Between Water Abundance and Scarcity: Discourses, Biofuels, and Power in Piura, Peru

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Abstract: In 2006, transnational ethanol corporations arrived in Chira, a semi-arid zone located in the Piura region of northern Peru. Large expanses of land were used to produce sugarcane for ethanol, which triggered local concern over the pressure this would mean on the regional water balance. From political ecology, I examine how the state and a corporation produced discourses on the idea of water abundance in the Chira Basin in order to secure water rights, which increased the risk of water scarcity for small communities, pastoralists and farmers in the region. In doing so, I call attention to the discursive strategies aimed to facilitate processes of dispossession under a technical ethos that reinforce capital accumulation. Finally, I argue that water abundance discourses contributed to produce a "waterscape" that not only produced unsustainable water use but also reinforced social inequalities.

Resumen: En el año 2006 varias compañías transnacionales interesadas en producir etanol llegaron al valle del Chira, ubicado en la región de Piura al norte de Perú. Adquirieron grandes extensiones de tierra en esta zona semi-árida para cultivar caña de azúcar, lo que preocupó a los usuarios locales debido a la presión que ello implicaría sobre el balance hídrico. Desde la ecología política, en este artículo analizo cómo el Estado y una compañía crearon discursos que proyectaban la idea de abundancia de agua en la cuenca del Chira para asegurar sus derechos de agua. Muestro cómo los derechos de agua que fueron asignados a esta compañía con base en la estrategia discursiva de la abundancia de agua incrementaron el riesgo de escasez de agua para las comunidades, pastores y los agricultores de la región. Finalmente, sostengo que estos discursos contribuyeron a producir un paisaje acuático (waterscape) que no sólo generó un uso insostenible del agua sino que también reforzó las desigualdades sociales.

Keywords: water, scarcity, abundance, biofuels, discourses, power

Introduction

Water is increasingly a disputed resource, with diverse—and often competing—interests vying for control of water governance and, particularly, of water distribution. Decisions on the allocation of water rights are generally preceded by discourses on the availability of water in a particular basin. Discourses not only depict the basin's water supply in specific, and often instrumental, ways, but they can also influence perceptions of which development imaginaries should prevail and, therefore, determine how water should be distributed. This paper deals precisely with such discursive struggles in the Chira Basin of Piura, a semi-arid coastal region in northern Peru, where biofuels companies have been planting sugarcane to produce ethanol since 2006.

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Since 2000, approximately 80 million ha of land in developing countries have been acquired for agribusiness. In many regions, the development of irrigated agriculture to produce bioenergy and food for export has increased water demand to previously unforeseen levels (Borras et al. 2011b, 2011a, 2012a, 2012b, 2013; FAO 2012; Franco et al. 2013; HLPE 2011; Huffaker 2010; Kay and Franco 2012; Li 2011; Oxfam Internacional 2011; White et al. 2012). Peru is among the Latin American countries with the largest commercial farms and plantations of flex crops, where land grabbing occurs to produce fruits, vegetables, sugarcane, oil palm, and minerals (Borras et al. 2011b, 2011a, 2012a, 2012b).[1] Nevertheless, case studies on biofuel production in Peru are rather scarce (Hollander 2008, 2010).[2]

In the Chira Basin, international energy corporations in search of land to produce ethanol triggered local concern about the impact they would have on the water balance. Representations of water abundance were inextricably linked to the constitution of a waterscape for biofuel production. As defined by Budds and Hinojosa-Valencia (2012:125), a waterscape is "a sociospatial configuration that is constituted by social and ecological processes, which become manifest through the particular nature of flows, artefacts, institutions and imaginaries that characterise a particular context". Here, I focus on the formation of discourses projecting water abundance in the Chira Basin to justify a waterscape formation that allows the allocation of irrigation water rights to an ethanol company. For this conceptualization, I rely on the idea of discourses as not only cultural representations but also social practices that portray reality in a particular way in order for power to operate. The struggle over the discursive creation of water abundance in the Chira Valley is the arena where particular material-symbolic dynamics are driven by local, national, and international forces with political and economic power differentials that ultimately impose particular representations and policies regarding water.

In the first section of the article, I delve into the critical political ecology and anthropology literatures to analyze discourses and imaginaries of water scarcity and abundance. In the subsequent section, I describe the historical representations of water scarcity and the modernization of agriculture through infrastructure. In the third section, I analyze the state policies on biofuels, which established the conditions that triggered the conflict. Next, I describe how different actors' discourses clashed in the process of deciding how water should be allocated. I then examine how the state's water allocation eventually imposed a new waterscape in the region that facilitated corporate water accumulation. This is followed by a discussion on the importance of discourse analysis in understanding how power takes shape during struggles over water resources.

The data for this article were gathered from primary and secondary sources. The multi-situated nature of my research led me to conduct 23 interviews in Piura and Lima. During the time I spent in Piura–August and November 2012 and April 2013–I interviewed experts on water and agriculture, authorities from the regional and local governments, members of peasant communities, small-scale farmers, and corporate workers and representatives. In Lima, I interviewed agricultural authorities, academic experts, and experts on biofuels and water. I also examined archival and legal records in both Lima and Piura.

Discourses on Water Scarcity and Abundance

During the 1990s, post-structural political ecology underscored discursive and symbolic analysis (Peet and Watts 1993, 2004; Walker 2005). As Bryant (1998:89) points out: "research has sought primarily to understand the political dynamics surrounding material and discursive struggles over the environment in the third world" (see also Baghel and Nusser 2010; Escobar 2010; Mung'ong'o 2009; Orlove and Caton 2010).[3] In fact, discourse analysis matters not only because discourses per se portray the world as "it should be", but also because such analysis can trace the often elusive circuits of power that lead to particular development interventions (Alonso 1988; Boelens 2008; Nader 1997; Swyngedouw 2009). Therefore, the discursive characterization of a basin as water abundant or water scarce is not a neutral assertion; its consequences extend far beyond the physical phenomena evoked (Urteaga 2014). The structure of knowledge created around the idea of water scarcity or abundance may contribute to particular perceptions of such physical phenomena, which in turn influence social practices and political decisions aimed at transforming waterscapes for particular agendas (Ahlers 2008; Bakker 2000, 2010; Boelens 2008; Budds 2008, 2012; Guevara 2014; Johnston 2005; Lynch 2014; Mehta 2003, 2007; Urteaga 2014; Wali 1989).

Historically, the idea of water scarcity has been used to support particular political and economic interests (Ahlers 2008; Bakker 2000, 2010; Budds 2008, 2012; Erensu 2013; Johnston 2005; Mahayni 2013a, 2013b; Mehta 2007). As a result, water scarcity has often been contested (Ahlers 2008; Budds 2012; Jairath and Ballabh 2008; Johnston 2003; UN Water 2007; Urteaga 2014). Similarly, water abundance is socially constructed and contested, though analyses of the social construction of water abundance are rather uncommon (Erensu 2013).[4] Here, I contend that discourses of water abundance and/or scarcity are systems of thought that simultaneously co-constitute the object (water) and the subjects under the aegis of power, thus creating conditions of exclusion (Harvey 1998, 2003). To understand how water discourses are shaped, I draw on Tania Li's (2007) concept of "rendering technical" and James Ferguson's (1990) idea of development as means to depoliticize political interventions.

Water Scarcity and Infrastructural Construction in the Chira Waterscape: A Historical Account

In this section, I focus on the way in which water scarcity has been used to promote particular development imaginaries that have transformed the Chira Basin. To accomplish this, I circumscribe the historical discussion to the late 19th century and, especially, the 20th century.

The northern department of Piura[5] accounts for approximately 3% of Peru's territory with 1.7 million inhabitants, its climate being tropical and humid, with an average temperature of 24°C, and irregular rainfall occurring during the summer. The Chira Valley is located in the Piura's provinces of Sullana and Paita (see Figures 1 and 2).

Despite the fact that most of its territory is a "*despoblado*" (Aldana and Diez 1994; Ploeg 2006),[6] the Chira Valley in the Sullana province has been historically considered an agricultural region (Aldana and Diez 1994; Seminario Ojeda 1994).[7]

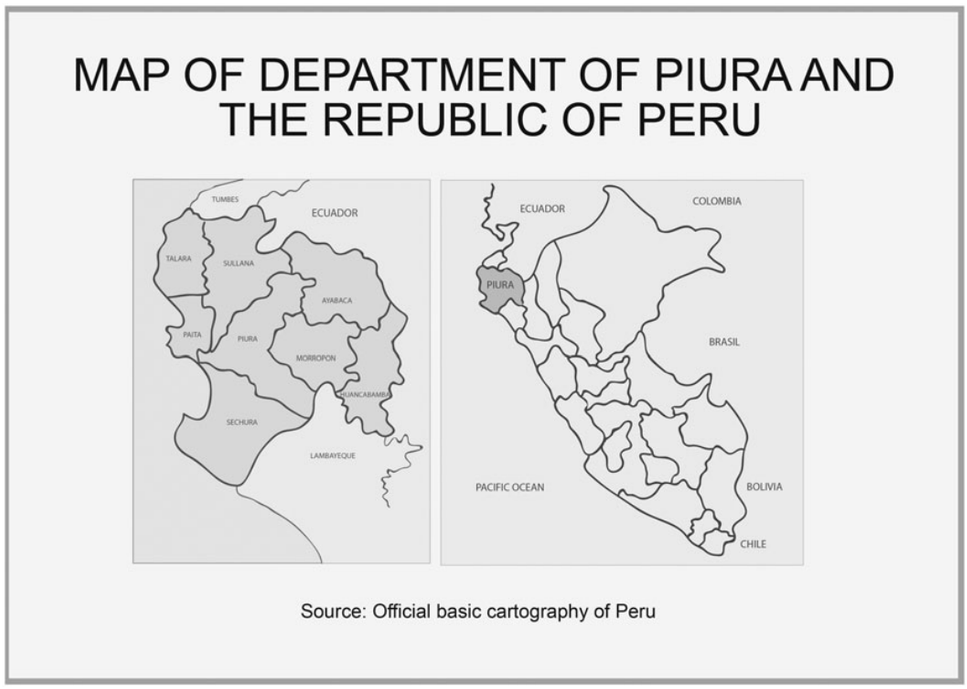

Figure 1: Map of Department of Piura and the Republic of Peru

Following the appropriation of indigenous lands, *hacendados* produced mostly cotton during the 19th century (Gutierrez Rivas 2004). Hydraulic projects accomplished the modernization imaginary, aimed at extending the agricultural frontier (Núñez 2004) and replaced *acequias* with canals for the benefit of large landholders (Aldana and Diez 1994; see also Ploeg 2006).[8] The international economic crisis, the devastating effects of natural phenomena on the Peruvian coast, and population growth increased state intervention in water management (Ploeg 2006; Vos 2006). From early 1900, the state regarded the Chira as a water-abundant river, which could irrigate other valleys (Aldana and Diez 1994; Ploeg 2006; Revesz and Oliden 2011; Temoche Benites 1975). In 1968, the military government approved the Chira-Piura Project, which would transfer 2500 Mm^3 from the Chira River to irrigate Piura and San Lorenzo valleys.[9] The goal of the Proyecto Integral de Irrigación Chira-Piura[10] was to "improve the agricultural production and productivity of 150,000 ha of irrigated land" (Peña Pozo 2004:600; see also Ploeg 2006). Consecutive governments continued developing the Chira-Piura Special Project, part of which was the construction of the Poechos Dam with 885 Mm^3 water volume.[11]

As Swyngedouw (1999) shows in his analysis of Spain's large dam-building program, a particular representation, which allows capital to operate, is crafted through and ingrained in these hydraulic works. In Piura, hydraulic infrastructure has been the symbol of progress and the means to transform previous socio-spatial configurations—"deserted lands" or "*despoblado*"—into "productive" private land and water regimes. As tokens of modernity, hydraulic works transformed Piura into an emporium of agricultural exports. In 2004, the coastal areas of Piura consisted of approximately 103,474 ha of agricultural land, of which 98.5% were irrigated. Only 1.5% was home to rain-fed agriculture (Gobierno Regional de Piura, Direccion Regional de Agricultura 2006). Between 2000 and 2009, the cultivated land in

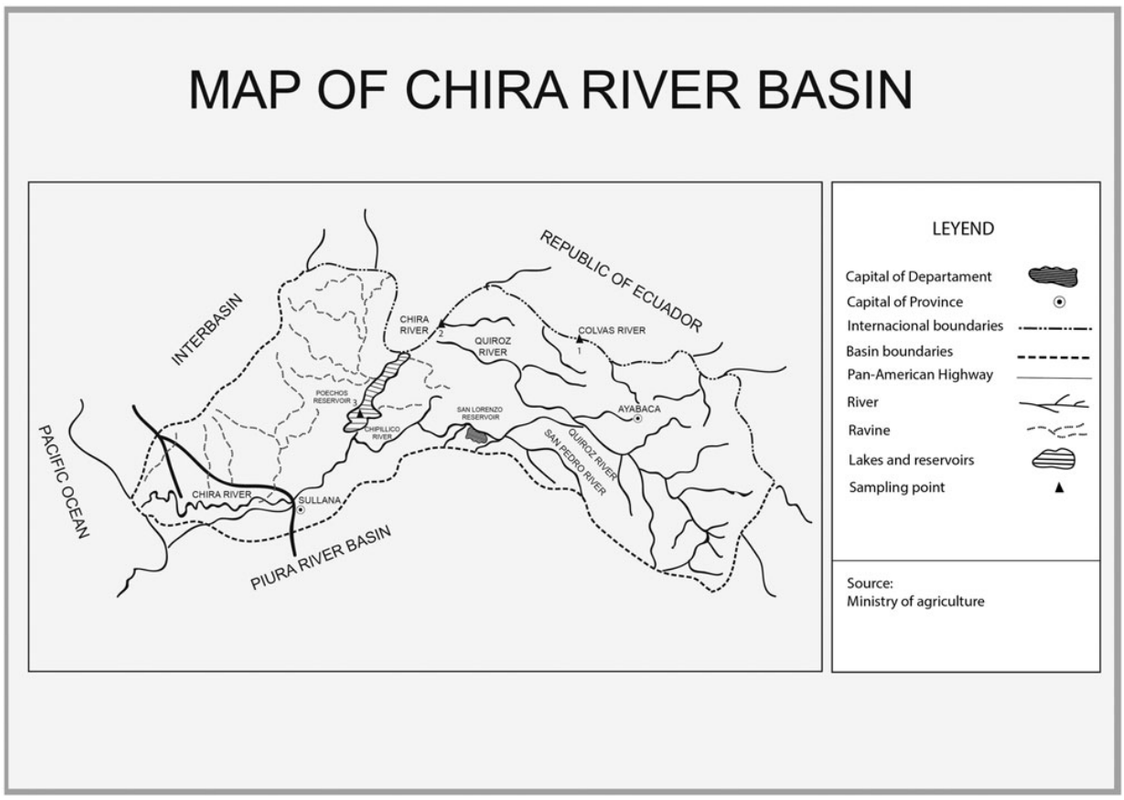

Figure 2: Map of Chira River Basin

the Chira Valley rose to 76.13%, reaching approximately 41,930.97 ha in 2009 (Gobierno Regional de Piura, Direccion Regional de Agricultura 2012).[12] Currently, 31 agro-industrial corporations own the largest tracts of land in the valley. The first group, made up of 17 corporations, cultivates rice; the second transforms, processes, and exports agricultural products; the third cultivates cotton; and the last produces bioethanol (Gallo 2013). This form of corporate control over land, whereby capital increasingly dominates agriculture and food production, has been referred to as "empires" (Ploeg 2006).

The Agricultural Modernization in the Chira River Basin

During Alberto Fujimori's regime (1990–2000), the legal framework allowed land grabbing for agro-industry in the coastal areas (Hendrix 1995:13). The burgeoning land market and water accumulation[13] benefited mostly medium and large farmers.[14] By the mid-1990s, large farmers controlled 77.6% of the agricultural lands (Del Castillo 2006).

Mainly designed as a tool to promote investment, the 2003 Law for the Promotion of the Biofuels Market (Law No. 28054) established the compulsory use of biofuels[15] while disregarded the water issue.[16] By 2005, land transfers in Piura had burgeoned and included marginal lands; allotments; grazing lands; and both communal and private lands, etc.[17] Large agro-industrial corporations were able to acquire land inexpensively.[18] There are no exact data on the amount of land sold in Piura from

the mid-1990s to 2012, though one of my informants calculates it reached approximately 150,000 ha.[19] In 2005, the arrival of bioethanol companies in Chira boosted the process of land accumulation with the purchase of 37,000 ha for the cultivation of sugarcane. The Chira-Piura Special Project put marginal lands that the regional government considered underutilized up for sale, yet some plots were not even owned by the state.[20] Companies, such as Maple Etanol[21] and Caña Brava, used various strategies to acquire agricultural and marginal land (Burneo 2013) (see Figure 3).

Usually, land transactions overlooked the fact that communities and small groups of farmers, pastoralists, and livestock owners possessed so-called marginal lands for economic activities,[22] and, therefore, neither the government nor the corporations granted any compensation for their plots. Not surprisingly, local resistance triggered. In 2007, the Frente de Defensa de la Tierra, el Agua y la Vida en el Bajo Chira, formed by people from the Ignacio Escudero, El Arenal, and La Huaca districts, and the San Lucas de Colan peasant community, filed a complaint against the Piura regional government for irregular land sales.[23] The municipality of the El Arenal district, the San Lucas de Colan community, and other landowners also sued the Chira-Piura Special Project for unlawful land appropriation.[24] All the same, land grabbing in Chira inevitably produced a clear hierarchy of landowners with big corporations with more than 1000 ha and small farmers with less than 5 ha (Cabrejos 2011). The new agricultural lands put further pressure on the water

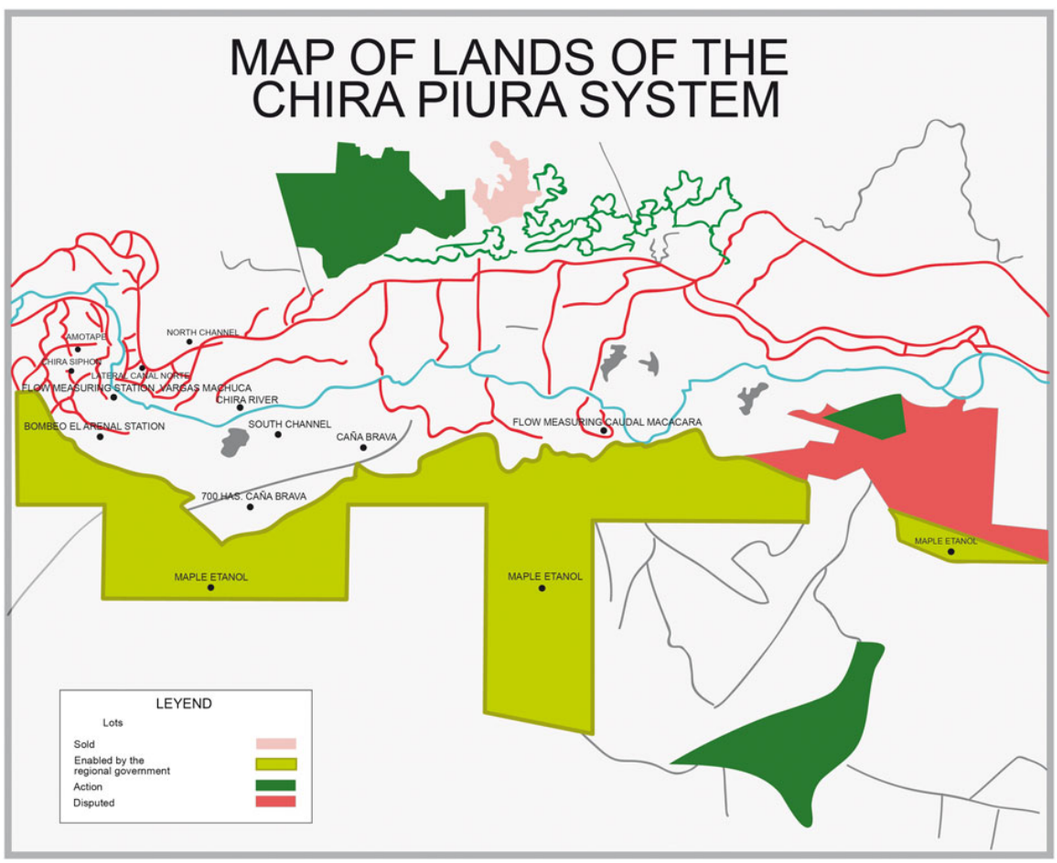

Figure 3: New lands incorporated into the Chira-Piura system

balance of the Chira-Piura Basin, affecting mostly local users who had previously requested water rights for irrigation and domestic use.

Biofuels Investment and Water Demand in Chira

In this section, I analyze the tension between the central and regional governments and among local actors regarding the capacity of the Chira Basin to support biofuels production. While climatic conditions in Chira were optimal for the cultivation of sugarcane,[25] water was a disputed commodity. Even though the central government was aware of and did not ignore issues of water availability (Ministerio de Agricultura 2009), it promoted biofuels in the region without hesitation. Technical discourses on water were particularly evident during the planning phase of the biofuels project. The corporations and the central government depicted the Chira Basin as capable of supporting the cultivation of 30,000 new hectares of land, for which they relied on the discourse of water abundance with technical arguments that "guaranteed" water availability. While INRENA[26] argued for "unexploited groundwater" (Ortiz 2008), the central government emphasized that increased infrastructure would provide an additional 12,400 Mm^3 of surface water.

Discussions centered on arguing technically whether or not the project threatened the water balance in the basin. The "water abundance" discourse was complemented with one emphasizing efficient use based on advanced technology.[27] Corporate discourses relied on technical efficiency in water use for irrigation, implying increased productivity with minimum water consumption (Roa-Garcia 2014). They contended that sugarcane demanded less water than rice, which local farmers cultivated using the flooding system (IRAGER 2007). Local agricultural experts countered that sugarcane requires year-round irrigation whereas rice is seasonal.[28] In terms of water consumption, they pointed out that 1 ha of irrigated sugarcane requires between 17,000 and 20,000 m^3 per year.[29] Maple's plant would produce 105 million liters of ethanol per year (USDA 2012), which meant that approximately 262 billion liters of water would be required just to irrigate the sugarcane. In addition, more water would be necessary to wash the harvested cane, refrigerate the machines, and clean the soil.[30] However, the company ensured they would merely use excess water. Agricultural experts also argued that the calculation of water availability should take into account the irreversible silting of the Poechos Dam (IRAGER 2007). Here, technical discourses on both water availability and water efficiency were at the core of the contestation.

Local authorities and farmers similarly showed great concern about water availability in Chira, which they did not view as adequate to cover even domestic uses: "When the river flow is scarce, there is not enough water even for domestic use", said Mr Juan Carlos Herrera, former official of the La Huaca municipality.[31] Similarly, Malve Luna, former mayor of El Arenal district, described the Chira's dynamic: "During the 1960s, water was abundant. We had to use rafts or canoes to cross the river. In the last 20 years, the water volume has decreased. Now the Chira is a dry river. Water volume increases during the rainy season, but in April, it starts to fall. This year [2013] there was little rain".[32] In fact, water for domestic use has been restricted to five hours in the areas surrounding industrial bioethanol facilities. In

the Tamarindo district, close to Maple's facilities, water is available only from 7 pm to 12 pm.[33]

In 2007, the Chira river flow exceeded 3000 Mm^3 and water demand was 1600 Mm^3 (Silva 2008). Yet, this scenario became complex when the seasonal variability in water availability was taken into account, as well as the fact that the Chira-Piura system covered the demand from the Medio Piura, Bajo Piura, and Chira valleys. In fact, an official report estimated that from May to January "the Chira Basin registers a water deficit of approximately 78.6 mm/month, and from February to April the surplus is 56.2 mm/month" (Vera Arevalo et al. 2007:11). Local farmers' worries centered upon the capacity of the hydraulic system to support such increased water demand (Centro de Investigacion y Promocion del Campesinado and Red de Accion en Agricultura Alternativa 2010; IRAGER 2007). They feared that during the summer, when the river flow lowers, Maple could not rely on excess water, so it would end up using water from the regulated system.[34] Engineer Juan Paiva explained that the farmers' fears were justified because "excess water only occurs during the rainy season, when it is impossible to store it ... generally from January to April ... From then on there is no water excess because discharges are used or stored" (IRAGER 2007:6).

The Food and Agricultural Organization (FAO) also warned about the risk of water scarcity due to bioethanol production in Chira. Ramos (2011) worked on four probable future scenarios, simulating water demand from the Poechos system for different crops, and showed that expanding the cultivation of sugarcane would affect water availability in the Chira-Piura regulated water system, leading to a decline in water availability. Other studies similarly demonstrated biofuels impacts on water and the environment (Delucchi 2010; Elcock 2010; Gerbens-Leenes et al. 2009; Huffaker 2010; Moraes et al. 2011; Perrone and Hornberger 2014). Nonetheless, the central government systematically overlooked these studies in favor of bioethanol production, thus aggravating the situation of the Chira Basin.

Opposing Discourses on "Water Abundance" in the Chira Basin

In this section, I analyze the discursive struggle that arose in 2006 when Maple required water to cultivate sugarcane for ethanol. Maple Energy is an integrated private energy company, whose operations include the development of ethanol, oil, natural gas, and hydrocarbons products.[35] Currently, Maple is registered in Ireland, its major shareholders being American and Belgian nationals. Maple Energy created two subsidiaries in Peru: Maple Etanol and Maple Biocombustibles. In 2014, falling ethanol prices led to the collapse of the market, for which Maple sold its assets in early 2015.

Following the passage of the Law for the Promotion of the Biofuels Market and its regulations, in 2005 the Piura regional government made institutional arrangements to promote biofuels, which included granting the Chira-Piura Special Project (PECHP) marginal lands close to the left bank of the Chira River. In 2006, Maple requested 10,684.15 ha for agrarian and industrial projects to produce ethanol, which the PECHP granted for US$640,588 and an annual payment of

US$500,000 for 20 years. The contract also required Maple to convert 1000 ha of local farmers' rice cultivation lands to sugarcane cultivation (Gobierno Regional de Piura, Direccion Regional de Agricultura 2006). The pressure on the Chira-Piura water balance was inevitable. Yet the central government, the regional government, and the companies all argued that there was enough water in the basin to irrigate more than 15,000 ha of sugarcane. In 2006, Cesar Trelles, president of the Piura regional government at the time, stated in reference to Maple's project, "there is excess water from January to July and only last year 30 Mm^3 of water flowed to the ocean; besides, there is a reservoir with the capacity to store 480 Mm^3. We will not have problems with water to cultivate 10,000 ha of sugarcane" (Correo 2006a). In addition, Maple representatives had guaranteed that the company would use excess water—that is, surface water that flows to the sea—thus respecting existing water rights (IRAGER 2007:7).

In September 2005, Maple submitted its project, entitled "Production of Ethanol Automotive Fuel from Sugarcane", to the local water authority, requesting a reserve of 186.6 Mm^3 of water that flowed from the Sullana Dam "to be lost in the sea". The arena of dispute included discourses for and against the ethanol project. Farmers' discourses utilized the arguments of water scarcity, the inefficiency of the water infrastructure to guarantee enough water for all users, and Maple's blatant land and water accumulation. They also suggested the apparent corruption of the regional government. In October 2006, Antero Nizama, president of the Water Users Organization from the Medio and Bajo Piura, announced that thousands of farmers would march against the agreement of the regional council, No. 352–2006, that approved the sale of land to Maple to cultivate sugarcane for ethanol. "We are not against private investment, but this measure threatens the water resource of the Poechos Reservoir ... It endangers the short agricultural season. The reservoir was not designed to expand the agricultural frontier. The farmers of the Medio and Bajo Piura will be the most affected" (El Tiempo 2006a). Likewise, Cesar Zapata, the president of the Committee of Cotton Producers of the Bajo Piura, accused the regional government of lobbying in favor of Maple and its ethanol project: "We denounce the fact that this company will cultivate more than 20 thousand hectares in areas that currently do not have water rights. Water is already a problem for the areas with water rights" (El Comercio, Piura 2008). Zapata also raised inequality issues "one hectare of sugarcane requires 22,000 cubic meters annually, which means that they would need 400 million cubic meters per year ... the question here is if we want to establish a Bioethanol Production Plant or we want a sugar hacienda in Piura" (El Tiempo 2006b).

In response, the regional government's discourse attempted to depoliticize the dispute by arguing for the necessity of modern and high-tech agriculture in Piura and the efficiency of technology in proving water abundance and settling the dispute. Cesar Trelles, former president of the Piura regional government, stated that:

> For the peace of mind of farmers, the 183 Mm^3 of water granted to Maple to cultivate sugarcane will not be taken directly from the Poechos Reservoir but will consist of "return flows" of water ... There is enough water to satisfy everybody, even the new crop. However, *the technicians will give a clear and definite response to this*. The promotion of great investment projects like this will not cease" (Correo 2006b, emphasis added).[36]

A discursive battle between state institutions attempting to technically calculate the water available for the ethanol project ensued. On 23 August 2005, the local water authority in charge of water rights allocation, Autoridad Tecnica del Distrito de Riego (ATDR), issued a resolution to require Maple to conduct a water balance. Maple completed the "Hydrological Study and Water Balance from the Sullana Dam Downstream to the Mouth of the Chira River" barely a month later and submitted it to the regional government in February 2006. On 21 February, ATDR issued a Resolution No. 020-2006-Gobierno Regional de Piura, which granted Maple Etanol the reserve of water of 186 Mm^3. This resolution would be later declared null and void.[37] Unsurprisingly, Maple's environmental impact assessment (EIA) concluded that there was enough water to allow the new agro-fuel project. No detailed data were supplied (Deforge-Lagier 2009).

The EIA stated that "the water demand in the Chira Valley was calculated as 896.4 Mm^3/year and corresponds to the Daniel Escobar and Miguel Checa canals and the Chira River" (Buenaventura Ingenieros S A 2007:85). As for water availability, the EIA included the water supply of the project but omitted the water supply of the whole basin. By stating the actual water demands of the basin and the water supply of the project, Maple not only represented the basin in a particular way but also established the parameters to evaluate its own water demand (Li 2009). The technical character of the EIA and the state's approval helped the company to legitimize a particular representation of nature under the aegis of scientific neutrality, as if it would accurately depict reality.

In a subsequent document, Maple's calculation of water availability in the basin was made on an annual basis: "in 2006, according to the average measurements, the Chira River discharged approximately 800 Mm3 of unutilized excess water into the sea" (Maple Etanol 2008:3). No reference was made to the variability of excess water during the year.[38] Accordingly, for Maple adding 186 Mm^3 to the basin's water demand of 1700 Mm^3 was not risky at all, for it would use excess water. After a thorough revision, both the Autoridad Autonoma de Cuenca Hidrografica Chira Piura (AACH-CHP) and ATDR Chira recommended a revision of the study since it did not include the water volume available during the lows of the dry season: "During the dry season, the volume of water lost into the sea is negative. Water supply is insufficient to cover the constant water demand of the Chira-Piura Special Project".[39] AACH-CHP further recommended that the state water authorities revise the study before granting any water right to Maple. The general manager of the Chira-Piura Special Project supported the position of AACH-CHP and, similarly, recommended the revision of the hydrological study.[40]

The contention between the local and the national water authorities was evident. There was reasonable doubt among local water authorities, users and even officials from INRENA about the system's capacity to irrigate 15,000 ha of new land allocated to biofuels production (see Vera Arevalo et al. 2007). Nevertheless, the "unconvinced" authorities of the Piura regional government decided to carry out another technical study to "prove" that there was enough water for all the proposed uses. Tania Li's concept of "rendering technical" is of use here, as the discourses deployed by the national and regional governments and the company attempted to "diagnose problems in ways that match the kinds of solution that fall within their

repertoire" (Li 2007:7). Accordingly, a technical study would indicate whether there was enough water to allow the investment.

Through the Ordenanza Regional No. 110-2006/GRP-CR, the regional government approved a water balance study, which indicated that the Chira River and the irrigation system could provide water for all users, even when a loss of 30% and Maple's biofuel project were taken into account (Deforge-Lagier 2009). The regional government's study considered the 10,672 ha for the Maple project and calculated water availability from the Chira River and the Poechos Reservoir; it also considered the water demand of actual users at 290 Mm^3, a loss of 30% that went to the sea, and Maple's demand of 186 Mm^3. However, it omitted other bioethanol companies and corporate, medium and small-scale water users who had requested more water.

Despite continued dissent from local water users, the national water authorities finally put an end to the conflict by calling for a technical solution that excluded "the structure of political-economic relations" (Li 2007:7), and, thereby, depoliticized the whole process. The national government and INRENA (2006) contended that, after evaluating Maple's and the regional government's water balances, which calculated water supply and demand on a yearly basis, it was possible to reserve 186 MCM for the company's agrarian and industrial uses. In September 2006, the central government circumvented Piura's regional government (Gobierno Regional de Piura 2006), and issued Decreto Supremo No. 056-2006-AG granting the PECHP a two-year right to a 186 Hm^2 reserve of surface water, which would be later granted to Maple. INRENA (2006) also demanded that the local water authority, AACH-CHP, determine the lower river's ecological flow in the Chira Basin, ordering them to monitor this flow. Despite the opinion of the president of AACH-CHP's Board of Directors, who was against the approval of Decreto Supremo No. 056-2006-AG, the national government ensured the water reserve for Maple.[41] The use of technical and legal discourses to proclaim water abundance in the Chira River laid the foundation for the formation of a new waterscape, depoliticizing the governmental decision to promote ethanol production in a semi-arid valley.

The Aftermath: Waterscape Formation in the Chira Basin

In January 2007, the agricultural water users organization of the Medio and Bajo Piura River complained before the president of AACH-CHP's Board of Directors for the irresponsibility of both the regional and central governments in granting water to a corporation while ignoring small farmers' needs. During the dry season when there is no return flow, they contended, Maple would use surface water from the regulated system, thus diminishing the water flow downstream in the middle and lower Piura River and hindering their livelihoods (Gallo 2009). Local farmers, including agro-industrial corporations,[42] also raised concerns on the allocation of water rights to a transnational corporation, whereas peasant communities such as San Lucas de Colán and Tamarindo, and the Miguel Grau Agricultural Producers Association were unsuccessful in their requests for access to water.[43] Despite

corporate and government attempts to depoliticize the issue by "rendering technical" the water balances, the inequality of the process was made evident by local leaders and politicians. Cesar Zapata, representative of the Cotton Producers of the Bajo Piura, stated: "Regional resolutions and ordenanzas to reserve land for the company and the Decreto Supremo reserving 186 million cubic meters from the Chira River have been approved within a 36-hour interval in favor of the same company" (El Tiempo 2006b). Likewise, Marisol Espinoza, a Congress representative, suggested corruption had mediated Maple's project (Con nuestro Peru 2008).

Once the national water authorities had approved the reserve of water for Maple, the national government transformed its discourse of water abundance into one of water scarcity. In fact, nine months later, on 18 May 2007, the Ministry of Agriculture issued a regulation (No. 380-2007-AG) stating that the water resources of the Chira Basin were exhausted and, as a result, no water rights could be granted from then on. Henceforth, a new waterscape began to take shape. Maple carried out diverse engineering studies, and with a financial loan from the World Bank, it started the construction of the ethanol plant. The National Water Authority approved Maple's request to construct two water-pumping stations named Macacara and El Arenal,[44] which together amounted to 650,000 m^3 of storage.[45] According to Maple representative, approximately 17,000 m^3 were used to irrigate 1 ha of sugarcane, the cost of which reached US$183 (474.98 soles) in 2013.

In May 2009, Maple requested additional water rights in the form of *Licencias* to the National Water Authority to irrigate sugarcane seeds. The *Licencias* granted to Maple were both for industrial and agricultural uses. The water authorities then allowed Maple to take water to adjacent landholdings that the company had acquired from small farmers.[46] Local farmers expressed their concern not only because of Maple's, but also its subcontractors' excessive water use. Local authorities such as Mrs Malve Luna, former mayor of the La Huaca district, argued that Maple's use of large volumes of water to irrigate sugarcane plantations was due to over-allocations to the company and its subcontracted landholders, which eventually affected local water users. In fact, Maple itself admitted that its water demand would affect the basin's water supply. Conveniently, after the contract between Maple and the Piura regional government was signed and the water reserve was legally approved, Maple admitted that:

> water use by the project could have effects or impacts on the populations and ecosystem by altering surface and groundwater; reducing the water volume available for domestic use, agriculture and livestock; and reducing the ecological flow of the river ... These impacts are not significant because the project will not use water from the canals, but will use excess surface water from the Chira River Basin that is not totally utilized (Maple Etanol 2008:7).

Both members of peasant communities and small local farmers were concerned upon water scarcity not only due to Maple's water use but also because of the companies Maple subcontracted. A member of the San Lucas de Colan community said: "if our lands are left without water, we will not be able to produce".[47] Not only have small peasants seen their crops spoiled because of filtration from the canals Maple's companies use, but they had to wait for days to irrigate their small plots until the companies finish irrigating.[48] The increasing corporate water use implied in the

new waterscape not only brought about a critical problem in the water balance in Chira, excluding all water users who had been asking for water rights, among them small farmers, local communities, and corporations. It also prevented small local farmers and peasant communities from irrigating their crops as they had historically. As a result, local water users ended up leasing or selling their lands.[49]

Conclusion: Discourses on Water, Biofuels and Power

This study demonstrates the crucial importance of discourse analysis in processes of waterscape formation as it unveils the nuanced ways that power operates to reinforce inequalities in access to water. By constructing water in particular ways, discourses lay the ground for the transformation of nature and simultaneously create conditions for social exclusion. Historically, these discursive interventions to change the waterscape in Chira have focused mostly on water scarcity rather than abundance. As a result, water infrastructure to overcome water scarcity and extend the agricultural frontier in other valleys ensured water accumulation by powerful water users.

The arrival of new corporate actors in Piura over the last decade has furthered the transformation of both land and water resources. The conversion of extensive areas of marginal lands to sugarcane plantations for ethanol has challenged the original capacity of the irrigation system and undermined historical water management practices, reinforcing local residents' fears of water scarcity. In response to local opposition, carefully crafted state and corporate discourses suggested the abundance of water in the Chira Basin at a level sufficient to cover new irrigation demand for 15,000 ha of sugarcane. Technical studies emphasizing water abundance in the basin omitted to calculate water volumes in different seasons, focusing instead on the total average annual water supply. The discursive struggle transcended the local level when regional water authorities and water users' organizations contended that Maple's study was inaccurate because it veiled water scarcity during the dry season as well as the siltation problems of the Poechos Reservoir and the water demands of existing agricultural water users.

By rendering technical the company's calculation of water supply, the government legitimized and depoliticized the appropriation of water to produce ethanol, which was strategic for the agricultural modernization of the region despite the resulting water scarcity for the users of water from the Medio, Bajo Piura and Chira rivers. The discursive representation of water abundance in the Chira Basin thus contributed to concretizing representations of efficient "modern" agriculture in Piura by allocating water for biofuel production. Interestingly, the case demonstrates the polymorphous nature of the state, as water authorities form a complex assemblage of local, regional, national and transnational interests that may be in opposition to one another, with decision-making outcomes being the result of the specific power dynamics among them.

The analysis demonstrates how discourses imagine socio-natures, upon which political decisions transform and construct waterscapes. The new waterscape formation in the Chira Basin implied more pressure on the overall water balance to satisfy global corporate water needs for biofuels production to the expense of local users. New forms of inequality arose, particularly due to the corporate appropriation of land and water.

Finally, meeting corporate water demand resulted in the systematic rejection of local water needs since the basin was subsequently declared to be exhausted. By imagining water abundance in the Chira Basin, the discourses favored the formation of a water-scape that reinforced not only unsustainable water use but also social inequality.

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Endnotes

[1] Here I use the term land grabbing as synonymous for large-scale formal and informal land acquisitions (Cotula 2014).

[2] The research focuses mostly on biofuels policies, geopolitics, and environmental issues (see also Hollander 2008, 2010; Scott et al. 2014; cf. Ariza-Montobbio et al. 2010; McCarthy 2008; Pye 2010; Richardson 2010; Vermeulen and Cotula 2010; White and Dasgupta 2010; Wilkinson and Herrera 2010).

[3] Some called attention to the repercussions political ecology's turn to the symbolic had on the balance between the political and ecology (for a detailed debate, see Walker 2005; see Boelens 2008 to understand the importance of the discursive dimension in the analysis of water rights).

[4] In fact, studies on water abundance have focused mostly on flooding, disasters and climate change.

[5] See http://hispagua.cedex.es/sites/default/files/especiales/Trasvases/monograficocuencas2012/Cuencas-compartidas-peru-ecuador.html (last accessed 21 January 2016).

[6] In Spanish, the name alludes to an uninhabited area, but the reality is very different. Interestingly, the particular geography of the area forces its inhabitants to practice seasonal activities. As these practices are not permanent, the state considers these lands unproductive, which has been a detriment to having local rights of use to this land recognized.

[7] Named after different Caciques of the Tallan ethnic group, these lands were irrigated by the Chira River during pre-Inca and Inca administrations. Systems of canals transferred water throughout the region, thus transforming unproductive lands into agricultural ones. Later, the Spaniards appropriated former Caciques' lands and the Incan canals (Paz Velásquez 1986).

[8] Miguel Checa y Checa was not only the owner of the Macara *hacienda* and the farms located upstream of the Chira River, such as Chocan and San Francisco, but was also in charge of the construction of the Checa canal, which benefited from approximately 2000 ha of his lands. The hydraulic works started in 1900. However, due to economic constraints in 1902 he was forced to associate with the Peruvian Corporation and the Duncan Fox commercial house, thus forming the Firm for the Irrigation of Chira (Empresa de Irrigacion del Chira) (Núñez 2004). The company went bankrupt not only because of labor claims but also because the *haciendas* that benefited from the canal refused to pay the monthly fees, accusing the company of contractual breach regarding water turns and volumes (Revesz and Oliden 2011; Rosas Navarro 2004).

[9] For a detailed account of the San Lorenzo project's upheavals, see Hirschman (1967).

[10] In English: Chira-Piura Irrigation Project. Here, I refer indistinctively to the Chira-Piura

Irrigation Project, the Chira-Piura Special Project or the Chira-Piura Project.

[11] See http://www.serbiaconstruction.com/projects/chira-piura-multipurpose-water-management-system/ (last accessed 15 October 2014).

[12] A great percentage was dedicated to rice, followed by sugarcane, banana, and lemon. Sugarcane is the first crop among the semi-permanent products (Instituto Nacional de Estadística e Informatica 2011).

[13] For an analysis of how land grabbing is closely connected with water grabbing, see Borras et al. (2011b, 2011a), Franco et al. (2013), Kay and Franco (2012); Mehta et al. (2012) and Woodhouse (2012).

[14] Regarding sugarcane, for example, from 2000 to 2006, large corporations dedicated more than 60% of the cultivated surface to sugarcane while small farmers retained between 34% and 36% (see Ministerio de Agricultura nd).

[15] Isabel Quispe, Professor at the Pontificia Universidad Católica del Peru, personal communication, 25 October 2012. See Valle (2011) for an analysis of biofuel-promoting policies in Mexico and the United States, and their scarce concern for environmental impacts. In the Chira Valley, ethanol companies initially discharged wastewater directly into the canals of the hydraulic system, damaged other tenants lands, etc. (Joaquin Garcia Torres, personal communication, 14 April 2013).

[16] For an account on the importance of the law in promoting biofuels in China, see Wang (2011).

[17] Eng. Carlos Cabrejos, personal communication, 26 August 2012.

[18] For instance, Espinoza Batistini, a small farmer of the left bank of the Chira, lost his land due to a bank debt, and the Caña Brava bioethanol company later purchased the land from the bank (Urbano Leon Álvarez, personal communication, 18 April 2013).

[19] Eng. Carlos Cabrejos, personal communication, 26 August 2012.

[20] The Chira-Piura Special Project even sold Maple Etanol land that was not the state's (Pineda 2010). The project omitted to carry out the physical and legal ordering of the land it auctioned; as a result, it sold private and public plots of land, among them two graveyards that belonged to local municipalities (Eng. Carlos Cabrejos, personal communication, 26 August 2012).

[21] Henceforth, I will use indistinctively Maple Etanol or Maple.

[22] El Tablazo is a deserted area in the district of La Huaca, in Sullana. When the Chira River rose, peasants and other people from Pucusala and Buenaventura, two small rural towns, moved to El Tablazo to protect themselves from potential floods. The Piura regional government sold this land to Maple, disregarding this fact, and consequently did not grant any compensation to them (Segundo Obando, personal communication, 16 April 2013).

[23] For instance, Camposol, a Peruvian agro-industrial company, invaded 1500 ha of land that overlapped land possessed by the Association of Livestock Owners and Pastoralists Nuevo San Vicente in Sullana. The association filed a legal complaint in the Piura Courts, which has yet to be settled. See https://redopan.wordpress.com/articulos-sobre-tema-tierras/ (last accessed 21 January 2016).

[24] Malve Luna and José Espinoza, personal communications, 17 April 2013. The complaint reached the Congress of the Republic of Peru and the Office of Institutional Control of the Controller General of the Republic. See Congreso de la Republica del Peru (2009) and Defensoria del Pueblo, Peru (2008). See also Contraloria General de la Republica del Peru, "Report No. 001-2008-2-5349".

[25] In fact, while approximately 132.5 tons per ha are produced in Piura, Brazil produces only half that amount (Ortiz 2008).

[26] Instituto Nacional de Recursos Naturales is the national institution in charge of managing natural resources.

[27] Dionisio Romero Paoletti, CEO of Caña Brava, one of the largest bioethanol corporations in the Chira Valley, indicated that Caña Brava is transforming marginal lands into productive plots through high-tech irrigation systems (see La Republica 2008). For reference on the predominance of the water efficiency discourse in Peru, see Roa-Garcia (2014).

[28] The Commission for the Study and Analysis of Investment in Biofuels and Water, made up mostly of engineers, university professors and consultants, raised these opinions in different fora. The commission was part of IRAGER (Eng. Ricardo Pineda, personal communication, 25

August 2012; see also IRAGER 2007).
[29] Eng. Ricardo Pineda, personal communication, 25 August 2012. Torres Aguas (1995:196) estimates that sugarcane's water consumption "ranges between 1,200 and 1,500 mm per year, whereas in subtropical zones were dry seasons are longer and evaporation is higher than in tropical zones, it is a bit higher".
[30] According to the USDA (2012:4), "Ethanol in Peru is produced using the diffusion method which is broadly used in Brazil. This method consists of shredding the cane very thinly then moving it through thirteen consecutive showers of warm water (between 70° and 80°C). The water that comes out of the last wash then is fermented. Once the alcoholic yeast is finished with the fermentation process, the liquor is distilled" (see also Buenaventura Ingenieros S A 2007).
[31] Personal communication, 16 April 2013.
[32] Personal communication, 17 April 2013.
[33] Joaquin Garcia, leader of the Tamarindo district, personal communication, 17 April 2013.
[34] Eng. Carlos Cabrejos, personal communication, 26 August 2012.
[35] The International Finance Corporation (IFC), part of the World Bank Group, granted Maple US$40 million for a greenfield ethanol project in 2007 (see http://ifcext.ifc.org/ifcext/spiwebsite1.nsf/0/8225D23285C7EA84852576BA000E2A3F).
[36] A "return flow" is surface water that cannot be stored in dams, surface water that flows to the sea, and groundwater stored in the aquifer (Gallo 2009).
[37] The Office of Institutional Control of the Controller General of the Republic of Peru reported that the ATDR had illegally issued the Resolution No. 020–2006, Gobierno Regional de Piura, not being authorized by law.
[38] Engineer Armando Santivañez, from the National Water Authority, contended that water balances should calculate water supply on a monthly basis rather than on an annual basis (personal communication, 18 November 2014).
[39] Autoridad Autonoma de Cuenca Hidrografica Chira-Piura, "Informe No. 1-2006-AACH".
[40] Proyecto Especial Chira Piura, "Oficio No. 580-2006-GRP-PECHP".
[41] Autoridad Autonoma de Cuenca Hidrografica Chira-Piura, "Oficio No. 518–2006-AACH-CHP". The decision was taken upon the approval of the study entitled "Determination of the minimum flows or ecological flows of the Chira River, from the site of the water releases of Poechos Dam to the mouth of the river into the sea" ("Determinacion de los flujos mínimos o caudales ecologicos del rio Chira entre la salida del desembalse Poechos y la desembocadura del mar"). Ministerio de Agricultura, "Resolucion Ministerial No. 01497-2007-AG" and "Resolucion Ministerial No. 380-2007-AG".
[42] Among the members of an organization called APERT were Camposol, Agricola del Chira, Ecoacuicola, Corporacion Miraflores (COMISA), and associations of pastoralists such as Cepibo, Baneco, Ambao (see Centro de Investigación y Promoción del Campesinado and Red de Acción en Agricultura Alternativa 2010).
[43] Jose Espinoza, leader of San Lucas de Colan peasant community, personal communication, 6 April 2013; and Juan Carlos Herrera, personal communication, 16 April 2013. See also http://radiocutivalu.blogspot.com/2010/11/presidente-de-la-comunidad-campesina-de.html (last accessed 22 January 2016).
[44] Intendencia de Recursos Hídricos, "Resolucion Directoral No. 1497-2006-IRH"; Instituto Nacional de Recursos Naturales, "Resolucion 565-2008-INRENA".
[45] For the Macacara pumping station, located in the district of La Huaca, Maple received a *Licencia* (Resolucion Directoral No. 0316-2012- ANA-AAA-JZ-V) from the National Water Authority (Autoridad Administrativa del Agua Jequetepeque–Zarumilla) in 2011 for approximately 2,452,800 m^3 of surface water from the Chira River for industrial use by the ethanol production plant. This *Licencia* renewed a former one granted through Resolucion Administrativa No. 0389-2011-ANA-AAA-JZ-V).
[46] Malve Luna, personal communication, 17 April 2013.
[47] José Espinoza García, personal communication, 27 November 2012.
[48] Malve Luna, personal communication, 17 April 2013.
[49] San Lucas de Colan leased 224 ha of land to Maple, while other small farmers have sold their land to bioethanol companies such as Caña Brava (see Burneo 2013). A more detailed

analysis is necessary in order to provide information on the exact number of hectares sold by small farmers to bioethanol companies.

References

Ahlers R (2008) Escasez, eficiencia y economia: palabras vacias, politicas neoliberales y problemas de desposesion. Un caso de estudio de reforma política de agua en un distrito de riego en Mexico. In *Curso de Formación Gestion Integrada de los Recursos Hidricos. Modulo 2: Gobernabilidad de los Recursos Hidricos: legislacion, administracion y politicas hídricas* (pp 21–41). Lima: Wageningen University, IHE Unesco, IPROGA

Aldana S R and Diez A H (1994) *Balsillas, Piajenos y Algodon. Procesos Historicos en Piura y Tumbes*. Lima: Cipca Tarea

Alonso A M (1988) The effects of truth: Re-presentations of the past and the imagining of a community. *Journal of Historical Sociology* 1(1):33–57

Ariza-Montobbio P, Lele S, Kallis G and Martinez-Alier J (2010) The political ecology of Jatropha plantations for biodiesel in Tamil Nadu, India. *Journal of Peasant Studies* 37(4):875–897

Baghel R and Nusser M (2010) Discussing large dams in Asia after the World Commission on Dams: Is a political ecology approach the way forward? *Water Alternatives* 3(2):231–248

Bakker K (2000) Privatizing water, producing scarcity: The Yorkshire drought of 1995. *Economic Geography* 76(1):4–27

Bakker K (2010) *Privatizing Water: Governance Failure and the World's Urban Water Crisis*. Ithaca: Cornell University Press

Boelens R (2008) *The Rules of the Game and the Game of the Rules: Normalization and Resistance in Andean Water Control*. Wageningen: Wageningen University

Borras S M, Fig D and Suárez S M (2011a) The politics of agrofuels and mega-land and water deals: Insights from the ProCana case, Mozambique. *Review of African Political Economy* 38:215–234

Borras S M, Franco J C, Gomez S, Kay C and Spoor M (2012a) Land grabbing in Latin America and the Caribbean. *Journal of Peasant Studies* 39(3/4):845–872

Borras S M, Franco J C, Kay C and Spoor M (2011b) "Land Grabbing in Latin America and the Caribbean Viewed From Broader International Perspectives." Paper presented at Dinámicas en el mercado de la tierra en América Latina y el Caribe, 14–15 November

Borras S M, Franco J C and Wang C (2013) The challenge of global governance of land grabbing: Changing international agricultural context and competing political views and strategies. *Globalizations* 10(1):161–179

Borras S M, Gomez S, Kay C and Wilkinson J (2012b) Land grabbing and global capitalist accumulation: Key features in Latin America. *Canadian Journal of Development Studies* 33(4):2–16

Budds J (2008) Whose scarcity? The hydrosocial cycle and the changing waterscape of La Ligua river basin, Chile. In M Goodman, M Boykoff and K Evered (eds) *Contentious Geographies: Environmental Knowledge, Meaning, Scale* (pp 59–78). Aldershot: Ashgate

Budds J (2012) La demanda, evaluacion y asignacion del agua en el contexto de escasez: un analisis del ciclo hidrosocial del valle del rio Ligua, Chile. *Revista de Geografia Norte Grande* 52:167–184

Budds J and Hinojosa-Valencia L (2012) Restructuring and rescaling water governance in mining contexts: The co-production of waterscapes in Peru. *Water Alternatives* 5(1):119–137

Buenaventura Ingenieros S A (2007) *Estudio De Impacto Ambiental—EIA. Proyecto Agroindustrial de Producción de Etanol Automotor*. Lima: Buenaventura Ingenieros S A

Burneo M L (2013) Espacio regional, recursos naturales y estudios sobre Piura. *Revista Argumentos*. http://www.revistargumentos.org.pe/espacio_regional.html (last accessed 1 June 2015)

Cabrejos C (2011) *Actualizacion del mapa regional del sector agrario Piura*. Piura: CIPCA

Centro de Investigacion y Promocion del Campesinado and Red de Accion en Agricultura Alternativa (2010) *Situacion de Biocombustibles en el Departamento de Piura*. Piura: CIPCA and RAAA

Congreso de la Republica del Peru (2009) *Agenda del Pleno del Congreso de la Republica del Peru–Sessions of 27 and 28 May 2009*. Lima: Congreso de la Republica del Peru
Con nuestro Peru (2008) Escandalosa venta de tierras en Piura. 1 November
Correo (2006a) Confirman llegada de Ministro de Economia. 6 October
Correo (2006b) Agua es suficiente para caña de azúcar. 8 October
Cotula L (2014) *Addressing the Human Rights Impacts of "Land Grabbing"*. Brussels: European Union
Defensoria del Pueblo, Peru (2008) *Reporte de Conflictos Sociales N° 57*. Lima: Defensoria del Pueblo, Peru
Deforge-Lagier S (2009) "Impacts of Agrofuel Production on Land-use and Water in Semi-arid Areas: The Case of Piura-Chira, Peru." Unpublished MSc thesis, UNESCO-IHE Institute for Water Education, Delft
Del Castillo L (2006) "Derechos de propiedad rural y titulacion de tierras." Paper presented at the 7th Annual Conference on Legal and Policy Issues in the Americas, Peru, 25–26 May. http://www.law.ufl.edu/_pdf/academics/centers/cgr/7th_conference/Laureano_del_Castillo-Setima_Conferencia.pdf (last accessed 13 June 2014)
Delucchi M A (2010) Impacts of biofuels on climate, land, and water. *Annals of the New York Academy of Sciences* 1195:28–45
Elcock D (2010) Future US water consumption: The role of energy production. *Journal of the American Water Resources Association* 46(3):447–460
El Comercio, Piura (2008) Denuncian favorecimiento de GR a empresa extranjera. 8 October
El Tiempo (2006a) Juntas de usuarios protestaran contra el Gobierno Regional. 1 October
El Tiempo (2006b) Proponen reconversion para producir etanol. 8 October
Erensu S (2013) Abundance and scarcity amidst the crisis of "modern water": The changing water-energy nexus in Turkey. In L M Harris, J A Goldin and C Sneddon (eds) *Contemporary Water Governance in the Global South: Scarcity, Marketization and Participation* (pp 61–78). New York: Routledge
Escobar A (2010) Postconstructivist political ecologies. In M Redclift and G Woodgate (eds) *The International Handbook of Environmental Sociology* (pp 91–105). Cheltenham: Edward Elgar
FAO (2012) *Coping With Water Scarcity. An Action Framework for Agriculture and Food Security*. Rome: UN Food and Agriculture Organization
Ferguson J (1990) *The Anti-Politics Machine: "Development", Depoliticization, and Bureaucratic Power in Lesotho*. Cambridge: Cambridge University Press
Franco J, Mehta L and Veldwisch G J (2013) The global politics of water grabbing. *Third World Quarterly* 34(9):1651–1675
Gallo L (2009) Conflicto por disponibilidad de agua para la produccion de etanol en el departamento de Piura, Perú. In P Urteaga (ed) *Conflictos por el agua en la region Andina. Avances de investigacion e instrumentos de manejo* (pp 139–158). Lima: Concertacion, IPROGA
Gallo L (2013) "*Los biocombustibles y el Agua, Piura-Peru*." Research report. Lima: WOTRO
Gerbens-Leenes W, Hoekstra A Y and van der Meer T H (2009) The water footprint of bioenergy. *PNAS* 106(25):10219–10223
Gobierno Regional de Piura, Direccion Regional de Agricultura (2006) *Plan Estrategico Regional Concertado de desarrollo Agrario de la region Piura*. Mesa de Trabajo: Gerencia Regional de Desarrollo Economico-Gobierno Regional Piura, Coordinadora Rural, PDRS-GTZ, CIPCA, Autoridad Autonoma de Cuenca Hidrografica Chira Piura, Centro Ideas y Universidad Nacional de Piura, Facultad de Agronomia
Gobierno Regional de Piura, Direccion Regional de Agricultura (2012) *Avances de Siembra de Campaña Agricola 2012/2013*. Piura: Gobierno Regional de Piura, Direccion Regional de Agricultura
Gobierno Regional de Piura (2006) *Acuerdo del Consejo Regional No. 368-2006/GR Piura-CR*. Piura: Gobierno Regional de Piura
Guevara J A (2014) La gestion (des)integrada del agua en la cuenca alta del rio Ica: el caso de Santa Rosa de Tambo, Huancavelica. In M T Ore and G Damonte (eds) *¿Escasez de agua? Retos para la gestión de la cuenca del río Ica* (pp 173–226). Lima: Fondo Editorial de la Pontificia Universidad Catolica del Peru

Gutierrez Rivas J (2004) Cap. VI. La Independencia. In J A del Busto and J Rosales Aguirre (eds) *Historia de Piura* (pp 321–388). Piura: Universidad de Piura, Departamento de Humanidades, Instituto de Investigaciones Humanisticas

Harvey D (1998) What's green and makes the environment go round? In F Jameson and M Miyoshi (eds) *The Cultures of Globalization* (pp 327–355). Durham: Duke University Press

Harvey D (2003) *The New Imperialism*. Oxford: Oxford University Press

Hendrix S E (1995) Property law innovation in Latin America with recommendations. *Boston College International and Comparative Law Review* 18(1):1–59

Hirschman A (1967) *Development Projects Observed*. Washington, DC: Brookings Institution

HLPE (2011) *Tenencia de la tierra e inversiones internacionales en agricultura. Un informe del Grupo de Expertos de Alto Nivel sobre Seguridad Alimentaria y Nutrición*. Rome: UN Food and Agriculture Organization

Hollander G (2008) "Toward a Political Ecology of the Emerging Global Ethanol Assemblage." Paper presented to the Berkeley Workshop on Environmental Politics, University of California, Berkeley

Hollander G (2010) Power is sweet: Sugarcane in the global ethanol assemblage. *Journal of Peasant Studies* 37(4):699–721

Huffaker R (2010) Protecting water resources in biofuels production. *Water Policy* 12(1):129–134

INRENA (Instituto Nacional de Recursos Naturales) (2006) *Informe–INRENA Publication No. 036-2006-INRENA-IRH-DIRH-MAN/ACF*. Lima: INRENA

Instituto Nacional de Estadística e Informatica (2011) *Piura Compendio Estadistico 2011*. Lima: INEI

IRAGER (2007) *Los Nuevos Proyectos Agroindustriales en la Region Piura*. Piura: Instituto Regional de Apoyo a la Gestión de los Recursos Hídricos

Jairath J and Ballabh V (2008) The context and problematique. In J Jairath and V Ballabh (eds) *Droughts and Integrated Water Resource Management in South Asia* (pp 3–39). New Delhi: Sage

Johnston B R (2003) The political ecology of water. *Capitalism, Nature, Socialism* 14(3):73–90

Johnston B R (2005) The commodification of water and the human dimensions of manufactured scarcity. In L Whiteford and S Whiteford (eds) *Globalization, Water and Health: Resource Management in Times of Scarcity* (pp 138–150). Santa Fe: School for American Research

Kay S and Franco J (2012) *The Global Water Grab: A Primer*. Amsterdam: Transnational Institute

La Republica (2008) Alistan proyecto de etanol. 6 June

Li F (2009) Documenting accountability: Environmental Impact Assessment in a Peruvian mining project. *PoLAR: Political and Legal Anthropology Review.* 32(2):218–236

Li T (2007) *The Will To Improve: Governmentality, Development, and the Practice of Politics*. Durham: Duke University Press

Li T (2011) Centering labor in the land grab debate. *Journal of Peasant Studies* 38(2):281–298

Lynch B (2014) La reforma del agua del Peru y sus implicaciones para el poder y la equidad en la cuenca hidrografica de Ica. In M T Ore and G Damonte (eds) *¿Escasez de agua? Retos para la gestion de la cuenca del rio Ica* (pp 25–54). Lima: Fondo Editorial de la Pontificia Universidad Catolica del Peru

Mahayni B (2013a) Producing crisis: Hegemonic debates, mediations, and representations of water scarcity. In L M Harris, J A Goldin and C Sneddon (eds) *Contemporary Water Governance in the Global South: Scarcity, Marketization and Participation* (pp 35–44). New York: Routledge

Mahayni B (2013b) Tensions in narratives and lived realities of water crisis in Damascus. In L M Harris, J A Goldin and C Sneddon (eds) *Contemporary Water Governance in the Global South: Scarcity, Marketization and Participation* (pp 45–60). New York: Routledge

Maple Etanol S R L (2008) *Levantamiento de Observaciones Realizadas al Estudio de Impacto Ambiental-EIA. Proyecto Agroindustrial de Produccion de Etanol Automotor*. Oficio No 03762-2007-Produce/DVI/DGI-DAAI, 21/12/2007

McCarthy J F (2010) Processes of inclusion and adverse incorporation: Oil palm and agrarian change in Sumatra, Indonesia. *Journal of Peasant Studies* 37(4):821–850

Mehta L (2003) Contexts and constructions of water scarcity. *Economic and Political Weekly* 38(48):5066–5072
Mehta L (2007) Whose scarcity? Whose property? The case of water in western India. *Land Use Policy* 24(4):654–663
Mehta L, van Veldwisch G and Franco J (2012) Water grabbing? Focus on the (re)appropriation of finite water resources. *Water Alternatives* 5(2):193–207
Ministerio de Agricultura (2009) *Plan Nacional de Agroenergia (2009–2020)*. Lima: Ministerio de Agricultura
Ministerio de Agricultura (nd) "Cultivos de importancia nacional." http://www.minag.gob.pe/portal/sector-agrario/agricola/cultivos-de-importancia-nacional/azúcar/producción25?start=4 (last accessed 13 August 2014)
Moraes M M G A, Ringler C and Cai X (2011) Policies and instruments affecting water use for bioenergy production. *Biofuels, Bioproducts, Biorefining* 5(4):431–444
Mung'ong'o C G (2009) Political ecology: A synthesis and search for relevance to today's ecosystems conservation and development. *African Journal of Ecology* 47(s1):192–197
Nader L (1997) Controlling processes. *Current Anthropology* 38(5):711–737
Núñez D (2004) Capítulo VIII: La Guerra con Chile y su secuela. In J A del Busto and J Rosales Aguirre (eds) *Historia de Piura* (pp 483–515). Piura: Universidad de Piura, Departamento de Humanidades, Instituto de Investigaciones Humanisticas
Orlove B and Caton S C (2010) Water sustainability: Anthropological approaches and prospects. *Annual Review of Anthropology* 39:401–415
Ortiz M (2008) Gobierno y regiones pondran en valor 150.000 hectareas. *El Comercio* 31 July
Oxfam Internacional (2011) Tierra y poder. El creciente escandalo en torno a una nueva oleada de inversiones en tierras. 22 September
Paz Velásquez J G (1986) *Piura en la conquista*. Piura: Industria Grafica Ubillus
Peet R and Watts M (1993) Development theory and environment in an age of market triumphalism. *Economic Geography* 68(3):227–253
Peet R and Watts M (2004) *Liberation Ecologies: Environment, Development, Social Movements* (2nd edn). New York: Routledge
Peña Pozo R E (2004) Capítulo X. La Hacienda reciente: 1950–2000. In J A del Busto and J Rosales Aguirre (eds) *Historia de Piura* (pp 575–641). Piura: Universidad de Piura, Departamento de Humanidades, Instituto de Investigaciones Humanisticas
Perrone D and Hornberger G M (2014) Water, food, and energy security: Scrambling for resources or solutions? *WIREs: Water* 1:49–68
Ploeg J D (2006) *El futuro robado. Tierra, agua y lucha campesina*. Lima: IEP, WALIR
Pye O (2010) The biofuel connection: Transnational activism and the palm oil boom. *Journal of Peasant Studies* 37(4):851–874
Ramos C L (2011) Analisis de los efectos de la produccion de cultivos bioenergeticos sobre la disponibilidad de los recursos hidricos: El caso del sistema Chira. In E Felix and C Rosell (eds) *Bioeneergia y Seguridad Alimentaria "BEFS". El analisis de BEFS para el Peru* (pp 53–70). Rome: UN Food and Agriculture Organization
Revesz B and Oliden J (2011) Piura: Transformacion del territorio regional. *Ecuador Debate* 84:151–176
Richardson B (2010) Big Sugar in southern Africa: Rural development and the perverted potential of sugar/ethanol exports. *Journal of Peasant Studies* 37(4):917–938
Roa-Garcia M C (2014) Equity, efficiency, and sustainability in water allocation in the Andes: Trade-offs in a full world. *Water Alternatives* 7(2):298–319
Rosas Navarro R (2004) Cap. IX. La primera mitad del siglo XX. In J A del Busto and J Rosales Aguirre (eds) *Historia de Piura* (pp 517–573). Piura: Universidad de Piura, Departamento de Humanidades, Instituto de Investigaciones Humanisticas
Scott D, Hitchner S, Maclin E M and Dammert J L (2014) Fuel for the fire: Biofuels and the problem of translation at the 10th Conference of the Parties to the Convention on Biological Diversity. *Global Environmental Politics* 14(3):84–101
Seminario Ojeda M A (1994) *Historia de Sullana*. Sullana: Municipalidad Provincial de Sullana, Maza Editores

Silva D (2008) "Conflicto por la disponibilidad del agua para tierras nuevas en el valle del bajo Chira." Unpublished manuscript

Swyngedouw E (1999) Modernity and hybridity: Nature, regeneracionismo, and the production of the Spanish waterscape, 1890–1930. *Annals of the Association of American Geographers* 89(3):443–465

Swyngedouw E (2009) The political economy and political ecology of the hydro-social cycle. *Journal of Contemporary Water Research and Education* 142(1):56–60

Temoche Benites R (1975) *Sechura. Lucha permanente contra la adversidad*. Lima: Grafica Inclan

Torres Aguas J (1995) Riegos. In D C Cassalett, A J S Torres and E C H Isaacs (eds) *El cultivo de la caña en la zona azucarera de Colombia* (pp 193–210). Cali: CENICAÑA

UN Water (2007) *Coping With Water Scarcity: Challenge of the 21st Century*. Geneva: UN Water

Urteaga P (2014) Creadores de paisajes hidricos. Abundancia de agua, discursos y mercado en las cuencas de Ica y Pampas. In M T Ore and G Damonte (eds) *¿Escasez de agua? Retos para la gestion de la cuenca del rio Ica* (pp 227–267). Lima: Fondo Editorial de la Pontificia Universidad Catolica del Peru

USDA (2012) *Peru Biofuels Annual*. GAIN Report. Global Agricultural Network Service. http://gain.fas.usda.gov/Recent%20GAIN%20Publications/Biofuels%20Annual_Lima_Peru_6-27-2012.pdf (last accessed 29 February 2016)

Valle V M (2011) Biofuels: A cure or a curse? Implications of increased production and consumption in Mexico and the United States. *Latin American Policy* 2(2):182–221

Vera Arevalo H, Acuña J and Yerrén J (2007) *Balance Hidrico Superficial de las Cuencas de los Rios Chira y Piura*. Lima: Direccion de Hidrologia Aplicada. Direccion General de Hidrologia y Recursos Hidricos. http://www.senamhi.gob.pe/pdf/estudios/Paper_BHSCHP.pdf (last accessed 1 June 2015)

Vos J (2006) *Piramides de agua. Construccion e impacto de imperios de riego en la costa norte del Peru.* Lima: IEP, Walir

Vermeulen S and Cotula L (2010) Over the heads of local people: Consultation, consent, and recompense in large-scale land deals for biofuels projects in Africa. *Journal of Peasant Studies* 37(4):899–916

Wali A (1989) *Kilowatts and Crisis: Hydroelectric Power and Social Dislocation in Eastern Panama*. Boulder: Westview

Walker P A (2005) Political ecology: where is the ecology? *Progress in Human Geography* 29(1):73–82

Wang H (2011) Building a regulatory framework for biofuels governance in China: Legislation as the starting point. *Natural Resource Forum* 35:201–212

White B, Borras S M, Hall R, Scoones I and Wolford W (2012) The new enclosures: Critical perspectives on corporate land deals. *Journal of Peasant Studies* 39(3/4):619–647

White B and Dasgupta A (2010) Agrofuels capitalism: A view from political economy. *Journal of Peasant Studies* 37(4):593–607

Wilkinson J and Herrera S (2010) Biofuels in Brazil: Debates and impacts. *Journal of Peasant Studies* 37(4):749–768

Woodhouse P (2012) New investment, old challenges: Land deals and the water constraint in African agriculture. *Journal of Peasant Studies* 39(3/4):777–794