water

MDPI

Article

Linking Water Scarcity to Mental Health: Hydro–Social Interruptions in the Lake Urmia Basin, Iran

Maja Ženko [1,*] and Filippo Menga [2]

[1] Institute of Environmental Science and Technology (ICTA), Universitat Autònoma de Barcelona, 08193 Cerdanyola del Vallès, Barcelona, Spain

[2] Department of Geography and Environmental Science, University of Reading, Russell Building, Whiteknights Campus, PO Box 227, Reading RG6 6AB, UK; f.menga@reading.ac.uk

* Correspondence: maja.zenko@uab.cat

Received: 29 March 2019; Accepted: 21 May 2019; Published: 24 May 2019

Abstract: Alterations of water flows resulting from the manifestation of powerful hydro–social imaginaries often produce an uneven distribution of burdens and benefits for different social groups or regions, reflecting their social and political power. Marginalized regions can suffer manufactured territorialized water scarcity, which disturbs the natural, economic and socio-political order of water users, and as this article shows, inevitably affects their psychological wellbeing. Set in the context of the surroundings of Lake Urmia in Iran, once one of the largest hypersaline lakes in the world and now a severely degraded ecosystem mainly as a result of water overuse in its watershed, this article explores how and through which pathways this manufactured water scarcity impacted the mental health of the water users in the region. The research findings reveal that alterations in this local hydro–social territory and the resulting biophysical, financial and social changes, as well as impacts on physical health of water users, relate to chronic psychological stress, social isolation, intra-community conflicts, despair, hopelessness, depression and anxiety.

Keywords: hydro–social territories; mental health; Lake Urmia; manufactured water scarcity; Iran

1. Introduction

Freshwater scarcity is becoming one of the leading global environmental issues of the 21st century [1–4]. The latest World Water Development Report released by the United Nations World Water Assessment Programme revolves around a straightforward correlation: our booming global population (particularly in low- and middle-income countries) puts a strain on global food and electricity production, which are both water-intensive. As a result, global water use is set to exponentially grow, making water increasingly scarce, and, according to the report, nature-based solutions are required to address these pressing challenges [5]. And yet, while this argument is formally correct, it also foregrounds an ontology of water primarily informed by the natural sciences and technical assumptions about ecological scarcity, one that can downplay the social and political choreographies of power that are key in defining water use, allocation and access [6]. Research has indeed illustrated how water scarcity is often not only a result of the physical shortage of water, but rather the product of complex interactions between waterflows and socio-economic and political relations [7–12]. The various actors sharing a river basin are driven by different imaginaries regarding the use of water, as well as by asymmetrical abilities to materialize those imaginaries through the use of hydraulic infrastructure [13–15]. Alterations of water flows result in the redistribution of burdens and benefits for different groups of people and impact the livelihoods of affected communities, including their social and political order, their economy, culture and health [16,17]. This large and growing post-humanist body of literature has advanced the notion of the hydro–social cycle to denote the ways in which the materiality of

water as a physical entity (H_2O) overlaps with the social and political flows of water as a resource. Research has therefore moved well beyond considering water as merely a physical substance, and acknowledged its multiple social, cultural, symbolic, political and natural dimensions [18]. While on the one hand the seasonal flows of water in river regimes play a central role in setting the organizational rhythms of human societies (as in the case of ancient Egyptian farmers and the Nile), on the other hand humans can alter water flows (and with them the hydrological cycle) with dams and reservoirs to serve their social and economic interests [19,20]. Yet, in spite of the considerable scholarly attention devoted to the social flows created and interrupted by H_2O, little has been written about the impacts of human-made territorialized water scarcity on the mental health of the communities directly affected by these phenomena. Mental health is an integral component of health and is defined as "a state of well-being in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community" [21] (p.1). Even though research has recognized that environmental changes increase psychological distress and the incidence of mental health disorders [22–27] the connection between mental health and water scarcity remains a largely under-researched domain.

Using the concept of hydro–social territory, which was developed by Boelens et al. [13] (p.1) to denote the "spaces that are (re-)created through the interactions amongst human practices, water flows, hydraulic technologies, biophysical elements, socio-economic structures and cultural-political institutions", this work explores how the reshaping of the hydro–social territory impacts the mental health of the population whose socio–natural environment is altered as a result of water management decisions that disregarded their water needs. Examining and understanding the link between mental health and water scarcity is important for at least two reasons. First, water scarcity is generally perceived as a pressing global challenge for humanity, and it will continue to be so in the near future. As the 2015 WHO report on 'progress on sanitation and drinking water' illustrates, by 2025, 1.8 billion people will be living in conditions of absolute water scarcity, relying on annual water supplies that will be lower than 500 cubic meters per person per year [28]. Against this backdrop, individual or communal water shortages are often produced by unequal power relations [29], and the experience of the dispossessed water users differs from those who are suffering physical water scarcity, because of the contested nature of their hydro–social territory and the artificial interruption of their hydro–social cycle. Communities are dispossessed of water as they are kept at the margins of the decision-making process in issues related to water governance [30]. Secondly, most of those marginalized water users live in low- and middle-income countries [31], which are also characterized by insufficient provision of and access to mental health services, with 75% to 85% of people suffering severe mental health conditions not having access to the needed mental health treatment [32]. The health loss from diseases, injuries and risk factors is quantified by the Global Burden of Disease (GBD), which incorporates their prevalence and the relative harm they cause. Vigo et al. [33] show that mental illnesses represent 32.4% of years lived with disability (YLDs) and 13.0% of disability adjusted years (DAYs) of the GBD. Given the current predictions of increases in water scarcity and considering the link between water scarcity and mental health, the global burden of mental illness is likely to further increase. As Tomlinson and Lund [34] observed, global mental health is an issue that has not yet received appropriate visibility. Yet, the fact that in 2015 the United Nations decided to include mental health in the UN Sustainable Development Goal 3 ('good health and well-being'), suggests that more policy attention and funding is going to be devoted to this matter, thus compelling researchers to further explore its interrelation with environmental degradation in general, and water scarcity specifically.

To do so, we take as a case study the area surrounding Lake Urmia in Iran, once one of the largest hypersaline lakes in the world, and now an agonizing ecosystem reduced to 12% of its original size during the past two decades [35], mainly due to unsustainable water use for irrigation of agricultural land in the upstream areas of the Lake Urmia basin. The diminished inflow of water to the lake from the supplying rivers and the decreasing volume and quality of groundwater in the area, created significant water shortage in the areas surrounding Lake Urmia. The wetlands once surrounding the lake have dried and the retreat of the lake exposed the salt-covered lakebed to wind erosion. The resulting salt

storms along with the water shortage have lowered the agricultural potential of nearby lands and pose serious economic, social and health treats to the population living in the area.

For these reasons, the decaying Lake Urmia provides a good platform to examine how human-made water scarcity affects the mental health of local communities. Indeed, the population around the lake consists mainly of small farmers, whose livelihoods were severely altered by the reduction of available water resources and environmental changes, as well as by the subsequent increased financial pressures and socio-political changes in their communities. Data for this article is sourced from 96 interviews with farmers living and working in the villages and settlements near the Urmia lakebed. The aim of the interviews was to explore the effects of water shortage and restricted access to water on the everyday lives of respondents, including their economy, social relations and health. Hence the purpose of this article is to explore how and through which pathways changes in access to water impact the mental health of marginalized water users in hydro–social territories. We argue that manufactured water scarcity can lead to mental health impacts for the marginalized water users with additional psychological stress being caused by governmentalization and increased state regulation of the irrigation infrastructure, which creates exclusion and further marginalization of a certain part of the population who depend on illegal appropriation of water resources.

The rest of this article is structured as follows. In Section 2 we briefly review the literature on hydro–social territories and waterscapes, and link it to the literature on the mental health impacts of environmental degradation. Section 3 contextualizes this research by providing an overview of the reasons behind the desiccation of Lake Urmia. We outline the interests and actors that are responsible for water distribution on the state and local level, and the historical political strategies and decisions that led to the current, unsustainable water consumption in the Lake Urmia basin. Section 4 describes the methods used for the study. Section 5 illustrates and discusses the main pathways that led to mental health disorders and explores their impacts on local communities, while Section 6 concludes and identifies future research avenues to be taken as a result of our findings.

2. Hydro–Social Interruptions

In this paper we examine the spatiality of nature–society relations through the notion of 'hydro–social territories' and waterscape. While naturalistic views tend to present the management of water flows as a set of technical, objective and rational decisions that can be clearly measured and defined, the hydro–social perspective foregrounds the sometimes messy, and inherently social and political nature of water as a resource [7,10,15,36], the access to and control over which is determined by broader political, economic and social conditions [9,12,37,38]. In this context, territories are not viewed as fixed spaces, but as spatially bound dynamic networks of hydro-social relations, that are constantly and interactively (re)constructed and (re)negotiated [13,14,39,40]. Hydraulic infrastructure, for instance, alters hydro–social territories and impacts different stakeholders in different ways, and results in changes and uneven distribution of burdens and benefits [16,17,41,42].

The advancement of the water interests of one group often comes at the detriment of other groups, and this not only impacts their biophysical environment, but also their social, cultural and political order [39–42]. Governments or preeminent groups are able to utilize discursive, technical and scientific types of support [14,15] to reconfigure hydro–social territories according to their legitimate water knowledge, while discrediting other, often local and traditional, illegitimate forms of water knowledge [13]. Water infrastructure projects become grounds of contestation of different knowledge regimes involving multiple actors and are often the manifestation of the epistemology of the dominant water culture [43,44]. Hydro–social transformations can be at the forefront of modernization processes, and are outlined and sustained by a period-specific use of contested dominant discourses, symbols, as well as socioeconomic, political and material processes. Water infrastructure systems therefore act as symbols of modernization [45] and are not only material structures but a combination of natural, technical, cultural, social and political components that are shaped in particular ways in the given location and time. They consist of natural and social dimensions and are also a part of broader historical,

natural and social processes [18]. Those in power can thus produce 'modern water' to offer hydrological certainty through technology, renegotiating the social relations between water users and technocrats [46]. So far, the literature on hydro–social territories have found the notion of governmentalization to be closely related to their constitution [13,40,47,48]. Territorial governmentalization entails the interventions that a state makes to extend its control over a territory and implement a common governance system over diverse local socio-political arrangements. While this can enable the provision of public services in some areas, it also transforms social and political power relations in a given territory, often disregarding local political and economic interests [13,36]. Governmentalization can be achieved through the exercise of sovereign power, or through the use of inclusive, bottom-up power mechanisms [49], such as the use of dominant discourses and ideology by the ruling groups in order to alter water users' worldviews, identity, sociality, and behavior according to the dominant hierarchic system. The process aims to achieve the materialization of the dominant hydro–social territories by controlling the societal development through the transformation of water users' beliefs, sense of belonging and identification with the community, and the creation of new relationships and ways of interacting between water users themselves and between water users and water authorities in such a way, that they would accept, internalize, and reproduce the new norms of morality, water knowledge and truths imposed by the dominant system [13,14,40,50]. Hommes et al. [39], Duarte–Abadía and Boelens [42] and Rogers et al. [51] for example, use the concept of governmentality to show how such mechanisms are employed by the state authorities in the case of dam-building in Turkey, in territories in Colombian highlands, and water transfer in China respectively, while Ioris [10] and Perramond [52] apply the concept of territorialization to describe similar processes in Lima's water management and New Mexico's state adjudication of water rights, respectively. Territorial governmentalization therefore creates spaces where dominant social, political and economic hierarchies are (re)established and (re)enforced by water governors on local water users, often eroding their local sovereignty.

Yet, multiple diverging and overlapping hydro–social territories can exist simultaneously within the same space, as informal or even illegal practices of local water management can be, to some degree, tolerated and recognized by the state to guarantee state's stability and legitimacy [14,41]. Under this socio–natural lens it is therefore apparent that if and when these hydro–social flows are altered or interrupted, the consequences go well beyond the so-called natural world.

Water is indeed deeply related to the everyday, and researchers have illuminated the economic, aesthetic, cultural and material value of water in the everyday life of ordinary people [53–55]. Yet, and we might add, surprisingly, while there is abundant research exploring the cultural, economic or geopolitical consequences of water scarcity, much less is known about the link between water availability and mental health, both at the national and at the community level. Research has more generally examined the interrelation between the environment and mental health [25,56], confirming that environmental degradation increases psychological distress [57–61]. Slow onset disasters such as drought have been found to have a positive correlation with increases in mental disorders such as depression and anxiety [22,23,25,26].

Dean and Stain [58], Berry et al. [57], Fritze et al. [62], Speldewinde et al. [25], Stain et al. [56] and Vins et al. [63] have identified the inter-related pathways leading to mental health disorders in cases of drought and environmental degradation as i) solastalgia, ii) financial pressures, and iii) changes in social networks. First, as mental health is linked to a people's sense of place [64] it is negatively affected by environmental degradation [65]. The relationship between mental health and environmental degradation is captured in the concept of 'solastalgia' developed by Albrecht [66,67], which relates to the distress or pain experienced by individuals that results from the degradation of their home environment. Even relatively small changes in the environment may result in depression, fear, anxiety, anger and sadness for people who have a close relationship with it. In the face of drought and degradation of their agricultural production systems, such feelings are often experienced by farmers, who are closely connected to their land for their livelihoods and lifestyles [59]. Second, environmental degradation, drought and limited access to irrigation water are connected to increased financial pressures for small

farmers, resulting from increased costs, decreased production and quality of crops, loss of livestock and increased debt [68]. Economic hardship is linked to increased psychological stress and sense of helplessness, as well as insecurity and social isolation, which are strongly related to depression [62,63]. With increased economic adversity out-migration from rural areas increases, and this affects social connectedness in the communities [58,68]. Third, changes in social networks and social exclusion, including the reduced access to services, can lead to symptoms of anxiety and depression [63]. Social capital is an important protective factor for mental health, and a decrease in critical social resources increases the incidence of depression and isolation. Additionally, people suffering mental health problems may experience depleted personal resources, something that decreases their ability to take part in adaptation activities [69]. In this article we argue that another mechanism impacting water users' mental health through the changes in community relations is the governmentalization of contested hydro–social territories. Territorial governmentalization impacts water users' behavior and sociality through the imposition of new vertical and alteration of the existing horizontal social relationships [13,52], inevitably affecting their psychological wellbeing.

Changes in the governance of water infrastructure may create further social, economic and political exclusion and marginalization of those users who lack the decision-making power in water governance and those who are, for economic or social reasons, unable to access water by officially recognized means, and thus depend on illegal irrigation practices. As we will illustrate in the following sections, interruptions of the hydro–social cycle have serious mental health impacts. Yet, before moving to the discussion, it is necessary to contextualize this research in the setting of the Lake Urmia in Iran. A multi-scalar analysis allows us to consider the state interventions on the national, basin and local levels and connect the dynamics of hydro–social territorial transformations and reconfigurations over various geographical scales.

3. The Desiccation of Lake Urmia

Lake Urmia, located in the North–West of Iran (Figure 1), used to be one of the largest hypersaline lakes in the world [70]. Over the last few decades the area of the lake started to decrease significantly [71–75], with researchers reporting an 88% reduction in the surface of the lake [35]. The overexploitation of water resources from the supplying rivers is largely believed to be the main reason for the desiccation of the lake [35,75,76]. As such, the current state of the lake can be attributed to the manifestation of different imaginaries, which have been playing out in the Lake Urmia basin since the 1960s, when first large dams and irrigation networks were built. Covering 3% of the area of Iran, but containing 7% of its water resources, the Lake Urmia basin has represented an important area for the country's modernization [77] with the focus of water management being the development of its agricultural potential. Since 1970, 56 dams have been built in the basin [78], mostly for providing water for the irrigation of agricultural land [79,80], the area of which has been sharply increasing during past decades [74,76,81]. Agriculture represents the largest burden on water resources in the basin, accounting for 94% of all water demands [77]. This increase in agricultural land is a manifestation of decades of policies that focused on agricultural development, which considered water a limitless resource. Pahlavi's Land Reform (1962–1971), implemented during the White Revolution, greatly contributed to changes in land use. To satisfy increasing water demands, pumping technologies were introduced to extract groundwater, and deep wells largely replaced the use of traditional qanats [82,83]. After the 1979 Islamic Revolution and during the war with Iraq (1980–1988), economic sanctions made food security one of the priority issues for the government, which also hoped to increase non-oil based revenues with the expansion of agricultural production. The area of agricultural land increased further and subsidies, including subsidies for agricultural water and energy use, were offered to farmers. Rapid development and modernization in the years after the Islamic Revolution, including a hydraulic mission with large-scale dam building, were the focus of the country's development decisions. Despite economic sanctions, Iran is today one of the top dam builders in the world, with such undertakings often overlooking the impact this has on the environment [82,83].

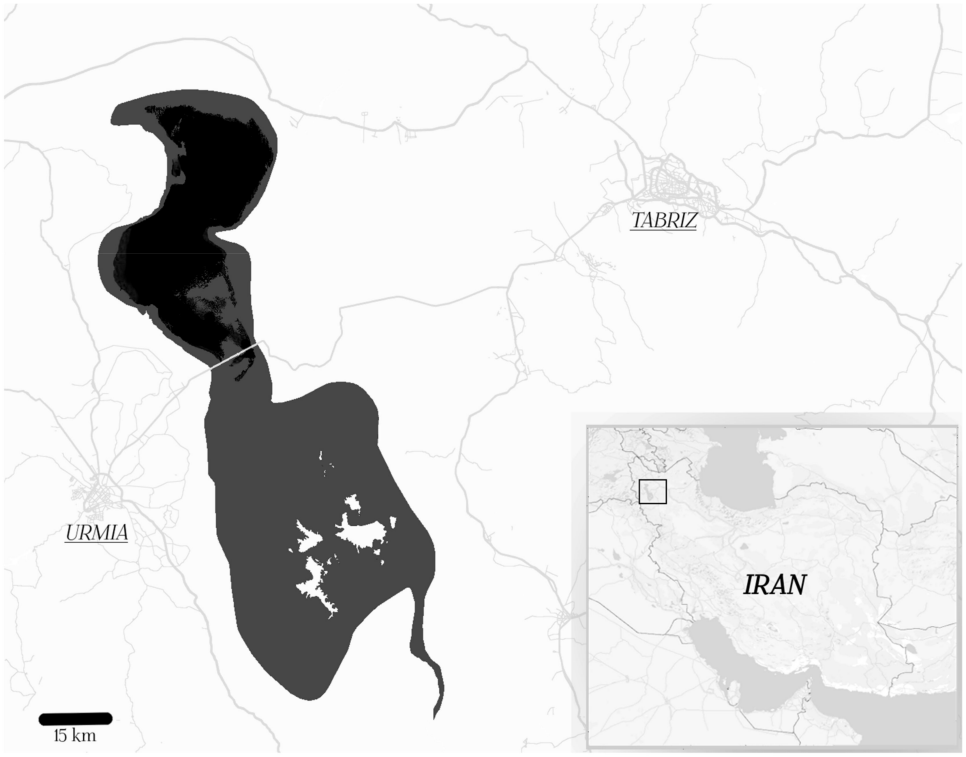

Figure 1. The location of Lake Urmia. The two outlines represent the area of the lake in 1995 (in grey) and in September 2015 (in black).

At the national level the key decision-maker for water allocation in Iran is the Ministry of Energy, which is responsible for the distribution of water to each sector and province of the country. The Ministry of Agricultural Jihad holds a significant influence over water allocation as well, due to agriculture being the largest water user in the country. While decisions on water allocation are made at the national level, at the provincial level regional water companies represent the Ministry of Energy. Conflict resolution for water allocation between the provinces is in the domain of the Water and Agricultural Commission and is later approved in the Provincial Planning Council [77]. As the Lake Urmia basin is divided between three provinces (West Azerbaijan, East Azerbaijan and Kurdistan), water management at the basin level becomes more challenging due to the administrative divisions and power disparities between the provinces competing for water [77,82,83]. Smaller dam projects are funded directly from the provincial budgets and many do not have water allocation permits, making control over water allocation difficult. Another factor further complicating effective water management is that most of the irrigation water is supplied by largely unregulated exploitation of groundwater in the basin [72,74,79,84]. Despite a legal Act from 1984 requiring all users to obtain a water allocation permit for the use of groundwater from private wells and qanats, most of them still operate without such permits. Unauthorized extractions of water from rivers are common as well [77].

Additional pressure on water resources is posed by rapid population growth and urbanization. Between the years 1976 and 2010 the population in the Lake Urmia basin increased by 121.5%. Tabriz, the capital of East Azerbaijan and the largest urban area in the Lake Urmia basin, receives its water supply from the Zarinarud dam in West Azerbaijan, with the water largely supplied from Kurdistan province [77]. Urban water needs have been prioritized ahead of those of the rural downstream population, which in turn suffers from substantial water shortages. Largescale water transfers implemented to meet urban water demands often come at the expense of surrounding rural areas [13,85,86], curtailing their water security.

The rapid desiccation of the lake raised the environmental awareness of the Iranian public and put pressure on the authorities to protect the lake from drying out. The attempts to do so resulted in

the Lake Urmia Restoration Program (2015), which aims to restore the ecological water level of the lake within 10 years, although such a goal is proving to be difficult to achieve [83]. The mechanisms of water consumption regulation that have been put in place have so far failed to sufficiently address the upstream water overuse. These mechanisms have instead put additional pressures on small farmers around the lake, who are now facing new obstacles in the already difficult access to irrigation and domestic water, which is causing significant psychological pressures, as will be discussed in the section after the methods.

4. Methods

This study was based on 96 semi-structured in-depth interviews conducted between June 2016 and August 2017 with farmers living and working in 21 villages and settlements within 10 kilometers of the Lake Urmia lakebed. The interviews were carried out with the help of an interpreter and aimed at understanding how the water shortage and the environmental degradation impacted the everyday lives of the respondents and their families. The list of covered topics was broad and divided into three groups; the first group of questions was focused on general information about the respondents, their household and the farm; the second group of questions explored the changes that the farm has experienced due to water shortage and the degradation of land; the last group of questions was aimed at understanding the economic and social changes experienced by the respondents, changes in workload, health and mental health, access to health services, and access to drinking water. The interviews were open-ended and when participants spontaneously mentioned additional topics they were encouraged to elaborate on them. Due to cultural constrains female respondents often wished to be interviewed together with male family members, and as most of the respondents approached while working in the fields were male, 29 (30%) of the respondents were female and 67 (70%) were male. The age distribution of the respondents is represented in Table 1. The interviews were coded and analyzed using Atlas.ti software (7.5.18, Scientific Software Development GmbH, Berlin, Germany).

Table 1. Age distribution of the respondents.

Age group	Number of respondents
16–20	6
21–30	20
31–40	21
41–50	19
51–60	14
61–70	8
71–80	7
81–90	1

5. Manufactured Water Scarcity and Pathways to Mental Health Disorders

Water flows are not only a physical phenomenon that can be altered and managed by humans, but they also constitute and shape social relations [9,87,88]. Therefore, any alterations of water flows inevitably affect the social linkages and by extension the psychological wellbeing of water users. Decisions on water distribution are usually made on a state level and may create territories of water abundance and scarcity. Territorialized water scarcity often results from agricultural development, state regulations and social relations [10] and it has indeed been recognized that water crises are produced by poor water management rather than physical water scarcity in a given territory [5,89]. The governmentalization of the hydro–social territory in the Lake Urmia basin through aggressive agricultural policies and investments into hydraulic infrastructure in the upstream areas, driven by the discourse of economic development, control over drought conditions, production of clean

hydropower energy and achieving food self-sufficiency [77], resulted in territorialized water scarcity in the downstream areas and a severe degradation of the environment. When the tragedy of Lake Urmia could no longer be ignored by the authorities, the narrative of climate change-induced drought became increasingly present in the government's and water authorities' discourses to justify the implementation of water saving measures in the basin. The conflicting nature of governance interests regarding water management is evident from the continuously expanding agricultural sector and increasing area of irrigated lands and water consumption in the upstream areas [90], while access to water for the downstream population is increasingly restricted by the water authorities. Downstream farmers, who were already facing severe water scarcity, were thus those most affected by these water conservation measures. Based on the interviews carried out with the rural downstream population, the degradation of the lake and the surrounding areas severely impacted their psychological wellbeing. Communities who rely on local ecosystems for their livelihoods are especially vulnerable to mental health impacts caused by their degradation [61]. Through an analysis of our data, we identified four main pathways that led to negative mental health impacts for the respondents: i) degradation of land and solastalgia; ii) changes in social networks and the governmentalization of local irrigation infrastructure; iii) increased financial pressures; and iv) impacts on physical health, as demonstrated in Figure 2. This corroborates research done on impacts of environmental degradation on mental health in other geographical areas [25,61,67,68,91].

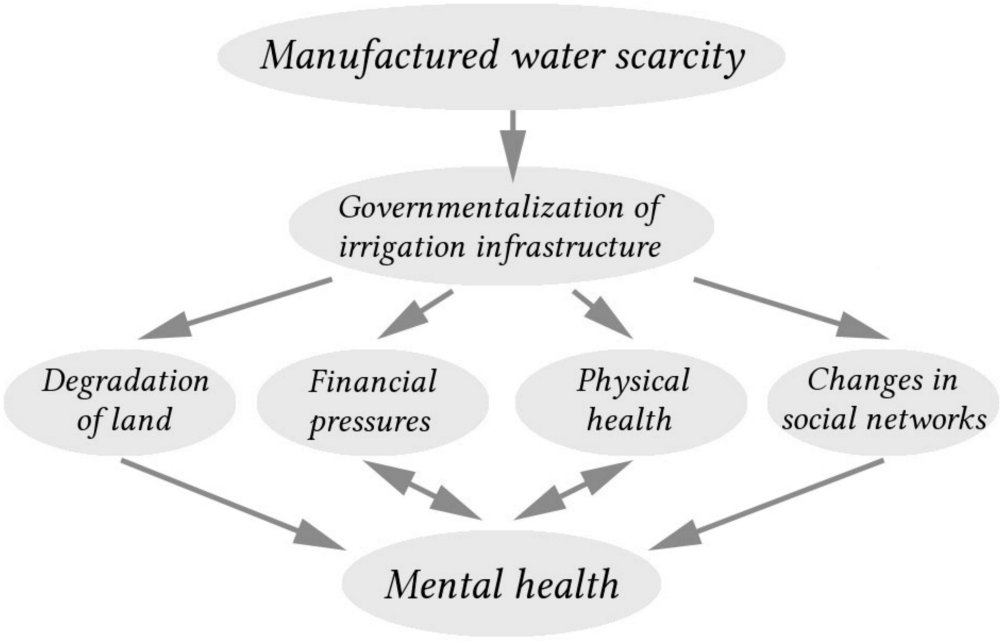

Figure 2. Manufactured water scarcity and the pathways to mental health impacts.

5.1. Degradation of Land and Solastalgia

It has been recognized that people may form strong psychological connections with their local environment, which plays an important part in their sense of belonging, identity, security and offers emotional solace [59,66]. Environmental change may therefore produce place-based distress in people who feel powerless in the face of the change unfolding in their home environment [67]. This change can lead to feelings of loss, trauma, depression, and anxiety. Such feelings are experienced with particular severity by those who retain a close relationship with land for their cultural, working or personal life. Hanigan et al. [23] have for example found a clear link between drought and an increase in suicide among farmers and farm workers in Australia. In the context of the Lake Urmia basin, the reconstruction of the hydro–social territory by the upstream water overuse resulted in the diminished supply of water to the lake and the surrounding downstream areas. This led to

drastic change in the environment, such as drying of the rivers, lowering levels and salinization of underground water, drying of vegetation and desertification of land, the desiccation of Lake Urmia and the resulting occurrence of sand and salt storms that carry particles from the exposed lakebed to the surrounding areas. As a result, the inhabitants are exposed to chronic environmental stressors that lead to the experience of solastalgia. Because of a strong attachment of farmers to their land, their occupation merges with their identity, and so farmers often perceive the degradation of their home environment not only as a threat to their subsistence, but also to their self-identity [58,59]. This sentiment was described by one of the respondents:

> "I have lived here my whole life. My parents were farmers, later my wife and I took over the farm and raised our children here. We have always lived off the land and we had good lives. Then the lake started disappearing and all the vegetation dried, even the trees started to die. I look around me and all our land that used to be so green and fertile is burnt. It breaks my heart."
>
> (Male, 81)

The mental burden of environmental change and the disruption of agricultural production system was experienced and reported by all of the respondents. It was often connected to the loss of a sense of place, loss of security and loss of emotional solace. The state of the environment was commonly mentioned in connection to their own wellbeing. The majority of interviewed farmers depended solely on income from farming and felt a strong connection to their farmland, as evident from the following quote by one of the farmers:

> "The economy collapsed and the green meadows and gardens turned into deserts. It makes me so sad to look at this place and remember how beautiful it used to be. I know that there is no future here, but I have farmed and lived here all my life and I will stay for as long as I can."
>
> (Male, 45)

Their strong bond with nature was frequently expressed by farmers using the expression that the plants are dying ("mordan" in Farsi), rather than drying ("khoshk shodan" in Farsi). This was expressed by one of the female farmers, along with the feelings of hopelessness:

> "I have been farming and living on this land for 50 years. For the past years I had been telling myself that the next year will be better. But now even the trees are dying, there is no water, just dust and salt. And now I know that I will die before it gets better."
>
> (Female, 50)

Avoidance behaviors, such as shutting the curtains and spending more time indoors so they would not see their destroyed farmland were also frequently described by the respondents. A female farmer reported it along with the symptoms of depression experienced by her husband:

> "All our vegetables have dried this year. We worked so hard for nothing. My husband has no motivation to come out of the house anymore. He stayed in the house for two months because he did not want to come out to see his fields destroyed by the drought and the winds."
>
> (Female 42)

Feelings of sadness, despair and a sense of hopelessness were commonly mentioned by the respondents in relation to the degradation of their home environment. There are clear links between hopelessness and depression, as well as other mental health problems [68], which might result in an increased risk of suicide [23].

It is therefore apparent that the alterations of water flows can produce a myriad of impacts for marginalized water users. Water has many dimensions, and people shape their identity, livelihoods,

culture and social order around it [13,42,52]. As such, when their access to water is altered, it can profoundly impact the psychological wellbeing of water users, challenging their livelihoods, identity and rituals, all of which increases their risk of developing mental health disorders.

5.2. Changes in Social Networks and the Governmentalization of Local Irrigation Infrastructure

With the increasing pressure on the government to take action and save Lake Urmia from dying, the role of the governmental institutions in water management on a local level increased. The urgency of saving Lake Urmia became a dominant discourse of the governmental institutions and media in the area, disregarding competing claims for scarce water resources by the small farmers living in the proximity of the lake. High upstream and urban demand for water in the basin which had produced and continues to maintain territorialized water scarcity in the downstream areas was not sufficiently addressed, and so the burden of saving scarce water resources for restoring Lake Urmia is disproportionately carried by the downstream farmers. The governmentalization of the local hydro–social territory in the villages encompassed in the study was articulated through the discourses of adaptation to climate change and restoring the lake, and was materialized through legal and administrative procedures and infrastructural projects. The hydro–social reconfigurations were portrayed as efficient and necessary for the restoration of the lake, and for the benefit and in the best interests of both the environment and the population of the basin, while discrediting competing claims for access to water by local small farmers. The use of such discourses of rationality and efficiency is common in the process of commoditization of water resources [42,48]. The imposition of water regulation in the study area included the construction of irrigation canals and in some villages the introduction of fees for the use of irrigation water, which is supplied from the dams and regulated by the water authorities.

The control of previously largely unregulated extractions of water from the rivers and from illegal wells increased, with such users facing fines and closure of their wells. A stricter application of the 1982 legal Act was undertaken, with it requiring users to obtain a water allocation permit for the use of groundwater from private wells and qanats. As obtaining such a permit and paying for water from irrigation canals represents a significant financial burden which many farmers are unable to afford, an informal and illegal hydro–social territory coexists alongside the official one. It is in part tolerated by the state due to its inability to provide irrigation and domestic water supply to all of the studied villages and settlements. As such, users with only one illegal well were reportedly not sanctioned; however, those without official water allocation permits are not allowed to take part in the governmental and non-governmental projects aimed at mitigating the impacts of water shortage on farmers, which creates a further social and economic exclusion of farmers relying on the illegal water infrastructure. Access to water is therefore characterized by the intertwinement of official and informal practices and norms, as has been observed in other geographical locations [13,14,41].

The increased state control of the irrigation infrastructure reconfigured the hydro–social territory and altered socio-political relations in the area. It is considered that a degree of tolerance towards illegal water extraction practices also serves as means to control the population, as the fear of fines and possible loss of illegal sources of water are seen as the reasons why no collective resistance against the control of water resources by the state was observed in any of the studied villages. This link between the reliance on illegal water sources and chronic psychological stress and anxiety among the respondents was described by one of the female farmers:

> "The canal was built by the officials and the water from it is shared between twenty to thirty farms, but it is almost always empty. We would have to pay to use the water according to the size of our land, but we cannot afford it, so we rely on two wells for irrigation [. . .]. But God forbid they [the officials] find out that we have two wells. If they close them, we will be left completely without water and what would we do then? We have always been farmers and it is the only thing we know."
>
> (Female, 50)

The unreliability of the water supply from the irrigation canals, as described by the respondent in the quote above, was observed in all of the studied villages with formal irrigation networks. The responsible institutions were providing irrigation water from the dams twice or less per month in insufficient quantities for all of the farms. In some of the villages the distribution of irrigation water from the state-built canals was not officially managed, which created competition and conflicts for water between the farmers and led to the creation of hydro–social hierarchy within the villages. Official irrigation infrastructures reconfigured social relationships and altered the behavior of water users and their identification with the community, something that has also been observed in the case of increased state control of water territories in other geographical settings [52]. As King et al. [92] note, access to water can differ significantly even within small communities. In the studied case informal networks of villagers with higher political power or political connections were formed to benefit the most from governmental water infrastructure, excluding those with less social and political power and those with illegal water infrastructure. Due to the fear of being reported to the authorities for the use of illegal sources of water, the existence of such networks was in most cases unchallenged by the marginalized water users. Feelings of injustice and social isolation, however, were commonly reported by the respondents as demonstrated by the following quote by a young male farmer:

> "When we still had enough water, all the farmers in the village were in good relations and would help one another. But now there is a lot of competition for water when there is some in the canal. More powerful farmers use all the water and the others have to depend on the rain. We have illegal wells and if we tried to use some water from the canal, someone would surely report us."
>
> (Male, 25)

The link between water shortage and increasing social isolation was further explored by one of the female farmers:

> "There is so little water in the canal that it never reaches our farm, the bigger farmers use all of it. There is a lot of competition and conflicts for water in the village. Before all the women would work together and we would chat and share our worries, but now we don't socialize anymore. We all keep to ourselves."
>
> (Female, 50)

Disruptions in social relations and loss of social capital are connected with an increased social isolation, depression and anxiety. The disputes and competition over water resources in the previously close-knit communities with a strong sense of belonging, reportedly resulted in reduced social interactions between farmers. Arguments and competition within the communities increased the psychological stress of individuals and the respondents often mentioned feelings of loneliness and sadness. Another factor impacting social cohesion and social structure is the out-migration from the study area, which has been reported in all of the studied villages, corroborating the findings from a previous study [93]. The official data from the Statistical Center of Iran shows as much as a 31% decrease of the population for those studied villages with official population data; however, the rates observed and reported by the respondents are much higher and in some of the villages only a few households remained inhabited. The out-migration was reportedly the result of increasingly difficult financial conditions, lack of employment opportunities and lack of access to water. For the remaining villagers this increased the sense of hopelessness and many described feeling trapped because of a lack of financial resources or urban social networks that would enable them to out-migrate as well. This sentiment was described by one of the young farmers:

> "There is a lot of depression and helplessness in the village. We have no income and live in poverty. I go out of the house and the village is almost empty as everyone who was able to move away has indeed left. There are no young people I could talk to or share my problems with."
>
> (Male, 28)

Out-migration from communities suffering drought and a depleted economy reduces the support systems, services and social resources of the population that remains [63]. It also alters their family and community structures. It negatively affects the psychological wellbeing of both those who leave and those who stay behind, with frequently reported symptoms of anxiety and depression among both groups [68]. While out-migration can positively impact the family level income through remittances of family members who out-migrate, it also shrinks the economy on a community level through the loss of a productive workforce and a reduced economic activity resulting from fewer economic interactions. Financial pressures further negatively impact the mental health of individuals.

5.3. Financial Pressures

The reconstructions of hydro–social territories for the benefit of some groups of people may result in the marginalization of others [48]. A socio-economically disadvantaged population has an increased risk of developing mental health problems due to higher exposure to psychosocial risk factors such as stress, social isolation, economic insecurity, reduced personal autonomy and negative self-perception [62]. Water scarcity in the study area and the degradation of agricultural land resulted in a substantial decline in income reported by all of the respondents. While 18 (19%) of the respondents found additional sources of income, mostly as day laborers or in the service sector, a vast majority depended solely on income from farming. Decreased quantity and quality of the irrigation water combined with salt and sand storms led to increased crop failure and higher expenses for fertilizers and pesticides, which left many farmers with increasing debt. This caused chronic stress, anxiety, depression and feelings of helplessness among the respondents. The unpredictability of income was the cause of significant concern for the respondents. One of the farmers reported:

> "I am afraid to sow in the spring, because I never know if there will be enough water for anything to grow. We have been growing the same crops since I can remember, but in the past years we got less than a quarter of the produce than we used to because of the lack of water, and even the quality of that has decreased. This field used to support seven people, but now the three of us can hardly survive with the income from it. Four family members had to move away to search for jobs in town, because life became too hard here. There is no future here."
>
> (Female, 67)

The contested discourse that climate change, rather than anthropogenic actions in the basin, is the main cause for the degradation of Lake Urmia and the surrounding areas, was adopted by some of the respondents. This discourse, used by the government, local authorities, and water companies [35,76,77,82], claims that regulating water consumption in the local hydro–social territory is the most efficient and rational way of restoring the lake. Discourses are important elements of the governmentalization of hydro–social territories [14,40,42] as means of creating specific truths, knowledge systems and forms of consciousness that are adopted by the water users, to align them to the dominant hierarchic system by altering their world views, beliefs, identification with the community, as well as their social relations and behavior [13]. It is interesting to note that the discourse of climate change has been used by the authorities both to justify the investments into hydraulic infrastructure as an adaptation policy to climate change, as well as to explain the cause for the degradation of the downstream areas [77], which is in fact primarily the result of poor water management decisions [82,90]. Presenting a disaster as the result of natural processes and climate change shifts the focus from the preventable internal causes to inevitable natural causes and to the international actors responsible for anthropogenic climate change. While the response to a natural disaster can be limited to relief measures, the response to a natural hazard turning into a disaster due to socio-political and economic factors requires deeper structural changes in the society [94] to address the underlying causes of inequality, which makes some groups within a society more vulnerable to natural hazards than others [95,96]. We believe that the use of the discourse of climate change as the main factor in the degradation of

Lake Urmia serves to shift the responsibility for the disaster from the governmental decisions on water use to unavoidable natural agency. This determined the response to the tragedy and instead of addressing the degradation of the lake as a symptom of unsustainable water use which should be tackled with profound changes in the water management on a national level, the response measures are so far limited to mitigating the impacts of the land degradation on local farmers and regulating water use in the proximity of the lake, while the water overuse on a basin level remains insufficiently addressed [78]. The dominant groups in the Lake Urmia basin justify and legitimize the materialization of the dominant hydro–social imaginaries by adopting the dominant discourse that the increasingly difficult life conditions and loss of livelihood are the result of climate change, and that there is nothing to be done to improve the situation. The sense of helplessness and depression increased among some of the respondents, as can be observed in a quote from one of the farmers whose village had no irrigation networks and the water in the wells was too salty to be used for irrigation or domestic purposes:

> "The lake and the rivers have dried because of climate change. There is nothing the government can do about it. And there is nothing we can do to save our crops and our source of income. If there is no water, all we can do is sit and watch them dry. It is unbearable."
>
> (Male, 47)

A similar sentiment was described by another farmer:

> "There is no more water in the rivers and wells because of climate change and so we depend on the rain. We used to have fish farms for additional income, but of course there is no water for them anymore. This field is our only source of income now, but there is no rain and the wells are empty. There is nothing I can do but watch the crops dry."
>
> (Male, 35)

Such feelings of powerlessness, hopelessness and lack of control over the course of one's life increase psychological distress and can lead to depression and anxiety.

5.4. Physical Health

Some previous studies have suggested that the degradation of Lake Urmia is likely to cause various health impacts on the local population [76,81,97,98]; however, to the best of our knowledge no comprehensive study on health impacts of the degradation of the lake has so far been done. Changes in hydro–social territories result in alterations in access to resources for different communities, and many studies have considered access to safe drinking water [10,37,40,88], which is one of the major public health and well-being concerns [99–101]. There are multifaceted interactions between physical and mental health, and it has been recognized that physical health conditions increase the risk of developing mental health disorders, with the reverse process also occurring. Such comorbidity negatively impacts the ability of individuals to use health services and to receive correct diagnosis and treatment [102].

In the studied area, the respondents considered the diminished access to safe drinking water and the occurrence of salt storms as the main threats to their physical health. Those factors cause serious health concerns for the local population, as stated by one of the respondents:

> "We get water from another village that has a pipeline for drinking water, but the taste of the water has changed over the years. I store it in a reservoir and after a while I noticed that there are a lot of sediments that are deposited at the bottom of the reservoir. Many people got kidney stones and cancer in the past years and I think it is from the water that we drink, but we have no alternative. I am afraid to drink this water and I worry about me and my family getting sick from it, but there is nothing we can do."
>
> (Male, 45)

Respondents most often reported the increased rate of different types of cancer, kidney stones, respiratory problems such as asthma and problems with eyes, with the latter two resulting from the

salt storms. Those physical health problems experienced by the respondents or their family members were often mentioned to be a cause of concern, chronic stress and depression.

> "Everyone in this village is sick now, the young and the old. We call it 'the lake disease'. When a salt storm comes we cannot see anything, our eyes become sore and it is hard to breathe. We have to hide inside. The salt does not affect only the respiratory system, all the vegetables and the fruits that we eat make us sick. All the food is poisoned by the lake. There is a lot of cancer in the village. My wife is sick, and lately I have started to wake up at night and cough and I cannot breathe. Then I lie awake and I worry about my wife and about getting sick myself, because I need to take care of her and work in the fields."
>
> (Male, 42)

The described health and mental health problems were reportedly rarely addressed due to the lack of financial means and health facilities in the area.

Despite neuropsychiatric disorders contributing a significant percentage of the global burden of disease [33], mental health is a low priority in most countries. Mental health disorders contribute to mortality and affect the rate of other health conditions, as well as severely impact the quality of life for those suffering from them [102]. There is evidence associating environmental degradation with increases in mental health disorders [22,23,25,26,61]. Most of the environmental degradation caused by climate change and human development is occurring and expected to further intensify in low-income countries [103], which have low investments in mental health care [102], contributing to the urgency of the problem.

Due to expected increases in relative water demand and absolute water scarcity in many parts of the world, substantial challenges to water infrastructure and water supply are expected to occur [2], which will reconfigure hydro–social territories and may increase the incidence of mental health disorders.

6. Conclusions

In this work we explored how and through which pathways the reconstruction of the hydro–social territory in the Lake Urmia basin impacted the mental health of marginalized water users. This study provides an example of how alterations of water flows as manifestations of politics focused on economic growth—without considering the cost to the environment and water needs of all—may lead to territorialized water scarcity and marginalization of some water users, which can severely impact their mental health. The governmentalization of the hydro–social territory in the studied basin during the last decades was driven by strong discourses of economic development, adaptation to climate change, production of clean hydropower and achievement of food self-sufficiency. This enabled large scale investments into hydraulic infrastructure and the expansion of irrigated agriculture in the basin, as well as water transfers from rural to urban areas, thus prioritizing urban water needs before those of the rural population. The created territorialized water scarcity in the downstream areas resulted in a severe degradation of the environment, including the desiccation of once the second-largest hypersaline lake in the world, as well as profound economic and social changes for the population in the area. When the tragedy of the lake could no longer be ignored by the authorities, the role of governmental institutions in water management increased, which further reconfigured the local hydro–social territory. The discourse of climate change was widely used by the government to avoid the responsibility for the desiccation of the lake, and shift the attention to the inevitable natural causes. Justified through the discourse of environmental conservation and restoration of Lake Urmia, as well as adaptation to climate change, a regulation of irrigation water and the charging of fees for its use was introduced in some of the studied villages. Additionally, the control of illegal extractions of water from rivers and wells increased with such users facing financial penalties. As all water users cannot access water through legal means, an illegal hydro–social territory coexists with the legally recognized one. Reconfiguration and governmentalization of hydro–social territories create new hierarchical relationships between water governors and water users, and disrupt the

relationships between the water users themselves, changing their very identity, sociality, worldviews and behavior [13,48,52,86]. As has been shown, all of these changes are closely linked to the mental health of water users. This article therefore contributes to the literature on hydro–social territories by adding another important dimension to the studies of the hydro–social interruptions, namely the mental health and the psychological wellbeing of water users. Mental health is an integral component of health and should be considered when assessing impacts of hydro–social alterations.

The concepts of hydro–social territory and waterscape allow us to view the Lake Urmia disaster through the lens of water dynamics in relation to social and political conditions. The hydro–social alterations in the studied territory greatly impacted the natural, economic and socio-political order of the local rural population. The study area is populated mainly by small farmers, most of whom depend on farming as their only economic activity, and form strong connections with their environment. As a result of water scarcity their home environment was degraded, which led to the experiences of psychological distress, loss of emotional solace and feelings of helplessness. Additionally, they experienced significant decreases in income, increased competition over scarce water resources, and physical health problems resulting from decreased quality of drinking water and the occurrence of salt storms. Those four factors, namely the degradation of environment, social changes, economic hardship and physical health problems were identified as the interrelated pathways that led to the mental health problems among the respondents. The most often reported mental health impacts were chronic psychological stress, social isolation, intra-community conflicts, despair, feelings of sadness and hopelessness, and symptoms of depression and anxiety. While it has been shown in other studies that different subgroups within a society might be differentially affected by the factors leading to mental health impacts [23,91,104], this has not been studied in the present research due to a limited number of respondents of different subgroups.

Understanding the inter-related pathways through which territorialized water scarcity impacts the mental health of the affected population may not only help recognize the most vulnerable groups of people and improve their access to mental health services, but may primarily serve to address the underlying causes of their mental health problems. Many of these are not solely the results of the impacts of physical water scarcity, but of policies and development plans that increase inequality among water users and solidify exclusion and marginalization of some groups, who become more vulnerable to mental health disorders. Mental health impacts should therefore be separately assessed before the implementation of hydraulic infrastructure developments, rather than being assessed among other health impacts, and therefore often neglected. In the allocation of funding, issues relating to mental health should be among the deciding criteria for funding agencies. With mental health disorders already representing a significant portion of the global burden of disease [21] and severely impacting the well-being of the affected individuals, prevention of mental health problems is one of the most important ways of decreasing this burden [105].

Author Contributions: Conceptualization, Maja Ženko and Filippo Menga; writing—original draft preparation, Maja Ženko and Filippo Menga; writing—review and editing, Maja Ženko and Filippo Menga.

Funding: This research was conducted with the support of the Secretariat of Universities and Research, Ministry of Economy and Knowledge, Government of Catalonia (AGAUR-FI grant).

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Kummu, M.; Guillaume, J.H.A.; de Moel, H.; Eisner, S.; Flörke, M.; Porkka, M.; Siebert, S.; Veldkamp, T.I.E.; Ward, P.J. The world's road to water scarcity: Shortage and stress in the 20th century and pathways towards sustainability. *Sci. Rep.* **2016**, *6*, 38495. [CrossRef]
2. Vörösmarty, C.J.; Green, P.; Salisbury, J.; Lammers, R.B. Global Water Resources: Vulnerability from Climate Change and Population Growth. *Science* **2000**, *289*, 284–288. [CrossRef]
3. World Economic Forum. *Global Risks 2015*, 10th ed.; World Economic Forum: Geneva, Switzerland, 2015.

4. Mekonnen, M.M.; Hoekstra, A.Y. Four billion people facing severe water scarcity. *Sci. Adv.* **2016**, *2*, e1500323. [CrossRef] [PubMed]
5. WWAP (United Nations World Water Assessment Programme). *The United Nations World Water Development Report 2018: Nature-Based Solutions*; UNESCO: Paris, France, 2018.
6. Menga, F.; Swyngedouw, E. *Water, Technology and the Nation-State*; Routledge: Abingdon, UK, 2018.
7. Bakker, K. Archipelagos and networks: Urbanization and water privatization in the South. *Geogr. J.* **2003**, *169*, 328–341. [CrossRef]
8. Budds, J. Whose scarcity? The hydrosocial cycle and the changing waterscape of La Ligua River Basin, Chile. In *Contentious Geographies: Environmental Knowledge, Meaning, Scale*; Goodman, M.K., Boykoff, M.T., Evered, K.T., Eds.; Ashgate Publishing Limited: Aldershot, UK, 2008; pp. 59–68.
9. Budds, J.; Hinojosa, L. Restructuring and Rescaling Water Governance in Mining Context: The Co-Prodution of Waterscapes in Peru. *Water Altern.* **2012**, *5*, 119–137.
10. Ioris, A.A. Water scarcity and the exclusionary city: The struggle for water justice in Lima, Peru. *Water Int.* **2016**, *41*, 125–139. [CrossRef]
11. Kooy, M. Developing informality: The production of Jakarta's urban waterscape. *Water Altern.* **2014**, *7*, 35–48.
12. Swyngedouw, E. Modernity and Hybridity: Nature, Regeneracionismo, and the Production of the Spanish Waterscape, 1890–1930. *Ann. Am. Assoc. Geogr.* **1999**, *89*, 443–465. [CrossRef]
13. Boelens, R.; Hoogesteger, J.; Swyngedouw, E.; Vos, J.; Wester, P. Hydrosocial territories: A political ecology perspective. *Water Int.* **2016**, *41*. [CrossRef]
14. Hoogesteger, J.; Boelens, R.; Baud, M. Territorial pluralism: Water users' multi-scalar struggles agains state ordering in Ecuador's highlands. *Water Int.* **2016**, *41*, 91–106. [CrossRef]
15. Zwarteveen, M.Z.; Boelens, R. Defining, researching and struggling for water justice: Some conceptual building blocks for research and action. *Water Int.* **2014**, *39*, 143–158. [CrossRef]
16. McCully, P. *Silenced Rivers: The Ecology and Politics of Large Dams*; Enlarged and Updated Edition; Zed Books Ltd.: London, UK, 2001.
17. World Commission on Dams (WCD). *Dams and Development. A New Framework for Decision-Making*; The Report of the World Commission on Dams; Earthscan Publications Ltd.: London, UK, 2000.
18. Obertreis, J.; Moss, T.; Mollinga, P.; Bichsel, C. Water, infrastructure and political rule: Introduction to the Special Issue. *Water Altern.* **2016**, *9*, 168–181.
19. Linton, J. Modern water and its discontents: A history of hydrosocial renewal. *Wiley Interdiscip. Rev. Water* **2014**, *1*, 111–120. [CrossRef]
20. Menga, F. Hydropolis: Reinterpreting the polis in water politics. *Polit. Geogr.* **2017**, *60*, 100–109. [CrossRef]
21. World Health Organization (WHO). Mental Health: A State of Well-Being. 2014. Available online: http://www.who.int/features/factfiles/mental_health/en/ (accessed on 1 October 2018).
22. Coelho, A.E.L.; Adair, J.G.; Mocellin, J.S.P. Psychological responses to drought in northeastern Brazil. *Rev. Interam. Psicol.* **2004**, *38*, 95–103.
23. Hanigan, I.C.; Butler, C.D.; Kokic, P.N.; Hutchinson, M.F. Suicide and drought in New South Wales, Australia, 1970–2007. *Proc. Natl. Acad. Sci. USA* **2012**, *109*, 13950–13955. [CrossRef] [PubMed]
24. Hayes, K.; Blashki, G.; Wiseman, J.; Bruke, S.; Reifels, L. Climate change and mental health: Risks, impacts and priority actions. *Int. J. Ment. Health. Syst.* **2018**, *12*, 28. [CrossRef]
25. Speldewinde, P.C.; Cook, A.; Davies, P.; Weinstein, P. A relationship between environmental degradation and mental health in rural Western Australia. *Health Place* **2009**, *15*, 880–887. [CrossRef]
26. Van Haaften, E.; Van de Vijver, F.J.R. Psychological consequences of Environmental Degradation. *J. Health Psychol.* **1996**, *1*, 411–429. [CrossRef] [PubMed]
27. Willox, A.C.; Stephenson, E.; Allen, J.; Bourque, F.; Drossos, A.; Elgarøy, S.; Kral, M.J.; Mauro, I.; Moses, J.; Pearce, T.; et al. Examining relationship between climate change and mental health in Circumpolar North. *Reg. Environ. Chang.* **2015**, *15*, 169–182. [CrossRef]
28. World Health Organization (WHO). *Progress on Sanitation and Drinking Water—2015 Update and MDG Assessment*; UNICEF and WHO; WHO Press: Geneva, Switzerland, 2015.
29. UNDP. *Beyond Scarcity: Power, Poverty and the Global Water Crisis*; Human Development Report 2006; United Nations Development Programme: New York, NY, USA, 2006.

30. Franco, J.; Mehta, L.; Veldwisch, G.J. The global politics of water grabbing. *Third World Q.* **2013**, *34*, 1651–1675. [CrossRef]
31. WWAP (United Nations World Water Assessment Programme). *The United Nations World Water Development Report 2015: Water for a Sustainable World*; UNESCO: Paris, France, 2015.
32. World Health Organization (WHO). *Mental Health and Development: Targeting People with Mental Health Conditions as a Vulnerable Group*; WHO Press: Geneva, Switzerland, 2010.
33. Vigo, D.; Thornicroft, G.; Atun, R. Estimating the true global burden of mental illness. *Lancet Psychiat.* **2016**, *3*, 171–178. [CrossRef]
34. Tomilson, M.; Lund, C. Why does Mental health not get the attention it deserves? An application of the Shiffman and Smith Framework. *PLoS Med.* **2012**, *9*, e1001178.
35. AghaKouchak, A.; Norouzi, H.; Madani, K.; Mirchi, A.; Azarderakhsh, M.; Nazemi, A.; Nasrollahi, N.; Farahmand, A.; Mehran, A.; Hasanzadeh, E. Aral Sea syndrome desiccates Lake Urmia: Call for action. *J. Great Lakes Res.* **2015**, *41*, 307–311. [CrossRef]
36. Bakker, K.J. *Privatizing Water: Governance Failure and the World's Urban Water Crisis*; Cornell University Press: New York, NY, USA, 2010.
37. Loftus, A. Working the Socio-Natural Relations of the Urban Waterscape in South Africa. *Int. J. Urban Reg. Res.* **2007**, *31*, 41–59. [CrossRef]
38. Sultana, F. Suffering for water, suffering from water: Emotional geographies of resource access, control and conflict. *Geoforum* **2011**, *42*, 163–172. [CrossRef]
39. Hommes, L.; Boelens, R.; Maat, H. Contested hydrosocial territories and disputed water governance: Struggles and competing claims over the Ilisu Dam development in southeastern Turkey. *Geoforum* **2016**, *71*, 9–20. [CrossRef]
40. Hommes, L.; Boelens, R.; Duarte Abadía, B.; Hidalgo-Bastidas, J.P.; Hoogesteger, J. Reconfiguration of hydrosocial territories and struggles for water justice. In *Water Justice*; Boelens, R., Perreault, T., Vos, J., Eds.; Cambridge University Press: Cambridge, UK, 2018; pp. 151–168.
41. Dajani, M.; Mason, M. Counter-infrastructure as resistance in the hydrosocial territory of the occupied Golan Heights. In *Water, Technology and the Nation-State. Menga, F., Swyngedouw, E., Eds.*; Routledge Earthscan: Abingdon, UK, 2018; pp. 131–146.
42. Duarte-Abadía, B.; Boelens, R. Disputes over territorial boundaries and diverging valuation languages: The Santurban hydrosocial highlands territory in Colombia. *Water Int.* **2016**, *41*, 15–36. [CrossRef]
43. Boelens, R.; Shah, E.; Bruins, B. Contested Knowledges: Large dams and mega-hydraulic development. *Water* **2019**, *11*, 416. [CrossRef]
44. Fox, C.A.; Sneddon, C.S. Political borders, epistemological boundaries, and contested knowledges: Constructing dams and narratives in the Mekong River basin. *Water* **2019**, *11*, 413. [CrossRef]
45. Swyngedouw, E. *Liquid Power: Contested Hydro-Modernities in Twentieth-Century Spain*; MIT Press: Cambridge, MA, USA, 2015.
46. Linton, J.; Delay, E. Death by certainty: The Vinça dam, the French state, and the changing social relations of irrigation the Têt basin of the Eastern French Pyrénées. In *Water, Techonology and the Nation-State*; Menga, F., Swyngedouw, E., Eds.; Routledge Earthscan: Abingdon, UK, 2018; pp. 49–64.
47. Rodríguez-de-Francisco, J.; Boelens, R. PES hydrosocial territories: De-territorialization and re-pattering of water control arenas in the Andean highlands. *Water Int.* **2016**, *41*, 140–156. [CrossRef]
48. Swyngedouw, E.; Boelens, R. " ... And not a Single Injustice Remains": Hydro-Territorial Colonization and Techno-Political Transformations in Spain. In *Water Justice*; Boelens, R., Perreault, T., Vos, J., Eds.; Cambridge University Press: Cambridge, UK, 2018; pp. 115–133.
49. Seeman, M. Inclusive recognition politics and the struggle over hydrosocial territories in two Bolivian highland communities. *Water Int.* **2016**, *41*, 157–172. [CrossRef]
50. Boelens, R. Cultural politics and hydrosocial cycle: Water, power and identity in the Andean highlands. *Goeforum* **2014**, *57*, 234–247. [CrossRef]
51. Rogers, S.; Barnett, J.; Webber, M.; Finlayson, B.; Wang, M. Governmentality and the conduct of water: China's South-North Water Transfer Project. *Trans. Inst. Br. Geogr.* **2016**, *41*, 429–441. [CrossRef]
52. Perramond, E.P. Adjudicating hydrosocial territory in New Mexico. *Water Int.* **2016**, *41*, 173–188. [CrossRef]
53. Allon, F.; Sofoulis, Z. Everyday water: Cultures in transition. *Aust. Geogr.* **2006**, *37*, 45–55. [CrossRef]

54. Browne, A.L.; Pullinger, M.; Medd, W.; Anderson, B. Patterns of practice: A reflection on the development of quantitative/mixed methodologies capturing everyday life related to water consumption in the UK. *Int. J. Soc. Res. Method* **2014**, *17*, 27–43. [CrossRef]
55. Sofoulis, Z. Big water, everyday water: A sociotechnical perspective. *Continuum* **2005**, *19*, 445–463. [CrossRef]
56. Stain, H.J.; Kelly, B.; Carr, V.J.; Lewin, T.J.; Fitzgerald, M.; Fragar, L. The psychological impact of chronic environmental adversity: Responding to prolonged drought. *Soc. Sci. Med.* **2011**, *73*, 1593–1599. [CrossRef]
57. Berry, H.L.; George, E.; Rodgers, B.; Butterworth, P.; Caldwell, T.M. *Intergenerational Transmission of Reliance on Income Support: Psychosocial Factors and Their Measurement*; Department of Families Community Services and Indigenous Affairs (FaCSIA), Social Policy Research Paper No. 31; Commonwealth Government: Canberra, Australia, 2007.
58. Dean, J.G.; Stain, H.J. Mental health impacts for adolescents living with prolonged drought. *Aust. J. Rural Health* **2010**, *18*, 32–37. [CrossRef]
59. Ellis, N.R.; Albrecht, G.A. Climate change threats to family farmers' sense of place and mental wellbeing: A case study from Western Australia Wheatbelt. *Soc. Sci. Med.* **2017**, *175*, 161–168. [CrossRef] [PubMed]
60. Sartore, G.M.; Kelly, B.; Stain, H.; Albrecht, G.; Higginbotham, N. Control, uncertainty, and expectations for the future: A qualitative study of the impact of drought on a rural Australian community. *Rural Remote Health* **2008**, *8*, 950. [PubMed]
61. Willox, A.C.; Harper, S.L.; Ford, J.D.; Edge, V.L.; Landman, K.; Houle, K.; Blake, S.; Wolfrey, C. Climate change and mental health: An exploratory case study from Rigolet, Nunatsiavut, Canada. *Clim. Chang.* **2013**, *121*, 255–270. [CrossRef]
62. Fritze, J.G.; Blashki, G.A.; Burke, S.; Wiseman, J. Hope, despair and transformation: Climate change and the promotion of mental health and wellbeing. *Int. J. Ment. Health Syst.* **2008**, *2*, 13. [CrossRef]
63. Vins, H.; Bell, J.; Saha, S.; Hess, J.J. The Mental Health Outcome of Drought: A Systematic Review and Causal Process Diagram. *Int. J. Environ. Res. Public Health* **2015**, *12*, 13251–13275. [CrossRef] [PubMed]
64. Ogunseitan, O.A. Topophilia and the quality of life. *Environ. Health Persp.* **2005**, *113*, 143–148. [CrossRef] [PubMed]
65. Rogan, R.; O'Connor, M.; Horwitz, P. Nowhere to hide: Awareness and perceptions of environmental change, and their influence on relationships with place. *J. Environ. Psychol.* **2005**, *25*, 147–158. [CrossRef]
66. Albrecht, G. 'Solastalgia' a new concept in health and identity. *Philos. Act. Nat.* **2005**, *3*, 41–55.
67. Albrecht, G.; Sartore, G.M.; Connor, L.; Higginbotham, N.; Freeman, S.; Kelly, B.; Stain, H.; Tonna, A.; Pollard, G. Solastalgia: The distress caused by environmental change. *Australas. Psychiatry* **2007**, *15*, 95–98. [CrossRef]
68. Berry, H.L.; Hogan, A.; Owen, J.; Rickwood, D.; Fragar, L. Climate Change and Farmers' Mental Health: Risks and Responses. *Asia Pac. J. Public Health* **2011**, *23*, 119–132. [CrossRef]
69. Hart, C.R.; Berry, H.L.; Tonna, A.M. Improving the mental health of rural New South Wales Communities facing drought and other adversities. *Aust. J. Rural Health* **2011**, *19*, 231–238. [CrossRef]
70. Ghaheri, M.; Baghal-Vayjooee, M.H.; Naziri, J. Lake Urmia, Iran: A summary review. *Int. J. Salt Lake Res.* **1999**, *8*, 19–22. [CrossRef]
71. Eimanifar, A.; Mohebb, F. Urmia Lake (Northwest Iran): A brief review. *Saline Syst.* **2007**, *3*, 5. [CrossRef]
72. Garousi, V.; Najafi, A.; Samadi, A.; Rasouli, K.; Khanaliloo, B. Environmental Crisis in Lake Urmia, Iran: A Systematic Review of Causes, Negative Consequences and Possible Solution. In Proceedings of the 6th International Perspective on Water Resources and the Environment (IPWE), Izmir, Turkey, 7–9 January 2013.
73. Jalili, S.; Hamidi, S.A.; Morid, S.; Ghanbari, R.N. Comparativee analysis of Lake Urmia and Lake Van water level time series. *Arab. J. Geosci.* **2016**, *9*, 644. [CrossRef]
74. Shokoohi, A.; Morovati, R. Basinwide comparison of RDI and SPI within an IWRM framework. *Water Resour. Manag.* **2015**, *29*, 2011–2026. [CrossRef]
75. Tisseuil, C.; Roshan, G.R.; Nasrabadi, T.; Asadpour, G. Statistical modeling of future lake level under climatic conditions, case study of Urmia Lake (Iran). *Int. J. Environ. Res.* **2013**, *7*, 69–80.
76. Hassanzadeh, E.; Zarghami, M.; Hassanzadeh, Y. Determining the Main Factors in Declining the Urmia Lake Level by Using System Dynamics Modeling. *Water Resour. Manag.* **2012**, *26*, 129–145. [CrossRef]
77. Hashemi, M. A Socio-Technical Assessment Framework for Integrated Water Resources Management (IWRM) in Lake Urmia Basin, Iran. Ph.D. Thesis, Newcastle University, Newcastle, UK, 2012.

78. Ghale, Y.A.G.; Altunkaynal, A.; Unal, A. Investigation Anthropogenic Impacts and Climate Factors on Drying up of Urmia Lake using Water Budget and Drought Analysis. *Water Resour. Manag.* **2018**, *32*, 325–337. [CrossRef]
79. Eamen, L.; Dariane, A.B. Estimating Agricultural Water Consumption impacts on water level fluctuations of Lake Urmia, Iran. In Proceedings of the International Conference on Civil Engineering Architecture & Urban Sustainable Development, Tabriz, Iran, 27–28 November 2013.
80. Yazdandoost, F.; Moradian, S. A resilient approach to integrated water resources management in water scarce basins. *J. Fundam. Appl. Sci.* **2016**, *8*, 137–151. [CrossRef]
81. Hesami, A.; Amini, A. Changes in irrigated land and agricultural water use in the Lake Urmia basin. *Lake Reserv. Manage.* **2016**, *32*, 288–296. [CrossRef]
82. Madani, K. Water management in Iran: What is causing the looming crisis? *J. Environ. Stud. Sci.* **2014**, *4*, 315–328. [CrossRef]
83. Madani, K.; AghaKouchak, A.; Mirchi, A. Iran's socio-economic Drought: Challenges of a Water-Bankrupt Nation. *Iran Stud.* **2016**, *49*, 997–1016. [CrossRef]
84. Zarrineh, N.; Abad, M. Integrated water resources management in Iran: Environmental, socio-economic and political review of drought in Lake Urmia. *Int. J. Water Res. Environ. Eng.* **2014**, *6*, 40–48.
85. Hoogendam, P. Hydrosocial territories in the context of diverse and changing ruralities: The case of Cochamba's drinking water provision over time. *Water Int.* **2018**, *44*, 129–147. [CrossRef]
86. Hommes, L.; Boelens, R. From natural flow to 'working river': Hydropower development, modernity and socio-territorial transformation in Lima's Rimac watershed. *J. Hist. Geogr.* **2018**, *62*, 85–95. [CrossRef]
87. Linton, J. *What is Water? The History of a Modern Abstraction*; University of British Columbia Press: Vancouver, BC, Canada, 2010.
88. Swyngedouw, E. *Social Power and the Urbanization of Water*; Oxford University Press: New York, NY, USA, 2004.
89. Mehta, L. The manufacture of popular perceptions of scarcity: Dams and water-related narratives in Gujarat, India. *World Dev.* **2001**, *29*, 2025–2041. [CrossRef]
90. Khazaei, B.; Khatami, S.; Hamed Alemohammad, S.; Rashidi, L.; Wu, C.; Madani, K.; Kalantari, Z.; Destouni, G.; Aghakouchak, A. Climatic or regionally induced by humans? Tracing hydro-climatic and land-use changes to better understand the Lake Urmia tragedy. *J. Hydrol.* **2019**, *569*, 203–217.
91. Alston, M.; Kent, J. The big dry: The link between rural masculinites and poor health outcomes for farming men. *J. Sociol.* **2008**, *44*, 133–147. [CrossRef]
92. King, B.; Shinn, J.E.; Yurco, K.; Young, K.R.; Crews, K.A. Political Ecologies of Dynamic Wetlands: Hydrosocial Waterscapes in the Okavango Delta. *Prof. Geogr.* **2018**, *71*, 29–38. [CrossRef]
93. Torabian, J.E. Exploring social vulnerability and environmental migration in Urmia Lake in Iran: Comparative insights from the Aral Sea. In *The State of Environmental Migration 2014: A Review of 2013*; Gemenne, F., Brücker, P., Ionesco, D., Eds.; International Organization for Migration: Paris, France, 2015.
94. Dove, M.R.; Khan, M.H. Competing constructions of calamity: The April 1991 Bangladesh cyclone. *Popul. Environ.* **1995**, *16*, 445–471. [CrossRef]
95. Birkmann, J.; Wisner, B. *Measuring the Un-Measurable: The Challenge of Vulnerability*; UNU-EHS: Bonn, Switzerland, 2006.
96. Mustafa, D.; Wrathall, D. Indus basin floods of 2010: Souring of a Faustian bargain? *Water Altern.* **2011**, *4*, 72–85.
97. Ghalibaf, M.B.; Moussavi, Z. Development and environment in Urmia lake of Iran. *Eur. J. Sustain. Dev.* **2014**, *3*, 219–226.
98. Hoseinpour, M.; Fakheri-Fard, A.; Naghili, R. Death of Urmia Lake, a Silent Disaster Investigating of Causes, results and solutions of Urmia Lake drying. In Proceedings of the 1st International Applied Geological Congress, Department of Geology, Islamic Azad University, Mashad Branch, Iran, 26–28 April 2010.
99. Gimelli, F.M.; Bos, J.J.; Rogers, B.C. Fostering equity and wellbeing through water: A reinterpretation of the goal of securing access. *World Dev.* **2018**, *104*, 1–9. [CrossRef]
100. Sustainable Development Solutions Network (SDSN). Indicators and a Monitoring Framework for Sustainable Development Goals—Launching a Data revolution for the SDGs. 2014. Available online: https://sustainabledevelopment.un.org/content/documents/2013150612-FINAL-SDSN-Indicator-Report1.pdf (accessed on 21 March 2019).

101. World Health Organization (WHO). *Guidelines for Drinking-Water Quality*, 4th ed.; WHO Press: Geneva, Switzerland, 2011.
102. Prince, M.; Patel, V.; Saxena, S.; Maj, M.; Maselko, J.; Phillips, M.R.; Rahman, A. No health without mental health. *Lancet* **2007**, *370*, 859–877. [CrossRef]
103. IPCC. *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects*; Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change; Field, C.B., Barros, V.R., Dokken, D.J., Mach, K.J., Mastrandrea, M.D., Bilir, T.J., Chatterjee, M., Ebi, K.L., Estrada, Y.O., Genova, J.C., et al., Eds.; Cambridge University Press: Cambridge, UK; New York, NY, USA, 2014.
104. Ženko, M.; Uležić, S. The unequal vulnerability of Kurdish and Azeri minorities in the case of the degradation of Lake Urmia, Iran. *J. Political Ecol.* **2019**, *26*, 167–183. [CrossRef]
105. World Health Organization (WHO). Prevention of Mental Disorders: Effective Interventions and Policy Options: Summary Report/A Report of the World Health Organization Dept. of Mental Health and Substance Abuse. In *Collaboration with the Prevention Research Centre of the Universities of Nijmegen and Maastricht*; WHO Press: Geneva, Switzerland, 2004.