Mapping the Human Right to Water in China

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ABSTRACT

According to the United Nations, the percentage of people without access to clean drinking water halved between 1990 and 2015, thereby meeting Millennium Development Goal (MDG) Target 7c for Water set in 1990. However, aggregate data used by the MDG to assess water resources fail to address enormous disparities between regions and countries, and across communities. In this research, China is used as a case study, where access to improved water is limited. I examined three case studies and documented their regional narratives on access to improved water sources and compared them with Joint Monitoring Programme's (JMP) data in order to evaluate the accuracy of JMP monitoring techniques used to assess progress towards the MDG. Despite JMP data suggesting improvement in China's water resources, previous studies in these regions show that access to improved water has actually declined between 2002 and 2010; except in metropolitan zones, where access to water improved. Wealthy, urban families were more likely to have access to improved water sources than poor, rural families. The persistence of regional disparities in access to clean water suggests the need to evaluate and adjust JMP's current monitoring methods and metrics, incorporating disaggregate data to identify communities most vulnerable to water scarcity, and formulate policy to better direct resources towards insufficient water infrastructures.

KEYWORDS

improved water, aggregate data, disaggregate data, regional disparity, Joint Monitoring Programme (JMP)

INTRODUCTION

Climate change stresses the availability of freshwater worldwide as incidences of drought, natural disaster and rate of rising sea levels increases. It is estimated that by 2025, one quarter of the world's population, particularly those that reside in developing nations, will experience severe water scarcity, thereby threatening quality of life (Postel 1997). Currently, although 348 million people have the potential to access clean water, they are unable to because local water development projects lack sufficient funding to ensure sustainable access to potable water (Seckler et. al 1999). In response, the United Nations (UN) passed Resolution 64/292 in July of 2010 with over 122 countries' signatures, explicitly recognizing the access to water and sanitation a human right. The resolution calls to mobilize international support from participating countries to accrue "financial resources, [and] encourage capacity development, and technology transfer" to address sufficiency, safety, physical accessibility and affordability of water in order to, under Target 7c of the United Nations Millennium Development Goals (MDGs), halve the percentage of people without access to clean water between 1990 and 2015 (UN Assembly 2010).

International water monitoring programs began in 1930 under the League of Nations Health Organization, which transitioned to the supervision of the World Health Organization (WHO), now working together with the United Nations Children's Fund (UNICEF) known collectively as the Joint Monitoring Programme (JMP) (Borowy 2014). The UN began leading international water monitoring in 1960 and continues to today, where the data collected by the JMP monitors progress towards MDG Target 7c. Through the MDG period, however, studies came out in response to JMP progress reports, skeptical of its metrics and methods used to track progress towards access to clean water (JMP 2014).

Main concerns are that in 1990, when Target 7c was written, there was no international metric established for collecting or monitoring water resources, suggesting that the single composite number indicating percentage of improvement unreliable. Furthermore, the data collected between 1990 and 2015 suggests that there were large gaps in knowledge for regional and disaggregate data, especially in developing countries. For this reason, the 2015 Update and MDG Assessment report suggesting that the world is "on track", or halved the percentage of people without clean access to water, is very questionable and must be revisited, working to improve both its methodology and quality of data, especially data in higher resolution in order to provide support towards specific populations of concern (WHO 2010). Direction for specific improvements and adjustments are currently unclear, and must be explored in preparation for monitoring activity in the Sustainable Development Goal (SDG) period between 2015 and 2030 in order to avoid the same mistakes made in the MDG period.

Other than assessing progress toward UN targets for water and sanitation, the JMP is relied upon to provide data for a number of powerful organizations including the UN Secretary General, the United Nations Development Program (UNDP), the World Bank, the World Water Assessment Programme, and the Ibrahim Index of African Governance amongst others to estimate the magnitude of global burden associated with poor access to water and investments needed to address these issues (Hutton et al. 2007). Since the inception of UN-led international water monitoring in 1960, the world has experienced an increase in population size by over two-fold, a life expectancy of now 68.7 years from 1960 average of 56.5 years, as well as unprecedented advancements in technology and medicine (Cohen 2003). After over 85 years of international water monitoring, it is important to reflect critically on the methods and metrics used to monitor the status of water access in order to prepare for future needs in water access, especially as the effects of climate change further stress water resources.

In July of 2010, China, along with over 120 other nations, voted in favor of UN Resolution 64/292 thereby explicitly recognizing access to clean drinking water and sanitation a human right (HRWS 2015). Despite JMP progress reports suggesting a 96% drinking water coverage in China, there have been an estimated 190 million reports of water-borne diseases in 2015, and an expected 30 million refugees fleeing water stress by 2020 in China alone (Gao et. al 2008). With its rapidly growing economy, large population, and ineffective water policies, China's water policy measures have been unable to distribute water resources equitably across urban and rural, north and south and socioeconomic gradients. Therefore, JMP methods and estimates of improved access to water resources in China must be revisited to incorporate regional, disaggregate data into its analyses to gain a more accurate understanding the status of water as a human right and how to address achievement gaps accordingly.

Goal with Specifics

The objective of my study is to examine how effectively the JMP's evaluation of "improved" access to clean water been in providing accurate information on access to water in China, as a case in point. The persistence of regional disparities across China in access to water suggests the need for closer examination at disaggregate data, while incorporating more metrics of analyses into assessing "improved" access. In doing so, international and regional policymakers can design policies that will more efficiently direct resources towards inadequate water infrastructures in vulnerable communities. I will do this through two central research objectives:

1. Using three regional case studies in China -- Xinjiang, Inner Mongolia and Chongqing -- contextualize each region's status on access to water.
2. Identify the methods in which the JMP has used to assess progress in China towards MDG Target 7c that have been used to support the country's status on access to clean water.

BACKGROUND

Current Challenges in China's Water Distribution

China has recently undergone dramatic changes in its economy and population size. Within the last three decades, China has emerged as a major economic player in the world economy. In 1992 alone, China amassed over $11 billion in foreign investments and is today's tenth largest exporter worldwide (Lardy 1994). Since 1960, China's population has essentially doubled from 660 million to 2013's estimate of 1.381 billion people, making it the country with the largest population in the world today (Lee 2001). Rapid changes create difficulties for policies to effectively direct water resources to populations most vulnerable to the repercussions of water scarcity.

Chinese water resources are regulated by multiple agencies; at times, a body of water can be governed by more than one agency and creates monitoring inefficiencies. In China, The Ministry of Water Resources (MWR) is the primary agency that creates and implements water policy and regulation. Under the MWR, several agencies serve to carry out national water policies and regulations at the provincial and county levels, including the Water Resource

Bureaus (WRBs) and the River Basin Commissions, one designated for each of the Huang He, Huai He, and Hai He river basins, the three veins of water in China. Aside from the MWR body and its local constituents, the Ministry of Environmental Protection (MEP), established in 2008 has a relatively large role creating policy and monitoring urban and industrial water pollution levels. Additionally, seven other agencies including the Ministry of Agriculture, Ministry of Housing and Urban-Rural Development, Ministry of Land and Resources, Ministry of Health, Ministry of Transport, State Forest Administration and Ministry of Finance have overlapping responsibilities with the MWR and MEP and all their local level agencies when regulating water policies, leading to inefficient monitoring methods as well as conflicts between local and national agencies (World Bank 2006). Aside from duplicated responsibilities and poor communication, unproductively low pollution fines and insufficient knowledge and resources for water monitoring result in ineffective policy implementation.

The first mention of water regulations in China dates back to 1989 under the Environmental Protection Law of 1989, preventing "pollution of fresh and marine waters" (Jahiel 1997). A series of increasingly specific water protection laws ensued -- the Law on Water and Soil Conservation of 1991 protected water resources from pollutants and mitigated for flood and drought disasters and the Law on the Promotion of Clean Production of 2003 urged industrial productions to employ water conservation and environmentally-friendly processes and equipment (Chen 2007). The Water Law of 2002 was the first to have introduced the relationship between water conservation, economic welfare and *people's* welfare, which is a big step towards realizing the human right to water. Additionally, this law assigned the Water Administration Department to design comprehensive water protection and distribution plans in the Huang He, Huai He, and Hai He river basins, regions home to over 34% of the Chinese population and contain three major river veins tapped most frequently for agriculture that contribute greatly to China's national growth (Yang et al. 2003). This is a step towards providing access to clean water for all because it assigned responsibility for water protection and distribution under a federal department, and affects a large fraction of the Chinese population. In 2008, The Control of Water Pollution Law established both federal and local standards for developing, regulating, utilizing and distributing water resources, which was the most comprehensive water regulation plan to date that encouraged communication between local and federal water regulators. Finally, in 2009, the Circular Economy Promotion Law focused specifically to reduce the impact of industrial processes on water resources, which account for most of China's water pollution, by encouraging sustainable practices through reducing, reusing and recycling (Yuan et al. 2006). It is important to note that although these laws are making steps towards providing access to clean water for all, the efficacy of these policies range across urban-rural, socioeconomic and north-south gradients.

Urban and Rural Disparities in China

Rural economies began to take off in 1978 after the inaction of DengXiaoPing's 1978 economic reform, which introduced open-door business with other countries, decollectivized rural economies and incentivized the emergence of private businesses. The effects of rural industrialization are still seen today, as rural economic activity contributes double-digit percentages to the country's annual economic growth rate (Wang et. al 2008). However, throughout these economic advancements, only 20% of industrial wastewater in rural areas is treated before being expelled into Chinese waterways and severely damages water resources with harmful pollutants (Qu and Li 1994). One reason for this phenomenon is the use of outdated infrastructure and technology in rural industries compared to their urban counterparts that have already phased out old infrastructure. And although China has installed stricter water laws directed at decreasing industrial discharge, which have largely been visualized by urban industries, rural industrial areas have experienced virtually no progress likely due to insufficient supervision and monitoring over rural industrial activity. This oversight needs to be addressed in rural industries before urbanization pushes municipal suppliers into rural industrial areas, as suppliers are not accustomed to treating water with high levels of pollutants (Zhang et. al 2010).

North and South Disparities in China

Water scarcity is more urgent in the North than in the South. In the North, conditions are more critical due to over-exploitation of surface and groundwater resources, lower quantities of water runoff from mountains and more frequent activities contributing to water pollution (Xia et. al 2007). The consequences of water scarcity are especially profound in the Hai River as almost 40% of the river is disconnected and fragmented, its wetland basin decreased by 9,000km^2 in just over half a century, and over-extraction of water resources affect the River's salinity content and ecosystem health (Cai and Ringler 2007). The North-South water disparity relates to rural industrialization since more industrial activity occurs in the Northern region, and comprises of 40% of the country's industrial output. Further, together with agriculture, the North not only has less total water resources than the South, but has also used 35% of its total ground water resources in comparison to the South, which has used only 6% (Wang 2012). In order for China to address the North-South disparity, policy must direct attention to lower industrial water pollution, monitor agriculture and industrial activity and provide effective water treatment mechanisms in the North.

METHODS

Study site

This study takes place on The People's Republic of China as a case study to examine JMP methods. It is currently the most populated country in the world, exceeding over 1.381 billion people as of 2013 (Lee 2001). Located in East Asia, China is rich in natural resources and contains tremendous physical diversity across its landscape. The northern and western parts of the country contain plateaus, mountain ranges and sunken basins while the southern and eastern parts comprise of predominantly fertile plains. Most of China's population is concentrated in urban pockets in the Eastern and Southern parts of the country. Currently, the United Nations Development Programme (UNDP) assigns mainland China a Human Development Index a value of 0.727, a country of "high human development" ranking 90th in the world, although comparatively low in respect to countries with similar GDP's such as the United States (ranking 8th for HDI) and Japan (ranking 20th for HDI) (UNDP 2015). As water becomes increasingly scarce due to climate change, population size and harmful pollution activity, water access in China is a growing concern.

Data processing

This study is simple in design, but offers new insight into the ways the JMP can improve its water monitoring methods by comparing the 2015 JMP Progress Report with the current reality of water access in China. First, I examined the 2015 JMP Progress Report and recorded JMP data on China's access to water along with the methods and metrics used to record this data. Then, in order to examine to what degree regional narratives' access to water was reflected in JMP data, I selected three regions in China -- Chongqing, Xinjiang and in Inner Mongolia and documented each region's narrative on water access based on their specific climactic, economic, and political conditions (Figure 1). Based on these three factors, I identified the major factors contributing to water scarcity in each region, and the populations most vulnerable to water scarcity. Finally, I compared regional narratives to JMP records to examine how they have been reflected under JMP's monitoring system and highlighted potential gaps in JMP data. In each of the Northwest, Northeast and Southern parts of China, regions were selected based on the Chinese National Bureau of Statistic's data, reflecting a steady decline in water resources between 2002 and 2010 despite showing progress towards JMP's definition of improved access to water since 1990. (China Statistical Yearbook 2010).

Figure 1: Map of China and three regional case studies. Xinjiang (top left), Inner Mongolia (top right), Chongqing (bottom).

RESULTS

JMP Data on China in 2015 Progress Report

According to JMP's 2015 Update Report, China increased water access for 488 million people between 1990 and 2015. In other words, 96% of the population in China has improved access to water resources from the 68% coverage in 1990. Improvement is especially notable in urban areas, where urban access to safe drinking water reached 706 million people and 91.93% of urban residents retrieved water from centralized urban water-supply services. In rural areas, access to safe drinking water reached 467 people, including 40.56 million teachers and students. All in all, China met Millennium Development Goal 7c, as the population without access to water decreased by over 50% in 2015 since 1990 (JMP 2015).

The Joint Monitoring Programme uses a combination of national household surveys, population censuses and national data to assess China's progress towards MDG Target 7c. National household surveys are disseminated and facilitated by UN workers, and include the Multiple Indicator Cluster Survey (MICS) and the Demographic Health Surveys (DHS), which are administered every 3-5 years. The National Bureau of Statistics of China and the United Nations Population Division (UNDP) typically conduct population censuses every 10 years. National data in China is collected by national agencies including the Ministry of Health, the Ministry of Housing and Urban-Rural Development, the Ministry of Water Resources, and the National Development and Reform Commission, and the Ministry of Foreign Affairs (JMP 2014).

JMP Methods for Evaluating Access to Water

JMP data supports progress towards Target 7c by determining national percentage coverage of improved access to water calculated using the ratio of people who use an improved drinking water source to the total population. This same computation is used for urban and rural breakdowns. Percent coverage estimates are extrapolated using national censuses and nationally represented household surveys collected by the United States' Agency for International Development (USAID) and the UNICEF; however, the final percentage is calculated using a unique combination of government data and household surveys from country to country, depending on the availability of data. In cases when data is insufficient, the JMP adjusts percent coverage to better compare with other countries. Since 1990, urban and rural household survey and census data are plotted on a linear regression trend to estimate respective coverage. Each point on the linear trend is five years apart from its adjacent points, and linear regression lines are drawn if two points are plotted. Total national percent coverage is calculated by urban and rural estimates, latest population estimates, and urban and rural distribution estimates given by the United Nations Population Division. Global coverage is calculated by weighing population-weighted averages by global population (UNSD 2015). With the introduction of Resolution 64/292, which emphasizes equitable distribution of water resources in addition to simply coverage, the JMP responded by incorporating wealth quintiles into its analyses in most of its reports since 2004. Reports are published biennially (UN 2015).

The JMP classifies drinking water resources as improved or unimproved depending on their source. Improved water resources are considered ones that are delivered to a user's home or dwelling through water pipes, or retrieved through an other source that is covered including covered wells, protected springs, public taps or rainwater collection. Unimproved sources are ones that are unprotected, unprotected, delivered by water carts with small tanks, and bottled water. The JMP reports access to improved water resources as synonymous to access to safe water resources (UN Stats 2010).

Parameters for the Human Right to Water

The MDG Target 7c for improved access to water was adopted in 2006 after a 5-year editing process amongst world leaders. The Human Rights to Water and Sanitation, or Resolution 64/292, was officially passed and recognized in 2010 by over 120 nations, which set more specific parameters by which improved access to drinking water was to be judged by the JMP, with emphasis on distribution equity (UN Assembly 2010). Four criteria were produced under this Resolution pertaining to water:

1. Sufficiency: **50 to 100 liters** of water are needed per person per day to fulfill basic needs

2. Physical Accessibility: The distance for water collection must not exceed **1,000 meters** from home and collection time should not exceed **30 minutes** per day
3. Affordability: No more than **3%** of household income should be spent on water-related expenditures
4. Safety: Water resources must be safe to use for domestic purposes, without microorganisms, chemicals or other hazards. Specific criteria vary from country to country depending on national and local standards. Guidelines lightly abide by WHO standards for drinking-water quality.

These parameters serve as general guidelines towards Resolution 64/292. Currently, there is no official monitoring technique implemented to assess progress towards these targets. The only monitor adjustment the Resolution introduced was the incorporation of wealth quintiles into JMP's assessment towards MDG Target 7c to capture potential economic disparities at the urban, rural and national scale.

Regional Case Study: Xinjiang

I. Climate

Located in the Northwest of China, Xinjiang has a desert climate, marked by its drastic changes in temperature across the year and low precipitation. The north tends to be cooler and receives over twice as much precipitation than in the southern region. In the summer, the region consistently sets the hottest temperature in the country every year, easily reaching over 40 degrees Celsius. In the winter, temperatures regularly fall below -20 degrees Celsius with even cooler temperatures in the north and areas with high elevation. Most of its rivers stem from the snowmelt generated from Tian Shan mountain ranges, but because of Xinjiang's arid climate and low precipitation, most of its waterways disappear or flow into salt lakes. When the river water is not completely reduced because of Xinjiang's hot desert climate, the remaining water resources are diverted heavily when flowing through populous mountain foothills for irrigation and agricultural purposes (Yang 2003).

II. Politics

Officially the Xinjiang Uyghur Autonomous Region, the region is one of China's five autonomous regions, meaning that it has limited power deciding its own political and economic agendas. The populations of ethnic minorities that reside in the region exceed the number of Han Chinese. Today, Xinjiang's four major ethnic groups include the Han Chinese and the Uyghur, Hui, and Kazak minority groups. The Uyghur people make up the largest percentage of Xinjiang's population, at 46.1% with the Han following at 39.2%. The percentage of the Han population in Xinjiang rose tremendously between 1949 and 2008, from 6.7% to 40%, while the percentage of ethnic minorities dropped proportionally (Howell and Fan 2009).

The region became a part of China in 1949 as a province, and eventually an autonomous zone in 1955. In the last two decades, conflicts between the Han Chinese and the Uyghur minority have become increasingly numerous and violent. Ethnic conflicts are attributed to the influx of privileged Han migrants threatening the livelihood of the Uyghur people, contributing to growing inequality between the two groups. This is seen in the overrepresentation of Han people in urban centers, where resources are more abundant and living conditions are better than in rural counterparts. While the Han comprise of only 40% of Xinjiang's total population, they comprise of 79.9% of Xinjiang's urban population (EWC 2004). Additionally, the literacy rate of Uyghur people is three times less than that of Han people, and the average monthly income of Uyghur employers is 31.9% less than that of Han people, suggesting economic and educational disparities between the two ethnic groups (Howell and Fan 2009).

III. Economy

The Develop the West campaign, created by the Chinese State Council, is an ambitious economic plan that was created to boost economic development in Western China. It set a 9% annual growth in GDP for Xinjiang, which is largely supported by the region's cotton industry. As of 2015, Xinjiang's GDP reached 930 billion yuan with an annual increase of over 10% in the last four years, exceeding the government-set quota of 9% (Feng et al. 2000). The cotton industry is identified as a strategic economic industry, and consists of 40% of Xinjiang's arable land, expecting to grow by 13% in the next decade with the renewal of the Develop the West campaign in 2009 (Hagt 2003).

IV. Water Scarcity

Because of climate change and water diversion projects, Xinjiang's total water resources have dropped 60 meters between 1970 and 2003, the most drastic decline recorded in China. There are no formal provincial restrictions for diverting water, meaning that anyone can divert water for any purpose (Deng 2009). Industrial wastewater discharge further threatens remaining water resources, inputting high levels of chemical oxygen demand, ammonium, biological oxygen demand, phenol and phosphorous into waterways, greatly threatening the quality of drinking water. The cotton industry is amongst the largest water polluters, accounting for 55% of industrial discharge due to its fertilizer and pesticide discharge (Ma et al. 2009).

V. Inequitable Distribution of Water Resources

According to the Xinjiang Water Conservancy Bureau, 78% or 16.4 million people receive water to their homes or yards through water pipes (Xia and Zhu 2002). However, other sources indicate that over 9 million people in Xinjiang who receive piped water actually receive river water that is not treated or purified, thereby containing higher traces of industrial chemical discharge and bacteria in the water. Treated river water is piped to predominantly urban areas, where, mentioned previously, the Han Chinese comprise of almost 80% of the cities' population despite only making up 40% of Xinjiang's total population (Leiwen et al. 2005). In comparison, the rural areas, where most ethnic minorities live, residents receive untreated river water. It is important to note that, according to JMP metrics for "improved" or "safe" water resources, Xinjiang's water resources would be considered safe by the JMP for drinking because it is delivered through pipes.

Because cotton is an especially water-intensive crop, its production processes in Xinjiang's already arid land greatly stresses the availability of water resources. Pressured to maintain an annual 9% growth rate in GDP, Xinjiang's lucrative cotton industry is expected to continue expanding in order to meet the government's annual quotas. The industry contributes to growing inequality and tension between Han Chinese and the Uyghur minority, as 400 of Xinjiang's 570 waterways run through cotton farms owned by Bingtuan, or Han Chinese farmers, leaving the Uyghur minority with less governance over the region's natural water resources (Chaudhuri 2010).

In Xinjiang, the distribution of water resources is weighed against ethnic minority groups. The influx of privileged Han migrants resulted in the group's growing influence over the region's waterways, economic composition and industrial activity.

VI. Gaps in JMP Data

Because 78% of Xinjiang's residents have access to "improved", or piped water sources, the JMP would consider the region to have met MDG Target 7c. However, this estimate does not account for the quality of water delivered to households through water pipes, as rural areas receive water directly from rivers without being treated or filtered, and the majority of Xinjiang's waterways contain high levels of industrial discharge unfit for drinking water. Furthermore, disproportionately more ethnic minorities experience the burden of water scarcity, which the JMP fails to capture in its aggregate percent coverage.

Regional Case Study: Inner Mongolia

I. Climate

Located in the Northeast of China, Inner Mongolia has a monsoon climate with temperatures ranging from -25 degrees Celsius in its long cold winters to 36 degrees Celsius in its short summers. Inner Mongolia receives little and uneven rainfall, averaging only 50 mm per year in the west and 550 mm per year in the east. In this sunny region, annual sunlight averages at 2700 hours. The eastern tip of Inner Mongolia is scattered with small wetlands, and the largest body of water in the region is the Yellow River (Chen et al. 2007).

II. Politics

Established in 1947, Inner Mongolia also known as Nei Mongol Autonomous Region is another one of China's five autonomous zones. In comparison to provinces, autonomous regions have less authority over their economic and political agendas. According to the 2010 Census, Inner Mongolia's demographics comprise of 79.5% Han Chinese and a sizeable Mongol population at 17.1% with small percentages of other ethnic minorities including the Manchu, Hui and Daur (Sneath 1994). Unlike other autonomous zones, inter-marriage between ethnic minorities and the Han Chinese is especially common, and Inner Mongolian policymakers have slightly greater influence in deciding the territory's economic agenda despite its status as an autonomous region. Because of Mao ZeDong's land reform and collectivization policies, most of the nomadic Mongol population has since settled down in permanent homes. Mongols who have completed higher education generally move to larger urban centers, where they receive comparable income and living standards to the Han population (Chang 1993). Although ethnic tensions are less in Inner Mongolia than that of Xinjiang, historical tensions between Mongols and the Han population continue to affect the distribution of resources and power today.

III. Economy

Inner Mongolia is rich in natural resources and its sparse population leaves an enormous amount of space for industrial processes, mainly the production of coal. As a region that contains one fourth of the world's total coal reserves, and generates on average 500 million tons of coal per year, Inner Mongolia's economy is cushioned on this lucrative industry, with its per capita GDP ranking fourth amongst all of China's provinces after Shanghai, Beijing and Tianjing. In 2015, its GDP reached almost 2 trillion yuan, increasing about 10% each year between 2010 and 2015 (Thomson 2003). The production of coal is justified despite its destructive environmental practices because it is accessible for people without experience, and pays considerably higher than other industries.

IV. Water Scarcity

In addition to the effects of climate change casting drought conditions upon 40% of Inner Mongolia's land and drying up waterways, the coal industry is by large the greatest anthropogenic factor contributing to water scarcity. Coal production requires substantial water consumption and accounts for more than half of China's industrial water usage. 85% of China's coal industries are located in Inner Mongolia, which only contains 23% of China's total water resources (Thomson 2003). The momentum to sustain its profitable coal industry suggests the need to maintain or even increase its current water consumption rates. The 13th five-year plan established by the Chinese government for the 2016 to 2020 time period focuses on economic growth, instigating a project to create 16 more large-scale industrial coal plants in the region. It is estimated that these additional facilities will require 10 billion cubic meters of water per year, which is greater than one fourth of the Yellow River's annual water supply (Xinhua 2015).

Industrial discharge also diminishes the quality of water in Inner Mongolia. In 2004, the Sawai Xinghuazhang Paper Company and the Meili Beichen Paper Company released a total of 2 million cubic meters of industrial wastewater into the Yellow River, amounting to over $300 million in damages. Instead of shutting down the industrial facilities, the local government built a pond to store the industrial wastewater. Two years later, the pond was in danger of spilling into the Yellow River due to high winds, so local authorities diverted the polluted water to Sugai, a nearby village, where the inhabitants were forced to evacuate and remains inhabitable to date (Hall 2009).

V. Inequitable Distribution of Water Resources

The World Bank estimates that access to piped water resources in Inner Mongolia saved 30 minutes per day for water retrieval, and now covers 72% of the urban population (Shuchen et al). However, this estimate does not account for the diminishing availability of water resources, as competition and price of water resources increase. The water-intensive coal industry is responsible for most of the region's 31% total water depletion, limiting the availability of water resources for drinking, grassland health, and animals. In return, nomadic people and farmers either endure more difficult living conditions in the grasslands, or are pushed into cities, sacrificing their traditional lifestyle to pay more for safe drinking water.

VI. Gaps in JMP Data

The 72% coverage of piped water supply in Inner Mongolia's urban areas suggests success in meeting Target 7c, but does not reflect water shortage and water pollution crises in the overall region. Where urban areas are home to more affluent populations that only experience the occasional sandstorm induced by drought conditions, it is the rural, nomadic and farmer people that experience greater burden of water scarcity.

Regional Case Study: Chongqing

I. Climate

Chongqing is a city in China's southern region and has a humid subtropical climate, characterized by its long, hot and humid summers, and short, mild and damp winters.

Temperatures range from -1.8 degrees Celsius in the winter to 34 degrees Celsius in the summer. The city receives only 1,055 hours of sunshine per year, one of the lowest in the country and receives considerable amount of precipitation, averaging about 1,108 mm per year (Zihua and Limin 1992) . Also known as the "City on Rivers", Chongqing sits on top of mountains surrounded by rivers, including the Yangtze, which is the longest river in Asia. In this region, natural water resources are abundant from waterways and precipitation (Gong et. al 2011).

II. Politics

Chongqing is one of five national central cities in China and one of four direct-controlled municipalities. It is the only direct-controlled municipality located inland, and was created in 1997. The municipality has a population of over 32.8 million people, making it the most populous Chinese municipality. Of the total population, 8.2 million people are migrant workers who tend to live farther away from city center, and are grouped in lower income brackets than those that live in city center (CSYD 2010).

III. Economy

Chongqing separated from the Sichuan province in 1997 as a part of the China Western Development plan to boost the economy in China's southwest region. Chongqing's economy is comprised largely by its automobile, motorcycle, iron, steel and agriculture production. In 2011, Chongqing's GDP reached 1001.1 billion yuan, with an annual growth rate of about 16.4% (He and Zhu 2010). The city has attracted large investors in recent years as it is expected to become an even greater economic hub in the next decade by building large-scale railway and road networks, creating an export station along the Yangtze River, and generating power from the Three Gorges Dam, (Shao and Qi 2008).

IV. Water Scarcity

In Chongqing, although water is relatively abundant, its quality is threatened by rapid urbanization and industrial pollution. Industrial wastewater has been recorded to flow continuously from 600 outlets into its waterways, exposing surrounding residents to water-borne diseases, and contaminating the water in the Three Gorges reservoir and its downstream subsidiaries. In 2006, Chongqing's tap water contained 80 of 101 banned pollutants that are harmful for human health. Additionally, only 20% of its pipelines met national guidelines for pipe materials, contributing to secondary contamination in its waterways. Aside from water treatment facilities that were built in 1990 or later, the rest of Chongqing's water treatment facilities, which account for 72% of the region's "treated" water, produce water that barely meets Category II or III (Category I being the safest drinking water) national standards for water quality set by the Chinese Ministry of Water Resources (World Bank 2006).

V. Inequitable Distribution of Water Resources

Despite being surrounded by rivers, Chongqing has limited access to clean surface water and underground water resources. Domestic water supply is monopolized by the Chongqing Water Group Corporation, as it continuously raises domestic water prices, thereby making it more difficult for people with lower income to afford (Xie and Warford 2007).

The repercussions of water scarcity affect disproportionately more people in the lower income brackets. In Chongqing, a city in China that experiences poor domestic water service quality and insufficient financial resources to improve the quality of water, the lowest income group that earns an average of 200 yuan per month or less, spends an average of 6% of their monthly income on water-related expenditures. In comparison, households earning more than 1000 yuan per month spend only 1% of their income on water resources, and most of these households reside in Chongqing's city proper. This 6% expenditure is far from the United Nations Development Program's income-based benchmark of maximum 3% of monthly income spent on water-related expenditures. In addition to the 3% monthly income that these families could use for other household expenditures, only 34% of low-income households in Chongqing gain water access through pipes. For households that do not receive water through pipes, they are more likely to acquire water-related diseases because they must resort to retrieving water through open wells or directly from the water source (Wang et al. 2010).

VI. Gaps in JMP Data

JMP considers the entire municipality of Chongqing to be an urban area, thereby aggregating all of its regional data into one composite number. 93% of Chongqing's population falls within the top 4 income brackets, overshadowing the other 7% of its population, or almost 2.27 million people who pay 6% or more from their monthly household income for water-related expenditures. People that pay more than 6% of their monthly income rely more heavily upon open and unsafe water resources (Wang et al. 2010). JMP data fails to reflect factors of affordability and water quality when assessing the status of Chongqing's water access.

DISCUSSION

JMP's evaluation of China's progress towards Millennium Development Goal 7c is centered on specific parameters of "improvement" for water resources, characterized by whether or not the water source is covered. With the introduction of Resolution 64/292, the JMP has incorporated wealth quintiles into its more recent analyses to try to account for potential socioeconomic disparities, although it still has several limitations and biases when assessing the accessibility of water resources. In the discussion section, I evaluate the reliability of data produced by JMP's current methods and offer potential adjustments in water monitoring to better inform international water policies and distribution needs in the future.

Accuracy of JMP Methods in Representing China's Coverage of Water Access

JMP's estimate of China's coverage situation is determined through linear regression models rather than deriving its estimate from more recent regional survey results, or using logistic regressions that are able to incorporate more metrics of analyses into assessing water access (UN 2015). Discrepancies are reported between the 2015 JMP Progress Report and regional case studies due to the latter's incorporation of water quality into assessing access to clean water. Furthermore, definitions for water quality differ between local and international monitoring standards. While different definitions may contribute to discrepancy between local studies and JMP data, other factors that likely influence this is JMP bias and error, unreliable national data, inadequate JMP methods, or some combination of the above (Bartram et al. 2014b).

Nationally represented data such as the 2010 Chinese census used to estimate coverage may result in error because these large-scale data tend to exclude marginalized communities or communities living in temporary settlements who do not have access to household surveys or censuses (Chien-Hsun Chen 1996). Furthermore, because of political tensions between the national government and marginalized communities residing in autonomous regions, the Chinese government, known for its intense censorship especially in regards to human rights, may leave out or alter certain socioeconomic indicators used by the JMP to assess water access in these communities.

Household surveys are administered by UN-workers, and likely contain interviewer or respondent biases. The respondent's source water is deemed "improved" or not based on his or her verbal account, which requires considerable interpretation of JMP's narrow definitions distinguishing improved from unimproved water sources to determine the most suitable category. In instances when respondents are unable to classify their water source because of language barriers or because they cannot recall the format of the water source, interviewers are pressured to fill in a response for the sake of producing results. Additionally, other biases may be introduced in JMP data when respondents respond in a way they think will benefit their community or conditions for water access, especially in more disadvantaged communities (Clasen 2010).

When the JMP does not have sufficient data to assess progress, it adopts the 50% rule, which assumes 50% improvement of water access, thereby automatically meeting MDG Target 7c of halving its population without access to clean water (Bartram et al. 2014). This assumption erases the narratives of water-disadvantaged communities, which is hugely detrimental when international aid decides where resources and attention should be directed.

JMP's data does not have a definition distinguishing between urban and rural areas, and often fails to capture the situation of areas that fall between the urban and rural binary (UN 2010). In Chongqing, a city with a large economy and population, the JMP considers the entire municipality to be an urban area, aggregating a range of socioeconomic factors into one composite coverage value. More methods are needed to assess the urban to rural gradient in order to avoid erasing in-between narratives.

The accuracy of data derived by JMP's current methods has its limitations and biases. To provide a better understanding of the status of water resources, efforts must be directed towards eliminating survey biases, incorporating disaggregate data into its analyses and a focus on documenting regional narratives.

Adjustments for Future International Water Monitoring

The effects of climate change, population growth and economic development are expected to further stress water resources in China and on the global scale. In order to mitigate these stressors and alleviate the burden of water scarcity experienced disproportionately more by vulnerable populations, better international monitoring methods are needed.

The JMP produces single composite numbers of coverage to water access. Although reduction of various factors allows for easy comparability between countries to inform policy, an oversimplification results in the overlook of ethnic, socioeconomic and regional disparities. In order to gain a fuller understanding of water access in each country, regional, disaggregate data is needed to account for these currently hidden inequalities.

Even though the terms "improved" and "unimproved" may be beneficial for large-scale comparability, this binary overlooks potential benefits and drawbacks of other water sources. Instead of an all or nothing approach, the JMP could use disaggregate data to rank sources based on their relative reliability in order to identify most problematic sources. For example, JMP's definition of "improved" water as water from a covered source may not be applicable in areas such as Inner Mongolia, where many nomadic people rely upon traditional knowledge to access clean water resources, albeit uncovered, over more traditional water source formats. "Improved" should also entail more than just the physical accessibility of water resources, and incorporate metrics for water quality. In Inner Mongolia and Chongqing, water quality is compromised by industrial and agricultural discharge, and in more rural areas, the presence of fecal matter in waterways can pose as serious public health risks.

The 50% improvement rule should be abandoned completely by the JMP. Instead, when data is insufficient, this gap should be highlighted in order to better direct future monitoring needs.

Studies have shown that water coverage follow S-curves more so than they do linear trends. The JMP's reliance on linear regression models to provide percent coverage introduces inaccurate representation of coverage at the national, urban and rural levels. Transitioning to weighted models, and models that incorporate more units of analyses may alleviate this discrepancy (WHO 1990).

The MDG period has revealed various challenges for the JMP to address in order to better assess the status of water resources. In preparation for the Sustainable Development Goals, which are in effect between 2015 and 2030, MDG monitoring challenges must evaluated critically adjusted for to prevent the same set of mistakes from occurring in the SDG period.

JMP Monitoring Approach

Resolution 64/292 calls for "capacity building" especially in vulnerable communities to address water scarcity issues from the bottom-up. However, the current UN model for research limits local capacity building because it is led and directed by UN workers. I propose a participatory-based research model called Participatory Action Research (PAR) to replace currently UN-led research and JMP's reliance on national data (Whyte 1991). Unlike traditional research models that tend to be exploitative of local knowledge, the PAR model encourages researchers and community members to contribute equally to the research design and methods, and weighs equal value in local and scientific knowledge.

Limitations and Future Directions

This paper traced regional narratives across three case studies in China to assess the accuracy of JMP data. However, because JMP data is quantitative and aggregated, and my data was qualitative and disaggregate, it was difficult to compare the two to pinpoint exactly where gaps in data existed. While other studies, such as Bain et. al evaluation of safe drinking water in five countries, compared JMP data with another set of quantitative data collected by the Rapid Assessment of Drinking-Water Quality (RADWQ) program, I was unable to do this because there is no other national dataset for China's water resources comparable to the JMP's (Bain et. al 2012). Therefore, by relying on regional narratives and synthesizing previous studies done in these areas, I realized there were barriers in comparison, but hoped to illustrate the complexity of water access through qualitative research.

My study focused on three regional case studies in China to evaluate JMP's current water monitoring techniques, which have pointed to gaps in JMP data. As alternative monitoring techniques are proposed to replace current techniques, research must couple these new proposals to evaluate their efficacy and adjust for any problems along the way. Specifically, further research is needed to assess the accuracy of S-models and weighted models in representing water access, as well as testing alternative household survey formats in order to alleviate survey biases.

CONCLUSIONS

As the availability of clean drinking water in China becomes increasingly scarce due to industrial contamination of water resources, depletion of groundwater resources, growing water demand and the stress of climate change, water-monitoring systems must be able to accurately identify populations most affected by water scarcity in order to appropriately adjust policies and direct resources to these communities. Otherwise, water scarcity could continue to widen inequality, spark social unrest and introduce a variety of public health hazards. The JMP estimates that 96% of the Chinese population now has access to "improved" water; however, regional case studies show that the JMP's definition of improved is too narrow and disregards other indicators for clean drinking water such as the quality and affordability of the water. Inadequate monitoring techniques erase the existence of vulnerable populations from the national and international radar, thereby reducing any opportunity to receive resources that may be needed to improve local water conditions. People who live in rural areas, ethnic minorities and people in lower socioeconomic brackets experience disproportionately more burden than people who are richer, reside in urban areas, and a part of the more privileged Han population.

Through the act of generalizing water security in using linear regression models, national household surveys, national censuses, simplified definitions of improved water and the 50% assumption rule, the JMP omits other factors of water insecurity. These techniques can be adjusted for in order to better assess progress towards the Sustainable Development Goals in the next 15 years, but in order for water monitoring to combat the rapid effects of climate change, continuous and critical reflection of international water monitoring is needed. As the SDG period unfolds, which introduces more criteria for improved water, it is important for the JMP to move away from aggregated national data and into understanding regional narratives so that resources are directly more effectively to people who need it the most.

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