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Stroma Cole, Paula Tallman, Gabriela Salmon-Mulanovich, Binahayati Rusyidi



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Title: Water Insecurity is associated with Gender-Based Violence: A Mixed-Methods Study in Indonesia

**Authors:** Stroma Cole (1), Paula Tallman (2), Gabriela Salmon-Mulanovich (3), Binahayati Rusyidi (4)

1. University of Westminster, London, UK
2. Department of Anthropology, Loyola University Chicago, Chicago, Illinois, USA
3. Institute for Nature, Earth and Energy, Pontificia Universidad Católica del Perú, San Miguel, Peru
4. Department of Social Welfare, Faculty of Social and Political Sciences, Universitas Padjadjaran, Indonesia

Corresponding author email [coles1@westminster.ac.uk](mailto:coles1@westminster.ac.uk)

## **Water Insecurity is associated with Gender-Based Violence: A Mixed-Methods Study in Indonesia**

### **Abstract:**

Gender Based Violence (GBV) is a global pandemic and water insecurity is increasing in intensity and extent. This study explores the association between these two global health threats. Cross-sectional, quantitative data were collected via surveys (n = 365 adult women) to measure household water insecurity (HWI) and women's experiences of GBV in the last year. Qualitative data were collected from semi-structured interviews (n = 24 men and women), two focus group discussions (n = 25 men and women) and a multi-stakeholder meeting (n = 35 men and women) to explore experiences, attitudes and risk factors associated with HWI and GBV. Multivariate logistic regression analysis showed that women in water insecure households were more than twice as likely to report experiencing GBV in the last year (OR = 2.2, CI: 1.0-4.9, p = 0.051). Examining household water insecurity scores as a continuous variable revealed an increased odds of reporting GBV with each increase in the HWISE score (OR = 1.1, CI: 1.0; 1.1, p <0.001). Qualitative data indicates that the intersection between HWI, a patriarchal social organization and a caste system produced water-related conflicts between intimate partners, between daughters-in-law and their in-laws, and between masters and enslaved women. These results are presented using an integrated theoretical framework – a Feminist Political Ecology of Health (FPEH) – to illustrate the many ways women encounter and experience multi-dimensional forms of violence across scales in connection to water insecurity. The combination of robust qualitative and quantitative data presented in this study suggests that HWI may be causally related to GBV in this context.

### **Introduction**

Gender based violence (GBV) is one of the most prevalent public health threats in the world, with as many as one out of every four women affected (UN SDG5 2019). The United Nations (1993) defines violence against women as “any act of gender-based violence that results in, or is likely to result in physical, sexual or psychological harm or suffering to women” (p.2). While the causes of GBV are varied ([Heise et al., 2002](#)), an emerging body of literature is documenting the relationship between water insecurity and GBV (c.f. Tallman et al., 2022).

Water insecurity can occur on multiple scales. Household water insecurity (HWI) is defined as the inability to access and benefit from affordable, adequate, reliable, and safe water (Jepson et al., 2017). Experiences of HWI can be measured using the Household Water Insecurity Experience Scale (HWISE) – an internationally used, cross culturally validated scale, to measure experiences of HWI (Young et al., 2019).

The aim of this paper is to qualitatively and quantitatively assess whether a relationship exists between HWI and GBV in Sumba, a small island in eastern Indonesia. In Sumba, water is scarce (Riptani et al., 2021) and water infrastructure differs across communities. Additionally, patriarchal systems of social organization make water-related tasks “women’s work”. We hypothesize that these spatial and social conditions create an opportunity for GBV to emerge in relation to HWI. To investigate this possibility, we analyzed data from a quantitative survey, which includes measures of HWI and GBV, and qualitative data collected via semi-structured interviews, focus groups, and a multi-stakeholder meeting that yield insights into the causes and experiences of GBV related to HWI. We present our results using an integrated theoretical framework – a Feminist Political Ecology of Health (FPEH) (Nunbogu and Elliott, 2021) to illustrate the many ways women encounter and experience multi-dimensional forms of violence across scales. Using the FPEH framework in Sumba we document the underlying dynamics of the HWI and GBV nexus in a new geographical area and identify challenges in applying this theoretical framework in an empirical study. Despite these limitations, the combination of robust qualitative and quantitative data presented in this study suggests that HWI may be causally related to GBV in this context.

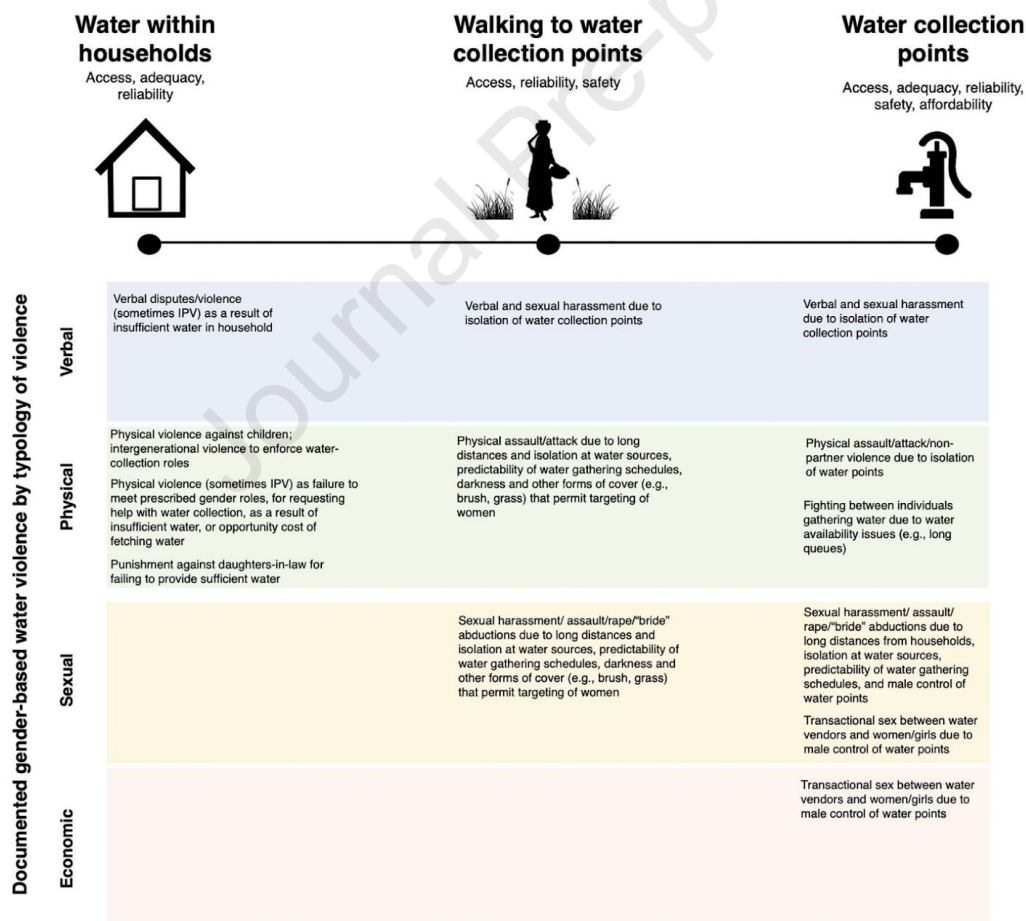
## Background

While the underlying causes of GBV are rooted in patriarchal relations, certain social and spatial “triggers” can lead to variations in risks of violence for women (McIlwaine, 2013). This includes inequitable access to water and gendered expectations of women related to water (Nunbogu and Elliott, 2021). In a recent review of the global literature documenting the association between water insecurity and GBV, Tallman and colleagues (2022) found that, GBV emerged in relation to all domains of water insecurity (i.e., access, adequacy, affordability, reliability, and safety) and along multiple spatial points where women engage with water (Figure 1.0).

For example, women have been harassed and sexually assaulted while fetching water (Thompson et al., 2011). Physical violence has erupted between individuals when waiting in queues for water (Mukhlani & Nyamupingidza, 2014). And sexual coercion, such as pressure to engage in transactional sex, has been perpetrated against women and girls vying to advance their chances of securing water (Pommells et al., 2018). Indeed, in the Tallman et al. (2022) review, the risk of physical and sexual violence occurring while women trekked long distances to procure water was the most common dynamic reported (Asaba et al., 2013; Assefa et al., 2021; Barchi & Winter, 2020; Chipeta, 2009; Choudhary et al., 2020; Collins et al., 2019; Epstein et al., 2020; Karim et al., 2012; Logie et al., 2021; Meyiwa et al., 2014; Mukhlani & Nyamupingidza, 2014; Mushavi et al., 2020; Narang, 2014; Pommells et al., 2018; Shah, 2002; Sultana, 2011; Thompson et al., 2011).

Water inadequacy was also a prevalent driver of physical and psychological violence between women, intimate partners, and other family members in this review (Tallman et al., 2022). In these cases, the primary mechanism connecting water insecurity to GBV appeared to be the opportunity costs of water acquisition that interfered with domestic activities (Assefa et al., 2021; Choudhary et al., 2020; Collins et al., 2019; Karim et al., 2012; Stevenson et al., 2012; Sultana, 2011), and insufficient water within the household for hygiene and consumption producing high levels of household stress (Collins et al., 2019; Mushavi et al., 2020; Pommells et al., 2018). Figure 1 showcases the types of GBV that occurred in relation to water insecurity, visualizing the spatial dimensions of this association in the household, to the path back and forth to collect water, and at water access points.

**Figure 1.** Spatial dimensions and types of violence related to water insecurity (drawn from Tallman et al. 2022).



In this study, we use mixed methods to ascertain whether a quantitative measure of HWI (the HWISE scale) is associated with reports of GBV on the island of Sumba,

Indonesia. We complement this quantitative analysis with qualitative data collected via semi-structured interviews and focus groups with both men and women in Sumba. We organize our qualitative findings using a feminist political ecology of health (FPEH) framework that foregrounds gender and power as critical variables in understanding the production of health inequalities. FPEH is a new theoretical framework that builds on feminist political ecology (FPE), a branch of political ecology, which analyzes complex relations between nature and society to explore access to and control of resources and their implications for the environment (Robbins, 2004; Watts, 2000). In particular, FPE critiques how power creates gender-based winners and losers as well as how policy outcomes impact women and other vulnerable and subaltern populations (Elmhirst, 2011). Importantly, the FPE framework can be used to explore the root causes of exclusion and injustice (Sultana, 2011), particularly at community, household and individual scales (Harris 2015).

There has been increasing interest in and use of FPE by scholars examining water insecurity (Truelove 2011, Sultana 2011, Harris 2015, Cole 2015, 2017, Adams et al 2018, Nunbogu et al 2021, 2023). We know from this body of work that unequal social hydrological flows (Swyngedouw, 2009) are inherently gendered. More specifically, power relations and patriarchal values, norms and institutions, shape access to water and to water governance. Scholars have articulated how these gendered power dynamics translate into every day, embodied, and emotional struggles with water for women (Sultana 2011, Harris 2015, Cole 2017).

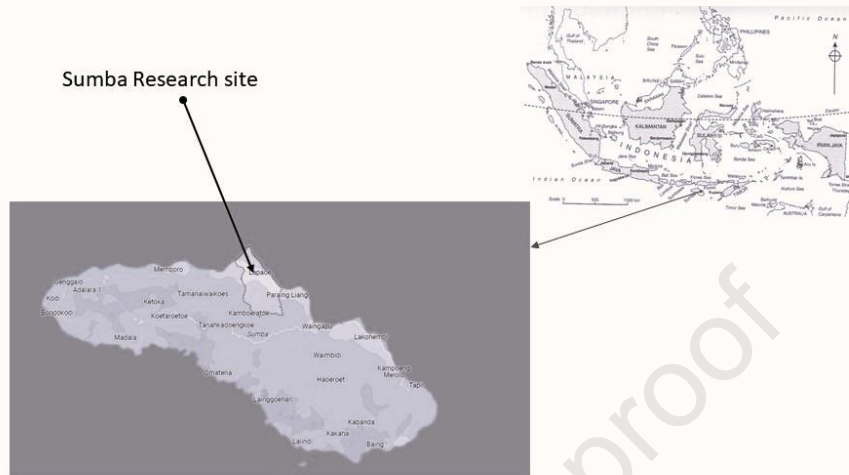
Following the burgeoning FPE literature on gender and water insecurity, Nunbogu and Elliott (2021) put forward a composite of FPE and the Political Ecology of Health (PEH) into a combined framework: a Feminist Political Ecology of Health (FPEH). FPEH is similar to other models such as the socio-ecological model (Bronfenbrenner, 1977) in that it uses nested circles that become progressively larger—like a ripple—to allow researchers to think through different levels of relationality between an individual and their environment (i.e., individual, household, community etc.). However, FPEH combines this multi-scalar approach with an emphasis on the role of gender and power in the production of health inequalities. Further, scholars have suggested that FPEH is particularly relevant for studies of water insecurity and GBV (Nunbogu and Elliott, 2021) providing an opportunity to examine how this framework applies to an empirical study of HWI and GBV.

### **Research Site: East Sumba, Indonesia**

Sumba is an island in eastern Indonesia (Figure 2), in the province of Nusa Tenggara Timur. East Sumba is a district on the island, which is one of the driest regions of the Indonesian archipelago.

**Figure 2.** Map showing location of the study site, Sumba Island, Indonesia.

## Research Setting



On the island of Sumba, the dry season regularly lasts from April to November, but reports from the Jakarta Post in 2019 indicated this area went 249 days in a row without rain. Fresh water is extremely limited. Less than 20% of the population have piped water and 36% of the population get water from unprotected sources (BPS 2022). Water grabbing by expanding industrial agriculture is reducing already limited freshwater supplies (Makambombu et al 2017, Fowler 2020).

Sumba is sparsely populated with an approximate population of 780,000 people (BPS NTT 2019). It is the third poorest area in the province of Nusa Tenggara Timur, with average poverty levels of 28% but with substantial urban-rural differences and poverty levels in rural areas closer to 70% (Vel and Makambombu 2023). Data from East Nusa Tenggara Province Statistics Agency (2022) showed that East Sumba had a high prevalence of *extreme* poverty (15.14%) and low education (average 7 years school), and stunting rates of children under 5 years old being over 50%.

Indonesia is a patriarchal society with implications for understanding the relationship between HWI and GBV on multiple scales. Specifically, social organization in the communities in East Sumba has three elements: (1) the house or *uma*, (2) exogamous patri-clans, and (3) castes (Forshee 2000, Soeriadiredja 2022). The caste system, which manifests on the community level, divides people into three tiers: the nobility, the free people and enslaved people. People of lower status are obliged to work on fellow clan members' land, and provide other services such as water fetching (Vel and Makambombu 2019). On the community and household level, regardless of caste, women have an inferior position in relation to decision making within a clan. Upon



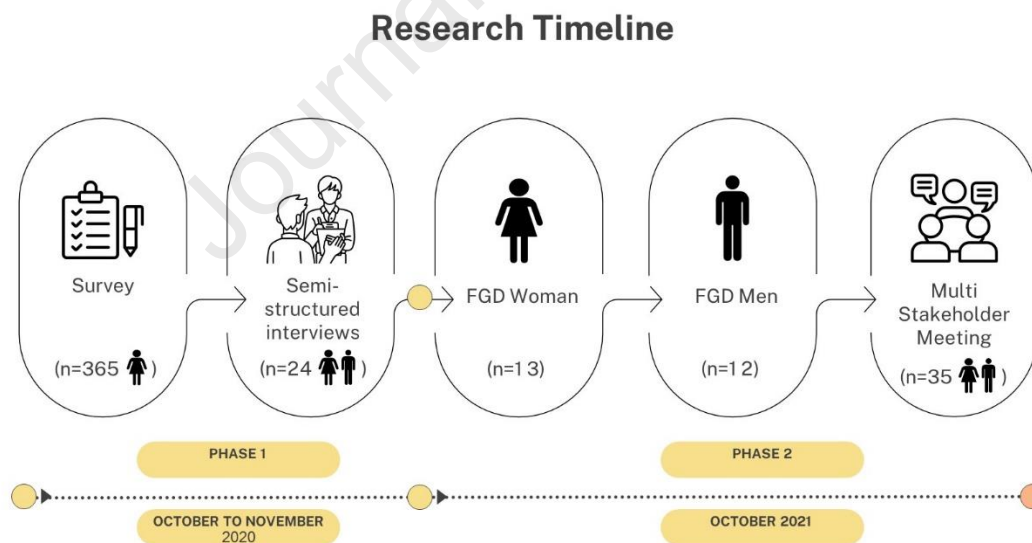
marriage, wives move to their husband's family's home until they can afford their own house. However, even after moving out of the family house, the wife will still “belong” to her husband's clan, setting the stage for conflicts with in-laws. Finally, the *uma*, or the household, serves as a center for decision making, disputes, and conflict resolution. These systems of social organization are important to understand HWI and GBV as they influence unequal power dynamics, including gendered inequalities, that shape who disproportionately suffers from water insecurity.

## Methods

### Study Design

This was a cross-sectional study using mixed methods in two phases of data collection. The first phase of research included surveys and semi-structured interviews. The second phase of research included focus group discussions and a multi-stakeholder meeting to discuss the preliminary results of the research and discuss locally relevant solutions to the gendered water problems identified in the first phase of the research (Figure 3).

**Figure 3.** Research Timeline



The first phase of research was conducted from October to November 2020, during the dry season, on the island of Sumba. The team collected quantitative data through a survey in four communities in a sub-district in the region of East Sumba. Based on information about available water infrastructure provided by the local government, we selected two communities hypothesized to be water secure and two communities



hypothesized to be water insecure, which were of sufficient size and accessibility. Surveys were conducted in a random sample of houses where women over the age of 18 resided. Field personnel were trained to apply the surveys following WHO guidelines to ensure privacy and sensitivity in collecting information on GBV. Sample size was calculated based on the national prevalence of GBV and to consider statistical significance ( $\alpha=0.05$ ) and power (80%). We aimed to deploy a total of 360 surveys in the field site to detect a prevalence of GBV in the past 12 months of 5% among 180 women without the exposure (HWI) and 20% of GBV among 180 women with HWI. Through the surveys, women victims of GBV were identified and invited to participate in semi-structured interviews. Victims of violence were also provided with referrals to local assistance services and study personnel visited them two weeks after the interviews for a follow-up to ensure they were safe.

The survey applied in all communities collected general demographic information (age, educational level etc.), characteristics of water access, experiences of household water insecurity (HWISE) and experiences of GBV in the last twelve months. Measures of food insecurity were also included given the association between these factors (Brewis et al., 2019, Bethancourt et al 2023, Young et al 2021).

We used the HWISE scale, a tool validated in different contexts and languages, to measure water stress in the home. This scale is comprised of 12 items to capture experiences about water use during the last month including: feelings of concern, annoyance, embarrassment due to water insecurity or interference with hand washing, hygiene, washing of clothes, household activities. This scale also assessed whether problems with water led to changes of diet or thirst. The answers to the items are never (0 times), rarely (1 or 2 times), sometimes (3 to 10 times), often (11 to 20 times) and always (more than 20 times). Cumulative scores can vary between 0 and 36. A higher value indicates greater HWI. A score of 12 or more was used to characterize households as water insecure (Young et al., 2019).

Following Walby and colleagues (2017), the information collected on GBV focused on four dimensions of violence: psychological, physical, sexual and economic. The participants were asked about the type of violence experienced and the frequency of violence experienced: never (0 times), rarely (1 or 2 times), sometimes (3 to 10 times), often (11 to 20 times) and always (more than 20 times) over the last year. If participants had experienced violence, we collected information on their relationship with the perpetrator of the violence, and about the triggers of the violence, including water related issues. Finally, to collect information on food insecurity, the four question screener from the USDA food security module was used (USDA, 2012). According to the scale, a cut-off point of three was used where households were categorized as having food insecurity.

In parallel to the surveys, in-depth, semi-structured interviews were conducted with representatives from the government, non-governmental organizations, community-based organizations and with victims of GBV ( $n = 24$ ), who were identified during the surveys. Non-victim participants were identified based on their role in the community and through snowball sampling. Prompts for the semi-structured interviews were drafted by the central research team and focused on water infrastructure and management, women's health and GBV. Because GBV is a sensitive topic, we worked with the \*\*\*Removed for Anonymization \*\*\* institutional review board (IRB) to ensure that all research tools guaranteed respectful and tactful treatment of participants. We also developed a protocol to respond to risky situations for participants and interviewers.

Once preliminary data analysis was complete on the surveys and semi-structured interviews from Phase 1, Phase 2 proceeded. In Phase 2, conducted in October of 2021, we held two focus groups and one multi-stakeholder meeting. Focus groups with men ( $n = 12$ ) and women ( $n = 13$ ) were held separately to allow for gender-sensitive topics to be discussed, following the research protocol set forth by the WHO Protocol and Practical Guidance for Research on Violence Against Women (2016). The focus groups included local villagers (including victims of GBV), community health workers, leaders of local government, water committees, and religious organizations. The facilitated group discussions considered the communities views on violence, issues of water insecurity and the connection between them.

The multi-stakeholder meeting was held in Waingapu (the regency capital) and included local and regional authorities ( $n = 35$  men and women). In the multi-stakeholder meeting, preliminary findings from the research were presented and discussed to receive input on the findings and assess potential solutions. We provide additional information on the study participants in the results, although we did not elicit demographic information such as age from the participants in the semi-structured interviews, focus groups, and multi-stakeholder meetings.

### *Quantitative Data Analysis*

The prevalence of GBV was estimated using a binomial distribution. The comparison of reported GBV prevalence between water insecure and water secure households was carried out with a chi-square test. A bivariate analysis was performed to analyze the association between GBV and HWI. The outcome and main predictor were then incorporated into a multivariate logistic regression model with forward selection to adjust for factors such as age, education, and economic status. The final model incorporated a hierarchy for the community level considering the potential clustering within them. All statistical analysis was performed using Stata 15.1 (StataCorp. 2017. *Stata Statistical Software: Release 15*. College Station, TX: StataCorp LLC).

### Qualitative Data Analysis

Semi-structured interviews were recorded, transcribed, and translated into English. We used Dedoose (Dedoose version 9.0.17, (Los Angeles, CA: SocioCultural Research Consultants, LLC www.dedoose.com), a qualitative data management software, to identify pre-selected and emergent categories in the primary data and then inserted relevant quotes into an Excel matrix. All team members then worked from the Excel matrix to consolidate quotes pertaining to HWI and GBV from the semi-structured interviews, focus groups, and multi-stakeholder meeting.

The data presented for this analysis are derived from both phases of the research. The quantitative results are presented first and test the hypothesis that higher HWI scores are associated with an increased risk of experiencing GBV in the last year. Qualitative results are then presented using an FPEH framework, which provides insight into the dynamics of power and gender underlying the association between HWI and GBV on four different scales: (1) institutional (2) community, (3) household and (4) individual.

### Results

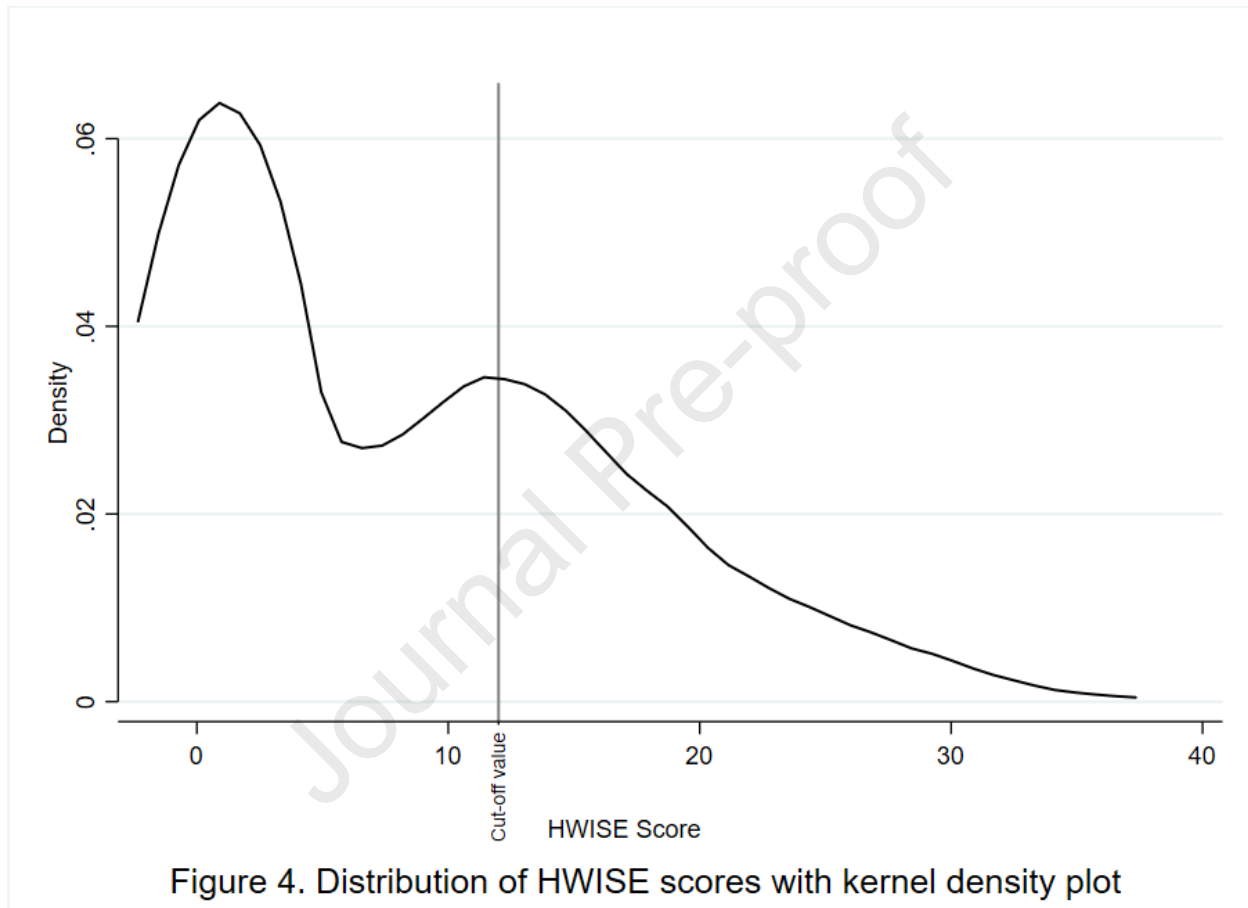
We collected surveys from 365 adult women. The demographic information from study participants is presented in Table 1.

		Water secure households	Water insecure households	Total	
		n=231	n=124	n=355	p-value**
Respondent's age (mean, SD)		39.2 (13.0)	40.6 (13.1)	39.7 (13.0)	0.364
Respondent education (n, %)	no education or incomplete primary	46 (19.9)	25 (20.2)	71 (20.0)	0.001
	complete primary	88 (38.1)	70 (56.4)	158 (44.5)	
	beyond primary	97 (42.0)	29 (23.4)	126 (35.5)	
Spouse's education (n, %)	no education or incomplete primary	72 (31.2)	29 (23.4)	101 (28.4)	0.001
	complete primary	69 (29.9)	66 (53.2)	135 (38.0)	

	beyond primary	90 (39.0)	29 (23.4)	119 (33.5)	
Number household members (mean, SD)		6.7 (3.2)	5.6 (2.4)	6.3 (3.0)	<0.001
Disability within household (n, %)		48 (20.8)	37 (29.8)	85 (23.9)	0.057
Place in economic ladder (mean, SD)		3.6 (1.9)	2.9 (1.5)	3.3 (1.8)	<0.001
Food security score (mean, SD)		4.3 (1.9)	5.4 (1.7)	4.7 (1.9)	<0.001
Respondent responsible for water collection (n, %)	Yes	165 (72.0)	104 (83.9)	269 (76.2)	0.013
	No	64 (27.9)	20 (16.1)	84 (23.8)	
Respondent responsible for water storage (n, %)	Yes	193 (87.3)	115 (92.7)	308 (89.3)	0.119
	No	28 (12.7)	9 (7.3)	37 (10.7)	
Main drinking water source (n, %)	pipied water	83 (35.9)	7 (5.6)	90 (25.3)	<0.001
	stand pipe	51 (22.1)	23 (18.5)	74 (20.8)	
	well	55 (23.8)	18 (14.5)	73 (20.6)	
	spring or surface water	15 (6.5)	29 (23.4)	44 (12.4)	
	tanker truck	27 (11.7)	47 (37.9)	74 (20.8)	
Time to water source in minutes (mean, SD)		58.0 (61.6)	152.9 (79.3)	91.1 (81.9)	<0.001
Frequency of water collection (n, %)	none	57 (24.7)	1 (0.8)	58 (16.3)	<0.001
	1-7 times/week	48 (20.8)	32 (25.8)	80 (22.5)	
	> 14 times /week	126 (54.5)	91 (73.4)	217 (61.1)	
Have a toilet at home (n, %)	None	83 (35.9)	57 (46.0)	144 (40.6)	<0.001
	Latrine	61 (26.4)	62 (50.0)	123 (34.6)	
	Toilet	83 (37.7)	5 (4.0)	88 (24.8)	
* All data in the tables are estimated with 355 observations with HWISE score					
** T-test or chi-square					

Ten surveys were excluded due to missing data, yielding 355 observations for all analyses including HWISE scores. HWISE scores for all households ranged from 0 to 35, with 35% of households in the study being categorized as water insecure (Figure 4).

**Figure 4.** Distribution of HWISE scores with kernel density plot.



The main perpetrators of GBV were spouses (88.1%) followed by other members of the household (11.9%). There were no reports of perpetrators from outside the household. Almost a quarter of the violent events were reported as happening “frequently” or “always”. The most commonly reported type of violence was psychological violence (92.5%), although this was frequently reported in combination with other forms of violence (Table 2).

		Water secure households	Water insecure households	Total	p-value**
		n=24/231	n=43/124	n=67/355*	
Reported GBV (%; CI) <sup>§</sup>		10.4 (6.8; 15.1)	34.7 (26.3; 43.7)	18.9 (14.9; 23.3)	<0.001
Perpetrator	Spouse or partner (n, %)	23 (95.8)	36 (83.7)	59 (88.1)	0.242
	Other members of household	1 (4.2)	7 (16.3)	8 (11.9)	
Frequency (past year)	Rarely (1 or 2 times)	8 (40.0)	21 (50.0)	29 (46.8)	0.295
	Sometimes (3 to 10 times)	9 (45.0)	9 (21.4)	18 (29.0)	
	Often (11 to 20 times)	3 (15.0)	10 (23.8)	13 (21.0)	
	Always (more than 20 times)	0 (0)	2 (4.8)	2 (3.2)	
Type of violence <sup>#</sup>	Psychological	20 (32.3)	42 (67.7)	62 (92.5)	0.667
	Physical	6 (46.1)	7 (53.8)	13 (19.4)	1.000
	Sexual	1 (14.3)	6 (85.7)	7 (10.4)	1.000
	Economic	1 (50.0)	1 (50.0)	2 (3.0)	1.000

\* Based on 67 reported cases that had HWISE score to categorize. Two cases could not be included.  
<sup>§</sup> Based on 355 women surveyed for reported GBV  
\*\* T-test or chi-square  
<sup>#</sup> Participants may have reported several types of violence within the studied timeframe

GBV was reported more frequently in water insecure households: 43 (34.7%; CI: 6.8; 15.1) reports in contrast to 24 (10.4%; CI: 26.3; 43.7) reports in water secure households ( $p > 0.001$ ) (Table 2 and Figure 5). In bi-variate logistic regression analyses, we found that the odds ratio of reporting GBV in water insecure households was over four times higher than in water secure households (OR: 4.6, CI: 2.6; 8.0,  $p < 0.001$ ). Unexpectedly, in the unadjusted model, higher spousal education was associated with an increased risk for reporting GBV (Table 3). This association was maintained in the final model (Table 4). Although survey data was collected on food insecurity, there was a lack of variation in the scores, with 90% of the study sample being characterized as food insecure, therefore this variable was omitted from the multivariate analyses.

**Figure 5.** Reported GBV by household water security status

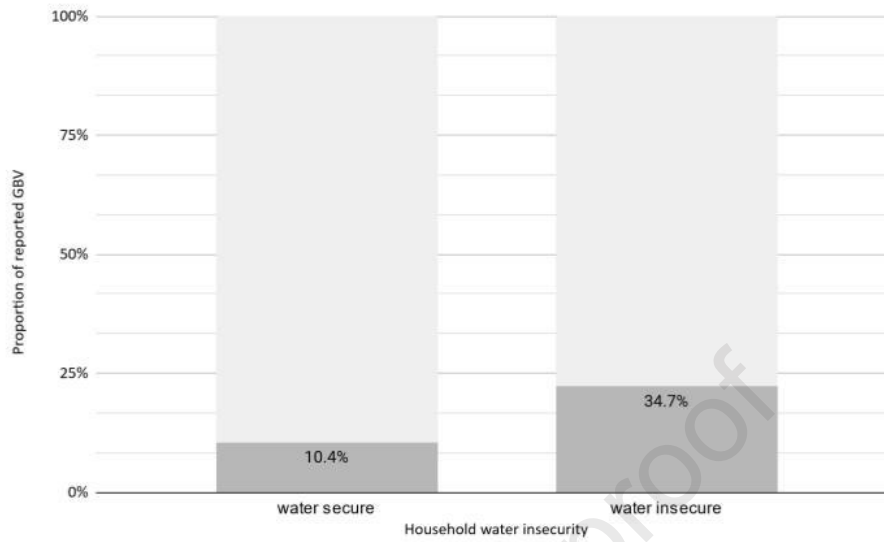


Figure 5. Reported GBV by household water security status

	OR	p-value	95% confidence interval
<b>HWI</b>			
No (water secure)	Reference		
Yes (water insecure)	4.6	<0.001	2.6; 8.0
<b>Age</b>			
18-29	Reference		
30-38	2.0	0.066	0.9; 4.3
39-47	1.4	0.361	0.6; 3.2
> 48	0.7	0.399	0.3; 1.7
<b>Respondent's education level</b>			
No education or incomplete primary	Reference		
Complete primary	1.9	0.090	0.9; 4.1
Beyond primary	1.1	0.850	0.5; 2.5
<b>Spouse's education level</b>			
No education or incomplete primary	Reference		



Complete primary	3.7	0.001	1.7; 8.1
Beyond primary	2.3	0.046	1.0; 5.3
Food insecurity			
No	Reference		
Yes	4.5	0.042	1.0; 19.2
Economic ladder			
1	Reference		
2-3	0.6	0.186	0.3; 1.3
> 3	0.8	0.639	0.4; 1.8

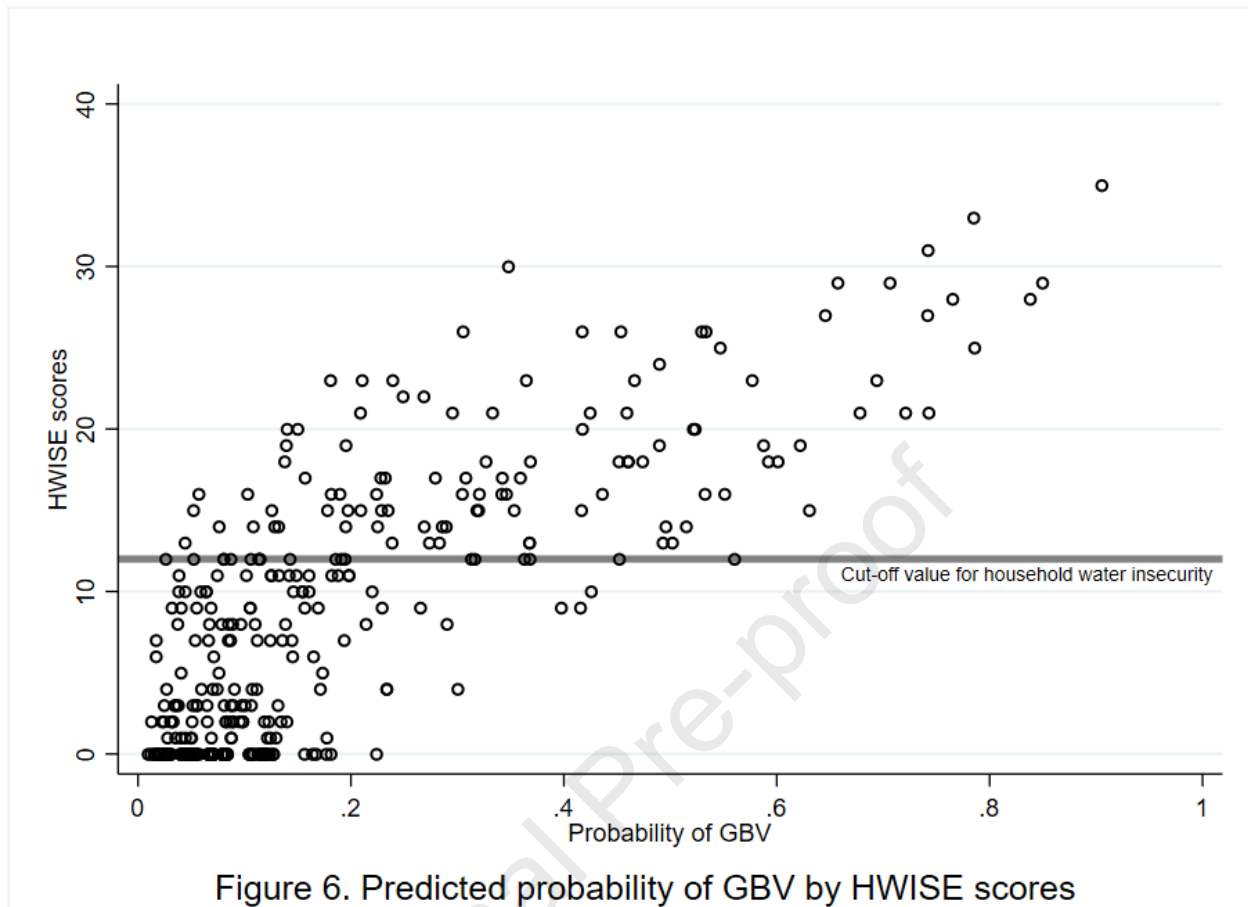
Given the expected similarities within the communities, for the multivariate regression models, we employed hierarchical modeling to apportion the variability within and between the communities. In these models, living in a water insecure household was associated with approximately twice the risk of experiencing GBV in the last year (OR = 2.2, CI: 1.0; 4.9,  $p = 0.051$ ) (Table 4). We also ran a multivariate logistic regression model, with HWISE scores as a continuous variable. In this model the odds of reporting GBV went up with each increase in the HWISE score (OR = 1.1, CI: 1.0; 1.1,  $p < 0.001$ ) (Table 5). The probability of reporting GBV based on HWI status is predicted in Figure 6.

<b>Table 4. Adjusted relationship of GBV with HWI</b>			
	OR	p-value	95% confidence interval
HWI			
No (water secure)	Reference		
Yes (water insecure)	2.2	0.051	1.0; 4.9
Age			
18-29	Reference		
30-38	1.4	0.496	0.6; 3.3
39-47	0.9	0.888	0.3; 2.5
> 48	0.5	0.169	0.2; 1.4
Respondent's education level			
No education or incomplete primary	Reference		
Complete primary	1.0	0.992	0.4; 2.5
Beyond primary	0.6	0.396	0.2; 1.8
Spouse's education level			

No education or incomplete primary		Reference	
Complete primary	2.9	0.020	1.2; 6.9
Beyond primary	2.9	0.035	1.1; 7.6
Economic ladder			
1		Reference	
2-3	0.6	0.270	0.2; 1.5
>3	1.0	0.950	0.4; 2.5

<b>Table 5. Adjusted relationship of GBV with HWI score</b>			
	OR	p-value	95% confidence interval
Household water insecurity score (HWISE)	1.1	<0.001	1.0; 1.1
Age			
18-29		Reference	
30-38	1.4	0.449	0.6; 3.5
39-47	1.0	0.945	0.3; 2.6
> 48	0.5	0.229	0.2; 1.5
Respondent's education level			
No education or incomplete primary		Reference	
Complete primary	1.1	0.865	0.4; 2.8
Beyond primary	0.6	0.452	0.2; 2.0
Spouse's education level			
No education or incomplete primary		Reference	
Complete primary	2.6	0.035	1.1; 6.3
Beyond primary	2.8	0.042	1.0; 7.5
Economic ladder			
1		Reference	
2-3	0.6	0.284	0.2; 1.5
>3	1.0	0.949	0.4; 2.4

**Figure 6.** Predicted probability of GBV by HWISE scores



We present the qualitative data collected in interviews and focus groups, using a multi-scalar approach forwarded by feminist political-ecologists e.g. [Harris \(2006\)](#), [Hanson and Buechler \(2015\)](#), and [Nunbogu and Elliott \(2021\)](#), including considerations of dynamics at the institutional, community, household, and individual levels. These are presented as nested circles in Figure 7 and further explored in the Discussion. No participants spoke about specific institutional or structural factors in relation to either GBV or HWI.

### **Community**

On the community level, patrilocal organization meant that many wives lived in households with their in-laws. We found that parents-in-law, and particularly mothers-in-law, were perpetrators of verbal abuse that related to HWI. For example, as one young woman recounted, “I was berated when my mother-in-law found that the water container was empty. She said to me “Why don’t you pay attention to the drinking water container? You have to make sure that the container is always full. An empty water container is not tolerated”. The young woman continued, “For example, if I am late or forget to fill the hot water container to make coffee, she will scold me for not doing it. My

mother-in-law got angry and screamed to my husband, “I am the one who takes care of you! I gave you money to pay for your wife’s belis (dowry)!” (SV9).

The caste system in East Sumba communities also plays a role in exacerbating GBV where water is insecure. Female *hamba*, or enslaved women, reported abuse from their masters when they were not able to secure water. Recounting her experiences with her master, a young, female *hamba* stated that, “If water is not available at home, she will get angry at me. If she thinks I spend a long time getting water, she will use it as a chance to get angry at me. Yesterday she got angry and hit my youngest daughter. It left the marks on my daughter’s back.... You can see the marks from it.” When we asked if she had been physically abused by her master in the past, she said, “Here, my back (pointed at her back). She pinched my mouth too.” (SV1).

**Figure 7.** Levels of analysis contributing to the GBV-HWI nexus in Sumba

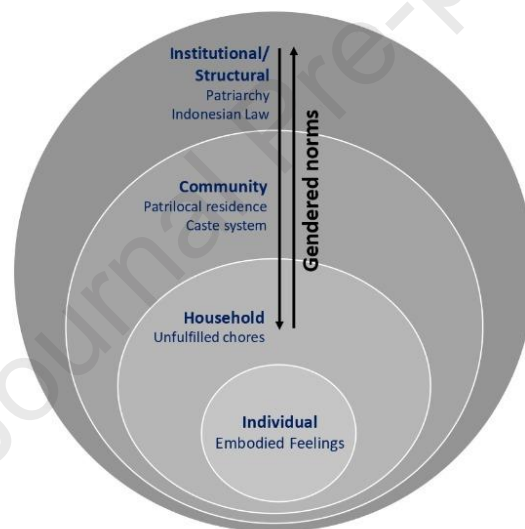


Figure 7. Levels of analysis contributing to the gender-based violence water insecurity nexus in Sumba, Indonesia.

Study participants articulated how community-level gender norms, related to water, increase the risk of GBV for women in Sumba. Specifically, a religious leader stated, “We know that in our community, when women do not collect water, they are at risk of experiencing verbal abuse or even physical violence. This is because of existing practices and norms, which make women responsible for providing water. Therefore, women receive negative consequences when they fail to do so.” (SR3).

A participant working in the local government also expressed how HWI influenced relationships across communities stating, “In the past, people spent a huge amount of

time taking water, so they didn't have any other activities.... both at the household and neighborhood levels — when they were tired, the possibility of fights and conflicts increased.” (SG7)

### **Household**

The tensions arising between HWI and gendered expectations in Sumba often manifested in households, specifically when women had issues securing water to make coffee and food. From a man's perspective, “When we, as the husbands, have a guest, all we say is, “Make our coffee, make our food,” but we're never bothered to know the water availability in the house... even for drinking purposes.” (SG7).

These tensions manifest in violence against women. According to a Sumbanese community member, “Men come home expecting food and drinks to be ready. Some easily raise their hand to hit their wives. We have to realize that the ones that carry the most burden are the women. Not the men. It's heavier for the women. Though we may feel stressed, the women feel it even more than the men. Especially when there are men who easily strike their wives. If a man gets stressed, the words coming from his mouth will surely be rough and bitter.” (SA2).

Victims of GBV expressed how this dynamic unfolded, stating, “My husband and I work hard at our farm, but because water is limited, we don't have enough water for our farm. He [her husband] expressed his disappointment at me. I think he was very stressed and got angry easily because of that. I was late boiling water when he asked me to make coffee for him. Or when I was late cooking. He yelled at me then hit me in my face. I think maybe because he was so tired and hungry after working on our farm.” (SV3).

### **Individual/Personal**

The individual/personal level describes the health and well-being impacts on women and their embodied feelings. Emotional and physical abuse related to HWI is compounded by the physical and emotional burden of carrying water. Reflecting on an interview with a victim of violence, one of our Indonesian team members observed, “The water source is located behind a hill, 700 meters from her master's house. Therefore, SV7 walks down the hill to reach the water source and hikes up the hill to get back home while carrying water. She has endured the verbal and physical abuses done by her female master and never sought help because she fears her master. In addition, she is discouraged by the absence of her relatives in the village.” The emotional and physical abuse can take several forms, for example one Sumbanese woman expressed her painful memories explaining, “I still had to draw water until it was time to give birth. I fell near the spring and I was taken to the hospital and gave birth to my child not being full term.” (SV7\_2).

The embodied, silent suffering of water fetching, endured particularly by enslaved females, came out when we asked a young woman about whether she felt any physical discomfort because of carrying the water. She explained, “Currently I feel the pain in my waist, but I have to force myself to continue working. Because I have to walk far distances, my feet are sore. My whole body is in pain. I am stressed, but I cannot say anything because they are my masters.” (SV1).

The power differential that leads to silent suffering was also expressed in the context of husband-wife relationships and between women and their in-laws. As mentioned above, a woman reported that because she was late boiling water for the coffee, her husband yelled at her and hit her in the face. When asked how she responded to the violence, she said, “I just cried, I never fought back because I am afraid of him. I am very sad.” (SV3).

Feelings of sadness were also expressed in relation to verbal abuse endured by women from their in-laws. For example, when we asked a young woman about whether she had experienced any conflicts related to water. She responded: “Yes, there are many conflicts that have happened at my parents in-law’s house..... one of them is related to water.” The woman continued, “In one day I have to collect water 3 to 4 times, so I am feeling very tired. If water is not available at home, my parents in-law will get angry at me. They are not satisfied with my work. They demanded that I do more in taking care of the house. But they did not express it directly to me, but through my husband. They also got angry with me. It makes me sad, angry, uncomfortable...”

We followed up asking if her in-laws were ever physically abusive to her. She responded, “No. But they are verbally abusive to me. I wake up at 5 am every day. I start collecting water for bathing and washing dishes. Then I prepare water to give a bath to my daughter and fill the hot water container for coffee. I also have to cook, preparing *titi jagung*<sup>1</sup>, and feed the pigs. For cooking and feeding the pigs and chicken I will need to get some more water. Making *titi jagung* for meals takes a very long time. Sometimes I do not have any chance to take a rest in the afternoon. Sometimes I also do not have a chance to eat until noon. At 3 pm I will start working again... getting some more water, doing some more chores until the evening.”

We asked if she had ever complained to her husband about her burden. Connecting back to water, she stated, “Yes, I told him. I also told him we have to save some money so we can build a tap water station near our house, so I don’t have to put in extra labor to get the water. Frankly, I am very tired of walking back and forth to get water. Not to

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<sup>1</sup> *Titi jagung* is a labor-intensive corn-based dish that takes hours to prepare.

mention the time spent queuing. That is too long. And I have a little baby to take care of.” (SV5).

### **Discussion**

Our mixed methods research documented a quantitative and qualitative association between HWI and GBV in Sumba, Indonesia. Specifically, multivariate logistic regression analysis showed that women in water insecure households were more than twice as likely to report experiencing GBV in the last year (OR = 2.2, CI: 1.0; 4.9,  $p = 0.051$ ). Examining HWI scores as a continuous variable revealed an increased odds of reporting GBV with each increase in the HWISE score (OR = 1.1, CI: 1.0; 1.1,  $p < 0.001$ ) indicating that even small stresses associated with water may be related to the risk of GBV. Qualitative data indicates that the intersection between HWI, a patriarchal social organization, and a caste system produced water-related conflicts between intimate partners, between daughters-in-law and their in-laws, and between masters and enslaved women.

Using the FPEH framework allowed us to investigate how broader structural factors intersect with gender to mediate the association between HWI and GBV on multiple scales. As featured in Figure 7, the outermost layer of structural and institutional factors include patriarchy, which is supported by Indonesian law. Specifically, Law No. 1 of 1974 regarding marriage stipulates that the husband is the head, protector, and provider of the family whereas the wife is the household manager. Such legal arrangements strengthen the segregation of men and women’s roles both in domestic and public domains, reinforcing gendered expectations that women are solely responsible for water-related tasks and setting the foundation for violence to emerge when water insecurity undermines the ability of women to complete these tasks.

At the community level, Sumba’s patrilineal and patrilocal culture appears to create an environment that promotes physical and psychological violence between wives and their in-laws. Specifically, in patrilocal, multigenerational households, psychological violence may be enacted when wives enter the household and mothers-in-law, who once occupied the lowest status in the household, renegotiate their position and exert new agency and control over in-coming daughters-in-law. Sultana (2011) observed similar dynamics in her research on water and arsenic contamination in Bangladesh, where daughters-in-law were burdened with water fetching for their in-laws. This water fetching not only involved “physical labor but also emotional labor, “...having to ‘keep quiet’ or overlook any insults or humiliation were common strategies women employed to keep their water access somewhat secure.” (Sultana, 2011; pg. 169). Other scholars have noted that patrilocality reduces women’s physical autonomy (Rammohan and Johar 2009) and creates a conducive context for abusive behavior by female in-laws (Gangoli and Rew, 2011). Our study reveals that these vulnerabilities are exacerbated by HWI.



Additionally on the community level, the caste system in Sumba, although weakening in importance (Barokah, 2016), remains significant. Violence from masters to enslaved women was commonly reported in our study. Lower caste women's intersectional identities not only means they suffer the most from water fetching but are also the most vulnerable to GBV. This intersection of gender and caste has been explored previously (Mitra and Rao 2019) and various studies have studied exclusion from water resources by caste in India (Smiley and Stoler, 2020; Hathi et al., 2016). To date this is the first study that has uncovered the link between GBV, HWI and caste.

At the household level, we found that unfulfilled domestic chores were the most common spark for GBV related to water. Similar dynamics were found in Choudhary et al., 's (2020) research in Nepal, which found a quantitative relationship between poor household access to water and women's exposure to intimate partner violence. Researchers from this study hypothesized that gendered patterns of household water management underlie the connections between water and intimate partner violence because of (1) failure to meet water-related household duties that was socially unacceptable, (2) sub-optimal water access preventing the completion of other household chores, and (3) water scarce households generally experiencing heightened tensions, increasing the risk of violence (Choudhary et al., 2020). In our study, we found that dynamics on the community and household levels contributed to negative outcomes for women in Sumba, including socio-psychological stress, pain, sadness, and low self-esteem experienced on the individual level.

In terms of the types of individuals involved in GBV, according to our survey the perpetrators of GBV violence were all within the household, including spouses and other relatives such as in-laws and masters. This contrasts with the majority of previous studies of water insecurity and GBV, which primarily found that violence occurred outside the household while collecting or queuing for water (Mushavi et al., 2020; Pommels et al., 2018; Meyiwa et al., 2014; Collins et al., 2019; Assefa et al., 2021; Logie et al., 2021; Thompson et al., 2011). Additionally, we found that the risk of reporting GBV was higher among women whose spouses had higher education levels (OR = 2.8, CI: 1.0; 7.5,  $p = 0.042$ ). Generally, higher education in men and women decrease the chances of experiencing GBV, although some reviews have found different patterns when power structures of masculinity are challenged by gendered differentials in education or employment (Fidan and Bui, 2016). Clearly, a different dynamic is emerging in this study context, which needs to be better explored and characterized through more extended participant observation.

Beyond the need for additional ethnographic fieldwork, our study and analysis had several limitations. One of the most significant limitations was that our survey did not ask respondents to identify which caste they belonged to, limiting our ability to

quantitatively assess whether this marker of social states functioned as a mediating factor between experiences of HWI and GBV from a quantitative perspective. Other limitations included only surveying women. This could have excluded non-binary people, although conservative belief systems in Sumba make it unlikely that participants would declare such a status. For logistical reasons the study was only conducted during one season, the dry season, but seasonal variation might add variability or provide more insights into the dynamics of HWI and GBV under different environmental conditions. In the future, it would be interesting to conduct this type of study in a matrilineal community for comparison and to further test our hypothesis that patrilocal residence is a driver of GBV in water insecure communities.

Finally, while using the FPEH framework helped us unravel the pathways underlying the relationship between GBV and HWI in Sumba, applying this framework to an empirical case study had limitations. Specifically, while researchers recognize how structural factors such as patriarchy shape social relations, on-the-ground perspectives rarely call out these larger forces, limiting direct evidence to community, household, and individual levels. There are also significant overlaps between what happens on the household level (for example a man hitting a woman at home) and how this manifests at the personal, or individual level, evading easy scalar categorizations. Similarly, the role of caste, patrilocal residence, and gender norms in underlying the connection between HWI and GBV, cuts across structural, community, and household layers. Thus, using a scalar approach to present empirical results limited our ability to fully flesh out the interactions between the analytic layers and does not provide a mechanism to assess which level is most influential in supporting the connection between HWI and GBV. This is particularly important when considering how research results can be used to inform interventions.

### **Conclusion**

This is the first robust qualitative and quantitative study to document an association between HWI and GBV. Women in East Sumba who are water insecure are twice as likely to report experiencing GBV in the last year, with psychological and physical violence being most frequently reported. The FPEH framework yielded new insights into the socio-spatial relationalities of HWI-GBV nexus and the strong intersectional links between caste, gender, and social position in increasing vulnerability to water-related GBV.

Specifically, utilizing a multi-scalar FPEH framework allowed us to unpack the institutional and community factors producing an enabling environment for GBV in the context of HWI, which included patriarchal institutions, patrilocal residence, and a caste system. These factors shape community practice, where there is widespread acceptance of the underlying norms that dictate that water work is “women’s work” and that violence is an acceptable response to gendered water duties not being fulfilled.

These relationships are bidirectional as unequal gender norms are reflected in governance structures from the village upwards, where women's voices are excluded from all decisions related to water provision.

The *syndemic* interactions between gendered inequalities and resource scarcities will continue to be magnified by climate change. SDG 6 commits the world to “ensure availability and sustainable management of water and sanitation for all”, while SDG 5 aims to end all discrimination against women and girls. This study shows that these phenomena are intimately linked and that policies promoting water security and gender equality can address these linked threats to global health.

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### **Highlights**

Household water insecurity is associated with gender-based violence (GBV).

GBV related to household water insecurity is enabled by patriarchal norms.

A caste system exacerbates risk of GBV associated with household water insecurity.

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