were not adequately represented due to economic interests connected with the oil industry (Gobierno Mexicano, 2014b).
The Federal Attorney for Environmental Protection (PROFEPA) finally fined Pemex with millions of dollars for the damages caused and for not communicating promptly the emergency status (PROFEPA, 2010); however, no further regulations and limitations to Pemex' activities were provided.

4.2.2 Normative and planning framework: Mexico

At the federal level, the *General Law on Fishing and Sustainable Aquaculture* approved in 2007 and modified until its final version in 2014, sets as its goal to regulate the management and promote the sustainable use of fishing and aquaculture, with a peculiar focus on environmental and social aspects (Gobierno Mexicano, 2014c). It establishes in its art. 8 that the regulation, promotion and administration of the fishing resources are a matter for the SAGARPA (*Secretariat of Agriculture, Livestock, Rural Development, Fisheries and Food)* and particularly for its *National Commission of Aquaculture and Fisheries* (CONAPESCA). The Law also recognizes the *Federal Fishing Regulations* as policy tools (art. 36-37).

According to the PECC (Gobierno Mexicano, 2014d), the federal institutions in charge of dealing with the themes of fishery and its gender dimension are three:

Fishery	
SAGARPA	• Promote sustainable fishing and aquaculture activities in coastal and fluvial zones
SEMARNAT	• Promote gender equality in the use and sustainability of natural resources: water, fishery, agriculture, cattle energy and renewable energies
SAGARPA/CONAPESCA	• Support substitution of fishing vessels' motors with more efficient ones • Retire too big fishing vessels

Table 1: Federal institutions formally in charge of implementation in support of fishery in Mexico.

4.2.3 Normative and planning framework: Tabasco

National lines of action are complemented at the state level with the *Law on Aquaculture and Fisheries of the State of Tabasco* (Gobierno del Estado de Tabasco, 2011b). The law promotes an environmentally rational and sustainable use of the natural resources and the reduction of those factors contributing to environmental deterioration, keeping in mind the principles established by the LGCC (Gobierno Mexicano, 2012b). Sustainable and equilibrated fishing appears therefore as a shared goal for both federal and state legislations.

4.2.4 Projects and initiatives in Tabasco and the CPM area

Concerning now financing to local initiatives, SEDESOL (*Secretariat for Social Development*) provides a number of Social Programs (SEDESOL, 2014), among which the Productive Options Program stands out (SEDESOL, 2015b); the aim of the Program is to actively support the implementation of productive projects economically and environmentally sustainable, through economic contributions. These can be either capitalizable, to be used to buy equipment, machinery or other tools to improve the activities, or non-capitalizable, for technical assistance and technical-productive capacitation services (SEDESOL, 2015b). The state of Tabasco possesses the requisites necessary to beneficiate of this program, which prioritises regions by level of marginalization (SEDESOL, 2015a). However, this year's deadline has already passed and the state of Tabasco did not apply for the support.

Another economic support could be represented by the *Secretariat for Agropecuary, Forest and Fishing Development* (SEDAFOP), which created this year a Program to support agro-industrial development and commercialization (PADAC) (SEDAFOP, 2015b) with the objective of promoting agro-industrialization and commercialization of Tabasco's agriculture, providing micro-firms with economic resources to increase the value of agricultural, cattle breeding, fishing, aquatic and forestry products. This deadline as well has already passed without the state of Tabasco applying for the aid (SEDAFOP, 2015a).

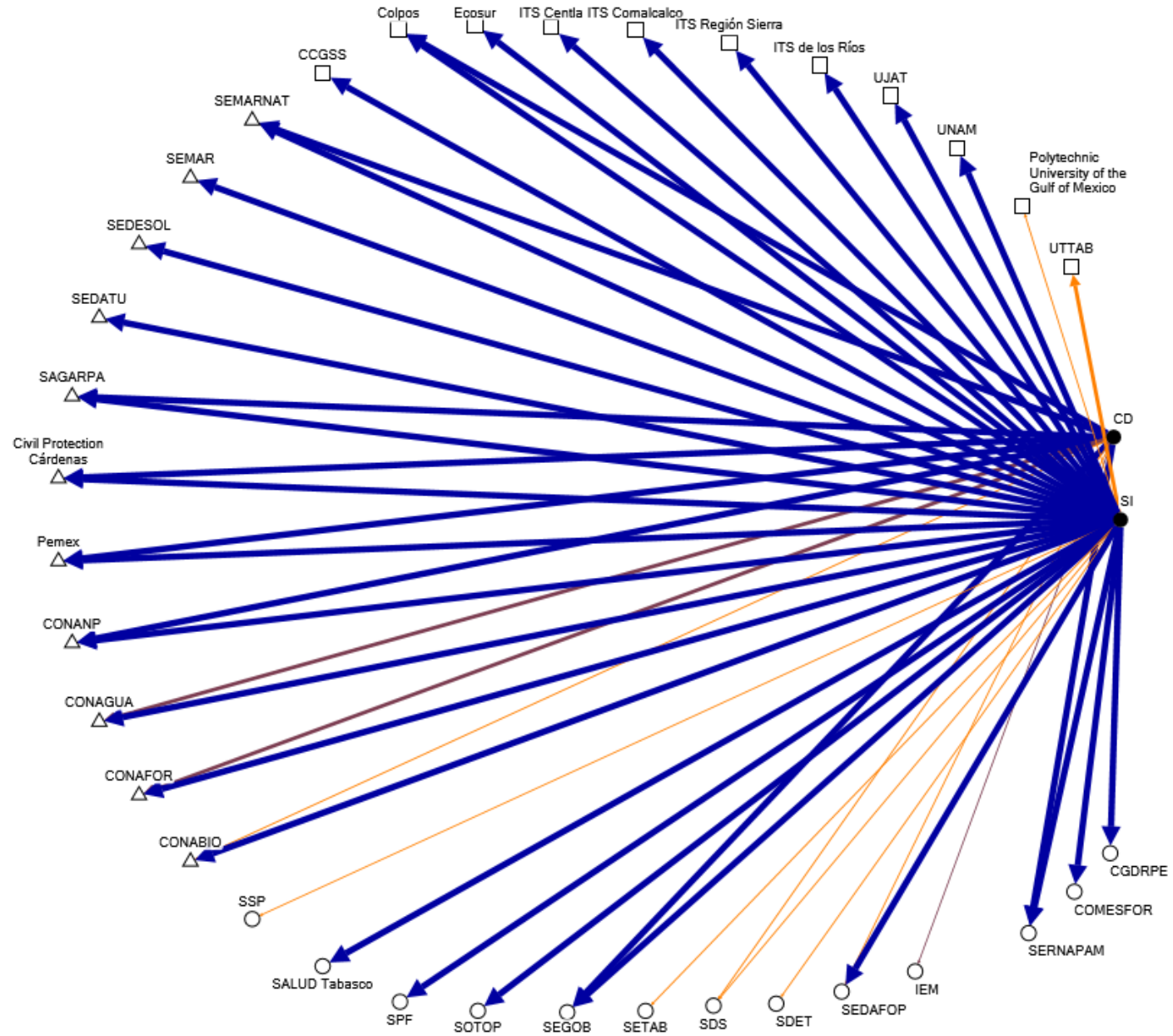
The *National Commission for Aquaculture and Fishing* (CONAPESCA), which belongs to SAGARPA and deals with technical aspects related to fishery, also provides some programs, aimed specifically at improving the regulation of the dimensions and quality of the fishing vessels in the most vulnerable areas of the lagoon: among their functions we can find the removal of excessively big boats and incentives for the substitution of current motors with more efficient ones (Gobierno Mexicano, 2014d). Concerning boats, this year the Commission also created the *Small Vessel Modernisation Project* (CONAPESCA, 2015). CONAPESCA also works to provide economic resources for agriculture, livestock and fish producers in the state of Tabasco to enhance modernization of the equipment, to improve reservoirs and to create strategic productive projects (CONAPESCA, 2014a).

4.2.5 Social Network Analysis

The Directions of SERNAPAM considered for this topic are two: the Direction on Social Involvement (SI) and the one on Communitarian Development (CD). They were selected in light of their link with the social dimension, particularly relevant in the fishery sector. Indeed, the contrasts between Pemex and the communities appeared to influence the relations of trust between local communities and institutions. To this regards, during telephonic interviews both Directors, appearing somehow uncomfortable, affirmed that the main role of their Directions is currently that of *mediators* in the conflicts between local communities and the multinational firm. The second reason for the selection of Directions dealing with the social sphere in the fishery context was the presence of an invisible and almost completely unrecognized female working community, assisting fishers in the products

gathering and selling processes. Given the presence of such criticalities, an investigation on the position maintained by the institutions in charge was due.

The graphs pertaining to the fishery analysis are represented in the following pages. As mentioned before, the black disks are the egos. The actors with a circle next to their name are Tabasco's state institutions; the ones with a triangle are federal institutions; and the ones with a square are universities, technical institutes and research centres. Those relations that are limited to a simple interchange of information are represented by orange threads; those involving coordination with purple ones; and those involving real cooperation with blue ones. Finally, the thickness of the threads signals the levels of frequency with which contacts occur.



Created with NodeXL (http://nodexl.codeplex.com)

Graph 4-1

The first thing we can notice from Graph 4-1 is that internal cooperation among the two Directions considered and the other Directions of SERNAPAM, which have all been integrated in the node "SERNAPAM", is very strong and frequent.

However, the number of ties linking them to the other actors varies a lot between the two egos; on the one hand, the Direction on Social Involvement shows strong relations of cooperation with SEMARNAT and SAGARPA, whose link includes its decentralized organ CONAPESCA. This is quite significant because CONAPESCA, as stated in its mission, is compromised with the development of mechanisms of coordination to implement policies, programs and laws for a sustainable fishing (CONAPESCA, 2014b), and it is very active in the state of Tabasco.

Moreover, the Direction on Social Involvement entertains strong and frequent relations also with SEDESOL and SEDAFOP, which stood out in the normative analysis as providing programs to develop local productions. The relationship entertained by the Direction on Social Involvement with universities and research centres, representing the so-called information-generating institutions, is also generally solid and cooperative, with the exception of the Popular University of Chontalpa, which is absent, and the Polytechnic University of the Gulf of Mexico and UTTAB, representing only informative actors.

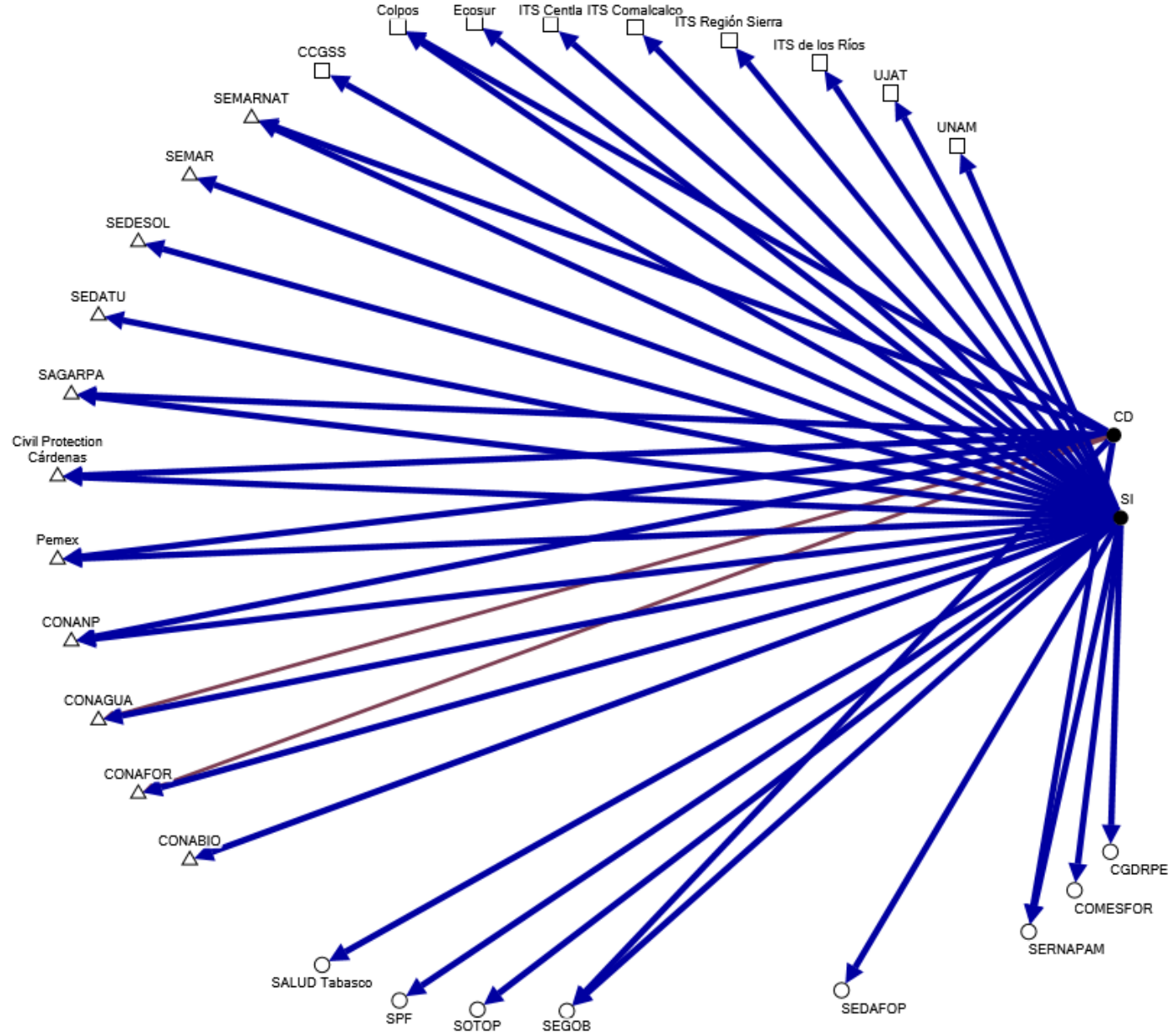
On the other hand, looking at the relations entertained by the Direction on Communitarian Development, we cannot appreciate the same positive features: from Graph 4-1, we can indeed observe the overall lower number of threads departing from its node, and despite its strong link with SAGARPA and SEMARNAT, there is no trace of collaboration with SEDAFOP or SEDESOL. This is particularly critical in that as mentioned before, SEDESOL provides some Social Programs that include productive incentives, and in general subsidies to improve social welfare to local communities.

Moreover, links with the academic sector appear to be almost completely lacking, apart from Colpos, with which the Direction seems to entertain cooperative and frequent relations. However, from telephonic interviews stemmed that Colpos, being a technical research institution, provides mainly technical support to the

other entities involved in the fishery field. In this sense, the social dimension does not beneficiate from such positive relationship.

Speaking about the female sector, we do not find active cooperation between the Directions and IEM (State Institute for Women). Stronger contacts between them would signal awareness at the institutional level about the situation of profound gender inequality and inappropriate working conditions currently undergone by the female population, also and especially within the fishing sector.

Finally, relations with Pemex are strong and frequent in both cases, this being probably attributable to the role of mediators between the multinational firm and local communities that had been referred to as quite frequent during telephonic communications.



Created with NodeXL (http://nodexl.codeplex.com)

Graph 4-2

Switching now our attention to Graph 4-2, we can notice that the total number of relations avoiding the ones involving a simple interchange of information and the ones hardly ever occurring.

The general number of ties appears relatively high, with the Direction on Social Involvement entertaining the majority of relations, very frequent and well distributed among federal entities, state ones and the academic sector. The Direction on Communitarian Development appears as the only one entertaining relations differing from cooperation, namely coordination with CONAGUA and CONAFOR.

4.3 Women's empowerment in Tabasco

Figure 5: Woman in rural household in Mexico. Retrieved from http://www.ipsnews.net/2012/06/mexico-yearly-floods-the-new-reality-for-rural-women/. Accessed on November 23rd 2015.

4.3.1 An introduction

Given the role played by women in the fishing activity, I decided to analyse more in depth the female condition in Tabasco and the CPM area, focusing on women's potential in creating and fostering adaptive capacity in the face of climate change.

Climate change impacts affect women and men in different ways, and the poorest individuals are the most vulnerable to its negative consequences (UNFCCC, 2014a; United Nations Development Program, 2013). Data show that women currently represent 70% of the world's poor, being therefore disproportionally affected (UNFCCC, 2014a).

Nevertheless, women play a crucial role in the adaptation processes: in particular, they have developed exclusive and unique knowledge and coping skills to contribute to the achievement of successful adaptation outcomes (United Nations Women Watch, 2009). However, women often tend to be denied financial aid, capacity building activities and technology, all of which represents a severe obstacle to their potential contribution in sharing their knowledge to help find solutions to climate change (United Nations Development Program, 2013).

Focusing particularly on adaptation, the inclusion of a gender perspective in medium and long-term adaptation policies can contribute to a broader and more equal participation in decision-making and implementation: as stated by the

UNFCCC, "women can act as agents of change at different levels of the adaptation process" (UNFCCC, 2014a). Ultimately and from a broader perspective, women's empowerment in the economic and social life of societies is key to the achievement of sustainable development (Worldwatch Institute, 2013).

In Tabasco and the CPM lagoon system, women have the potential to increase local resilience and generate sustainable socio-economic activities that convert the issues generated by climate change into opportunities for the region: besides their activities in the fishing sector, they also perform agricultural activities, harvesting and selling seasonal products, even though they are allowed to operate almost exclusively within their own communities (SERNAPAM & Ecosur, 2011). Indeed, men are the only ones dealing with the selling of products outside the community, and are usually the only ones receiving a salary. Women instead are not generally considered key-elements of the productive process, and therefore deserving an income (SERNAPAM & Ecosur, 2011).

Gender inequality conveys a particularly negative significance in this context especially if we think that, as highlighted in the study carried out by Colpos (2009), the CPM lagoon's agro-ecosystem has the potential to become a place for the empowerment of women. The domestic environment, where they spend the majority of their time, could be the starting point of a new way of conceiving women's employment: there are indeed fields traditionally assigned to females and of which they have the widest knowledge, as is the case for the cultivation of plants destined to medical treatments or to alimentation. In such fields, they are able to design conservation strategies and thus promote leadership. Women must therefore be seen as positive agents who possess the abilities to actively contribute in the adaptation processes (SERNAPAM & Ecosur, 2011).

Finally, empowering women in this perspective may bring about many positive effects also for social development, especially by increasing women's self-esteem and independence (Colpos, 2009).

4.3.2 Normative and planning framework: Mexico

The LGCC in its art. 71 clearly states that the federative entities' programs, to be elaborated at the beginning of each administration, shall always provide special attention to gender equality and make sure to fully represent society's most

vulnerable sectors in the face of climate change, in addition to natives and people with disabilities, academics and researchers (Gobierno Mexicano, 2012 p. 21).

Based upon the Law, the PECC includes a section on "Gender and Climate Change" (Gobierno Mexicano, 2014d), and its relative National Development Plan (2013-2018) is the first Mexican Development Plan that widely addresses the vital importance of the inclusion of a gender perspective in all federal and state legislations, also those concerning climate change and adaptation (Gobierno Mexicano, 2013e).

The federal institutions identified by the PECC as in charge with the gender issue in different contexts are listed below.

Women's empowerment	
CDI (Centre for Indigenous Development)	• Impulse access to financing by women from indigenous communities
CONABIO	• Provide instruments for the sustainable management of biodiversity which take into account gender equality
SAGARPA	• Carry out actions to increment rural women's participation in productive projects on basic foods • Promote sustainable fishing and aquaculture activities for women in coastal and fluvial zones
SEDATU	• Design and support auto constructing alternatives for poor women and female heads of household • Carry out positive actions for disaster female victims, incapacitated or old women to gain, re-gain or regularize their houses. • Promote the construction, conservation and re-modelling of the public space to be adequate for women and little girls' needs. • Promote urban design with a gender perspective to impulse conciliation, family life and recreation
SEDESOL	• Integrate alternative economies in rural, poor and indigenous areas with female households • Consolidate programs for basic electricity infrastructure and sewage system beneficiating women in high-vulnerability areas

Women's empowerment	
SEGOB	• Integrate cultural and gender aspects within the use and management of territorial resources among disaster-affected communities • Integrate women and girls' risks and necessities in the evacuation plans • Integrate a gender perspective in Civil Protection programs • Assure integrity and human rights to women and girls in post-disaster shelters • Respect women's right to privacy during emergencies
SEMARNAT	• Drive productive, touristic and environmental conservation projects, especially for indigenous and rural women • Drive programs aimed at reducing the gender gaps in the access, use and exploitation of natural resources: water, agriculture, cattle industry, renewable energies • Align and coordinate federal programs and promote a green growth with a focus on gender • Guarantee that financial tools for mitigation, adaptation and vulnerability reduction beneficiate equally women and girls

Table 2 Federal institutions formally in charge of implementation in support of gender equality in Mexico.

The National Strategy for Climate Change (ENCC) (Gobierno Mexicano, 2013a), as well as the PECC, demands considering gender-related aspects in the design of all climate change policies and for the reduction of social vulnerability (Gobierno Mexicano, 2013a).

Such planning tools were mainstreamed in the *Law for the Creation of the National Women Institute* (INMUJERES), promulgated in 2001 (Gobierno Mexicano, 2012a). According to its creating Law, INMUJERES aims at the empowerment and development of women in the social, cultural, political and economic spheres (Gobierno Mexicano, 2012a).

4.3.3 Normative and planning framework: Tabasco

At Tabasco's state level, the *Gender and Climate Change Agenda* is the main informative and planning tool on women and climate. It was created by

SERNAPAM's Direction on Climate Change Policies in collaboration with *The College of the South Border* (Ecosur) and sets out as the primary impulse for the creation of programs and policies dealing with women in a climate change context (SERNAPAM & Ecosur, 2011).

The Agenda begins with a general *excursus* on the relations between women and climate change in Tabasco. Subsequently, it focuses more specifically on the various spheres of competence concerning and involving them directly, among which stand out fishery, agriculture and backyard cultivation. Interestingly, the following section analyses both local men and women's views on the most serious climate change impacts taking place in their environment, investigating their impressions and feelings about them and about the role of the omnipresent multinational Pemex in increasing environmental and human damages. The relevance of this part lies in its attempt to offer a different perspective on climate change, diverging from the exclusively institutional point of view. In its final section, the Agenda offers a review on the current normative framework on gender and climate change internationally, federally, and at Tabasco state level.

As it is also deducible by its internal structure, the Agenda was not meant to be an implementation tool; instead, it represents an informative guide on the current situation of women in Tabasco with regards to climate change and related issues, suitable for consultation before the creation of public policies.

Following the federal government, the Government of the state of Tabasco promulgated in 2006 the final version of the *Law of the Women's Institute of the state of Tabasco* (IEM) (Gobierno del Estado de Tabasco, 2006a), which designates its creation. The principles pursued are the same as its homonymous at the federal level (INMUJERES), namely the empowerment of women in all sectors of public life.

Concerning finally the protection of women as victims of violence and abuses, included working exploitation related to fishing practices, the *State Law on Women's Access to a Life Free of Violence* (Gobierno del Estado de Tabasco, 2014b) reflects its homonymous at the federal level (Gobierno Mexicano, 2013b).

4.3.4 Projects and initiatives in Tabasco and the CPM area

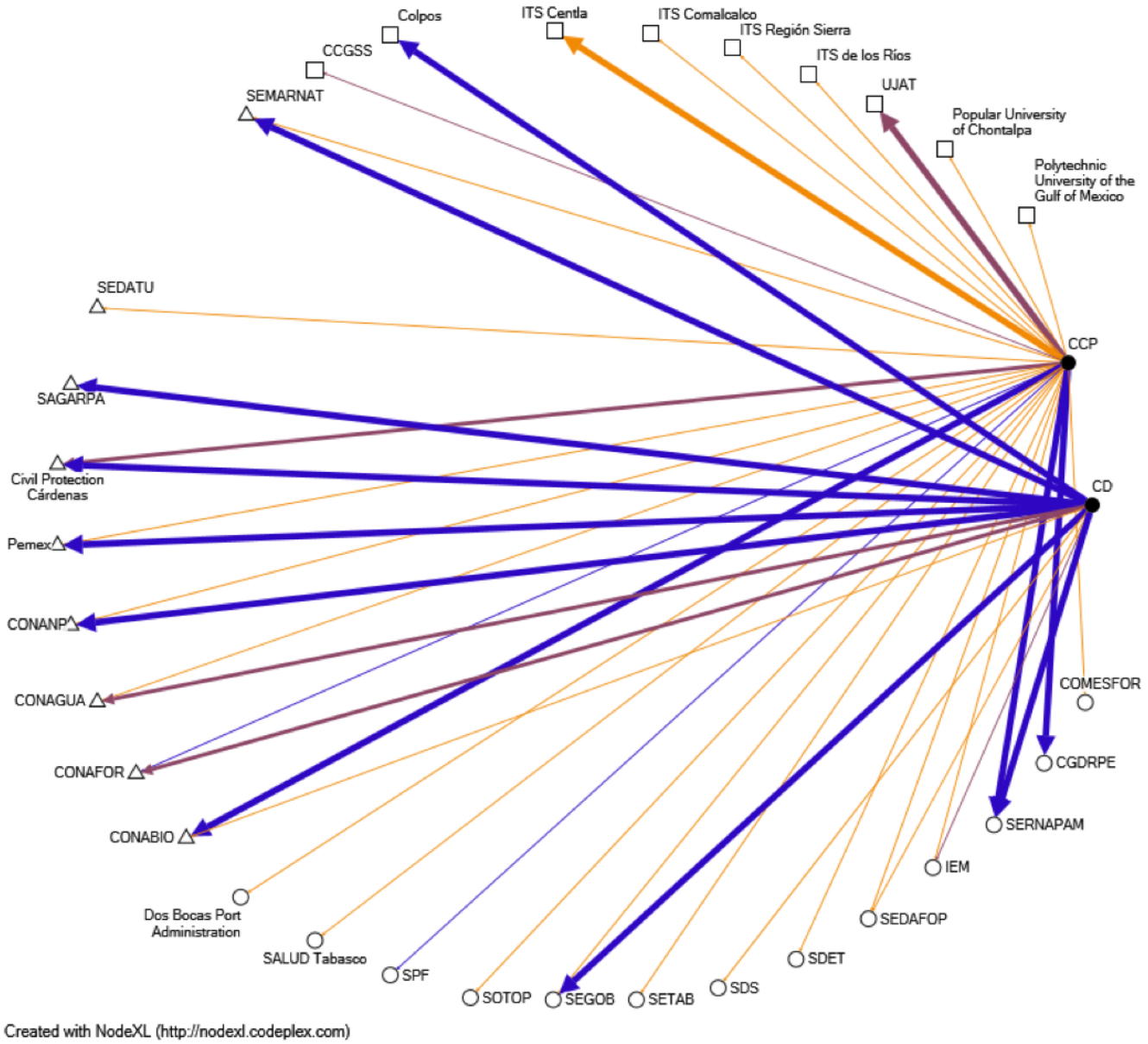
Despite its internal rules being dedicated to the empowerment of women, the majority of the programs promoted by INMUJERES appear to be focused almost exclusively on the protection of women from violence and abuses; the role of women as potential enablers of adaptive processes and capacitation through the generation and sharing of skills and knowledge does not seem to be paid much attention to.

The IEM, reflection of its homonymous at the federal level, seems to convey the same discrepancy between what is expressed in its principles, and their subsequent implementation into concrete programs and norms: indeed, the majority of the initiatives currently in action and promoted by the Institute are dealing with the protection of women from violence and abuses, including working exploitation. A representative example among them is the monthly initiative "Día Naranja" (Orange Day).

Figure 6. Tabasco celebrating the Orange Day. Retrieved from http://comsocial.tabasco.gob.mx/content/se-viste-tabasco-de-naranja-en-contra-de-la-violencia-de-género. Accessed on November 23rd 2015.

It takes place in Tabasco on the 25th day of each month and consists in a common celebration with people going out wearing orange clothes to demonstrate against violence and abuses towards women. The campaign is realized in Mexico by INMUJERES and implemented in Tabasco through IEM. It sets out as a monthly reproduction of the International Day for the Elimination of Violence against Women (Orange Day), designated by ONU globally on November 25th.

4.3.5 Social Network Analysis



Graph 4-3

SERNAPAM's Direction on Climate Change Policies (CCP) and the one on Communitarian Development (CD) appeared as the most suitable for the analysis on the gender issue. The first one has indeed demonstrated to be strongly involved in the thematic, actively contributing to the creation of the Agenda and calling for the inclusion of a gender dimension in Tabasco's PEACC (SERNAPAM & Ecosur, 2011). The second Direction has been selected in light of its involvement in social issues throughout the state.

What stands out primarily from Graph 4-3 is that both the Directions considered seem to entertain strong and cooperative relations with the other Directions of SERNAPAM. In addition, given the dimension of their disks, we can observe that they have a comparable number of contacts. However, the two egos entertain quite different types of relations: while the Direction on Communitarian Development (CD) tends to have less and more cooperative connections, the one on Climate Change Policies (CCP) appears to own a wider network of relations, and yet few of its connections imply real cooperation.

This is especially relevant in that when asked to respond to the question concerning the main functions of the Direction, the respondent addressed primarily the creation of policy instruments to enhance adaptive capacity, through the promotion of cooperation within all sectors of society.

Relations with SEGOB, dealing with women protection in environmental disasters situations, appear to be perceived as cooperative and frequent by the Direction on Communitarian Development, signalling thus a positive aspect. On the other hand, the Direction on Climate Change Policies appears to entertain feeble and sporadic relations with the same Secretariat. As stated by the PECC, SEMARNAT has a leading role in reducing gender gaps in resources access and exploitation, and in providing financial tools equally beneficiating girls and women. However, as we can observe from Graph 4-3, it appears to cooperate only with the Direction on Communitarian Development, whereas it hardly entertains any contact with that on Climate Change Policies.

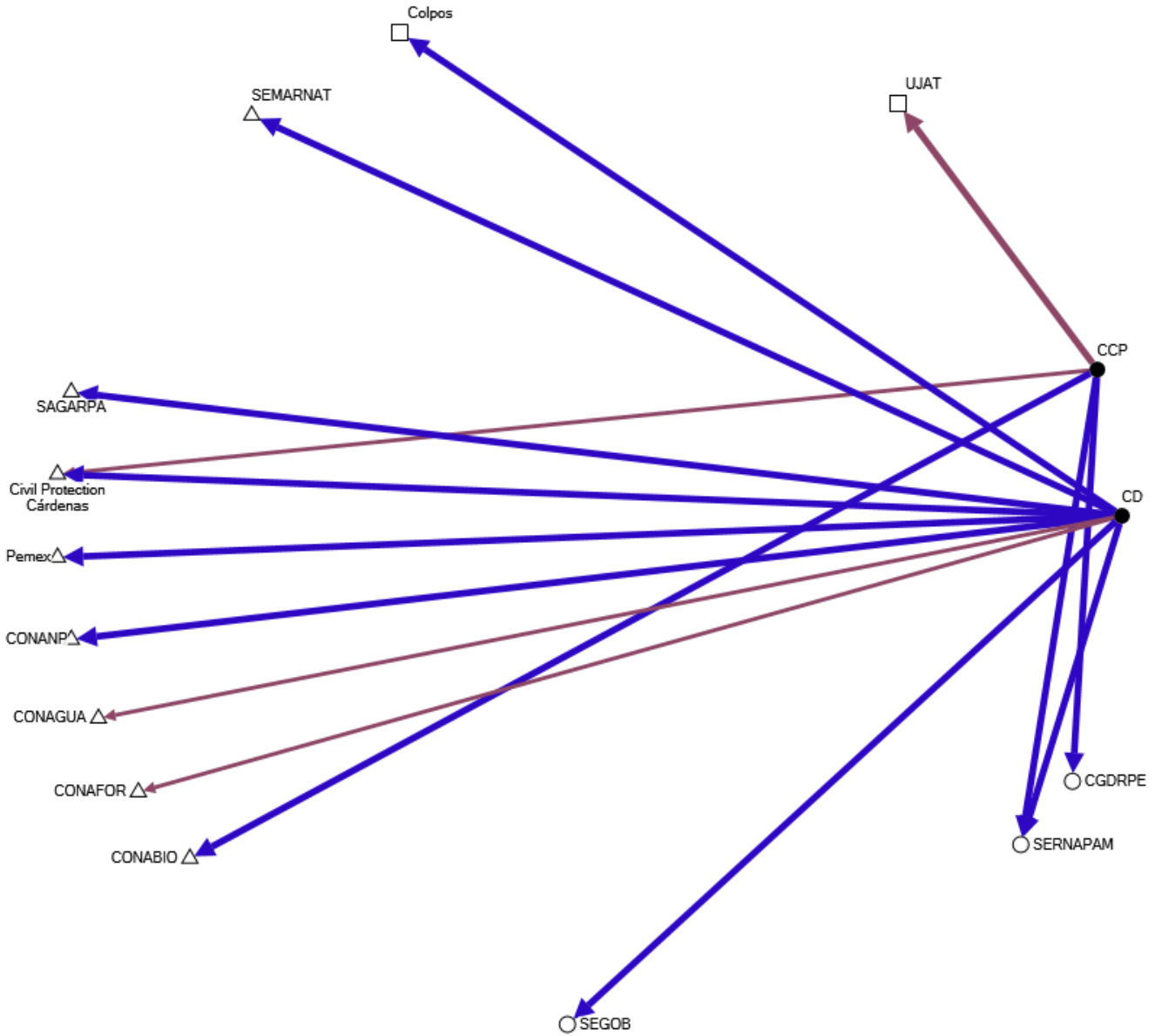
For both Directions, the relations with IEM appear very infrequent, although Communitarian Development coordinates sporadically its actions with the Institute. The feeble and unstable connections with IEM are quite significant in that, as mentioned before, the law creating IEM (Gobierno del Estado de Tabasco, 2006a) explicitly states that its functions include coordination – through transversal cooperation with the public administration – and implementation of public policies with a gender perspective, and most importantly, the promotion of participative mechanisms to include women in the economic, social, cultural and political life of the state.

In general, relations with SEDATU and SEDESOL, the institutions dealing with the social dimension and the integration of new economic alternatives to beneficiate the female sector, appear very feeble or absent.
Concerning now the different relations with universities and research centres – the institutions in charge with creating, gathering and spreading of knowledge, especially among young people – the Direction on Communitarian Development's only linkage appears to involve Colpos, which nevertheless appears quite cooperative and frequent. The Direction on Climate Change Policies appears instead to coordinate actions with UJAT very frequently. Concerning the Direction on Climate Change Policies' relations, it is however due mentioning that the respondent did not comment on its connections with Colpos, Ecosur and UNAM.

When we reduce the present relations to the ones of coordination and cooperation, illustrated in Graph 4-4, we can notice that the total number is strongly reduced.

CONABIO appears as entertaining relations of cooperation very frequently with the Direction on Climate Change Policies, while no contact exists with the Direction on Communitarian Development. CONABIO has been cited both by the PECC and the Agenda as quite relevant in the gender and climate change issue, with a special focus on sustainable management of biodiversity.

SAGARPA appears to entertain a cooperative and frequent relation with the Communitarian Development Direction, probably due to its social functions in empowering rural women, while it does not have any linkage with the Direction on Climate Change Policies.


Colpos
SEMARNAT
UJAT
CCP
SAGARPA
Civil Protection
Cárdenas
CD
Pemex
CONANP
CONAGUA
CONAFOR
CONABIO
CGDRPE
SERNAPAM
SEGOB
Created with NodeXL (http://nodexl.codeplex.com)

Graph 4-4

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4.4 Sustainable use of natural capital in Tabasco

Figure 7. Mangroves surrounding the banks of a stream in the CPM area. Retrieved from http://www.agua.org.mx/h2o/index.php?option=com_content&view=category&id=1337:manglares&Itemid=99&layout=default. Accessed on November 23rd 2015.

4.4.1 An introduction

Within this macro-thematic area, our focus lies specifically on the reforestation of mangroves. Indeed, the ecosystem of mangroves represents a crucial resource for the state of Tabasco: 21,796 families rely on this plant for economic survival (Zavala-Cruz, Martínez-Zurimendi, & Domínguez-Domínguez, 2011).
In general, mangroves play a pivotal role in the preservation and maintenance of coastal zones: they provide the habitat for oysters, prawns and different kinds of fish, representing also their alimentation (CONABIO, 2013a); they also function as a protection against the strong coastal winds and as shelter for many species of different birds, some of which are protected or endangered (CONABIO, 2008a).
In 2010, SEMARNAT included mangroves within the category of Mexico's endangered species, presented in its Official Norm 059 (SEMARNAT, 2010).

However, despite their utility for the socio-ecosystem, the main causes for the destruction of mangroves result to be anthropic: conversion to aquaculture, exploitation by oil companies, excessive and unregulated cutting of wood and change in the use of soil are the most relevant activities damaging mangroves' ecosystems (Movimiento Mundial por los Bosques Tropicales, 2002; PROFEPA, 2014; Smith, Schellnhuber, & Qader Mirza, 2001).

The need for a better regulation in this field is exhaustively exemplified by an *ejido* (common land) located in the municipality of Paraíso, in which more than 75 deep wells have been settled by Pemex in the last years, which have already destroyed more than one thousand hectares of mangroves forest, without any kind of reforestation process following (CONABIO, 2013a). Moreover, illegal cutting by local communities' citizens and organizations is also a common phenomenon (SEMARNAT, 2013).

4.4.2 Normative and planning framework: Mexico

At the federal level, the Constitution of the United States of Mexico (Gobierno Mexicano, 2014a) inspired the creation of three laws promoting the protection and preservation of mangroves: the *General Law on Wildlife* (LGVS) (Gobierno Mexicano, 2015a), the *General Law on Ecologic Equilibrium and Environmental Protection* (LGEEPA) (Gobierno Mexicano, 2013c) and the *General Law on Sustainable Forest Development* (Gobierno Mexicano, 2003, reformed in 2015).

In particular, art. 60 Ter. of the LGVS, which was added in 2007 to improve existing regulations, clearly states that the removal, stuffing, transplant, pruning or any other activity affecting the integrity of the mangroves shall be prohibited. The only exception is represented by activities pursuing the aim of protecting, restoring, researching or preserving the mangroves' areas (Gobierno Mexicano, 2015a, pp. 26-27).

However, as some critics of the Law point out, deforestation has not decreased since art. 60 Ter. has come to life, and the main causes continue to be human: touristic infrastructure, substitution for cultivation fields and oil extraction activities are only the most relevant ones (Rivera Perera & Sánchez Trujillo, 2007).

The PECC identifies the following institutions as in charge with natural capital preservation, protection and reforestation:

Sustainable use of natural capital	
CONABIO	• Apply instruments for the sustainable management of biodiversity in priority areas • Evaluate climate change vulnerability among priority species and propose strategies for their management and conservation

CONAFOR	• Reforest and integrally recover deteriorated forests prioritizing Protected Natural Areas (ANPs) • Promote integral management of territories strengthening intergovernmental collaboration mechanisms to favour adaptation and mitigation
CONANP	• Implement programs for adaptation to climate change for ANPs • Promote ecologic connectivity among ANPs through biologic corridors, integral restoration and other methods • Implement projects for landscape integrated management in vulnerable areas, with the participation of communities • Increase ANPs surface prioritizing vulnerable regions
SEMARNAT	• Implement measures for conservation and restoration to endangered species with high vulnerability to climate change • Promote green growth that both preserve the country's natural capital and stimulate productivity

Table 3: Federal institutions formally in charge with implementation in support of a sustainable use of natural capital in Mexico.

The federal institutional actors actually found to be participating in the regulatory process of the use of mangroves are mainly SEMARNAT and PROFEPA (Procuraduría Federal de Protección al Ambiente): the first one is responsible for the previous authorization necessary for any kind of action concerning mangroves (Zavala-Cruz et al., 2011), and as we mentioned has recently put different species of mangroves under special protection in its *Mexican Official Norm for Environmental Protection* (SEMARNAT, 2010).

PROFEPA, which is a decentralized administrative organ depending on SEDESOL created in 1992 (SEDESOL, 2005), monitors the legal conformity of SEMARNAT's permissions and checks for the presence of illegal tree cutting (Zavala-Cruz et al., 2011). It also started the "*Mexico protects its mangroves*" operation, active from 2011 to 2013 (PROFEPA, 2014). During this operation, field research was conducted and the most vulnerable areas were detected and classified for further measures, to be carried out in collaboration with CONANP and CONAGUA.

4.4.3 Normative and planning framework: Tabasco

At the state level, two laws were created following the federal input: the first one is the *Environmental Protection Law of the State of Tabasco* (Gobierno del Estado de Tabasco, 2013a), which in its art. 11 par. XIV identifies SERNAPAM as the entity in charge of promoting, coordinating and participating to actions for the protection, conservation and reforestation of the natural resources present in the state. More specifically, the Law states that SERNAPAM should promote environmental education through all levels and sectors of society, by educational programs fomenting environmental culture (art. 220).

The second law is the *Forest Law of the State of Tabasco* (Gobierno del Estado de Tabasco, 2006b), which declares that coordination should be promoted by SEDAFOP, acting as a bridge between the federal and local levels through the *State Commission for Forestry*, with the consultation of organs of superior teaching and research centres operating in the state of Tabasco. The State Commission is a public organ with technical and functional autonomy, which shall develop and promote activities for the production, protection, preservation and restoration of mangroves, applying the existent norms on sustainable forestry. Concerning specifically the theme of reforestation, the State Commission is supposed to collaborate with CONAFOR, municipalities and public, private and social institutions, to promote consciousness and forestry culture (art. 48).

4.4.4 Projects and initiatives in Tabasco and the CPM area

CONAFOR has been found to be very active in providing federal economic resources to promote reforestation (CONAFOR, 2015), particularly through the state program *ProÁrbol* (CONAFOR, 2012a). The Program, developed annually from 2008 to 2012, aimed at contributing to the preservation and restoration of the ecosystems through the recuperation of forest vegetation and the reparation of the soil (CONAFOR, 2011), and it included the state of Tabasco among its beneficiaries (CONAFOR, 2012b). Experts are not unanimous on the success of this program; some of them indeed have called for an improvement in the methodology (Ricker, Castillo Santiago, Mendoza Márquez, Nava Cruz, & Peña Ramírez, 2010). In particular, what was considered as one of the most relevant weaknesses of the Program was the

absence of any analysis of existent rural and forest development policies, which would have allowed for the identification of complementarity, duplicity or contrast among the different programs (SEMARNAT, 2012).

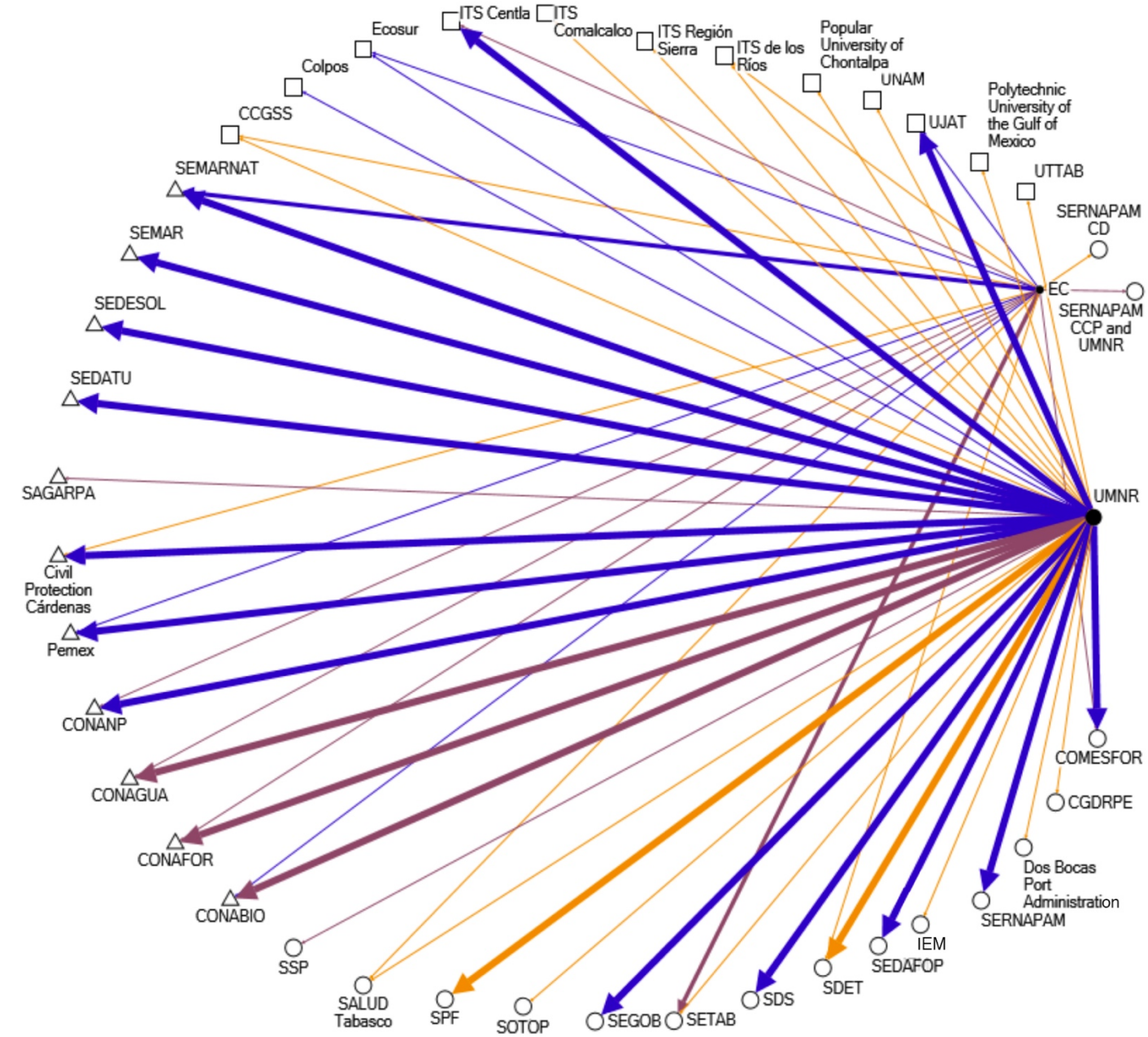
Since 2013, CONAFOR changed its way of providing financial support for special reforestation projects in Tabasco: the new program, created in collaboration with SEMARNAT, is called *Pronafor* (SEMARNAT & CONAFOR, 2014) and has a national coverage with a focus on the states and regions considered more at risk, according to criteria such as the vocation of the territory or the type of ecosystem involved (SEMARNAT & CONAFOR, 2014).

In 2013, CONABIO implemented the project *Sustainable Productive Systems and Biodiversity* (SPSB) (CONABIO, 2013b) in collaboration with SERNAPAM (SERNAPAM, 2014a). The project, carried out in Tabasco and other states of Mexico, has a covering period of four years, and was developed with the support of the Global Environment Fund, with the World Bank as implementation agency (CONABIO, 2013b).

However, it is due mentioning that no projects nor funding activities are currently dealing specifically with the sustainable use of natural capital to increase adaptation in the CPM lagoon system.

4.4.5 Social Network Analysis

The Directions taken into consideration in this case are the one on Use and Management of Natural Resources (UMNR) and the one on Environmental Culture (EC). They were selected on the basis of the idea that a correlation exists between a correct and sustainable use of the natural resources and environmental awareness. In this vision, environmental awareness represents a pre-condition for a correct behaviour towards the natural capital. Such idea stemmed from the case of the mangroves' illegal cutting phenomenon, widely performed by local communities' citizens despite their experiencing a progressive deterioration on their ecosystem and wellbeing. This made it possible to assume that local communities do not have an adequate knowledge of the negative and dangerous consequences of cutting the mangroves for both their welfare and that of their ecosystem.



Created with NodeXL (http://nodexl.codeplex.com)

Graph 4-5

Looking at Graph 4-5, a preliminary explanation is needed: this Direction represents the case mentioned in sub-paragraph 3.2.6, in which the internal relations entertained with the other Directions of SERNAPAM could not be merged into one tie because they were classified as different in intensity and frequency. The tie named "SERNAPAM CD" represents therefore the Direction on Environmental Culture's perceived relation with the one on Communitarian Development; on the other hand, the tie labelled "SERNAPAM CCP and UMNR" represents instead the perceived relations with the Directions of Climate Change Policies and that on Use and Management of Natural Resources. The other Directions are not included in the graphs as the respondent gave a 0-0 answer on the questions referring to its relations with them, signalling the absence of any contact.

Proceeding with the analysis, we can notice from Graph 4-5 that relations between the Direction on Use and Management of Natural Resources and the other Directions of SERNAPAM appear cooperative and frequent, including those with Environmental Culture. As to this, we need to report a criticality: indeed, the Direction on EC affirmed that its relations with UMNR are of simple coordination and do not occur on a frequent basis. The most interesting and critical aspect concerning EC is however the *total absence* of any type of relation with the Direction on Social Involvement. Given that social capacitation appears as a core aspect for a successful adaptation policy, at least some degree of coordination between the two Directions would be expected. Indeed, based on EC's functions and applications in the different sectors relying on environmental awareness, this appears to be a quite negative factor.

Generally speaking, the absence of relations with SERNAPAM's three Directions dealing with energy may find consistency in their being relatively new and very specifically directed and focused on energy issues. However, it is also true that social awareness on the possible ways to save energy and improve energy efficiency at government and municipal level, and within the private and social sectors, function explicitly described as pivotal by the Director of Energy Efficiency and Responsible Consumption, clearly forms part of the broader concept of environmental culture.

Concerning external relations, as shown by the different dimensions of the two black disks identifying the egos, UMNR has an overall quite higher number of relations in comparison to EC. The different dimensions depend on the *out-degree centrality*

feature, which automatically identifies and signals the node with the highest number of ties departing from it.

Among the federal entities highlighted by PECC, SEMARNAT figures as a frequent and strong linkage for both Directions, even though with a lower level of frequency for EC.

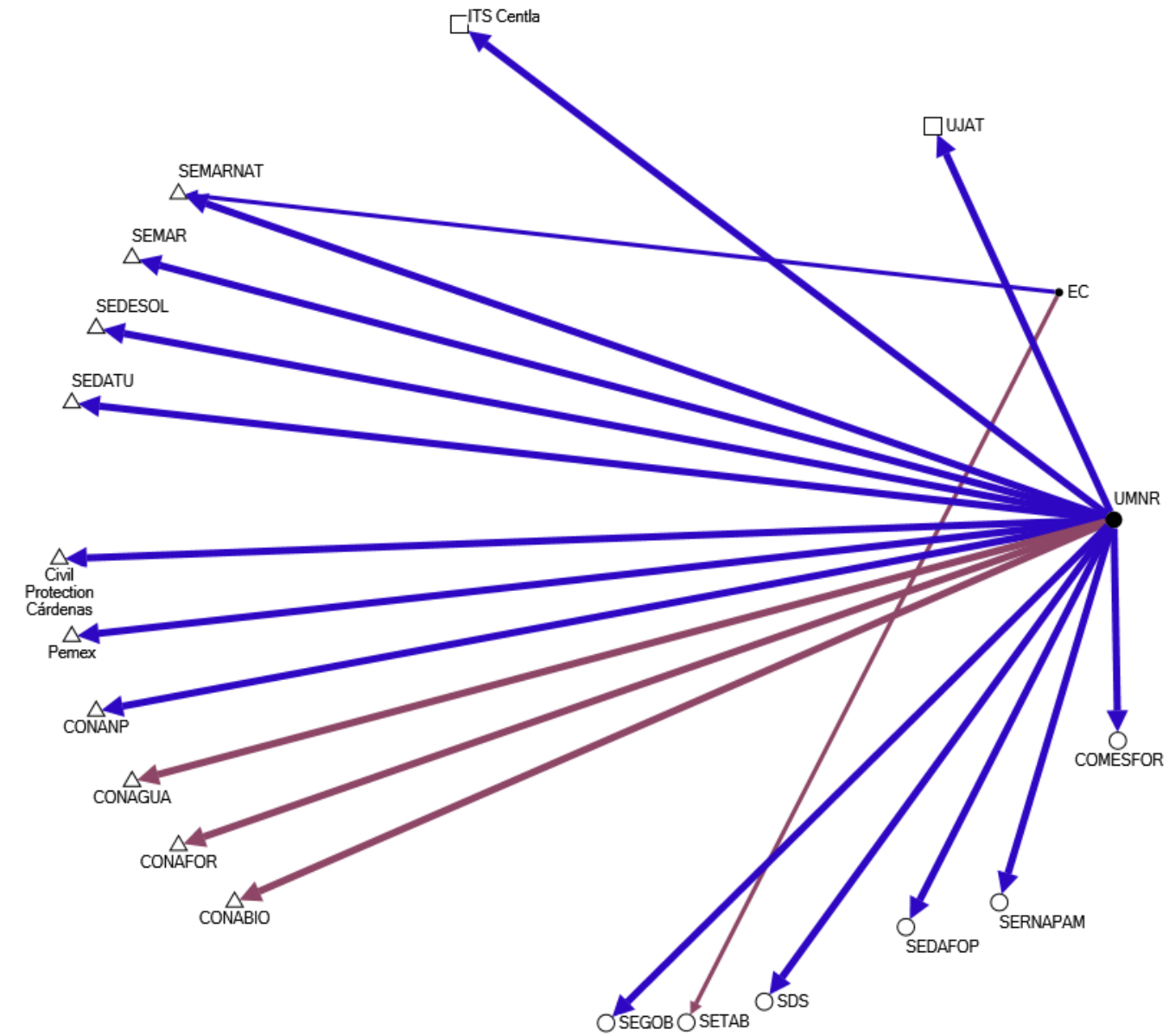
CONANP instead appears to entertain relations of cooperation only with the Direction on Use and Management of Natural Resources, while it occasionally coordinates its activities with EC.

CONAFOR and CONABIO, which are the most specifically involved with the reforestation of mangroves in the state of Tabasco, appear to be linked to the Direction on Use and Management of Natural Resources only by a violet thread, meaning that relations are limited to coordination and do not reach active cooperation. Environmental Culture seems to cooperate with CONABIO occasionally, as it occasionally coordinates its actions with CONAFOR.

With regards to PROFEPA, which belongs to the SEDESOL node being a decentralized branch of the Secretariat, its linkage with the Direction on Use and Management of Natural Resources appears quite strong and frequent, while Environmental Culture does not entertain any relation with it.

Turning our attention on Graph 4-6, it appears that the Direction on Environmental Culture entertains only two relations of cooperation: one with SEMARNAT, with whom it cooperates with the highest frequency, and interestingly one with the Secretariat on Education of the state of Tabasco, even though with a lower degree of frequency. The respondent affirmed that the Direction is indeed involved in school projects to enhance environmental culture among young citizens.

On the other hand, the Direction on Use and Management of Natural Resources, although downsizing considerably its total number of relations, maintains a certain number of connections with differentiated types of institutions, the majority of which involves real cooperation.


ITS Centla
UJAT
SEMARNAT
SEMAR
EC
SEDESOL
SEDATU
UMNR
Civil Protection Cárdenas
Pemex
CONANP
COMESFOR
CONAGUA
CONAFOR
CONABIO
SEDAFOP
SERNAPAM
SDS
SEGOB
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Created with NodeXL (http://nodexl.codeplex.com)

Graph 4-6

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On the other hand, the Direction on Use and Management of Natural Resources, although downsizing considerably its total number of relations, maintains a certain number of connections with differentiated types of institutions, the majority of which involves real cooperation.

4.5 Capacity development for environmental use and management in Tabasco

Figure 8. Women cleaning a beach from residues left by the sea. Retrieved from http://sernapam.tabasco.gob.mx/content/sernapam-coordina-limpieza-de-playas-en-centla Accessed on November 23rd 2015.

4.5.1 An introduction

This thematic area refers to the presence of processes of capacity development targeting Tabasco's rural communities living in the CPM area. Solid waste management and the presence of processes of adaptation and renewal in agricultural practices towards resiliency are specifically investigated.

Evidence demonstrates that social capacitation in the use and management of the environment is pivotal: as was mentioned in Chapter 2, the CPM area is indeed particularly affected by the issue of solid waste management. Water contamination, generated by urban and industrialized centres' discharges, acquired more and more relevance with the time. The Grijalva River is the most problematic stream, because in his section La Angostura-Chicoasén the untreated discharges of many localities are concentrated. In the same section, the problem of solid waste from the same localities is also evident, since the diminution of rapidity of the water flow lets the waste be transported and stuck in the Sumidero canyon (Buenfil Friedman, 2009b).

The Mexican Official Norm (NOM) 022, promulgated by SEMARNAT in 2003 and explicitly prohibiting to leave waste in coastal wetlands (SEMARNAT, 2003, 4.20) does not seem to have solved the problem.

4.5.2 Normative and planning framework: Mexico

Concerning waste management, Mexico's federal normative framework stems from the LGCC (Gobierno Mexicano, 2012b, art. 8), which identifies as a federative entities' responsibility that of formulating, regulating, leading and implementing mitigation and adaptation actions in response to climate change, among which the sustainable management of waste. Such topic is also addressed in the ENCC and the PECC (Gobierno Mexicano, 2013a, 2014d).

The PECC does not provide us with a list of the federal institutions in charge to deal with the waste management issue; however, among its *Activities to strengthen public policy tools on climate change issues*, it highlights the importance of establishing a shared policy among federal, state and local governments for the management of solid waste (Gobierno Mexicano, 2014d, p. 91).
As mandated by the *General Law for the Prevention and Integral Management of Waste* (LGPGIR) promulgated in 2003 and reformed until 2015 (Gobierno Mexicano, 2015b), in 2006 SEMARNAT elaborated the *Guide for the elaboration of municipal programs for the prevention and integral management of urban solid waste*, which explicitly addresses the steps to follow to create and implement an efficient plan for the prevention and management of solid waste at the local level (SEMARNAT, 2006a).
Moreover, in 2008 it also created the *National Program for the Prevention and Integral Management of Waste 2008-2012* (SEMARNAT, 2008) with the objective of contributing to Mexico's sustainable development through a policy based on the promotion of changes in the production, use and management of waste. Prevention and minimization of the generation of residuals are core points, along with the education to reuse and recycling (SEMARNAT, 2008).

Speaking about sustainable agricultural techniques, CONAFOR's *Pronafor* program indicates in its operational rules (SEMARNAT & CONAFOR, 2014) that the federal economic supports provided must be destined to the establishment of an agroforestry system, and includes Tabasco in its list of states suitable for the support.

4.5.3 Normative and planning framework: Tabasco

At Tabasco's level, the normative framework stems from the *Environmental Protection Law*, which indicates the executive state power, SERNAPAM and the municipalities – through their Direction on Environmental Protection and Sustainable Development – as the authorities in charge of environmental management (Gobierno del Estado de Tabasco, 2013a). More specifically, in its article 11 the Law specifically addresses SERNAPAM's responsibilities, among which: the collaboration with municipalities in building, preserving, maintaining, supervising and operating the infrastructures and services for the integral management of waste; activities of reduction, separation, reuse, recycle, transportation etc. of solid urban residuals, individually or in collaboration with other entities (Gobierno del Estado de Tabasco, 2013a).

Tabasco's PEACC as well highlights the importance of a good management of residuals, even though it focuses more on a mitigation approach (Gobierno del Estado de Tabasco, 2011c).

As for resilient agricultural techniques, we find that Tabasco's government seems to propend for agroforestry: indeed, it has been announced that soon a wood processing plant will be launched in the town of Huimanguillo (Gobierno del Estado de Tabasco, 2015a).

On the same topic, COMESFOR's internal rules indicate the *Unity for Forest Development and Protection* as the responsible for the promotion of alternative production systems, including agroforestry (Gobierno del Estado de Tabasco, 2012b).

4.5.4 Projects and initiatives in Tabasco and the CPM area

At the local level, SEMARNAT is working to provide support and subsidies to local projects (SEMARNAT, 2014a); particularly relevant in this sense are the *Program to support projects concerning management of solid residuals and special management* (SEMARNAT, 2015a), and even more the *Program to support environmental culture and capacitation for a sustainable development* (SEMARNAT, 2015b); the latter aims at supporting and strengthening the initiatives developed by organized civil society groups and educational institutions of all types and levels. The state of Tabasco however does not appear as one of the beneficiaries of such programs.

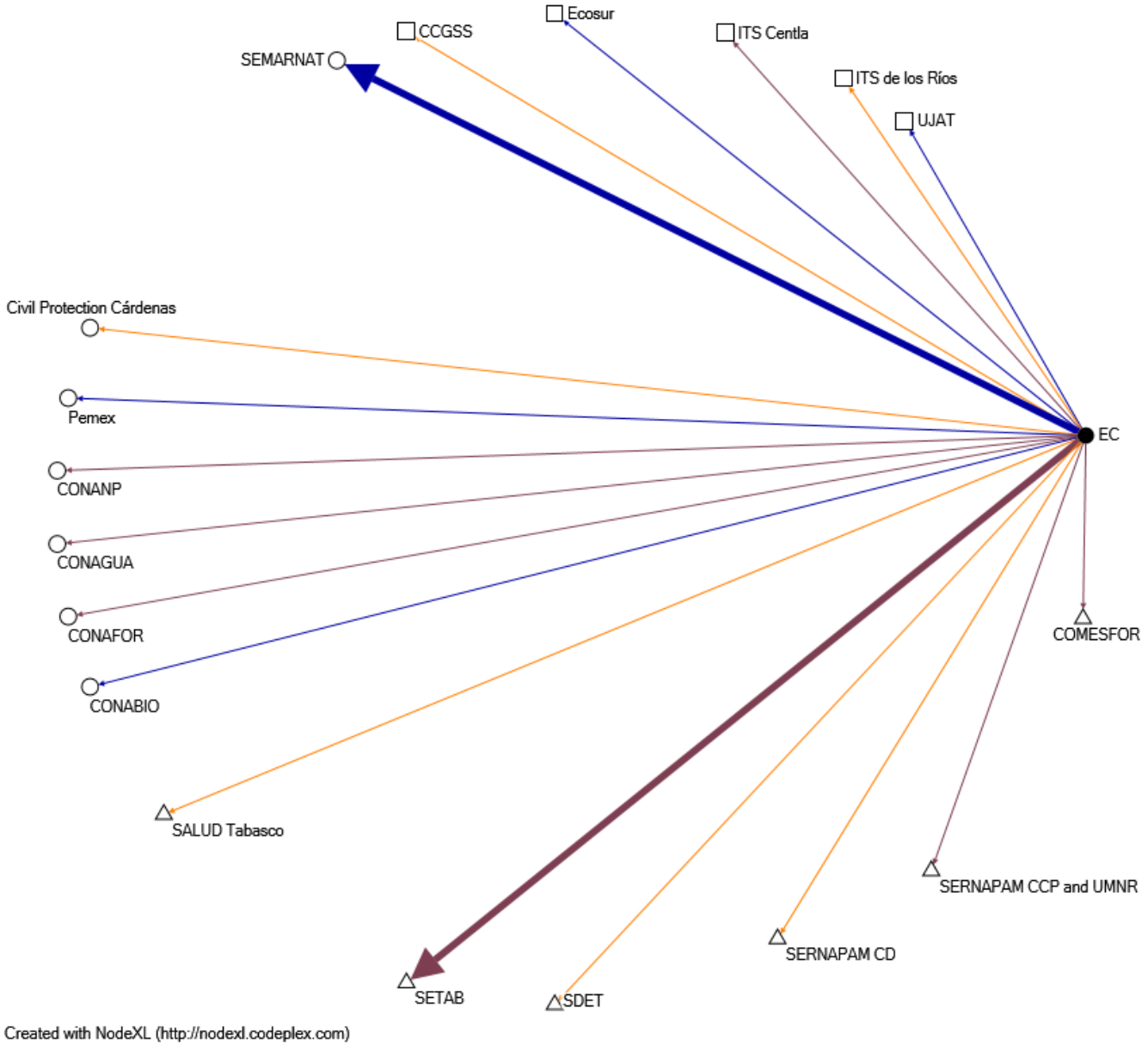
Actively operating in Tabasco we can instead find some campaigns of information directed to citizens, promoting the culture of reuse and recycling: SERNAPAM's Environmental Culture Direction is the entity that carries out campaigns such as the *Reciclatones* (big recycles) of Christmas pines, electronics, tyres and paper, collaborating in some of them with SEMARNAT (SERNAPAM, 2015a, 2015b, 2015c, 2015d).

Figure 9. Flyer of the "Reciclatón" Campaign for paper and cardboard for its 6th edition (2014). Retrieved from http://www.tabasco.gob.mx/content/6to-reciclat%C3%B3n-papel-cart%C3%B3n-tabascon Accessed on November 23rd 2015.

In 2014, during a radio-conference, some officers of SERNAPAM communicated to the public that SERNAPAM is currently also dealing with environmental complaints by citizens, attending up to 54 only in 2014. Moreover, officers exhorted citizens to always report witnessed irregular practices, to actively collaborate to the achievement of a sustainable and environment-friendly development (SEMARNAT, 2014b). In the same year, SERNAPAM and SEMARNAT also carried out an environmental culture workshop for the personnel of the cement plant Holcim, located in the town of Macuscapana, Tabasco (SERNAPAM, 2014b).
However, none of the abovementioned initiatives on sustainable management of waste and on environmental education currently involve the CPM area.

Speaking about sustainable agriculture, concrete programs do not exist yet, even though broader programs as the Productive Options (SEDESOL, 2015b), the PADAC (SEDAFOP, 2015b) or Pronafor (SEMARNAT & CONAFOR, 2014) would be suitable for implementation in Tabasco.

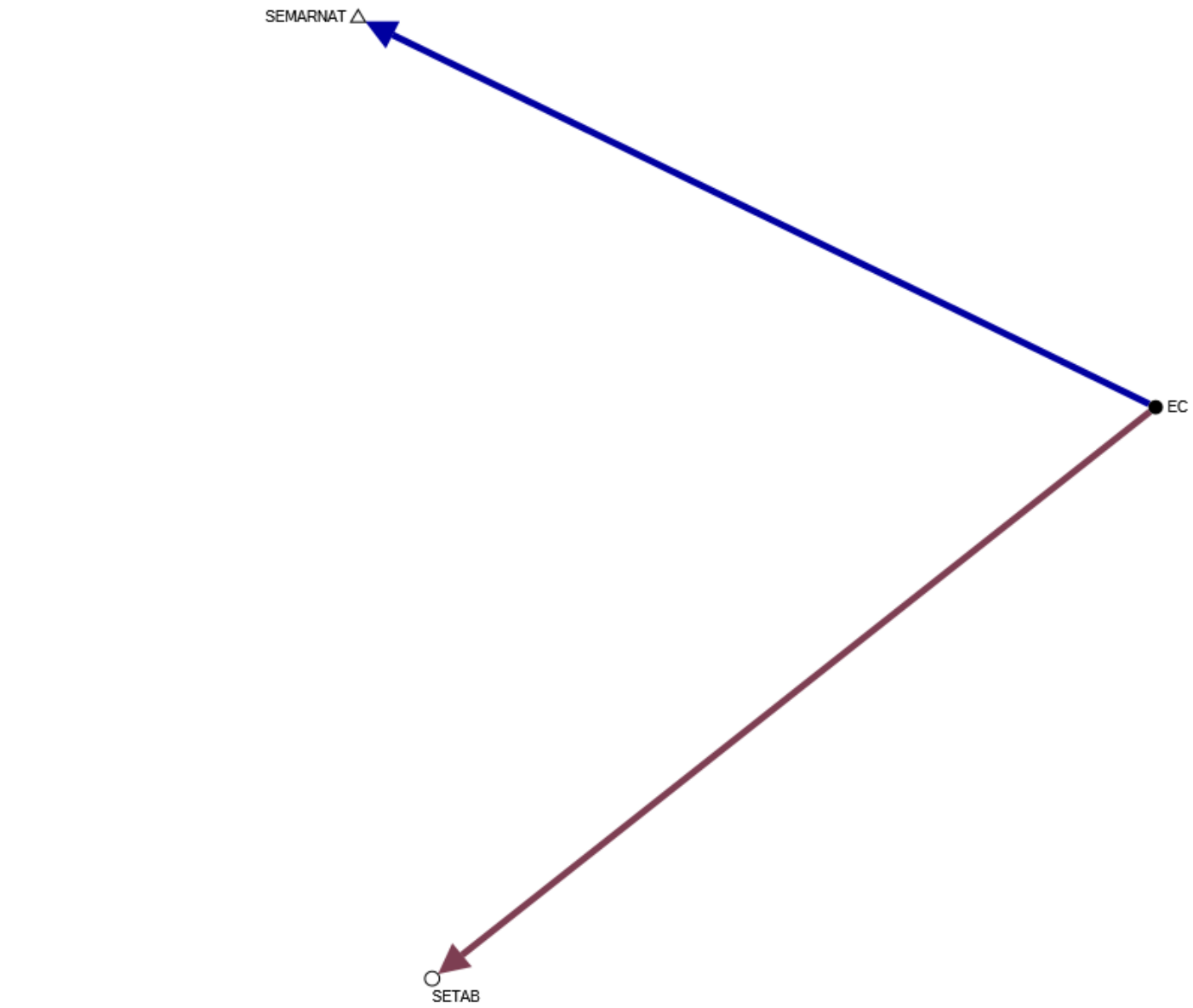
4.5.5 Social Network Analysis



Graph 4-7

The object of the present SNA is uniquely SERNAPAM's Direction on Environmental Culture, in light of its pivotal function as promoter of adaptive capacity through environmental education practices and initiatives, remarked also during telephonic communications.

First of all, as can be noticed from Graph 4-7 and was already commented on subparagraph 4.4.5, the Direction appears to entertain a low number of overall interactions; given its transversal and multi-spectrum character, this point represents a relevant criticality.
What is also interesting to observe is that, differently from the other Directions of SERNAPAM considered until now, that on Environmental Culture did not respond positively about its internal relations with the other Directions: the intensity of their contacts is perceived as simple interchange of information, and only in a few cases coordination. The overall frequency is perceived by EC to be really low.
Another interesting aspect is the low number of relations appearing with the information generating institutions, namely universities and research centres. However, we do find some kind of cooperation with two of the ones present: Ecosur, which deals with the social dimension in its research, and UJAT, a more technical institution. What is predominantly perceived as lacking is an adequate frequency in the development of projects and activities.


SEMARNAT
EC
SETAB
Created with NodeXL (http://nodexl.codeplex.com)

Graph 4-8

Switching now our attention to Graph 4-8, the main criticality regarding the Direction on Environmental Culture appears once again clear: its only relation of cooperation with a high level of frequency appears to involve SEMARNAT. In this case, this outcome appears faithful to the institutional outline provided in sub-paragraphs 4.5.2 and 4.5.3. What may represent a good factor is the presence of a certain level of coordination between the Direction and Tabasco's Secretariat for Education; such linkage acquires a particular significance if matched with the outcomes of the semi-structured section of the questionnaire (see Annex, question 2), in which the Director mentioned as one of the main activities of the Direction that of promoting environmental awareness in schools, through summer courses, workshops, visits and events.

4.6 Energy efficiency in Tabasco

Figure 10. Windmills in Mexico, retrieved from: http://cumbre.com.mx/?p=4426 Accessed on November 23rd 2015.

4.6.1 An introduction

Alternative energy has acquired more and more relevance in the sustainable development context. Especially in rural areas, according to the OECD (2012) switching to renewable energy conveys various positive effects, among which: the creation of new revenue sources for land owners; new direct and indirect job opportunities; innovation, through the use of new practices and the adaptation of them to local needs; enhancement of capacity building and community empowerment, through the gaining of skills by actors and the creation of local institutions to deal with the sector; finally, alternative energies make energy affordable through the opportunity for rural areas to produce their own instead of importing the traditional one from outside, implying strong benefits for economic development (OECD, 2012).

4.6.2 Normative and planning framework: Mexico

Mexico's normative framework concerning energy has developed very quickly in the last years: from a feeble presence of regulations and an even smaller evidence of implementation until 2012, we are today facing an extremely well structured legislative and planning system. The following paragraphs provide a brief description of the main normative and planning tools delineated by the federal government for the transition towards a clean-energy environment.

4.6.2.1 National Energy Strategy

The Strategy stems from art. 33 of the *Organic Law of the Federal Public Administration,* which was amended and integrated many times until 2014, to include the issue of renewable energies (Gobierno Mexicano, 2015c). The article - as reformed in 2008 - (Gobierno Mexicano, 2015c) establishes that the executive power shall send the Congress a national strategy on energy in February of each year, which cover a time frame of 15 years (SENER, 2013) and be created in collaboration with the *National Council on Energy*, created by SENER in 2009 as a supportive tool for the design of medium and long-term energy policies (SENER, 2009).

The *National Energy Strategy* (ENE) shall include Mexico's national energy sector's conditions year by year, and the analysis of its results should impulse the modification of the current lines of action or the creation of new ones aimed at pursuing the objectives set (SENER, 2013).

To date there has been just one edition, covering the period from 2013 to 2027.

With its ratification, the ENE 2013-2027 (SENER, 2013) managed to establish a shared vision on the future of the energy sector in Mexico; its main characteristic was the effort to represent and give voice to all social sectors: academic, social, industrial, researching and all the three levels of government. Its main goal was to reach a general consensus not only on the objectives set, yet also on the measures and policies to achieve them. Such inclusive system is in principle very positive in that it implies common efforts by the different social sectors to achieve shared goals.

The Strategy also recognizes the importance to provide energy access to all, especially the most marginalized sectors of society, along with modern energy technology and improvements in education, health, gender equality and environmental sustainability.

To sum up, ENE's "strategic objectives" are set both to promote economic growth for Mexico and to provide all sectors of society with high quality, responsible energetic services (SENER, 2013).

4.6.2.2 Energy Reform

Since January 2014, Mexico is experiencing a Constitutional Reform on Energy, proposed by the President Enrique Peña Nieto at the end of 2013 (Gobierno Mexicano, 2013g).

The main points of the Reform are the reaffirmation of the federal government's exclusive control over oil and any other mineral lying under the Mexican territories; moreover, Pemex and the Federal Electricity Commission will be converted into state productive firms able to compete with other external firms for the providing of oil and energy, setting agreements by means of simple contracts; finally, the government will maintain exclusive authority to plan and control the electric system at the federal level (Gobierno Mexicano, 2014a).

According to the authors of the reform, these objectives are going to be translated into concrete benefits for Mexican citizens, given that electric tariffs are going to fall, as the cost of gas and food, also thanks to the use of cheaper fertilizers (FONDEN, 2012).

4.6.2.3 Renewable Energies

The federal normative framework in the renewable energies field demonstrates to be wide and accurate. According to the *Law for the Development of Renewable Energy and Energy Transition Financing* (LAERFTE), adopted in 2008 and amended frequently up to the present day (Gobierno Mexicano, 2013d), the generation of electric energy from fossil sources should not exceed 65% of the total amount in 2024, 60% in 2035 and 50% in 2050 (Gobierno Mexicano, 2013d). To achieve such an ambitious objective, it is necessary to count on new generation technologies based on renewable energy sources (Gobierno Mexicano, 2013g).

Following what established in the LAERFTE, in 2014 SENER created the *Special Program on Renewable Energy Development* (PEAER) (Gobierno Mexicano, 2014e), later included in the *National Development Plan 2013-2018* (Gobierno Mexicano, 2013f), and the *National Program for Sustainable Energy Development 2014-2018* (PRONASE) (Gobierno Mexicano, 2014f).

Also based on the LAERFTE (art. 27), the *Fund for Energy Transition and Sustainable Energy Development* was created (SENER, 2014a) to promote the use, development and inversion in renewable energies and energy efficiency.

Concerning bioenergetics, the *Law for Sustainable Energy Use* (LASE) (Gobierno Mexicano, 2008) highlights their relevance as a technical solution to favour electrification of rural areas, generating a better lifestyle for the highly-marginalized communities and to achieve energetic diversification and sustainable development.

This focus on renewable energies in rural areas is reflected in the *Program for Productive Activities in Rural Areas with Renewable Energies* (SENER, 2014b), still in process and created by three Under Secretariats of SENER: the Under Secretariat for Energy Planning and Transition, the Under Secretariat for Electricity and the one for Hydrocarbons. The objective pursued is the integration of some projects in rural areas that include photovoltaic and wind systems and to provide some micro-financing schemes to allow their economic independence (SENER, 2014b).

The institutions identified by the PECC as involved in the energy sector are presented below.

Energy efficiency	
SAGARPA	• Orchestrate sustainable agricultural practices, exploitation, generation and use of renewable energies, energy efficiency and generation and use of biomass.
SENER	• Improve the use of clean and renewable energy sources, promoting energy efficiency and social and environmental responsibility.

Table 4: Federal institutions formally in charge with implementation in support of energy efficiency in Mexico.

4.6.3 Normative and planning framework: Tabasco

The public institution in charge with the energy sector in Tabasco is the General Direction on Energy of SERNAPAM, created in 2012 to promote the responsible and efficient use of the energetic resources existing in the state, producing positive effects on Tabasco's citizens' quality of life and therefore on their competitiveness (SERNAPAM, 2012).

SERNAPAM's internal rules (Gobierno del Estado de Tabasco, 2013c) identify two ramifications of the General Direction on Energy – the *Direction on Energy Development* (art. 39) and the *Direction on Research and Technology for Sustainable Energy* (art. 41)- as the appropriate organs to achieve these goals.

With regards to the electrification of rural areas and the improvement of infrastructures, the *Law of Fiscal and Financial Coordination of the state of Tabasco* (Gobierno del Estado de Tabasco, 2012a) establishes that all federal economic contributions for social infrastructures must be devoted to the financing of works, basic social activities and inversions specifically directed at the poorest and most marginalized sectors of the population. Rural electrification is explicitly mentioned (art. 22).

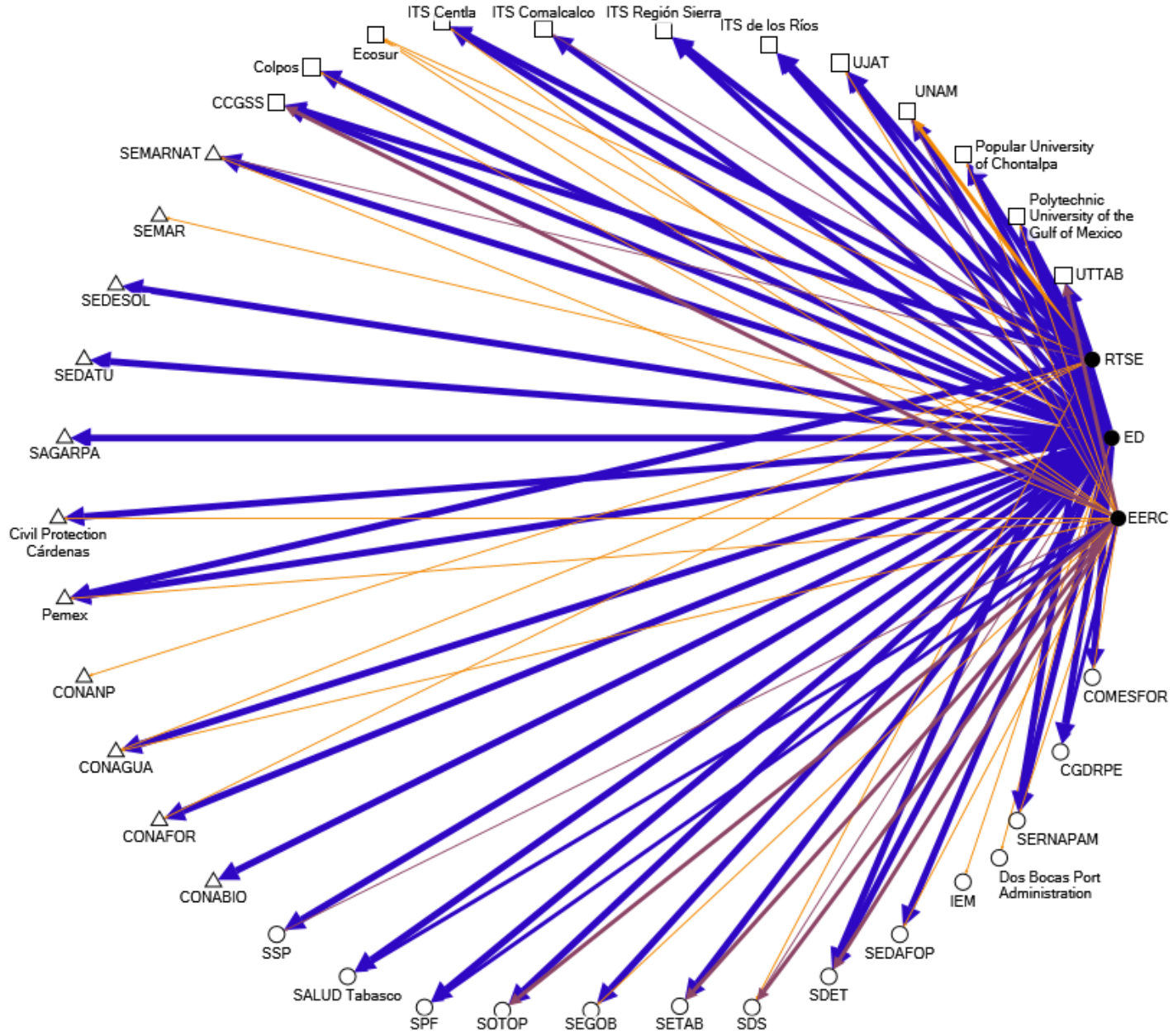
4.6.4 Projects and initiatives in Tabasco and the CPM area

The institution playing a major role in managing and distributing economic resources locally is the *Federal Electricity Commission* (CFE), which provides support to improve infrastructures and services in the state of Tabasco (Gobierno del Estado de Tabasco, 2014a). The CFE is also committed to signing agreements with local communities to regulate historical debts in the electric energy payment. All the three municipalities closest to the CPM lagoon system (Cárdenas, Comalcalco and Paraíso) recorded the highest number of formal agreements, signalling the good acceptance of such mechanism by the citizenship (Gobierno del Estado de Tabasco, 2015b). However, no other projects nor initiatives by federal or local actors are currently being carried out in Tabasco or the CPM lagoon system.

4.6.5 Social Network Analysis

SERNAPAM's General Direction on Energy is composed by three Directions: all of them were chosen for this SNA, as they all deal with energy from different perspectives: the Direction for Energy Efficiency and Responsible Consumption (EERC) implements programs and actions of energy efficiency within the three levels of government, and relies on the support of 30 Committees (SERNAPAM, 2015e); the Direction for Energy Development (ED) deals with projects for alternative energies in the state of Tabasco; finally, the Direction for Research and

Technology of Sustainable Energy (RTSE) promotes projects for capacitation and researches ways to facilitate energy transition towards sustainability in climate change circumstances (information retrieved from personal communications).



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Graph 4-9

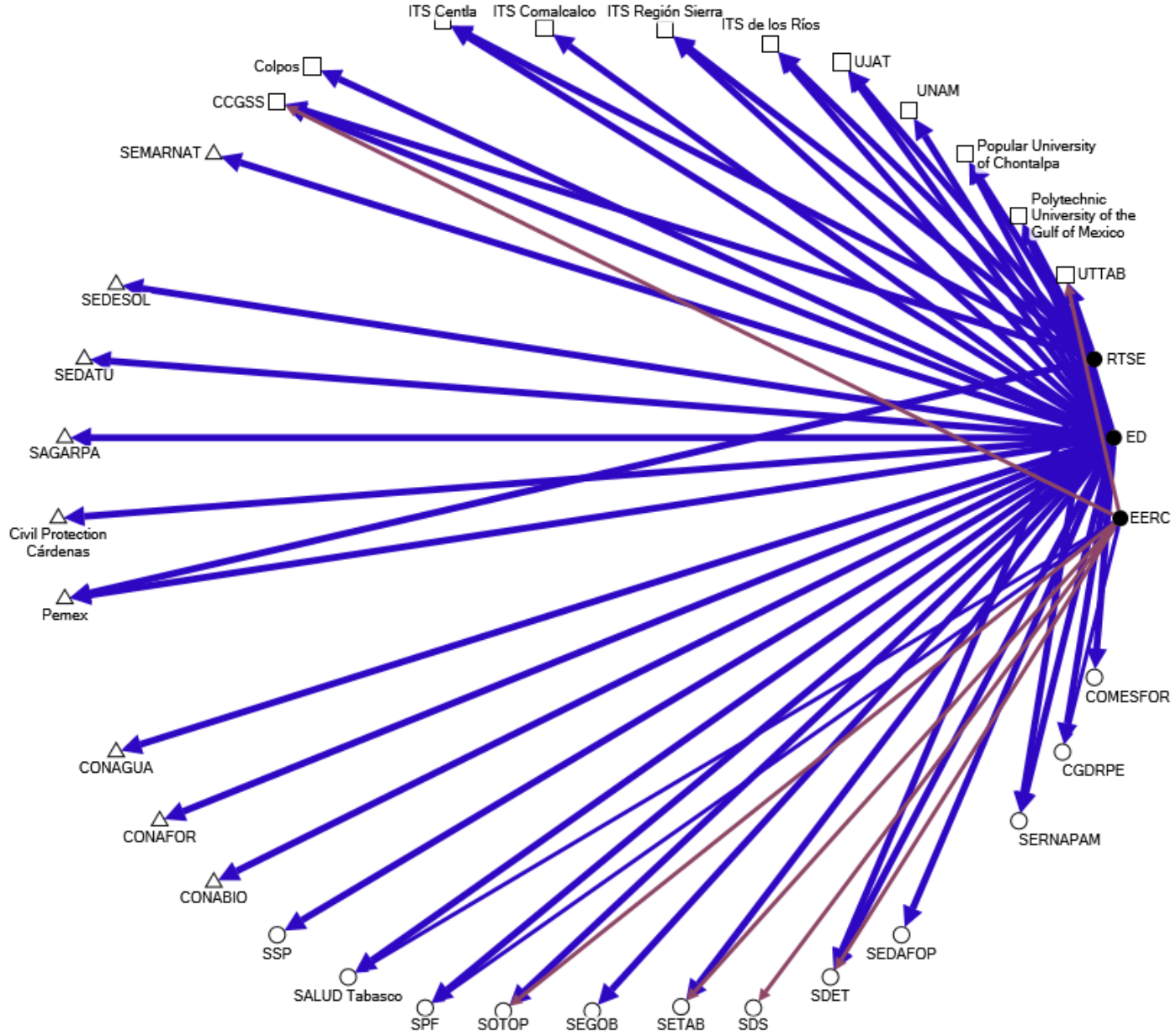
Starting our analysis focusing on internal linkages with the other Directions, we can notice in Graph 4-9 an interesting criticality: despite the Directions on Research and Technology of Sustainable Energy and Energy Development affirm to entertain intense and frequent relations with the other Directions, the one on Energy Efficiency and Responsible Consumption describes its interactions as infrequent and reduced to a simple interchange of information, including the ones involving the other two dealing with energy.

From Graph 4-9, we can also observe that the general number of edges is considerably high; indeed, all the actors included in this Study appear linked in some ways to at least one of the three Directions.

The Direction on Energy Development is the one that appears to cooperate more and with differentiated types of institutions; concerning Energy Efficiency and Responsible Consumption, we can see more threads of coordination, even though it does not appear to entertain any relation with SEDESOL, which as was already mentioned, deals with the social dimension.

Concerning SENER, the Direction on Energy Development did not provide a response on the existence of a relation with the Secretariat, while the Direction for Energy Efficiency and Responsible Consumption perceived the presence of a contact, without specifying however the levels of intensity, nor of frequency. Finally, the Director of Research and Technology of Sustainable Energy specified that his Direction and SENER entertain relations of cooperation on a frequent basis.

With regards to SAGARPA, which is supposed to promote renewable energies in agriculture and in general enhance energy efficiency, only the Direction on Energy Development appears to entertain a relation with it, which involves cooperation on a very frequent basis.



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Graph 4-10

If we delete all the interactions apart from those including collaboration or cooperation, as was done in Graph 4-10, we can notice that the Direction entertaining the highest number of relations is by far the one on Energy Development, while the one having the lowest number of contacts is that on Research and Technology on Sustainable Energy, which however cooperates with almost all the information-gathering institutions taken into consideration: the CCGSS; Centla, los Ríos and Región Sierra Institutes of Technology; UJAT; the Popular University of Chontalpa and the Polytechnic University of the Gulf of Mexico.

Pemex appears as a strong linkage, cooperating both with RTSE and ED, probably in light of its function as an economic supporter of SERNAPAM, as was mentioned during telephonic communications by some of the respondents.
The Direction on Energy Efficiency and Responsible Consumption, despite being the one whose activities belong to a broader spectrum, is however the one from which all the violet threads in the graphs depart, revealing that its general degree of cooperation is less developed than in the other two cases.

5 Discussion

From the normative review, we could appreciate broad and well-structured legislative and planning frameworks both at federal and state levels. Multi-level and inter-institutional cooperation is strongly promoted and encouraged (Gobierno del Estado de Tabasco, 2013a; Gobierno Mexicano, 2012b, 2013a, 2014d), and frequent allusions are made to the importance of including the social dimension in decision-making processes regarding adaptation strategies (Gobierno Mexicano, 2013a, 2014d; SERNAPAM & Ecosur, 2011).

However, if we look at the actual levels of horizontal cooperation currently existing among the institutional actors considered in this Study, we find that the general level is not satisfactory. Social Network Analysis' outcomes demonstrate that, apart from the relations existing between the different Directions of SERNAPAM - generally cooperative and frequent - the institutions identified by the PECC as relevant were rarely found to entertain strong relations with the Directions. This may be explained with a generalized misinterpretation and **minimization of the high importance** of climate change-related issues, especially in a vulnerable area such as the CPM lagoon system, which struggles every day with the enormous fragilities of its own ecosystem.

Cooperation between institutions formally sharing the same objectives appears to be scarce; this suggests the presence of a **sectorial approach** that is not adequate in the context of building adaptive capacity in the face of such a multifaceted problem as climate change is. It is indeed understandable that some Directions, dealing with relatively specific issues (such as the Direction on Use and Management of Natural Resources or the Directions dealing with Energy), do not construct a wide network with the other actors, and may prefer to strengthen relations with other entities with whom they share specific goals and objectives. Nevertheless, other Directions such as Environmental Culture or Climate Change Policies, presenting an essentially multi-sectorial vocation, would be expected to entertain wider networks, and to cooperate with a quite higher number of institutions dealing with social aspects in Tabasco such as SEDESOL or PROFEPA.

On the other side, relations between SERNAPAM and the oil-extracting multinational firm Pemex appear to be omnipresent in all the SNAs carried out, often being among the strongest ones. The reason given by more than one official during telephonic interviews, and mentioned in Chapter 4, was that Pemex covers an important role in the financing of SERNAPAM's different Directions. Economic interests may therefore play a relevant role in shaping the relations between the institutional sphere and local communities.

Finally, collaboration with universities and research centres appeared generally scarce, highlighting thus a lack of interest by the institutional sector in gathering and spreading climate change knowledge at the social level and especially among young people. Contacts were indeed found to be limited to technical advice and support mostly provided by technical institutes, while linkages with universities dealing with social research were almost absent.

The absence of horizontal cooperation was also noticeable through another clear example: Tabasco's Intersecretarial Commission on Climate Change and the Interinstitutional Committee for Climate Change. As was mentioned in subparagraph 4.1.5, such organs are established and mandated by Tabasco's Environmental Protection Law, and should be specifically directed at promoting a transversal and collaborative focus among institutions at the local level. The Commission in particular is thought as an organ of support and consultancy in the planning, design and execution of public policies in coordination with the state power. The Committee instead should help achieve transversality in state's public policy on climate change by unifying the three levels of government, the academic, business and productive sectors, ONGs, and all sectors of society. However, such organs revealed to not function properly, signalling a generalized **lack of awareness and interest** among local institutions in the problems related to climate change in Tabasco and the CPM area. Referring to the information gathered during telephonic interviews, it appears that SERNAPAM is currently trying to mitigate the scarce activity of Committee and Commission through informal reunions and working groups with other secretariats and institutions operating in Tabasco. As perceived by the respondents, SERNAPAM managed to achieve a better integration among the three levels of government, civil society and more in general the other

actors involved in climate change adaptation. This was possible through the predisposition of consulting meetings and discussions and the organization of symposiums and workshops of capacitation, which were greatly appreciated by local authorities.
All said activities represent an important and positive achievement towards integration and cooperation. Nevertheless, they are not enough to substitute a more structured process of cooperation, to be carried out through the work of the organs officially created for this purpose.

In addition to the lack of an efficient collaboration among institutions, a relevant criticality emerges when it comes to local **implementation** of laws and strategies. Indeed, research on projects and initiatives currently active in the CPM area achieved scarce results: no projects are currently being held there or in the nearby municipalities, except for the annual recycling initiatives organized by SERNAPAM's Direction of Environmental Culture.
Within the context of scarce implementation of norms and provisions, the involvement of the **social dimension** in the decision-making processes revealed to be insufficient. In addition, a critical element is represented by the presence of a so-called *subsidy-mentality* among the inhabitants of the CPM area, detected by a certain number of SERNAPAM's functionaries. Such phenomenon consists in the assertion of false or exaggerated claims by local fishers or land owners, affirming that they have allegedly been damaged by accidents during oil extracting activities, and requesting monetary refunds (personal communication with the author). This subsidy-mentality could represent a decisive element in wrecking the already fragile equilibrium of trust between local communities and the institutional sphere, already deteriorated by the tense situation caused by oil extracting activities. Indeed, the soft and sometimes unclear position adopted by the institutional sector in response to the irregularities committed by Pemex decreased considerably the overall level of **trust** towards institutions.

Implementation appears scarce also within the issue of women's empowerment in the adaptation context: despite it being clearly mentioned as an objective to pursue in the statutes of both National and State Institutes for Women, along with their inclusion in the socio-economic life of society, we do not find programs or strategies

that deal with the revaluation of women as active factors in the adaptation process. The vast majority of programs and laws are indeed against gender-based violence and abuses. These results represent a clear signal that serious social development issues are setting out as barriers for successful adaptation outcomes in the CPM area.

However, to promote climate change awareness and culture, it is necessary to provide an enabling environment for social development to occur. In this sense, the institutional sphere at the local level seems to lack the right vision of women as active factors in the development of adaptation strategies. Stronger efforts in this direction would beneficiate the adaptive capacity of the whole society, as women represent positive agents for the creation of adaptation strategies both at the local and national level, and they may also play a role in the economic development of the country, as is the case in the fishing activity in Tabasco.

Different possible reasons were given by the respondents to explain such apparent lack of interest among institutions for the creation of effective adaptation processes in the CPM area. Some of them appealed to bureaucratic barriers that would impede automatic and rapid intervention in the area; other arguments focused more on the logistic difficulties in reaching the site, along with the scarcity of personnel and apt vehicles.

All these reasons induce to think that the CPM lagoon system is not currently considered as a priority region in need of adaptation planning measures. However, we know that the environmental situation is critical, and the region formally appears among the land, marine and hydrologic priority regions selected by CONABIO (2008b, 2008c, 2008d).

6 Conclusions

Strengthening resilience and reducing climate change vulnerability are identified as crucial factors for the deployment of effective adaptation strategies, contributing also to the achievement of sustainable development (United Nations, 2015).
In this context, institutions are recognized as having a crucial role to play: they shape how societies will be affected and their responses to climate change impacts, they allocate resources and act as mediators between communities and external actors (A. Agrawal, 2008). Despite the difficulties in defining and evaluating institutions due to their complex and dual nature, there is general consensus on their inclusion among the determinants of societies' adaptive capacity (B. Smit & Pilifosova, 2001). Particularly in the local context, *institutional cooperation* appears as an essential feature to face climate change in all its complex and multifaceted nature, minimizing the risk of duplication and giving impulse to the creation of better-informed and articulated adaptation policies (A. Agrawal, 2010).
Being a coastal zone, the Carmen-Pajonal-Machona lagoon system in Tabasco (Mexico) revealed particularly high levels of vulnerability to climate change-related impacts.
This Study aimed thus at exploring the different levels of institutional cooperation existing among the actors dealing with climate change adaptation in the CPM lagoon system, to favour the creation of *ad hoc* adaptation policies to increase its resiliency. The methodology used was that of Social Network Analysis, which explores the existence and quality of the different relations involving a group of selected institutional actors. The aim was to identify the mechanisms of influence lying behind decision-making processes in the adaptation context (Lucas & Mayne, 2013).

The results of the Study revealed a peculiar aspect: broad and detailed normative and planning frameworks at the federal and state levels are not followed however by an efficient implementation at the local level. Inter-institutional cooperation, pursued and promoted at both federal and state levels, does not appear sufficiently developed at the local level. This signals the presence of a sectorial approach among the actors considered, who seem to lack a multi-spectrum vision towards adaptation and appear to be concentrated only on accomplishing their individual tasks. This outcome was particularly relevant in that it interested also those Directions that, for

their inner multidimensional nature, should interact with a wide number of institutions dealing with different issues, included social development.

In addition, strong social issues were found accountable for a generalized lack of trust by communities towards local and federal institutions, making it more difficult to achieve an inclusion of the social dimension in climate-change related decision-making processes and in the implementation of local projects, which resulted almost inexistent in the CPM area.

6.1 Policy recommendations

After the in-depth analysis carried out on the institutional dimension of adaptation in the CPM socio-ecosystem, some recommendations were elaborated.

Firstly, greater efforts should be made to assure that institutions follow what mandated by the well-structured and wide normative frameworks at both national and state levels. We already mentioned the clearest example of this need, represented by the scarce work realized by both the Committee and the Commission on Climate Change of Tabasco in promoting and enhancing inter-institutional cooperation. A possible enabling factor may be represented by the apparently strong ties already existing among the different Directions of SERNAPAM. Indeed, despite the negative results obtained from the Direction on Environmental Culture's questionnaire, collaboration among the Directions seems generalized. Such positive outcome, along with the promotion of activities to involve other institutions, may represent a positive example. Collaboration and cooperation habits within the same unit represent the right attitude and could be a first step towards inter-institutional cooperation.

Secondly, in order to overcome the current sectorial approach characterizing the actions of SERNAPAM's directions and related institutions, climate change adaptation and environmental protection objectives should be strongly coupled with social ones. Indeed, the CPM area revealed to be affected by serious social issues which are perceived as priority by local communities. To couple environmental questions with social ones would allow communities to understand, accept and legitimate them. The goal should thus be that of accompanying local communities towards adaptive capacity step by step, increasing their knowledge and awareness of the different issues concerning them and their environment.

Doing so could also contribute to solve the problem of the generalized lack of trust in institutions, which is accountable for ulterior criticalities such as the origination of a so-called subsidy mentality.

A *real* and active participation by the social sector should thus be pursued, seeing citizens through the lens of *social capital:* thinking about each of them as an active factor conveying potential solutions and strong contributions to the adaptation process. Indeed, as highlighted at the beginning of this Study, social acceptance represents an essential element for the successful implementation of norms and strategies. Adaptive capacity cannot take place in an "institutional vacuum": institutions need to be the promoters of an effective implementation of climate change and environmental policies, actively showing their commitment by providing communities with direct actions to help them through the process of adaptation. Without it, all the existing wide and well-structured normative frameworks are bound to fall into a void.

Finally, more efforts should be performed by institutions in promoting environmental awareness through all sectors of society. The profound social need in this sense is exemplified by the illegal cutting of mangroves. Laws against this phenomenon have not prevented until today local communities to cut the trees, exacerbating the already existent phenomenon of deforestation. If citizens were better informed about the crucial role played by mangroves in maintaining and protecting their own ecosystem and wellbeing, the frequency of the illegal cutting would most probably decrease. In this sense, it would be recommendable to pursue a broader collaboration and cooperation with universities, not limited to technical support but also involving shared projects to spread environmental education among young people.

6.2 Directions for future research

Given the limited interest found among Tabasco's local institutions towards adaptation to climate change impacts and related issues, it would be quite interesting to identify the main causes for that. The identification of the main barriers to adaptation should be pursued through a deeper analysis of the reasons lying behind the scarce presence of environmental culture among public institutions.

As to implementation of projects and initiatives, we know that the problems lying beneath Tabasco and the CPM lagoon system's social fabric play a fundamental role as barriers in this sense. It would be therefore interesting and useful to research concrete and *ad hoc* options for the protection and inclusion of local communities within the decision-making process in the adaptation context, to favour an efficient implementation of adaptation measures and actions. One path could be that of promoting a process of *capacitation*, read with the meaning given by Sen in his Capability Approach (1980). The goal is to provide local communities with the instruments to appropriate of the basic concepts and good habits linked to a sustainable vision of environmental and social development, that favour an effective adaptation process in the face of the multiple and diverse challenges posed by global warming.

Ringraziamenti.

Giunta alla fine di questo lungo e gratificante percorso, vi sono alcune persone che desidero ringraziare.

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Annex

Default Question Block

Q1.
Este breve cuestionario se propone evaluar el nivel de coordinación existente entre las distintas Direcciones de SERNAPAM y entre éstas y otras instituciones locales y nacionales relevantes en los ámbitos de la adaptación al cambio climático y de la gestión y protección de los recursos naturales. El objetivo final es el de fortalecer las relaciones inter-institucionales existentes e individuar otras colaboraciones posibles para favorecer la implementación de las medidas de adaptación individuadas en el sistema lagunar Carmen-Pajonal-Machona dentro del Proyecto de Adaptación de Humedales Costeros del Golfo de México ante los Impactos del Cambio Climático, coordinado por el Instituto Nacional de Ecología y Cambio Climático (INECC) y financiado por el Banco Mundial.

Si tiene alguna duda puede contactar a ottavia.carlon@gmail.com.

Por favor, indique la Dirección de SERNAPAM a la cual pertenece:

Q2. Por favor, describa brevemente el tipo de actividades llevadas a cabo por su Dirección. Si es posible, adjunte unos ejemplos (proyectos, iniciativas...).

Q3. ¿Tiene su Dirección proyectos o iniciativas en el área del sistema lagunar Cármen-Pajonal-Machona?

Sí

No

Q4.a. Si contestó positivamente a la pregunta antecedente, indique por favor las **entidades** con las cuales colabora en la zona C-P-M (instituciones federales, sus órganos desconcentrados, municipios, instituciones locales...) y las **comunidades**.

Q4.b. Si su respuesta es negativa, cuál cree Usted que podría ser la razón? Tuvimos informaciones de que las comunidades de la zona aparecen particularmente difíciles; podría ser esta una razón?

Q5.0. Por favor, evalúe ahora el **grado de colaboración** y la **frecuencia** con que su Dirección se relaciona con otras entidades que trabajan sobre temas de cambio climático o manejo sustentable de los recursos.

Puede evaluar el grado de colaboración a través de **4 niveles**:
0= ningún contacto;
1= intercambio de informaciones;
2= coordinación (apoyo activo a iniciativas realizadas por el otro actor, subdivisión de los ámbitos operativos...);
3= cooperación.

Para evaluar la frecuencia, Usted tiene también **4 opciones**:
0= ningún contacto;
1= de vez en cuando;
2= de manera frecuente;
3= muy frecuentemente.

Primera lista: instituciones tabasqueñas.

	Relación: 0	1	2	3	Frecuencia: 0	1	2	3
Administración Portuaria de Dos Bocas	☐	☐	☐	☐	☐	☐	☐	☐
Comisión estatal forestal COMESFOR	☐	☐	☐	☐	☐	☐	☐	☐
Coordinación general de desarrollo regional y proyectos estratégicos CGDRPE	☐	☐	☐	☐	☐	☐	☐	☐
Dirección de								

Concertación Social SERNAPAM	☐	☐	☐	☐	☐	☐	☐	☐
Dirección Cultura Ambiental SERNAPAM	☐	☐	☐	☐	☐	☐	☐	☐
Dirección de Desarrollo Comunitario SERNAPAM	☐	☐	☐	☐	☐	☐	☐	☐
Dirección de Políticas para el Cambio Climático SERNAPAM	☐	☐	☐	☐	☐	☐	☐	☐
Dirección de Uso y Manejo de los Recursos Naturales SERNAPAM	☐	☐	☐	☐	☐	☐	☐	☐
Dirección de Desarrollo de Energía SERNAPAM	☐	☐	☐	☐	☐	☐	☐	☐
Dirección de Eficiencia Energética y Consumo Responsable SERNAPAM	☐	☐	☐	☐	☐	☐	☐	☐
Dirección de Investigación y Tecnología de Energía Sustentable SERNAPAM	☐	☐	☐	☐	☐	☐	☐	☐
Instituto Estatal de las Mujeres IEM	☐	☐	☐	☐	☐	☐	☐	☐
Secretaría de Desarrollo								

Agropecuario, Forestal y Pesquero SEDAFOP	☐	☐	☐	☐	☐	☐	☐	☐
Secretaría de Desarrollo Económico y Turismo SDET	☐	☐	☐	☐	☐	☐	☐	☐
Secretaría de Desarrollo Social SDS	☐	☐	☐	☐	☐	☐	☐	☐
Secretaría de Educación SETAB	☐	☐	☐	☐	☐	☐	☐	☐
Secretaría de Gobierno SEGOB	☐	☐	☐	☐	☐	☐	☐	☐
Secretaría de Ordenamiento Territorial y Obras Públicas SOTOP	☐	☐	☐	☐	☐	☐	☐	☐
Secretaría de Planeación y Finanzas SPF	☐	☐	☐	☐	☐	☐	☐	☐
Secretaría de Salud SALUD TABASCO	☐	☐	☐	☐	☐	☐	☐	☐
Secretaría de Seguridad Pública SSP	☐	☐	☐	☐	☐	☐	☐	☐

Q5.1. ¿Existen otras instituciones tabasqueñas con que su Dirección u otras de SERNAPAM colaboran que Usted quiere añadir?

Q5.2. Secretarías, Comisiones y otras entidades a nivel federal:

	Relación 0	1	2	3	Frecuencia 0	1	2	3
CONABIO	☐	☐	☐	☐	☐	☐	☐	☐
CONAFOR	☐	☐	☐	☐	☐	☐	☐	☐
CONAGUA	☐	☐	☐	☐	☐	☐	☐	☐
CONANP	☐	☐	☐	☐	☐	☐	☐	☐
Pemex	☐	☐	☐	☐	☐	☐	☐	☐
Protección Civil	☐	☐	☐	☐	☐	☐	☐	☐
SAGARPA	☐	☐	☐	☐	☐	☐	☐	☐
SEDATU	☐	☐	☐	☐	☐	☐	☐	☐
SEDESOL	☐	☐	☐	☐	☐	☐	☐	☐
SEMAR	☐	☐	☐	☐	☐	☐	☐	☐
SEMARNAT	☐	☐	☐	☐	☐	☐	☐	☐

Q5.3. ¿Existen otras instituciones federales no incluídas en la lista con que su Dirección u otras de SERNAPAM tienen contactos?

Q5.4. Universidades e Institutos Tecnológicos y Centros de Investigación:

	Relación 0	1	2	3	Frecuencia 0	1	2	3
Centro de Cambio Global y Sustentabilidad en el Sureste CCGSS	☐	☐	☐	☐	☐	☐	☐	☐
Colpos (Colegio de Postgraduados)	☐	☐	☐	☐	☐	☐	☐	☐
Ecosur (El Colegio de la Frontera Sur)	☐	☐	☐	☐	☐	☐	☐	☐
Instituto Tecnológico Superior de Centla	☐	☐	☐	☐	☐	☐	☐	☐
Instituto Tecnológico Superior de Comalcalco	☐	☐	☐	☐	☐	☐	☐	☐
Instituto Tecnológico Superior de la Región Sierra	☐	☐	☐	☐	☐	☐	☐	☐
Instituto Tecnológico Superior de los Ríos	☐	☐	☐	☐	☐	☐	☐	☐
UJAT (Universidad Juárez Autónoma	☐	☐	☐	☐	☐	☐	☐	☐

de Tabasco)								
UNAM (Universidad Nacional Autónoma de México)	☐	☐	☐	☐	☐	☐	☐	☐
Universidad Popular de la Chontalpa	☐	☐	☐	☐	☐	☐	☐	☐
Universidad Politécnica del Golfo de México	☐	☐	☐	☐	☐	☐	☐	☐
Universidad Tecnológica de Tabasco UTTAB	☐	☐	☐	☐	☐	☐	☐	☐

Q5.5. ¿Existen otras universidades, centros de investigación, institutos tecnológicos con que su Dirección u otras de SERNAPAM tienen contactos?

Q5.6. ¿Existen unas organizaciones de la sociedad civil (por ejemplo ONG) no incluidas en las listas antecedentes y con las cuales su Dirección u otras de SERNAPAM tienen alguna relación? Si la respuesta es positiva, por favor indique los nombres abajo.