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Linking Land and Water Resource Management in Southern Thailand:

Viewing sustainable resource solutions through a double lens

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Abstract

Global demands for water continue to rise while at the same time, the availability of reliable water resources are deteriorating. As 70% of the world's human consumption of water resources is directed towards agricultural production, the need to improve water use efficiency and sustainability in these areas is of utmost importance. In order to tackle these issues, the concept of ***"Integrated water resource management"*** (IWRM) has been developed and is currently the most globally accepted and widely implemented strategy for attaining equitable, efficient and sustainable water management. Due to the extensive adoption of IWRM, the need to examine the successes and challenges of this strategy is warranted.

This case study, which is set in an agricultural river basin in southern Thailand, will address the question of how government policies in Thailand encouraging palm oil production are influencing the ability of rural communities to effectively manage their water resources. While the Thai government has formally embraced IWRM, its effectiveness in coordinating land and water resource management in the nation across all levels of government is still in question. For many cases of IWRM, one of the most significant obstacles facing practitioners is that of developing full and effective stakeholder engagement. Although this term has been understood as a vital component for IWRM success, the disconnection between 'ground-up' local community resource management efforts and 'top-down' higher level governmental policies still persist. Through the analysis of this case using ***Institutional Theory*** and in particular, the "***Institutional Analysis and Development (IAD) Framework"***, the results of this study demonstrate that efforts to enhance stakeholder engagement could benefit from a deeper understanding of the local level institutional processes that are at the core of rurally based natural resource management strategies.

Key words: Integrated Water Resource Management, Institutional Theory, IAD Framework, Institutional Change, Palm Oil, Biofuels, Community Based Natural Resource Management

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Table of Contents

List of Tables and Figures:

Abbreviations

ADB	Asian Development Bank
AEDP	Alternative Energy Development Plan
ALRO	Agricultural Land Reform Office
BOI	Board of Investment
CORIN-ASIA	Asian Coastal Resources Institute Foundation
CPD	Cooperative Promotion Department
DEDE	Department of Alternative Energy Development and Efficiency
DOA	Department of Agriculture
DOAE	Department of Agricultural Extension
FAO	Food and Agriculture Organization
GIS	Geographic Information System
GWP	Global Water Partnership
IAD	Institutional Analysis and Development
INBO	International Network of Basin Organizations
IWRM	Integrated Water Resource Management
LDD	Land Development Department
MOE	Ministry of Energy
MOAC	Ministry of Agriculture and Cooperative
MNRE	Ministry of Natural Resources and Environment
NESDB	National Economic and Social Development Plan
NST	Nakhon Si Thammarat
OAE	Office of Agricultural Economics
PAO	Provincial Administration Organization*
PPRB	Pak Phanang River Basin
RID	Royal Irrigation Development
ROM	River Operation Model
SEI	Stockholm Environment Institute
TAO	Tambon Administrative Organization*
WB	World Bank

* The TAO and PAO are the local and provincial governmental units in Thailand

1. Introduction

It is well recognized that the availability of reliable water resources in the world are declining alongside the drive for economic development and the improvement of social welfare (FAO, 2000). While demands for water are on the rise, supply-side based approaches emphasizing greater efficiency in resource extraction that were widely popular in the past are proving to be less and less able to meet continuously growing demand side needs (Ostrom, 1990). Although the construction of large scale water utilization schemes such as irrigation and hydropower have resulted in significant economic and social benefits, they have also resulted in irreversible changes to the ecosystem functioning of many rivers, lakes and aquifers (GWP & INBO, 2009). The lack of integration of water policies into national agendas can often pose substantial obstacles to socio-economic development, while at the same time deepening environmental degradation (UN Water, 2012).

Irrigation for agriculture is estimated to account for 70% of the population's freshwater use (UN Water, 2013). As the vast majority of human water consumption is utilized for agricultural production, the link between land and water management is clear (Ostrom, 1990). As stated by Bossio and Geheb (2008; pg.12), "every land-use decision is a water-use decision". Increased demands within the agricultural sector will lead to higher water extraction from the environment. Although plant use of water is directly linked to both food production and ecosystem functioning, "green water" has in the past been under-considered or neglected in favour of the more obvious "blue water"[1] (FAO 2000). Land use change can induce significant alterations in flow characteristics as well as in water quantity and quality (FAO, 2000). Land conversions from food based agriculture towards biofuel feedstock production is particularly a rising concern, as increased biofuel production is likely to add an additional pressure on already scarce resources. In Thailand, rising energy demands have put biofuels at the forefront of national policies. This in turn, has affected the way land and water management practices are developing (Polpanich, et al., 2013).

Within the agricultural sector, other activities in the landscape such as clearing and tilling of land, alterations for water storage, and chemical interference through fertilizer and pesticide application

[1] **Blue vs. Green Water:** "There are two types of human intervention in the hydrological cycle. Blue water is the volumes of water available in streams, lakes and groundwater aquifers. Green water flows are the water supply for all non-irrigated vegetation, including forests and woodlands, grasslands and rain-fed crops." (FAO, 2000; pg.3)

further compounds the problems of declining water quality and quantity (Bossio and Geheb, 2008). Given these circumstances, the question then arises of how to integrate land use with water management. Their interdependencies would appear to indicate a need for a more integrated method towards resource management (GWP & INBO, 2009). Integrated Water Resources Management (IWRM) is an approach which emphasizes the need to take into account and balance social, economic and environmental interests in an integrated approach in order to achieve efficient, equitable and sustainable water management (GWP & INBO, 2009). Nearly 80% of all countries have reported efforts towards the adoption and implementation of IWRM related schemes (UN Water, 2012), indicating the IWRM approach as the most widely agreed upon means for achieving effective development of water resources (UN Water 2008).

For this reason, the need to examine the successes and challenges of this globally accepted strategy is warranted. The World Bank has identified the main challenge for IWRM to be the actual implementation of the concept, rather than the understanding of the concept itself (Snellen and Schrevel, 2004). The translation of IWRM from ideals into practice has been a slow process. Numerous critics of IWRM have pointed out that the social complexity of both community and individual decision making presents a significant obstacle in understanding how the development of institutions for effective water resource management should be achieved (Plummer and Fitzgibbon, 2004; Lewins, 2007). Mollinga, et al (2007; pg. 700) has suggested that "social engineering approaches should acknowledge the inherently political character and plurality of actors, institutions and objectives".

Given these concerns, the Institutional Analysis and Development (IAD) Framework, as developed by Elinor Ostrom, has become a conceptual framework which has proven its usefulness for analyzing and understanding institutional features and processes (Ostrom, 2005). The IAD framework is meant to aide in the analysis of complex diverse polycentric institutional arrangements that exist in varying situations-- the most well-known being 'common pool resource dilemmas' such as those existing within agricultural river basins[2]. While IWRM contributes to watershed planning, the implementation and drive of potential strategies must come internally-taking into account the social structures, norms, and needs of local level actors (Ferreyra, et al., 2008; FAO 2000). The IAD framework places emphasis on the dynamics between ideas, rules, decision making and learning while focusing on "*choice*" as a fundamental part of human behavior as well as the basic mode for social and institutional change (Aligica and Boettke, 2011).

[2] River basin: "the land area drained by a river and its tributaries" (Source: The American Heritage® Dictionary of the English Language, Fourth Edition copyright ©2000)

1.1 Aim of Study

The goal of this study will be to illustrate how the implementation of IWRM and biofuel related strategies through top-down government methods interact with community driven bottom-up water management efforts to produce results that are beneficial or detrimental to the achievement of water resource sustainability, equitability and efficiency[3]. This will be done through the analysis of a case study set in southern Thailand, where national goals and government policies are encouraging the expansion of oil palm cultivation for both food and biofuel purposes. Specifically, the study will examine the implications of land use change to oil palm within a river basin context on the water management strategies of smallholder communities in the southern Thai province of Nakhon Si Thammarat (NST).

Through the lens of both the IWRM concept and the IAD framework, the objective is to illustrate how joint and consecutive consideration of both may lead to an improved understanding of the institutional change processes necessary at all levels to achieve effective water management strategies. The Thailand case study will be used as an example to examine how and why water management schemes are developing in the particular context chosen. The research question will thus focus on:

> **"How do Thailand government policies encouraging land use change to palm oil production influence the strategies of the community of the Karaked sub-district in Nakhon Si Thammarat to equitably, efficiently and sustainably manage their water resources?"**

This study will illustrate how the outcomes of land-water resource management can be defined by the quality of intersection between government policies for resource management (top-down process) and the strategies taken by local communities (bottom-up process) to improve their livelihoods while conserving their natural resources. Concurrently, it aims to demonstrate how national IWRM strategies can benefit from an enhanced understanding of the processes of community institutional change.

[3] **'Top-down' approach**: Strategies beginning with a policy decision, usually at the level of the government, which are then implemented downwards to the operational or local actors. **'Bottom-up' approach**: Strategies which begin with the analysis of the multitude of actors who interact at the operational (local) level, which then shape or influence policy formation at higher levels. (Sabatier, 1986; pg. 22)

2. Background

2.1. Development of Biofuels in the National Agenda

The demand for biofuels has experienced a global increase due to several factors, including concerns over energy security, rising oil prices and climate change mitigation efforts (IEA, 2009). Within the region of South East Asia, nearly all ASEAN-6 countries[4] have adopted medium and long term targets for renewable energy production and consumption, with Thailand taking the lead (Olz and Beerepoot, 2010). Due to the growing view that the nation is depending too heavily on imported energy, the Thai government has placed biofuel development as a high priority and is currently implementing its 10 year Alternative Energy Development Plan 2012-2021[5] (Preechajam & Prasertsri, 2012). This plan aims to increase the share of renewable and alternative energy to a total energy consumption target of 25% by 2021.

The two most common forms of biofuel are bioethanol and bio-diesel, however, this study will focus only on biodiesel originating from palm oil. In addition to being an important source of biodiesel, palm oil is also a major staple food product in Thailand (Polpanich, et al., 2013). Palm oil is especially targeted globally as a viable source of biofuel because of its high productivity and competitiveness in the market as compared with other vegetable oils. It has been shown to be at least five times more productive per hectare and has the lowest requirements for inputs of fuel, fertilizers and pesticides than other vegetable oils (IFC 2011).

(Left image: A palm oil fruit bunch, from which the palm oil product is derived; Right image: An oil palm tree)

[4] ASEAN-6 countries include: Indonesia, Thailand, Malaysia, Singapore, Philippines and Vietnam

[5] The current 10 year plan (2012-2021) has replaced its old 15 year Alternative Energy Development Plan 2008-2022

2.2. Characteristics of Oil Palm

Thailand is one of the largest exporters of agricultural commodities in the world. It has long been the world's largest rice exporter, making rice production important for food security as well as for the development of the national economy (Polpanich, et al., 2013). If Thailand is to meet its energy and biofuel targets, this will mean a vast change in the national agricultural sector (Salvatore and Damen 2010). Despite the relatively low requirements of oil palm for land, it is estimated that approximately an additional 400 000 ha will be needed for oil palm expansion to meet biofuel targets, of which half is considered to be suitable in southern Thailand (Salvatore and Damen, 2010). As land availability within Thai boundaries is sparse, this will inevitably mean a re-allocation of land use from food based agricultural goods towards biofuel feedstock.

Land use conversion from food to fuel crops may lead to food security concerns since an increased demand for crops which serve both food and biofuel purposes could lead to higher food prices (Islam, 2012). Cases have shown that biofuel development can also place additional pressure on water and land resources, although this will vary depending on the social and environmental context in which biofuels are grown (Islam, 2012; Larsen, et al., 2012). Different crops will require varying irrigation needs depending on the type of land brought into biofuel production. Although suitable land can produce yields as high as 28 tons/ha, the maximum yield for moderately suitable land is only half that (Salvatore and Damen, 2010).

Despite the reputation of oil palm for its resilience to adverse growing conditions, the effects of water availability fluctuations on yields are quite complex. Research has shown that oil palm trees are particularly vulnerable to stress at a number of critical periods, such as when sex selection or pollination occurs. If they are subject to water stress at these times, then fewer flowers will become product bearing fruits (Naandanjain Irrigation, 2011; Legros, et al., 2009). These long and indistinguishable intervals between plant life events and harvesting[6] make it difficult to establish a causal link between environmental factors and yields (Carr, 2011). Although oil palm can grow in many types of soil, the nutrient requirements for economic yields are normally higher than what can be sustained without the addition of fertilizer. While the plants require well-drained soils which are also able to retain water, it has been shown that surface compacted clay soils can also be beneficial for increased yields (Stakland, 2013). The exact water requirements for mature plants are not agreed upon, but estimates have hovered around 280-300L of water/tree/day (Carr, 2011). The distribution of tree roots are found mostly in the 0-1.5m depth horizon, but as roots

[6] Maturation of oil palm occurs at approximately 3 years of age, at which point it can start to produce the palm oil product

can often reach depths of greater than 5m, it is important that the water holding capacity of soils exceed beyond just the surface layer (Legros, et al., 2009; Stakland, 2013). It is essential that these oil palm requirements are considered, especially when expansion is targeted towards 'degraded lands' or towards farmers who may not have adequate access to these resources.

3. Study Site

3.1. Targeting of Nakhon Si Thammarat

The site chosen for this case study lies within the Pak Phanang River Basin, located in the province of Nakhon Si Thammarat (NST) in southern Thailand. This area is appropriate for the examination of land use change impacts on water management because it has been targeted by the Thai government as a suitable location for palm oil expansion. NST was deemed appropriate based on climatic factors, rainfall, land topography and soil physics (Polpanich, et al., 2013). The promotion of oil palm expansion has been incentivized by several government agencies who offer local farmers technical assistance, support with inputs and other provisions.

3.2. History of the Pak Phanang basin

The Pak Phanang River Basin (PPRB) is located at the southern east coast of Thailand, covers an area of 3193 km^2 and has a total population of approximately 600 000 (Amphorn, et al., 2012). In the past, NST was characterized by fertile land, a thriving coastal fishery and was one of the most prominent rice producing areas in the nation. However, past mismanagement of resources and inconsistent land use planning has led to severe degradation of environmental quality and agricultural production (Polpanich, et al., 2013). The transformation of the coastal area to aquaculture production through the destruction of mangrove areas and land conversion, sea water intrusion into the Pak Phanang river, massive deforestation in the upper parts of the basin, soil erosion and sedimentation, run-off of agro-chemicals and water pollution due to sewage from shrimp farms along the river and have led to detrimental impacts resulting in the decline of economic productivity and deepening poverty in the Pak Phanang Basin (Osbeck, Polpanich and Naruchaikusol., 2010; Prabnarong and Kaewrat, 2006).

To alleviate these impacts, in 1999 the *Uthokawiphatprasit* gate was constructed at the Pak Phanang District, NST as a Royal Initiated Project (Amphorn, et al., 2012). The main objective of the PPRB Project was to provide sufficient fresh water for agricultural and domestic use in order

to improve the welfare of the local population. The major activities of this canal-gate system were to drain excess water during the wet season and to prevent salt water intrusion into agricultural production areas during the dry season. It is estimated that 73% of the project area benefits from the project, through improved water storage, flood protection and irrigation (Penporn, 1995).

This engineered water management system influences water flow in the entire river basin. The authority responsible over the control and monitoring of water flows in this project is the Royal Irrigation Department (RID) whose task is to ensure reliable water resources to support agriculture in the basin (RID interview). The project is ongoing but has been considered successful in partially restoring the land and improving the quality and quantity of water available for agriculture (Polpanich, et al., 2013).

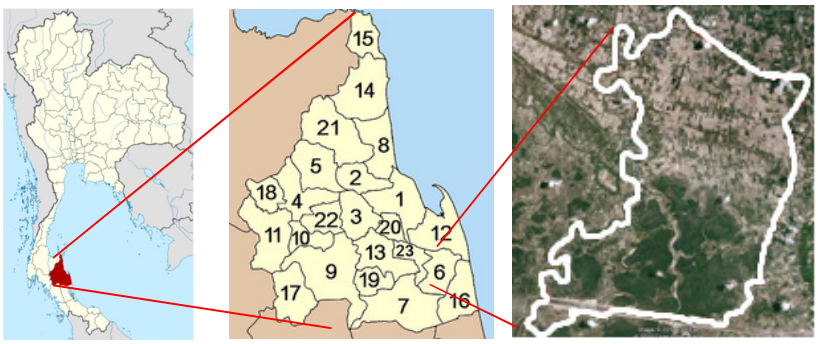

Figure 1: Location of the Study Area
Left= Location of NST in Thailand; **Middle** = NST with sub-districts indicated; **Right=** Karaked Sub-district
(Source: SEI- Polpanich et al, 2013)

3.3. Sub-district of Karaked

The area that will be the primary focus for examination in this study will be the sub-district of *Karaked* within the Pak Phanang River Basin, located approximately 12 km from the river mouth and covering an area of 60.28 km^2 [7]. The sub-district contains within it 12 villages (see location of villages in figure 3 below) and in 2008 had a population of 3664 people (1674 male and 1991 female)[8]. The terrain is characterized mainly by alluvial soils caused by the deposition of sediments through the intrusion of sea water into the plain areas. The soil has a very fine texture and a poor drainage system, but is moderately fertile, making it most suitable for rice cultivation (Polpanich, et al., 2013). It is bordered to the west by the Pak Phanang River and to the north by

[7] Information from the Karaked Local Administrative Organization in 2008
[8] Information from the Chian-Yai Agricultural Office 2008

the *Pra Rad Dhamri Canal*. In the south there exists a large drainage canal called the P*rak Muang Emergency Gate*, which redirects water towards the sea during times of flooding.

Agriculture has been the dominant activity in the Karaked sub-district, with 53% of the households cultivating rice. Other agricultural activities include oil palm, rubber, casuarina pine, sugar cane and vegetables (CORIN-Asia 2012). The rice farmers depend mainly upon annual rainfall patterns, while many also utilize water from the river and the irrigation canals (CORIN-Asia 2012). The northern area of Karaked consists primarily of rice paddies and shrimp farms while the southern area is mainly peat swamp forest[9] and oil palm farms. Although palm oil is currently concentrated in the southern areas, in recent years there has been a rapid conversion of traditional agricultural crops to oil palm in the northern zone. More than 60% of smallholders had converted part of their rice paddy fields into oil palm by 2012 (Polpanich, et al., 2013). The primary motivations for this were due to low productivity of rice farms and the rising input costs for rice each year.

The southern area of Karaked holds part of the *Pa Phur Kuan Kreng* peat swamp, one of Thailand's largest protected wetland sites. In 2012, the peat-swamp suffered a massive forest fire which burned for more than two months[10]. Part of the cause was claimed to be due to farmers' efforts to make way for rubber and oil palm plantations in order to occupy the land[11]. It was estimated that more than 1300 of the 1997 *rai* [12] of peat swamp forest within the PPRB Project has been destroyed by fire.

In 2011, a water user group system was established by CORIN-Asia in collaboration with the Karaked Tambon[13] Administrative Office (TAO) (Polpanich, et al., 2013). The projects of CORIN-Asia emphasize livelihood development approaches which contribute to poverty reduction, food security and sustainable development. The Karaked water user project was developed in collaboration with local governors, the Karaked sub-district and its village leaders. It currently serves as a pilot project for the demonstration of a community management model. In support of the project is the provincial governor of NST who has monitored the project and

[9] **Peat**= Peat soils consist of partly decomposed biomass mainly in wet coastal areas where the rate of biomass production from vegetation such as mangroves or swamp forest are higher than the rate of decomposition. This is due to the presence of a permanently high water table that prevents aerobic decomposition of plant debris. (Mutert, et al., 1999; pg. 23)

[10] http://www.prachachat.net/news_detail.php?newsid=1346817304&grpid=00&catid=19&subcatid=1900. Reported on September 5th, 2012.

[11] http://www.nationmultimedia.com/national/DNP-seeks-stronger-control-over-encroaching-farmer-30188979.html NST August 24, 2012

[12] **Rai**= a unit of land area covering approximately 1600 m^2

[13] **Tambon** = the local government unit in Thailand

allocated funds, as well as the RID who has offered financial and infrastructure support for the irrigation system and they pumps (CORIN-Asia 2013).

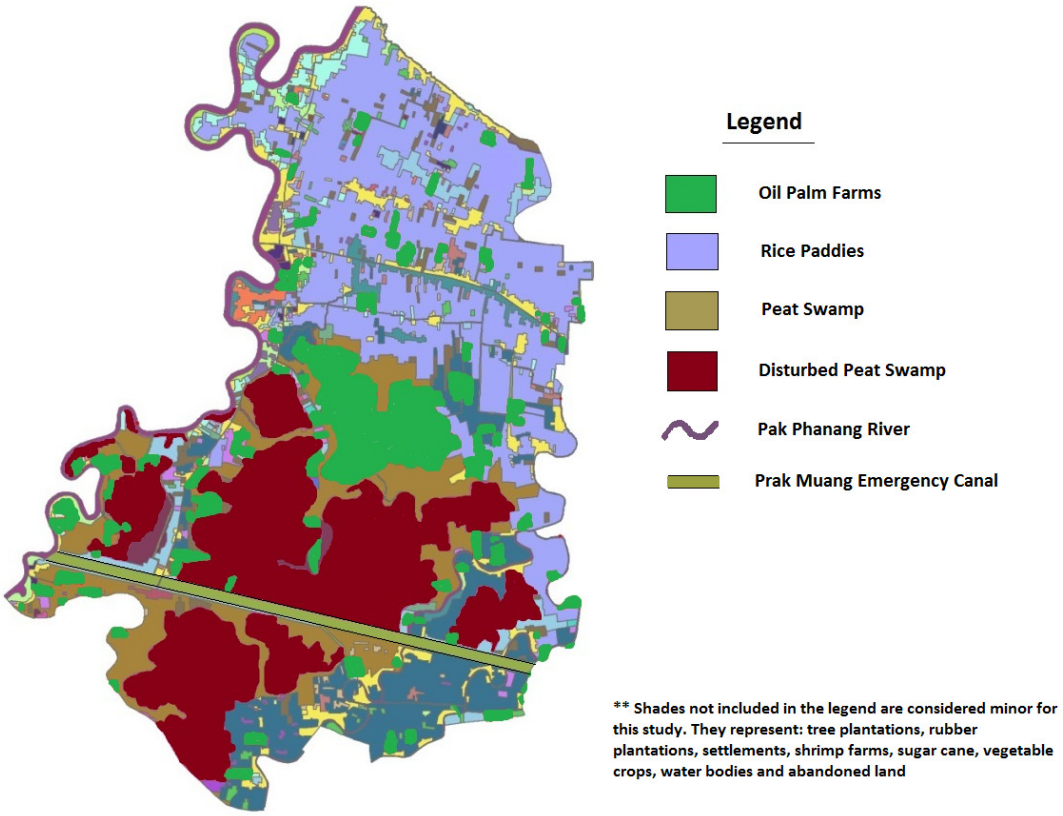

Figure 2: Land use map for the Karaked Sub-district in 2007
(Source: Polpanich, et al., 2013)

The Karaked sub-district has been zoned into three areas by the local government during the development of the irrigation and water management plan. The criteria for zoning were based on several factors, including soil type, community characteristics, dominant agricultural crops and topography.

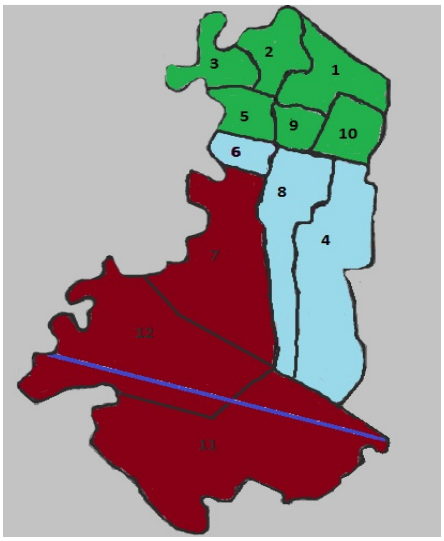

Figure 3: Location of the villages and zones in Karaked
(Green= Zone 1, Blue= Zone 2, Red= Zone 3)

Zone One: Located in the northern area of Karaked. Rice paddy fields dominate in this zone, although oil palm is on the rise. Due to a history of drought and water shortage problems, experiences with water management is the highest, and the irrigation system is the most advanced. Zone 1 consists of villages 5, 9, 10, 3, 2 and 1.

Zone Two: Located in the mid-section of Karaked, this is a transition zone consisting mainly of rice paddy fields, oil palm and orchard fields. Oil palm cultivation is expanding most rapidly in this zone, however, the community irrigation and water user scheme has only recently been put in place. Zone B consists of villages 6, 8, and 4.

***Zone Three*:** Located in the southern area of Karaked, the majority of this zone exists within a protected peat swamp forest. Oil palm cultivation is the dominant crop cultivated. Water management is weakest here and infrastructure development for irrigation is incomplete. Zone 3 consists of villages 7, 11, and 12.

The analysis of water management strategies in Karaked will examine each of these zones separately when looking specifically at the action situations in section 7. The main reason for this, in addition to differences in cultivation, soil characteristics and infrastructure, is because the water user plan has been zoned into these three areas and staging of the project has proceeded beginning with zone one to zone two and lastly to zone three (CORIN Interview).

4. Analytical Framework

There are two frameworks which will guide the analysis of the research question: the integrated water resource management (IWRM) framework, and the institutional analysis and development (IAD) framework. The analytical framework will begin in section 4.1 with an explanation of the IWRM process from a top-down perspective: with the understanding of the concept to its application through the three pillars of IWRM. The second part of the analytical framework- section 4.2- will describe what institutions are and how they can develop and evolve within common pool resource[14] situations, such as that of the Pak Phanang River Basin.

4.1. Integrated Water Resource Management (IWRM)

The IWRM concept gives recognition to all the competing uses and interests within the water sector, such as water supply, sanitation, agriculture, hydropower, industry, and environmental conservation (UN Documents, 1998). It necessitates a more holistic view and appreciates the need to ensure that water management decisions are formulated in the context of broad national strategies while taking into account long term planning.

IWRM was defined by the GWP (2010) as "***a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems***". It aims to achieve three policy principles known as "the three E's" (Savenjie and Van der Zaag, 2008): (1) Equity, (2) Ecological Integrity, and (3) Efficiency. The principle of equity emerges from the universal acknowledgement that water is the most basic human need and development requirement, and therefore the first priority should be to ensure that the "bottom billion" people in the world without secure access to water are provided with universal coverage (UN Water, 2012). In addition, this principle extends out towards other issues related to human security, such as protection against floods, drought, famine, and other disasters (Savenjie and Van der Zaag, 2008; pg292). The second principle of ecological integrity is based on the foundation that water resources will only persist in an environment which is of adequate health to maintain its regeneration capacity. It centers the focus onto the protection of the environmental so that it can in turn deliver the environmental goods and services needed for social and economic development. Efficiency- the third "E"- advocates for the efficient use of water.

[14] "Common pool resources" are natural resources which are used by many individuals in common (Ostrom, Elinor. 1990; pg.1).

Within this, the issue emerges of whether or not water should be priced according to its economic value and to how water can be reallocated towards higher productivity outputs.

The holistic approach promoted by the IWRM concept highlights the need to coordinate water with land management. In the natural world, land and water are fundamentally linked, and enhancements in one very often lead to improvements for the other. For example, changes in land use practices can improve water production efficiency in agricultural settings through the improvement of soil quality (Bossio and Gehab, 2008). Conversely, degraded soils can affect water processes through factors such as water holding capacity, erosion, and sedimentation. The efficiency of water usage per drop in agriculture can be limited due to constraints in soil properties rather than in water availability itself.

The FAO (2000) has pointed out that in dealing with water management issues, "*the crucial scarcity may not necessarily be the scarcity of the water resource itself, but rather the scarcity of the social resources needed to adapt to water scarcity*" (pg7). Theoretically, when the restraints of water scarcity start to tighten, the first order response is generally to find ways of increasing the withdrawal of water from the environment, changing the way that it exists in space and time. This can be seen through infrastructure projects such as water storage using dams and changes in spatial distribution using irrigation systems. Once infrastructure approaches are no longer sufficient for meeting the growing demands, the second order solution is to increase the efficiency of water usage- getting more value per drop. Here, waste reduction, resource recycling and intensified resource management come into play. The last option when the maximization of water use efficiency has reached its' limit is to turn to the re-allocation of water rights.

Once this last stage is reached, it becomes necessary to withdraw water rights from schemes which are perceived to generate low values per unit of water. This can necessitate significant changes in national policies and plans, as well the restructuring of social, economic and political institutions. This last stage, which is promoted by the IWRM concept, is understandably not easy to accomplish. While re-allocation has the potential to reduce the amount of water needed to produce food and services, the process of re-allocation in itself will most often result in gain for some while others will lose out (Bossio and Geheb, 2008 & FAO, 2000). Therefore, this process tends to be slow, requiring time consuming negotiations and trade-offs between and within sectors (UNEP-DHI, 2009). The achievement of large scale social restructuring is one of the greatest obstacles facing practitioners of IWRM.

While the concept of IWRM is well-defined, the difficulties of its implementation were made clearer through the four Dublin Guiding Principles. These principles were commended at the Rio Summit (1992) and were seen as fundamental for the execution of Agenda 21[15] (The Dublin Statement, 1992). In brief, these principles reiterate the importance of (1) Recognizing the basic fundamentalisms of water, as finite and essential for life, development and the environment, (2) The participatory approach, involving users, planners and policy makers throughout the decision making process, (3) Recognizing women as pivotal providers and users of water, and (4) Acknowledging that water has an economic value in all its competing uses, and thus is an economic good. See full document in appendix IV.

4.1.1 Attaining the Three Pillars of Water Management

Several guides have been developed in order to help practitioners with the IWRM process. The "Three Pillars of Water Management Framework" is a well-known framework which illustrates how the IWRM process might be carried out and achieved. In this framework, successful implementation of IWRM is seen as a matter of achieving these three pillars ((UNEP-DHI, 2009; pg.6):

> **(1) Moving towards an enabling environment of appropriate policies, strategies and legislation for sustainable water resources development and management**
>
> **(2) Putting in place the institutional framework through which the policies, strategies and legislation can be implemented**
>
> **(3) Setting up the management instruments required by these institutions to do their job**

In this study, the quality of fulfillment of the enabling environment, institutional framework and management structures of higher level water governance in Thailand will be examined (table 1).

[15] Agenda 21: the main output and blueprint for global action into the 21st century aimed at solving the problems of environmental destruction and sustainable development (Snellen and Schrevel, 2004)

Table 1: Framework for the Three Pillars of Water Management *(Adapted from GWP & INBO: A handbook for IWRM in Basins; Pg. 30)*

The Three Pillars of Water Management		
Enabling Environment	**Institutions**	**Management**
Laws and Policies: • Frame water resources management within a country and between countries **Water User dialogues:** • Cross sectoral and upstream-downstream dialogues • Basin committee **Budgets:** • Financing operations and investment **Cooperation:** • Within international river basins	**Roles and Responsibilities:** • Of basin and other water sector organizations at different levels in the government, non-government, and private sectors • Effective coordination mechanisms • Planning process • Financing	**Structures to:** • Assess water resources (availability and demand) • Set up communication and information systems • Resolve conflicts in allocation of water • Establish regulations • Establish financing arrangements • Establish self-regulation (voluntary actions) • Research and develop • Undertake development works • Ensure accountability • Develop organizational capacity • Coordinate

As recommended by the UN (Documents 1998), setting up the enabling environment requires the establishment of national policies and strategies which encompass the entire water sector and are integrated with overall socio-economic development plans. This process should encourage dialogue and coordination between "bottom-up and top-down" processes, as IWRM operates under the idea that local management alone is not sufficient and should be undertaken in line with national objectives (UN Documents 1998). The strengthening of institutions should allow for capacity building of not only government departments but also of decentralized agencies and community based organizations involved in IWRM planning. Management at all levels requires sufficient and dependable funding, resources and human capacity, as these all set the operational limitations for integration and coordination (UNEP-DHI, 2009).

As can be seen from Table 1, the three pillars are quite comprehensive in their aims and goals. Ideally, all aspects of the framework should be in place and harmonized. However, it is not necessary for all of the components to be fulfilled in order to achieve IWRM. The process should be an iterative one which works with the components present and attempts to build upon these assets to establish the other components. In this respect, there are several planning characteristics or aspects that are considered fundamental to all IWRM strategies (GWP & INBO, 2009; pg.35):

- The 'river basin' as the primary unit for IWRM planning and execution[16]
- River basin organizations (RBOs) as the functioning unit for water management within river basins
- Financial support is a major enabling or restricting factor for all IWRM activities
- Stakeholder engagement throughout the entire IWRM process
- Strategic long term planning aligning basin plans with regional and national development goals
- Basin information systems to enable the monitoring of water characteristics and dynamics
- Communication of information is necessary for ownership of the river basin

All these aspects listed above have been addressed to some extent through the water management policies of the Thai government in their efforts to achieve the three pillars of IWRM. This will be further elaborated on in Section 6.1.

The implementation of IWRM is promoted at the watershed or *river basin level*, due to its practical use as a primary hydrological unit for water resources management (GWP-INBO, 2009; Roy et al., 2009). When setting up management mechanisms, the river basin approach is able to observe and take into account the inter-related upstream-downstream processes that exist and gives a more holistic view of how cumulative land uses interact with and impact water resources (UNESCO, 2009). In order to oversee these basin plans, *RBOs* are the institutions by which actual implementation of IWRM activities, such as responsibility over management, stakeholder collaboration, information gathering/processing, financing and accountability mechanisms can be carried out (GWP/INBO, 2009). The plans require adequate and reliable funding at all levels of government, from local districts to national agencies. Effective *stakeholder participation* enables accountability in decision making while setting the stage for empowerment and ownership of IWRM plans and their sustainability. It should encompass not only consultation, but also the implementation, monitoring and feedback processes. (UN Documents, 1998). Basin activities should be a part *of strategic long term plans*, while being flexible enough to adapt to changing circumstances (GWP/INBO, 2009). Plans can only be sustained when they are able to endure beyond the timescales of project implementation (Mula, et al., 2008). The success of these strategies should be monitored and assessed through the use of a *basin information system*, which is able to produce information on water storage capacity and flows, quantity and quality, recharge and discharge patters, allocation between users, etc. Lastly, all information should be available

[16]. Agenda 21 states that 'integrated water resources management, including the integration of land- and water-related aspects, should be carried out at the level of the catchment basin or sub-basin. (Nielsen, 2008)

and *communicated* to all basin stakeholders, policy and makers in order to enhance IWRM strategies at all levels (GWP/INBO, 2009).

4.1.2. Challenges facing IWRM implementation

This study will focus on two important and well-known challenges currently facing Thailand: (1) institutional fragmentation especially of land and water management, and (2) the need to strengthen the capacity of local institutions.

Successful coordination of multiple sectors in water resource usage and governance has proven difficult to achieve. Land and water management in particular, is often difficult to harmonize since land management which covers forestry, agriculture and industry, are not usually governed in a way which is connected with water usage and policies (GWP/INBO, 2009). In Thailand, institutional fragmentation has been identified as one of the key limitations for IWRM (WB, 2011). There is a lack of an institutional framework at the national level which has the authority necessary to establish the effective coordination of water related agencies (GWP-SEA, 2011; pg.37).

While the importance of developing effective government institutions is most often stressed within IWRM strategies, the need to strengthen social institutions can be underemphasized or over-simplified (Plummer and Fitzgibbon, 2004; Lewins, 2007; Hibbard and Lurie, 2011). The focus on demand side management is not easily translatable into institutional arrangements (FAO, 2009) because issues such as power relations, individual choice and vulnerability are often overlooked. Efforts to improve integration across a broad and diverse range of actors fails to consider that at all levels, different actors are pursuing their own interests while at the same time interacting with and influencing one another (Ferreyra, et al., 2008). Strategies aimed at achieving full and equal participation although idealistic can bring with them unequal power relations between stakeholders while simultaneously diminishing flexibility and increasing bureaucracy (Plummer and Fitzgibbon, 2004).

In agricultural settings, farmers and communities are direct resource users and thus are most strongly linked to the management of the natural environment. For poor farmers seeking to improve their economic situation, it is important to realize that institutional change is often most strongly linked to the desire to escape from poverty through increased production and profit. In

order to direct local institutions towards support strategies such as the IWRM, it is necessary to consider the costs and benefits that may be incurred when putting in place or changing institutional arrangements (UN Water, 2012).

4.2. Institutional Theory

"Modes of water governance are highly contested across sectors of society. Managing water resources for the socio-economic well-being of people and the robust functioning of ecosystems is a complex challenge. Stakeholders are diverse and have competing demands for water, as well as being higher differentiated in terms of influence over decision making." (Lazarus, et al., 2011: Pg 6).

Water resources in the Pak Phanang River Basin represent a type of common pool resources situation where the resource is subtractable upon consumption (one user's consumption of the resource results in a decreased amount available to others) (Ostrom, 2007). Prevention of resource degradation and depletion in such cases most often requires collective action in order to preserve the integrity of the resource while maximizing communal and long term individual benefits (Basurto and Ostrom, 2008; German and Keeler, 2010). Collective action is dependent on the existence of rules or institutions. As defined by (North, 1991), "institutions are the humanly devised constraints that structure political, economic and social interaction. They consist of both informal constraints and formal rules." (pg. 97) Through these restraints, institutions can reduce uncertainty in human interaction- allowing for actions and behavior to be consistent with the norms of the community (North, 1991). For example, water resources within a river basin can be prevented from destruction through collective rules on water allocation, timing of withdrawals and agreements on priority needs. Without institutions, uncertainties regarding the water usage patterns of others mean that problems such as resource depletion will be difficult to foresee or mitigate against (North, 1992).

The field of Institutional Theory broadly looks at the deeper aspects of social structure and examines how institutions are created, adopted, spread, or fail (Scott, 2004). '*New Institutionalism'* falls within the umbrella of institutional theory, but focuses primarily on how and why institutions evolve (Gorges, 1999). While individual actors operate within institutional constraints, these institutions were in turn created and shaped by the actors themselves. This indicates that actors are both empowered and constrained within their institutional environments (Bell, 2011).

Institutional change occurs when new rules are proposed and adopted or current rules are changed. When a new rule is created, the imposition of the rule creates the enactment of a particular action. When actors behave repeatedly according to rules to such an extent that the behavior has become internalized, then the institution becomes sedimented. In other words, the actors themselves no longer recognize that they are acting according to an institution but believe rather that the action is performed out of rationality (Bjorck, 2004. Pg2)

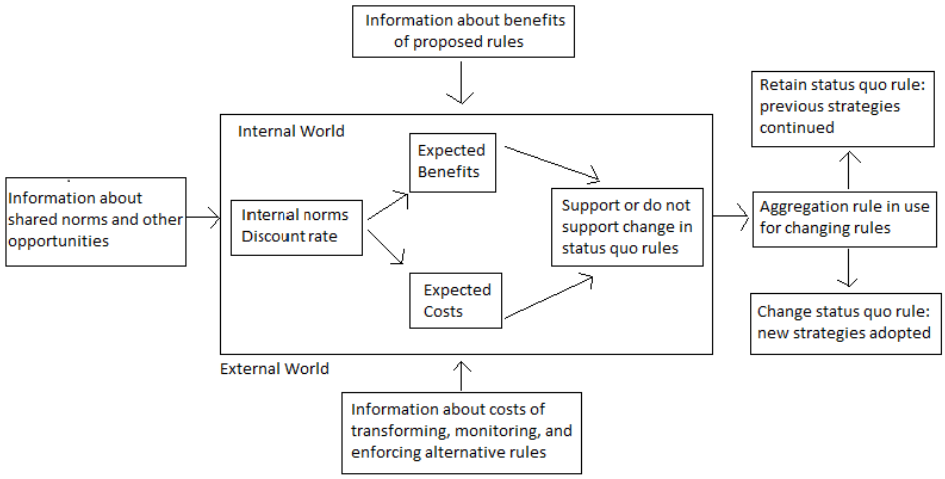

Figure 4: The Institutional Choice Framework
(Source- Ostrom, E. 1990; pg 193)

The above diagram illustrates how the process of institutional change may occur in self-governing community resource management systems. To give an example, if a community decides that it is necessary do adopt a new water management plan due to rising water resource scarcity, a new rule may be proposed such as a restriction on the maximum water withdrawal per member. Individuals then evaluate the costs and benefits that may arise as a result of the proposed rule. Benefits in this case could include long term sustainability and accessibility of water resources for irrigation, while costs could include decreased yields in the short term as well as costs incurred to members for enforcement of the new rule. Assuming a democratic process and that rule enforcement cannot occur without consent from the majority, a sufficient proportion of community members must decide to support the new rule in order for its enactment to occur. If members abide by this rule repeatedly over time so that the new rule has become internalized, they the process would be described as a successful example of community driven institutional change.

The question of *why* institutional change occurs is understood differently in each of the three schools of thought within *new institutionalism* (Gorges, 1999): (1) Historical Institutionalism (2)

Sociological Institutionalism, and (3) Rational Choice Institutionalism. Historical institutionalists believe that institutions are most easily or commonly changed when actors are facing crisis situations or are reacting in times of new problems or opportunities. It is during these times or 'critical moments' when major institutional change is the most possible. Sociological institutionalists consider how practices arise from discussion and shared understandings, while rational choice institutionalists argue that institutional change is motivated out of the will for individuals to overcome collective action problems. Institutional changes are reinforced only through evidence that the new rules can offer higher benefits than other institutional arrangements.

While collective action may occur at the community level, group undertakings are the result of *individual choice*. This indicates that a polycentric approach to decision making processes may be appropriate. As any particular community consists of many actors and each actor has the capacity to make choices, there are a large number of possible livelihood strategies that can be taken simultaneously, all of which interact and influence one another (Aligica and Boettke, 2011).

4.2.1. The IAD Framework

In the analysis of common resource dilemmas and community management strategies, frameworks are useful in helping to identify the key elements and the relationships among them that should be considered for institutional analysis (Ostrom, 2007). This study will focus on determining how IWRM national strategies interact with local community water management schemes under the influence of biofuel policy reforms. The IAD framework will be used in this study to develop a closer look at the essential component of institutional change, upon which the success of IWRM is dependent.

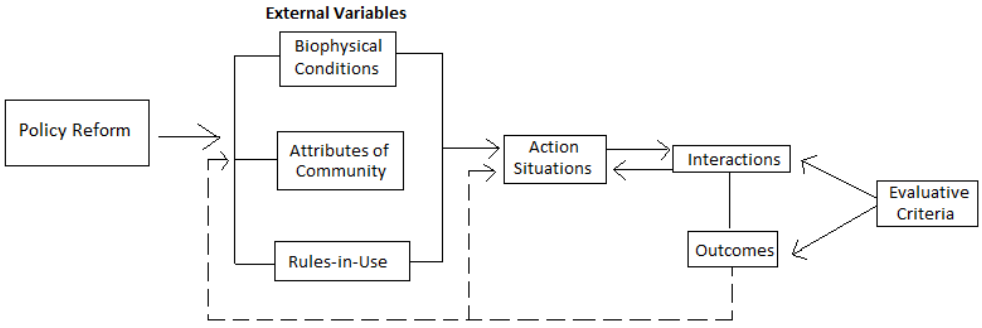

Figure 5: The IAD (Institutional Analysis and Development Framework)
Source (Adapted from Ostrom, Elinor. 2005. Pg15)

The IAD framework is organized into six main components: (1) the policy reform (2) the contextual situation, (3) the action arena, (4) the patterns of interaction, (5) outcomes, (6) and evaluative criteria (Ostrom, 2005; pg.15).

The Policy Reform: There can be many policy reforms in effect at one time and these can come both internally from within the community or as an external influence. The policy reform for this study will be the national strategy for oil palm expansion and the targeting of the province of NST as a suitable area for production. This will place an external influence on the community in the form of various governmental incentives encouraging smallholder farmers to uptake oil palm cultivation.

The Context: The context in which community members live can be described through three main characteristics: the biophysical environment, the socioeconomic conditions, and the institutional arrangements. The biophysical environment includes factors such as climate, soil characteristics, topography, vegetation, water storage capacity, and water quality and quantity. Socio-economic conditions include demographic variables, income, community characteristics and social capital. The attributes of the community are related to the type of institutional arrangements in place, as they include the norms and patterns of behavior which are generally accepted in the community (Ostrom, 2007). Community characteristics such as the extent of homogeny in knowledge, values and preferences are often determining factors in what kind of water management strategies are chosen, how they are enforced and their probabilities of success.

The Action Situation: The scope of the action situation analyzed in this study will be defined as how community members in the Karaked sub-district make decisions regarding land and water management, such as crop choice, cultivation timing, or water withdrawal patterns. This will be further elaborated on below in section 4.2.2.

Patterns of Interaction: During this stage, actors will learn about the patterns of behavior of others in this new institutional arrangement as well as ascertain the benefits gained or costs incurred to their own welfare and the welfare of others through the actions chosen.

Outcomes: Repeated interaction of the action situation will result in continuous changes in the contextual situation. Depending on whether or not the strategies chosen by individuals are

beneficial or detrimental to their livelihoods, the current institutional arrangements can either be altered or remain enforced.

Evaluation Criteria: The merits of the potential outcomes as well as the process of achieving these outcomes are evaluated using a set of criteria. Ostrom (2007; pg. 16) lists several evaluative criteria that are often considered: (i) economic efficiency, ii) equity (iii) accountability, (iv) conformance to values of local actors, and (v) sustainability. However, the criteria that individual actors use to weigh the costs and benefits of outcomes will vary individually, as will the meanings behind the criteria chosen.

4.2.2. Inside the Action Situation

As illustrated in figure 6 below, the structure of the action situation can be described using seven main variables (Ostrom, 2007 pg.33):

1) The set of **actors**
2) The **positions** held by the actors
3) The set of allowable **actions** of actors and their linkages to outcomes,
4) The potential **outcomes** that are linked to individual sequences of actions
5) The level of **control** each participant has over the outcomes
6) The **information** available to participants about the structure of the action situation
7) The **net costs and benefits** assigned to actions and outcomes

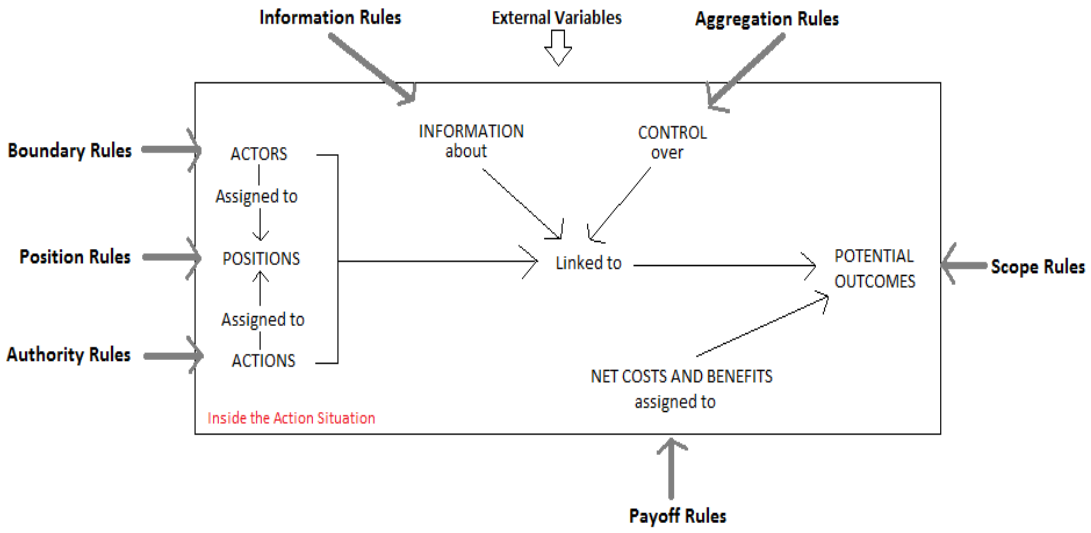

Figure 6: Inside the action situation
(Source- Ostrom, E. 2005. Pg33)

The variables within each of the seven components of the action situation are bounded by a set of *'working rules'*: **(1) Position Rules (2) Boundary Rules (3) Authority Rules (4) Aggregation Rules (5) Scope Rules (6) Information Rules and (7) Payoff Rules** (Ostrom, 2007) (see figure 6 above). For instance, the number of actors in an action situation is limited by *boundary rules* regarding entry and exit from the community. In this analysis of the action situation, the actors will be defined as all those who live within the Karaked community. These actors can hold one or more *positions*, and according to these positions, each actor will have a specific action set from which they are able to base their land and water management strategies upon. These action sets are defined by *authority rules,* which designate what actions are permitted or possible to take for each actor in his/her position. Available actions within the study context could include water withdrawal patterns, income generating strategies, and crop choice or cultivation intensity. While *scope rules* demarcate how actions can be linked to potential outcomes, the level of control that a participant has in determining individual or group outcomes is shaped by *aggregation rules.* For example, an individuals' decision to follow rules regarding maximum permitted withdrawal may not result in enhanced resource sustainability if others within the community do not follow this rule as well. *Information rules* correlate with the information and knowledge sets available to participants. Each actor holds different and limited knowledge about the action situation, whether it is information about other actors, their own capabilities and options, or knowledge about the natural environment. The knowledge set of each actor sets the limit for what is known to be possible or what likely outcomes are. *Payoff rules* guide individuals in calculating the perceived net costs and benefits arising from potential outcomes. Here, trade-offs must often be made, as the fulfillment of one criterion may not always be compatible with other criteria. Once decisions are made regarding which actions to take, actors moves out of the action situation and into the interaction stage of the IAD framework.

Working rules shape the internal decision making processes for all individuals regardless of whether or not their existence is consciously or subconsciously acknowledged. Since it is not possible to identify all the working rules in play within an action situation, in this case study the working rules analyzed will encompass only those which were identified by the interviewer or interviewees during the study and will be restricted to variables which are associated with land and water management (see Appendix III for a detailed interpretation).

5. Methodology

5.1. Epistemological and Ontological Approach

This study takes a deductive approach, since the decision to examine natural resource management strategies has emerged from a pool of previous knowledge and theories. As this study focuses on institutional processes and how they both influence and are influenced by social structures, the epistemological position will be that of critical realism (Bryman, 2004; pg.14). The ontological approach strongly points towards the idea of 'social constructivism'. In this view, the meanings of the world are considered to be developed from individual subjective experiences and interpretations (Creswell, 3007; pg.21). This position is appropriate for the study, as the research aim is to gain an understanding of how informal and formal institutional structures are understood and how these understandings influence behavior.

5.2. Case Study: Karaked Sub-district

The value in case study research is to contribute to the expansion and generalization of theories through the generation of empirical support (Yin, 2009; pg.33). The Karaked sub-district is representative of this in two ways. First, it aims to contribute to the body of research on IWRM within a river basin context, while paying special attention to locally driven institutional change processes. Secondly, this study provides further empirical evidence on how the increased international demand for biofuels can impact the ways that land and water resources are managed within a rural, agricultural context. Bryman (2004: pg.50) states that case studies should be chosen because the case offers complexity and reasons for interest in its own right. The Karaked sub-district is receiving much attention from the government, policy makers, NGOs and academics on the land/water use implications of biofuels. In addition to this, the water management plan will be used as a pilot project for other communities in the river basin. Thus, the Karaked sub-district represents an ideal site for this study.

5.3. Accessing the field site

Access to the field site was gained through CORIN-Asia. With the assistance of SEI, a direct contact was made to the municipal mayor of Karaked two weeks prior to arrival in the study site. Permission to conduct research in the community was granted by local authorities, and before conducting the interviews a public announcement was made during a sub-district community meeting, where the author was able to explain the purpose of the research and what it would entail

for the community. Local government representatives were made available as guides to help the researcher access potential participants.

5.4. Sources of data

The data for this study came from a variety of sources, including semi-structured individual interviews, a group discussion, review of documentation, direct observation and conversations with academics, NGOs and community leaders. Within the study site, purposive sampling was used to select interviews in order to first gain a broad range of information regarding the site, and to later on develop information on more specific, in-depth topics. The interviews were selected through a combination of structured snowball sampling and sampling based on maps (Mikkelsen, 2005). Once categorization of the desired interviewees were determined (based on zone, distance from water source, village, type of agriculture grown, other), the researcher was introduced to a participant known to the guide through snowball sampling within the category requested. Maps were used in order enhance interview coverage of the study site.

5.4.1. Semi-structured Individual Interviews

A total of nineteen individual semi-structured interviews and one group discussion were carried out in December, 2012. Qualitative interviews were chosen as they are meant for providing access to the world of the interviewees, who can then share their activities, experiences and opinions with the researcher (Kvale, 2007; pg.12). Fifteen community members were interviewed, of which five were village heads and/or TAO members. Eight interviewees lived in zone 1, four in zone 2, and three in zone 3. (See appendix I for a list of interviewees and Appendix II for the interview guide). Two representatives from government agencies were interviewed: one from the Royal Irrigation Department and one from the Ministry of Natural Resources and Environment. CORIN acted as a gate keeper and key informant for the area. Two participants from the academic sector were also interviewed. For the semi-structured interviews, a list of questions was prepared which allowed for flexibility in answers (Bryman, 2004; Pg.321). Each interview began with a briefing, in which the interviewer and translator were introduced, and the purpose of the interview was explained. Afterwards, the interview was de-briefed and the participant was asked if he/she had any further comments or questions.

5.4.2. Group Discussion

The group discussion took place on the first day in the field before any individual interviewees had begun, in order to gain a better understanding of the research area and problem. The interviewees present consisted of members of the water council, village heads, the current mayor, and Mr. Wanpen from CORIN, who led the discussion as a moderator. The group interview proved beneficial in two ways: (a) it enabled a clearer understanding of the water management system and land-water related community challenges, and (b) allowed community members and leaders the opportunity to offer input on the scope of the planned research.

5.5. Data Analysis

Transcriptions from the auditory interview recordings and field notes composed the bulk of the information gathered directly from the field site. Throughout the field work, the analysis of data was an ongoing process. In the course of gathering data, re-occurring issues and concepts emerged and were noted, gradually narrowing the focus of the study as the understanding of the area improved. In order to enhance the validity of the data collected, triangulation practices were used and information was checked against several different sources. To reduce uncertainty and improve understanding between the researcher and the translator, interview questions as well as participant responses were reviewed daily, before and after the interviews.

5.6. Ethical Considerations

The identities of the participants were kept confidential through the use of coding to distinguish between each interviewee (Creswell, 2007; pg 142). The exceptions to this were a few key informants who approved of the use of their names in the study. Verbal consent to use interview information in the study was obtained at the beginning of each interview and only adults were allowed to participate in the study. As the research topic of water management was well-known within the community, the researcher did not perceive any concerns that mentioning it could potentially harm the participants. Participants were made aware that the dissemination of sensitive information would be kept confidential and would not be connected to them.

The results from this research will be distributed to the community as well as all those who formally participated in the research. Contact information was given to participants, and

continuous communication between the researcher and CORIN (who works directly with the community) will allow for feedback and exchange.

5.7. Study Challenges

It is acknowledged that the researcher has brought with her an interpretation of the results which is based upon the researcher's own social and cultural background (Creswell, 2007; pg.179). As a representative from the academic sector who has been largely influenced by objectives from SEI and CORIN, both of which work in policy related fields, it is recognized that this positioning may have influenced the author's interpretation of the data and thus the outcomes of the study. During interviews, it is highly unlikely that the transfer of information from the participants to the researcher occurred without biases or errors. With this in mind, validity of the data was checked continuously through triangulation of information in an effort to minimize these errors.

6. Analysis Part 1: Top-Down Resource Management

6.1 Integrated Water Resource Management in Thailand

Thailand has recognized IWRM as a means for achieving sustainable water resources management and the government has incorporated its concept into the national policy since the 1990's (World Bank, 2011).

> The Thai National Water Vision is:
>
> ***"To have sufficient water of good quality for all users through an efficient management, organizational and legal system that would ensure equitable and sustainable utilization of its water resources with due consideration on the quality of life and the participation of all stakeholders"***
>
> *(World Bank, 2011pg.40)*

The Department of Water Resources (DWR) was commissioned to formulate a national water law in 1994. They have attempted to proceed forward with this through extensive consultation with relevant agencies, local communities, NGOs and the general public, however, due in part to government instability and political unrest, the water law has yet to be approved by the parliament (IUCN 2011, World Bank, 2011). Due to this, the *enabling environment* of appropriate laws and policies- the first pillar of water management- still remains in progress (FAO, 2011).

The development of an effective *institutional framework* for water management in Thailand has also been underway. There are currently approximately 30 departments under 10 ministries along with six national committees that are involved in water resources development in Thailand (FAO, 2011).

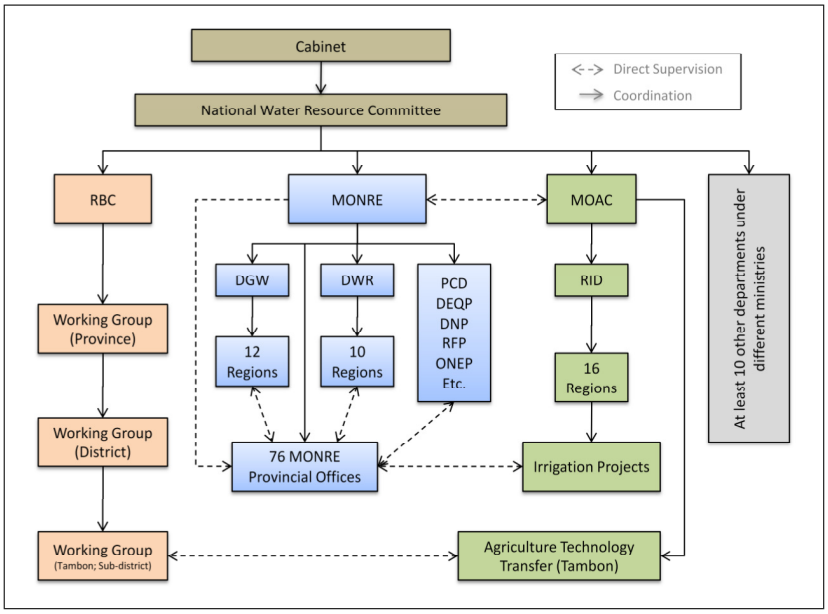

Figure 7: Government agencies involved in water management in Thailand
(Source: World Bank, 2011. Thailand Environment Monitor. Pg.41)

The Department of Water Resources (DWR) is under MONRE and is the lead agency responsible for implementation of IWRM, while the RID who is under MoAC (the Ministry of Agriculture and Cooperatives) is the main authority over planning, development and management of surface water resources as well as water storage (World Bank, 2011). In accordance with the IWRM concept, 25 river basin committees (RBCs) were established by the NWRC in 2004 for each of the 25 main water basins in Thailand (IUCN, 2011). The purposes of the RBC's are to coordinate and regulate water resources management within the river basins as well as oversee the budget systems for water projects (IUCN, 2011). The *management structures* put in place through the development of the RBCs aim to cover aspects such as accountability, communication and information systems, conflict resolution mechanisms, self-regulation and the development of organizational capacity (World Bank, 2011 pg.43).

Decentralization policies in Thailand have transferred responsibility over water management from central authorizes to local governments. While a significant amount of the government budget has

been made available for use by local level communities, not all the funding is allocated to water management system improvements but is instead split into several categories such as security, education, public health, housing, community development, industry and agriculture. Water management is only included mainly through agriculture and community development planning (World Bank, 2011).

6.2 Challenges of IWRM in Thailand

Major gaps in the institutional and policy frameworks governing water management in Thailand have posed significant challenges to the achievement of IWRM.

The lack of a National Water Law has remained an obstacle rather than tool for the empowerment of the RBCs and as a result, the capacity and performance of the 25 RBCs in place have not been perceived to be effective in the implementation of IWRM strategies (IUCN, 2011). Limiting factors are in part due to the lack of finances needed to carry out management plans as well as difficulties in introducing the IWRM concept to local communities. While the inclusion of local communities into water management planning processes is of high priority, most plans are characterized by a top-down centralized approach which generally involves local populations only during the initiation stages (Ti and Facon, 2001). In order to strengthen RBC operations, there is a need to improve coordination between sector agencies while supporting community projects which promote IWRM strategies (World Bank, 2011).

As Thailand is one of the largest agricultural exporters in the world, environmental concerns related to land use change induced issues and their impacts on soil-water degradation are critical. Policies related to land allocation and distribution are challenging as land availability is sparse and land-water policies are fragmented and dispersed (GWP-SEA, 2011). Institutional fragmentation in IWRM activities is widespread, and can be seen through the different priorities of government agencies which often overlap or even conflict with one another (Ti and Facon, 2001). This lack of institutional coordination can result in misunderstandings on all levels of governance.

6.3. Water Management in the Pak Phanang River Basin

The Pak Phanang River Basin Project is well-known in Thailand as a successful case of integrated water resources management (PoSU, 2013). The operation of the gates and canal systems are under the responsibility of the RID and are carried out through a River Operation Model (ROM)

which functions as the main forecasting and mathematical simulation system for determining all gate operations (Ditthakit and Chittaladakorn, 2008). As it is not possible for the ROM to determine the optimal operational activities needed to control both water and quality criteria simultaneously, this requires gate regulator experience as well as communication with communities within the basin for consultation and feedback (Ditthakit and Chittaladakorn, 2008). Since there are many different economic activities occurring in the basin such as agriculture, shrimp farming and fishing, decisions on when to open and close the gates affects all basin water users differently (RID Interview). For this reason, committee meetings with stakeholders are held before decisions are made regarding the opening and closing of the main gate. While the PPRB irrigation system is managed by the RID, the smaller tertiary irrigation canals are to be managed by the local governments and communities themselves through the use of water user groups (FAO, 2011).

Image: The Uthokawiphatprasit Gate- Pak Phanang River, Thailand

The promotion of oil palm expansion in NST has led to the involvement of several government agencies in shaping the development of land use in the area. The Office of Agricultural Economics (OAE) under the MoAC is responsible for leading the project "***Integrated agricultural estates for palm oil in Nakhon Si Thammarat***" in partnership with the RID, LDD and CPD (Cooperative Promotion Department). As government policy states that oil palm production should not compete with food production, the LDD has developed a land use suitability map for biofuel crops in the country, identifying suitable land based on physical and climatic factors (Polpanich, et al., 2013). Numerous incentive schemes have been put in place by varying

governmental departments[17] to increase uptake of oil palm cultivation by smallholder farmers in the region, such as compensation for oil palm seedlings, fertilizer, technical assistance, land preparation, training costs and fertilizers, as well as loans at low interest rates and training courses (Polpanich, et al., 2013).

The *Pa Phur Kuan Kreng* peat swamp forest, which lies partially within the boundaries of Karaked, is currently being managed by three main departments: the Ministry of Natural Resource and Environment (MNRE), the Agricultural Land Reform Office (ALRO) and the RID.

(Left: Office of the Ministry of Natural Resources and Environment, Bor-Lor district; Right: Image of the *Pa Phur Kuan Kreng* peat swamp forest)

The primary responsibility of the MNRE[18] is to preserve the environmental integrity of the peat-swamp[19] and to prevent the encroachment of trespassers into the area. However, they are experiencing a high frequency of trespassers who engage in activities including deforestation, drainage of the peatland for irrigation, and burning and clearing of land for agriculture production (MNRE interview). The duties of the MNRE are partially conflicting with the intensions of the ALRO due to overlapping territorial claims. Contrary to the objectives of the MNRE, farmers are permitted to use some parts of the forest peat-lands but cannot own the land. The ALRO has declared these allocated lands to be used for agriculture and to exclude them from forest lands

[17] Cooperative Promotion Department, the Land Development Department, the Department of Agricultural Extension, the Bank of Agriculture and Agricultural Cooperatives, the Agricultural Land reform office, the Board of Investment, and the Department of Alternative Energy Development and Efficiency

[18] Bor-Lor office

[19] Conservation of National Forests Act (B.E. 2507); National Forest Act (B.C. 2484) and Preservation and Protection of Animals Act (B.E. 4284)

(Polpanich, et al., 2013). The RID is also involved in the area due to their responsibilities to provide flood protection for the communities. Annual flooding poses a threat to agricultural activities and farmer livelihoods especially in the low lying peatland areas. In order to reduce the severity, the RID has constructed a large canal called the '*Prak Muang Emergency Gate'*, which connects the Pak Phanang River on the west border of Karaked through the peat area to allow for drainage towards the sea.

The PPRB project is an IWRM endeavor which has only partially fulfilled the elements of the three pillar framework. Although the RID monitors the state of water resources in the basin, it is not backed by an effective basin-wide RBC, making it difficult for them to engage in strategic long term water management planning. The can provide only assistance in maximizing water availability, while guarding over the provision of the first Dublin principles: ensuring security from water related hazards. While the government led expansion of oil palm cultivation is an example of a third order water strategy (re-allocation of water to higher output uses), it seems that the challenge lies in the fact that water management activities are currently restricted to first and second order solutions (maximizing water quantity and efficiency). In effect, decentralization policies coupled with the lack of workable legal or institutional framework, appears to drive the operationalization of any third order water solutions to the responsibility of water user communities.

7. Analysis Part 2: Ground-up Resource Management

7.1. Water resource governance in Karaked

The water user group management strategy in Karaked was set up through the collaboration of the Karaked Tambon Administrative Organization (TAO) and CORIN-Asia. The aim of establishing these water user groups was to improve the problems of water allocation and management within the sub-district. Smallholder participation in this new water management plan is currently on-going with great hope from the farmers that they will receive water equally according to the agreed scheduling plans (Polpanich, et al., 2013).

This community plan entails several main rules which govern water resource use (Source: group discussion). First, through community agreement on a "payment for ecosystem services" scheme, costs for water usage have been set at 70 baht/rai per farmer for each season. As this does not cover the full cost of the pump, fuel and maintenance, the majority of this cost is actually subsidized by the TAO's annual budget. Due to the low water levels in the river during the dry

season, it is understood that all the pumps in Karaked should not be used at the same time, therefore each area is allocated a certain number of days per month, and usage is rotated between pumps. As for the upstream-downstream irrigation line conflict, the rule is that upstream users must wait for downstream users to get the water first. This is necessary due to the elevation change from low to high, which necessitates the use of a pump rather than gravity to push water through the irrigation system. Efforts to sustain water resources in the river are considered to be related to the amount of water withdrawn through the pumps. For the community, the pumping capacity is based on both supply and demand, and is an ongoing learning process.

The irrigation infrastructure in Karaked was put in place by the RID in 2005 and was under their management until 2008, at which point responsibility over the water system was passed over to the community to manage. A sub-district level water committee was set up, consisting of members from the TAO and the PAO[20] as well as CORIN. Sub-committees for each zone were also put in place which currently acts as the main mechanisms for preventing and resolving conflicts.

The main component of the new water management strategy as set forth by the TAO is to use participatory methods and community involvement to develop, implement and solidify an equitable and efficient water allocation plan. This was to be achieved in three main steps (Source: group discussion):

1. Identify a leader who is not an official or from the government, who has the capacity to manage water resources and resolve conflicts within the community. Achieving community participation is recognized as a critical step for success.

2. Demonstrate that the TAO and water council can manage the water effectively. This implies that they will aim to build community trust through good results. Since the sub-district is part of a larger river basin, they will also need cooperation and support from the RID and PAO.

3. Convert the informal institutions to formal ones. The Karaked water plan is a pilot project for other communities in the basin. After defining an efficient, equitable and sustainable water management plan, proven to the community through results and sustained through effective leadership, the next step would

[20] TAO (Tambon Administrative Organization) and PAO (Provincial Administrative Organization) are the local and provincial units of government in Thailand.

be to set up a multi-stakeholder committee, formalize the management system and propose the plans to congress.

The expansion of oil palm throughout Karaked was well-recognized by community leaders, who generally agreed that it was certain to increase in the future (source: group discussion). The limits and potentials for crop expansion were considered directly dependent upon the level of water availability. Some suggested that water shortages arising from land use changes could be alleviated through improvements in infrastructure, such as more pumps, deepened irrigation canals and stronger motors. The issue of having sufficient financial funding was seen as a prerequisite to accomplishing these tasks and so participants felt that support from the RID and PAO with infrastructure and repair was needed. It was also expressed that there was insufficient governmental support with the management of the peatland area. While competition for water was expected to rise, the main proposed mechanism to prevent exploitation and conflict was to build a high level of cooperation among community members so that a fair distribution of water resources could be ensured.

Representatives from the TAO and the water council all identified water scarcity as one of the most critical issues in Karaked, as it is necessary prerequisite for the livelihoods of all community members. Emphasis was placed on ensuring that there was enough water available and that the water was distributed as properly and fairly as possible, with the equitability of water being simply described as “everyone having enough”.

Given these aspects of the current contextual situation, section 7.2 will move onto an examination of the ‘action situation’.

7.2. The Action Situation

7.21. Zone 1

All of the farmers interviewed in zone one (interviews: F1,F2,F3,F4) had partially converted their land from rice to oil palm farms within the last three years. The main motivations for this were based on hopes for higher income generation, perceptions that oil palm would survive better than rice during times of drought, low income generation from rice, and government incentives. In general, rice was produced bi-annually- during the rainy “in-season” and the dry “off-season”. Farmers utilized rainfall during the rainy season (approx. Oct-Jan) and needed to use irrigation water during the dry season (approx. Feb-May). The availability of water in the irrigation system

depended strongly on the season as well as the timing of harvests, since both rice and oil palm need more water prior to harvesting.

Actors in zone one appeared to be very familiar with the rules and water usage patterns of other members in the community. Interviewees perceived that nearly everyone participated fairly in the water user plan, with only a few occurrences of rule-breaking. Knowledge regarding the water and soil requirements of oil palm varied between participants. Since famers were aware of the high water holding capacity of the clay soil underlying much of zone one, they adopted a ditch-pond system (see figure below) where clay ditches are dug between oil palm rows to store water during the dry season (interview: F2, F1).

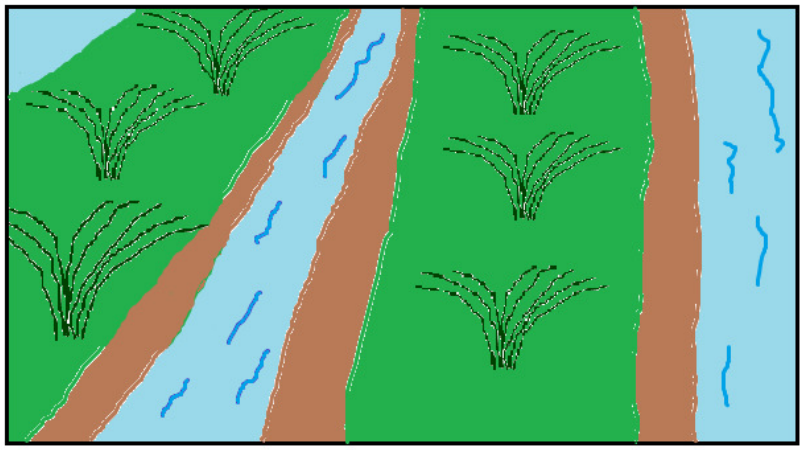

Figure 8: The pond-ditch irrigation system for oil palm

However, one participant expressed his concerns that this type of system might not be as effective when the trees become more mature (interview F1):

"In Krabi, they use ground water and the oil palm can dig for water. But here, they don't have the soil for that. Instead, they have to pump in water to surface ponds to grow the oil palm. The clay soil here has high water holding capacity, so there is only water on the surface and it does not get very deep. This will be a problem when the oil palm gets bigger. Most people have young trees right now, but the problem will arise when it is time to harvest."

Farmers did not have water scarcity problems with oil palm production due to their young age and the pond-ditch water conservation system. Instead, rice production appeared to suffer more, with those farmers living further away from the canals having the most difficulty in maintaining sufficient water supply in the paddy fields. In particular, those living in village 10 are dependent upon two separate irrigation lines which must both be running simultaneously with full

cooperation from users along both lines in order to receive water. Despite this, all participants expressed that there was good cooperation among farmers in zone one and believed that the system was fair.

All participants predicted a definite increase of oil palm within the zone in the future. Views on the sustainability of water resources in the future given these trends varied, as some believed water availability was not a problem at all (Interview:F4), some foresaw impending water scarcity (interviews: F2, F1), and some believed that it depended on the success of the water resource management plan (F3). One participant voiced concerns that the intensification of rice production from two to three times a year while simultaneously increasing oil palm production would put a major strain on the irrigation system during the dry season. The main recommendations offered given the predicted trends included statements on the need for improved infrastructure development, ideas on land reform, and education of community members regarding the water resource system.

"Palm oil production should be limited through land reform. They should go directly to the issue of water management, not just the symptoms. But it does not work like this- the land use decided first and then later on they think about how to manage the water"(interview F1)

"The first priority for the municipality should be on water management. This depends on water demand. More thought should be put into educating the community members about water management, not just the leaders."(Interview F3)

7.22. Zone 2

In addition to receiving government support, many farmers living in zone 2 chose to grow oil palm because of its potential for quick yields and because they were aware that the soils near the peatland were well-suited for palm oil cultivation (Interviews: KIs). It was also explained that the success of making the change to oil palm for other farmers had made it an increasingly popular trend (Interview F6). Water withdrawals from the irrigation system occurred mainly in the dry season. For some farmers living near the peat swamp who were not well-connected to the irrigation line, it was also possible to pump water from the peatlands to the village if necessary (Interview: KIs).

All participants in zone two recommended that immediate actions should be taken regarding the improvement of infrastructure: building more sub-canals, constructing them from concrete rather than in the soil, and stronger, faster pumps. The attitude towards water infrastructure and

agricultural potential was clear, with one informant stating, "*If we have enough water, we can grow anything*." (Interview:KI)

It was clear that farmers in zone two suffered problems with water deficiency. Due to this and the incomplete irrigation system, water users in this area do not currently pay for the water services. They receive support from the TAO who covers the cost of the pump, motor and diesel. Despite this, all those interviewed in zone two stated that the present system was not fair because people were not getting enough water, especially those further down the irrigation line or those without access to the canals. Perceptions of how to improve the fairness of the system were focused on infrastructure developments to reach those most in need.

The economic situation for farmers in zone two, especially those in village 4 was quite poor:

"People in village 4 are in debt from agriculture and are losing money. They have no assets and budget to develop this zone. Right now the people are very poor and the income is less than the expenses. For example, rice farmers have the problem that the price of fertilizers is too high and the selling price is too low. Also, rice endures many hazards such as flood and drought. They lose money with the rice because their expenses are greater than their income. So people turn to oil palm." (Interview: KI)

Due to weak crop diversification and insufficient income, the decision to invest in oil palm cultivation for farmers in zone two comes at a greater risk. Productivity is dependent largely on water availability, and so in times of water insufficiency, crop production will suffer (Interviews: KI,F6,F7). Currently, oil palm cultivation is only being 'tested' by the community. If oil palm production results in low yields, there is a chance that people may decide to switch back to rice again. However, it is unclear how the impacts of oil palm cultivation will affect soil fertility after conversion.

All participants interviewed in zone two agreed that people would be sure to cooperate to manage the water resources, as long as they received supported from the local government. With regards to long term water sustainability, concerns over the state of the peat swamp due to excessive water withdrawal were articulated (interview: KIs). The intensification of rice cultivation coupled with increased oil palm production was also seen as an additional pressure on water resources (KIs).

7.23. Zone 3

All the participants interviewed in zone 3 (Interviews: F9,F10,F11) cultivated oil palm, with the main motivations cited as the potential for high yields and improved income generation. There was a general consensus that zone 3 required more support from not only the TAO but also the RID. The water management system in zone is in a premature stage, and so it has not yet put into full operation.

> *"We still have a lack of management in this area. We need cooperation from the community. We also need support from the government about water, land and agriculture." (Interview: F9)*

As there is a low population density in zone three, interaction and competition among farmers regarding water usage is low. Since it lies mainly within the peatland and low-elevation areas, the most prominent problems are of flooding rather than water scarcity. Other oil palm related issues included concerns over the fluctuating price, the costs for fertilizer, decaying of the roots due to annual flooding and issues with insects, rats and diseases (Interviews: F9,F11). Another livelihood risk not mentioned by the inhabitants of zone three, but by the MNRE and community leaders was the risk of forest fire outbreak in the peatland. This was a concern particularly due to the recent fires experienced in 2012.

The idea of equitable distribution was not given much attention in zone three, however all participants mentioned that there was a need for improved management in the area. Regarding community cooperation for improved water management, participants stated that they would be willing to cooperate as long as they could get support from the government. They did not consider much regarding their future access to water, given their position in the peatland and the lack of water management scheme. In addition to building more sub-canals for the improvement of water access in the zone, participants requested help with flood protection and more knowledge regarding oil palm cultivation.

7.3. Emerging polycentric resource management strategies

Polycentric management is a re-occurring theme in many community based natural resource management schemes. This concept suggests that the way in which problems and solutions are understood can vary greatly within any given community (Adams, et al., 2003). Throughout analysis part two and the examination of each of the three zones in Karaked, the disparities between farmers with regards to financial and monetary assets, access to land and water resources and livelihood vulnerabilities is apparent. Due to these differences, the multitude of possible

individual strategies employed can make it difficult to predict or control the outcomes of community resource management activities.

The land-water management strategies available for individuals of the Karaked community are restricted by the element of bounded rationality. Since it is not possible to know all the potential outcomes of all actions taken both internal and external to the community, individuals must make choices based on incomplete information of the possible alternatives and their likely outcomes. This has major implications for the types of strategies which are available to actors (Ostrom, 2001; Ostrom, 2011). In Karaked, the use of the pond-ditch system for oil palm cultivation (figure 8) demonstrated community skills and knowledge regarding methods for maximizing water *efficiency* during times of drought. On the other hand, incomplete information regarding life cycle characteristics and the water/soil requirements needed for profitable economic yields, coupled with uncertainties regarding fluctuating palm oil market prices leads to increased risks for farmers. As learning and knowledge generation can positively influence the way in which opportunities and preferences are ordered, this demonstrates the importance of ensuring sufficient access of information as a prerequisite to making well-informed decisions (Ostrom, E. 2011; Aligica and Boettke, 2011).

In this sense, knowledge of existing laws and institutions should be interpreted as providing both constrains and opportunities for community resource management. Within any given community, the understandings of group concerns will depend on individual experiences, knowledge, and priorities (Adams, et al., 2003). For example, in Karaked, concerns over water scarcity and oil palm were not homogenously understood, as some people believed oil palm presented an opportunity for producing a highly drought resilient crop, while others predicted that the high resource demands of the crop would result in worsened community water resource scarcity. With the promises of enhanced water management from the local government in mind, all farmers interviewed saw oil palm cultivation as an asset, despite their different understandings on the subject. This illustrates how the outcomes of institutional instruments can be altered, through individual interpretations of how institutions may offer benefits or constraints to actors.

In this study, the intensification of agriculture through increased rice production and expansion of oil palm in zones one and two was observed. This is not surprising, due to the insufficient income generation from the traditional production of rice in addition to the potential income benefits that palm oil offers. Unfortunately, in addition to causing soil degradation, this also poses a problem for the *timing* of irrigated water use. If rice production is intensified from two to three times per

year, water demands during the dry season will come from both rice and oil palm (which needs water all-year-round). This trend of land-use intensification and degradation of resources is often assumed to be due to the necessity for low asset communities to fulfill their short term economic needs (Baldson, 2007; Raintree and Warner, 2007). However, it should not be presumed that economic improvement will result in better management of natural resources (Abbasi and Khan, 2009). If the source of poverty alleviation is driven through intensified agricultural outputs, this could instead lead to detrimental impacts on resource conservation (Balsdon, 2007).

In Karaked, there exists a formalized decision making structure and resource rights regime, however, enforcement and conflict resolution procedures are weak and still in development. Fabricius and Collins (2007) state that good governance of community based natural resource regimes are strongly dependent on community cooperation and the acceptance by the community members. In support of this, studies by Ostrom (2011) have shown that cases of successful governance systems have consistently been those in which social capital levels are high and where trust and reciprocity between community members is secure. With this knowledge, it is clear why the local government of Karaked has prioritized the encouragement of community participation and support as the key towards attaining a robust and effective water management system.

8. Analysis Part 3: A View through the Double Lens

Although water resource planning in Thailand is meant to use both a "top-down" and "bottom-up" approach, the connection between these two processes is still unclear (World Bank, 2011). The promotion of oil palm in the national strategy illustrates how changing patterns of resource use due to increased commodification of agricultural products can impose a challenge to local forms of resource management (Armitage, 2005). This study has shown that increased palm oil production can place constraints on the capacity of local leaders to govern the management of water resources in an *equitable* and *sustainable* manner (Kurian, 2004). The wide-spread adoption of oil palm cultivation will no doubt result in competition for water resources between rice and oil palm in the dry season, when water resource availability is at its worst. This presents major challenges for the local government to ensure sufficient provision of water services through their newly developed water management plan. Although community support is currently strong, past studies indicate that community support may be at risk if there is disappointing performance of new structures of if there are early negative impacts (Lewins, 2007). Thus, it can be seen how the lack of land-water coordination and planning at national governmental levels can pose an additional obstacle to an already resource stressed area.

Although all those interviewed (both leaders and members) agreed upon the importance of secure water resources for agricultural livelihoods, there appeared to be a disconnection between the priorities of the local government and the conditions for support desired by the members. The need to "establish trust through results" will be a challenging task if water resource demands are to surpass water provision capabilities. Whether or not the TAO can improve irrigation infrastructure while meaningfully engaging farmers and securing community cooperation, the restriction faced by the TAO is similar to that of the Royal Irrigation Department: a basin wide water limitation. As the sustainability of water resources in the Pak Phanang River are dependent on all communities and water users in the basin, the capabilities of the local government are thus constrained to focusing on individual efforts and short term water provision.

Given these limitations, it is clear that local governance resource management strategies would benefit from improved higher level institutional support. This has been requested by the community, as they have stated the need for financial, infrastructure, and management support, especially in the peatland, where government policies are overlapping and contradicting. In cases where resource management is decentralized from national or regional governments to local levels, it is vital that adequate attention is given to the development of an institutional framework which can support the effective performance of local governance efforts (Armitage, 2005).

The achievement of national policies and plans depend greatly on the capabilities and limits of those who are at the core of their operation (Ostrom, 2007). Local community management of land and water resources can only be carried out within the boundaries of knowledge and of individual and community capabilities. When asked about what should be done regarding the potential impacts of extensive oil palm cultivation on soil and water sustainability, the main comments from actors external to the community were focused on ideas of what farmers should or should not do, or "how to prevent farmers from growing palm oil" (interviews: KI's). However, it would be more useful to instead consider how the current institutions in play at all levels are shaping the choices, behaviors and interests of local level agents, with consideration of their contextual situations (Bell, 2011). Supporters of the IWRM strategy suggest that finding solutions to land-water management problems will require the use of both ground-up and top-down strategies. However, as illustrated by this study, the problem lies not in the existence of these structures, but rather in the quality and level of ***connection*** between them.

9. Conclusion

The goal of this research was to determine how Thai government policies encouraging oil palm cultivation are influencing the strategies of the community of Karaked to equitably, efficiently and sustainably manage their water resources. This study has demonstrated the importance of recognizing local level institutional change as a process shaped both by internal community processes and externally placed institutional structures. This is illustrated in the figure 9 below:

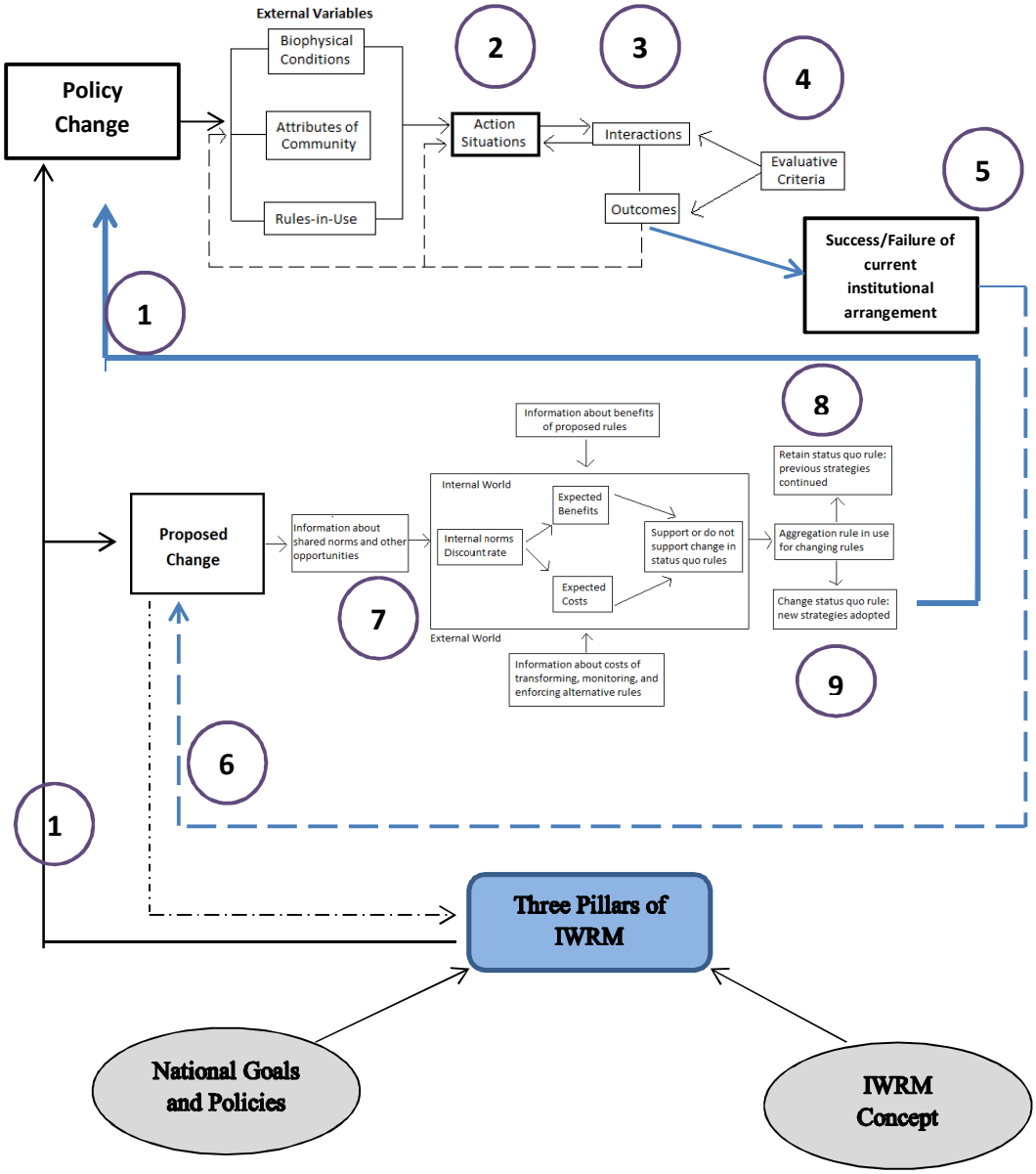

Figure 9: Understanding IWRM through institutional change

Policy changes which are introduced to communities (1) come from both internal (community driven resource management strategies) and external factors (biofuel expansion and land use policies). Within the action situation (2) important factors such as polycentric governance, individual choice, experience, knowledge set and actor agency come into play, affecting both the outcomes as well as the context. The nature of interaction (3) between community members and the local government as well as between members depends upon levels of social capital within the community, such as trust, cooperation, reciprocity and valuations of equity. Then, outcomes (4) on various factors such as income generation, food security, equitable and sustainable water distribution and environmental protection lead to the evaluation of whether or not the current institutional arrangements should be retained or changed (5). If the current institutional arrangements in the community fail to produce satisfactory results, then members may propose to add, remove or alter the rules (6). Efforts from higher governmental levels to alter local level activities for the improvement of environmental, social or economic situations will also be assessed by the community (7). All approved institutional changes will be tested in the action situation, and the outcomes will be re-assessed (2&4). The case of the PPRB has shown that while some external resource management efforts to direct community activities (such as regulations on land use) may not be accepted by the community (8), other policies that are supported and considered beneficial to local level users may be given the opportunity to be adopted and put to the test (9).

The main lesson of this study is that the robustness of proposed local level institutional changes depends on two main factors: **First, changes must be understood and endorsed by the community members themselves, and secondly, institutional changes will only be sustained upon evidence that they are effective in fulfilling the needs of the resource users.** These findings have been substantiated by numerous studies and are at the core of the lessons learned from Ostroms' work on institutional development in common pool resource governance situations. The widely accepted IWRM strategy, while comprehensive in its' technical and normative approaches, is lacking in its operational execution. Rather than vaguely referring to concepts such as "participation" and "stakeholder engagement", efforts aimed at harmonizing water management strategies across different levels could benefit substantially from a deeper understanding of the local level institutional processes that at the core of rurally based natural resource management.

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Appendix I: List of Interviewees

Number of Interviews	Interview Code	Zone and Village	Type of interviewee (smallholder, CSO, government official)	Other
1	F1*	Zone 1 Village 1	Smallholder Farmer	Formerly worked at the oil palm research center
2	F2	Zone 1 Village 9	Smallholder Farmer	
3	F3	Zone 1 Village 10	Smallholder Farmer	
4	F4	Zone 1 Village 2	Smallholder Farmer	
5	KI5*	Zone 2 Village 4	Smallholder Farmer	Previous Karaked Mayor
6	F6	Zone 2 Village 8	Smallholder Farmer	
7	F7	Zone 2 Village 4	Smallholder Farmer	
8	KI8	Zone 2 Village 8	Community Leader	Village Head
9	F9	Zone 3 Village 7	Smallholder Farmer	
10	F10	Zone 3 Village 12	Smallholder Farmer	
11	F11	Zone 3 Village 11	Smallholder Farmer, Conservation Area Guard	Employed as a conservation area guard to prevent trespassers and fire in the peatland
12	KI12		Government: Current TAO Mayor	Mr. Apichet Elected in Nov, 2012
13	KI13	Zone 1	Government: TAO member	
14	KI14	Zone 1	Government: TAO member	
15	KI15	Zone 1	Community Leader: Karaked Head-Man	
16	GD*		Government, CSO	CORIN, Mr. Apichet, TAO and water committee representatives
17	KI17		CORIN- CSO	Mr. Piya Wanpen
18	KI18		Government- RID (Royal Irrigation Department)	Mr. Prasert Mahakit
19	KI19		Government- Ministry of Natural Resources and the Environment	Bor-Lor Department
20	KI20		Academia	Dr. Pakorn- water resource engineering Ms. Chanklap- palm oil supply chain in NST

***F= Farmer, KI= Key Informant, GD= Group Discussion**

Appendix II: Interview Guide

Interview #: __
Date: __
Zone (1, 2 or 3): __
Village (1-12): __
Description of interviewee (farmer, TAO member, water council member, village head, government official, other) __

Introductory briefing:

-introduce myself and the translator, where we are from and why we are here
-explain the purpose of the study
-the interview will be anonymous and cannot be traced back
-ask for permission to record the conversation
-explain that the participant can ask questions at any time, and that they do not need to answer questions if they feel uncomfortable

Semi-structured Interview Question Guide:

1. How many rai of land do you have?

2. What are your main sources of income?

3. What kind of agriculture do you grow?
    a. How much of each?
    b. When are they planted and harvested?

4. What are your sources of water for agriculture?
    a. Where does it come from, and how is it accessed?
    b. When do you need to access the above listed sources of water?

5. When do you have enough water for your agriculture, and when is there not enough. Why?

6. If they grow oil palm:
    a. Why did you choose to grow oil palm?
    b. When was it planted and how old was it when it was planted?

7. Do you think the amount of oil palm will change in:
    a. Your village
    b. Your zone

8. What happens when you cannot get enough water for agriculture?

9. Do you think that people in your zone are cooperating to manage water?

10. Do you think that people in your zone are getting water fairly? Why or why not?

11. Do people in your zone have to pay for the water services?
    a. If yes, how much? If not, why?

12. What is the most important thing to think about when you consider water management in:

a. Your zone
b. Karaked

13. When you think about your (a) zone (b) village, do you think there will be enough water in the future?

14. Are you satisfied with the current water management plan?
    a. Why or why not?

15. Do you have any suggestions for changes in the current water management plans?

Debriefing:

-thank the participants for his/her time
-ask if he/she has any additional comments, questions or concerns
-let them know how to contact the researcher during the study for further questions

Appendix III: Working Rules Framing the Action Situation

Boundary Rules	Actors	• Applicable actors: [all actors in this defined action situation live and own land within the Karaked sub-district] • Distance from water origin • Types of agriculture grown [rice; palm oil; rubber; orchards; shrimp; other] • Amount of land owned [# of rai]
Position Rules	Positions	• Zone: [1; 2; 3] • Village: [1-12] • Status: [Farmer, TAO member, Water Committee member, Other]
Choice Rules	Actions	• Oil palm cultivation and motivation • Water Withdrawal Patterns [Source x When] • Planting and harvesting patterns • Actions Recommended
Information Rules	Information about	• Water withdrawal patterns of others • The general state of water resources: [quantity, quality, reliability, climatic factors] • Soil Characteristics: [type, water capacity, other] • Biological/ecological characteristics of palm oil: [water needs, soil needs] • External Incentives/dis-incentives for palm oil production: [Government Incentives from various departments; market prices for selling; market prices for agricultural inputs] • Current status of productivity • Perception of equitable distribution • Personal concerns
Scope Rules	Potential outcomes	• Productivity of cultivation • Immediate water availability for the actor [sufficient; insufficient] • Future water availability for the actor [sufficient; insufficient]
Aggregation Rules	Control over	• Ability to make individual choices over what to produce • Amount of palm oil in sub-district or zone: [overall increase or decrease of palm oil] • Community cooperation in water management strategies: [level of cooperation] • Personal access to water [secure, not secure] • Planting and harvesting patterns of others

Appendix IV: The Dublin Statement and the Four Principles

The information below is taken from pgs.15 & 16 from: "The International Conference on Water and the Environment: Development issues for the 21st century. 26-31 January 1992, Dublin, Ireland. The Dublin Statement and Report of the Conference. IWCE Secretariat c/o World Meteorological Organization.

THE DUBLIN STATEMENT
ON WATER AND SUSTAINABLE DEVELOPMENT

Scarcity and misuse of fresh water pose a serious and growing threat to sustainable development and protection of the environment. Human health and welfare, food security, industrial development and the ecosystems on which they depend, are all at risk, unless water and land resources are managed more effectively in the present decade and beyond than they have been in the past.

Five hundred participants, including government-designated experts from a hundred countries and representatives of eighty international, intergovernmental and non-governmental organizations attended the International Conference on Water and the Environment (ICWE) in Dublin, Ireland, on 26–31 January 1992. The experts saw the emerging global water resources picture as critical. At its closing session, the Conference adopted this Dublin Statement and the Conference Report. The problems highlighted are not speculative in nature; nor are they likely to affect our planet only in the distant future. They are here and they affect humanity now. The future survival of many millions of people demands immediate and effective action.

The Conference participants call for fundamental new approaches to the assessment, development and management of freshwater resources, which can only be brought about through political commitment and involvement from the highest levels of government to the smallest communities. Commitment will need to be backed by substantial and immediate investments, public awareness campaigns, legislative and institutional changes, technology development, and capacity building programmes. Underlying all these must be a greater recognition of the interdependence of all peoples, and of their place in the natural world.

In commending this Dublin Statement to the world leaders assembled at the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro in June 1992, the Conference participants urge all governments to study carefully the specific activities and means of implementation recommended in the Conference Report, and to translate those recommendations into urgent action programmes for

WATER AND SUSTAINABLE DEVELOPMENT.

GUIDING PRINCIPLES

Concerted action is needed to reverse the present trends of overconsumption, pollution, and rising threats from drought and floods. The Conference Report sets out recommendations for action at local, national and international levels, based on four guiding principles.

Principle No. 1 – Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment

Since water sustains life, effective management of water resources demands a holistic approach, linking social and economic development with protection of natural ecosystems. Effective management links land and water uses across the whole of a catchment area or groundwater aquifer.

Principle No. 2 – Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels

The participatory approach involves raising awareness of the importance of water among policy-makers and the general public. It means that decisions are taken at the lowest appropriate level, with full public consultation and involvement of users in the planning and implementation of water projects.

Principle No. 3 – Women play a central part in the provision, management and safeguarding of water

This pivotal role of women as providers and users of water and guardians of the living environment has seldom been reflected in institutional arrangements for the development and management of water resources. Acceptance and implementation of this principle requires positive policies to address women's specific needs and to equip and empower women to participate at all levels in water resources programmes, including decision-making and implementation, in ways defined by them.

Principle No. 4 – Water has an economic value in all its competing uses and should be recognized as an economic good

Within this principle, it is vital to recognize first the basic right of all human beings to have access to clean water and sanitation at an affordable price. Past failure to recognize the economic value of water has led to wasteful and environmentally damaging uses of the resource. Managing water as an economic good is an important way of achieving efficient and equitable use, and of encouraging conservation and protection of water resources.