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EVALUACIÓN DE LA SEGURIDAD DEL AGUA EN 2 COMUNIDADES SHAWI DE LA AMAZONÍA PERUANA

TESIS PARA OPTAR EL GRADO DE

DOCTORA EN CIENCIAS DE LA VIDA

PAOLA ALEJANDRA TORRES SLIMMING

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WATER SECURITY EVALUATION IN 2 SHAWI COMMUNITIES FROM THE PERUVIAN AMAZON

THESIS FOR COMPLETING DOCTORAL DEGREE IN LIFE SCIENCES

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LIMA – PERU

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DEDICATORY

For Andy

Fly me to the moon, let me play among the stars,

let me see what spring is like on Jupiter and Mars,

in other words, HOLD my hand, in other words [….]

Fill my heart with songs and let me sing for evermore,

You are all I long for, all I worship and adore

In other words, please be true [….]

In other words [….]

I LOVE YOU

Frank Sinatra

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PREFACE AND DECLARATION OF OWN WORK

This thesis supervision was done principally with Dr César Cárcamo, who was my mentor and supervisor at all stages of the doctoral process, until the final submission of this dissertation. Dr Sherilee Harper was my external co-supervisor for mixed-methods and qualitative studies in EcoHealth and water security with Indigenous populations. She supervised my fieldwork, data analysis, writing, and paper publishing.

Chapter I corresponds to the introduction and literature review. Chapter II presents the case study that guided the research in water security, while Chapter III focuses on the theorical framework used in this thesis dissertation. Chapters I, II and III were designed and researched entirely by the author.

A summary of the research methodology that can be found in Chapter IV emerge from close work with Dr César Cárcamo and Dr Sherilee Harper. The protocol idea was conceived, designed and written by the author **(Annex 3)**. Chapter V presents the overall results which are inputs for both mixed-method studies published in peer-reviewed journal articles (**Annexes 1 and 2**). These final publications were done with the review, advice and support in collaboration with the IHACC research team. Final thesis analysis, discussion, conclusion, and recommendations from this doctoral thesis dissertation can be found in Chapters VI, VI and VIII respectively.

I, the author, have written all sections in this dissertation, hence reflecting my own and exclusive positionality.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS

CRED	Child and Development Program
GSAAC	Gestión Social del Agua y el Ambiente en Cuencas
IHACC	Indigenous Health Adaptation to Climate Change
ICH-GCP	International Conference on Harmonisation-Good Clinical Practices
IDRC	International Development Research Centre (Canada)
IPCC	Intergovernmental Panel on Climate Change
JAAS	Juntas Administradoras de Agua y Saneamiento
NGOs	Non-governmental organizations
MDG	Millennium Development Goals
SDG	Sustainable Development Goals
SIL	Summer International Institute of Linguistics
SPIDER	Sample, phenomenon of interest, design, evaluation, research tool

SUNASS	National Superintendence of Water Supply and Sanitation Services of Peru
TTM	Transtheoretical Model
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations International Children's Emergency Fund
US 21 CFR Part 50-PHP	United States Code of Federal Regulations-Protection of Human Participants
WASH	Water access, sanitation and hygiene
WHO	World Health Organization

ABSTRACT

Introduction: Water security research is critical to understand how livelihoods and health can be affected by different water dimensions. Water dimensions encompass access to a safe water source, the use of the water source for daily and economic activities, and adequate water for safe drinking, sanitation and hygiene (WASH). As such, water shapes dynamics around peoples' lives either by strengthening resiliency or deepening vulnerabilities within their cultures and societies. As an example, Indigenous Peoples around the globe are often at higher risk of water insecurity and are a priority to accomplish the Sustainable Development Goals (SDG).

Objectives: This dissertation research characterized, through Shawi observations, the current state of water security and impacts on livelihoods in Indigenous Shawi communities along the Armanayacu river basin, in Peru.

Methods: A case study was constructed from two exploratory concurrent mixed-methods studies that were guided by an EcoHealth framework. The Indigenous communities partnered in this study belong to the Shawi Ethnia. Two communities, chose by convenience, are both in the same area of Balsapuerto district, province of Alto Amazonas, department of Loreto. Data collection was done using surveys, interviews, PhotoVoice, focus groups and walking paths in two communities during 2015. This study followed ethical principles under Indigenous Peoples guidelines for research.

Results: Overall results collected from both mixed-methods studies illustrate a landscape of water insecurity in the area. These communities underscore for the SDG in water, sanitation and hygiene (WASH) outcomes. Additionally, climatic factors are affecting Shawi's water systems and livelihoods. Meanwhile, non-climatic factors as deforestation aggravate climatic factors in the Shawi area.

Conclusions: This thesis dissertation documents important information about water insecurity in two Shawi communities with ongoing challenges related to WASH, and climatic and non-climatic drivers which need to be considered in addressing and complying future challenges in SDG.

Keywords: Water security, WASH, Mixed (qualitative and quantitative) methods, Shawi, Indigenous Peoples, Sustainable Development Goals, Peru

RESUMEN

Introducción: El enfoque de seguridad del agua (hídrica) ha ganado validez en los últimos años al tratar de comprender cómo las diferentes dimensiones del agua pueden afectar la salud y los estilos de vida en las personas. Las dimensiones de la seguridad del agua abarcan el acceso a una fuente de agua segura, el uso de las fuentes de agua para las actividades diarias y económicas, agua adecuada para beber, saneamiento e higiene (WASH). Como tal, el uso del agua perfila la dinámica en relación con la vida de las personas ya sea fortaleciendo la resiliencia o profundizando las vulnerabilidades dentro de las culturas y las sociedades. Como ejemplo, las poblaciones indígenas a nivel global tienen mayor riesgo de sufrir inseguridad hídrica y representan una prioridad en el logro de las metas en los objetivos de desarrollo sostenible (ODS).

Objetivos: El objetivo principal de esta tesis fue caracterizar, a través de las observaciones de los participantes shawi, el estado actual de la seguridad hídrica y los impactos en los estilos de vida de las comunidades indígenas shawi a lo largo de la cuenca del río Armanayacu, en Perú.

Métodos: Se construyó un estudio de caso a partir de dos estudios exploratorios concurrentes de métodos mixtos, bajo el enfoque de EcoSalud. Las comunidades indígenas incluidas en este estudio pertenecen a la etnia Shawi y son las que se asociaron con el programa IHACC. Todas las comunidades se encuentran en la misma zona del distrito de Balsapuerto, provincia de Alto Amazonas, departamento de Loreto. La información fue recolectada de dos comunidades shawi elegidas por

conveniencia durante 2015. El estudio siguió pautas éticas para la investigación con pueblos indígenas.

Resultados: Los resultados generales recopilados de ambos estudios de métodos mixtos proporcionan un panorama relacionado con la inseguridad hídrica en el área. Estas comunidades tienen una puntuación baja en relación con indicadores de agua, el saneamiento y la higiene (WASH) respecto a los ODS. Además, variaciones en factores climáticos están afectando la dinámica en los sistemas de agua shawi, y a su vez estos factores climáticos se están viendo afectadas por otros factores no climáticos, como la deforestación.

Conclusiones: La presente tesis presenta información muy importante acerca de la inseguridad del agua en dos comunidades shawi, poblaciones vulnerables que merece ser priorizadas. Asimismo, puede ayudar a abordar adecuadamente esta problemática en relación con los retos futuros que suponen los ODS.

Palabras clave: Seguridad hídrica, WASH, Shawi, comunidades indígenas, objetivos de desarrollo sostenible, Perú

RESUMÉ

Introduction: L'accent mis sur la sécurité hydrique s'est vu renforcé ces dernières années lorsqu'il s'est agi de comprendre comment les différentes orientations de la gestion de l'eau peuvent affecter la santé et la façon de vivre des personnes. Les paramètres relatifs à la salubrité de l'eau englobent l'accès à une source d'eau potable, l'utilisation de sources d'eau pour les activités quotidiennes et économiques, et une eau potable et de qualité pour la consommation, l'assainissement et l'hygiène (WASH). L'usage qui est fait de l'eau, comme telle, définit la dynamique de la vie des peuples soit en renforçant leur résilience ou en accentuant la vulnérabilité de leurs cultures et de leurs sociétés. Les peuples autochtones du monde entier, par exemple, sont souvent plus exposés à l'insécurité hydrique et constituent une priorité lorsqu'il est question d'atteindre les objectifs de développement durable (ODD).

Objectifs: l'objectif principal de cette thèse, consiste, grâce aux observations menées chez les Shawi, à caractériser l'état actuel de la sécurité hydrique et les impacts qu'elle produit sur la façon de vivre des communautés autochtones Shawi le long du bassin de la rivière Armanayacu, au Pérou.

Méthodes: Une étude de cas a été élaborée à partir de deux études exploratoires mixtes, concurrentes, sous l'angle de l'EcoSanté. Les deux communautés autochtones préalablement choisies en 2015, sont situées dans la même zone du district de Balsapuerto, dans la province de l'Alto Amazonas (Loreto); elles appartiennent à l'ethnie Shawi et font partie du programme IHACC. La collecte de

données qui se fonde sur des entretiens et des groupes de discussion s'est déroulée dans le respect et les principes éthiques dus à toute recherche portant sur les peuples autochtones.

Résultats: Les résultats globaux recueillis à partir des deux études reposant sur des méthodes mixtes montrent un paysage régional marqué par l'insécurité hydrique. Les indicateurs d'eau, d'assainissement et d'hygiène (WASH) révèlent des scores très faibles dans les deux communautés si on les compare aux ODD. Par ailleurs, les variations climatiques affectent le bon fonctionnement des systèmes d'eau Shawi; ces mêmes variations climatiques, à leur tour, sont altérées par des facteurs non climatiques, tels que la déforestation.

Conclusions: Cette thèse fournit des informations importantes sur le caractère insalubre de l'eau au sein de deux communautés shawi; population vulnérable dont les besoins doivent être traités en priorité. Une réflexion sur une approche appropriée des défis futurs suscités par les ODD se doit d'être menée.

Mots clés: sécurité hydrique, WASH, Shawi, Peuples autochtones, objectifs de développement durable, Méthodes mixtes (qualitatives et quantitatives), Pérou

WATER SECURITY IN INDIGENOUS SHAWI COMMUNITIES FROM THE PERUVIAN AMAZON: USING AN ECOSYSTEM APPROACH TO HEALTH

CHAPTER 1: INTRODUCTION

A. Background

Water is essential for life, human health, and wellbeing. According to the U. S. National Academy of Medicine the recommended average daily water intake is 2.5 liters per day, this coming from drinks and 20% from food (1). Lack of water intake can cause severe dehydration leading to collapse of organs, with lethal consequences and death. It is well documented that a person cannot subsist for more than five days without drinking a drop of water.

As an example, dehydration can be caused by poor water quality, with contaminated drinking water with waterborne pathogens. This causes diarrhoea and malnutrition, both being principle causes of morbidity and mortality in developing countries particularly in children under five (2–4). National strategies on rotavirus vaccination along with household WASH interventions reduce the number in childhood diarrhoea clinical visits (5). Another example is the lack of proper sanitation and hygiene which elevates the risk of water washed diseases such as Ascariasis and other parasitosis affecting nutritional status and development (6,7). There is increase evidence between the association of increase in temperature, water insecurity and diarrhea. In a study reported by Carlton et al. found that for every increase in a degree of temperature there was an increase in 7% of all causes of diarrhea (8–10).

Vector ecologies depend closely on water for growth and propagation. Water-vector-borne diseases such as malaria, *dengue, chikungunya*, and *zika* causes a burden for over one billion cases annually with over a million of death (8,11–13). From this total, the poorest and excluded people are mostly affected. As for malaria, in 2019 a total of 229 million cases were reported globally with 409,000 deaths (WHO 2019). Furthermore, it is expected that deforestation, climate change and global warming will increase population density of these vectors and scalar transmission threshold levels (14–17). As an example, it is projected by 2070 that the vector for malaria (Anopheles spp.), will expand to almost 50% of South America (18–20).

As such, higher prevalence's of water diseases relates to the following conditions (i) insufficient water supplies or water scarcity, (ii) inadequate water supply or water quality, sanitation, or solid waste, (iii) domestic hygiene, (iv) preventive medicine such as vaccines or deworming programs, (v) adequate water resource management (UNICEF 2020).

Globally, there is still a high proportion (30%) of people who lack access to water and handwashing facilities. While 4 billion people are exposed to health hazard due to lack of basic sanitation services (WHO 2021), almost a billion continue practicing open defecation (WHO 2021). Regarding water resources, this are essential for physiological needs of human beings and daily activities, food consumption and economic growth. Therefore, inadequate and excessive use of water systems (surface water and groundwater) can increase water stress (21–26). Reports indicate that around 40% of todays global population suffers from poor

water access (27), and it is predicted that by 2050 this number will rise to 60% (28). These water hazards on ecosystems will affect furthermore the wellbeing and mental health of communities. It is reported that natural disasters like floods and other water related tragedies account for 70% of all deaths (29–32).

In addition, there is growing evidence on how negative environments and sudden changes in them can trigger depression and stress related disorders (27,33,34). More than 1.7 billion people live in river basins, while 80% of residual water is spilled into rivers and oceans increasing contamination of water ecosystems. These scenarios are becoming more visible among Indigenous territories affecting not only their physical health: in fact, studies done with Indigenous populations, the Inuit in the Artic of Canada and other in the Awahun in Peruvian Amazon report evidence water distress health outcomes related to ecological drivers (26,35).

At the global scale, a study by Vo¨ro¨smarty et al., where a spatial framework was used for quantifying multiple water stressors and impacts, showed that almost 80% of the world's population is exposed to high levels of threats to water security (36). Population stressors, environmental variations and future climate models suggest that different areas around the globe will face water scarcity or droughts, increasing water health risks in the decades to come (22,37–39).

The average availability of water per person in Latin America (LA) is 5,732 m^3/ inhabitant, while at the global scale the average of water per person is 21,844 m^3/ inhabitant (World Bank 2017). Peru is among the ten countries with the largest water reserves in the world and one of the ten LA countries with the highest water

availability. However, it is not among the countries with the highest availability of the resource per person (BID 2017). It has an average of water per person is 52,188 m^3/ inhabitant (World Bank 2017). But this is inequal in certain areas, like the desert coast, rural and peri-urban areas. Furthermore, it is estimated that by 2040, Peru will be one of the countries in LA to suffer from water stress (World Bank 2017).

Besides, Peru has a system of micro basins that flow into the Amazon, the largest water source in LA. This ecological water system is home for several Indigenous communities with a historical and political background of colonisation, extraction, and exclusion (40,41). This transgenerational burden is associated with higher prevalence of infectious diseases, malnutrition, chronic diseases, and alcoholism (42–44)What is more, this will become more apparent and critically revealed in the years to come. Consequently, making a pause to comprehend, analyze and adapt strategies in working with vulnerable populations is a first step for rethinking primary health care oriented in rural and excluded areas.

As such, water security has become an emerging paradigm, where its definitions initially ranged from water quality and quantity, and now extends to include water's role in the natural environment for human needs (45–47). Other definitions of water security incorporate a more multi-dimensional concept that recognizes human rights to water access[1] (48–50) and linking it to water source administration,

[1] Upon recognition to human rights to water, the United Nations set up the baseline standard for all countries and organizations. They declare by resolution that: "[…] every person has the right to between 50 and 100 liters of water per day for personal

management, and governance at the individual, local, regional and global levels (51–53). Additionally, some broader definitions also incorporate human sustainability in terms of ecosystem health on a watershed basis (52,54,55).

These definitions fluctuate and vary between different disciplines in academia and policy[2]. Hence, framework models on water security, with specific indicators for outcomes, can be very extensive and vary across the literature (56–58). For instance, some water security frameworks focus on the quantity and availability of water, while others focus on water-related hazards and vulnerability (36,59). Yet others incorporate the Anthropocene dimensions of *human-water system needs*, and more recently the term *sustainability* (1,36,57,60,61). As V. Srinivasan et al. reported in a meta-analysis, the patterns observed for models ensuring adequate indicators of water insecurity can be grouped into: (i) culture/economy, (ii) water resources, (iii) wealth/investment, and (iv) governance (62). Intrinsically, numerous

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and domestic use, from a source that is within 1,000 meters of their home and does not take more than 30 minutes to collect, and the cost for access of this water should not exceed 3% of household income" (Resolution A/RES/64/292. United Nations General Assembly, July 2010).

[2] The following international organizations promote the term *water security*: Global Water Partnership, World Economic Forum, UNESCO's Institute for Water Education, Asia-Pacific Water Forum, United Nations, and World Health Organization (WHO).

water indexes result from water security conceptual frameworks, ranging from the Falkenmark water stress index for water stress and water shortage, the Blue and Green indexes, the Water Poverty index, and the Global Water Footprint (63). In Rosinger and Young's review, water security indicators incorporated availability, accessibility, safety, use and reliability (64).

B. Research relevance

Throughout history, water has defined people's cultures, reflecting their relationship with the environment and water subsistence. Water availability builds hierarchical powers around water access leading to the development and expansion of cultures and civilizations. For example, water shapes the hierarchy and social structure of communities at an individual's identity, gender roles, family and household structures, and divisions of work between men, women and across age groups. These social hierarchies can expose groups more than others into vulnerable situations such as the case of girls recollecting water in remote rural areas (45,56,57,65–67).

On the other hand, at the political level, water access and development can create hierarchies between different cultures. In these cases, conflicts often arise when bodies of water are shared across borders, as legal claims to water are disputed (68–70). The distinguishing types of bodies of water play a role in determining human culture development and civilizations expansion.

Additionally, there is a connection between the type of water near a community and the potential for water storage throughout time in the form of wells, reservoirs,

dams, channels, and pipes. Ultimately, these impact shapes water-related human health risks. Both flowing water (i.e., in rivers and streams) and stagnant water (i.e., in ponds and swamps) have been significant to the surrounding communities concerning water-related diseases (71).

It is well reported that health promotion activities on human behavior's, attitudes, practices and knowledge are not sufficiently included in water and sanitation promotion, management and decision making (72,73). Along the path of history, health promotion dynamics around water have slowly incorporated the collaboration across different disciplines. Since health promotion is interdisciplinary, evidence shows that actors from all backgrounds must play a role in the sustainability of water health promotion activities. This should reflect how to balance power dynamics and the acceptance of professional-community collaboration (74–76).

Over the past decade, water security has become a growing challenge, as water has become vital for health and sustainable development, aside being an exhaustible resource. Globally we have moved from a water and sanitation perspective to incorporate an ecosystem and governance approach. For this to happen, several global health efforts have been made since the Declaration of Alma Atta in the 1980s, a decade which concentrated on safe drinking water, sanitation, and sufficient amount for food production indicators (77–82). Reinforced by the Ottawa

Charter[3], pillar of health promotion, surveillance of sustainable environments was included among the strategies to be prioritize in the health sector. Subsequent 2015 Millennium Development Goals (MDG) focused on ensuring water and environmental sustainability with their targets to "halve the proportion of the population without access to safe drinking water and sanitation" (83–85).

The 2030 Sustainable Development Goals (SDG) emerged from the political agenda left from the MDG and are reinforced with the Agenda in the Social Determinants of Health (SDH) (51,54,86). Its intention was to strengthen the need to balance human and environmental needs (56). Hence, SDG by including in goal number 6 (SDG6) the role of water on human development and environmental sustainability, highlighted future hazards in water scarcity (65,87,88). Additionally, the International Decade for Action on Water for Sustainable Development was announced for 2018/2028 by the United Nations, highlighting the importance of global participation by raising awareness through the World Water Day and the World Toilet Day, to be celebrated on March 22 and November 19 respectively (51,54,89,90).

[3] The 1986 Ottawa Charter defines health promotion as: "the process of enabling people to increase control over, and to improve their health". In 2016 the Ottawa Charter celebrated its 30th anniversary. Health promoters define it as their 'gold standard' framework. The Ottawa Charter focuses in three strategies for health promotion: 1. advocacy, 2. mediating, and 3. enabling.

In 2003, the Third World Forum of Water was held in Tokyo, Japan. From these meetings, the Kyoto Declaration of Indigenous Peoples brough up the rights to water and land as a common law recognizing them as guardians of human natural (water) resources. Thus, incorporating an integral Indigenous territoriality dimension understood as their collective identity forged in biodiversity, and knowledge constructed in a symbolic observation of nature (78,91).

By 2018, a new health commitment was taken under the Declaration of Astana[4]. The intention was to revalue and give strength to Alma Atta's principles in primary care. This declaration positions health professionals to revalue health promotion for the XXI century challenges, with a particular emphasis in environmental determinants of health through the life course of an individual and communities (92,93).

[4] The Astana Declaration "emphasizes the critical role of primary health care in promoting good health, social and economic development, and global security. It aims to refocus efforts to ensure that everyone everywhere can enjoy their right to the highest standard of health. The Astana's Declaration commits itself to prioritizing disease prevention and health promotion and aims to meet all people's health needs across the life course through comprehensive preventive, promotive, curative, rehabilitative services, and palliative care".

Influencing rural medicine, as Cummings et al. points out there is an importance in considering rurality though different levels of actors, from the macro to the micro level, that impact rural health delivery (94–96). These relationships go back and forth, between the health providers and Indigenous community members, being fixed by the role of culture, determinants of health, socio-politics, and the sense of place and space in a community. Furthermore, according to Farmer et al., health workers should "go beyond the concept of place" and build theories for explaining rural health relationships around the provision of health (97). As such, the author invites rural health providers to move forward on the already accomplished goals, into a more "critical engagement with theory supported in findings from different disciplines" (97).

Peru as a country has been highly successful in water and sanitation activities since the 1980s, achieving important global goals within these indicators. As a nation, MDG7 indicators were successful meet concerning water quality but fell short on matters of sanitation, with improvements in infrastructure and household facilities still required (98). Peru reached the goal of the MDG7 in 50% between 1980-2004. During this period, there was an increase in access to clean water from 30% to 64%, and an increase of 9% to 30% in sanitation (98–100). In 2016, entering the SDG decade, the Peruvian government reported that almost 90% of households had access to a reliable drinking water supply and that 70% had access to adequate sanitation.

Within regions, in the rural Andean area there was an upscale in water and sanitation indicators (101–103) with the implementation of community

organizations called *Juntas Administradoras de Agua y Saneamiento* (JAAS) under the National Program of Rural Sanitation[5]. Unfortunately, this did not expand to other geographical rural areas. As such, there are still important disparities in the Amazon region: as an example, regarding water supply access, 93.7% have access among Amazon urban areas, while in rural areas only 68.8% of the population does. Additionally, in terms of sanitation access, 85% of urban areas have sanitation facilities, versus 46% in rural areas (86,98,104–107).

At the national level, the Peruvian government at the beginning of the XXI century established a new reform challenging the National Superintendence of Water Supply and Sanitation Services of Peru (SUNASS) to go beyond the urban and peri-urban area scope (108–111). They are developing a regulatory framework for supervising water quality and access in 28,000 small and rural communities (110–112). Even though as a country Peru has adopted legal normative within different ministries to address water security under the SDG6 goals, the challenge remains in how to articulate the work between different sectors to identify and reach vulnerable populations. As an example, drinkable water and sanitation in Peru are controlled by the public system, but in remote areas, access to drinkable water and

[5] Supreme Decrete N° 018-2017-Housing, 2017, that approves National Rural Water Supply and Sanitation Program 2017-2021-PRONASAR. In rural areas, water and sanitation services are not provided by one supplier company. District municipalities or local governments must provide the service to rural areas through participatory budgets requested by the organized JAAS.

sanitation are left to multiple local actor's experiences for communities to either pay or manage environmental surveillance systems (113).

Unfortunately, geographically isolated areas as rural Amazonian communities and Indigenous populations experience disparities and remain an important challenge for accomplishing future water security goals in Peru. For instance, in the Amazon rainforest area, 73.4% of households have access to drinking water (either through a drinking water infrastructure or from an improved water source) while only 40.5% have access to sanitation facilities (113–116).

Additionally, the history of water health promotion activities is muddled by the presence of different actors in the Peruvian Amazon area. Differences in cultural, language, geography and varying access to technology approach have made sustainable activities fail over time (117,118). To address the disparities in water health indicators in this region, (a) historical achievements must be considered around water activities and (b) cultural traditions should be integrated into policy decisions related to water management and health promotion practices. Moreover, research in this field must be long-term, methodical, and sustainable, and be conducted in partnership with the communities.

As mentioned previously, Peru is one of the most vulnerable countries for water extreme events and future climate change scenarios. Despite national advances in climate change regulations and reported achievements in water and sanitation goals, efforts ought to focus on accurate identification of gaps and plans to action in the

emerging field in water security research and integrate data across different disciplines (45).

C. Motivation for choosing the topic in water security

There is an urgent need to clearly define concepts and indicators and formulate research questions for choosing the adequate methodological scope to address challenges in water security and their impacts on rural health. This can only be achieved by better understanding epidemiological concepts, water-related hazards, mechanisms of prevention of natural disasters, future climate change scenarios, and their associated uncertainties, to be related into local contexts, vulnerable situations, vulnerable individuals, and communities (66,69,90,119–122). Efforts should focus on analysing and redefining academic and medical (rural) work in vulnerable populations to achieve these objectives and present clear methodologies for future scenarios. This will involve integrating qualitative and quantitative methods as the basis for comparing socio-epidemiological research inquiry in water health promotion (123–129).

The IHACC Program began activities in 2010 in Peru, Uganda and Canada. Its main objective is to develop and maintain surveillance systems for adaptation on climate/weather signals, environmental change and related health outcomes. Since its inception, the IHACC Program has oriented its goals towards developing frameworks for adaptation in collaboration with Indigenous Peoples and their knowledge systems, with a focus on community participation and cultural context.

Data collected from the three regions are intended to be analysed under a meta-synthesis approach to make comparisons between and within countries, considering water security as a relevant topic. Results gathered from these objectives enable the IHACC Program to generate valuable evidence for academia and decision-makers on climate-health-related adaptation in Indigenous communities from Canada, Uganda, and Peru.

My research interest presented in this dissertation was to explore, analyse and discuss water security in Indigenous Shawi communities along the Armanayacu river basin in the Peruvian Amazon. Additionally, it aimed to outline the methodological scope of epidemiological research in Indigenous health promotion (following the Ottawa Charter and the 2018 Declaration of Astana) under an EcoHealth framework to understand water security as it related to the 2030 Sustainable Development Goals agenda within vulnerable population context.

Asides, rural health in Indigenous Populations is a constant challenge, and many proposed models fail because of lack of either political, economic, cultural, or geographic sustainability. These data in water security in Indigenous communities from the Peruvian Amazon will contribute to improving and developing future frameworks in water-health related programs and guiding the next steps toward achieving the SDG in water and sanitation, climate change under a water security framework.

D. Formulation of research question

This study concentrated on answering a central and complementary question. The

construction of the central qualitative research question was based on the acronym SPIDER Tool format (**Table 1**) (130–132). The United Nations (UN) water security[6] defined the phenomenon of interest, while the dimensions for thematic analysis, under the Grounded Theory[7] approach, implied an understanding of health hazards using EcoHealth principles[8]. (This is explained in further detail in Chapters

[6] Across this study, we have used the concept in water security proposed by the United Nations in 2013, which clearly defines it as: "The capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability".

[7] In 1967, Glaser and Strauss introduced Grounded Theory to qualitative research as a systematic inductive methodology. Research done under a qualitative lens had been questioned because of the bias it might introduce to the results. Therefore, as opposed to quantitative research, where it is driven by a hypothetico-deductive model, Grounded Theory intended to validate qualitative scope through a strategy that involved the construction of theories "grounded/focused on the data" to explain a particular phenomenon.

[8] EcoHealth discipline emerged in the 1990s. It relies on different inquiry approaches trying to understand and integrate how changes in ecosystems can influence human health. Initially, three pillars comprised an EcoHealth approach to research: transdisciplinarity, participation and equity (170). The

II and III).

- What is the current water security situation in Indigenous Shawi communities along the Armanayacu river basin, Peru and why is this happening?

Table 1. SPIDER Tool used for developing the central research qualitative question

S (sample)	*Two Indigenous Shawi communities along the Armanayacu river basin, Peru*
PI (phenomenon of interest)	*The current water security situation*
D (design)	*Case study*
E (evaluation)	*Health hazards according to the 2030 SDG agenda*
R (type of research)	*Concurrent mixed (qualitative and quantitative) methods*

International Development Research Centre-Canada (IDRC) now speaks of six principles instead of three pillars: (1) transdisciplinarity, (2) community participation, (3) gender and social equity, (4) system-thinking, (5) sustainability, and (6) research-to-action (Charron, 2011).

The complementary research question was the following:

- What is the methodological scope of epidemiological research in health promotion, for facing water security health hazards, and for achieving the 2030 sustainable development goals agenda in collaboration with Indigenous Peoples?

E. Study objectives

The central objectives of this dissertation correspond to the following and correspond to each published paper in peer-reviewed journals (**Annexes 1 and 2**). These included:

- To describe water security in terms of knowledge, attitudes, practices and perceptions for water access, sanitation and hygiene (WASH) in two Indigenous Shawi communities in the Peruvian Amazon.

- To document climatic and weather change impacts on water systems observed by Shawi, characterize impacts on Shawi livelihoods, and explore adaptation options and challenges.

As for the complementary objectives of this dissertation, they correspond to the following categories:

- Integration, analysis and discussion from key findings in the two research case studies

- Reflections on the scope of the methodology and framework used in the two research case studies

F. Study methods design

An inclusive case study was designed for answering both the central and the complementary question (129,133–138). To address the central question about water security in Indigenous Shawi communities along the Armanayacu river basin, two concurrent mixed methods (129,133,136,139) were designed. Both mixed methods are composed from quantitative and qualitative study approaches (**Figure 1**).

Figure 1. Graphic outlining the study design and data collection

CHAPTER II: EPISTEMOLOGICAL CHARACTERISTICS

A. Case study in water security in two Shawi Indigenous communities

Social epidemiology frequently uses case studies as research design for exploring *social units* of society. Generally, case studies are conducted on a small scale, such as a single individual, group, location, organization or event (126,137,138,140). Their nature is empirical. They have an import descriptive component of the phenomenon withing its context, relying on multiple sources of information.

There are four types of case studies which can be used according to the specific research question or phenomenon: (i) exploratory, (ii) explanatory, (iii) instrumental and (iv) intrinsic (137,138,141,142). The source of evidence used to inform the case study can be quantitative, qualitative or both. The intention is to link, contrast, and compare the inputs from both epistemological results and generate an overall conclusion or *meta-inferences* (137,142–144).

For this thesis dissertation, an exploratory case study was conducted, driven by a concurrent mixed-method approach, under EcoHealth principles. This mixed-method design had a qualitative principal component with a Grounded Theory lens.

This explanatory case study intents to explain and describe water security, built upon the voices and perceptions from participants. The utility of this water security case study was to do a causal investigation with the intention to understand relations around water, ecosystems, and social dimensions (136,142).

Multiple methodological strategies were used to optimize our study findings and were grounded in Shawi Indigenous knowledge and local actor's background. These different strategies incorporated components of water security, water management, weather variations and water health activities influencing these communities in an Indigenous Amazonian and Peruvian context, to serve as inputs for future programs in the area.

Also, it is important to mention that Indigenous knowledge is based on different ways of understanding the world (different ontologies) and has different approaches and criteria for what counts as knowledge (different epistemologies). Therefore, literature advises against straightforward assimilation of Indigenous knowledge "into" western science systems. The literature warns that we should not assume that western science is a legitimate means to "validate" Indigenous knowledge (41,145–147).

The focus on Indigenous knowledge as a form of data is a strength and novel contribution of this dissertation research and can inform important global assessments in the water sector and climate change (e.g., IPCC 6th Assessment Report on Impacts, Adaptation and Vulnerability, National Ministers Reports), which have an explicit aim to increase the utilization of Indigenous knowledge as a source of evidence for public health interventions (148–150).

B. Methodological approaches

As previously mentioned, this explanatory case study relies on concurrent mixed-method approach. Mixed-methods studies are rigorous and are widely accepted methodologies (41,128,131,151,152). Furthermore, qualitative research methods are now widely used and are considered a reliable, rigorous and useful type of research.

Many disciplines of science are exclusively founded on the use of qualitative/mixed methods research (153). Moreover, contributions to global academia are well-established and have garnered an increasing amount of attention in recent years (154). Additionally, the important role of social science and qualitative methods in the water sector, human health, environmental, climate change and EcoHealth research have been described in many articles published in leading journals (41,155,156).

The author wants to emphasize the value and importance of this qualitative oriented case study in adding to the water sector, the environment/climate-health literature and Indigenous research. As stated by Belgarave, Zablotsky and Guadagno (2002), there is "increased recognition of our need to understand subjective health experiences", and that "such work is best approached via inductive, qualitative research" (157). This is reflected in the increasing number of articles and editorials in high impact journals bringing attention to the value of qualitative research. For example, in a recent editorial in *Nature Sustainability*, the editors state that "to address grand sustainability challenges, we need more than numbers alone. A lot of knowledge is uncovered through qualitative means only" (158,159).

As for the scope in qualitative and quantitative research, both have rigorous yet different approaches to validating data, and data validity is viewed through different "lenses". In quantitative research, "investigators are most concerned about the specific inferences made from test scores on psychometric instruments and the internal and external validity of experimental and quasi-experimental designs"; while in qualitative research, "researchers use a lens not based on scores, instruments, or research designs but a lens established using the views of people who conduct, participate in, or read and review a study" (139). In quantitative research, it is called "validation of results", while in qualitative research it is often called "validity and authenticity of results" (139,160,161). While fundamentally different from quantitative research, it is still possible to see commonalities between the two, with one example being the use of multiple methods or techniques to ensure data validity and minimize bias (151,162–165).

Indeed, there are several established procedures for data validation in qualitative research, as summarized by Creswell and Miller (2000) (139). Qualitative research methods are rigorous and there are specific approaches to validating qualitative data. Additionally, in social epidemiology sciences, qualitative research methods can stand alone as a useful and valid form of scientific knowledge (without being "validated" by quantitative instrumental data).

Therefore, Grounded Theory lens was the adequate qualitative design for generating new explanatory theories around water security phenomenon in these two Shawi communities along the Armanayacu river basin. The construction of a water security related theory was done through participants' perspectives in an

iterative process. This iterative process meant that data collection and analysis were interconnected occurring often simultaneously and cyclically (132,166). Thus, this open-ended methodology allowed data to be collected during the two visits and in different stages; meanwhile, analysis was carved and perfected during this process (167). Once sufficient information was saturated, a novel water security theory emerged "grounded" from the data (168). This water related-ecosystems theory responds to the research question of this doctoral dissertation: *what is the current water security situation in Indigenous Shawi communities along the Armanayacu river basin, Peru, and why is this happening?*

CHAPTER III: THEORETICAL FRAMEWORK

A. EcoHealth framework

In order to comprehend water security in an Indigenous context, this case study followed an EcoHealth framework (41,156,169) that examines interlinkages between environment, human health and its social context (170). In this case study, EcoHealth inquiry enabled the characterization of how environmental changes are affecting water security and health in Indigenous Shawi communities. Pillars in EcoHealth framework (169,170) guided throughout all stages of the research process. Special consideration was given to social and gender equity, (171–174) and participatory research (175–178).

Just to mention, the research project was co-developed in collaboration with members of the Shawi communities. With the intention to holistically integrate two or more disciplines a *transdisciplinary-system thinking approach* (179–182) was used. This means recognizing the need to explore waters and the environment complex interrelations, by including diverse interpretations which are probably are unaware or oblivious (51,88,183). Likewise, research results were interpreted and shared with the communities throughout the process of data collection. In doing so, principles of knowledge to action and sustainability were applied (89,179–182,184,185).

Additionally, local perceptions and practices in water, sanitation and hygiene were well documented through mixed methods. These different lenses—the deductive lens, contrasted by the inductive—let us explore water security very broadly. In the

environmental health and climate change literature, there has been a strong call for more of this type of information like mixed-methods research based on Indigenous knowledge and observations. The literature discusses Indigenous knowledge as valuable stand-alone forms of knowledge (i.e., Indigenous knowledge does not need to be "validated" with quantitative instrumental data to be considered valid and valuable) (148,186).

Indeed, in recent years, the scholarly debate surrounding the need for meaningful engagement with Indigenous knowledge in international evaluations and policy has progressively gained influence and vigour. Many organizations are recognizing the importance of engaging with Indigenous knowledge. Such examples are the Intergovernmental Panel on Climate Change (IPCC), the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the United Nations Framework Convention on Climate Change (UNFCCC), who are increasingly incorporating local knowledge for climate change adaptation. This is reflected in recent reports, as well as the UN-approved outlines of forthcoming reports, such as the IPCC Sixth Assessment Report (37,39,177,187).

It is also important to mention that Indigenous knowledge is based on different ways of understanding the world (different ontologies) and has different approaches and criteria for what counts as knowledge (different epistemologies). Therefore, literature advises against straightforward assimilation of Indigenous knowledge "into" western science systems. The literature warns that we should not assume that western science is a legitimate means to "validate" Indigenous knowledge (41,145–147).

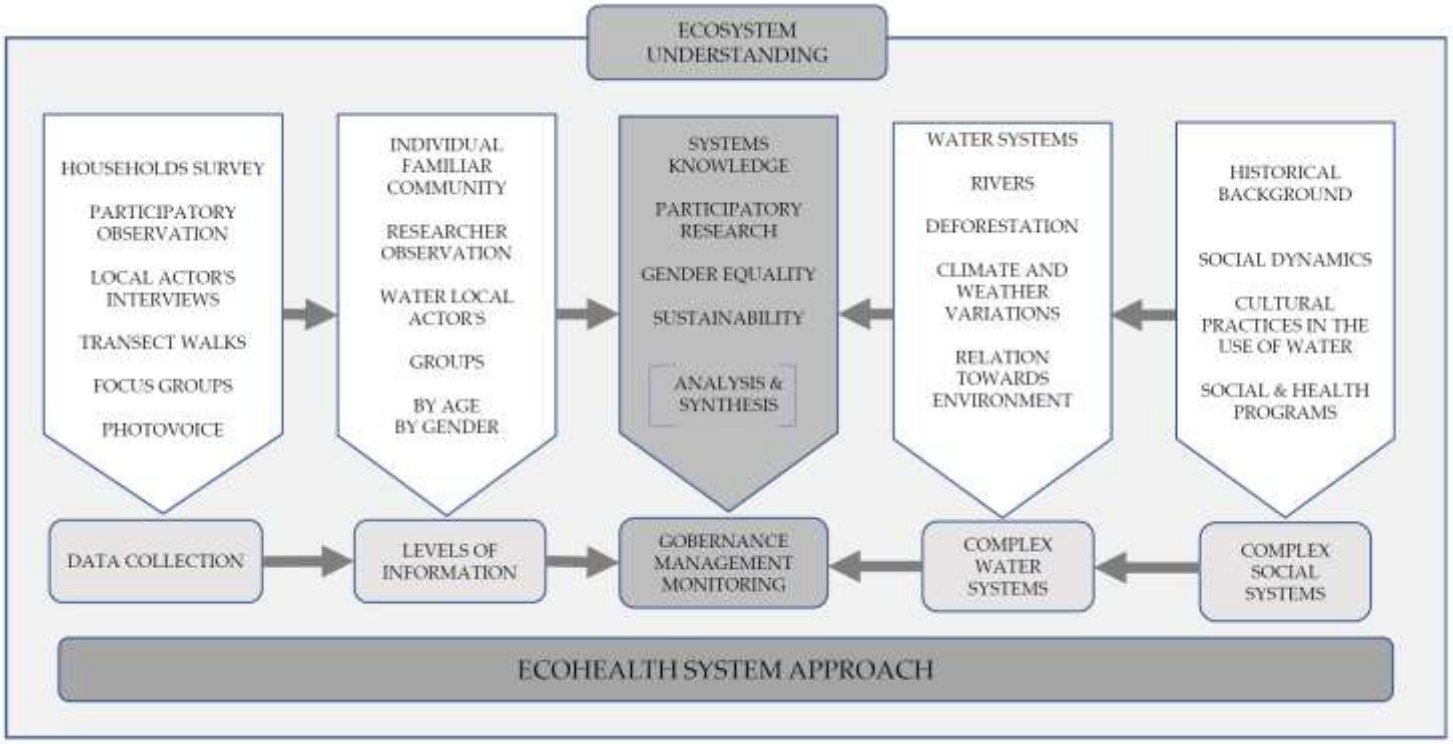
Notably, it is becoming more extensively accepted that in many instances Indigenous knowledge has more detailed, fine-grained and reliable observations than instrumental datasets. This growing body of evidence is reflected in an increasing number of publications in high impact journals about the incorporation of Indigenous knowledge in terms of research and international policy in climatic and non-climatic observations. For example, an article published by Ford et al. (2016) details how:

> "Indigenous knowledge provides an alternative, yet equally valid, way of understanding the human dimensions of climate change to mainstream science and acknowledge that both knowledge systems may differ and contradict each other in some circumstances (39). In such cases, both knowledge systems should not be pitted against each other to arrive at a 'correct' understanding but viewed as providing diverse perspectives" (150,188–190).

Likewise, the ecosystems approach to water sustainability and health outcomes supposes hierarchical societies around Shawi communities which are embedded and pertain to a larger ecological system. Changes in environmental structures impact ecological systems which consequently affects social dynamics and vice versa. By observing and monitoring these dynamics, the ecosystem approach incorporates a deeper understanding of social processes interwoven with ecology that challenge human health and water management. Therefore, by incorporating a sustainable development research lens, the framework allowed local narrative guide us for understanding how social, water and climate systems interact and co-evolve

(156,191). Hence, these inputs helped to elucidate water/climate governance and management providing adequate statements based in local evidence(192,193). See **Figure 2.**

Figure 2. EcoHealth systematic approach used in two communities along the Armanayacu basin



CHAPTER IV: METHODOLOGY

4.1. Type of study

This is an explanatory case study, qualitative oriented, that used two concurrent mixed-method approaches (**Annexes 1 and 2**). The mixed-method approach relied on quantitative and qualitative components. The quantitative component was a cross-sectional survey conducted in each community. The principal component, qualitative, used a Grounded Theory lens supported by multiple data collection methods.

4.2. Shawi history

The god Kunpanama created Shawi or Chayahuita from a peanut, and from the shell scattered his brother, the Awajun. From the beginnings, Kunpanama created a complex hydrographic system run by three river basins: Paranapura, Cahuapana and Sillay. Kunpanama allowed basins to be inhabited by Shawi's docile spirit, while Awajun got a rebellious one (194).

As the different worlds were developed in Shawi cosmology, water played (and still does) and important role in Shawi culture. The worlds of water and rain is one of the spaces that the Shawi universe represent. Spirits act as guardians to water sources and can inhabit aquatic creatures, as well as nurture and protect them. Any transgression to these relations can be sanction by unleashing water natural disasters with intense tropical rains and floods (194,195).

This way of living was interrupted in the XVI century, by Spanish colonizers who began their exploration in the Peruvian Amazon. This made Indigenous People, particularly Shawi, emigrated into the upper hills (*el monte*) fleeing contact seeking for refuge (196). Those Shawi who were contacted, opposed no resistance and were immediately slaved. Meanwhile, the process of colonization brought along epidemics with the immediate decrease in Indigenous population. This disrupted even more the peace inside and between Indigenous groups, with consequently interethnic conflicts (197).

For instance, the Awajun accused the Shawi of being responsible of deaths and being involved in witchcraft. Hence, they killed Shawi spiritual leaders (196,198,199). It is documented that, to restore peace, Shawi people accepted their responsibility. In taking responsibility, they sought acceptance under Jesuit missionaries' protection. By doing so, they accepted Catholic faith and the Spanish crown (200,201). Syncretism occurred with the symbiosis and coexistence between both spiritual systems: one based on the belief in a single God, the other with an animism view. This syncretism persists and is part of Shawi identity.

The most important missions that harbored a large Shawi population were (1) *Nuestra Señora del Paranapuras* and (2) *Presentación de Chayabita* (199). The latter Jesuit evangelic presence lasted from 1650 to 1750. Evangelization was not a homogenous process due to the extensive territory of the Amazon. In some remoted areas, once Jesuits relocated Indigenous Peoples, they could not stay longer time. Their mission was to bring the "uncivilized" Indigenous Peoples scattered in upper hills to live near the river. Once settled near the riverside, they will be undergoing

Spanish protection and evangelization under the *encomienda* (202). The *encomienda* was a colonial institution by which colonization was structured and gave political and economic power to Spanish conquers. Much of their power relied on their slaves, Indigenous Peoples working force. This was well stablished in bigger cities like Yurimaguas, Tarapoto, Balsapuerto and Moyobamba, where trade flow occurs. After the Jesuits expulsion, Franciscan's missionaries continued evangelization and the system of labour dependence established by the encomienda. Those Shawi slaves who lived under the Spanish owner protection or the *encomendado* were loyal to them, as they did not participate in rebellions against the conquers (202).

Like those conquerors and explorers who entered the Amazon looking for gold, animal skins and cinnamon, during Republican times merchants were guided by the thirst of rubber (*caucho*) and rice booms. All booms had their sudden bonanza and decline (197,199,201). Consequently, many traders and landowners left the Amazon area. Although slavery among Indigenous Peoples had been abolished, a system of dependence on landowners remained. Despite the withdrawal of settlers, other ways of trade were created along the micro basins of rivers. *Regatoneros*, people who travel the river selling products, stablished a system of barter with Indigenous communities, offering commercial products in exchange of natural. Western medicines not officially delivered found a way to enter Indigenous communities (200,203). Meanwhile, other evangelic missionaries started to have more presence in the area in the second half of the 20th century. One of them was, the Summer Institute of Linguistics (SIL International) whose mission was to

translate the Christian Bible into local languages had access to different Indigenous groups (196,198,204). Shawi were not the exception to this influence.

During the mid XX century a Law for Native communities was enacted enabling Indigenous Peoples with the legal right to land.[9] Since then, many Amazonian Indigenous communities have registered for territorial demarcation and tenure (199,205,206). As for Shawi communities, there are a total of 92 officially register in the Minister of Agriculture[10]. Historically, the Datem area became the emblem of Indigenous resistance to Spanish conquest. Hence, those Shawi who remained to these days in that area, in the now known district of Cahuapanas, are thought as more traditional compared to the more *mestizo* Shawi in the Paranapura basin (197). Through the years, Shawi communities have organized themselves in federations[11] to ensure their rights to land and preserve their culture, ethnic identity and social organization.

[9] *Ley General de Comunidades Campesinas, LEY Nº 24656*.

[10] *Directorio de comunidades Nativas del Perú, 1999.*

[11] *Federación de Pueblos Indígenas Shawis de San Martín* (FERISHAM); *Federación de Comunidades Chayahuita del Río Sillay* (FECOCHASI), *Federación de Comunidades Nativas Chayahuita* (FECONACHA), *Federación de Comunidades Nativas del Distrito de Cahuapanas* (FECONADIC).

Figure 3. Photographs from Shawi people

Credits: PA Torres-Slimming

4.3. Study area and community profile

Shawi Indigenous communities[12] is one of the 51 Indigenous groups distributed in the Peruvian Amazon, with an estimated population of 25,000 people settled in the northern regions of Loreto and San Martin. In the region of Loreto, there are approximately 100 Shawi communities, predominantly along the river basins of the rivers Paranapura, Yanayacu-Shanusi, Supayacu-Aipena and Cahuapanas-Sillay, and their smaller tributaries. Most of these communities live in five districts of the Alto Amazonas district, where the Paranapura basin and its tributaries runs.

In this lowland Amazon Rainforest wide navigable rivers create microenvironments occupy the headwaters of these rivers up to their outlets. These ecological microenvironments give fluvial landscapes consisting of permanent flooded alluvial plains, terraces, ponds and oxbow lakes. In general, tributaries from these basins have low current water flows and limited biotic resources (196,207).

The climate is tropical, humid and warm with high temperatures throughout the year. The average annual temperature is between 26 C°. The minimum relative

[12] *Indigenous Peoples* referred to ethnic groups who were known to be originally, first people in a territory, and self-identify as Indigenous. A global estimation from the United Nations considers 220-350 million of Indigenous People. In Peru, according to the 2017 census, 4 groups (with 5’747,734 people) self-identified as Indigenous living in the Andes (99.6%), and 51 groups (with 332, 975 people) self-identified as Indigenous living in the Amazon.

humidity is of 74.5% and the maximum relative humidity of 81.5%. The dry season is from May to October. The rainy seasons are from December to May. The total annual precipitation range is between 2000-2500 mm per year (198).

Shawi worldview is centred around the environment, with livelihoods, well-being and health systems based on respect for the land and rivers (196). Shawi people usually settle in a central location away from riverbanks, building their houses on top of hills around a central community area. Like many other Indigenous Peoples of the Amazon, Shawi shares the same social, economic, historical and geographical challenges related to accessing basic health facilities (194,195,197–199), and in recent years they are experiencing environmental threats directly affecting Shawi well-being (195).

Communities partnered in this study are in the Peruvian Amazon along the basin of the Armanayacu river, which is a tributary of the Paranapura river that empties into the Huallaga river. This area is in the Balsapuerto district, province of Alto Amazonas, department of Loreto (**Figure 5**). Data collected from 2014 shows that community A had a total population of 350, while community B had a total of 68.

Figure 4. Photographs of Shawi communities de-identified A and B

Credits: PA Torres-Slimming

Community A

Community B

4.4. Selection criteria of communities

All research components of this doctoral thesis emerged from one study protocol (**see Figure 1 and Annex 3**) as part of the Indigenous Health Adaptation to Climate Change (IHACC) Program (http://ihacc.ca/), which were working in collaboration

with ten communities from the Shawi Indigenous group in the Loreto region. Data collection was done in two communities chosen by convenience.

4.5. Quantitative sample size, sampling, data collection and analysis

A cross-sectional survey was conducted in households from each community. Respondents had to be one adult member older than 18 years and had to be a resident in the community for at least the previous six months.

The questionnaire captured data on (i) sociodemographic indicators, (ii) water access, hygiene and sanitation information (WASH), and (iii) climate and weather variables. In collaboration with local Shawi researchers, all survey questions were revised, validated and translated from Spanish to Shawi language.

Three trained local Shawi research assistants orally administered the final survey questionnaire at the participant's house. Participants could choose either language (i.e., Shawi language or Spanish). Responses were uploaded into the Magpi database (http://home.magpi.com/) through mobile phones and then downloaded into Stata/SE version 15.0 (StataCorp, 4905 Lakeway Drive, College Station, TX, USA) for data cleaning and statistical analyses.

Descriptive statistics were performed to summarize data. Frequencies and percentages were used for categorical variables, while for continuous variables, means were reported with standard deviations and the median with the interquartile range. Bivariate analysis of categorical variables was tested using either Chi-squared or Fisher's exact tests depending on expected values. For comparison

between continuous variables, Student's t-test was used. A p-value < 0.05 were reported as statistically significant.

4.6. Qualitative conceptual framework and data collection

As mentioned in Chapter II, Grounded Theory was used with the intention of developing an emergent water related-ecosystems theory. Rather than merely describing the phenomenon, this approach is grounded in data that explored water security in the context of cultural background, perceptions and lived experiences from participants in the two communities and local actors (167,208).

The research question that guided the qualitative component was: what is water security for you, your family, and your community? To explore this question, purposeful sampling was used to identify participants with specific knowledge and backgrounds in water security. The sampling process was carried out by the principal investigator in collaboration with the local researcher.

Grounded Theory uses an inductive approach for sampling, data collection and analysis (130,193,209–214). Moreover, Grounded Theory used a diverse qualitative data collection techniques, tools and approaches (132,166) to gain insights and lived experiences of water security in the two communities.

Five qualitative data collection tools were used: (i) participatory observation, (ii) in-depth interviews with key actors, (iii) PhotoVoice, (iv) focus group discussions, and (v) transect walking paths. Open and semi-structured thematic questions oriented all qualitative workshops.

Participatory observation is an ethnographic technique used in qualitative research with the aim to document interactions and local environmental practices and familiarize the researcher with a given group of participants during the observation period (215,216). In this study, during each field work visit, the principal investigator lived and interacted with a local Shawi family group in order to observe local water practices. A moderate type of participatory observation was undertaken, according to Spradley's classification, where there was a balance "in the bystander role and becoming a member of the community" (217).

In-depth interviews is a strategy used to open one-on-one spontaneous conversations, discussions and analysis between the interviewer and the key informant (218). It was used with individuals who had worked for at least five years in the local water management sector, educational programming, Indigenous healthcare and /or climate change, with the aim to explore individual experiences.

PhotoVoice is a qualitative visual methodology commonly used in health promotion, Indigenous health and in participatory research (178,219–222). It facilitates participants in documenting their concerns through photography while exploring possible solutions (178). In this study, PhotoVoice was only done in community A. Activities were clearly outlined: (i) give participants training in the use of camaras, (ii) encourage participants to take photographs to document their daily activities in relation to water and water security, (iii) meet one week later in a workshop to reflect on the photographs, develop and discuss recurring themes, (iv) each participant could select three photos and messages that best represented their concerns on water security and (v) share messages with local authorities.

Focus groups are dynamic group guided interview conversations that allow the group to explore lived experiences around water security in the context of their cultural background (162). Focus groups were conducted in each community with adults and were stratified by gender. A local Shawi researcher and the principal investigator facilitated the focus groups.

Transect walking paths were shared walking activities, whereby with Shawi participants and the principal investigator walk along a path to explore their water livelihoods, "sense of place", environment, changes in weather and water relations (223).

4.7. Qualitative units of analysis, sampling and sample size

The units of analysis were chosen with a purpose. This purpose was to explore and oversee the most relevant cases which can characterize water relationships, human actions and behaviour, and understand the different meanings concerning water security phenomenon.

Thus, to judge whether a sample size is adequate in qualitative research, it is necessary to know the context and purpose of the study. Hence, qualitative researchers can start with a tentative sample size, guided by the sampling design, but this must be corroborated by saturation point (224). Therefore, considering these points, an initial sample size was proposed and contrasted along with the richness of the data as provided and unfolded by participants (168).

Regarding the purposeful sampling design (126,210,212,225) the intention was to include all those cases or situations that could represent typical cases and homogenous situations. Additionally, the author chose to seek other participants that could help compare different situations, extreme or deviant cases. Additionally, intensity cases were included, meaning those which without being deviant could explain water security phenomenon with special richness. **Table 3** illustrates the sample and all sampling techniques used in this study.

4.8. Qualitative saturation point

Social interactions are complex and in constant change, so it can be arguable if a phenomenon can be fully displayed by a researcher. However, a social scientist should learn how to understand how this complex reality reveals through data collection (130,218,226). Therefore, the concept of saturation emergences as the precise moment in which the researcher considers information capable to illustrate the phenomenon in quest. For this reason, the inclusion of new units of observation should continue until the necessary elements to build a comprehensive and convincing explanation or theory (127,134,227).

Furthermore, saturation is understood as the point at which a certain diversity of ideas has already been heard and with each additional interview or observation no other elements appear. If new data or new ideas continue to emerge, the search must not stop (29).

In such sense, voices from different participants were included in this dissertation through different data collection techniques. All techniques continued until the

saturation point was reached (224). Data was explored in the number of times a piece of information was repeated and on the quality of information (168,228). This even included contradictory pieces of information as they helped to understand the phenomenon of water security in this two Shawi communities.

4.9. Qualitative analysis

Qualitative findings were conducted under a Grounded Theory lens (166,210,229), where themes were developed using a constant comparative method. This method consisted of four steps: (i) data familiarization, where audio recordings were transcribed verbatim and translated from Shawi to Spanish, if necessary, (ii) initial creation of codes and categories (open and axial coding), (iii) identification and development of themes (selective analysis), and (iv) reviewing and refining themes (166).

Additionally, quantitative and qualitative data were used as the unit of analysis for this thesis discussion, as well as for inputs for reflections on the scope of the methodology and framework (**Figure 6**). Hence, throughout this case study, simultaneous methodological triangulation under a hybrid inductive and deductive approach (124,136,230,231) was conducted to contrast divergent and convergent ideas(136,232).

4.10. Qualitative rigor

Qualitative research focuses in recognizing human subjectivity as an objective fact to be accounted for (233,234). Thus, qualitative researchers rely on two important

concepts for methodological rigor: (i) transferability and (ii) reflexibility (128,213,235).

Transferability refers to the possibility of generalizing water security results from two Shawi communities along the Armanayacu river basin to similar areas whose meaning and contexts alike the one studied herein. As for this study, multiple data collection techniques, saturation of data and contextualization of data analysis, supports transferability to surrounding communities in the Armanayacu Amazon river basin. As for credibility, this concept refers on the capacity this dissertation water security results fully represent the study phenomenon from the subjectivity of all qualitative participants who gave their voices. As such, the author's own fidelity as a researcher is involved along all stages of this study. How the author perceives, captures and experienced (positionality) water security phenomenon along the different stages of research has unfolded along with the complexity of research itself. Therefore, it was necessary to demand reflexivity in recognizing the many nuances of the author's own intersubjective, relationships between participants, research inquiry and bias in analysis (236).

Furthermore, several triangulation strategies were used for reducing researcher or observer biases and developing a comprehensive understanding of water security from the voices of the participants (135,142,160). Triangulation was done by contrasting all information from different sources for testing the validity of the results.

All results were triangulated (i) by methods: using multiple data from interviews, participatory observation, focus groups, photovoice and transect walks; (ii) by investigators: were different researchers, especially Indigenous, participated in the study to provide multiple observations, verify interpretation in the analysis and conclusions; (iii) by epistemological scope by complementing qualitative methods with quantitative lens; (iv) by data source triangulation where different profiles of individuals, families, communities, ages and local actors were included to gain diverse perspectives of water security; and (iv) by time-involvement in the area (160,164).

4.11. Researcher positionality

The concept of positionality stands on how researchers conduct their study reflecting upon his/her own insights towards the phenomenon under investigation, the participants and the contexts that surrounds the outcomes (237). As for me, the author, since medical school I have been deeply interested in epidemiology and developed a profound respect in rural medicine. In this field I have learn—and continue to—to overcome multiple difficulties, different levels of prejudices and incomprehension towards generating medical knowledge from the most excluded populations. Although there has been some progress in rural medicine, there are many health practices that are used without any kind of evidence. This completely worries me. Therefore, I sustain the need to build theories of approach in health based on solid evidence from both the traditional and the Western medicine. Aside, my relation towards communities has developed overtime based on a deep honesty and respect between them and myself. I present myself as who I am, with my own

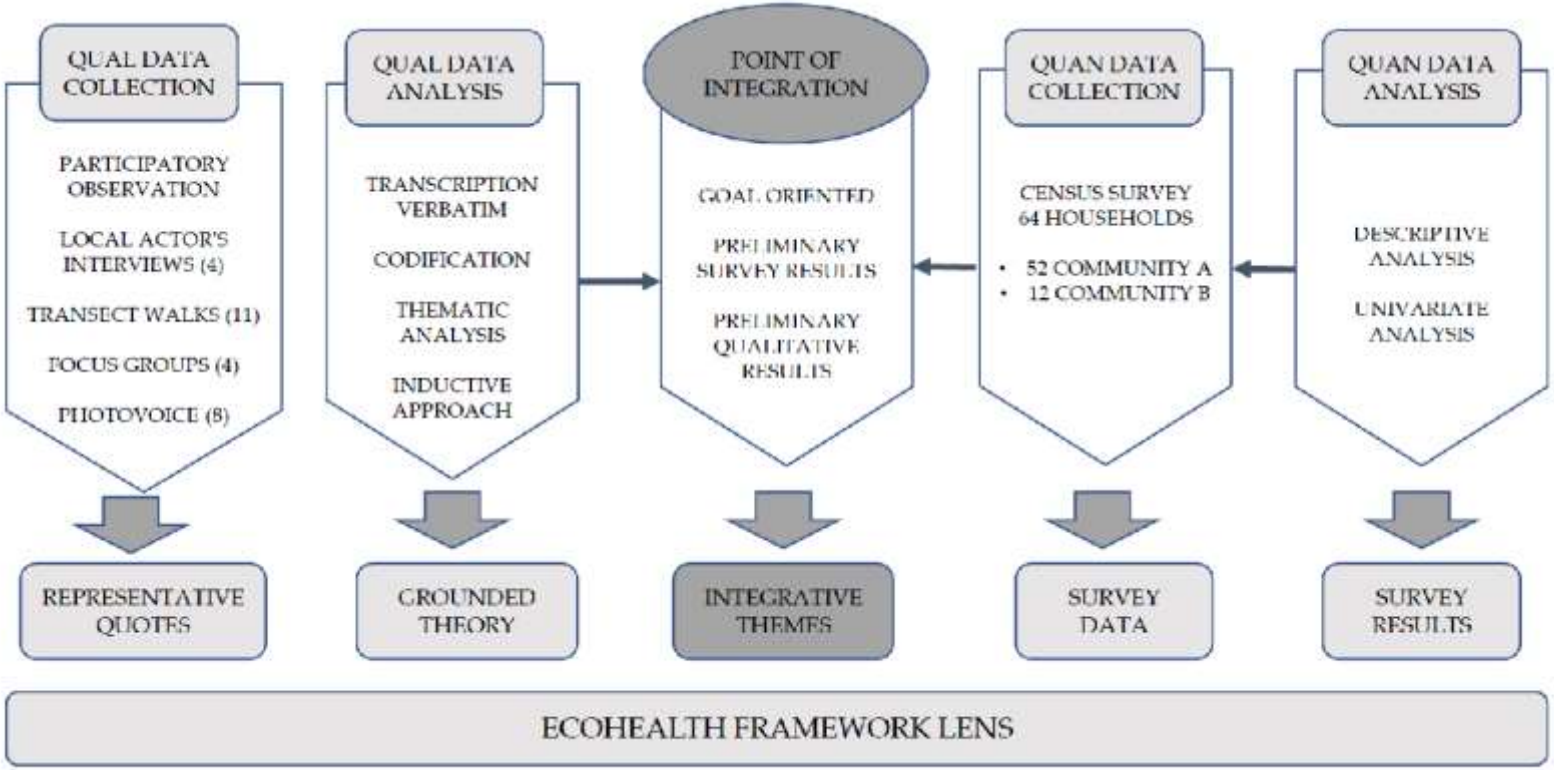
historical background, settled as a medical doctor. I stand firmly that, once recognizing and allowing differences to dialogue, one can build strong and lasting healthy relations.

4.12. Ethical considerations

Protocols within this doctoral thesis received approval by the Ethics Committee of the Universidad Peruana Cayetano Heredia IRB 65470 (**Annex 3**). This study has been conducted under the International Conference on Harmonisation-Good Clinical Practices (ICH-GCP), according to the Helsinki Declaration, the United States Code of Federal Regulations-Protection of Human Participants (US 21 CFR Part 50-PHP) and Part 56-Review Ethics Committee, and followed ethical guidelines for research with Indigenous Peoples (177,238–241). All informed consent was based upon the principles of the current edition of the Declaration of Helsinki and the domains of justice according to the World Health Organization (WHO) guidelines "Indigenous Peoples & Participatory Health Research" (242).

Study and consent information was provided to all participants in an oral and written form. All dynamic qualitative conversations were audio recorded with previous permission through the informed consent process. PhotoVoice participants were specially trained in the ethics of photography. Participants could ask for all the details of the study if they had any doubts regarding the procedures to be performed (**Annex 3**).

Figure 5. Qualitative and quantitative data collection and analysis



CHAPTER V: FIELD WORK RESULTS

The main goal of this PhD dissertation research was to characterize the current water security situation in Indigenous Shawi communities along the Armanayacu river basin, Peru through local perspectives.

Field work results have been published in peer reviewed articles by the author, **hence I will cite myself along the following section** (207,243). For further details of the published articles, please refer to **Annexes 2** and **3**.

5.1. Fieldwork

Data collection was underpinned by community participation principles (169,244). Consequently, an initial visit to the city of Yurimaguas, and both communities was held on July 2015. The intention was to identify key actors in the water sector, ask collaboration and consent for working with members of both Shawi communities.

During this first visit, that lasted almost a month, local Shawi researchers were identified, with whom, the principal investigator, revised and validated, qualitative guiding questions and the survey questionnaire. Additionally, identification of purposeful qualitative participants was conducted. Also, a community map was drawn as a tool for qualitative workshops. Furthermore, participant observation was done and field notes were also taken by the principal investigator.

Qualitative data collection was completed in the month of November 2015, in a period of three weeks. Field work was done by the principal investigator supported by a local Shawi researcher (**Figure 7**). Qualitative respondents and data characteristics are presented in **Table 2**.

Figure 6. Photographs from field work

Credits: PA Torres-Slimming

Table 2. Qualitative respondents and data characteristics**.** *Adapted from PA Torres-Slimming Int J Environ Res Public Health. 2019;16(13)*

	In-depth interviews	**PhotoVoice**	**Focus groups**	**Transect walking path**
Water local actors	Five participants (four males and one female) who had experience working with local institutions in the water sector and communities (n=5)	NA	NA	NA
Community A	NA	Eight participants, six adults (three women and three men) and two children (one boy and one girl).	Seven women and eight men participated in community A (n = 15).	A total of three adult females and five adult males (n = 8).
Community B	NA	NA	Seven women and eleven men participated in community B (n = 18).	A total of one adult female and two adult males (n = 3).

Results	The interviews were audio recorded, with permission, and averaged 60 min in duration. A total of 190 min of conversation were recorded.	Participants took a total of 202 photographs. The discussions were audio recorded, with permission and totaled 228 min of recorded discussion. In the final session, each participant selected images to be included in a small book. Messages were written in Spanish and Shawi alongside each photograph. This small book was left with the *Apu* (community leader) and used by the local school to disseminate information to the rest of the community.	The focus group discussions ranged between 30 to 45 minutes, and were audio recorded, with permission, 218 minutes of discussion were documented. Maps and diagrams were used in all sessions to stimulate discussions.	Transect walking paths were audio recorded with permission, with a total of 214 min of recorded discussions and 216 photographs taken.

NA: Not applicable

Quantitative data collection was done during the months of December 2015 and January 2016. During the census survey a total of 73 occupied households were identified in the two communities and invited to participate in the survey. Eight of the households declined participation. The participation rate was of 89% (65/73). Additionally, one household questionnaire was excluded as data were input incorrectly, leaving 64 households. The number of household respondents in community A were 52 (81.2) and in community B were 12 (18.8) (**Table 3)**.

5.2. Results: integrating qualitative and quantitative findings

5.2.1. Theme 1: General communities dynamics

Communities are separated by approximately a 30-minute walk. Before 2010, they were accessible only by boat; nowadays, after road construction, communities are a one hour walk or 30 minutes away by motorcar from the health post and two hours by motorcar from the nearest city of Yurimaguas. The river Armanayacu runs alongside these communities; most families take around seven to fifteen minutes to get water from the river, and everyone helps to carry buckets of water.

In both communities, almost all community members identify themselves as being Shawi. The relationship between members seems very cohesive, as they enjoy festivals, football matches and land activities together. Agriculture is their main way of subsistence throughout the year, and community members of all ages contribute to agricultural activities. Families are assigned a plot of land by the community, where they can plant and harvest crops. When needed, families help each other to plant crops; the community calls this type of collaborative activity a

minga, a pre-Colombian tradition that can last an entire Sunday. During *minga,* they work together to address community needs, as helping the group is more important than the individual; thus, decisions are made that respect the collective, rather than the individual, benefit. The traditional beverage *masato* made up from cassava - *mandioca* or *yucca*- (*Manihot esculenta*)- is central to the Shawi culture, is enjoyed both during a *minga* and during the everyday life of the Shawi. During these activities, it is usually served by women in their own *mocawas* (cups made of 25 ccs of clay).

A typical day for the Shawi begins at 5 am with a cup of *masato*. These traditional beverages invite us into Shawi culture, as they are part of any social gathering, and serve as nutritional support in daily life. Morning routines also include listening to local Spanish radio, where advertisements and local news are disseminated to the areas of Balsapuerto and Yurimaguas. They also listen to religious programs, which are either Evangelical or Catholic rosary prayers. Additionally, the *Apu* (chief of the community) makes important announcements over the megaphone.

In each community, there is a school and a church. In addition to the *Apu*, there is a local priest and a traditional healer, but there are no local health workers or promoters in the communities. However, there is evidence that non-governmental organizations, Evangelical groups and/or health post practitioners have been present in the area, organizing different health promotion activities to inform the community's hygiene practices. As a result, community members have different levels of hygiene knowledge and varying access to healthcare. For example, based on participant observation and interview reports, community members use a

combination of medicinal plants, traditional medicine, and Western medicine. The individual will follow different routes of treatment depending on what they perceive to be a health risk, which will then determine the type of medicine needed.

5.2.2. Theme 2: Demographic characteristics of household respondents

Demographic characteristics of the household respondents' sample are presented in **Table 3**. A high proportion of household respondents were male (80.9%), with an average age of 40 years. A family was composed of was 5.1 residents per house, with an average of 2.3 adults and 2.8 children per house. Within families, a high number (82.8%) were benefited by a government cash-transfer program for families facing extreme poverty (JUNTOS). Additionally, respondents reported being registered (90.6%) for the national healthcare insurance *Seguro Integral de Salud* (SIS) provided by the Peruvian Ministry of Health for those living in extreme poverty who do not have access to other health insurance systems.

Respondents reported using health programs from the nearest health post located within forty minutes walking distance. The programs mentioned for childcare were the Children in the Growth and Development Program (CRED) in 79.7% of household respondents. It seems some programs (e.g., pregnancy check-ups and healthy child under 5 growth monitor controls) do have higher rates of community participation. This could be due to the monthly conditional cash transfer program, through which community members get reimbursed by the government for accessing health programs if they abide by the conditions of the cash transfer.

None of the respondents mentioned deworming programs delivered in the area (**Table 3**). This was corroborated in the interviews where there have no deworming campaigns had been delivered either by health campaigns, at the health post and/or non-governmental organizations.

Table 3. Household socio-demographic characteristics of survey participants (N = 64)

Sociodemographic characteristics	n (%)
Number of household respondents in community A	52 (81.2)
Number of household respondents in community B	12 (18.8)
Household respondent was male	51 (80.9)
Age of respondent in years	40.2 (14.2) *
Number of households receiving government cash transfer assistance	53 (82.8)
People per house	5.1 (2.1) *
Adults per house	2.3 (0.9) *
Children per house	2.8 (1.8) *

Social assistance programs	**n (%)**
Comprehensive health insurance (SIS)	58 (90.6)
Children in the Growth and Development Program (CRED)	51 (79.7)
No deworming program	64 (100.0)
Government cash transfer assistance (JUNTOS)	53 (82.8)
Labor activities	**n (%)**
Number of respondents participating in agriculture activities	63 (98.4)
Number of households with children participating in work activities	47 (73.4)

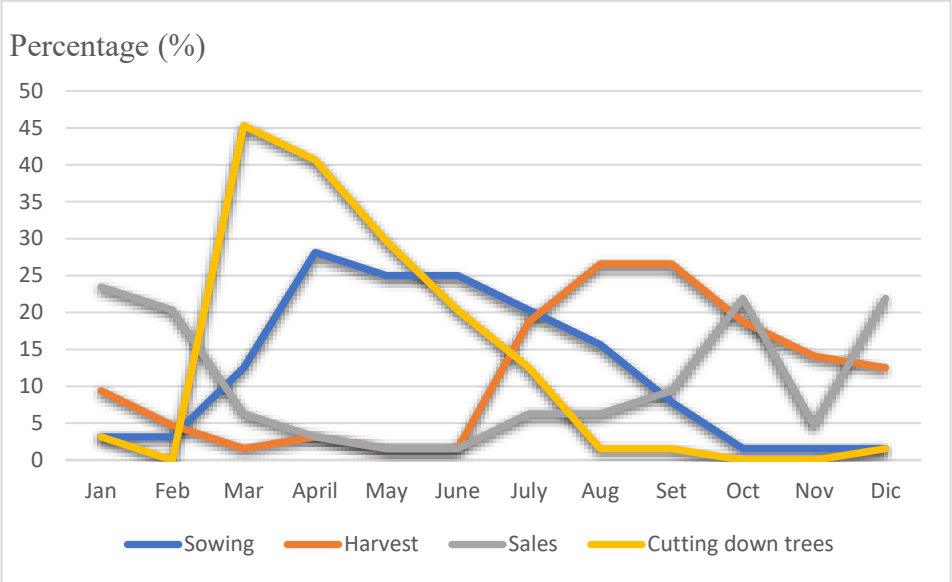
* Mean (standard deviation)

Adapted from PA Torres-Slimming Int J Environ Res Public Health. 2019;16(13)

Subsistence agriculture (98.4%) was a common practice among community members with children participation in work activities (**Table 3**). This activity was practiced throughout the year (**Figure 8**), starting from March to July, with the preparation of the ground by cutting down trees for planting crops. This is followed by the harvest season, from July to December. Crop sales takes place from October

to February. Other reported labor activities were crafting, fishing and hunting.

Figure 7. Annual timeline of agricultural activities reported by Shawi survey respondents (N = 64)



5.2.3. Theme 3: Water source availability and collection systems

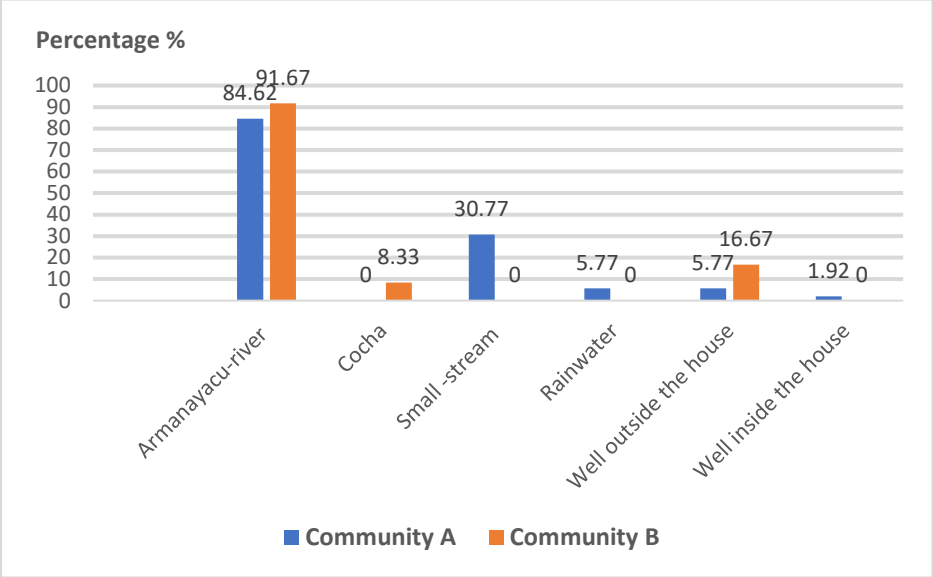
The main water source was the Armanayacu river as indicated by household survey respondents (85.9%) and interviewees (**Figure 9**).

Figure 8. Photograph of Armanayacu river

Credits: PA Torres-Slimming

Other sources of water collection were small streams (25.0%) and water gathered from a *cocha* (pond). They also collected water from a well outside the house (4.69%) and a few from an inside well inside (1.6%) (**Figure 10**).

Figure 9. Water source reported by Shawi survey respondents in each community (N = 64)



At the household level, Shawi families collected water twice a day, early in the morning and late in the afternoon. The round trip from the water source to their homes will take them on average 20 minutes walk (**Figure 11**). All family members, irrespective of gender or age, will help in carrying water in either buckets of 5L or 18 L, four to five times per day (**Figure 11**).

Figure 10. Household level water collection

Credits: PA Torres-Slimming

Survey respondents reported that they mostly stored the water in buckets (98.4%), although some families used bottles, too (15.6%) (**Table 4**). This quantity will provide sufficient water for daily activities, such as cleaning food and making *masato*.

Table 4. Household types of water storage

Household types of water storage:	**n (%)**
Households that store water in buckets	63(98.4)
Households that store water in bottles	10(15.6)

Adapted from PA Torres-Slimming Int J Environ Res Public Health. 2019;16(13)

Regarding household water treatments, some families had built their own rudimentary small wells. This water collection consisted of a sedimentation systems used for daily activities such as cleaning dishes. If community members wanted to wash their cloths or bath, they went directly to the river (**Figure 12**).

Figure 11. Household water collection (PhotoVoice and transect walks photographs)

Adapted from PA Torres-Slimming Int J Environ Res Public Health. 2019;16(13)

Moreover, there were four public wells in community A. Participants mentioned being built by a foreign NGOs and by the government through the Cooperation Fund for Social Development (FONCODES) from the Peruvian Ministry of Development and Social Inclusion (MIDIS). They were not in use. Also, in community A's primary school they had installed a rainwater harvesting system. (**Figure 13**).

At the community level, there were no organized groups for water collection, treatment and sanitation. The only organized water collection identified was centered at the local schools. This responsibility is given by the *Apu*, the schoolteacher or the Parent's Association who gives the responsibility each day to one family to oversee water collection for school activities. The family in charge is assigned of collecting around 18 L buckets of water from the river. This water is used for preparing student's breakfast and lunch meals. This food was provided through the social program Qali Warma National Schools Food Social Program.

As one interviewee explained (168): "*Normally, mothers responsible for cooking bring water from the river. Every day they work, and every mother has her own commitment. I have a relationship with the mothers, and they know who will take care of everyday responsibilities. They already know because I have pasted (the list) in the dining room so the moms can look at it*" (I2) (243).

Figure 12. Non-functioning wells and rainwater system collection in community A (PhotoVoice and transect walks photographs)

Adapted from PA Torres-Slimming Int J Environ Res Public Health. 2019;16(13)

5.2.4. Theme 4: Water acceptability and water consumption

Qualitative participants mentioned that the river was different than preceding years. They noted the quality of the water was dirtier, with more sand and turbid. Therefore, they had to take more time to allow the water to sediment. They also noticed that water temperature had increased, being warmer at midday, not allowing them to take their usual baths. They link these changes to deforestation, particularly around the riverbank. As one individual noted during a transect walk: "*First, you see dirty water with a lot of sand, and then, first thing you do when collecting the water is to pour the water into another container and let it settle. All the time is like that, when the children bathe, the sand gets up easily*" (TWP6) (243).

While, in survey data, **Table 5** shows the perceptions around water quality from the Armanayacu river. The survey used a Likert scale for registering quality in terms of taste, color and smell. Although in terms of acceptability, 75.0% of household respondents felt water was "drinkable", they considered it to be dirty (56.3%). Although herein we do not present this data, we found that 58.33% considered the water "drinkable" versus 96.43% who considered the water source "not dirty" and "drinkable" ($p < 0.001$).

A total of 38.1% of survey respondents considered water of "regular" quality for their daily uses such as preparing *masato*, washing and cooking (**Table 5**).

Shawi interviewees explained that it is very rarely that they quench thirst with river water or with purchased beverages, as they are accustomed to hydrate themselves since early age with *masato*. They drink *masato* in small clay bowls called

mocahuas. This *mocahuas* have an approximate capacity of 250 cc. On average, they drank 14. 6 *mocahuas* of *masato* or water per day. This was corroborated from quantitative data (**Table 6**).

Table 5. Acceptability and water perception according to survey participants (n = 64)

Acceptability of water from the river and small streams:	**n (%)**
Water is drinkable	48(75.0)
Water can be used for bathing	35(54.7)
Water is dirty	36(56.3)
Quality of water collected (taste, smell, color):	**n (%)**
"Poor"	25(40.3)
"Regular"	14(22.6)
"Good"	23(37.1)
Quality of water for daily drinking (taste, smell, color):	**n (%)**
"Poor"	16(25.4)
"Regular"	24(38.1)
"Good"	23(36.5)
Quality of water from the river and small streams:	**n (%)**

“Poor”	27(43.5)
“Regular”	15(24.2)
“Good”	20(32.3)

Adapted from PA Torres-Slimming Int J Environ Res Public Health. 2019;16(13)

Table 6. Drinking preferences according to survey participants (n = 64)

Source of liquids that the household drinks:	**n (%)**
River water	16(25.8)
Masato	46(74.2)
Preferred drinking water source:	**n (%)**
River water	10(16.1)
Masato	46(74.2)
Soda	6(9.7)
Average *mocahuas* † of *masato* or water per day	14.6(7.7)
Household prefers to purchase drinking water:	**n (%)**
No	60(96.8)
Yes	2(3.2)
Preferred purchased drinks:	**n (%)**

Water	2(3.1)
Soda	29(45.3)
Juice	7(10.9)
Alcoholic drinks	3(4.7)
Does not purchase drinks	23(35.9)

† 1 *mocahua*= 250 *cc*

Adapted from PA Torres-Slimming Int J Environ Res Public Health. 2019;16(13)

5.2.5. Theme 5: Practices around water, sanitation and hygiene (WASH)

Handwashing practices were reported by household survey participants. For example, 65.6% reported washing their hands before preparing *masato* and 95.3% before eating. While only 35.9% washed their hands after defecating. Regarding washing their hands with soap, 59.4% of households stated they would if they could own one. There were no significant differences in terms of hand washing practices between communities or genders (data not shown).

All households' respondents (100.0%) practiced open defecation. When asked about open defecation site, more than a third of respondents said it was done near their family home, while 50.0% reported to openly defecated anywhere in the community (**Table 7**).

Table 7. Practices related to sanitation according to survey participants (n = 64)

Practices related to sanitation	**n (%)**
Practices open defecation	64 (100.0)
Open defecation site:	
Anywhere in the community	32(50.8)
Spaces shared by family	24(38.1)
Spaces shared with other families	7(11.1)

Adapted from PA Torres-Slimming Int J Environ Res Public Health. 2019;16(13)

Regarding sanitation infrastructure, at the local schools there were two latrines. They were for exclusive use for teachers and children who attend the local school. When exploring both communities, particularly during the transect walks, it was notices of the existence of three other non-functioning latrines in the two communities (**Figure 14**). When exploring qualitative data, during transect walks, participants reported: "*Sometimes children do defecate in the river, so we boil the water to drink; we have no other option: there is no other river—only when the river grows, we take (water from) the stream*" (TWP6) (243).

Figure 13. School latrines and non-functioning latrines (transect walks photographs)

Particularly women from focus group attributed river defecation practices to upstream communities affecting downstream: "*The river is dirty and is contaminated with the feces from the residents from the upstream communities. That's why a woman wants to make a well so that they can draw clean water from there*" (FG1W) (243).

Participants from qualitative component indicated that they usually washed their hands with water, before preparing food and making the process of *masato* beverage. They explained that they did not used soap, because they did not have the chance to access to purchase soap in a nearby store. It was interesting to notice, how PhotoVoice children were very particularly aware of hand washing practices. They told us, that in their local schools they were constantly reminded about the importance of this practice and about the use of soap.

Table 8 presents data collected from survey household participants regarding hand washing practices.

Table 8. Practices related to WASH according to survey participants (n = 64)

Household reports running out of water for handwashing:	**n (%)**
"Never"	12(18.8)
"Rarely"	27(42.2)
"Sometimes"	25(39.0)
Yes	52(81.2)
No	12(18.8)
Practices related to hygiene	**n (%)**
Handwashing practices:	
Wash hands before preparing *masato*	42 (65.6)
Wash hands before preparing meals	44(68.8)
Wash hands before eating	61(95.3)
Wash hands after eating	47(73.4)
Wash hands after defecating	23(35.9)
Handwashing with soap:	
No	17(26.6)
Only when soap is available	38(59.4)

Yes	9(14.0)
Practices related to water quality	**n (%)**
Water treatment practices:	
Boils or heats water	38(59.4)
Chlorinates water	0(0.0)
Allows the water to stand/sedimentation	36(56.3)
Filters water/	0(0.0)
Adds plants to water	2(3.1)
Buys water	0(0.0)

Adapted from PA Torres-Slimming Int J Environ Res Public Health. 2019;16(13)

5.2.6. Theme 6: Climate/weather changes related to natural resources and water systems

Weather/climate is indeed changing. Through participants observations, local weather has varied across time creating new micro-climates that are affecting their daily lives. For example, one participant stated that "*in the center of the nearby city of Yurimaguas, the temperature and rainy season patterns have changed dramatically over the last five to fifteen years*" (I4) (207). This was corroborated by household respondents, where nearly 80% affirmed that seasonal climate/weather patterns had changed over time affecting their labor activities (**Table 9**). Some household responds did not recall the time of these changes (28.0%), and others

referred changes occurring in the last 5 years (18.0%), 10 years (34.0%), or more than 15 years (20.0%) (**Table 9**).

Nearly all households reported that changes in climate/weather had affected their labor activities (94%) (**Table 9**). When asked if their family and community were affected by changes in climate/weather, 38.8% household survey respondents considered changes in food resources to be an important concern for them and/or their families (**Table 10**). Additionally, over 40.8% considered changes in river water to be an important concern for them and/or their families. They also reported that they observed changes in the water from the Armanayacu river over the past few years (p = 0.012; **Table 11**). More than half (58.0%) of the household survey respondents who observed changes in river water reported that the water level in the river was higher than in previous years (**Table 11**) (207).

Table 9. Reported seasonal climate/weather pattern changes (n = 64)

Households reported seasonal climate/weather pattern changes over time	
Yes	50 (78.1)
No	14(21.9)
Reported period of observed changes in climate/weather (n=50)	
5 years	9 (18.0)
10 years	17 (34.0)

More than 15 years	10 (20.0)
Unsure	14 (28.0)
Labor activities were affected by changes in climate/weather (n=50)	
Yes	47(94.0)
No	3(6.0)

Adapted from PA Torres-Slimming Sustainability 2020, 12(8), 3422

A large proportion of households survey participants who reported observed changes in seasonal climate/weather patterns also reported that their family and community were already being affected by these changes (86%). Among those who observed changes in seasonal climate/weather patterns over time, 76.0% (n = 38) of households reported changes in community A, while 24.0% (n = 12) reported changes in community B (**Table 11**).

Additionally, in those households who observed changes in seasonal and/or climate/weather patterns over time (50/64 households), a small proportion stated that it rained less often in recent seasons (4.0%). Still, they mentioned that when it did rain, the rainfall was more intense and resulted in flooding (58.0%) (**Table 12**). Similarly, narratives from qualitative research participants described how annual rainfall levels appeared to have decreased in past years. However, they noticed that during the rainy season, rainfall was more intense but shorter in duration. This increase in rainfall intensity was reported to increase the risk of flooding in the area. Indeed, flooding was constantly mentioned as a concern through out the different participants. Particularly, in the focus groups it was explained that flooding affected

the community's sowing practices. Occasionally flooding could cause some individuals to lose all the work they had put into planting and maintaining their field.

Table 10. Household observed change over times in seasonal weather patterns related to sociodemographic variables (n = 64)

Sociodemographic variables	**n (%)**	**Did not report observed changes (n = 14)**	**Reported observed changes (n = 50)**	***P****
Community				
A	52 (81.2)	14(100.0)	38(76.0)	0.054
B	12 (18.8)	0(0.0)	12(24.0)	
Gender				
Male	51 (80.9)	10(71.4)	41(82.0)	0.457
Yes	13 (19.1)	4(28.6)	9(18.0)	

Adapted from PA Torres-Slimming Sustainability 2020, 12(8), 3422

Table 11. Observed changes in seasonal weather patterns over time associated to environment variables (n = 64)

Weather-related variables	**n (%)**	**Household did not report observed changes (n = 14)**	**Household reported observed changes (n = 50)**	***P****
Household, family or community received support to respond to climate events				
No	54(84.4)	14(100.0)	38(76.0)	0.054
Yes	10(15.6)	0(0.0)	12(24.0)	
Changes in resources that would most affect daily life and the health of your family				
Changes or deterioration in water	24 (37.5)	3(21.4)	21(42.0)	0.371
Changes or deterioration in forest	11(17.2)	3(21.4)	8(16.0)	
Changes or deterioration in food	29(45.3)	8(57.2)	21(42.0)	

Adapted from PA Torres-Slimming Sustainability 2020, 12(8), 3422

Table 12. Households observed changes in seasonal weather patterns over time associated to river-water variables (n = 64)

Water-related observations**	**n (%)**	**Did not report observed changes n = 14**	**Reported observed changes n = 50**	***P****
Observed changes in river water over time.				
No	22 (34.4)	9(64.3)	13(26.0)	**0.012**
Yes	42 (65.6)	5(35.7)	37(74.0)	
Observed changes in river water				
Water level in the river is higher	35(83.3)	6 (42.9)	29(58.0)	0.578
Water level in the river is lower	5 (11.4)	1(7.1)	4(8.0)	
River water is dirtier and sandier	2 (4.8)	0(0.0)	2(4.0)	
No clear changes observed	22 (34.4)	7(50.0)	15(30.0)	

Adapted from PA Torres-Slimming Sustainability 2020, 12(8), 3422

5.2.7. Theme 7: Deforestation related to water systems

Water from the Armanayacu river is usually dirtier and more turbid during the rainy season. As water levels increased, more leaves, debris and sediments on water streams gave a "reddish" color in the water. This was perceived as more "dirty" (207). They were more cautious about bathing in the river after heavy rainfall. This was because water currents could become dangerously strong and bring along harmful unseen debris. Also, when the river is filled with leaves and sediment, the water became stagnant, which further contributed to increases in water temperature. Narratives from participants related these changes to riverbank erosion. Under their perception this was a consequence of deforestation, as well as by climate-related changes in seasonal rainfall frequency and intensity.

In the latter observation, qualitative research participants described the river water as more transparent and less turbid, during the dry season. Moreover, the low water levels and increased sediment in the river resulted in the creation of new beaches along the riverbank (**Figure 5**). Some community members reflected on how deeply these environmental changes affected their relationship with water and their daily activities. They particularly mentioned water collection and bathing (207).

As previously described, impacts of deforestation on the river system was constantly mentioned. Although, deforestation was not explicitly linked to climate/weather changes, it did result in environmental degradation. This posed challenges for effective adaptation practices. For instance, participants reported that in previous years there were many trees lined the riverbank, which shaded the river and provided support and structure for the riverbanks. However, recently they had

been cut down to make fields for farming. This had caused that the river no longer received as much shade as before.

Additionally, as cutting down trees' activities are becoming more often, river edges tend to erode and collapse more easily. During the Photovoice sessions, particularly one participant was eager to explain: "*Years ago, around the edge of the riverbank, there were large trees and clean water. Some people cut down the trees to build farms near the ravines, but now the riverbanks have no resistance and fall*" (PV7) (207). Climate-related changes further exacerbate negative impacts of deforestation on the river. For example, warming of water temperatures is exacerbated both by warmer weather and ed fewer trees to provide shade. Similarly, erosion and water turbidity are increased due to increased rainfall intensity and flooding, as well as reduced riverbank stability from deforestation (207).

Reforestation of riverbanks was multiple times mentioned as an important adaptation strategy. For example, one PhotoVoice participant stated: "*I believe they should plant resistant trees at the edge of the riverbank, to give shade and help the river not be refilled with sand and stay deeper*" (PV7) (207). Furthermore, during a transect walk participant recalled:

> "*Sometimes you feel very warm, and you want to bathe in the river, but the water is too hot. It is more refreshing at night around nine or ten. This did not happen before; there were more trees beside the riverbank, and everything was different. We have done this to the environment. It would be nice if we could reforest and plant large trees*" (TWP5) (207).

Figure 14. Riverbanks from Armanayacu basin

Credits: PA Torres-Slimming

Adapted from PA Torres-Slimming Int J Environ Res Public Health. 2019;16(13)

In the focus group discussions, there was a genuine concern about further degradation of Amazonian rivers and tributaries. Community members wanted to draw the attention of government authorities to the challenges of environmental protection and water safety. Men were keen to engage community authorities and municipal government personnel in water-related programs along the Armanayacu river (207):

> "*We must call the authorities from each community. Here we are twenty communities that live in the Armanayacu area. We should all meet in a community and talk about how to get more water care. We can have a talk about the best care of water and water safety, such as not fishing, not throwing garbage in the river, not cutting trees for clearing chacras [farms] along the river… for taking care of fresh water so it is not like this in these times… as the water is warmer, right now the water is getting too hot… That*

is why all community authorities must talk with the [municipal] authorities to teach us about how not to contaminate the river" (FGM1) (207).

Another transect-walk participant conveyed a similar argument:

"[*We should] ask for educational training in water and river contamination, fishing and avoiding throwing dead rotten animals into the river. [Government authorities] should train community authorities, so they can teach our community information about well-being*" (TWP10) (207).

In addition to changes in river water levels, groundwater changes were also observed and participants noted the need to begin planning for adaptation. As one interview participant recalled:

"*It feels as if we are squeezing the last drops of milk from the cow [referencing lack of groundwater collected via wells] … I do not know what the situation will be like here in the next five years, we must be planning for the long term, not just the next twenty years… This is a very deep problem at a health and educational level, but there are no government plans or policies*" (I3) (207).

This participant also identified the *aguaje* (*Mauritia flexuosa*) and the *pijuayo* (*Bactris gasipaes*) palm trees as being particularly important indicators of groundwater availability. As further explained by the participant, these palm trees, have an ability to store large quantities of groundwater. This local actor's perception was corroborated with others community participants. They explained that if the trees can no longer access the adequate amount of water necessary for them to thrive

abundances of trees could be reduced. This is an indirect indicative of declining groundwater levels (**Figure 16**). Even more, interviews participants explained that these trees provide one method of monitoring variations in groundwater levels due to climate change. As one participant stated:

> "*There is a tree called aguaje that keeps inside enough water, it is an indirect way to monitor the amount of underground water. Unfortunately, the aguaje has diminished lately. This could be that the aguaje is indicating to me that underground water is missing*" (I4) (207).

Participants were concerned that recent removals of these trees would inhibit their ability to monitor variations in groundwater levels in this traditional way.

Figure 15. Trees reported as monitoring groundwater levels

Credits: PA Torres-Slimming

5.2.8. Theme 8: Cultural practices related to water security

During the process of making *masato*, water is collected and left to rest for a few hours. Once the water has stood (this process is called *cruda*), it is heated and then mixed with cassava (*mandioca* or *yucca*), followed by the process of *chapear,* where the mass (the cassava with heated water) is left to ferment for about a week. Afterwards, more water is added to the mass before consumption.

Some participants were aware that they needed to bring the water to a boil when preparing *masato*, while others were not. Among those who were unaware, there were more cases of diarrhoea than among those who boiled the water. Differences in *masato* preparation between communities are primarily religious: For example, community A has a Catholic background whereas community B is predominantly Evangelical. Due to their religious beliefs, community A drinks fermented (alcoholic) *masato* beverage, whereas community B drinks unfermented (non-alcoholic) *masato*. To prepare non-alcoholic *masato,* individuals in community B prepare the boiled juice of the cassava but do not allow it to undergo the process of fermentation (**Figure 17**).

Figure 16. *Masato* beverage

Credits: PA Torres-Slimming

As a woman explained during a transect walk:

> "*The process of making masato: first we take the yucca and then we heat it in the water when it is boiling, we put the yucca inside it and let it boil and boil. When the yucca is cooked, we crushed, and some add sugar for* chapear *and to be able to mix the masato and let it start to ferment […] Then we add more water*" (TWP11).

Some fish farms were observed scattered throughout the community. They were built for increasing food resources as residents observed that fish have become very scarce. Many people attributed this scarcity to warmer water temperatures occurring

both during the daytime and nighttime, which has adversely affected fish habitat and freshwater ecosystems. Others attributed this to the prohibited, but ongoing, traditional practice of fishing in the Amazon, in which poison from the *barbasco* plant is poured into the water to numb the fish, making them easier to catch (Dirección General de Epidemiología 2008). *Barbasco* is the local name given to several species of plants (*Lonchocarpu*s spp.) that contain poisonous chemical compounds traditionally used for fishing by Indigenous populations in Central and South America. *Barbasco* plants are gathered and cast into the water to numb and disorient fish. Groups of families are then able to collect the stunned fish.

Through PhotoVoice, participants identified overfishing with the poison *barbasco* as a source of diarrhoea and water-related illness. This technique was reportedly used most often in the summer when water levels are low and calm. Participants said that communities downstream could potentially be exposed by upstream *barbasco use*, causing skin problems and acute diarrhoea for those who consume the contaminated water. Children were reported to be particularly susceptible to *barbasco-induced diarrhoea*. Due to these concerns, this traditional fishing activity has been prohibited by the local authorities but is still practised by some communities.

As one PhotoVoice interviewee described:

> "*The disease comes from above* [upstream] *where fishing is taking place because nobody knows that the poison is coming down with the river flow. Even if they cook (fish), the microbe is in and it hurts the stomach, sometimes*

gives diarrhoea. The barbasco always is released from what the machete releases" (PV1).

Some participants mentioned becoming sick with different types of diarrhoea, such as "*diarrhoea from the forest due to sadness*", "*diarrhoea from spirits or harm*", "*diarrhoea from the heat*" and "*cold diarrhoea*" (TWP10). Participants reported that "*heat diarrhoea*" and "*cold diarrhoea*" are related to weather changes and water levels, and that the former occurs more often in the summer when water levels are low, whereas the latter occurs primarily during the winter.

Community members also noted that higher water levels contributed to more symptoms of respiratory diseases, such as coughing and fever, whereas low water levels and still water were more often related to cases of diarrhoea, especially in children. As one focus group member commented:

"*Children often get sick with diarrhoea during the summer season* [dry season]*... This usually happens when children play out in the sun due to heat exposure. Nowadays, we are seeing diarrhoea and vomits in children during the winter season* [rainy season]*. This did not happen before… it is due to the contamination (of the river water)*" (FG2).

5.2.9. Theme 9: Health promotion related to water security

This communities have been impacted by health promotion activities coming from outside. As many narratives refer, Shawi knowledge in water, hygiene and sanitation practices predominantly came from non-governmental organizations,

evangelical groups and/or health post practitioners. Although the health post is one hour away from both communities, there were no local health workers or health promoters in the communities. Hence, there was no "official" monitoring of symptoms of water related diseases like diarrheal illness through oral rehydration or breastfeeding. Some interviewees mentioned that diarrhea occurred due to drinking *masato* that was made with unsafe water. They considered unsafe water, either because it was not boiled or because it was polluted. When further explored about quality and safety of water, some participants clearly explained some community members incorporated the knowledge and practice of boiling water, whereas others thought that water only needed to be heated (but not brought to a boil) to be "perceived" safe for consumption.

Most interviewees mentioned if an individual experienced mild diarrhoea, community members would use traditional medicine provided by their families. If the condition worsened, the individual would visit the healer to be treated with medicinal plants. The healer will determine whether the illness needs to be treated in the health post. For severe symptoms (i.e., blood, severe dehydration produced by constant vomiting), they would travel to the health post to access western medicine. In many cases, they would prefer not going to the health post for consultation. Instead, individuals would opt to spend money on sending a family member to buy the medication at the local pharmacy, without receiving proper instructions from a healthcare provider on dosage.

In other cases, community members with health issues reported that they would even combine western medications with their traditional plants, while a few claimed

that they preferred to be transported directly to Yurimaguas to get attended by a private doctor.

Qualitative analysis showed that participants believed this risk has increased over the past two decades. Many related it to more people throwing garbage into watercourses. They observed plastic bottles, cans and washcloths thrown into the river. In addition, they notice an increasing number of individuals defecating directly into the river. They even narrated the presence of dead and rotten animals floating in the river. Community members pointed out that upstream communities and foreigners were causing direct river pollution. As one focus group participant explained: "*I always say that the area of the river Armanayacu, that if people from upside river stream use it for washing, bathing, and defecating the downstream communities have to boil the water*" (FG1M) (243). When explored about the consequences of river pollution, in general, qualitative participants related to an increased episodes of diarrhea due to unboiled water.

From the multiple qualitative research participants, they all mentioned a bad flood occurred in 2014. They all described as that during night, while the community was sleeping, a "silent" and "constant" rain. This single rainfall event over one night accumulated approximately 50 cm of water. As participants repeatedly mentioned, this rainfall event covered the central field of one community, even reaching the upper hills. Residents reported that not being prepared to deal with flooding during and afterwards. They also commented that they were neither alerted nor prepared for such an extreme rainfall event. There were no community-level organized plans for disasters and climate prevention for responding to extreme weather events.

Some elder participants, mention similar event had occurred twenty years before (207).

Furthermore, when this extreme event occurred, they did not have assistance from the government, local municipalities, neither NGOs. Local community authorities organized themselves and travelled to the city of Yurimaguas for contacting *Defensa Civil* (National Institute of Civil Defense, a government-sponsored citizen protection service for natural disasters). Through a local radio they warned about the disaster and a journalists arrived at the community. Several months later, municipal authorities carried out a local census for registering the flood victims for delivering support (207).

5.2.10. Theme 10: Perceptions towards water management and water practices in the area

The most common activities participants identified related to water management and practices are safe water consumption, sanitation, handwashing and identifying high-risk symptoms of water-related illness. These activities are delivered approximately once or twice a year, mainly by the health post and the government. To a lesser extent, religious institutions contribute to water management practices, with NGOs and academic institutions playing a more minor role in delivering water management services to communities. As for the implementation and management of latrines, participants claimed that they are commonly misused, or not used at all.

We spoke to one participant who had 25 years of experience in health promotion projects in the Andes and the Amazon. They were familiar with the work of the

Juntas Administradoras de Servicio y Saneamiento (JASS), a participatory joint group for water consumption and sanitation, described the difference between JASS programs in the Andes and the Amazon. For example, the program proved to be very successful in the Andean region; however, the interviewee could not identify a reason for which the program did not work in the Amazonian area. As the interviewee suggested there may be a more established participatory approach with communities in the Andean region, rather than in the Amazon.

The same interviewee commented on the deep connection between Indigenous communities and nature. Communities believe that *Mother Nature* needs to be respected, as *she* provides them with food and harmony but can also take everything away from them. Therefore, the solutions to many of their problems are interpreted and understood through observing nature and maintaining their deep connection with the environment. Communities are not concerned about the availability of water, as they believe that *Mother Nature* will provide them with everything that they need to survive. As the interviewee commented, "*Living is having enough [water and food] to survive for the Shawi*".

Another example of the challenges of water management practices, according to organizational representatives, is in the use of chlorinated water. Indigenous Peoples have been taught and trained on the use, but they still do not fully incorporate the practice of chlorination. As mentioned by one local actor: "*While chlorinated water is sometimes used in masato, mothers often chapean masato by submerging the fingers and move the masato served in the mocawa—which can contaminate the masato*" (I2).

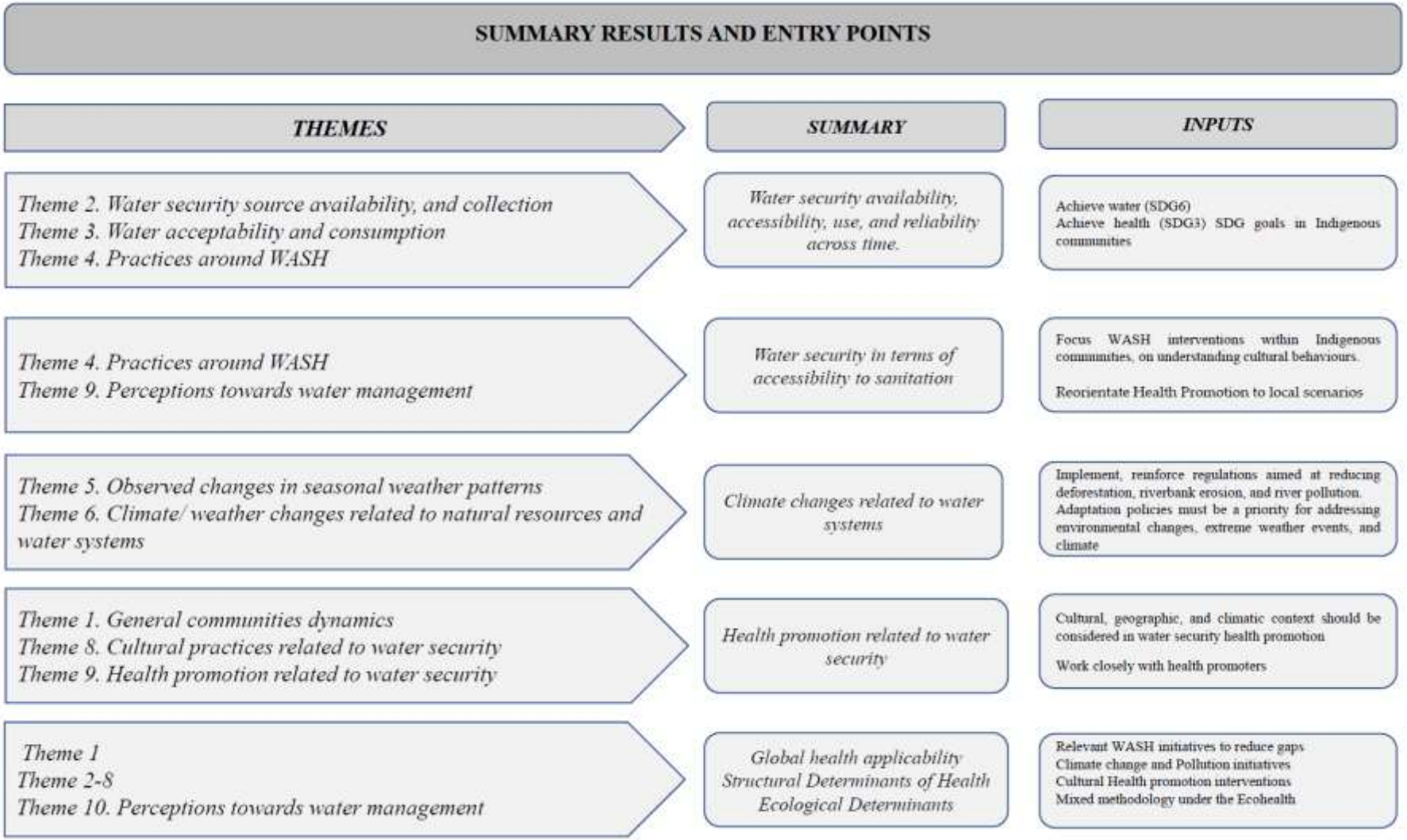
Additional water contaminant is the use of barbasco. In the past, there have been several health campaigns in these communities against the use of barbasco, due to its polluting qualities. However, as some interviews suggest, it appears that certain communities are still using barbasco for fishing, and the presence of it in fish or water may be the cause of respiratory problems in children after having bathed in the river.

Interviewees mentioned that health personnel working in the Amazon lack sufficient knowledge for working at a health post or the community level. As a possible solution, they express the urgency of either providing cultural-safety training to health personnel already working in the community or sending people who are aware of the geography and local culture of the communities to work on the ground. Additionally, the health minister should have a census of community health promoters in the area. Another interviewee mentioned that medical care should incorporate and leverage the benefits of local medicine.

According to some of the Catholic leaders who were interviewed, water availability was not a concern for the communities; however, one interviewee mentioned water problems would be greater in the city. The reason is that various resource extraction companies have caused major damage to the environment and people have become aware. However, the Amazon community would still be affected by these water problems because families in the Amazon tend to send at least one child to the city to access water, sanitation and education services.

Nevertheless, the Catholic leader interviewee claims that Amazon still depends on oil, but it should not be at the expense of damaging the environment. He emphasized that the State or regional government or municipality should not allow the invasions of oil companies in low-lying areas, as it is difficult to install sanitation services. As the interviewee explained how the water supply for the city of Yurimaguas was installed remarkably close to the sanitation pipe for a hospital, resulting in contaminated water. When questioning the engineer in charge of designing the water supply system on the reason they chose that location, the engineer replied that it was "*because it was on the map*!". According to the same interviewee, building wells in communities along the Amazon was a good intention on the part of the Peruvian government, but it failed due to insufficient training on good maintenance. **Figure 17** illustrates a summary of results and entry points for discussion.

Figure 17. Summary of results and entry points for discussion


SUMMARY RESULTS AND ENTRY POINTS
THEMES
SUMMARY
INPUTS
Theme 2. Water security source availability, and collection
Theme 3. Water acceptability and consumption
Theme 4. Practices around WASH
Water security availability, accessibility, use, and reliability across time.
Achieve water (SDG6)
Achieve health (SDG3) SDG goals in Indigenous communities
Theme 4. Practices around WASH
Theme 9. Perceptions towards water management
Water security in terms of accessibility to sanitation
Focus WASH interventions within Indigenous communities, on understanding cultural behaviours.
Reorientate Health Promotion to local scenarios
Theme 5. Observed changes in seasonal weather patterns
Theme 6. Climate/ weather changes related to natural resources and water systems
Climate changes related to water systems
Implement, reinforce regulations aimed at reducing deforestation, riverbank erosion, and river pollution.
Adaptation policies must be a priority for addressing environmental changes, extreme weather events, and climate
Theme 1. General communities dynamics
Theme 8. Cultural practices related to water security
Theme 9. Health promotion related to water security
Health promotion related to water security
Cultural, geographic, and climatic context should be considered in water security health promotion
Work closely with health promoters
Theme 1
Theme 2-8
Theme 10. Perceptions towards water management
Global health applicability
Structural Determinants of Health
Ecological Determinants
Relevant WASH initiatives to reduce gaps
Climate change and Pollution initiatives
Cultural Health promotion interventions
Mixed methodology under the Ecohealth

CHAPTER VI: DISCUSSION

This explanatory case study in water security, is grounded in the perceptions and knowledge of Shawi participants and people working in the area. This study provides a strong meta-inference in the field of EcoHealth and yield several concrete recommendations for navigating the challenges associated with deploying water security public health initiatives in remote areas, which will be increasingly complicated by changes in the climate and environment.

The Armanayacu river basin is scenario of a cumulative historical process of colonization concluding in a weak presence of local governments in this two Shawi communities. Consequently, multiple actor's in the area had different levels of impacts in approaching water security and health. Unfortunately, none of them have been suitable and sustainable. Moreover, many local water practices are not considered by the water health sector. These structural flaws lie in the gaps of taking greater relevance to water and health indicators rather than if they are relevant to Indigenous communities. Hence, structural and ecological determinants of health have been perpetuated. Even more, climate water related diseases are not contemplated, nor health providers are present in the area, neither prepared for mitigating future scenarios.

The overall thematic results are discussed in detail and compared with the reported literature in the following sections.

6.1. Water security in terms of availability and accessibility, across time

Armanayacu river waters are the resource for these communities. It is accessible to all community members within a 15-minute walk. Good accessibility reduces risks related to water collection, particularly those related to water quality (245–247), as several studies report that the quality of water decreases as the distance from the household to the source of water increases (248–250). Furthermore, longer distances to collect water can increase the risk of physical harm because of accidents and overexertion (48,63,208,251). Gender harassment has emerged as a major problem in water collection in many rural and excluded areas around the globe (48,252–254). For the Shawi, however, water collection was carried out by all members of the household, which contrasts with reports in the literature where women and children oversee water activities (21,255).

Regarding water availability, the amounts of water collected by these two communities corresponds to that suggested by the UN declaration of 50 to 100 litres for personal and domestic use (Resolution A/RES/64/292. United Nations General Assembly, July 2010). While it can be argued that these communities use water at any time directly from the river, they still scored low for water access indicators as they do not have direct water pipelines for clean and safe water, neither at the community nor the household level (250,255–257). In the Peruvian Amazon area, water projects historically are related to evangelization, with little government initiatives, and in the past century with the growing presence of NGOs activities (110,258–260). Water and sanitation national programs were built mainly with the participation of churches and NGOs within the communities. Still, the sustainability of these initiatives has been one of the major issues for these communities, like what has been reported in rural and Indigenous communities in other secluded areas

(73,260–266).

Within these two Shawi communities, participation around water collection and sanitation are organized around school activities, mainly because of social cash transfer and food programs implemented by the government. As other impoverished areas of Peru, these social programs have improved nutritional outcomes due to direct social and economic familiar progress (267,268). This is comparable to several reports from other regions, as in Sub-Saharan Africa, where they reported educational behavioural improvements towards reducing health risks (269–271). Still, as Zavaleta et al. points out, although national social programs have made a great efforts to reach the remoteness of these communities they fail by not being linguistic and culturally adequate interventions (272). Consequently, these initiatives are felt as unfamiliar.

For Shawi Indigenous participants in these communities, there is not a standard monetary value for water exchange (author's unpublished data), as in other cultures is, where "water has an economic standard value", due to its availability for trade (251,273,274). In these two Shawi communities, there are two clear patterns or dynamics for collecting water. The first one is at the household level where family members organize themselves every day to collect water for *masato* and domestic cleaning. The second is at the community level where they organize themselves for water collection for preparing food for schoolchildren. These are common practices in the Peruvian Amazon area as reported in a study done in Shawi Indigenous communities along the Sillay River basin (107,259,275). In contrast in the Peruvian

Andes, the Organization and Formation of Community Organization-JASS[13], administers water and sanitation resources in rural level areas (111,113,276–278) through community organization. This has been a very successful pattern of water collection for rural areas (110,279). Nevertheless, its applicability has not been extended in the rural areas of the Peruvian Amazon, congruent to data recollected from this study. As Ore argues this water organization systems were not effective in the Amazon because water activities have historically, and politically prioritize Coast productive activities over general population needs. Furthermore, this has contradictions between water regulations and JASS participatory objectives (279). Similarly, in this study sedimentation was the unique and only observed house water treatment options in both communities. Aside, few rudimentary wells were found, which probably correspond to itinerant and uneven WASH health promotion activities (27).

Data collected from this study show water is available through all seasons. It appears though, that in these communities along the Armanayacu river, night baths are becoming less usual. As acknowledged in Saavedra's work, waters provide the foundation for Shawi cultural practices such as drinking *masato* and everyday activities such as bathing and fishing (194). The loss in connection with water rituals and their relation towards nature are affecting the wellbeing in several Indigenous communities around the globe (152,280). The lack of water available systems can lead to emotional distress, as suggested by data reported from a study

[13] *Juntas Administradoras de Agua y Saneamiento*.

in Uganda (70) and Peru (281). The *aguaje* was mentioned by participants as a natural groundwater harvesting monitoring systems. There are few studies in the Amazon area regarding local water monitoring systems. In ethnoecological works in the Amazon, reports from this Amazonian palm tree document its growth in flooded areas called the *aguajales*. These ecological systems nurture different wildlife species, store large amounts of carbon and water (282,283). Furthermore, locally Indigenous Peoples believe water malefic spirits are surrounding the *aguajales* (282). Instead, in the Andean area, water collection systems of groundwater through *cochas* are well known and are beginning to spark stronger attention from the environmental community (68,284).

6.2. Water security in terms of water quality and accessibility to sanitation

As mentioned by multiple participants, water quality from the Armanayacu river was perceived dirtier and hotter in rainy season. These observations are common in middle river basins with characteristics like the Armanayacu and the Sillay. In a local report from Shawi communities along the Sillay river basin, it was mentioned that spring water was getting difficult to collect as they were getting dryer (204). In Marañon river basin, Kukoma Kukamiria Indigenous communities are experiencing changes in water quality because of direct extractive activities (285).

Although, data across this study did not evidence lack water, neither from the river nor from springs, multiple participants coincide about water quality was getting worse, irrespective of the season. Several studies carried out in local farmers from Mexico, India and China report perceived changes in water levels and quality (286–

290). This is becoming increasing alarming, as people are starting to become more aware of their own environment. In a recent study published by Torres-Slimming et al. care of water was a major concern to climate change in three regions of Peru (291).

Community participants perceived more episodes of diarrhea in children because of river defecation. This was corroborated by Bussellau et al. who collected water samples with faecal coliforms bacteria from river and streams (292). A similar example was done in a study along the micro basin of the Purires River, in Costa Rica. They found out surface water was contaminated with faecal coliforms bacteria. These concentrations were higher during the rainy season and in places with higher population density place (293–295). In addition, there are several studies that relate intensity in rainfalls and floods to higher episodes of diarrhea (8). For example, increase precipitations levels can overwhelm and contaminate water and drain reservoirs (296). On the contrary, lower rainfalls, decreases water flows and concentrate faecal coliforms (297,298).

Furthermore, sewage disposal is not available in the area and there is a lack of latrine infrastructure, facilitating open defecation and river defecation to be widely practised. These inequalities occur mainly in rural and poor areas (101,299,300). One of the reasons in the failure of successful sanitation indicators is whether to install toilets if there is no perceived demand by the population (301). Hence, as Mara mentions, cultural local preferences should be explored before locating any sanitation infrastructure (302). Failures related to sanitation strategies are inadequate location and the odor removal system (303,304). Besides, qualitative

and quantitative data corroborated no presence of deworming campaigns in local schools or at the community level. Evidence is unclear on deworming impacts of school-based campaigns in preventing transmission to the broader community (305). Results from a meta-analysis support to expand targeted deworming to mass deworming for better health outcomes, particularly in areas where open defecation is practiced (306).

In data collected by the author (under peer-review) it was found that there was a higher prevalence of childhood diarrhoea in households using latrines compared to households practising open defecation. Some studies reported a similar situation along river basins where inadequate latrines were implemented in flooding areas (29,30,32). Ending open defecation worldwide remains a challenge (307–314). Indeed, O'Reilly et al., based on their work in rural India, propose that to have success in building toilets a program must rely on three factors: (i) "multi-scalar political will over the long term", (ii) "proximate social pressure" (contact people and toilets), (iii) "political ecology" (access to water and soil) (308). In a randomized controlled trial for measuring the effect of India's Total Sanitation Campaign (TSC) delivery after 21 months in 80 rural villages, the intervention improved household sanitation facilities by an average of 19% and decreased open defecation among adults by an average of 10%, though no improvement in child health outcomes was observed (315).

As reported by participants there are no local water organizations inside the communities to supervise water quality neither surveillance along watersheds. Although since 2005 the Peruvian government has implemented a National Rural

Program for Drinking Water and Sanitation, which aims to supply water and sanitation to communities from the 4 basins in the Peruvian Amazon, there is no evidence of their presence in the Armanayacu river basin. Global research evidence in rural and Indigenous areas show the impact of WASH interventions in reducing health hazards at the household and community level but report the lack of continuity in monitoring interventions as a major failure, as found in this dissertation research with Shawi communities (68,87,90,261,265,300,316–320).

6.3. Climate changes related to water systems

Shawi participants have cultural practices related to water, which were registered along with the interview's thematic codes and in surveys from these studies. These practices are shared by Shawi and many other Indigenous cultures around the globe (321–323), where their cosmovision relies on a deep connection with water gods, rivers livings, *tipisha animas*, and the forest by communication through myths, ancestors' oral traditions and nature observation where there is a constant circulation of water from either side of the basin of rivers (194,195,199). Although water practices are present, Shawi reported that they are not being respected by newer generations, creating an imbalance between riverbanks, land, and trees (deforestation).

As mentioned in this case study, environmental changes are affecting Shawi water relationships. Difficulties reported in water quality were related to rainfall, water turbidity and increases water temperature, river defecation and pollution. Similar reports along Amazon basins show rises in water temperature and fire-related to

drought along with deforestation (324–328). Challenges related to river pollution are likely due to more human contamination in the area caused by changes in human activities and globalisation (35,145,327,329–331). As for deforestation, reports indicate that Peru has already lost in the Amazon an area the size of Chile, and this are related to gold river mining (15,332).

Furthermore, these non-climatic drivers can exacerbate climate change impacts and reach tipping point scenarios for water insecurity (120,325,333,334). This kind of evidence is seen along several river basins not only in Peru but around the globe, where inorganic wastes are not well processed or eliminated, resulting in the contamination of rivers and finally, oceans, generating high plastic pollution (335–340).

In Peru, the Program Social Management of Water and the Environment in Watersheds[14] (GSAAC) was created for the management and administration of regional watersheds and micro-watershed. It intended to supervise and manage water in river basins through the interaction between the government, institutions and communities. An interesting experience was achieved by the Maori Indigenous Peoples in New Zealand, who managed to win protection over the Whanganui river. By 2017, there are three rivers (the Whanganui river in New Zealand, and the Ganges and Yamuna rivers in India) that have legal rights as persons (341,342). This puts awareness into the safety and protection of humans towards nature

[14] *Gestión Social del Agua y Medio Ambiente en Cuencas (GSAAC).*

stewardship and community resilience, and as an alternative for river management (342).

Likewise, similar initiatives have been implemented to document Indigenous voices around water culture, climate change and governance (71,343–347). As an example, a mixed-method study done by Ostapchuk et al. (2012) in the community of Rigolet, Nunatsiavut, Labrador, Canada, explored the relevance of Inuit Elder's perceptions, knowledge and cultural strategies on mitigating health impacts related to climate change (347).

Another study in collaboration with First Nation's people from the Yukon, Canada, concluded that the importance of understanding Indigenous water relations is seen in traditional and spiritual dimensions of wellbeing (70,323). In this study, there was a genuine concern about changes in weather/climate variations and river pollution. It appears that the concept of climate change is not yet internalized by all participants. This information is consistent with a study by Torres-Slimming in climate change perceptions across three regions in Peru, where the meaning of climate change was not clearly identified by participants (291). The 2014 flood exposed all community members equally to the extreme weather event. It seems that participants carry a hidden level of post-traumatic stress due to the aforementioned event. This should be explored in further detail, stratified by gender and age, as reports suggest women and children are and will be highly impacted to future climate scenarios (36,348,349).

6.4. Health promotion related to water security: relevance for rural health

The two communities that participated in this dissertation research, though only separated by a 30-minute walk, differ in the religious denomination, with Catholicism present in community A and evangelism present in community B. As Gonzales suggests, rivers were seen as the way to spread the path of evangelization in the Amazon area, and the starting point in contacting (and beginning the process of colonization) Indigenous Peoples around the XVI century (195,197). In recent decades, the Amazon area of Peru has seen the presence of Christian evangelic churches working along the river basins with Indigenous communities (106,350,351), like what occurred in the borders of Brazil, where Indigenous colonization occurred mainly by Evangelical Christian groups (171,352,353). In data collected by the author, these communities have been impacted by the process of religious education. As an example, for one community (community B), the process of making *masato* has changed to exclude alcoholic fermentation. This process might have stopped the natural protection that *masato* provides in reducing the risk of bacterial infection (292). Similar experiences of religious impositions and juxtaposition of rituals have occurred around the globe with Indigenous communities where colonialism has been present (147,190,354–356). Many of these health-promotion activities have been implemented as solidarity programs. As Hooks clearly express, multiple systems of oppression where community interests and beliefs are not included underlies these sort of implementations (357,358). These cumulative historical impacts have shaped Shawi Indigenous relations around water collection. This is similar as reported by Tamsyn et al. working with Shipibo communities in the Ucayali region manifesting the need to target health efforts and outcomes according to rain seasonality (359).

In terms of adequate hygiene, both quantitative and qualitative data results showed that knowledge of the importance of boiling water was present, but not all people practice it, particularly in the process of making *masato*. In terms of the use of soap and chlorine, knowledge exists but they lack access to handwashing facilities and cleaning products. Additionally, if they had the chance, they did not consider soap and chlorine essential for domestic uses. Particularly when comparing Shawi participants reluctance in boiling and chlorine practices, literature reports changes in taste as a barrier. As for chlorine, the taste of bleach decreases adhesion to these practices. Rothstein et al, in a qualitative study carried out in peri urban areas in the Peruvian Amazon, describes how not having the correct dosage of chlorine in caregivers end up being a barrier in its use (360).

Furthermore, qualitative data showed a desire from interviewees to create initiatives in waste management and health education along the Armanayacu basin. These results can be understood under the complexity of health-related behaviour theories. For example, under the Transtheoretical Model (TTM) (361–366), we can argue that these communities do have the knowledge and are in the process of making some change, for example in boiling water. Additionally, under the social cognitive theory proposed by Bandura (367,368), some households have incorporated specific WASH "self-efficacy" actions for overcoming health risks (369,370). Examples in the WASH sector include studies done by Curtis et al. for improving handwashing use behaviour change models intervention (270,367,371–373).

Although this communities have a health post one hour walk, they do not have health provision services at the community level. Reasons related to this gap in

health provision is the constant rotation of health professionals in the area (374). As explained by Menendez, when health services are absent, communities opt for different ways to treat their ailments (375–377). In this case study, diarrhoea is a clear example, as participants will go to health facilities only when perceived severity (378). Unfortunately, as reported, health professionals are unaware to explore the water related diarrhoea's related to local practices like barbasco (379). In addition, as reported from this study, community members lacked immediate health and government support after the flood. These corresponds to the often-limited health delivery in these remote areas (380). Ford et al research outlines the importance to incorporate Indigenous knowledge and resilience, for going beyond in preparing the health sector for climate change scenarios in rural areas (39,381). Furthermore, Primary health care concept was not fully understood by health professionals (82,382,383). Nowadays, lacking structural elements to respond to health hazards, health professionals are not yet prepared to respond to health syndemics (11).

6.5. Global health applicability

The results from this case study align with the ongoing surveillance monitor global directives in the WASH sector. Many regions have published works that highlight the need for reinforcement among vulnerable populations who do not have access to clean safe water. Working groups in Africa, Asia and Latin America focus on the importance of improving adequate water and sanitation access (98,384–387), particularly in practices and attitudes (72,319,388,389). Furthermore, the need for surveillance is well documented among these highly vulnerable populations who

have indicators of low water security, as thus may be impacted more severely (316,318,385,390,391). Within the national context of Peru, J.J Miranda et al. reported that progress in water access has not been equal across the country (392).

Applying the WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (JMP) indexes, these communities score low for WASH SDG6 indicators (99,393,394). Like many Indigenous communities settled around rivers and streams, they lack water access and sanitation facilities, which hinders the achievement of the 2030 Sustainable Development Goals (56,89,90,395,396). A comparable situation is faced in African countries, where SDG-6 universal access was made a priority. However, results in WASH indicators show some weakening trends due to population dynamic that will make it difficult for Africa to reach the 2030 targets (397,398).

Results in our study described a recent Peruvian flood that took place in 2014.These observations are consistent with other literature that described this flooding season in the Amazon as particularly severe, the consequences of which resulted in a state of emergency being declared in Bolivia and Peru (399). These actions aligned with climate change preparation policies within these countries. For instance, Peru as a country has recently renewed its climate change strategy, agreeing to adopt mitigation and adaptation policies for 2050. In this commitment Indigenous People's voices are to be included (187,400). As qualitative data suggests, people are reporting weather and climate changes within their environment (14,119,393,401–404). However, challenges remain in developing and implementing public policies for adaptation and preparation for future climate

hazards (405,406). This result aligns with multiple qualitative studies done in farmers, who perceive the growing threat to global warming (407). Callaghan et al. goes even further, claiming there is an urgent need for dialogue among researchers, policy makers, locals and Indigenous communities (408).

Another important result from our case study that aligned with the literature were the impacts of non-climatic drivers, such as river pollution and deforestation. Several studies show how land rights of Indigenous territory are being affected by projects on both small and large scales (11,327,409,410). Moreover, these studies show how the environment not only affects local Indigenous Peoples, but also larger communities, as river pollution like garbage and plastic is released into the larger water bodies (339,411–413). Unfortunately, global health indicators are centered in sea levels, but not in micro-basins of rivers (28,120).

As shown in this study, no adaptative or mitigation programs are present at the local level. Neither improved WASH programs for geographic excluded communities. Although regulations in these sectors do exist, they do not intersect, cross, or express in local actions (101–103,264). Thus, there is a contradictory situation in recognizing rights to water access through regulations, but depriving rights to incorporating local perspectives. As Farmer et al. manifests, in the path of embracing water healthcare we are perpetuating poverty and pathologies of power (97).

Ethnographic work through this water security case study questions the role of primary health work in the area, as well as the role of policy makers. Indeed,

Raphael and Mck Queen invoke questions about the evidence we are using in health promotion to guide our interventions (76,414–418). Prussing et al. also comment on the urgent need for critical epidemiology that incorporates the cultural perspectives of communities (91). Results from this study show a level of presence from the government through health promotion campaigns. However, these are itinerant, without a direct accompaniment of the population (265,419). As several studies report, it is very difficult—or almost impossible—to understand Indigenous perspectives and their own mechanisms to cope to any hazard if there is failure to accompany health promotion activities (416,420). As Salomon points out, any practitioner working with Indigenous communities should understand the "*kincentric relation to ecosystems*" (421). Meanwhile, Rupert Ross mentions that a key to healing work with Indigenous communities is "decolonization therapy" by consciously listening to traditional world views (422).

6.6. Limitations

Despite the strong meta-inference grounded from this case study, the author must point out certain limitations.

For instance, results may not be generalizable to other Shawi populations beyond the Armanayacu river basin. Indeed, qualitative research methods do not aim to achieve representativeness or external validity, but rather aims to characterize phenomena and lived experiences. It is useful to note the small scale of this study, as we collected data from two remote Indigenous communities with a total of 64 households in two of the published mixed-methods papers. However, this research

showed similarities to results seen in research conducted with other Shawi Indigenous communities living along the river basins of the Amazon of Peru (106,196,200,423).

Importantly, the Shawi and Peruvian Spanish languages do not have different terms for *weather* and *climate*. To allow us to distinguish between weather and climate observations, participants were asked about season and timescale of observed changes. Despite the difficulty in distinguish between concepts of climate and weather, results are convergent with other research in the region supporting our data (424).

Finally, there has been a gap of five years between the collection of the data and the time the paper is submitted; however, there is relevant information/data from the observation period. The authors did not collect additional data in the observation years. This is not unusual in community-based research (221,425). Due to the nature of community-based research and the time invested in establishing partnerships and consulting with communities at all stages of the research (including during the analysis process and in results dissemination, before publication), it is common for a gap of five or more years to occur before publication in a peer-reviewed journal. This timeframe required outlined in various publications, such as Castleden, Morgan and Lamb (152,354).

CHAPTER VII: CONCLUSIONS

This dissertation's main goal was to characterize, through Shawi observations, the current state of water security and impacts on livelihoods in Indigenous Shawi communities along the Armanayacu river basin in Peru. This exploratory case study, qualitative oriented, was constructed from two exploratory concurrent mixed-methods studies under an EcoHealth framework. The research provides important baseline information about water insecurity related to WASH outcomes, whilst considering community-based data on cultural, geographic and climatic factors. The methodological scope used for answering the research question was rigorous, relevant and coherent, and allowed detection of methodological limitations (426,427).

The Armanayacu river is the main source of water for human consumption and domestic use, but according to Shawi perceptions its quality is not adequate. Shawi participants observed less rain but more intense precipitation events over time, reporting an increased risk of flooding related to changes in seasonal patterns. Water dynamics are also being affected by environmental changes like riverbank degradation that increase water turbidity and temperature.

There are few functioning water infrastructures, such as wells. None of the communities had access to handwashing facilities nor soap, thus handwashing was not a common practice. No latrines or other sanitation infrastructures were available at the households, making open and river defecation practices common. No local community health promoters were present to support WASH activities, likely

contributing to failed monitoring initiatives and creating future challenges in these two Shawi communities for meeting the SDG-6 targets.

There are nine years left to meet the SDG, and Indigenous communities are far from meeting these. For future directions to really take effect, they must be articulated from the different government sectors, prioritizing the right to basic access to WASH services and the indispensable care of common goods such as rivers. In addition, I must point out, academia must reflect, so as not to insist on perpetuating errors in water security-oriented health promotion programs with vulnerable populations.

Cultural, geographic and climatic context are not being considered and should be when employing water and sanitation public health interventions in the Amazon region. In order to implement sustainable improvements in WASH SDG-6 targets goals, it is strongly recommended to work closely with local community health promoters. Upon the results of this study, Indigenous communities around the Armanayacu basin should be prioritized for improved and locally relevant WASH initiatives to reduce gaps in water and sanitation and achieve water (SDG6) and health (SDG3) SDG goals. Hence, before implementing WASH interventions within Indigenous communities, researchers and public health leaders should focus any initiatives on understanding cultural behaviours.

At the beginning of this research, Peru had no national strategy for climate change, either developed or approved. To date, 2021, there is a National Law enacted with regulations that protects the promulged strategy on Climate Change. Therefore,

results from this case study are ought to be used as inputs for the upcoming decade. As adaptation policies must be a priority—at the local and regional level—for addressing environmental changes, extreme weather events and climate, authorities are aiming at reducing water security risks for Shawi and Indigenous communities in the Amazon. There is an urgent need to implement reinforce and regulations to reduce deforestation, riverbank erosion and river pollution.

Mixed methodology under the EcoHealth approach is highly recommended as a comprehensive tool for understanding how ecosystems can affect water security and health promotion dynamics. Health professionals and policymakers must focus their research on understanding how natural events and historical background can shape behaviours and resilience within Indigenous communities. Finally, this exploratory case study provides rich theoretical information for understanding how the concept of "place-nature" relates to rural health care models and can improve medical attention in vulnerable populations.

CHAPTER VIII: RECOMMENDATIONS AND FUTURE DIRECTIONS

Based on the research inputs/findings presented in this dissertation, the following recommendations are made for the immediate term water security 2030 SDG:

Strengthen WASH health promotion activities across social programs like JUNTOS and Kaliwarma. Furthermore, advocate for "health promotion evidence based" activities: for example, conducting supervised WASH activities like handwashing practices at local schools and working closely with local actors like Religious Institutions and Indigenous organizations.

Work closely with the National Superintendence of Water Supply and Sanitation Services of Peru (SUNASS) and General Directorate of environmental Health (DIGESA) in implementing a regulatory framework for supervising water quality, wastewater, adequate sanitation to all Indigenous rural communities along the Armanayacu river basin. Cultural practices in water must be further explored in close work with Ministry of Culture. In addition, carry out surveillance across basins with the participation of riverine communities.

Expand programs of adaptation and mitigation to climate change in the rural areas. For instance, the Catholic Church has the Laudato Si, which promotes healthy ecosystem. This is transmitted in their churches and schools. The program called *Hora del Ambiente* promoted by the Ministry of Environment (MINAM) and the Ministry of Education (MINEDU) can be adapted to local Shawi radios with the intention to give specialized information on water (river) environmental education.

Create a certified teaching program for medical students in rural health for working with Indigenous communities through future SERUMS[15] activities. This program approach should incorporate different study case scenarios using rural and EcoHealth principles, Climate Change and interculturality. Additionally, it could be implemented that universities can support participatory academic research in rural health through their medical graduate students working in those areas. This will generate local evidence in addition to providing a degree of training to newly certified physicians.

[15] *Servicio Rural y Urbano Marginal de Salud* (SERUMS) regulations were established in 1997 under the Law N 23330. It is a community program carried out for a year by certified health professionals. The scope of the programme is to do preventive and health promotion activities in rural, remote, and most impoverished areas of Peru.

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ANNEXES

Article 1. Achieving the Sustainable Development Goals: a mixed methods study of Health-Related Water, Sanitation, and Hygiene (WASH) for Indigenous Shawi in the Peruvian Amazon

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International Journal of
Environmental Research and Public Health

MDPI

Article

Achieving the Sustainable Development Goals: A Mixed Methods Study of Health-Related Water, Sanitation, and Hygiene (WASH) for Indigenous Shawi in the Peruvian Amazon

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check for updates

Abstract: Sustainable Development Goal 6 (SDG-6) addresses poor water quality, inadequate sanitation, and improper hygiene, all of which negatively impact health and disproportionately impact Indigenous Peoples' health. Understanding and responding to local contexts is critical to effectively improve water, sanitation, and hygiene (WASH); however, in-depth understanding of local knowledge, practices, and perceptions are often overlooked. As such, this study described the knowledge, practices, and perceptions of WASH held by residents of two Indigenous Shawi communities in the Peruvian Amazon. Quantitative data were collected via a cross-sectional survey and analyzed using descriptive statistics. Qualitative data were collected via interviews, PhotoVoice, focus group discussions, and participatory transect walks, and analyzed using a constant comparative approach to thematic analysis. Emergent themes included characterizing water sources, collection methods, and consumption patterns; knowledge, perceptions, and practices related to WASH; and knowledge and perceptions of health issues related to WASH. This study provides insight into the ongoing challenges related to WASH in Indigenous communities in the Peruvian Amazon and highlights the need to prioritize interventions that will advance WASH-related SDGs.

Keywords: indigenous health; Shawi; sustainable development goals; SDG-6; Peru; WASH; water security

Article 2. Climatic Changes, water systems, and adaptation challenges in Shawi Communities in the Peruvian Amazon

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sustainability

MDPI

Article

Climatic Changes, Water Systems, and Adaptation Challenges in Shawi Communities in the Peruvian Amazon

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check for updates

Abstract: Climate change impacts on water systems have consequences for Indigenous communities. We documented climatic changes on water systems observed by Indigenous Shawi and resultant impacts on health and livelihoods, and explored adaptation options and challenges in partnership with two Indigenous Shawi communities in the Peruvian Amazon. Qualitative data were collected via PhotoVoice, interviews, focus group discussions, and transect walks, and analyzed using a constant comparative method and thematic analysis. Quantitative data were collected via a household survey and analyzed descriptively. Households observed seasonal weather changes over time (n = 50; 78%), which had already impacted their family and community (n = 43; 86%), such as more intense rainfall resulting in flooding (n = 29; 58%). Interviewees also described deforestation impacts on the nearby river, which were exacerbated by climate-related changes, including increased water temperatures (warmer weather, exacerbated by fewer trees for shading) and increased erosion and turbidity (increased rainfall, exacerbated by riverbank instability due to deforestation). No households reported community-level response plans for extreme weather events, and most did not expect government assistance when such events occurred. This study documents how Indigenous peoples are experiencing climatic impacts on water systems, and highlights how non-climatic drivers, such as deforestation, exacerbate climate change impacts on water systems and community livelihoods in the Peruvian Amazon.

Keywords: climate change; weather changes; water systems; Indigenous health; Indigenous livelihoods; Peru; Shawi

Annex 3. Ethical approvals

UNIVERSIDAD PERUANA
CAYETANO HEREDIA
Vicerrectorado de Investigación
Dirección Universitaria de Investigación, Ciencia y Tecnología (DUICT)

CONSTANCIA 509- 24– 15

El Presidente del Comité Institucional de Ética (CIE) de la Universidad Peruana Cayetano Heredia hace constar que el proyecto de investigación señalado a continuación fue **APROBADO** por el Comité de Ética.

Título del Proyecto : **"Evaluación de la Seguridad del Agua en 2 comunidades Shawi de la Amazonía Peruana"**

Código de inscripción : **65470**

Investigador principal : **Paola Alejandra Torres Slimming**

La aprobación incluyó los documentos finales descritos a continuación:

1. **Protocolo de investigación,** versión 2 de fecha setiembre 2015.
2. **Consentimiento informado para dirigentes: Declaración informativa,** versión en castellano y traducida al Shawi, recibida en fecha 08 de noviembre 2015.
3. **Consentimiento informado verbal para las actividades individuales,** versión en castellano y traducida al Shawi, recibida en fecha 08 de noviembre 2015.
4. **Consentimiento informado para el personal de salud,** versión en castellano y traducida al Shawi, recibida en fecha 08 de noviembre 2015.
5. **Consentimiento informado: Estudio cualitativo photovoice,** versión en castellano y traducida al Shawi, recibida en fecha 08 de noviembre 2015.
6. **Consentimiento informado para padres: Estudio cualitativo photovoice,** versión en castellano y traducida al Shawi, recibida en fecha 08 de noviembre 2015.
7. **Asentimiento informado: Estudio cualitativo photovoice,** versión en castellano y traducida al Shawi, recibida en fecha 08 de noviembre 2015.
8. **Consentimiento informado familiar para encuestas en seguridad del agua,** versión en castellano y traducida al Shawi, recibida en fecha 08 de noviembre 2015.

La **APROBACIÓN** considera el cumplimiento de los estándares de la Universidad, los lineamientos Científicos y éticos, el balance riesgo/beneficio, la calificación del equipo investigador y la Confidencialidad de los datos, entre otros.

Cualquier enmienda, desviaciones, eventualidad deberá ser reportada de acuerdo a los plazos y normas establecidas. El investigador reportará cada seis meses el progreso del estudio y alcanzará un informe al término de éste. La aprobación tiene vigencia desde la emisión del presente documento hasta el **09 de noviembre del 2016**. Si aplica, los trámites para su renovación deberán iniciarse por lo menos 30 días previos a su vencimiento.

Lima, 10 de noviembre del 2015

Dra. Frine Samalvides Cuba
Presidenta
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/fsv

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Annex 4. Survey questionnaire

ENCUESTA UPCH IHAAC SEGURIDAD DEL AGUA

A. FAMILIAR

PASO 1 PRESENTACIÓN

(Entrevistador): Buenos días /tardes. Mi nombre es (Nombre del encuestador) y vengo en nombre de la Universidad Peruana Cayetano Heredia y del Proyecto SIAAC (Salud Indígena y Adaptación al Cambio Climático). Estamos haciendo un estudio acerca de la SEGURIDAD DEL AGUA EN 2 COMUNIDADES SHAWI. Quisiéramos hacerles algunas preguntas en relación al tema del agua y su salud pero antes le vamos a explicar en qué consisten las preguntas y el estudio.
ENTREVISTADOR: PASAR A APLICAR EL PROCESO DEL CONSENTIMIENTO INFORMADO. NO OLVIDE ENTREGAR UNA COPIA.

Wekama/iwata kasu nininewe(nombre del encuestador) kasu wesarawe nututun peikeran nininenke Universidad Peruana Cayetano Heredia y del Proyecto(mata nisarewa kanpua nuya yawekasumare isu nisha nisha taweri weninke). Napatun kiasu iseke nitutenan nisarai unpu yawate ta nuya yawekasumare, napatun shawichinken unpuinta isu nisawisu, i su kirika ketaranke (Leer el Consentimiento Informado).
Las preguntas que le haremos tomarán unos 20 minutos de su tiempo y agradecemos nos responda. Sus respuestas serán de gran ayuda y son confidenciales.
Isuwita natananke su ku wakiu napatun nuya tupatan nanite, isu kema shawiransu katawarinpua napurawatun ku interanta nitutarinwe kema nunansu

PASO 2:

APLICACION DE LA ENCUESTA

INSTRUCCIONES: Luego de haber realizado el procedimiento de lectura, firma y entrega de consentimiento se dará inicio a las entrevistas. Cada casa tendrá asignado un Código. Asignar el código correspondiente a la familia.
Nani shawituate mamaresuna nininsu , consentimiento firmawachin inaran ketuatan nanitaun natanamasu.a na ya a naya pei código yawetaun inamare isupuchin

código se refiere al tipo de Respuestas a las Preguntas. Si éstas son únicas (U) o Múltiples

A. Datos de Afiliación & Hogar

No.	Pregunta	Alternativas	Tipo Código*	Pasar a
1	Código del Encuestador (kema codigonen)	(1)(2) (3)		2
2	Código Familiar(pei codigonen)	( )( )( )( )	(M) (U)	3
3	Fecha (de entrevista) (ma a tawerita ina ke inansu)*****	__/__/___ [dd/mm/aa]	(M) (U)	4
4	Código de la Comunidad	( )( )	(M)*inst ruccion (U)	5
5	Nombre del Apoderado(jefe de familia) entrevistado(intana natanan isu mare)	_____	(M) (U)	6

6	Número de personas viviendo en el domicilio Unputa piyawisa inake yawewi peike.	Total ( ) Total de Adultos ( ) • Adultos Mayores de 18 años y menores de 65 años ( ) • Adultos Mayores de 65 años( ) • Embarazadas( ) Total de Niños ( ) Menores de 3 años ( ) Menores entre 3 y 5 años ( ) Menores entre 6 a 12 años ( ) Menores de 13 a 17años ( )	(M) (U)	**7**
7	Tienen Seguro Integral de Salud (SIS)seguro yaweterin ke	Si (1) No (2)	(M) (U)	**Si la RPTA es No pasar a 9**
8	¿Quién de su familia no está registrado en el SIS? Insuta iseke yaweramasu ku yaweterinwe seguro	_____	(M) (U)	**9**
9	Los menores de 5 años reciben los controles periódicos del Programa Control de crecimiento y desarrollo (CRED) Wawarusa ku a natrapu pii yaweterinsu keparan a petentaun	Si (1) No(2)	(M) (U)	**10**
10	¿Los menores mayores de 5 años asisten a la escuela? Yaipichachin winan wawarusa nininsu panin achin peike nitutamare	Si (1) No(2)	(M) (U)	**11**
11	¿En la escuela los menores han recibido algún programa de desparasitación? Achin peike wawashanen mimiriu ketui kuimare?	Si (1) No(2)	(M) (U)	**12**
SECCIÓN B: Agua Segura y Saneamiento				
No.				
No.	**Pregunta**	**Alternativas**	**Tipo Código***	**Pasar a**

12	¿De dónde saca o trae agua para tomar mayormente? Intuaranta manan isha uhukamare nani taweri?	Río (1)tekeinkeran Cocha (2)sunukeran Quebrada (3)ishanakeran Pozo escavado dentro de la vivienda (4)yaweraike pei anake pozo yaweterinkui. Pozo escavado fuera de la vivienda (5) Yaweraike aipiran pozo yaweterinkui Agua de un manantial (6) isha anui keran Agua de lluvia (7) unai manai uhukawaimare No sabe (8) Ku nituterinwe No responde (9) Ku ya shawirinwe Compro el agua (10) Pa anawe isha uhukamare Otro (anote cuál) a na iseke ninshike_____	(M) (U)	**13**
13	¿Si la fuente de agua anterior no está disponible de dónde sacarías o traerías agua para tomar? Ina isha ya mananke napunin napuni intuaranta isha maituwe uhukamare?	Río (1)tekeinkeran Cocha (2)sunukeran Quebrada (3)ishanakeran Pozo escavado dentro de la vivienda (4)yaweraike pei anake pozo yaweterinkui. Pozo escavado fuera de la vivienda (5) Yaweraike aipiran pozo yaweterinkui Agua de un manantial (6) isha anui keran Agua de lluvia (7) unai manai uhukawaimare No sabe (8) Ku nituterinwe No responde (9) Ku ya shawirinwe Compro el agua (10) Pa anawe isha uhukamare Otro (anote cuál) a na iseke ninshike_____	(M) (U)	**14**
14	¿Qué te parece la calidad del agua que recoges para usar? (Tomando en cuenta el olor, el sabor, el color) ¿Unpuinta isha ina uhuransu? (nuyai)	Muy mala (1)papi ku nuyawe Mala (2)ku nuyaiwe Regular (3)nuyamiachin Buena (4)nuya Muy buena (5)papi nuyai No sabe (6)ku nituterinwe No responde (7)ku ya shawirinwe	(M) (U)	**15**
15	Antes de tomar el agua ¿le echas o le haces algo? Ku isha uhushatarawen nunen iran unputeranta?	Si (1) No (2)	(M) (U)	**16**

16	¿Qué le echas o que le haces? Mata akuteran, ninan?	hervir o cocinar (1)unpi teran filtrar (2)panshairan agrega sustancias químicas como cloro (3)materanta akuteran x compra agua purificada (4)isha pa anan deja reposar (5)akuran yakei kamare le pongo hojas/plantastas (6)masha werun akuteran Otro (7)a na no sabe (8)ku nituterinwe no responde (9) ku yashawirenwe	(M) (U)	17
17	¿Qué te parece la calidad del agua que recoges para usar en sus quehaceres diarios? * (Tomando en cuenta el olor, el sabor, el color) Unpuinta ina isha manansu kamai kamasu mare? (Nuyai) Lavar platos Masato Bañarse Para cocinar	Muy mala (1)papi ku nuyawe Mala (2)ku nuyaiwe Regular (3)nuyamiachin Buena (4)nuya Muy buena (5)papi nuyai No sabe (6)ku nituterinwe No responde (7)ku ya shawiri	(M) (U)	18
18	¿Cree que utilizar cloro en el agua cuida la salud? Mata tenan cloro isha akutuwatera nuya kanpuamare?	Si (1) No (2)	(M) (U)	19
19	¿Cómo almacenas el agua? Unpuiketa isha taparan?	En baldes (1)baldes En botellas (2) putiake Tenemos agua potable y/o tanques en la comunidad (3)yaweterinkui isha tapawisu iseke comunidad En el refrigerador (4)refrigerador No sabe (5)ku nituterinwe	(M) (U)	20
20	¿Para beber agua prefiere comprar el agua? Isha uhukamare pa anan?	Si (1) No (2) No sabe (3)	(M) (U)	21
21	¿Si prefiere comprar bebidas, cuáles compra? Yamuruwatana mata pa a nan uhukamare?	Agua (1)isha Gaseosas (2)gaseosa Jugos (3)kashi i Bebidas alcohólicas Cerveza (Tragos) (4) awarinchi No compra (5)ku manta pa a nawe No sabe (6)ku nituterinwe	(M) (U)	22
22	¿Cuántos gastas al día en las bebidas que compras? Unputa pawereteran uhui mare a na taweririake?	0 soles (1)ku manta 5 soles (2)a na trapu 10 soles (3)shunka No sabe (4)ku nituterinwe	(M) (U)	23
23	A veces se queda sin agua para beber? A na taweri ku manta isha yawerinwe uhukamasu mare?	Nunca (1) ku unpuruteranta Rara vez (2)a na taweri No (3) ku ----------ej24 No sabe (4) ku nituterinwe	(M) (U)	24

24	¿Aproximadamente cuántas mocahuas de agua toma al día una persona en promedio? Sea en masato o agua pura Unpu mine puchinta isha uhuran a na tawerike, wenu nipu isha inawita?	( )	(M) (U)	25
25	A veces se queda sin agua para lavarse las manos? A na taweri ku isha yawerinwe wisekasumare?	Nunca (1)ku unpuruteranta Rara vez (2)a na taweri Algunas veces (3)unpuwachinasu Frecuentemente (4)ya pawanin mini Siempre (5)papi pawani mini	(M) (U)	26
26	¿Qué le parece el agua de río o quebrada (puede marcar más de una opción)? Unpuinta ni nan tekein, ishana inawita? animales muertos Basura Heces en el rio	Uno puede tomar agua (1)nanitere uhukasu Está limpia, uno se puede bañar (2)nanitere amakasu Está sucia (3)ku nuyawe Dicen que tiene mercurio, plomo y otros minerales (4)tupi newei apitasu yawetumara Dicen que tiene fertilizante, pesticidas (5)miniriu sha a mare nunenpisu yaweterin Dicen que tiene petróleo (6)ku nuyaiwe gasolina puchin nininsu yaweterin No sabe (7) ku nituterinwe	(M) (U)	27
27	¿Dónde haces tus necesidades mayormente? Intuata chichiran ya chichiwatana?	Baño conectado a desagüe (1)baño conetado al desgue Letrina cubierta (2)chichishinante peiwan Letrina descubierta (3)chichishinante ku peiwawe En el monte (4)tananke En el río (5) i ike Alguna otra facilidad (6)unpuikesu No responde (7)ku ya shawirewe Afuera de la casa (8) peike aipiran Camino a la chacra (9) irake	(M) (U)	28
28	¿Quienes usan este lugar? Inpitata iseke chichiwi?	Es sólo para mi familia (1)kiamare ichin Compartida con personas de otras familias (2)anawitamarenta Comunitaria (3)yaipimare No sabe (4) ku ituterinwe No responde (5) ku ya shawirinwe	(M) (U)	29
29	¿Tienen en su vivienda un lugar especial donde se lavan las manos? Ya weterin kema insesuna wiseramasu yaweramake?	Si (1) No (2)	(M) (U)	30
30	¿Cuándo te lavas las manos? (Puede marcar más de una opción) Unpuruta wiseran?	Antes de preparar el masato (1)wenu yanipatura Antes de preparar los alimentos (2)kusharu ya nipatura Antes de comer Después de comer (3)kushaterai pikeran Después de hacer sus necesidades (4)chichirai pikeran	(M) (U)	31

31	¿Cuándo te lavas las manos usas jabón? Wisewatana shapunke wiseran?	Si (1) No (2) Sólo cuando tengo (3)yawewachina ichin	(M) (U)	32
SECCION C: Riesgos relacionados al Agua & al Cambio Climático				
No.				
	Pregunta	Alternativas	**Tipo Código***	Pasar a
32	¿En los últimos años ha habido cambios en las estaciones? I su piirusake unpuinta taweri ninama?	Llueve más fuerte (1)apiraya apiraya unanin Llueve más fuerte y durante más tiempo (2)waki taweri unanin Llueve menos (3)ku akete unaninwe No llueve (4)ku ya unaninwe Crecen y desbordan los ríos (5)pama tuachina tawerin Hace más calor (6)nakunnakun wenuka ninin Hay más inundaciones (7)nakun pakun yawerin Sucede lo mismo de todos los años (8)inauchin nisarin yaipi pii panike	(M) (U)	33
33	Estos cambios han sucedido en los últimos I su taweri nishapuchin ninin nani waki?	5 años (1) 10 años (2) 15 años (3) 20 años (4) No lo recuerdo (5)ku yunkirawe No hay ningún cambio(6)ku manta nishapuchin yawerinwe.	(M) (U)	34
34	Estos cambios en el clima, han afectado a su familia y comunidad? I su taweri nishapuchin nikatun ku nuyawe ninin?	Si (1) No (2) Algunas familias más que otras (3)anake nakunakun.	(M) (U)	35
SECCIÓN D: Criterios para caracterizar al ecosistema				
No.				
	Pregunta	Alternativas	**Tipo Código***	Pasar a
35	En los últimos años el agua de sus ríos está distinto Isu tawerisa paninke isha ku nuyaterinwe	Si (1) No (2)	(M) (U)	36

36	En relación a la pregunta anterior. El agua viene distinta: I su tawerisa paninke isha ku nuyaiwe wenin?	Con más arena (1)inuterachin Más cantidad de agua (2)naku naku isha wenin Contaminada con petróleo, mercurio y/o plomo (3)ku nuyaiwe mapitasu yaweterin Sucia con basura (4)newei Hay menos agua (5)ku nakun isha wenin Las cochas se han secado (6)sunurusa winkintuwi Está igual (7)ina chachin nisarin Otra (8)a na Especifique _iseke ninshike_____	(M) (U)	37
SECCIÓN E: Características de las actividades económicas y de desarrollo				
No.				
	Pregunta	Alternativas	**Tipo Código***	Pasar a
37	¿Cuál es el ingreso familiar, de qué vive su familia? Unputa kuriki nani yuki yaweterin mata pa antun yaweran?	De la agricultura (mi chacra) (1)iminke De la pesca (2) sami ke De la piscigranja (3)sami petawa raweke Del Comercio (4)masha pa anaweke De la minería (5)de la mineria De la artesanía (6)kemaura masha ninaukeran (teshi,shunpi,mio, inawita) Maderero (7)mara pa antu Otros (8)a na masharusa	(M) (U)	38
38	Su actividad la realiza en forma: I na uraran nani taweri?	Permanente (1) nani taweri Eventual (2) a na taweri	(M) (U)	39
39	¿En qué meses del año hacen a las siguientes actividades? Ma a yukiketa isuwita inan? 1. Labores de Cultivo ( )shateran 2. Labores de Cosecha ( )senateran 3. Labores de Post Cosecha ( )manansu awinteran 4. Labores de Venta ( )pa anan 5. Minería ( )mineria 6. Tala de árboles ( )nara aneran 7. Pesca ( )samike 8. Venta Piscigranja ( )pa anan sami petawaransu 9. Artesanía ( ) kemaura masha ninan(teshi,shunpi,mio, inawita) 10. Cazar en el monte. 11. Palma aceitera. Construcci Ganadería.	Enero (1) Febrero (2) Marzo (3) Abril (4) Mayo (5) Junio (6) Julio (7) Agosto (8) Setiembre (9) Octubre (10) Noviembre (11) Diciembre (12) Todo el año (13)	(M) (U)	40

40	¿Participan niño/as haciendo las actividades mencionadas en la pregunta anterior? Wawarusanta katawarinkema inawita ninamake?	Si (1) No (2)	(M) (U)	**41**
41	¿Los menores dedican tiempo en acarrear agua para beber y lavar? Wawasharusa isha mapi uhukasumare pesainkasuma Re inawita?	Si (1) No (2)	(M) (U)	**42**
42	¿Quiénes dedican más tiempo en acarrear agua? Inta nakun nakun isha nanin?	Niños (1) kemawi awa rusa Niñas (2) sanapi awa rusa Edad ( )pii pinen	(M) (U)	**43**
43	¿Cuántas horas diarias realiza esa tareas el/a niño/niña (nombre) para su familia? Unpu urapuchinta ina isha sakatuterin?	2 horas o menos Menos de 2 horas diarias (1)a na katu horapuchin 3 a 4 horas diarias (2) 5 a 6 horas diarias (3) 7 a 8 horas diarias (4) 9 horas diarias a mas (5)	(M) (U)	**44**
44	¿Les impide ir a la escuela? Inamare ku escuela paniwe?	Si (1) No (2) 0	(M) (U)	**45**
45	¿En general sus actividades laborales se han visto afectadas por los cambios en el clima (Temperatura, lluvias, inundaciones, sequías? Yaipi i su ninansu ku nuyake taweri nipachina ku naniteranwe sakatu nikamare(chiniken pii nipachina, pakun pachina, uhnanpachina)	Si (1) No (2) 0	(M) (U)	**46**
46	¿Qué tipo de ayuda o apoyo ha recibido su familia/ comunidad para mitigar estos eventos? Maketa katawarinema kanpita iseke(chiniken pii nipachina, pakun pa pachina, uhnan chiniken nipachina) Espontaneo inducida	Apoyo de la comunidad(1)iseke yawerusa katawarinakui Hemos contactado a la municipalidad (2)municipalidad katawarinkui Hemos recibido ayuda de ONGs u organismos religiosos (3) a na wita piyawisa katawarikui Hemos recibido entrenamientos/capacitaciones en prevención de riesgos (4)achinterinakui unpu ka waisuna a ma masha unpukasumare inauchin taweri nipachin. Hemos recibido del sector público/salud/agricultura/otros hace campañas (5)inamare salud keran ,agriculturakeran shawirawi unpukasuna inauchin nipachin Otras razones a na yunki (6) Especificar i seke ninshike _____	(M) (U)	**47**

47	¿Qué medidas se han tomado al respecto? Mata unpukasuta yunkirama inamare?	Hemos realizado planes comunales(1)iseke nani yunkirai unpukawaisuna En la escuela los niños están aprendiendo acerca del cambio climático (2)Escuela wawarusa nitutawi i su taweri nisha nisarinsumare Hemos realizado coordinaciones con instituciones como el sector salud, municipalidad (3)inamare municipalidad salud ina witaruku ni nunterai ina mare Implementamos guías de calidad de agua (4) yaweterinkui unpu nuyai takasuta isha Ninguno (5)ma anta ninaiwe Otros (6)a na Especifique iseke ninshike_____	(M)	48
48	¿Qué recurso es el que más teme que le falte o se deteriore y afecte su diario vivir junto con la salud de su familia? Mata ku pa wainwe tenama a ma kañukasumare nuya yawekasu mare?	Los ríos (1)isha La calidad / como viene el agua (2)nuyai isha weninsu Los bosques (3) tanan Los alimentos (4) kusharu Los peces (5)samirusa Otro (6)a na Especifique iseke ninshike_____	(U)	

Estas son todas las preguntas que tenía que hacerle. Muchísimas gracias por sus respuestas.
I suwita ya natanten naputeranke, yusparinken inamare.

Annex 5. Qualitative interview guide / opened questions

INSTRUMENTOS CUALITATIVOS

Guía de Preguntas para el estudio

Acá se presentan las preguntas guías que se utilizarán en las metodologías propuestas y para ser aplicadas después del acercamiento. Antes de empezar, el documento informativo será explicado en el idioma nativo del participante y el consentimiento verbal será obtenido. El participante podrá leer el documento informativo. Si el participante no sabe leer, el investigador o traductor le leerá detenidamente el documento. Se grabará la información solo si el participante lo desea.

Tabla N° 1 Preguntas generales guía.-

Temas	Seguimiento
La carga de enfermedad con AGI/ experiencias vividas	
¿Me puede decir sobre cuándo usted o sus niños están enfermos con diarrea o/y vómitos? Naniteran shawitankusu unpuranta chichikañu /imui mapachinkeran kema winan inawita?	¿Qué pasa? ¿Cómo le/les afecta? Unpuranta? ¿Maketa ku nuyawe akurima?
¿Cómo se siente cuando usted (o su niño) está enfermo? ¿Qué pasa? Unpuinta ni natanan kema winan kañuwachina unpuranta?	¿Cómo son los síntomas físicos? ¿Son muy intensos/severos? ¿Con cuál frecuencia pasa? Unpurinta nina? ¿chiniken marin/wakirin?
¿Cómo son los otros problemas no-físicos que resultan por la diarrea o vomito severo? Unpuramata i su puchin kañu watamara?	¿Afecta el trabajo, salud social, salud emocional o salud oficial? Ku sakatuchinachin ninama, ku nuyawe yawerama.
¿La diarrea o/y vomito es una enfermedad grave o peligrosa? Chichikañu /imui inawita papi ku nuyawe kañu?	¿Por qué? Unpanta?
Comportamiento en la búsqueda de servicios de salud	* Orientado a padecer diarrea
¿Qué hace cuándo usted o alguien en su hogar tiene diarrea grave o/y vómitos? unpuramata kanpita iseke yaweramasu chichikañu imuire mapachin mara?	¿Por qué hace eso? ¿Cómo es el tratamiento para sus hijos? Unpan ta inauchin ninan? ¿unpuinta nunen keteran winan mare
¿Ha usado las plantas medicinales o tratamientos tradicionales por un curandero (curandero, vegetalista o tabaquero) para tratar los síntomas de la diarrea o/y vomito? Nunen namen makatun ni nunenan, penutunke ni uwateran chichikañu/imui mapachinkeran?	¿Cómo se llaman las plantas o remedios? ¿Cómo las usan? ¿Qué hacen estas plantas o remedios? ¿Creen las plantas aquí en la comunidad? Maninta ina nunen werun mimirio mare manan? ¿unputereta?¿mata ninan ina werunke?¿i seke yawerin ina nunen mare nininsu?
¿Cuándo (o para cuales enfermedades) no usaría las plantas medicinales?	

Unpu waterata ku nunen naterinwe manin kakuta nipachina.	
¿Cuándo busca los servicios de salud de la posta/clínica? ¿Cuándo usa las plantas medicinales? Mamareta postake pa nan?unpuatananta mimirio postakeran mapateran?.	¿A quién busca primero cuando tiene diarrea y porqué (medicina tradicional, farmacias, promotores de salud, sistema de salud)? Intuata pa nan chichikañu mapachinkeran unpanta?nunen uhuran, ni uwateran,mimirio pa a nan, promotor yuniran, postake pa nan?
¿Cuáles son las barreras o problemas que le impide ir a la clínica/posta/hospital? Unpanta ku naniteranwe postake/hospitalke pa kamasu?	¿Hay barreras (físicas, económicas, sociales)? Ku naniteraiwe(akenitun, ku kuriki yakerinwe pakamare, ku nuyawe nikunpi nitun)?
¿Qué tipo de tratamiento recibirá en el hospital? Unpuinta nunen nininenpu hospitalke pa pa tera?	
¿Cuándo no querría ir al hospital? Unpu watanata ku nuwanteranwe hospital pa kamasu?	
¿Toma suero/terapia de re-hidratación oral? Uhuran ishapuchin suero itupisu?	
Percepciones de las enfermedades	
¿Qué cree es la causa de la diarrea grave o/y vómito? Mata na nika ina chichikañuterinpu/imuire?	¿Llave los manos? ¿Hierve el agua? Wiseke?¿isha unpite uhukaman?
¿Qué comida come cuándo usted o sus hijos tienen diarrea o/y vómito? Manin kusharuta kanan chichikañu/imuire chachin mapachimara?	¿Come comida del día anterior, o comida frio o vieja? Kanan iwara yasurinsu, waki akuresu inawita?
¿Hay cosas que puede hacer para prevenir la diarrea y/o vómito? Yawerin ma sha chichikañu/imuire ku makainpusumare ?	
¿La Diarrea causada por los espíritus, por el curandero, por el hambre es por problemas del agua? Wayan naniterin chichikañu itinpusu,penutun,ishakeran ku kushataterawe?	¿Ha aumentado más este último tiempo?, ¿a qué se debe? Nakun nakun chichikañu/imuire materin isu pii rusa paninke? ¿unpanta nika?
¿Quiénes se enferman más los niños, adultos, ancianos? Inpitata nakun nakun isu kañuri manin, (mashurusa, wawarusa , tatamashurusa)?	¿Por qué sucede esto, en qué época sucede con mayor frecuencia? Unpanta inaurin nika, pii pike, unawike, isu kañu nakun nakun materin?
La última vez que te enfermaste por EDA Iwa chichikañu masapenke?	¿Qué hiciste? ¿A dónde fuiste? Unpuranta intuata pa nan?
Según tu opinión, ¿qué es más efectivo para las EGI: un tratamiento con plantas o un	

tratamiento con pastillas? Mata tenan kema isu kañu mare? Mimirio postakeran , kanpu nuken mata nuya nuya nika?	
Estacionalidad	
¿El ambiente puede afectar (los síntomas) de diarrea o vómito? Unpuinsuna taweri nipachina naniterin akete nikakasu isu kañu mapachinpura?	Lluvia, calor, estación de lluvia, estación seca Unan, wenuka, unaike, piipike.
¿La diarrea o vómito pasa más en el verano o en el invierno? Unpuinta chichikañu/imuire materin, pii pike nakun nakun, unaike nakun nakun?	
Preguntas sobre acceso al agua y saneamiento	
¿Dónde sacas el agua? Intuaranta isha manan?	Agua potable, Agua entubada, Pozo, Río o quebrada, Letrina, Fosa séptica, Otro. Isha tapanan yaweterima iseke, isha grifoke yaweterinkema peinamake, tekeinkeran, ishanakeran, pozokeran, a na.
¿Dónde hace sus necesidades? Intuata ya chichiwatana pa nan?	Letrinas, campo abierto, Rio, Otro. Chichishinanteke,tananke,ike, a na.
¿Se lava las manos antes de comer, hierve el agua antes de tomarla? Wiseran ya kushatuatana, unpiteran isha uhukamare?	Explorar creencias Nike unpuwita
Fuentes de información	
¿Dónde y quien te informas sobre temas de diarrea y cómo prevenirla y curarla? Intuata, inta shawiterinke unpu nunen kasuta chichikañu, unpuateta ama kañu makainpusu mare achinterinen?	Alguien le ha dicho que hervir el agua mejora la salud de su población, quien? Usted le cree, por qué? Inta shawiterinka isha unpi i tate uhu patera ku akete kañu maninpuwe? ¿nateran ina , unpanta?
¿Cuáles crees que son las fuentes de información más efectivas para transmitir la información sobre salud en tu comunidad? ¿maketa nuya nuya su shawituachinenpu nitutari nuya yawekasumare?	
Percepciones del Ministerio de Salud	
¿Cuán efectivas son sus campañas de lavado de manos y cuidado del agua en las comunidades? ¿nuya ina nunpisu, wiseku nuya isha apaiku tupaichinara katawarinpu nuya yawekasumare?	¿Por qué? ¿unpanta?
¿El Ministerio de Salud/Gobierno realiza programas/proyectos de agua y EGI en las comunidades? ¿ministerio /gobierno nipi iseke unpuateta nuya isha uhu kasumare ?	Son efectivas, por qué si o no. Qué sugerencias tiene. Nuya ina, unpanta Nika. Mata tenan nika inamare.

Cambio Climático	
En los últimos años ha cambiado el clima? (Aumento de temperatura, inundaciones, lluvias, Isu pi'irusa paninke nisha puchin ninin taweri? Nakun nakun wenuka ninin, pakunin, nakun unanin.	Esto ha afectado las actividades en su comunidad, a su familia en qué. Hay más enfermedades? Inawita ku sakatechin nachinwe ninin iseke yaweramake ,nakun nakun, kañu yawerin ?
Me puede comentar como es un día típico en una estación del año? Naniteran shawiteinkusu unpuinta ira ka su pi i pirusa ninin?	Ha habido variaciones en las estaciones? Cómo se han adaptado a nivel familiar y a nivel comunitario? ku ina ina uchin unai pi ipi ninin?, inauchin nipachina unpuramata iseke yaweramasu?
Tienen problemas de acceso de agua saludable cuando hay estos cambios en el clima? isha ku nuyai isu uchin taweri nipachina?	Por qué? Puede explicarnos. Unpanta ? inta shawiteriku.
Ecosistemas	
Han cambiado sus ríos, número de árboles, la cantidad de peces y animales en su comunidad? Ku nuyawe isha ninin tananta tawantarin, samiru santa kapa ninin, kanan nusa kapa nisarin iseke yaweramake .	A qué se debe ese cambio? Cómo cree que se debe de cuidar la naturaleza? Cómo se protegen ustedes de esos cambios? Unpanta napuarin nika? Unpu apaikasuta nika i su masharusa? Unpu ni apairamata kanpitasu nika?

Tabla N° 2 Guía de preguntas para el Fotovoz.-

¿Qué es para usted el agua? ¿Qué valor tiene? Mata ina isha kemamare? Unpuhuchinta pa terin?
• Explorar el significado cultural entre las EGI y el agua Yunike mata nika isu kampitamare isu chichikañu /imui, isha inawita
• ¿Qué aspectos de su vida diaria se ven afectados por las EGI y las fuentes de agua? Existe alguna relación? Mata ku nichinachinwe isu kañu mapachinpura? Chichikañu ishakeran uhkuire?
• ¿Cómo se relaciona con las EGI/EDAs? Unpuinta chichikañu waki mapachinpura?

Annex 6. Thematic codebook

WATER SECURITY *"The capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability."*					
Theme	**Label**	**Definition**	**Inclusion Criteria**	**Exclusion Criteria**	**Example (s)**
Water security	Household level	"A household level unit consists of one or more people who live in the same dwelling and also share meals or living accommodation, and may consist of a single family or some other grouping of people".	• How at the household level they express threats or resilience to face problems related to water- related hazards and water security	Exclude any event or hazard or resilience that is not related to water at the household level.	*Transectional Walk #5: 82-90.* *Focus group#2:22-24, 29-30, 64-65* *Focus group#3: 424-5* *Photovoice #5: 245-8.*
	Community level	"A community level unit consists of the same population groups who live in the same community and share similar cultural characteristics.".	• How at the community level they express threats or resilience to face problems related to water- related hazards and water security	Exclude any event or hazard or resilience that is not related to water at the community level.	*Interview #1: 256, 260, 262-4, 266-282, 287, 297, 308-312, 318, 322-330, 332-333, 339-342, 345-349, 386-387, 394-397.*
Water- Related Hazards	River Pollution	Any pollutant or trash in the river or water sources and resources. It can be due to daily community activities, seasonal changes including floods, and or droughts.	• How at the Individual/ community level they express resilience to face problems related to water- related hazards	Exclude any event or hazard that is not related to water.	*Focus group#1:71-74, 176-180,200-201, 205-207, 215-216, 218-222,226, 228-231, 275-6,287-91* *Focus group#2:155-165, 190-191* *Photovoice #7: 34-37, 39-41.*
	Seasonal or Temperature variation or climate change	Any seasonal or temperature variation associated with water variations. Changes in climate patterns in the last decades	• How at the Individual/ community level they express resilience to face problems related to water- related hazards & variations • Do communities identify differences in seasonal changes	Exclude any event or hazard that is not related to water. Exclude any event or hazard that is not related to water & has not occurred within the past decade.	*Transectional Walk #4:83-88,95-99, 206.* *Transectional Walk #5: 92-3, 95-6.* *Transectional Walk #6: 157-8.* *Transectional Walk #9: 267-271* *Transectional Walk #10: 72-73, 106-9, 139-145.* *Focus group#1:452-460, 466-467, 519*

			versus weather and within periods of time		*Focus group#2:182-189,281-285, 349-50, 355-6, 358- 368, 373-9.* *Focus group#3:239, 242, 245, 247-9, 253-255, 269, 275-6, 342-52, 367-71.* *Interview #3: 47-55, 253-54, 325-6* *Interview #4: 28-9, 31, 33-48, 52-54, 56-63, 70-72,83-95, 130-132, 275-278, 282-288, 322-332.* *Photovoice #1: 198-213, 241-251, 254, 259, 262-3.* *Photovoice #2: 288-90* *Photovoice #5: 241* *Photovoice #7: 148-152.*
	Floods	Any floods associated with water variations.	• How at the Individual/ community level they relate or express resilience to face problems with water variations • Consider any flood as heavy rains affecting houses and daily activities for several days.	Exclude seasonal heavy rain	*Focus group#1:476-481* *Focus group#2:369-372, 388- 406, 415-* *Photovoice #1: 155-8, 160-4, 166-70, 172-6, 184-5, 189,191, 196-7, 241-51.* *Photovoice #4:44-57.* *Photovoice #5: 241, 245-8*
	Rain & Droughts	Any droughts associated with water variations.	• How at the Individual/ community level they relate or express resilience to face problems with water variations	Exclude any man made water variation	*Transectional Walk #2: 346-8, 382-7.* *Transectional Walk #7: 217-220.* *Interview #3: 9-16, 95-105* *Interview #4: 102-104, 106-109, 113, 296-301, 304.* *Photovoice #1: 267.* *Photovoice #8: 426-7.*

	Open defecation (OD)	The human practice of defecating outside—in the open. In lack of toilets or latrines, people use fields, bushes, forests, open bodies of water or other open space.	• Where do you defecate? • Bushes, forests, open bodies of water or other open space • Presence of faeces	Exclude if they use river defecation or latrines.	
	River defecation	The human practice of defecating in the river	• Where do you defecate? • River • Presence of faeces	Exclude they use open defecation or latrines.	*Transectional Walk #2:156-7.* *Focus group#1:71-74, 230-231, 576-82*
HEALTH OUTCOMES RELATED TO WATER HAZARDS					
Health outcomes related to water hazards	Acute Gastrointestinal Diseases (AGI)	(a) Diarrhea, either alone or in conjunction with other gastrointestinal symptoms, such as vomiting, fever, or abdominal cramps. (b) Vomiting in conjunction with either diarrhea or two other gastrointestinal symptoms, such as fever or abdominal cramps.	• Any AGI symptoms episode related to food, pollutants, seasonal changes like temperature changes, including floods, and or droughts? • Any perception related towards AGI symptoms	Exclude any AGI not related by the individual with seasonal events and or challenges	*Transectional Walk #2: 275-82, 415-20.* *Transectional Walk #3: 79-84.* *Transectional Walk #4: 129-132.* *Transectional Walk #5: 70-3.* *Transectional Walk #7: 271-280.* *Transectional Walk #9: 191-3, 201-2, 208-12, 254-5, 267-271.* *Transectional Walk #10: 22-23, 148-9, 229-49.* *Transectional Walk #12: 155-160, 163-4* *Focus group#1:295-6, 299-301, 342-5, 348-58, 363-366, 376, 388-9, 396-8, 404-406, 413.* *Focus group#2: 180-191,192-199, 349-50, 373-9, 532-42* *Focus group#3:224,280-86, 311, 321-322, 362-4.* *Interview #1: 741-5* *Interview #2: 157-8, 162-4.* *Photovoice #3:340-3.* *Photovoice #5: 49-51*

					Photovoice #6: 62-5, 111-9.
	Upper Respiratory Tract infection (URI)	Nonspecific term used to describe acute infections involving the nose, paranasal sinuses, pharynx, larynx, trachea, and bronchi. The prototype is the illness known as the common cold, which is discussed here, in addition to pharyngitis, sinusitis, & tracheobronchitis.	• Any URI symptoms episodes related to, pollutants like oil leaks, seasonal changes like temperature changes, including floods, and or droughts. • Any perception related towards URI symptoms	Exclude any URI not related by any described threat	*Focus group#3:119, 121, 124-5, 149.*
	Skin Related Diseases (SRD)	Inflammation of the skin; skin become s itchy and may develop blisters. allergic eczema. eczema caused by an allergic reaction. eczema herpeticum. eczema characterized by a feverish condition and widespread eruption of vesicles; most common in children.	• Any SRD symptoms episodes related to water, like pollutants, parasites or seasonal changes like temperature changes, including floods, and or droughts. • Any perception related towards SRD symptoms	Exclude any SRD not related by any described threat	
	External Trauma (ET)	Any injuries, wounds, sprain or wounds related to water security activities	• Any ET due to carrying water buckets, bathing, building the wells or pozos. • Any perception of ET related to water safety hazards	Exclude any ET not related by any described threat	*Transectional walk #1: 39* *Photovoice #4: 151-62.* *Photovoice #8: 275-82.*
ECOSYSTEMS "Ecosystems are preserved and can deliver their services, on which both nature and people rely, including the provision of freshwater"					

Ecosystems	Soil Pollution	Soil and land Ecosystems are preserved and can deliver their services, on which both nature and people rely on and finally affects the provision of freshwater	• Individual makes association between changing the soil environment because of pollution. • Pollution refers to any garbage, deforestation, faeces, dead animals, plastic, changes in agriculture (palm trees affecting the soil)	Exclude if individual does not relate a change in the soil environment to wellbeing.	
	River Pollution	Any pollutant or trash in the river or water sources and resources. It can be due to daily community activities, seasonal changes including floods, and or droughts.	• How at the individual/ community level they express resilience to face problems related to water- related hazards	Exclude any event or hazard that is not related to water.	*Transectional Walk #2:119-126, 130-136, 144, 156-161,176-182, 250-3, 300-4.* *Transectional Walk #6: 44-46.* *Transectional Walk #8: 58-78, 84-90.* *Transectional Walk #10:186-91.* *Transectional Walk #11:99-102, 105-6, 110-111.* *Transectional Walk #12: 119, 121, 125-131.* *Focus group#2:110-111* *Focus group#2:155-165, 467, 469-70, 483-6, 494-8, 502-8.* *Focus group#3:520-21, 525-27, 532, 539-540, 543-544, 547-8, 578.* *Focus group#4:575-8* *Interview #2: 28-45, 117, 119, 123-125, 140-1.* *Photovoice #3: 172-3, 176-7, 180-93.* *Photovoice #5:17-27.* *Photovoice #6: 116-21.* *Photovoice #7: 34-37, 39-41, 49-55.*

	Outside community threats	Any hostile intention or action perceived from outside the community by the individual as to inflict pain, injury, damage on someone.	• Individual makes association between changing environment (soils & rivers) and changes in mood/attitude of both themselves and the community (e.g. changes in climate, weather, pollution, other communities, urbanization) due to outside threats	Exclude anything that is not perceived as an Outside community threats	Transectional Walk #8: 99. Transectional Walk #10: 186-91 Transectional Walk #11: 220-21, 223-35. Focus group#1:71-74, 101, 200-201 Focus group#2:155-165 Interview #4: 136-145, 168-171, 247-254, 354-361. Photovoice #5:17-27. Photovoice #7: 49-55.
	Inside community threats	Any hostile intention or action perceived from inside the community by the individual as to inflict pain, injury, damage on someone.	• Individual makes association between changing environment (soils & rivers) and changes in mood/attitude of both themselves and the community (e.g. changes in climate, weather, pollution, attitudes, practices inside their communities, urbanization) due to local threats	Exclude anything that is not perceived as an Inside community threats	Transectional Walk #2:173-174, 176-182, 300-4. Focus group#2:420-8, 458-9, 467 Photovoice #1: 58-9, 62-3, 69-75, 155-8, 160-4. Photovoice #7: 49-55.
	Stewardship	"Responsible use and protection of the natural	• Who are the responsible?	Exclude any definition not related to doers, donor or practitioner	Transectional Walk #2:166-167, 300-4. Transectional Walk #4: 276-282 Transectional Walk #5: 95-105

		environment through conservation and sustainable practices" There are 3 types of environmental stewards: (i) Doers go out and doers help the cause by taking action. (ii) A donor is the person that financially helps the cause. (iii) Practitioners work on a day-to-day basis to steer governmental agencies, scientists, stakeholder groups, or any other group toward a stewardship outcome.	• Recognize who are the Doers, donors and practitioners. • What do they do? • How they do it? • What takes to stewardship? • Does the community have the 3 types? • What mechanisms of resilience do they have?		*Transectional Walk #8: 193-8* *Transectional Walk #10: 195-8, 201-202,* *Transectional Walk #11: 71-77,* *Transectional Walk #12: 137, 142-3.* *Focus group#3:520-21, 525-27,552-4.* *Focus group#4:564-6, 567-573.* *Interview #2: 140-1* *Interview #3: 117- 123, 143-155.* *Interview #4: 70-72, 83-95, 395-401, 411-417,* *Photovoice #1: 78-86, 221-232.* *Photovoice #5: 137-144,163-66, 178-202* *Photovoice #7: 229-30*
	Economic Activities for Development	Indirect or Direct water economic activities for development that are available for food and energy production, industry, transport and tourism.	• What kind of Water related activities for economic development are being developed that affects positive or negatively the ecosystem (individually and community level)	Exclude any activity not directly related to water activity	*Transectional Walk #10: 148-68* *Transectional Walk #11: 79-91* *Transectional Walk #12: 15-24* *Focus group#2:420-8, 432-440* *Interview #3: 169-178, 229-231.* *Interview #4: 411-417, 437, 439-43, 453-454, 499-503.*
	River	Populations relations with river water access (quality of	• How Individuals directly/indirectly have ways to afford for river	Exclude if they do not relate to the river	*Transectional Walk #4: 261-273,* *Transectional Walk #8: 99.*

		water, changes in seasonality of the water, food)	water for their basic needs. (bathing, cooking, drinking) • Relation with river • Perceptions towards the quality of the water (heat, sand, currents, fishes)		*Focus group#1:506* *Focus group#2:22-24, 31-38, 41-50, 53-60, 83-92, 128-137, 139-148, 432-440.* *Focus group#3:73, 80-81, 177-8.* *Photovoice #1: 97-8, 102-5, 241-51,* *Photovoice #3: 107-8, 114-24.* *Photovoice #4:44-57.* *Photovoice #5:17-27.* *Photovoice #6: 49* *Photovoice #7: 34-41, 79, 89-90, 136-8.*
	River banks	Nature or man-made bank hazards affecting river quality	• How is the river water being challenged due to river banks and hence affecting individual and community life	Exclude if they do not relate to the river and banks	*Transectional Walk #4: 261-273.* *Transectional Walk #8: 58-78.* *Focus group#2:114-118.* *Focus group#3:71, 109.* *Photovoice #1: 106-110, 221-232.* *Photovoice #5:17-27,178-202* *Photovoice #7: 148-152, 229-30*
HYGIENE & SANITATION Knowledge, Attitudes and Practices of WASH. Water, sanitation and Hygiene					
Hygiene	Hygiene knowledge	Any condition and knowledge that help to maintain health and prevent the spread of diseases.	• Knowledge, that the individual and the community do toward WASH and diarrhea	Exclude anything that is not related to knowledge	*Transectional Walk #2: 240-1, 244-5* *Transectional Walk #3:118-125,283-5* *Transectional Walk #4:115-6.* *Transectional Walk #5: 64-9, 74-8.* *Transectional Walk #6: 53-4,58-63, 91-3,99-102* *Transectional Walk #7: 96-99, 116-7, 161-2.* *Transectional Walk #8: 121-123.* *Transectional Walk #9: 80-81,96-109, 145-7*

					Transectional Walk #10; 27-34, 121-5, 130. *Transectional Walk #11; 138-46, 205-209.* *Transectional Walk #12; 52, 54, 61, 65-72, 77-79, 81, 83.* *Focus group#1;101, 188* *Focus group#2;288-9, 293-303, 314-6,322-32, 479-80* *Focus group#3;132-3, 135, 143, 172, 188, 213, 304, 325-8, 334, 337.* *Interview #2; 52, 56-70, 79, 81* *Photovoice #1; 36-7, 39-42, 44-6, 50-1, 58-9, 62-3,68-75, 346-56* *Photovoice #3;252-67, 317-9, 340-3,* *Photovoice #4;285-6, 386-8, 425-36, 442-50.* *Photovoice #5;36-7,44-5,* *Photovoice #6; 53, 63-7, 133-40, 145-50.* *Photovoice #8; 92-3, 96-7, 103-6, 458-67.*
	Hygiene attitudes	*Any* condition and attitude that help to maintain health and prevent the spread of diseases.	• Attitudes, that the individual and the community do toward WASH and diarrhea	Exclude anything that is not related to attitudes	*Transectional Walk #4; 137-8.* *Transectional Walk #5; 74-8.* *Transectional Walk #6; 91-3, 99-102.* *Transectional Walk #10; 37-38* *Transectional Walk #11; 54-6, 59-62, 64-9.* *Focus group#2;305-6* *Focus group#3;196-8,213.* *Interview #2; 52, 56-70, 79, 81* *Photovoice #1; 68-75*

					Photovoice #3: 317-9. Photovoice #7: 162,167. Photovoice #8: 364-5, 369-70, 372-3, 377-80, 458-67.
	Hygiene practices	Any condition and practices that help to maintain health and prevent the spread of diseases.	• Practices that the individual and the community do toward WASH and diarrhea	Exclude anything that is not related to practices	Transectional Walk #2: 344-5, 395-7, 400-1. Transectional Walk #3:126-139. Transectional Walk #4:115-6, 119,212-227. Transectional Walk #6: 53-4, 58-63, 91-3 , 99-102. Transectional Walk #7: 116-7, 155-8,161-2 Transectional Walk #8: 137-147, 178-185 Transectional Walk #9: 80-81,96-109, 150,157-160. Transectional Walk #10: 37-38 Transectional Walk #11:129-130, 138-46. Transectional Walk #12: 52, 54, 61, 65-72, 77-79, 81, 83. Focus group#1:535-7, 540-546, 550-1, 556-7, 564 Focus group#2:192-199, 202-203, 206-7, 210-228,235-6, 293-303, 339, 347-8 Focus group#3: 172, 188, 213, 280-6. Interview #2: 52, 56-70, 79, 81, 86, 115. Photovoice #1: 58-9, 62-3, 68-75. Photovoice #2: 221 Photovoice #3: 233-9, 245. Photovoice #5:36-7,41 Photovoice #6: 53, 63-7, 133-40, 145-50. Photovoice #7: 162,167.

					Photovoice #8: 80-3, 87-88, 92-3, 344, 364-5, 369-70, 372-3, 377-80, 458-67,
WATER ACCESS "Access to clean water"					
Clean Water Access	Wells	Wells at the community level	• How did they build them? • Who told them to build them? • When did they build them? • Is the water clean? • For what do they use they water for?	Exclude anything that is not related at the community level	*Transectional Walk #5: 80.*
	River	Populations relations with river water access (quality of water, changes in seasonality of the water, food)	• How Individuals directly/indirectly have ways to afford for river water for their basic needs. (bathing, cooking, drinking) • Relation with river • Perceptions towards the quality of the water (heat, sand, currents, fishes)	Exclude if they do not relate to the river	*Transectional Walk #2: 259-70.* *Transectional Walk #3:44-6, 65, 71-2.* *Transectional Walk #4: 64* *Transectional Walk #5: 115-120.* *Transectional Walk #8: 153-6.* *Transectional Walk #10: 47-60* *Transectional Walk #11: 172-92, 196-202.* *Transectional Walk #12: 48-50, 112-119.* *Interview #2: 110-113.* *Photovoice #1: 25,27-9, 50-1, 414-6.* *Photovoice #4: 172-3, 178-87, 192-202.* *Photovoice #5:17-27,,94-5, 104-9,228-232, 241* *Photovoice #7: 34-41, 79, 89,90, 136-8.*
	Ravines or water streams	Populations relations with river water access (quality of water, changes in seasonality of the water, food)	• How Individuals directly/indirectly have ways to afford for river water for their basic needs. (bathing, cooking, drinking) • Relation with ravines or streams	Exclude if they do not relate to the ravines or streams	*Transectional Walk #2: 319-325, 331-2, 337, 345.* *Transectional Walk #3:151, 155, 157.* *Transectional Walk #4:18-19, 64, 69-72, ,144-8.* *Transectional Walk #6: 44-46, 115-120.*

			• Perceptions towards the quality of the water (heat, sand, currents, fishes)		*Transectional Walk #7: 244-8.* *Transectional Walk #11:172-92, 196-202.* *Photovoice #1: 25,27-9, 446-51, 455-70* *Photovoice #5:17-27, 123-4, 132.*
	Water buckets	Buckets for carrying water	• Number of buckets in average per day • Number of buckets in average per day in droughts • Number of buckets in average per day in floods • Number of buckets in average per day per season	Exclude if they do not mention the word buckets	*Transectional Walk #2:68-82, 106-110.* *Transectional Walk #3: 179-180,187-188* *Transectional Walk #4: 30-30.38, 43-44.* *Transectional Walk #5: 21- 6, 50-7.* *Transectional Walk #6: 11-12.* *Transectional Walk #7: 206.* *Transectional Walk #8: 38-50.* *Transectional Walk #9: 17-20, 26, 29, 33-41, 52-53, 57-8.* *Transectional Walk #10: 62-65, 67* *Transectional Walk #11:113-118.* *Focus group#3:393-4, 399-402, 417-8, 424-5* *Photovoice #3: 114-24, 138-9, 142-62.* *Photovoice #4: 118-9, 123-8, 137-143, 151-62, 262-7.* *Photovoice #6: 87-110.* *Photovoice #7: 83-4, 89, 90, 92, 99-100, 111-12* *Photovoice #8: 175, 186-7, 202-4, 206-9, 213-4, 218-220.*
	Pozos	Pozos at the household level	• How did they build them? • Who told them to build them? • When did they build them? • Is the water clean?	Exclude anything that is not related at the household level	*Transectional walk #1: 18-25, 27-37, 41-47, 51-59,61-62, 64-67, 70-71, 76-78, 82-83, 90-95, 101-103* *Transectional Walk #3:37, 47-62, 155, 197-212.*

			• For what do they use they water for?		*Transectional Walk #6: 17-19.* *Transectional Walk #7: 20-23, 29-30,35-54,57-8, 64-66, 75-6, 81-4, 101-2.* *Transectional Walk #10: 179-184.* *Transectional Walk #11: 162, 165, 196-202.* *Transectional Walk #12: 52, 110-111.* *Focus group#1:164-8, 176-184, 188, 191-195, 503-6, 511-14, 517-18* *Focus group#2:72-74,66-80,94-111, 120-125, 237-248, 515-8.* *Focus group#3:57-9, 71-2, 87-92, 462-465, 472-4.* *Focus group#4:136-155,564-65.* *Interview #2: 50, 108-9.* *Photovoice #1: 270, 274-8, 282-95, 302-5, 309, 311-323, 329-340, 342-3, 346-56, 369-370, 375-8, 414-6, 419-21.* *Photovoice #6: 78-9.* *Photovoice #8: 80-3, 133-46, 227-234, 247-50, 254-55, 259-60, 267,293-4.*
SANITATION "Refers to the provision of the facilities and services for the safe disposal of human urine and faeces. Maintenance of hygienic conditions, through services such as garbage collection and wastewater disposal"					
Sanitation	Open defecation (OD)	The human practice of defecating outside—in the open. In lack of toilets or latrines, people use fields, bushes, forests, open bodies of water or other open space.	• Where do you defecate? • Bushes, forests, open bodies of water or other open space • Presence of faeces	Exclude if they use river defecation or latrines.	*Transectional Walk #3: 214-222.* *Transectional Walk #6: 109-112.* *Focus group#1:572-574* *Focus group#2:258* *Focus group#3:490*
	River defecation	The human practice of defecating in the river	• Where do you defecate? • River • Presence of faeces	Exclude they use open defecation or latrines.	*Focus group#1:71-74, 230-231, 576-82* *Focus group#3:501-8.* *Photovoice #1: 50-1.*

					Photovoice #8: 151-2, 162-3.
	Latrines	The human practice of defecating in latrines	• Where do you defecate? • Latrines	Exclude if they use open defecation or river defecation	*Focus group#2:253-257, 259-272* *Interview #2: 93-96*
HEALTH EDUCATION IMPARTED BY "Health education in health promotion and health prevention care"					
Health Education imparted by	Health Promoters & Health Post	Trained person in health promotion and preventive care working in the official public health sector	• How at the Individual/ community level they were thought about health promotion and prevention by an official health promoter	Exclude if they do not mention official health promoter from the ministry of health (posts)	*Transectional Walk #3:87-113.* *Transectional Walk #9:226-7, 233-4.* *Transectional Walk #10: 35-36, 204-14.* *Focus group#2:319* *Focus group#3:183-186, 192-4, 282-286, 289-292, 299-301, 304* *Photovoice #3: 245,249.* *Photovoice #5:59-65, 70-1, 75-6.* *Photovoice #8: 92-3, 96-7.*
	Non-Religious promoters	Trained person in health promotion and preventive care working for an NGO	• How at the Individual/ community level they were thought about health promotion and prevention by an NGO health promoter	Exclude if they do not mention health promoter from an NGO	*Interview #1: 473-487, 494, 497, 499-500*
	Religious promoters	Trained person in health promotion and preventive care working for a religious institution	• How at the Individual/ community level they were thought about health promotion and prevention by a religious institution	Exclude if they do not mention health promoter from an NGO	*Focus group#1:418-422* *Interview #1: 170-172, 177, 179-187, 201-203, 207-211, 213-217, 225-229, 239-250, 256, 260, 427-438, 442, 445-447, 449-456, 458-466, 468-9, 473-487, 499-500, 517-22, 524-542, 544, 820-6, 823-843, 856-9, 869-71, 876-83, 885-889, 896-7, 899-910, 919-22.*
	Non-specified	Person who gave knowledge in health promotion and preventive care.	• How at the Individual/ community level they were thought about health promotion and prevention by any outsider	Exclude if they mention health promoter from the official Ministry of health, an NGO, or any religious institution.	*Transectional Walk #6: 74-86.* *Transectional Walk #8: 178-185* *Focus group#1:188, 193-95* *Focus group#2:314-6*
WATER CULTURE & IDENTITY "How culture, identity and religion influences water relations"					

Water culture	Culture, Religion & Knowledge	How religion, culture and local knowledge influences water security	• Specify in what ways? • Specify risks and resilience • Specify differences between Shawi knowledge, evangelic religion and catholic religion.	Exclude if they do not explain the idea related to indigenous knowledge, religion and water security	*Transectional Walk #2: 395-7, 400-1.* *Transectional Walk #4: 177-188.* *Transectional Walk #5: 21-45* *Transectional Walk #7: 161-2.* *Transectional Walk #8: 112-117.* *Transectional Walk #10: 229-249* *Transectional Walk #11: 20-42.* *Transectional Walk #12: 27-47, 88, 90-91.* *Focus group#1:215-6, 254-5, 606* *Focus group#2:305-6, 532-42, 549-52,* *Focus group#4:49-61.* *Interview #2: 28-45.* *Interview #4: 285-288.* *Photovoice #1: 30-32, 446-51, 455-70, 475, 477, 479-99, 518.* *Photovoice #4: 315-330, 341-5.* *Photovoice #5: 230.* *Photovoice #7:197-8*
	Age (children, adults)	Who is in charge of water activities based on age?	• Specify in what ways? • Specify risks and resilience	Exclude if they do not relate to age	*Transectional Walk #3: 190-4.* *Transectional Walk #4: 43-4, 51-55* *Transectional Walk #5: 70-3.* *Transectional Walk #6: 44-46.* *Transectional Walk #9: 208-12, 291-6, 310-313, 319-20, 330-31, 335-6.* *Transectional Walk #10: 126-7.* *Transectional Walk #12: 163-4* *Focus group#1:239-43, 248-50, 254-259, 295-6, 299-301, 305-309, 484-491* *Focus group#2:322-32, 347-9* *Focus group#3: 168.* *Interview #2: 54-57, 162-4.*

					Photovoice #4:289-90, 296-7, 301-313, 315-330 *Photovoice #6: 63-7,* *Photovoice #7: 83-4, 89, 90, 99-100, 124-6, 197-8* *Photovoice #8: 188-189, 275-82, 397-99, 403-4,409-9,*
	Gender	Who is in charge of water activities?	• Who is in charge of water activities based on gender	Exclude if they do not relate to gender	*Transectional Walk #4: 43-4, 51-5* *Transectional Walk #7: 186-196,* *Focus group#1:484, 491, 500* *Focus group#2:144-148* *Focus group#3:399-402, 411-414* *Interview #2: 46-46, 54-57,* *Photovoice #4: 315-330*
	Beverage	Masato	• How is the process? • Who is in charge? • Do they boil the water? • Do they macerated it?(alcohol process)	Exclude if they relate to any other beverage	*Transectional Walk #7: 125-133, 138-148, 155-8,* *Transectional Walk #8: 137-147, 170-173,* *Transectional Walk #9: 130-133, 136-7, 140-3, 145-7, 164-8,* *Transectional Walk #10: 41-46, 221-7,* *Transectional Walk #11: 133-4, 148-54,* *Transectional Walk #12: 45-7,* *Interview #2: 28-45,86, 88-89,* *Photovoice #1: 30-32, 68-75, 423-26, 429, 432-36,* *Photovoice #2: 198-206, 216-8, 221* *Photovoice #3: 129-135,* *Photovoice #4:96-98, 260-83, 399-412,* *Photovoice #5:17-27,* *Photovoice #6: 133-40, 145-50,* *Photovoice #7: 34-37, 39-41,* *Photovoice #8: 50-1, 57-60, 62-5, 74-6,*

					175, 356-61, 364-5, 369-70, 372-3, 377-80, 397-99, 403-4.
	Local Healers	"Any person who uses long-established methods passed down from one healer to another to treat a person suffering from various illnesses, many of which have psychological underpinnings". (WHO)	• Specify the person • Specify vulnerable groups who are attended • Specify possible diseases • Specify resilience	Exclude if they do not relate to a healer definition	*Focus group#1:323, 586-591* *Focus group#2: 202-203, 206-7,210-228,235-6.*
	Attitudes & Practices (Point of view, Positionality)	What is the positionality towards water policies for their community?	• If they were local leaders what Attitudes & Practices would they take towards water safety	Exclude if they do not relate to the river	*Transectional Walk #1:202-204* *Transectional Walk #10: 195-8, 201-202.* *Transectional Walk #11: 216-18.* *Transectional Walk #12: 95-98* *Focus group#2: 237-348* *Focus group#3: 427-458* *Interview #1: 92-110, 120-122, 124-133, 134-6, 138-150, 152-159, 179-187,192-194, 196, 199, 201-203, 207-211, 213-217, 225-229, 239-250, 256, 260, 504-512, 514-5, 524-542, 544, 546-551, 561-585, 598-599, 601-602, 613-621, 626-637,639-40, 642-8, 654-56, 658-665, 670-3, 677, 681-7, 692-706, 708-714, 722-26, 729-732, 741-5, 750-1, 753-4, 756-8, 760-70, 783-9, 939-45.* *Interview #4: 70-72, 83-95* *Photovoice #1: 196-7*
PERCEPTIONS OF WATER QUALITY "Physical dimension of overall drinking water, wellbeing and quality perceived"					
Water quality	Clean or Dirty	What is their perceptions?	• Individual makes direct/indirect	Exclude if they do not explain the idea related	*Transectional Walk #2:140-141, 193-4, 209, 223-4, 229-234, 292-94.*

			reference the source of water is clean or dirty	to clean or dirty, health and water	Transectional Walk #4:95-99, 151-6. Transectional Walk #5:58-63. Transectional Walk #6: 24-8, 31-33, 38-9. Transectional Walk #7: 20-23,223-4. Transectional Walk #8: 55-6. Transectional Walk #9: 111-112,186-7. Focus group#1: 381-385 Focus group#2:71-74, 230-231, 576-82 Photovoice #1: 414-6. Photovoice #3: 172-3, 176-7. Photovoice #4:44-57, 229-31. Photovoice #5: 114-5. Photovoice #6: 87-110. Photovoice #7: 67-8, 124-6. Photovoice #8: 243-50, 254-55, 335-40.
	Color, odor, taste of water	What is their perceptions?	• Individual makes direct/indirect reference to the color of the source of water • Individual makes direct/indirect reference to the odor of water • Individual makes direct/indirect reference to the taste of water	Exclude if they do not explain the idea related to color, health and water Exclude if they do not explain the idea related to odor, health and water Exclude if they do not explain the idea related to taste, health and water	Transectional Walk #4:103-4, 107-111, 120-1. Transectional Walk #9: 124-8. Transectional Walk #10: 75-82, 95. Transectional Walk #10: 71-74 Focus group#3: 159,161-2 Photovoice #2: 172-3, 176-7, 221-22. Photovoice #4:44-57, 205-12, 216-25, 234-7, 239-50. Photovoice #5:56 Photovoice #6: 80-1.