WaSH Policy Research Digest

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Detailed Review of a Recent Publication: The use of multiple sources of water is a common household practice that contributes to resilience

Elliott, M., MacDonald, M.C., Chan, T., Kearton, A., Shields, K.F., Bartram, J.K., Hadwen, W.L. (2017). Multiple household water sources and their use in remote communities with evidence from Pacific Island Countries. *Water Resources Research*, 9106–9117. doi: 10.1002/2017WR021047.

In a paper published in November 2017, Elliott et al. present the findings of a survey of 405 households in rural communities of the Republic of the Marshall Islands and the Solomon Islands. Unlike most surveys that typically focus on one "main source of drinking water", the authors used a survey instrument, administered by Computer-Assisted Personal Interviewing (MacDonald et al., 2016), that allowed households to report on up to ten water sources and eight uses for each, differentiating between wet and dry season use.

The data reveal that in the two countries, 91% of households use more than one water source, with significant variations in use of the sources across seasons. "Multiple water source use" is thus a common water management strategy in these communities[1].

The two countries differed considerably in terms of their water sources and uses. In the Marshall Islands, most households relied on rainwater and private wells (with the somewhat surprising addition of seawater which is preferred for cooking fish). In the Solomon Islands, a greater diversity of water source types was available and used, with nearly all households using a mix of local rivers, streams, public taps, natural springs, and private and shared rainwater. On average, two water sources were used by each household in the Marshall Islands, and three in the Solomon Islands (Figure 1).

Differing water resources and precipitation patterns in the two countries have determined water use patterns and investment in household water infrastructure. In the Marshall Islands, the lack of surface water sources and high risk of drought has made harvesting rainwater essential,

Key Policy and Programmatic Takeaways

- Focusing on a single water source for all domestic use may exclude other appropriate options, and can increase vulnerability to precipitation and climate-related hazards
- Multiple water source use may be a particularly important contribution to household resilience in Small Island Developing States
- Providing improved storage for households using rainwater may be an effective programmatic intervention, and this infrastructure can contribute to community level resilience if households share water
- Improved indicators are needed to measure and monitor use of multiple sources
- Household surveys should be designed to provide decision-makers better data on use of multiple sources, and provide a full picture of seasonal water access, water use behaviour and resulting health effects

[1] "Multiple water source use" should not be confused with "Multiple use of water systems (MUS)" which entails using a water source for agriculture, livestock, fish culture and/or home-based enterprises as well as for domestic purposes.

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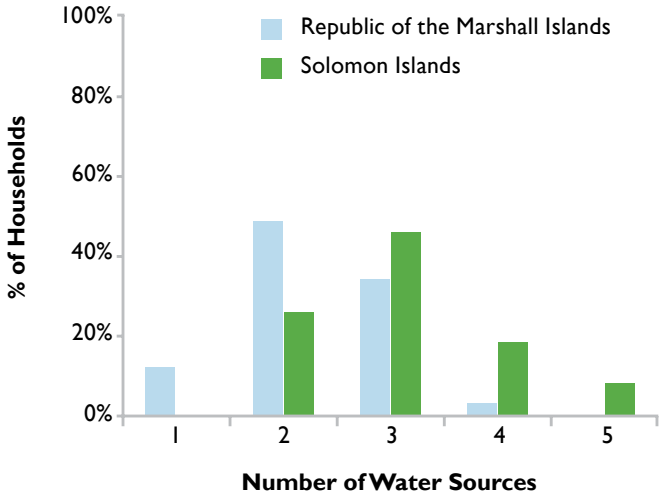

Figure 1. Number of different water source types used per household, as reported by respondents from 405 households in communities surveyed in the Republic of the Marshall Islands and the Solomon Islands (Elliott et al., 2017)

and households have large storage tanks. In the Solomon Islands, which have plentiful (though often poor quality) freshwater sources available as alternatives in the dry season, households store water in small vessels, precluding storage across seasons.

Sharing is a key element of water use in both countries. Sharing of private sources was found to be common in the Marshall Islands, where in the wet season 43% of households reported sharing privately collected rainwater and 25% shared their private well water with neighbours. In the Solomon Islands, sharing of private rainwater was not common, but wet season use of rainwater that had been collected on a shared basis was reported by 43% of households. However, sharing of water dropped in the dry season; for instance, sharing of private rainwater dropped more than 14 percentage points in the dry season in the Marshall Islands.

Source use also varied with seasons. In the Marshall Islands, 95% of households used rainwater for drinking in the wet season, and rainwater was the most common source for cooking. Households had large-volume rainwater tanks and rationed stored rainwater for drinking throughout the dry season. While the proportion of households using private rainwater for drinking did not change between seasons, using it for cooking decreased in the dry season.

In the Solomon Islands, pots and pans were used to collect relatively small quantities of rainwater, and the use of rainwater for any purpose declined substantially from wet to dry season for both private and shared rainwater.

The authors surmise that seasonal changes in water use increase the risk of water-borne disease. In the dry season, households shift from using rainwater for drinking to unsafe sources, such as unprotected wells. Likewise, seasonal shifts affected handwashing. In both countries, using rainwater for handwashing became less common in the dry season, while the use of water from rivers and streams for handwashing increased, with handwashing more likely to take place exclusively at the source. Significantly more households reported that they had no source of water for handwashing in the dry season than in the wet season. The findings suggest an interesting insight into the lack of reported health impacts in blinded drinking water treatment studies (for instance reported by Clasen et al., 2007), which may be due to waterborne risk exposure as a result of unreported use of multiple sources and seasonal changes between these sources.

The paper has several limitations. These include the relatively small sample size of 13 communities, spread across two very different geographical settings; the self-reporting of water source use; and the use of cross-sectional data collection at a single time, requiring recall across seasons. The paper nevertheless provides useful insights into the important role of multiple source use in creating household water resilience.

In their conclusions, the authors state: "the premise that a new water source must replace all traditional sources may be unrealistic, may exclude affordable and appropriate options, and can increase vulnerability to changing precipitation and climate-related hazards". Understanding the use of multiple sources in a community may provide insight for decision-makers that helps them design initiatives that supplement, rather than replace, existing water sources. However, investment in multiple sources may affect the willingness of stakeholders to connect to and pay for piped water, meaning that decision makers must balance progress towards resilience against progress towards the higher levels of service called for under the Sustainable Development Goals (SDGs).

The lack of understanding of use of multiple water sources by households is reflected in the almost exclusive focus on the "main drinking water source" in most drinking water projects and programs, and in data collection. Major global surveys collect data on the main drinking water source only. These data are used by the Joint Monitoring Program (JMP), which consolidates data sources to track progress towards SDG 6 targets. An example of the inconsistency of results based on asking about a single source at a single point in time is the use of water from natural springs for drinking in the Solomon Islands. The JMP, which categorises natural springs as unimproved sources, reports that 17% of people used this type of source in 2015. However Elliott and his co-authors found that use of natural springs for drinking was 17% in the wet season (consistent with the JMP), but jumped more than 9 percentage points in the dry season.

Increased understanding of how households use a complex "portfolio" of sources can reveal resiliency to water insecurity. This is of vital importance in Small Island Developing States (SIDS), which, particularly in the Pacific, are highly vulnerable. The authors suggest that rationing and sharing of rainwater in the Marshall Islands illustrate

"how household-level infrastructure could contribute to community-level resilience to climate change". The authors suggest both exploring the provision of rainwater tanks as an option for projects aiming at improving climate change resilience in SIDS, and investigating whether (and how) to "import" use of multiple sources to communities that have not used this approach before, and whether those communities can accrue the same benefits experienced by communities where it has developed indigenously. The findings in these two Pacific Island countries suggest that "climate change resilience projects should build upon existing local adaptations to precipitation variability and seasonality".

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Literature Review: Climate Resilience and risks associated with Multiple Water Source Use

In the paper reviewed in detail in this Digest, Elliott et al. (2017) examine the use of multiple household water sources in two Pacific Island countries. However, the practice is not limited to these countries, and is found around the world in countries with varying precipitation patterns, water resources, and other characteristics. Foster and Willetts (2018) identified a variety of water sources accessed by households in Vanuatu, including both public and privately-owned sources such as wells, boreholes, piped connections, and bottled water. Özdemir et al. (2011) showed the practice of multiple water source use was common among households in Vietnam, which made use of rainwater, surface water, piped connections, and water from vendors. Adekalu et al. (2002) found that in Nigeria many sources (taps, wells, boreholes, rainwater, etc.) were accessed by users for drinking and cooking in secondary capacities in addition to primary sources. The use of multiple water sources has been reported on all continents (Foster and Hope, 2017, Aleixo et al., 2018, Hu et al., 2011, Elliott et al., 2019), however this common practice is recognized by few researchers and policy makers.

As secondary sources of water are frequently unimproved, high-risk water use practices may be underreported, and estimates of use of safe drinking water can be inflated (MacDonald et al. 2016). In a study using household surveys in eight countries in Africa and Asia, Vedachalam et al. (2017) compare the prevalence of high-risk behaviors including the use of unimproved water sources to estimates by widely accepted Demographic and Health Surveys (DHS). Their results revealed an average 5.5% greater use of unimproved water over the DHS estimates, representing a population of 25 million people in the eight countries studied whose regular use of unimproved water goes unreported.

Use of multiple water sources by households is influenced by a combination of factors, and there are positive and negative impacts associated with it. Pearson et al. (2016) documented the risk associated with switching sources among largely pastoralist communities in Uganda and Tanzania, and showed that seasonal shifts result in changes in the water sources used in terms of the biological and chemical quality of the water, accessibility of water sources, and their reliability. In their study, 20% of surveyed households in Uganda switched from a source of lower risk in the wet season to a source of higher risk in the dry season (Pearson et al., 2016). Likewise, Kelly et al. (2018), in a paper reviewed in Issue 10 of the WasH Policy Research Digest, showed that seasonal changes in Zambia, Ghana, and Kenya, such as greater availablity of water in nearby shallow wells during the rainy season, or poor performance of solar-powered community pumps, caused users to switch from shared community water systems to higher-risk unimproved sources. On the other hand, 26% of Ugandan and 9% of Tanzanian households surveyed by Pearson et al. switched from a source of higher risk in the wet season to sources of lower risk in the dry season, and the authors posit that the ability to switch to an alternative source during the dry season provides these households with climate resilience (Pearson et al., 2016). This is supported by the authors of the paper reviewed in this issue of the Digest, who claim that communities that access multiple sources for their water needs gain climate resilience, as the likelihood that all water sources become unavailable during a single climate-related event (such as drought or flooding) is reduced (Elliott et al., 2019).

These findings challenge the implicit assumption that a desirable outcome is that every household relies on a single, high quality, source of water. This is not today's reality, and policy makers, practitioners and researchers need a better understanding of what influences multiple source use, its associated risks, and how it can contribute to building resilience to weather extremes and climate change. Greater insights are required into how multiple water source use can be taken into account when designing programming and monitoring progress. For instance, pricing models may be biased if research on water demand does not account for secondary sources (Coulibaly et al., 2014).

Computer-assisted personal interviewing (CAPI) offers opportunities for more detailed data collection on complex

multiple water source use, and allows data collection to be more tailored to specific communities (MacDonald et al., 2016). Tools such as this can support the integration of multiple source use into planning, managing and monitoring, and provide a more nuanced understanding of how households' use of multiple sources can contribute to tackling global water access challenges and climate resilience.

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