A ROBUSTNESS ANALYSIS OF THE CHANCAY – LAMBAYEQUE BASIN (PERU)

Cathy Rubinos
Arizona State University

ABSTRACT

In this paper I analyze the conflict between two groups of farmers in the Irrigation System of the Chancay-Lambayeque basin. One groups is located upstream the main canal of the system, and the second groups downstream. Upstream users are free riding from the canal: They do not pay for the infrastructure maintenance, and at the same time they appropriate water without any formal regulation. Downstream farmers are members of an irrigation association and follow their rules. The national water law supports these rules. Using the Robustness framework I identified that unintended consequences of past policies have caused incentives to free ride from the main canal, and that the system's sustainability risk is from climate change and population growth.

I. INTRODUCTION

The Chancay-Lambayeque Basin is situated in a semi arid area with very little precipitation in northwest Peru, and it has three defined areas: A valley in the lower region (coast) of Lambayeque region; the middle-elevation area shared by Lambayeque and Cajamarca regions, and the high-elevation area (highlands located in Cajamarca. The valley is the most important irrigated area of the basin (118,523 ha.), and farmers, users of the main irrigation infrastructure, constantly fight for water. In this paper, I use the Robustness Framework proposed by Anderies et al. (2004), and the design principles proposed by Ostrom (1990) to 1) analyze the hidden fragilities of the system that allowed reaching the current conflictive situation, and 2) to explore how, by not solving these fragilities, the sustainability of the system could be at risk in a longer term. This paper is based on data collected thought secondary information and from field research performed by the author in 2012.

II. BRIEF STORY OF THE IRRIGATION INFRASTRUCTURE, ITS USERS AND ITS CHALLENGES.

The main river of the Chancay – Lambayeque basin is the Chancay River and it has an extension of 5,309 Km^2 (see figure 1) and the main components of the hydrological infrastructure are theTinajones Project Hydrological System, the Taymi Canal and the Tinajones Reservoir.

In 1964 the Peruvian Government built the Tinajones reservoir, recognizing the importance of agriculture in the basin and the need to build an irrigation system for its development. Later, in 1975 the government, with farmers' participation, built the Taymi canal to bring water from the Chancay River to farmlands that were located near the coast (Presidency, 2010). Farmers who were actively farming at that time were located downstream and to right side of the canal.

In 1992, acknowledging the need for organized water management the farmers formed the Irrigation Association of Chancay- Lambayeque (JUCHL). In compliance with the Legislative Decree[1] 653, an Act that promoted private investment in the agricultural sector, the JUCHL was placed in charge of infrastructure maintenance, tariff charge, water allocation, among other duties.

Later, through the Law Decree[2] Nº 25986 ("Budget of the Public Sector Law of 1993") the government created the Olmos -Tinajones Special Project as an agency that depends on the Presidential Ministry and the National Development Institute (INADE). The main goal of this project is the design and implementation of hydropower and irrigation systems to improve the economic development of irrigated land. They are also the supervising entity of the JUCHL in regard to the infrastructure maintenance. The entity that supervises and co-manages water allocation and appropriation with the JUCHL is the National Water Authority (ANA) through the local agency Local Water Authority (ALA – Chancay Lambayeque).

---

[1] In Peru, a Legislative Decree is an executive order of national application, issued by the President and the cabinet when granted powers by Congress to directly pass legislation

[2] In Peru, a Law Decree is an executive order issued by the President and the cabinet but not previously authorized by Congress. In 1992, pressured by political inaction and radical opposition in both chambers of Congress, President Fujimori closed the Peruvian Congress and called for elections for a Constitutional Assembly which later in 1993 passed the new and current Peruvian Constitution, under which a new Congress -comprised of only one chamber of congressmen- was elected shortly after. During the time of Constitutional Assembly and new Congress election, the executive branch under Fujimori directly passed Law Decrees, when rules of the hierarchy of a Law of Congress were needed. Law decrees passed during that time -covering many fields- remain in force, except where amended by subsequent Congress legislation.

Besides farmers that are part of JUCHL, referred to here as "tailenders", there is another group of farmers. These farmers do not participate in formal water governance systems and are located upstream along the canal, close to the first 30 km of the canal. These farmers, referred to here as "headenders" because of their location upstream along the canal, arrived from the adjacent Andean region of Cajamarca (especially from Chota and Santa Cruz towns) to the basin, beginning in 1984 to work in agro-industrial companies, mostly related to the sugar industry.

Later on, they saw the opportunity of using water from the canal (see figure 2) and decided to build their houses and farms upstream along the canal. Most of them are still working for sugar companies, but are also farming and trying different crops in these areas. Since the settlement of this community was actually spontaneous, improvised and not planned nor overseen by the government at its national or regional levels, it has experienced limited development and still faces serious problems associated with nutrition, education and access to basic services, such as potable water and electric power (ANA, 2008).

At the beginning, these settlers were not able to register their farms or houses within the legal system. However, given that the Peruvian Civil Code[3] grants "squatters rights" for anyone that possesses land for more than 10 years, they are *de facto* owners of that land[4]. However, none of these *de facto* landowners have registered themselves in the irrigation water association and thus any water they appropriate is ultimately outside the formal structure of rules that governs the activities of members of the association.

The 1,500 headender farmers grow mainly maize, which is a relatively low water consumptive crop, but because of their small-scale parcels, their crops are produced at a high cost and low profits. The 3,000 tailender farmers on the other hand tend to grow high water-intensive (but also higher-value) crops such as rice (39%), sugar cane (38%), and cotton (7%).

Conflicts among users and goal of this study Alfaro (2008) reported that there have been violent conflicts among headenders (upstream farmers that are illegally pumping water), and

[3] Articles 950 to 953 of the Peruvian Civil Code set the rules for acquisitive prescription in Peru. Acquisitive prescription, also named *usucapion* (Latin), is a concept found in civil law systems -those used in continental Europe, Central and South America, and even the State of Louisiana-, which originated in Roman Property Law. Usucapion is a method by which property can be gained by possession of it beyond the lapse of a certain period of time, providing that possession is public, continuous and pacific -meaning not formally nor physically disputed-. The real effect of *usucapion* is to remedy defects in a title, and therefore make it certain in order to transit to its most valued use. Peruvian Law establishes that acquisitive prescription of land is obtained after 5 years of possession if a sufficient title to property and good faith are proven. If no title exists, Peruvian Law requires a continued, pacific and public possession of the land for 10 years for courts to apply the remedy.

[4] This is called adverse possession.

tailenders (farmers that are part of the formal sector). This was corroborated in field research. The amount that headenders are withdrawing, while difficult to quantify, is (anecdotally and based

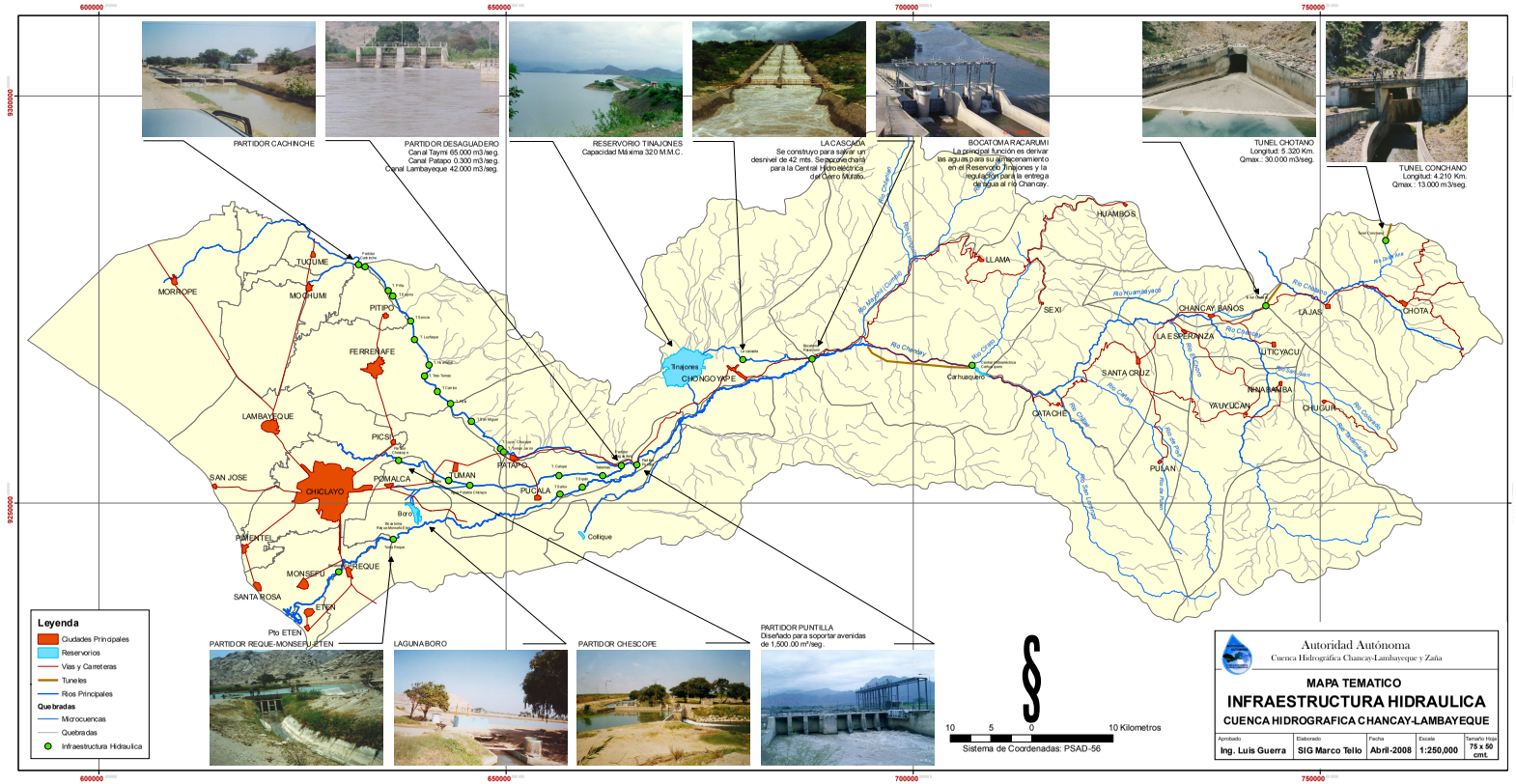

Figure1. **Chancay - Lambayeque Infrastructure**

upon the implicit water needs of the acreage under headender tillage) considerable. However, they have not been paying tariffs. During fieldwork, I talked to a headender that mentioned that some of them have started paying but there is not record of such payments, and when they show receipts they are not from the Irrigation Association. The local water authority confirmed this fact, but they cannot ensure what is happening: Are headenders falsifying those receipts? Is the irrigation association giving different receipts? Is someone else illegally charging a water tariff anonymously? etc. These questions remain unanswered, but for farmers and for the national authorities, the conflict between these two groups of farmers is one of the main concerns in regard to water management.

Figure 2. **Headenders' Pumps in the Taymi Canal**

III. FRAGILITIES OF THE FORMER SOCIO-ECOLOGICAL SYSTEM

Using the robustness diagram proposed by Anderies et al (2004) we can graphically represent the socio-ecological system (see figure 3). The highlighted parts of the diagram shown in figure 3 are the aspects considered as the key fragilities of the system that enabled the current conflictive situation: Public Infrastructure and its relationship with Water Users and their Appropriation

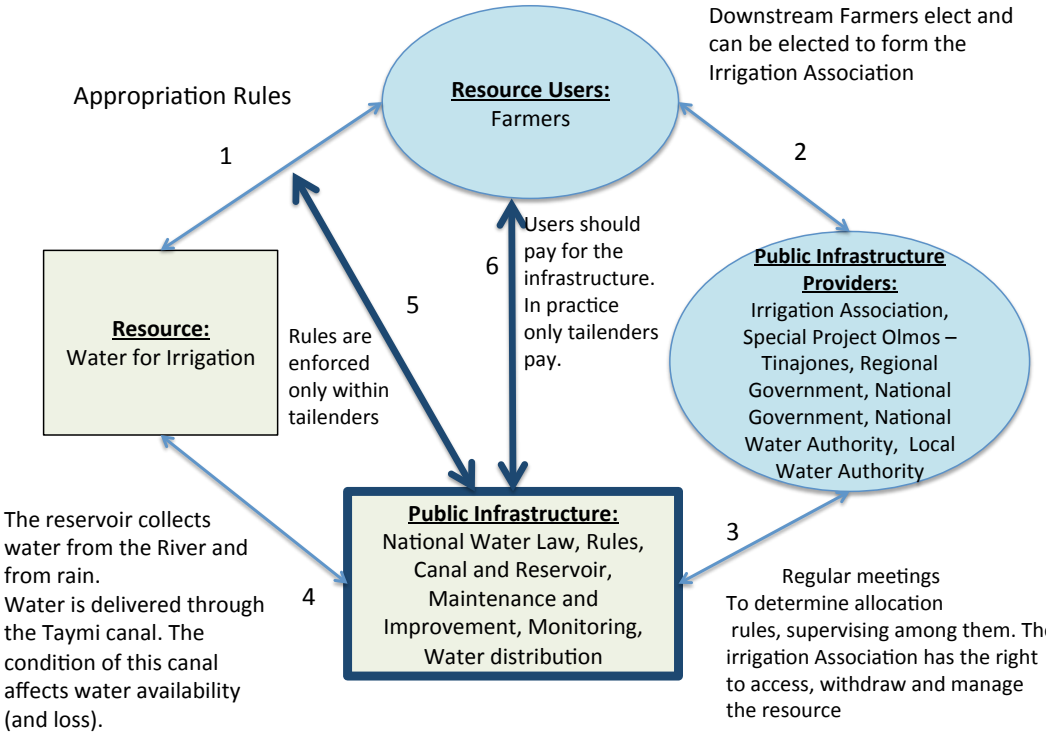

Figure 3. **Robustness Framework without disturbances**

Public Infrastructure and its relationship with Water Users and their Appropriation

1) Institutions Description

One important characteristic of the management of water in Peru is that there is only one set of rules for every basin in the country. Then, this does not capture the specific characteristics of each system. The first law and the base of the legal framework of water use was issued in 1969 - Law 17752 - "Ley general de Aguas" (LGA). It was issued in the context in which the national government centralized the management of all natural resources and at the same time focused its policies in the agricultural sector. Thus, the law ascribed the Ministry of Agriculture as the national authority of water management, which were supported by local authorities: Irrigation District Technical Managers (ATDR).

Later, in 2010 the law was changed into a new one: Ley de Recursos Hídricos, Ley N 29338 which states that water users association (Irrigation Districts) have the right to access, withdraw and to manage water resources in the basin. This last right includes the right to construction and maintenance of infrastructure related to water (and duties), to distribute water and to designate tariffs. However, the State maintains its rights of exclusion and alienation.

Farmers have to register their farm in the water local authority (ALA) so they can obtain a license that allows them to use water for agricultural purposes. This license allows the farmer to use a maximum amount of water related to their land size (10,423m3 for 1 ha). The license is valid indefinitely and it is not transferable. However, the law also states that when water is scarce they may have access to less water than indicated in the license. Who can be a user in each basin is not stated. Moreover, there are no limits to agriculture land expansion, and any new farmer can claim his right to water use. This absence, as is also known, of boundary rules (Ostrom 1990) is one of the fragilities of the system. Without a well definition of potential users of the basin, anyone could claim water rights from it causing fights and even a system collapse.

On the other hand, the law also states that if a farmer has been using water for irrigation purposes for more than 5 years, even if it was through informal arrangements, they automatically gain the right to water[5]. Accordingly, some of the current informal farmers have the legal right to use water from the basin, but still have to respect others sectors higher priority rights and the allocation rules stipulated by water managers, and pay water tariffs. This rule incentivize potential farmers to use water without asking for rights and without any formal regulation, because they know that if they maintain their usage of it for 5 years, they will automatically gain the right of it.

Although the law establishes the rights and obligations referred to water appropriation and public infrastructure provisioning (infrastructure construction and maintenance), it does not clarify the administration of how to proceed in the case of non-compliance of a rule by any agent. Moreover, government agencies do not have the power or the resources to effectively enforce water rules and strengthen governance

Tailenders' rules. There is no evidence of major conflicts among Tailenders[6]. Water appropriation and public infrastructure provisioning rules enables coordination among tailenders and they are bound by the following collective action rules.

Tailenders' water appropriation rules. Water appropriation for tailender farmers depends on the crop they grow and of the size of their landholding. At a national level there is a consensus of irrigation coefficients for each crop and the Irrigation District will deliver water considering those coefficients (see table 1) and for the determined month too (e.g. rice will

[5] This is called adverse possession.

[6] No conflict is mentioned in any report or research in the basin, nor mentioned in interviews performed in fieldwork, even when I asked about it.

receive water only from December to May, each month has its coefficient and in the total period the maximum amount per ha is 14,000 m^3). However, when water is scarce, if the size of the landholding of the farmer is big, he will only receive a percentage of what he asked (e.g. if he is declaring that he intends to grow in 20 ha then the irrigation district will deliver water to his farm considering the needs for 12 ha only). Because cotton is very sensitive to drought, cotton growers have a priority of water when the resource is scarce. Farmers cannot declare an intention to use more land of what he really has because he must previously declare his farm size to the water national authority and the irrigation district has this information.

Table 1

Crops and Irrigations Coefficients – 1000m^3/Ha (example)

Crop	Irrigation Period	Monthly Irrigation Coeficients in 1,000 M3												Total
		August	September	October	November	December	January	February	March	April	May	June	July	
Sugar Cane	12	1.2	1.4	1.4	1.5	1.7	2.1	2.2	2.4	2.1	1.5	1.3	1.2	20
Rice	6	0	0	0	0	0.9	3.6	2.6	3.6	2.4	0.9	0	0	14
Cotton	5	0	0	2.6	0	1.7	1.4	1.4	0	0	0	0	0	7.1
Maize (yellow corn)	0	0	0	0	0	0	0	0	3	0	1.6	1.3	1.2	7.1
Beens	3	0	0	3	0	1.2	0	0	0	0	0	0	0	4.2

Note. From Junta de Regantes Chancay Lambayeque (Irrigation District)

Rules conceive as unfair. Given the insufficiency of government's capacity to enforce water appropriation and public infrastructure provisioning rules, one would hope to see collective action among users but this is not happening. Headenders and tailenders have different approaches of fairness in regard to current water management and rules. Headenders claim that the rules are organized in such a way that favors rich farmers and forbids equal opportunities (Alfaro, 2008). Thus they do not pay water tariffs and are pumping without any restriction and legal authorization from the canal (see figure 4). Tailenders believe that what is unfair is that they are the only group that pays for water and that gets constraints in their water use. Some of them would even prefer to avoid extending membership to the headenders since that would imply to recognize their right to appropriate water, and they fear that it could be translated in higher appropriation levels from headenders.

Headenders frequently claim that the rules are organized in such a way that favors rich farmers and does not allow for equal opportunities (Alfaro 2008). When I did field work, I did not have the opportunity to talk to them about this perception but it may be because governmental

policies have traditionally been focused on the development of the capital city and its surroundings, marginalizing people from the highlands and the jungle. Since upstream farmers are originally form the highlands, they may have already the feelings of abandonment from the government. Moreover, downstream farmers do not want them to use water from the canal, to take away form them their mean for subsistence, knowing this background, is probably seen as unfair.

2) Hard Infrastructure: The Taymi Canal

When the government with farmers' participation built the Taymi canal, they did not foresee that they were leaving 30 kms of free land next to the canal, which could be potentially used in the future. They, without knowing, created a big incentive for immigrants to settle down in this land. Without any supervision or rule monitoring, the incentive was quite bigger.

However, that land was still far from the city and no one saw the opportunity. With the development of new industries like the mills of rice and sugar that demanded new labor force, people came from less developed regions of the highland. It was then when people saw the opportunity of becoming farmers at a low cost.

IV. CURRENT FRAGILITIES: ROBUSTNESS ASSESSMENT

Because of the presence of violent conflicts among users, we could consider that the water management is unsuccessful, but the irrigation system is still working. To consider the sustainability of the system in a longer term we need to assess the transformability of the system (Anderies et al. 2013). For this, we need to identify first the potential disturbances that could harm the system the most. In this case, using the robustness framework as shown in figure 4, I have identified two majors potential shocks: 1) Population growth, specially from migration to upstream the canal, and 2) Climate Change.

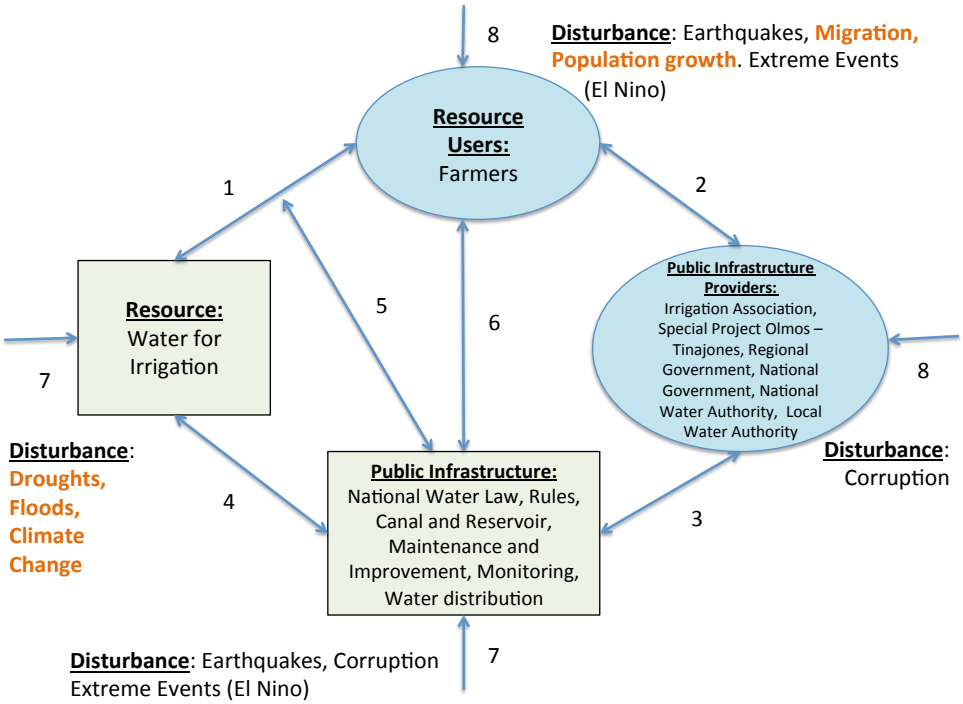

Figure 4. **Robustness Framework with disturbances**

1) Population growth

There isn't updated information of the actual population that is living in the basin, but for Lambayeque it was 1.4%. Population growth in a context of diminishing water availability stresses more the water resource, specially when domestic water use as today, doesn't satisfy the total demand in rural areas (in some districts of the region, like Manuel Mesones Disitrict 75% of the population doesn't have access to potable water for domestic consumption (Alfaro 2008). The discontentment of the population could grow and generate even more pressure on the water management.

Table 2 Chancay- Lambayeque Basin: Projected Population 2000 – 2020

Years	TOTAL	% Change in 5 years	Lower Valley	% Change in 5 years
1993 Census	837512	--	735840	--
2000	962102	14.9%	852819	15.9%
2005	1035633	7.6%	917998	7.6%
2010	1106434	6.8%	980757	6.8%
2015	1172928	6.0%	1039698	6.0%
2020	1237024	5.5%	1096514	5.5%

Source: Proyecto de Modernizacion de la Gestion de los recursos hidricos Anexo a3 basada in informacion del INEI

However, it is more alarming that the number of headenders has been growing (data collected from field work). The irrigation association, formed by tailenders is working because they still get an acceptable amount of water. However, if the number of headenders increases, then the system could collapse. Tailenders could be forced to stop farming and a new form of organization will be needed.

2) Climate Change

The region is highly vulnerable to extreme events as droughts and floods. The last El Nino event that took place in the basin was in 1998, and it affected agriculture in many ways: impacting the GDP with a reduction of 13%, damaging all types of infrastructures and taking away 150 000 lives (Government 2012). Moreover, as stated by (Bustamante 2010) this region is highly vulnerable to climate change especially because of changes in precipitation that could increase water scarcity, but also is vulnerable to floods. Current conflicts between users cause under provisioning of the hard infrastructure, and that limits the system capacity to cope with extreme events caused by climate change. For example, there is a project to expand the Tinajones reservoir capacity and also to build a smaller reservoir. These projects would not only be useful for collecting water in a normal year, but also for preventing catastrophes as floods. However, that project has not been approved yet because of lack of economic resources.

V. CONCLUDING THOUGHTS.

Using the Robustness framework I could identify past and current fragilities of the system that explained why the system shows conflict between users, and presents high risks. Unintended consequences of past policies have caused incentives to free ride from a canal. These incentives were created by 1) biophysical characteristics (they left 30 kms of free land next to the canal), and

2) institutional aspects (no boundary rules, adverse possession rules, no sanctioning rules, no capacity of law enforcement, among others).

Given that the region is highly vulnerable to climate change, and that the incentives for migration to farming upstream the canal are present, the system sustainability is at risk. A new institutional design is needed to enhance their adaptive and transformability capacity to prevent or, in the case of climate change, to cope with it.

VI. REFERENCES

Autoridad Nacional del Agua – ANA (2008). Proyecto de modernización de la gestión de recursos hídricos. Diagnóstico de problemas y conflictos en la gestión del agua en la cuenca Chancay – Lambayeque.

Alfaro, J. (2008). Conflictos, gestión del agua y cambio climático. Propuesta de adaptación al cambio climático y gestión del agua en Lambayeque, Piura y Cajamarca. Lima: *Soluciones Prácticas-ITDG*

Anderies, J. M., Janssen, M. A., & Ostrom, E. (2004). A framework to analyze the robustness of social-ecological systems from an institutional perspective.Ecology and Society, 9(1), 18.

Anderies, J. M., Folke, C., Walker, B., & Ostrom, E. (2013). Aligning Key Concepts for Global Change Policy: Robustness, Resilience, and Sustainability. Ecology and Society, 18(2), 8.

Bustamante, M.J. (2010). Cambio climático en el Peru. Costa Norte. *Fundación M.J. Bustamante De La Fuente*. Lima, Perú.

Ostrom, E. (1990). Governing the Commons: The Evolution of Institutions for Collective Action. *Cambridge University Press*.

Regional Government, Lambayeque. (2012). Plan Estratégico 2012 – 2016.

Regional Presidency. (2010). Propuesta Tecnica Para La Creación Del Consejo De Recursos Hídricos De La Cuenca Chancay – Lambayeque. Gobierno Regional de Cajamarca, Gobierno Regional de Lambayeque.

Rubinos, C. (2013) Institutional Analysis of Water Management for Agriculture in the Chancay-Lambayeque Basin, Peru"