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Kashmir and Conflict: The Risks of Water Scarcity

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Abstract

As global warming increases, natural resource scarcity consistently becomes central to interstate tensions and local dissatisfaction. As water supplies dwindle, countries are becoming more desperate to cling to any accessible water supply, often at other groups' expense. The tension that grows over water scarcity can compound with pre-existing identity-based tensions. Kashmir is an ideal region to examine these concerning patterns, as it is an essential water source tied to interstate conflicts between Pakistan and India. My goal was to analyze three water scarcity types determined by Lyla Mehta and their potential to engender conflict in Kashmir. After looking through multiple case studies and trying to decipher the relationship between water scarcity and conflict, there is little evidence to prove that water scarcity in Kashmir will aggravate interstate tensions or lead to more local fatalities within Kashmir. Although no discernible empirical evidence illustrates a causational relationship between water scarcity and conflict, the consistent local frustration with new infrastructure and debates over longstanding water management treaties are a cause for concern. However, the lack of violent retaliation as a method of water preservation is an encouraging sign. Ultimately, this research showcases an optimistic example proving the potency of effective bilateral negotiations and international arbitration.

Introduction

With the rising urgency of climate change, discussions about water scarcity have grown more relevant locally and internationally. Much research has established the importance of preserving the environment and managing global water supplies. According to the World Health Organization (WHO), over 2.1 billion people lack access to reliable safe water, and 32% of the human population has limited sanitation facilities (WHO 2023). Lack of reliable water is not only detrimental for essential hygienic purposes but also cripples any potential for agriculture, water-based industries, and electricity. These effects on local populations are undeniably tragic; disease, uncleanliness, and lack of resources are rampant in these communities. Without improved management and infrastructure, these figures will rise. As communities grow more desperate, they might resort to violence to gain control of clean water supplies. In certain enclaves of the world, this is already the case. Although "water wars" were not significant in the past, the rising stakes mean that water is at the center of many regional conflicts in areas where the ownership of water is debated.

Kashmir is a disputed region between India and Pakistan. It is the source of the valuable Indus River and its many tributaries, with glaciers providing water. On the surface, Kashmir shows all the signs leading to a "water war."

To understand the nature of water scarcity and conflict in Kashmir, I need to establish a solid historical overview of what catalyzed conflict in the region and how water scarcity has played a central role in this issue. The areas of Jammu and Kashmir lie on the disputed territory between India and Pakistan. India currently controls around 55% of the region, with Pakistan controlling about 30% and China controlling the remaining 15%. However, the evolving nature of the conflict means that these numbers are likely to fluctuate. These regions are rich in

historical significance, cultural impact, and natural importance, making them desirable for all parties involved.

The roots of this conflict lie in Britain's destructive and neglectful colonial practices. The partition was an oversimplistic solution to a complex problem arising from tensions between the Muslim and Hindu sectors of British-controlled India. The partition caused an extensive regional upheaval, leading to mass migration and conflict. Since then, India and Pakistan have fought three wars over the disputed regions of Kashmir and Jammu, with frequent skirmishes in between from more minor non-state-based actors.

Journalist Christian Parenti notes in his work *Tropic of Chaos: Climate Change and the New Geography of Violence* how more recent environmental strains have led to the creation of an issue that is as ecological as it is ethnic and nationalist. He notes, "Pakistan is long and thin, sandwiched between two hostile states, India and Afghanistan. It is arid with a large and growing population, most of which works in agriculture. Pakistan is one of the most 'water-stressed' countries in the world, and this fact helps animate the struggle with India over control of Kashmir and Jammu" (Parenti 2011). Parenti's context is essential to understanding the origins of this conflict and how it gradually evolved into an issue surrounding water accessibility. There are deep-seated ethnic tensions in the bloody history between Pakistan and India. As a region that heavily relies on agriculture and has a history of conflict, monitoring growing tensions and providing climate-friendly technology to induce reliable water collection is paramount.

Before 1960, India had the power to shut off essential water resources for Pakistani crops, strongly weakening crop output in Pakistan. The Indus Waters Treaty is a water-distribution agreement signed in September of 1960 that aimed to partition control over the Indus River and set reasonable water usage limitations for both countries. Organized by the World Bank, the

Treaty would foster cooperation between the two countries by recognizing both nations' right to water from the Indus system. Pakistan would receive 80% of the water supply, with India receiving the remaining 20% (World Bank 2023). Pakistan heavily relies on the Indus River and its many tributaries as a stable source of water (Al Jeezera 2011). The Treaty was deemed successful until recent developments.

The steady and devastating advent of global warming, water stress, and international tensions have aggravated global conflicts. The regions of Kashmir and Jammu are no exception. What became an issue of national pride eventually became an issue of survival. This new race against time has only made the people of Kashmir increasingly desperate. With such a large percentage of the population relying on consistent access to water to sustain their livelihoods, it is not unsurprising that Pakistan and India are so uncompromising when it comes to controlling Kashmir and the water supply related to it.

Unlike in the Nile River Basin and Gaza, little research relates to water, historical animosity, and present-day conflict in Kashmir. I aim to look at water scarcity in Kashmir and estimate the likelihood of a water war in the coming years. Looking at this region would be a way to see if it aligns with other examples of water-based conflicts and estimate how violent water-based conflicts could become as global water scarcity increases.

Literature Review

This section describes the scholarly literature on water scarcity, conflict originating from and leading to natural resource scarcity, and the economic fallout of these factors. These works are analyzed to show the logical progression of water scarcity and its effects by describing the causes, effects, and responses of water scarcity and conflict in heavily agricultural-dependent economies. Major themes, frameworks, and topics explored relate to the correlation between resource scarcity and political and social conflict.

Political scientist Thomas Homer-Dixon's seminal work analyzes the link between environmental scarcities and social conflict. Homer-Dixon disagrees with the presumption that ecological scarcity is more an indication of a failing government or economy. By establishing the causal role of environmental scarcity, he argues that ecological scarcity is not merely an endogenous variable but a robust local stressor that can generate conflict. Homer-Dixon's model proposes three types of scarcity-induced conflicts: identity conflicts, sociopolitical unrest, and coups. According to his case studies, water is most directly related to sociopolitical unrest and identity conflicts (although coups could arise from deep-seated dissent towards the government), and less economically secure areas will likely specifically suffer from a rise in social strife when a necessary resource becomes scarcer (Homer-Dixon 1994). Homer-Dixon concludes that scarcity-induced conflicts will only rise as resources dwindle, and these conflicts can even cascade into interstate disputes.

Sociologist Lyla Mehta paints a vivid picture of how water scarcity is not only environmentally constructed but also socio-politically constructed. By delineating between "real" biospherical scarcity and "manufactured" political scarcity, Mehta's work challenges the notion that water scarcity is purely an ecological issue and affirms that social forces are in play when

controlling water supplies to specific areas. Mehta studies the Kutch peninsula of India's Gujarat district to show how water scarcity can be constructed for political reasons. In doing so, she notes how policymakers weaponize the idea of "real" natural scarcity to legitimize "manufactured" scarcity. She argues, "Scarcity is made out to be 'natural,' thus ignoring the anthropogenic areas of culpability. The 'manufactured' nature of scarcity legitimizes controversial schemes… and also unequal access to water and land resources" (Mehta 2003). This particular analysis becomes increasingly topical as more institutions create structure-induced scarcity in other areas to create a comparative advantage for themselves. Mehta also highlights how the wealth gap in the Kutch region of India leads to vastly different means of coping with water scarcity.

That last detail is essential when exploring how people cope with natural resource scarcity. Thomas Homer-Dixon returns with an analysis determining how poor countries respond to water scarcity. According to him, the first resort is a supply of two types of ingenuity: technical ingenuity to address water scarcity and social ingenuity to facilitate the growth and application of technical ingenuity. Ingenuity is considered a resource that should be cultivated and nurtured to give underdeveloped countries the means to address scarcity. However, this resource might be limited by market failures, social constraints, and tension. Homer-Dixon states, "Some societies are locked into a race between a rising requirement for ingenuity and their capacity to supply it" (Homer-Dixon 1995). All kinds of conflict can result from this ingenuity gap and will further negatively limit the capacity to supply more ingenuity to address scarcity. Conflict, then, is shown as a last resort for societies struggling with resource scarcity and an ingenuity gap.

Swedish hydrologist Malin Falkenmark further quantifies water scarcity risks by researching changes in the biosphere. She labels blue water as intended for hygienic purposes and health and defines green water as utilized for agriculture. Falkenmark describes the short-lived success of the Green Revolution in the 1970s, a global initiative intended to create lasting green water supplies and increase the yield or resistance of crops. According to Falkenmark, the revolution had unintended side effects on such a large scale that the global water circulation system changes may still threaten long-term water security. Those side effects include water pollution, river flows and basin damage, and groundwater depletion (Falkenmark 2013). She emphasizes carefully considering new water accumulation, desalination, and preservation methods. Falkenmark weaves an intricate web detailing the many factors and effects of water shortage, concluding that by 2050, around 46% of the world population will be dealing with water insecurity.

Water insecurity is an element in many worldwide conflicts. Water politics in the Tigris and Euphrates river systems have become turbulent. Journalist Achref Chibani discusses how Turkey's Southeastern Anatolia Project, which includes various dam and hydropower projects, has reduced Iraq's water supply along the Tigris and the Euphrates by 80% (Chibani 2023). Syria and Iraq have pushed back on these projects, as they are heavily reliant on agriculture and are susceptible to climate change. Pakistan is similar in that sense, as its emphasis on controlling Kashmir comes from a need for stable access to water. The Southeastern Anatolia Project has also forcibly displaced Kurdish communities in Turkey, showing how water infrastructure can be used as a means of coerced displacement for targeted communities. Considering the vulnerability of the Tigris and Euphrates river basin, there is a growing concern surrounding regional tensions and climate-induced migration.

Kerstin Unfried, Krisztina Kis-Katos, and Tilman Poser researched the link between water scarcity and social conflict in Africa and Central America. They refer to Homer-Dixon's conflict model, stating that their research describes how water scarcity leads to conflict that targets both government bodies and civilians. Their results show that a decrease of one standard deviation in the local water supply tripled the likelihood of regional conflict. They also highlight that general access to water can significantly mitigate the potential dangers of water scarcity. They conclude that governing agencies play an instrumental role in rectifying the risks of climate change and reducing the likelihood of social conflict (Unfried et al. 2021). However, governing agencies might sometimes be incentivized to restrict water access in certain areas to further their political ambitions.

Much research has shown ties between water scarcity and conflict in some areas of the world. Israel and Palestine have an extensive history of conflict, and more recent developments in water infrastructure have sparked more discussions about how water access can be weaponized against a population during conflict. Legal scholar Stephen McCaffrey describes how water access can become a "core issue" surrounding conflicts between and within countries. He explains the dispute between Israel and Palestine as not only an ethnic conflict but also a resource-based water access conflict. The Israeli government's understanding of the dangers of water scarcity during the 1940s led to them taking steps to establish long-term control over surface water. After the Six-Day War in 1967, Israel took control of all the West Bank and Gaza water resources. This vast access and control of water resources over the Mediterranean Sea, the Dead Sea, and the Lake of Tiberius have given Israel a significant comparative advantage regarding water control, desalination, and dissemination. Palestinians have no choice but to cave to Israeli regulations and limitations regarding water access or improvise with limited resources.

McCaffrey complicates the relationship between water scarcity and conflict by describing conflict as an effect of water scarcity as well as a cause of water scarcity (McCaffrey 2014). If one ties this conflict back to Mehta's description of the two types of water scarcity, fear of "natural" scarcity for Israel has become a justification for "manufactured" scarcity within Palestine.

Even with recent developments in Israel and Palestine, water remains a core issue that threatens the livelihoods of Palestinians. Historically, Israeli authorities have held a monopoly on water control in both Israel and Palestine. Amnesty International cites Military Order 158 as the main culprit that has enabled Israel to deliberately deprive Palestinians of clean water (Amnesty 2017). Israel's policy of water deprivation is not even necessarily limited by location. There is a clear and intentional ethnic-based restriction rather than geographic. Whereas most Israelis receive clean water, many Palestinians in similar areas have much less access to water. This is a deliberate restriction set to weaken and endanger the Palestinian population. According to B'Tselem, Israeli regulations prohibit Palestinians from developing more water-based infrastructure without having to give up something in exchange, which usually comes in the form of land (B'Tselem 2023). This behavior clearly shows how manipulating water flow exasperates longstanding identity-based conflicts. Water scarcity's role in this is essential. When daily life becomes uprooted by another nation, animosity will grow. The current aggravation of the conflict has only led to more hatred, bigotry, and deaths. Palestinians have a vast comparative disadvantage regarding water supply, limiting their success in vital hydration, hygiene, and agricultural needs. McCaffrey displays how pre-existing religious tensions can incentivize targeted, structure-induced water scarcity.

The Nile River Basin is currently a site of violence between many countries fighting for control over the Nile. Political scientists M.K. Mahlakeng and Hussein Solomon's work on scarcity and conflict in the Nile River Basin further corroborates this analysis and exemplifies more complex ways to examine scarcity types. They support Homer-Dixon's prediction that interstate conflicts would increase as the demand for water grows. They also explain how the increase in worldwide population and the soaring consumption rates discourage states from equitably allocating water resources. These factors create a breeding ground for competition, greed, tension, and conflict. They use the Nile River Basin as an example of how environmental conflicts are exacerbated significantly when a once plentiful resource steadily declines (Mahlakeng and Solomon 2015). The Nile River Basin is a good site that describes demand-, supply-, and structural-induced scarcity. Demand-induced scarcity arises from population growth not matched by increased natural resources. Supply-induced scarcity comes from the degradation and depletion of the resource; climate change, manmade pollution, and unsustainable usage contribute heavily to this scarcity. Structural-induced scarcity arises from one party unfairly restricting access to a resource from another party. This can come from new infrastructure, such as dams, artificially limiting access in certain areas.

The Nile River Basin's rising population, decreased water access and quality, and escalating government measures to preserve control over the remaining water reserves make it the perfect region to study all three forms of scarcity and how they can engender conflict. Unoptimized farming techniques dominate the Nile River Basin, severely degrading water quality and supply (Mahlakeng and Solomon 2015). The 1929 and 1959 Nile Water Agreements specified water distribution along the Nile for the downstream countries. However, tensions rose once young and newly independent upstream countries sought fairer deals amidst this power

differential. The ensuing and ongoing political deadlock has brought conflict in the region over water. One noteworthy detail is that the conflict revolves not only around water insecurity but also around the Nile's role in the identity of these riparian states. Losing control over the Nile would also mean losing control over its enduring cultural significance to its people. This historical element also acts as fuel for this conflict. We can see how this case links cultural identity to water resources while also lending credence to Homer-Dixon's environmental scarcity theory. We now need a more comprehensive overview of how water scarcity and its relationship to agriculture can aggravate the risks of these conflicts.

Developing countries' economies often hinge on agriculture, and because of their lack of infrastructure, they have little buffer to counter the threats of natural resource scarcity. An inquiry into Ethiopian agriculture provides valuable insight into the impacts of natural resource scarcity on agriculture. Economics scholars Alemu Mekkonen, Abebe Damte, and Rahel Deribe Bekele empirically analyzed the effects of natural resource scarcity on time spent on agriculture. Their goal was to determine how fuelwood and water scarcity affected the time spent on agriculture in Ethiopian agricultural households. Their results showed that fuelwood scarcity negatively correlated with time spent on agriculture. However, water scarcity had little to no effect on time spent on agriculture. The justification for this is that the increased labor allocation for water collection did not come at the expense of agricultural productivity but instead of leisure time or domestic work (Mekkonen et al. 2015). This research complicates the relationship between water scarcity and agricultural productivity, and there is more room to examine the general effects of water scarcity on agriculture. However, given international trends, Ethiopia is an outlier.

Ertharin Cousin, A.G. Kawamura, and Mark W. Rosegrant composed an extensive paper on the threats of water scarcity from global warming. The ensuing climate change and the instability that it brings can alter rainfall patterns, increase the number of dramatic climatic events, and degrade water quality. These factors will reduce food production, weakening food security. Although the previous example from Ethiopia does not establish a positive correlation between more difficult access to water and agricultural productivity, it does highlight that livelihoods are altered by water inaccessibility (Cousin et al. 2019). Climate change, water scarcity, and the overarching factors contributing to water availability all transform the livelihoods of the people affected, sometimes with violent consequences.

After identifying the causes, effects, and factors attributed to water scarcity, there remains a prominent gap regarding a region that would be a suitable topic of study. Kashmir is a region of conflict with pre-existing tensions because of the ongoing territorial grapple between Pakistan and India. However, climate change, new infrastructure, and a spike in population have possibly aggravated and intensified these conflicts as local forces become destitute, desperate, and agitated. Pakistan and India are becoming more water-stressed, and Kashmir is heavily reliant on agriculture, making the once identity-based conflict a more desperate struggle over crucial water supplies. Because Kashmir is an agriculture-based region, its population heavily relies on green water for food production and biomass generation and blue water for its primary hygienic purposes, which touches back to Falkenmark's ideas. Lyla Mehta's concept of "manufactured" scarcity and Mahlakeng et al.'s discussion on structural-induced scarcity are particularly relevant as I analyze the effects of political conflict and the construction of dams on Pakistani Kashmir water supply. Considering the precedents set by the Nile River Basin and the intense conflict between Israel and Palestine, the circumstances in Kashmir are worrying. However, Kashmir

also has little pre-existing scholarship and data, making the relationship between water scarcity and conflict an ideal subject of study. My goal is to determine the extent to which water scarcity catalyzes conflict.

Case Studies

Methodology

Having established the topic and background of the study, I will now determine which factors are most critical when considering water scarcity and conflict in Kashmir. I will do so by following the framework Mahlakeng et al. followed while also considering how these scarcities fit into the "natural" and "manufactured' delineations that Mehta constructed. Since causality is hard to pinpoint (especially for a conflict that has so many actors and variables), I will instead look to see if the conflict in Kashmir correlates with water scarcity. I will look at cases of demand-induced, supply-induced, and structural-induced scarcity in Kashmir to determine which types most represent Kashmir and if we can estimate the propagation of conflicts in the region. I will do this mainly using the conflict dataset from the Uppsala Conflict Data Program, which tracks conflict locations, actors, and casualties globally, along with other resources relating to each case.

Context

First, I want a general overview of the current state of water scarcity and conflict in Kashmir. Kashmir and Jammu's population have been exponentially increasing since their inception. The following figures provide an outline of overarching trends relating to the Kashmiri population, water stress in both Pakistan and India, and fatalities in Kashmir.

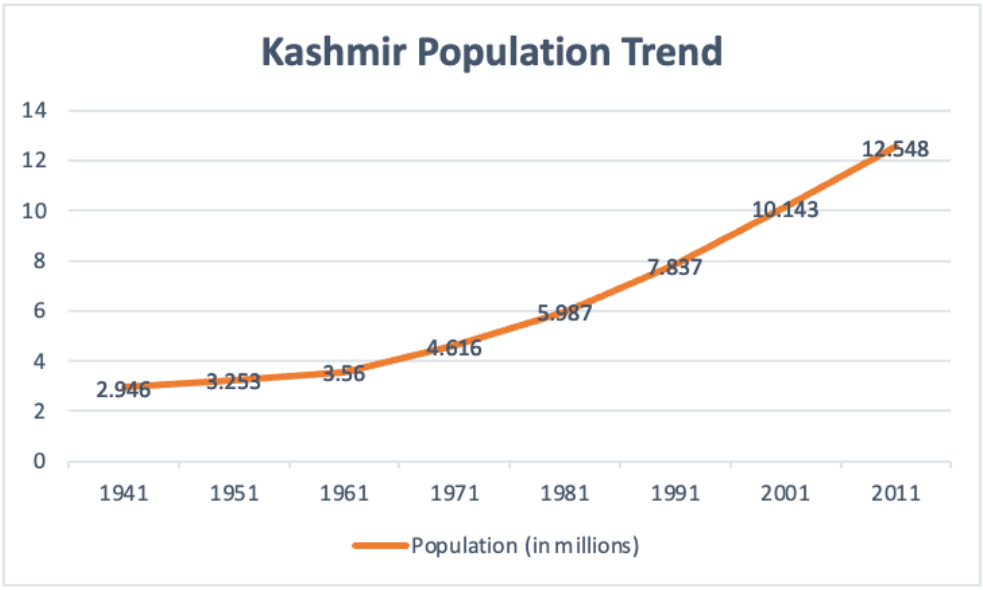

Fig 1. This graph will map the population of Kashmir and Jammu to the number of conflict-based deaths in the region. The graph is modified using data from the decennial India census.

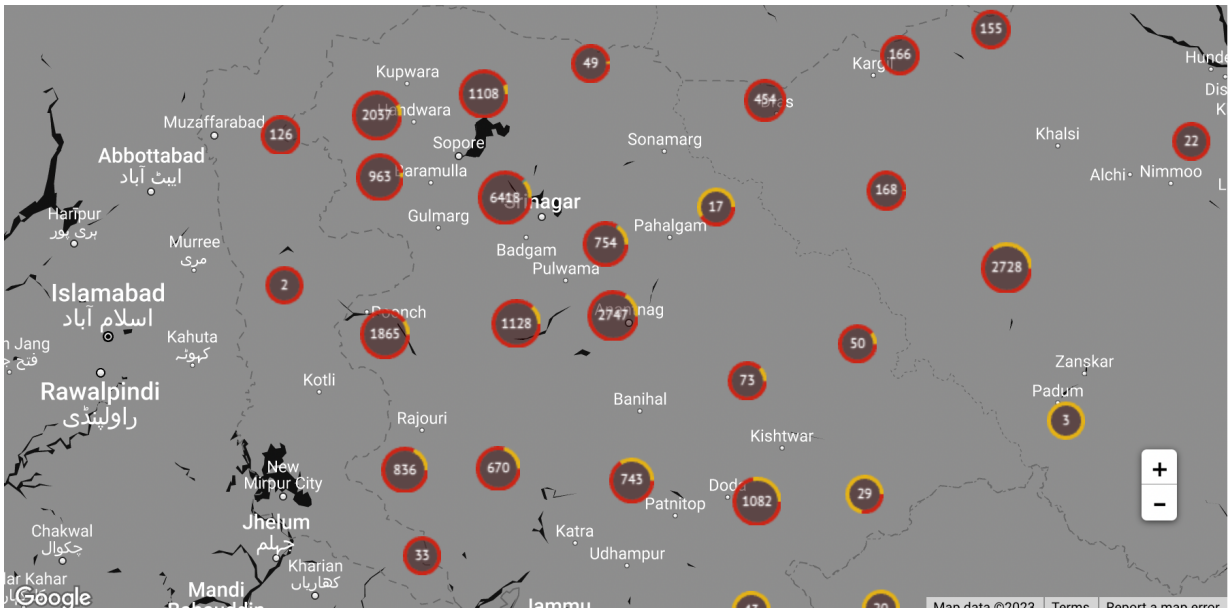

Fig 2. This map from the Uppsala Conflict Data Program displays the number of organized conflict-based fatalities in Jammu and Kashmir. Deaths become highest in areas next to water sources, indicating larger-scale/more frequent conflicts in areas with easily accessible water.

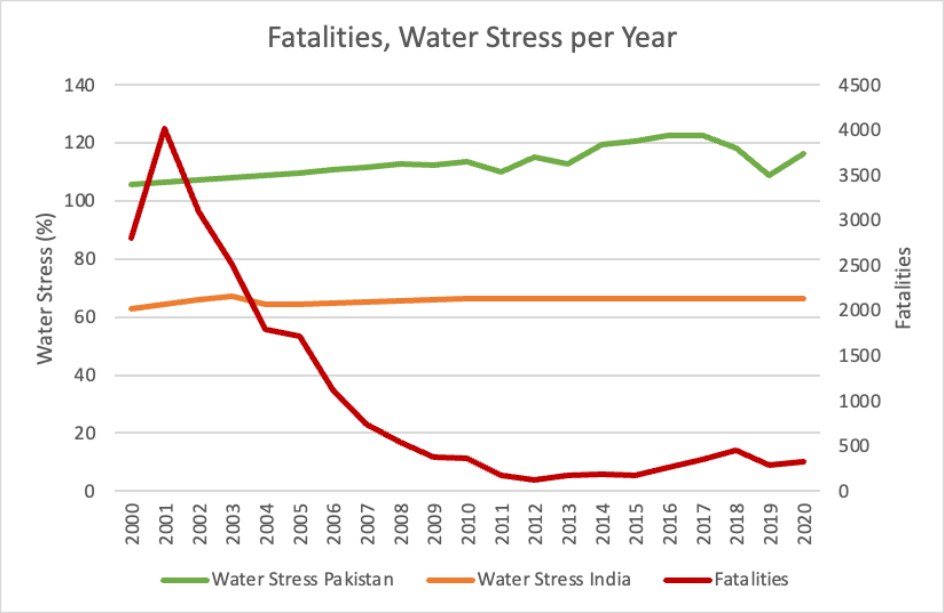

Fig 3. This graph represents the relationship between water stress in India and Pakistan and fatalities in Kashmir. This graph uses data from the World Bank determining water stress for each country and fatalities data for Kashmir and Jammu from the South Asia Terrorism Portal.

I will refer back to these figures as I discuss the specific types of water scarcity and how they relate to Kashmir, but a preliminary analysis is helpful. Fig 3.'s spike in fatalities is likely due to either the conflict in the Kashmiri mountain range of Kargil or the possible involvement of Al-Qaeda forces in Pakistan. The unprecedented ceasefire instated in November of 2003 has had an undeniable effect on fatalities in the region. Looking at these two figures shows an encouraging trend. Organized violence has been trending downward since 1989, with interstate conflicts especially becoming less intense.

Nevertheless, tensions are still high. Although fatalities are nowhere close to the fighting in the early 2000s, sightings of surveillance drones on the India-Pakistan border have doubled since 2021, and more recent elements have heightened animosity between the two countries and

their constituents (UCDP 2023). Having established this, we can now think about how water factors into conflict in Jammu and Kashmir.

Demand-Induced Scarcity

Demand-induced water scarcity rises when the current water supply cannot meet a spike in water demand. Globally, water resource managers consistently wrangle with this form of scarcity. Figure 1 describes Jammu and Kashmir's general population growth trend, which has become increasingly alarming. Pakistan has a current population of around 200 million, and *The National Bureau of Asian Research* estimates that it will reach 350 million by 2050 despite having the same, if not lower, water supply. This rise in water demand poses a significant risk, and policymakers will have to figure out how to optimize water usage in the coming years to offset this increasing demand.

Pakistan and Kashmir rely heavily on agriculture and hinge on water availability and land productivity. India and Pakistan must revamp their agriculture methods to offset this incoming water stress. Elements relating to supply-induced and structural-induced scarcity will likely compound these stresses. Looking at Fig 2., we can already see higher fatalities around freshwater sources. This could be the result of a mix of factors. For example, populations tend to be more dense around freshwater sources, meaning conflicts will invariably result in more deaths in those areas. This map-based analysis does not consider this factor. Fig 3. shows that water stress in Pakistan is trending upwards alongside fatalities. Half of Pakistan’s labor industry centers around agriculture, and Pakistan is wholly dependent on the Indus River and its tributaries. Undoubtedly, water stress could be a substantial factor correlating with violence, and given the rising population of Kashmir and the uptick in water stress, fatalities could keep trending upwards.

Supply-Induced Scarcity

This rise in demand for water does not coincide well with the increasing inconsistency associated with water and the decreasing reliability of water. Climate change plays an essential role in this inconsistency. The Kashmiri neighborhood of Srinagar fell particularly victim to this water variability, as it had to cope with flooding in May 2023 and record-high temperatures in September 2023. Journalist Muheet Ul Islam notes that cash crops that the Kashmiri economy hinges on, such as apples and saffron, were severely damaged (UNICEF 2023).

Pakistan also suffered from devastating floods in 2022 that displaced around 33 million people. UNICEF reports that the severe water damage and the ensuing displacement meant people had to resort to contaminated water (UNICEF 2023). The affected population was evacuated but still had to contend with a cycle of malnutrition and infection because of the depletion in water access and quality.

Kashmir is located between two mountain ranges that are particularly susceptible to global warming. The Karakoram range on the Afghan side and the Hindukush on the Pakistani side both have melting glaciers, leading to dried riverbeds and depleting tributaries. Glaciers have recessed by 28.82% from 1980 to 2018, according to a research paper from Shakil Ahmad Romsoo et al. (Romsoo et al. 2020). According to a comprehensive review by researcher Zahoor Ahmad Dar, potable water is increasingly difficult to obtain, leading to higher school dropout rates, especially for women (Dar 2022).

The following figure from Javaid M. Dal et al.'s research titled *Time series analysis of climate variability and trends in Kashmir Himalaya* provides interesting general trends regarding climate trends in Kashmir.

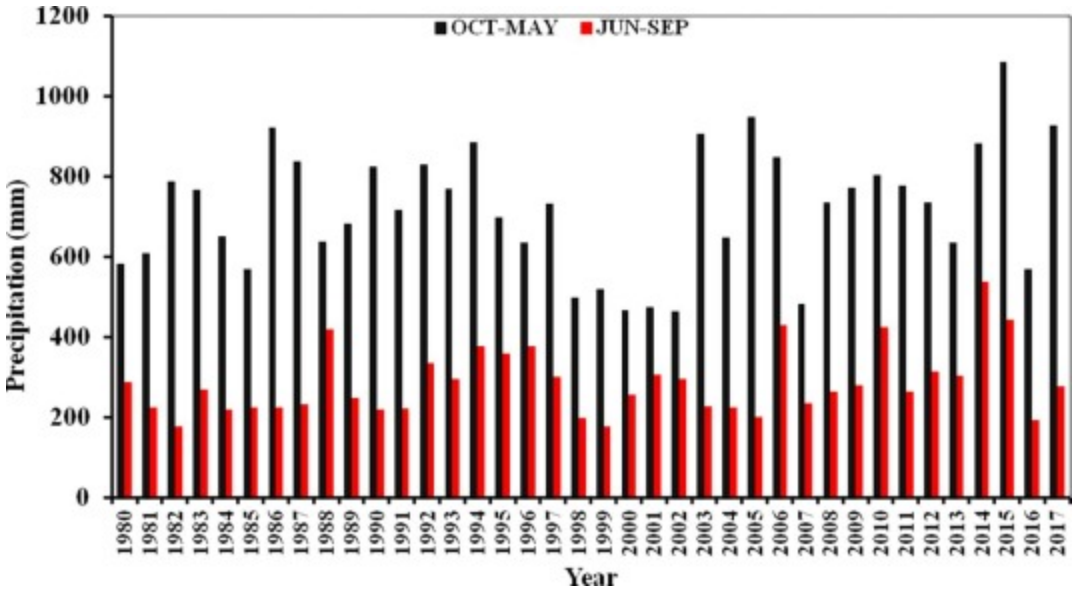

Fig 4. This graph is taken from Javaid M. Dal et al.'s research measuring climate variability and change in Kashmir.

Local maximum and local minimum temperatures have steadily increased. Considering these worrying patterns with the increasing demand for water to sustain a quickly growing population does not bode well for water-induced tensions in Kashmir. This unreliability means that both India and Pakistan have to adjust their water productivity to avoid escalation into conflict over an increasingly limited resource. New agricultural methods will have to be devised to counteract this reduction in water availability.

Pakistan, especially, is a culprit of water mismanagement. Robert Wirsar notes that Pakistani agriculture is relatively inefficient: one-third of India's crop yield and one-twelfth of the United States' crop yield. Possible solutions to increase water productivity will be discussed in the analysis section of this thesis. Nevertheless, the possibility of conflict amidst these flooding, desperation, and displacement cases is significant. However, the direct relationship between supply-induced scarcity is nowhere near as evident as the following form of scarcity.

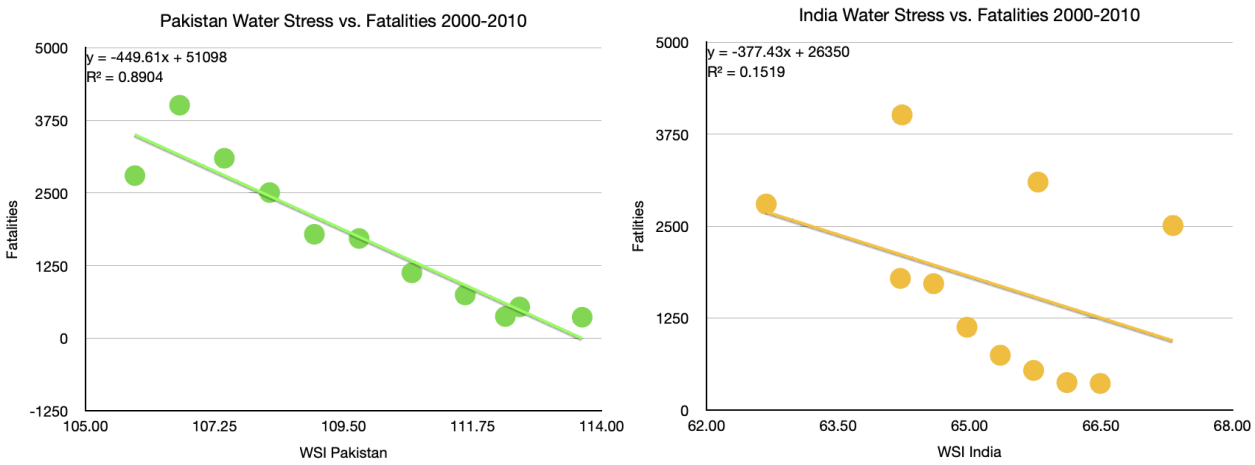

Fig 5. These figures show a regression model between Pakistani and Indian water stress measures compared to fatalities in Kashmir from 2000 to 2010. Values were obtained from the same sources as Fig 3.

These two models show a negative correlation between water stress in both Pakistan and India and fatalities in Kashmir. In 2003, the two countries agreed to an uneasy but unprecedented ceasefire, which explains the later decrease in fatalities in Kashmir and Jammu. These results illustrate the complexity of this conflict. The conflict initially came from an ideological and political value of Kashmir and Jammu, and climate change has led to an evolution of this conflict into one surrounding resource scarcity. This scarcity will only become more severe as climate change strengthens. I chose the values from 2000 to 2010 to encompass the war, the ceasefire, and its fallout.

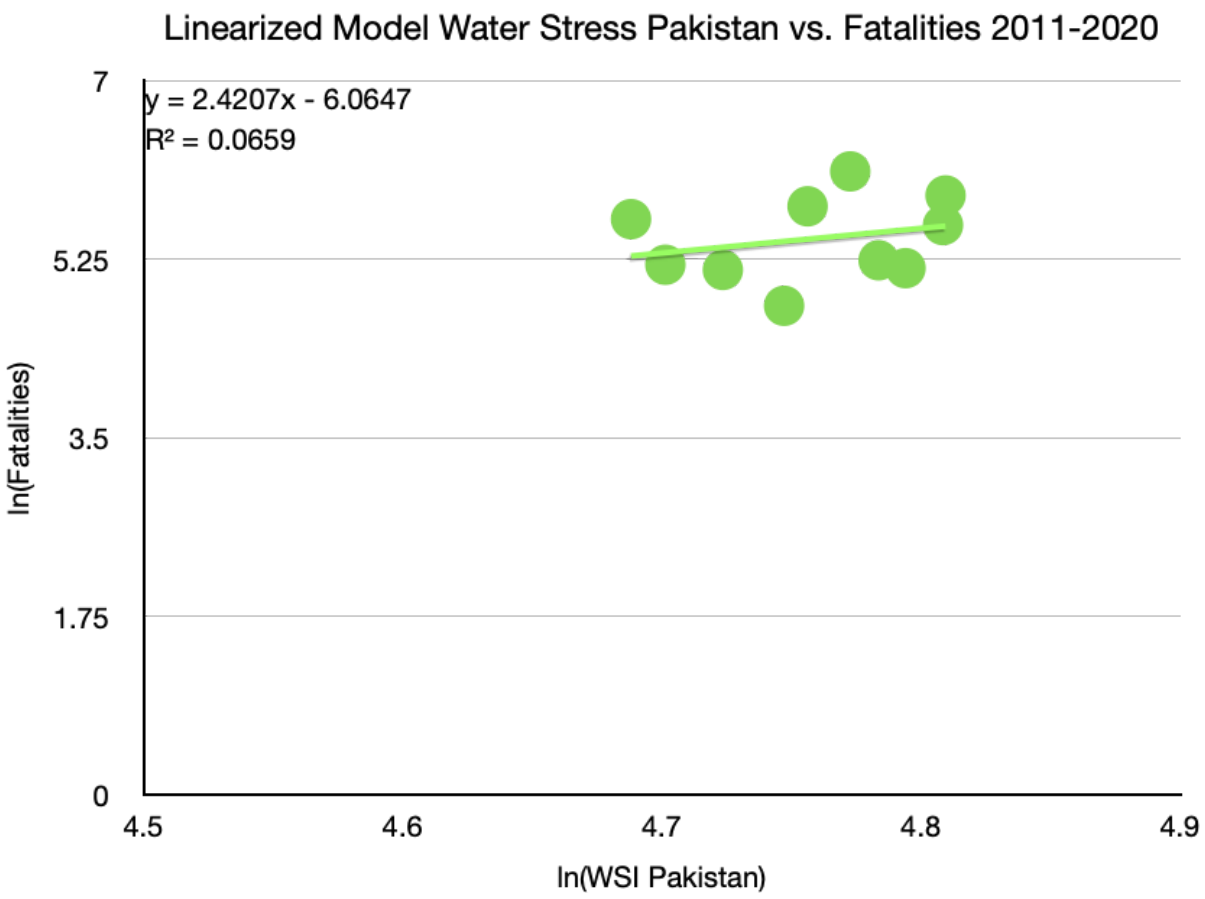

Fig 6. These figures show a regression model between Pakistani water stress measures compared to fatalities in Kashmir from 2011 to 2020. Values were obtained from the same sources as Fig 3.

This figure only includes Pakistani water stress values because Indian water stress data is not readily available. The two variables have a slight positive correlation, but it is very weak. These statistics prove the effectiveness of the 2003 ceasefire. However, our knowledge of other interstate conflicts regarding water worldwide, as well as new "manufactured" forms of scarcity, means that this trend has the potential to become null soon.

These models were based on the assumption that conflict and water scarcity are linearly correlated. However, that might not be the case, and another model might be more applicable. We can convert these values by using a statistical linearization technique that might better illustrate the relationship between these variables:

$$y = ax^b \rightarrow ln(y) = ln(a) + b*ln(x).$$

Performing a regression would give us the best estimates for the unknown variables *a* and *b*, which could tell us more about the nature of this trend.

Mathematically, it is possible to fit a high-degree polynomial to increase the R^2, but the validity of this prediction would not be as appropriate.

Plotting these values yields an interesting, albeit weak, relationship:

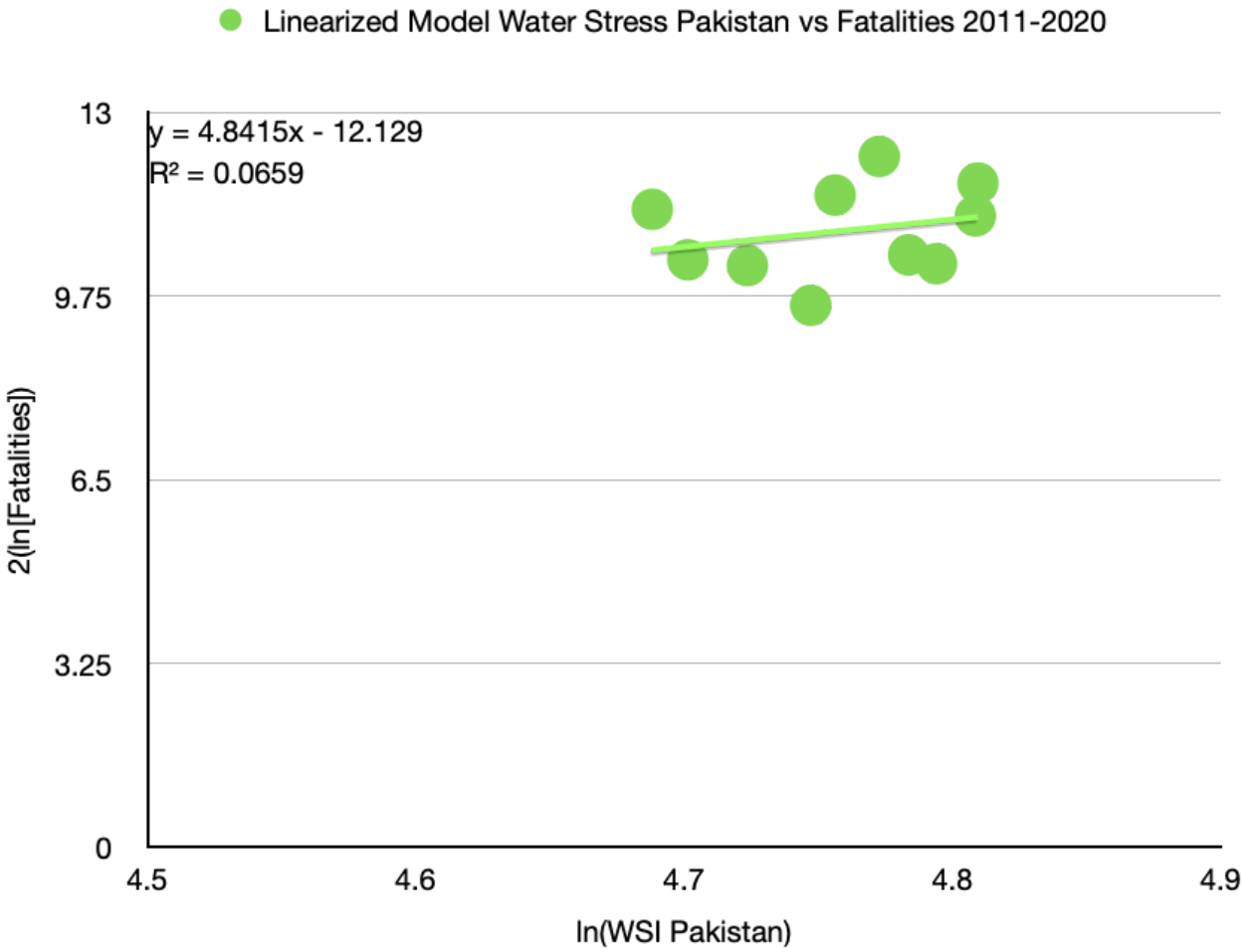

Fig 7. The figure is derived from the linearization technique illustrated above. This figure still uses the same data from Fig 3.

What this graph shows is that there is a very weak positive linearized correlation between water stress and fatalities in Kashmir. The value R^2 of 0.0659 indicates that water stress accounts

for 6.59% of the variation in fatalities. The graphs show little evidence to conclude that a linear model successfully represents a direct correlation between conflict and water scarcity.

It is important to note that other trendlines may better match the data provided here. For example, testing a 6th-order polynomial trendline returns a much higher R^2 value of 0.7037, but the trendline itself is not meaningful.

Structural-Induced Scarcity

From the outset, supply-induced scarcity seems to be the most direct contributor to rising tensions and violence in Kashmir. Infrastructure induces this form of scarcity, which an entity such as a governing agency must oversee. This structure provides a direct scapegoat for people negatively affected by this constructed scarcity, fomenting dissent and conflict. Examining how India's construction of two dams has engendered conflict provides a firm overview of structural-induced scarcity and its correlation with violence. The *Climate Diplomacy* organization has published a conceptual model outlining water conflict and cooperation between Pakistan and India.

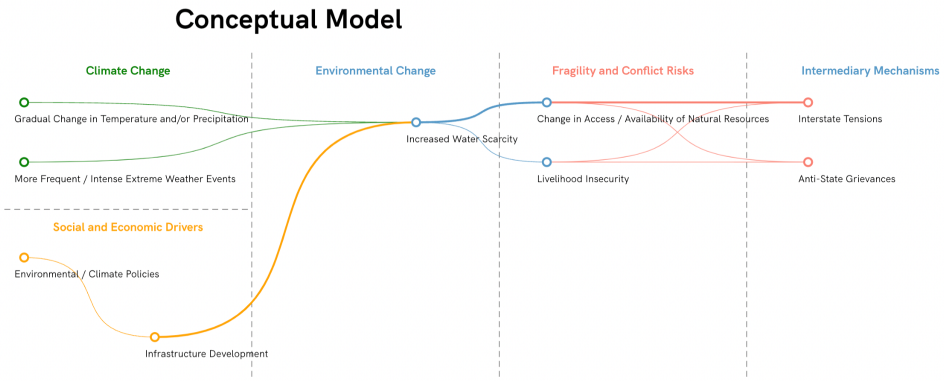

Fig 8. This model comes from the Climate Diplomacy's conceptual model tying natural resource scarcity to conflict and tensions.

One notorious case is the building of the Baglihar Dam in India. Because of the aforementioned Indus Waters Treaty, India controls the upstream flow of the Indus River and its tributaries until the Pakistani border, giving India an advantage over water flow into Kashmir and Pakistan. India has used this fact to build infrastructure limiting the water flow into Pakistan. The Baglihar Dam on the Chenab River in India-administered Kashmir is one such infrastructure. Using dams like the Baglihar dam, India has reduced water flow in Pakistan by 30%, with the added ability to cut off water flow during times of crisis.

Naturally, hydroelectric projects such as the Baglihar Dam have caused upheaval in both local Kashmiri communities and Pakistani communities at large, sparking newfound animosity as water becomes scarcer. According to the journalist CJ Werleman, the small town of Pul Doda was wholly submerged in water once the dam released water downstream, leaving its 400 once-prosperous families in poverty (Werleman 2020). The effects on Pakistan, which already faces water stress and needs water for its vast, albeit inefficient, agricultural industry, are also significant. John Briscoe cites building this new infrastructure as a "whole new ballgame" and a possible violation of the Indus Waters Treaty. Conflict analysts Robert G. Wirsing and Christopher Jasparro analyze the Baglihar Dam dispute, stating, " Intensified rivalries over river resources could precipitate violent interstate conflict between them in the future. Even if direct violence is avoided, the inability to resolve river resource issues between them will undoubtedly limit the ability of both countries to manage and utilize water resources in the most efficient manner." (Wirsing and Jasparro 2006). The fallout of the Baglihar dam and water stresses in the region show that their concerns were not unfounded.

Nevertheless, India's hydroelectric projects are not slowing down. Construction for the Kishanganga Hydroelectric Power Plant (KHEP) began in 2007. According to anthropologist

Mona Bhan, the KHEP attracted backlash from locals, fearing they would suffer the same fate as Pul Doda (2018). Pakistan also objected to the dam, as it initially diverted full water flow typically going downstream toward a local Indian power plant. International actors mediate these disputes, limiting the potential for interstate conflict. Pakistan took this case to the Permanent Court of Arbitration, with the ultimate decision being in India's favor with some conditions. Pakistan insisted that this violated the Indus Waters Treaty, whereas India cited the Indus Waters Treaty as a flimsy justification for this unilateral water flow control. Shafqat Kakakhel, chairman of the Sustainable Development Policy Institute, states that ensuring the continued success of the Indus Waters Treaty is paramount, saying, "The countries should work towards a more prudent management of the rapidly depleting water assets in the Indus Basin in order to address the looming water crises faced by both" (Kakakhel 2014). However, these hopes are weakened by the view that both Pakistan and India show harbor towards the Treaty. Whereas India is content with controlling the upstream flow of the Indus River, Pakistan believes that these hydroelectric projects violate the Treaty by reducing water access. Cooperation towards reimagining this Treaty would be difficult.

These cases also provide a new lens through which we can examine conflict in Kashmir. Whereas they engender inter-state tension, local dissatisfaction must also be considered. These dams were met with local protests, fueling anti-state grievances, as shown in the conceptual model from Fig 8. This pattern continues when looking at other hydroelectric projects throughout Pakistan and India. These developments, compounded with climate change, do not bode well for the future of Kashmir, both environmentally and socio-politically. These tensions may escalate unless measures are taken to alleviate the effects of water scarcity.

Analysis

Empirically, no evidence suggests that water scarcity from Pakistan or India breeds more conflict in Kashmir and Jammu. This lack of evidence could be due to numerous factors. Water stress levels for India and Pakistan might not be the best quantifiable indicators of conflict in Kashmir. India also did not have reliable data for water stress measures, as it stayed perfectly level through the last decade. Although Pakistan relies predominantly on Kashmir for its water, its frustrations might not directly translate to fatalities. Other indicators could be more effective if we want to establish a strong correlation regarding deaths in Kashmir. The climate variability measured by Dal et al. has potential, but the data needs to be updated. However, since data accumulation is more challenging in Kashmir, it might be challenging to see which indicators correlate most strongly with conflict.

Nevertheless, a tangible case exists for growing animosity caused by manufactured water scarcity in Kashmir. My analysis of structural-induced scarcity is the most topical here, as its "manufactured" nature means a clear "villain" exists toward which to point. Tensions continue to rise, and fatalities have been trending upward since 2012. Applying the Homer-Dixon model to the case studies, water scarcity in Kashmir has increased sociopolitical unrest and identity tensions.

The ongoing dispute over the Indus Waters Treaty is one clear example. Pakistani officials and constituents consider India's manipulation of the Indus Waters Treaty a violation. India also finds Pakistan to be agriculturally inefficient, using Indian infrastructure projects as a scapegoat to fuel insurgent operations within India-administered Kashmir. Both countries have called for a treaty revamping, but with each party pushing for opposing goals, those talks have led to nothing. As with many international disputes, both arguments are valid to a certain degree.

Critiquing the Indus Waters Treaty

This dispute leads to a broader discussion on the merits of the Indus Waters Treaty, which has been central to many local Kashmiri disputes. As stated before, the Treaty was created in 1960 with little to no adjustments since then. The Treaty was initially seen as a monumental success, as it was deemed an acceptable agreement between both countries. However, this Treaty does not account for river-related changes and infrastructure projects. The Baglihar Dam, discussed in the case studies, was the first domino that led to widespread Pakistani discontent regarding the Treaty. In their eyes, according to Robert Wirsing, ". The treaty… not only reserved the waters of the three western rivers almost exclusively for Pakistan's use but also guarded against India's taking advantage of its treaty-authorized right to the non-consumptive use of these waters" (Wirsing 2000). Both countries have opposing perspectives on whether projects such as the Baglihar dams violate the Treaty, with both countries seeking international arbitration to support their claims. Because of this arbitration process, many of India's hydroelectric projects are still in effect. Fortunately, Pakistan has yet to retaliate with violence.

As a result, India has used its control over the water flow in Kashmir as a political bargaining chip. If India controls the water flowing into Pakistan, it can influence Pakistan's involvement in the region, limiting Pakistani retaliation. Environmental journalist Daniel Haines comments on this behavior and its potential to spill into a war: "'water wars' are virtually unprecedented in the past and unlikely in the foreseeable future, including in South Asia. But a breakdown in hydro-diplomacy could feed into a wider deterioration in bilateral relations, perhaps putting the hard-won cease-fire in Kashmir at risk" (Haines 2023). My empirical

analysis supports this. However, this also speaks to the effectiveness of the 2003 ceasefire and both countries' recognition of the value of bilateral agreements and international arbitration.

Overall, the Indus Waters Treaty remains conscientious. On the one hand, it symbolizes the ability and willingness of usually implacable sides to cooperate on sharing a vital resource. On the other hand, it also fails to account for the ever-changing nature of limited natural resources and the encroaching urgency associated with their scarcity. Nevertheless, the Treaty provides a robust framework upon which both countries should be willing to build. It embodies a hopeful opportunity for regional cooperation from countries historically engaged in violent disagreement.

Revamping Water Usage

These disagreements do not mean Pakistan and India should not revamp their agricultural or water accumulation methods. As stated before, Pakistan is an inefficient culprit, and some revisions of their agricultural sector can help alleviate their water stress and assuage their worries about India controlling the water supply in Kashmir. Growing populations, countrywide urbanization, and climate change pose challenges that Pakistan can address using climate-smart methods. According to a report from the World Bank by Abrar Chaudhury and Nadia Ayub, an approach that prioritizes water management, new industrial methods, and accessibility can help most small-scale farmers. Investments in infrastructure projects that make renewable energy more efficient, roads that make the farming process more manageable, and investments in pest control and wastewater management that make the quality of agriculture better are all methods proposed by the World Bank to address these concerns. Another facet of this transition is education, which Chaudhury and Ayub discuss: "Developing climate conscious policy-making and recognizing the threat of climate change in national planning agendas as well as training

farmers in latest technologies and practices through farmer programs would further encourage [climate-smart agriculture] adoption in Pakistan" (Chaudhury and Ayub 2017). These adjustments are paramount since Pakistan is one of the countries most vulnerable to climate change.

Climate-smart adoption has begun global adaptation with mixed results. In sub-Saharan Africa, climate-smart investments led to varied profitability. Research done by Andrew M. Simons, Ellen B. McCullough, and Julianne D. Quinn shows how the high costs of increased fertilizer usage for maize are not always warranted in certain areas because of the high variability in soil types, rainfall, temperature, and plot slope (Simons et al. 2022). If Pakistan is to revamp its water usage effectively, it has to identify the most optimal sites for climate-smart investments. This case highlights the need for education programs that underscore the dangers of climate change and provide techniques that could help alleviate it.

Kashmir also has water resource potential in the form of freshwater springs. According to research by Sami Ullah Bhat, Shahid Ahmad Dar, and Aadil Hamid, many water springs in Kashmir have acceptable water qualities that the general population can use. Their measures of the water quality index determined that "39.5% of the springs had excellent waters, 47.7% had good water" (Bhat et al., 2022). This discovery of freshwater springs is a promising development and could help alleviate communities disproportionately affected by water scarcity in Kashmir.

India has been gauging the demand and effectiveness of new technologies to make farming more water-efficient. According to research from Travis J. Lybbert, Nicholas Magnan, David J. Spielman, Anil K. Bhargava, and Kajal Gulati, using an innovative laser land-leveling technique, which works by smoothening the farmable land, could help reduce groundwater extraction by 24% (Lybbert et al. 2018). This practice would help India and Pakistan optimize

their water needs. These techniques should become increasingly accessible as they are implemented globally.

Given these developments, there is potential for Pakistan, Kashmir, and India to meet their needs for water through innovation and education. Empowering farmers, encouraging water sustainability, and developing technologies that can better map the future damages of climate change can all help alleviate water scarcity, mitigating risks of conflict.

Interstate Tensions

Finally, we can tie all of this back to the main idea of this thesis: interstate tensions and conflict in Kashmir. Although the current course is favorable, worldwide patterns provide another cause for concern. My analysis of the Nile River Basin and the conflict between Israel and Palestine show how identity-based can spike in violence if involved parties cannot agree on natural resource management plans. If neither country can provide a viable long-term solution for water availability, productivity, and usability, this historical conflict in Kashmir can spiral into widespread violence.

Professor Michael Klare illustrates this concern in his journal article, stating, “In the absence of greater efforts by these countries to address this peril in a collaborative, equitable manner, looming water shortages could combine with other antagonisms to trigger armed conflict, possibly entailing the use of nuclear weapons” (Klare 2020). His statements echo my concerns about water scarcity amplifying pre-existing tensions and the devastating effects that this amplification can bring about.

Political analyst Shamsa Nawaz optimistically notes growing trust in bilateral dialogue from constituents in India and Pakistan: “Recently, peace movements have found a natural constituency in the growing middle classes and younger populations… these visionaries

preach the virtues of compulsory arbitration of disputes, international courts, disarmament, human rights and peaceful co-existence" (Nawaz 2016). This perspective frames the decades-old dispute over Kashmir not as a source of conflict and interstate animosity but as an opportunity to showcase the values of extensive bilateral dialogue and trust. This perspective seems to be supported by the data and the fact that both countries look towards international arbitration to resolve tensions rather than directly confront each other through more violent means.

Limitations

After looking through the data, there was a significant reliability issue. Since there are few numerical studies in Kashmir, finding data directly related to water scarcity in Kashmir was difficult and limited. That makes the empirical section of this thesis not wholly conclusive. Not only did I not have the geographic information system (GIS) knowledge to map the highest conflict zones in Kashmir, but I also did not have access to information that directly tied water scarcity to specific areas in Kashmir. As technologies improve and more data is gathered, these studies can be more comprehensive. Unfortunately, the lack of directly relevant data made it hard to make conclusions regarding the correlation between water scarcity and conflict.

Conclusion

As more and more areas become prone to droughts, floods, and general climate inconsistencies, tensions will rise. Internationally, this is a growing trend. Christian Parenti noted that water has become a crux around which different actors fight (Parenti 2012). Since water is especially valued in increasingly water-stressed regions, this value is tied to its agricultural usage and the national spirit.

Kashmir is an intriguing region to study because water is a central reason Pakistan and India highly value it. After multiple wars, skirmishes, and ongoing tensions, fatalities in Kashmir have lowered dramatically despite a rise in water stress. Recently, Pakistan and India have gone through international intermediaries expressing dissatisfaction with pre-established processes. Although not perfect, this progress bodes well for the future. However, local populations are often drowned out, and their frustrations should not be disregarded. There is much potential for remaining research, ranging from exploring the implications of international involvement and policy to looking at the effects of water scarcity on specific population subsets.

International Involvement

There remains much room for exploration on this topic. India and Pakistan are not wholly independent actors, and water scarcity is not purely a cause of climate change and water management. China is a powerful state actor that holds tremendous influence in Pakistan. China views its plans for power plants in Pakistan as a cornerstone of its far-reaching Belt and Road Initiative. According to research from Professor Meir Alkon and others, “While these facilities may help address Pakistan's energy shortages…by 2055, climate change-induced water stress in Pakistan will increase by 36–92% compared to current levels”(Alkon et al. 2019) International

involvement and interdependence is only going to keep growing, and that has to come in tandem with sustainable and careful water management policies.

Effects on Local Population

More space exists to research how water scarcity changes lifestyles for specific subsets of the affected populations. Women worldwide typically bear the burden of water accumulation, which dissuades them from pursuing other endeavors conducive to their autonomy and empowerment. Researchers Nadeem Ilahi and Franque Grimard study how water access affects women's time allocation for water-based chores. They conclude, “With improvements in the water-supply infrastructure, women increase the time that they allocate to income-generating activities” (Ilahi and Grimard 2000). Their finding illustrates the importance of proper water management concerning gender disparities. Adequate water supply allows women to go after more personal autonomous behavior. I wonder how one can frame local protests of dams and other infrastructure projects under a feminist lens. This field has much more nuanced categories to explore.

Final Remarks

What started as a study regarding the dangers of water scarcity has led to exploring the potential for peace, cooperation, and progress in Kashmir, Pakistan, and India. Tensions still exist, disagreements are constant, and the dangers of water stress are increasingly severe. However, suppose all parties continue to respect crucial ceasefires, acquiesce to valuable treaties and regulations, and vow to sustain peaceful relations. Then, there is reason to be optimistic regarding water scarcity and conflict.

Pushing for climate-safe infrastructure that makes efficient water usage more accessible to local populations is a valuable step. Newly discovered water resources and innovative technologies have the potential to offset water stress. To promote these technologies, education about climate change and its effects is paramount. Ensuring a fair distribution of resources across Kashmir and the Indus' tributaries by consistently revisiting the Treaty with international oversight is also crucial. Hopefully, all parties will keep working towards the appropriate foundations of a future that values peace, national identity, and indispensable resources.

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