

NADI FILTER

LOCALLY INNOVATED, INTERNATIONALLY REWARDED

*Safe Drinking Water for Developing
Countries*

Scoping Study



Authors:
A. Khurshid Bhatti
Habibullah Khaskheli

**ASSOCIATION FOR HUMANITARIAN
DEVELOPMENT**

A Step Towards Sustainable Development

TABLE OF CONTENTS

| | |
|--|-----------|
| Preface | 3 |
| Acknowledgements | 4 |
| 1. Problem | 5 |
| 1.1. Water Scarcity..... | 5 |
| 1.2. Water Contamination | 6 |
| 1.3. Health Hazards due to Unsafe Water | 7 |
| 1.4. Water Storage..... | 8 |
| 1.5. Expanding Gaps to Access..... | 9 |
| 2. Need | 10 |
| 2.1. Solution for Drinking Water..... | 10 |
| 2.2. Cost Effectives and Acceptability..... | 11 |
| 2.3. Universal Pertinence..... | 10 |
| 3. The Solution..... | 12 |
| 3.1. Revival to Antiquity – Clay Pots | 12 |
| 3.2. Why to Choose the “Nadi Water Filter”..... | 14 |
| 3.3. Effects of Drinking Water from Nadi Filter | 17 |
| 3.3.1. Health & Nutrition..... | 18 |
| 3.3.2. Education & Gender..... | 19 |
| 3.3.3. Poverty | 20 |
| 3.3.4. Environment | 21 |
| 3.4. International Recognition | 22 |
| 4. Global Adaptation of Nadi Filter | 22 |
| 5. Outcome and Scalability | 22 |
| 6. Endorsements of AHD Nadi Filter/Safe Drinking Water Initiative | 23 |
| 7. FAQs | 25 |
| 8. References | 27 |

Preface

I feel pleasure to share scoping study of AHD Nadi Filter - a nature-based solution to all of you. As the year 2023 has ended with challenges of war, disasters and economic crisis and the world poverty index for poor and developing countries has increased rapidly.

I remember the year 2005, the news in the papers wrote about the death of 500 children due to gastro/diarrhea in Civil Hospital Hyderabad in Sindh, Pakistan. That was the time my inner self forced me to think for a solution of safe drinking water and save the dying children from waterborne diseases. AHD team started thinking and searching about safe drinking water and came to know that Bio-sand filters are available all over the world and they are used in Europe, Africa and Asia, but the solution of 100% safe and clean drinking water was not in it.

During the year 2006, AHD started one Nadi Filter in Jati, district Sujawal, Sindh; the result for safe drinking water was quite encouraging; and we decided to install 10 more Nadi Filter units in 2007. Repeatedly, AHD installed 100 Nadi filter units in the same area.

Mr. Tarim Waseem, CEO ADP - USA along with his team visited Jati and saw AHD installed Nadi Filters providing safe drinking water to the rural people. He approved 100 additional Nadi Filters. AHD morale went high, and we started promoting Nadi Filter as sole source for safe drinking water and prepared this video message to promote it further:

https://www.youtube.com/watch?v=AuNu_xOWUE0&t=10s

After watching this video, the Oxfam GB team visited AHD and selected Nadi Filter for its research project. Oxfam GB conducted research on 100 Nadi Filter units and after six months research results informed that 80% to 98% biological contamination is removed from Nadi Filter water and it is fit for drinking purposes, that research is available at AHD website.

Now, after a span of 20 years, Nadi Filter has emerged as an AHD brand, and it is introduced in different parts of the world. AHD has its own laboratory as well, but other laborite's tests have also proved that AHD Nadi Filter 100% fit for drinking purposes. The recent lab test result of the year 2022 by PCSIR could be referred to at AHD website.

Now the time is to replicate the AHD Nadi Filter on a mass scale and end the crisis of drinking contaminated water by rural and peri-urban communities in the developing countries. We assure, AHD Nadi Filter water is better than drinking bottled water.

Dear Humanitarian organizations this is time to give relief to rural poor communities of Pakistan and in Asia and Africa and we are very happy to share that Nadi Filter we installed in the year 2006, those families are still using at the time, I have written this note.

I Hope you all go through this Scoping Study and promote it in rural and semi-urban vulnerable and indigenous groups and help them to equip with skills for installation of Nadi Filter technology; so that they can use this filter for longer term to keep their families safe.

We will be happy to share more if needed.

Abdul Khurshid

President/CEO AHD Pakistan



Acknowledgements

We herewith acknowledge the efforts and contributions of people who have been actively part of this scoping study and extensively shared their views about Nadi Filter with study team.

From AHD team they include Miss Anita Ishaq for providing project documents and database which facilitated us in desk review of AHD Nadi Filter projects and facilitated us to reach field locations throughout this scoping study. We acknowledge support of Mr. Abdul Khurshid Bhatti, CEO/President and Mr. Habibullah Khaskheli, Executive Director of AHD, who supported and facilitated for this study at all levels. Apart from that we are thankful to Miss. Sheza Kanwal, who coordinated for key informant interviews, without her support it was not possible to reach them. Respectively, we are thankful to the Sujawal based AHD team who supported in data collection for this study.

We are extremely thankful to Ms. Mary Conley Eggert, Co-Executive Director, Global Waterworks, Mr. Azhar Qureshi Founder/CEO ECO Conservation Initiative Pakistan, Ms. Alina Pelka, President & Founder YORGHAS Foundation, Mr. Saif UR Rehman Memon, Branch Manager, JS Bank Hyderabad, Sindh, Mr. Karsten Gjeffe, Senior Advisor, International Development, Norges vel, Mr. David A Dodd - Sustainable Resilience Consultant USA, and Mr. Randy Shaw, PE Retired Manager of the Brackish Groundwater National Desalination Research Facility, USA for their comments about AHD Nadi Filter and the appreciation and support of incredible work AHD is doing in providing safe drinking water to the communities around the world.

Lastly, we are thankful to the AHD support team who took care of our lunches and we are thankful to the drivers who drove carefully to get us back to write this scoping study report.

1. Problem

1.1 Water Scarcity:

Water covers 70% of our planet, and it is easy to think that it will always be plentiful. However, freshwater—the stuff we drink, bathes in, irrigates our farm fields with—is incredibly rare. Only 3% of the world's water is fresh water, and two-thirds of that is tucked away in frozen glaciers or otherwise unavailable for our use. As a result, some 1.1 billion people worldwide lack access to water, and a total of 2.7 billion find water scarce for at least one month of the year. Inadequate sanitation is also a problem for 2.4 billion people—they are exposed to diseases, such as cholera and typhoid fever, and other water-borne illnesses. Two million people, mostly children, die each year from diarrheal diseases alone. Many of the water systems that keep ecosystems thriving and feed a growing human population have become stressed. Rivers, lakes and aquifers are drying up or becoming too polluted to use. More than half the world's wetlands have disappeared. Climate change is altering patterns of weather and water around the world, causing shortages and droughts in some areas and floods in others. At the current consumption rate, this situation will only get worse. By 2025, two-thirds of the world's population may face water shortages. And ecosystems around the world will suffer even more.¹



According to the UN Waters 02 billion people (26% of world population) lacked safely managed drinking water in 2020. Globally 44% of household wastewater was not safely treated in 2020. Over 03 billion people do not use quality water they are at significant risk because the health of rivers, lakes and groundwater is unknown. And 2.3 billion people live in water stressed countries; out of which 733 million live in high and critically water stressed countries. And 107 countries are

not at track to have sustainably managed water resources by 2030².

¹World Wide Fund - <https://www.worldwildlife.org/threats/water-scarcity>

²United Nations - Water - <https://www.unwater.org/>

1.2 Water Contamination

We have learnt that water covers 71% of earth's surface. And of that 97% of the earth's water is found in the oceans, which is too salty for drinking, growing crops, and most industrial uses except cooling. And only 3% of earth's water is fresh. Coming to the figures about facts of water has informed that 2.5% of the earth's fresh water is unavailable because it is locked up in glaciers, polar ice caps, atmosphere, and soil; highly polluted; or lies too far under the earth's surface to be extracted at an affordable cost. And 0.5% of the earth's water is available fresh water.³

According to National Geographic Society 'Only about three percent of Earth's water is fresh water. Of that, only about 1.2 percent can be used as drinking water'. Globally, over 3 billion people are at risk of disease because the water quality of their rivers, lakes and groundwater is unknown, due to a lack of data. "Our planet is facing a triple crisis of climate change, biodiversity loss and pollution and waste. These crises are taking a heavy toll on oceans, rivers, seas and lakes," said UNEP Executive Director Inger Anderson. Historically, there has been little data on the global state of freshwater ecosystems. Researchers surveyed more than 75,000 bodies of water in 89 countries and found that more than 40 percent were severely polluted.⁴

We know that 'water pollution affects drinking water, rivers, lakes and oceans all over the world. This consequently harms human health, wildlife and the natural environment. According to the NIEHS, water pollution is any contamination of water with chemicals or other foreign substances, such as fertilizers and pesticides from agricultural runoff, sewage and food processing waste, lead, mercury and other heavy metals, chemical wastes from industrial discharges, and chemical contamination from hazardous waste sites, that are detrimental to human, plant or animal health. Polluted, unsafe water is the leading cause of sickness and death with half of the world's hospital beds filled with people suffering from water-related illnesses.⁵



1.3 Health Hazards due to Unsafe Water

Contaminated water and poor sanitation are linked to transmission of diseases such as cholera, diarrhea, dysentery, hepatitis A, typhoid and polio. Absent, inadequate, or inappropriately managed water and sanitation services expose individuals to preventable health risks. Some 1 million people are estimated to die each year from diarrhea as a result of unsafe drinking-water, sanitation and hand hygiene. Yet diarrhea is largely preventable, and the deaths of 395 000 children aged under 5

³United States Bureau of Reclamation - <https://www.usbr.gov/mp/arwec/water-facts-ww-water-sup.html>

⁴United Nations Environment Programme - <https://www.unep.org/news-and-stories/story/globally-3-billion-people-health-risk-due-scarce-data-water-quality>

⁵ Everything Connects – Why Nature Matters - <https://www.everythingconnects.org/water-pollution.html>

years could be avoided each year if these risk factors were addressed.⁶As per our world in data.org, in the year 2019, Pakistan had 4.8 percent share of deaths due to unsafe drinking water, which is more than countries in Africa: Kenya - 4.7%, Mauritania- 4.7% Cameroon -4.6% Tanzania – 04.1%, Congo 04% Zambia -3.8%, Zimbabwe -03%, Mozambique -2.6%⁷

Pakistan's availability and quality of water is feared to present with many complications. There have also been many threats to Pakistan's public health due to water sanitation and hygiene problems as the risks for waterborne disease exponentially increases. In Pakistan; 50% of the country's diseases and 40% of deaths occur due to consumption of contaminated water. Pakistan is severely challenged at an economic level as poor water sanitization has costed around 343.7 billion PKR (1.5 billion USD) in 2019.⁸



In December 2015, the federal minister for science and technology said that 82pc of Pakistanis consume dirty water⁹. At least 77 percent of the water in 14 districts of Sindh was found to be unsafe for human consumption.¹⁰In rural and urban areas of Pakistan, cases of waterborne diseases, typhoid, dysentery, cholera, and hepatitis are systematically reported. In Peshawar, most of water samples were found to be contaminated with coliform bacteria. In Karachi, it was also found that the drinking water samples were heavily contaminated with total and fecal coliform. In Khairpur, a city of 0.12-million population, water quality seems to be poor and therefore could be a potential source for waterborne diseases especially among children. In Islamabad and Rawalpindi, 4000 cases of hepatitis were registered and were due to unfit drinking water and improper treatment.¹¹

Unsafe drinking water is a major cause of the disease, which otherwise may be prevented, in particular in young children in developing countries. Pathogens present in drinking water including many viral, bacterial, and protozoan agents caused 2.5 million deaths from endemic diarrheal disease each year. Major health problems were reported as gastroenteritis (40%–50%), diarrhea (47%–59%), dysentery (28–35%), hepatitis A (32%–38%), hepatitis B (16%–19%), and hepatitis C (6-7%) by respondents. In southern Sindh, waterborne diseases such as diarrhea, vomiting, gastroenteritis, dysentery, and kidney problem are caused by polluted drinking water.¹¹

1.4 Water Storage

⁶World Health Organization (WHO) - <https://www.who.int/news-room/fact-sheets/detail/drinking-water>

⁷ Our World in Data - <https://ourworldindata.org/clean-water>

⁸ Science Direct - <https://www.sciencedirect.com/science/article/pii/S2049080122014698#bib4>

⁹ DAWN Newspaper - <https://www.dawn.com/news/1276429>

¹⁰DAWN Newspaper - <https://www.dawn.com/news/1345508>

¹¹National Center for Biotechnology Information – National Library of Medicine- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5573092/>

Generally, it is observed people store water in plastic vessels/pots. Because, the plastic pots and vessels are durable, easy to carry, light in weight, and easily available everywhere on the stores, people prefer to use plastic bottles, jerry cans, and tanks for water storage. But it is found that plastic bottles are not easily cleanable due to their design, and multiple chemicals, which are of low quality are used in manufacturing them may cause health complexities when kept in health. According to cleanwater.org 325 average numbers of plastic particles is in a liter for the water sold, and 93% of bottled water sold has plastic particles.¹²

In fact, our kitchens are replete with plastic bottles, jars, containers, utensils, garbage bags etc. and their usage is increasing at an alarming rate. But many researchers have informed that plastic produces Dioxin, when it is exposed to the sun, and Dioxin can accelerate breast cancer. Along with that the Biphenyl A is an estrogen-mimicking chemical that can lead to a lot of health problems like diabetes, obesity, fertility problems, and behavioral problems and early puberty in girls. Along with this, plastic affects immune system; the chemicals from plastic bottles are ingested and tend to disturb our body's immune system. Apart from this liver cancer and reduced sperm count are also reported due to presence of a chemical called phthalates in plastics¹³. Recently in 76th World Health Assembly WHO in its agenda 04 has suggested to 'continue to provide technical support to countries, in particular developing countries, upon request, to build capacity to conduct science-based assessments and research, including on the association of pollution from plastics, including micro plastics, as well as cadmium, arsenic, lead, agrochemical pesticides, among others, with known health effects, in order to inform the development of public health policies and support the strengthening of health systems in this area¹⁴.



It's better not to store and drink water from a plastic bottle. Plastic water tanks can only be considered a good alternative for ceramic or cement water tanks if they were resistant to heat and Ultraviolet (UV) rays and manufactured from non-toxic material that does not affect the odor and taste of water. The plastic tanks and bottles available in the market today are mostly manufactured from Polyethylene (PE), Polypropylene (PP), Bisphenol (BPA), High Density Polyethylene (HDPE), Polyethylene Terephthalate (PET) and cross-linked Polyethylene (PEX), or Thermoplastic Polymer, which have very well-known health risks for end users. Bill Brown, an Australian journalist, reported of the research carried out by the Department of Public health, Government of Western Australia that plastic tanks are causing copper poisoning due to the corroding of water pipes attached to these plastic tanks. Rainwater mixes with the drinking water in the tanks left open, and the naturally acidic rainwater then reacts with the copper pipes and that contaminated water moves into the drinking water taps in the households.¹⁵

1.5 Expanding Gaps to Access

¹² Clean Water - <https://cleanwater.org/2020/07/29/bottled-water-human-health-consequences-drinking-plastic>

¹³ INDIA.DOT COM - <https://www.india.com/lifestyle/5-harmful-side-effects-of-drinking-from-plastic-water-bottles-5116887/>

¹⁴ World Health Organization (WHO) The impact of chemicals, waste and pollution on human health. SEVENTY-SIXTH WORLD HEALTH ASSEMBLY Agenda item 16.3, A76/A/CONF./224 May 2023

¹⁵ DAWN Newspaper - <https://www.dawn.com/news/1173628>

Although we have seen the progress, in the provision of safe drinking water 'but there are still around 2 billion people around the world without access to safely managed drinking water service. People with low access to drinking water services are concentrated in Sub-Saharan Africa. In 2020, only 64% of the population living in Sub-Saharan Africa had access to at least basic drinking water services, compared with more than the population from the other six regions'¹⁶.

An international pledge to ensure that the entire world's population has access to safe drinking water by 2030 is woefully off track. 80 percent of the world's waste water flows back into the environment without being treated or reused. Consequently, at least 2 billion people use a source of drinking water that is contaminated with feces, which puts them at risk of contracting various diseases, such as cholera. The global urban population facing water shortages is projected to increase from 933 million people in 2016 to 2.4 billion people in 2050.¹⁷



2. Need

2.1 Solution for Drinking Water

During the year 2005, AHD witnessed death of 500 children due to gastro/diarrhea in Civil Hospital Hyderabad in Sindh, Pakistan. AHD being present in Hyderabad, felt liability to support local people to prevent from waterborne disease. This was the time AHD kept on learning and exploration for sustainable solution for safe drinking water for the people in Pakistan. The organization came through a solution for safe drinking water in the year 2006.

Nevertheless, AHD found a solution for drinking water, but scale of the need, year by year was touching alarming numbers, the drinking water contamination, water infrastructure, water preservation was already a challenge to public sector; the repeated flood emergencies added more woe in the voices of



¹⁶ The World Bank – Blogs -<https://blogs.worldbank.org/opendata/world-water-day-two-billion-people-still-lack-access-safely-managed-water>

¹⁷ New Scientist Magazine -<https://www.newscientist.com/article/2365541-around-2-billion-people-dont-have-access-to-clean-drinking-water/>

people. According to the health department data, a total of 891,915 cases of diarrhea were recorded in the province in the year 2022.¹⁸ And this remind unchanged, research published by National Library of Medicine in the year 2023 writes; ‘in Pakistan, a country of over 225 million, 60% of infant and child deaths are caused by diarrhea. Children under 5 comprise of only 15% of the population, yet make up 50% of the mortality rate. However, Pakistan has the highest ratio in Asia for infant mortality from diarrhea. The World Health Organization (WHO) has ranked Pakistan 23 in terms of childhood mortality caused by diarrheal illness, with almost 6.4 million cases of pediatric diarrhea annually.’¹⁹

AHD objectively planned to contribute to safe drinking water limit waterborne diseases in Pakistan through its sustainable solution for drinking water. The organization has been witnessing massive funding on WASH sector, but as per reports 85% of Pakistani people do not have access to safe water, and the data reports that we are still behind many African countries. There are challenges to manage WASH sector, probably funding is not only issue, we could see in the year 2021–22, WASH sector financing from international donors totaled PKR 37.5 billion (USD170 million).²⁰

2.2. Cost Effectives and Acceptability

The safe drinking water solution, which is cost effective and acceptable to every developing nation has been challenge, AHD has learnt. Various solutions are tested, recommended by leading international organizations and UN Agencies for developing countries, but acceptability of all has been under questions owing multiple questions related to cost, context, availability, adoptability and maintenance.

‘Most filters contain activated carbon to capture contaminants, which can be used in pitchers, refrigerator dispensers, faucet attachments or systems installed under the sink. Activated carbon is good at removing many chemicals and metals but not all (it doesn’t capture nitrate, for example), and it cannot filter out most bacteria.’²¹

In developing countries multiple types of water filters are adopted some of them include chlorination process, solar disinfection (SODIS), bio-sand filtrations, ceramic filters, slow sand filters, and membrane filtration.

Bio-sand is one of the simplest filtration systems to use since it requires little knowledge to prepare/install/use. The only requirements are to change the top layer of sand periodically and know how to pour the water over the sand. The products needed for bio-sand filtration can be made locally, at a low cost and they have a long-life span. The bio-sand filtration filters out not only pathogens such as bacteria and protozoa, but can also filter out inorganic materials that can make water turbid. About 81–100% of bacteria and protozoa are filtered out on average²².

Several different varieties of ceramic based water filters that prevent water borne diseases have existed on the market over the past years. However, these filters have limitations in terms of either delivering a sufficient flow rate, cost, market acceptance, fragility and most important scale, reach and sustainability. The primary function of the water filter is to provide safe and clean water for domestic use. The person using the filter has to know how to operate it correctly so as to get safe and clean water.

AHD has been promoting bio-sand water filter through Nadi (clay pitcher), which in comparison to all other types of water filters is safe. Because as discussed above the water filters which use plastic bottles are also hazardous for health.

2.3 Universal Pertinence

¹⁸ DAWN Newspaper - <https://www.dawn.com/news/1712930>

¹⁹ National Center for Biotechnology Information – National Library of Medicine- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9811062/>

²⁰ Water for Women Fund - <https://www.waterforwomenfund.org/en/learning-and-resources/resources/KL/Publications/Climate-Financing-for-WASH-Pakistan-Web.pdf>

²¹ The New York Times- <https://www.nytimes.com/2023/05/30/well/live/water-filter-bacteria-pfas.html>

²² Journal for Public Health and Emergency - <https://jphe.amegroups.org/article/view/4741/5523>

AHD while working on innovation of water filters expanded its canvas to come up with the safe drinking water solution which is appropriateness to all the people, contexts and cultures especially in developing countries around. AHD adopted clay water pitcher for water filtration by selecting bio-sand process; because clay pots have been used for water and food for centuries in the world, they are proved safer sources for storing water and food through many researches in the modern times as well. And at the same time clay is available everywhere in the world to make pitchers, and also sand is part of our land everywhere in the world.

AHD's bio-sand water filter through Nadi is a landmark innovation which is detailed in the next chapter of this document.

3. The Solution

3.1 Revival to Antiquity – Clay Pots

Clay supports life on Earth. It provides physical support to plants and holds water, which in turn retains nutrients to support growth. Clay itself can also retain nutrients that can be retrieved as needed by plants and microorganisms. Legends around the world claim that life itself emerged from clay. These include the Jewish tradition of the Golem, an anthropomorphic being made of clay or mud; the Greek god Prometheus, believed to have created humans from clay; and the Sumerian god Enki.²³ Respectively the Qur'an describes how Allah created Adam: "We created man from sounding clay, from mud molded into shape..." (15:26). and, "He began the creation of man from clay, and made his progeny from a quintessence of fluid" (32:7-8). Thus, human beings have a fundamental attachment to the earth²⁴.



Clay pot making or pottery is an ancient art form that is as old as mankind. Prevalent in various civilizations, clay pots were invented when early humans transitioned from a nomadic to an agrarian culture. Pottery in the Indus Valley Civilization which dates back approximately between 3300 BC to 1500 BC. Also, known as Harappan Civilization, it was a popular trading center located close to the Indus River. To store and carry everyday commodities, various kinds of pots and utensils were manufactured and sold. Egyptians who were excellent artisans were one of the earliest to create high-quality pottery, (around 1500 BC).²⁵ And in these challenging times, it's perhaps no surprise that pottery is booming.²⁶ People have learnt benefits by using clay for water, food and environment, because clay pots:

- **Maintain the pH balance in the body**

The human body is acidic; meanwhile, the clay pot is alkaline in nature, so the combination of the two results in creating a balanced pH level in the body. Controlling intake into the body plays a huge role in balancing the body's pH to prevent the development of various viral or bacterial diseases. When the body's pH level is clinically trying from the standard pH balance (7.35-7.45),

²³ Clay Ground Collective - <http://www.claygroundcollective.org/clay-in-common/>

²⁴ Northern Arizona University - <https://www2.nau.edu/~gaur/bio301/content/iscrst.htm>

²⁵ Kulture Street – Blogs - <https://kulturestreet.com/blogs/blog/the-historic-significance-of-clay-pot-usage>

²⁶ BBC - <https://www.bbc.com/culture/article/20210428-why-the-slow-mindful-craft-of-pottery-is-booming-worldwide>

the body can experience various possible health problems. Especially if the body has a high acidity level, it can affect the ability to circulate oxygen throughout the body, resulting in fatigue and decreased immunity.

- **Increase Metabolism**

Metabolism is the chemical processing in our body by nutrients absorbed by the body and converted into energy. Metabolism is needed to maintain the health of body tissues. Drinking water stored in a clay pot will maintain testosterone levels in the body, which is known to be very good at supporting metabolism.

- **Refreshing Our Body**

Consuming water in the heat of summer or during strenuous activities can refresh the body. However, in some situations, the temperature of the water also affects the sensation of freshness. The clay pot surface generally has pores that allow the evaporation process to store drinking water. This process gives a cold sensation to the water so that it can refresh the body, especially when we have a sunstroke in the summer; making a clay pot a solution to improve your drinking experience at a low cost.

- **Filter out Impurities in Drinking Water**

The surface with microscopic pores on the clay pot is not only used for air circulation. Several types of clay pots are used as clay-based water filters. The surface covered with microscopic pores is intended to filter drinking water from various dissolved substances that are harmful to the body. Water will seep through the pores in the clay filter, which is then accommodated in a container for daily consumption.²⁷

- **Nutrient-Rich Food**

Cooking with terracotta utensils help to maintain the nutritional value of the food. In addition, low heat cooking, which is recommended with terracotta products, ensures moisture without adding extra water, providing a superior flavor to your food.

- **Less Oil Usage**

It has the quality of being a natural absorbent. Clay pots will naturally retain the oil and moisture of food, so you do not have to add extra oil to keep your food moist, resulting in a healthier cuisine.

- **Provider of Minerals**

Iron, phosphorus, magnesium, and various other minerals can be found in clay pots, which are essential for human health. Clay is also alkaline, so it works to neutralize the acidity in food, making it simpler to digest.

- **Life-Saver for Plants**

Clay pots are absorbent, which might benefit those interested in gardening. As water evaporates quickly through these pores, plants survive longer, particularly plants that prefer dry soil.

- **Eco-Friendly**

Since they are essentially formed of soil, they disintegrate swiftly, making them better for the environment. Unlike utensils made of other products, terracotta vessels naturally decay without harming the environment. Investing in high-quality terracotta will pay off in the long run. At graamyam.com, you can find some outstanding terracotta products that are both economical and convenient²⁸.

“I am Mrs. Mehboob Zadi from Mattiari District, Sindh Pakistan. After using Nadi filter water, our lives have become very good; my children are safe from various diseases, and because of this, we don't need to spend our money on medicines. We are living a healthier life now, thanks to AHD for providing us with the Nadi filter technology.”

²⁷<https://www.terrawaterindonesia.com/post/drinking-water-from-a-clay-pot-is-it-healthy-or-outdated>

²⁸<https://graamyam.com/the-incredible-benefits-of-using-terracotta-products/>

3.2 Why to Choose the 'Nadi Water Filter'



AHD has been promoting Nadi (clay pitcher) Filter for safe drinking water around in the world. The organization has explored this solution for safe drinking water almost 20 years ago, keeping in view the children's deaths from waterborne disease in Pakistan. AHD has invested its time and efforts for the research to find Nadi Water Filters; which has appeared to be 'sustainable solution' for safe drinking water for the people in developing countries.

Over the time various scientific researches, laboratory tests have been conducted throughout world to look into the quality of drinking water used in multiple type of filters. Every research has identified many pros and cons for different filters and water storage vessels/pots either made by clay, plastics, concrete, steel and copper. AHD within its approach, practicality and research have finalized clay pitcher (Nadi) for water filtration purpose.

We have learnt that 'ceramic filters, whether produced commercially by companies in the developed world or by local potters in developing

countries, have been shown to be effective in removing bacteria, in particular, *E. coli*, and larger organisms such as protozoa and helminthes, and in reducing the incidence of diarrhea among users. However, they are not very effective for virus removal'²⁹.

Not only this but 'for the first time under pressure clay pots were used as a water filter. Some other researches (AIIT, 2002; Rebecca, 2002; Kowalski, 2003) showed that clay pot (ceramic filter) had an excellent efficiency for removing of turbidity and microbial indicators'³⁰.

AHD has gone multiple investigations to finalize Nadi – the clay pot for water filters. These researches are carried out in many parts of world including Asia, Africa, America and Europe. However, AHD has been claiming that through Nadi Filter 'reduces less than 1, faecalis coli form reduced by 95-100%, often landing a little over 99%, viruses are usually reduced by 100%, the level of organic material purified is lowered by 60-75%, iron and magnesium are largely removed, and the level of heavy metals is reduced anywhere from 35-95%. What this is saying is that within a day you can build a filter that will give you some very clean water with fewer parasites, viruses, bacteria and chemicals then what you would normally drink'³¹.

Whereas some researchers are carrying out the removal of arsenic through clay pot filters. 'The results suggest that the designed test filter has a significant potential for removing arsenic concentrations to below both WHO and EPA drinking water standards. In addition, the clay pot filter alone demonstrated substantial reduction in the concentration of arsenic. Further research must be done to investigate longevity and practicality of the test filter, and to explore the extent to which reduction in arsenic concentration is attributable to the additional bone char layer versus the clay pot filter. Our research team aims to continue investigating the new design to maximize removal of arsenic, other harmful metals, and bacteria. Further development will also include

²⁹Maggy NB Momba, Department of Environmental, Water & Earth Sciences, Tshwane University of Technology and Gordon Nameni, University of Illinois, Urbana-Champaign, USA, Development of A Prototype Nanotechnology based Clay Filter Pot To Purify Water For Drinking And Cooking In Rural Homes. WRC Report No. KV 244/10, ISBN 978-1-4312-0003-0, August 2010,

³⁰K Naddafi AM Mahvi, S Nasser, M Mokhtari, H Zeraati - Evaluation of the Efficiency of Clay Pots in Removal of Water Impurities. Dept. of Environmental Health Engineering, School of Public Health, Tehran University of Medical Sciences, Iran, Dept. of Epidemiology & Biostatistics, School of Public Health, Tehran University of Medical Sciences, Iran. Iranian J Env Health Sci Eng, 2005, Vol.2, No.2, pp.12-16.

³¹Hydrate Life - <https://www.hydratelifelife.org/the-nadi-filter/>

finding the optimal pore size and surface area for maximum arsenic adsorption to the bone char layer and the clay pot itself. Given the variance in manufacture methods of different communities producing the clay pot filters, identifying physical characteristics that result in optimal arsenic adsorption can help promote best practices for improving the effectiveness of the filters.³²

AHD, while knowing the fact has promoted Nadi Filter for the people in developing countries. Because poor people in these countries do not have access to the safe drinking water which corresponds to their environment and atmosphere. Mostly, in current times due to climate change global heat index has been enhancing and people need to drink cool water. And access to cool water is related with electric/solar energy gadgets which cost more for the poor people in these countries. AHD Nadi filter keep drinking water cool without any cost. AHD is informed that 'for generations that water kept in clay pots remains cool and clear... The factors that contribute to cooling of water in a clay pot, rate of cooling, evaporation rate and enthalpy drop with time. Three clay pots filled with water were used for the investigation. They were kept in three different environments of sand, concrete and tiled floors. It was observed that, within 16hrs, the volume by 3 liters, average enthalpy difference in 16hrs stands at 21.5KJ/Kg and average enthalpy reduction rate is 1.375KJ/Kg/hr. Again, at about 18oC the water seems to show some latent heat properties, with reduction in enthalpy without visible reduction in temperature.³³

AHD has been using pure clay pot and sand for water filtration. Both are natural ingredients and do not have any negative effects on human health. However, in some countries clay pots are made with other material for water filtration. As this study from Thailand says: 'The clay pots were prepared by combining clay with sand, coconut shell charcoal, and rice husk charcoal at various ratios. The result showed that all types and ratios could remove 100% coliform bacteria, and *Escherichia coli*. When the filtered water was compared with the drinking-water standard by WHO, the types and ratios of clay-pot water filter were within the acceptable range for turbidity, coliform bacteria, and *Escherichia coli*³⁴. Respectively 'studies were carried out towards the development of the filter from clay, laterite and sawdust. As measured by flow rate and water quality tests, the filter having 45% sawdust and 55% clay body by volume was adjudged the best having satisfied the acceptable flow rate (between 1 and 2 liters/hour) and water quality (turbidity less than 5 NTU); in addition, the removal efficiency of suspended solids was 94%.³⁵



³²Roger D. Lewis, PHD, CIH, Stephen D. Passman, and Tyler J. White, MPH- Point-of-Use Water Filtration for Arsenic: A Sustainable and Simple Solution in Resource-poor Settings. International Journal for Service Learning in Engineering Vol. 9, No. 1, pp. 79-91, Spring 2014 ISSN 1555-9033

³³Jinyemiema, Tamuno k; Ledogo, Leera T; Esukuile, 4Awajiokinu. J.; and Amie-Ogan, Tekena G - Investigation Of Thermophysical Characteristics of Water in Clay Pot. International Journal of Scientific & Engineering Research Volume 11, Issue 8, August-2020 1623 ISSN 2229-5518. Email: kurotamuno2000@yahoo.com, tjinyemiema@gmail.com

³⁴WatcharapornWongsakoonkan, TawachPrechthai and KraichatTantrakarnapaSuitable Types and Constituent Ratios for Clay-Pot Water Filters to Improve the Physical and Bacteriological Quality of Drinking Water. The international journal published by the Thai Society of Higher Education Institutes on EnvironmentAsia. Available online at www.tshe.org/EA Environment Asia 7(2) (2014) 117-123

³⁵Adeyemi Samson, Adeleke Kamar Taiwo Oladepo and Julius Olatunji Jeje (2018) - A Study of Ceramic Pot Filters Made from Clay Body and Sawdust. Journal of Resources Development and Management www.iiste.org ISSN 2422-8397 An International Peer-reviewed Journal Vol.45, 2018

AHD Nadi Filter is accredited for improving human health, because Nadi water, in comparison to plastic vessel has positive impacts on human health. AHD has learnt 'that the material of storage containers significantly affects the quality of the water with time. TDS, EC, pH, Total hardness, Nitrate, and DO of stored water are changed in the steel, clay pot, and plastic vessel. The storage vessel viz. plastic bottle significantly affects the DO of handpump water and affects the quality of the water. The water quality parameters of all water sources stored in the steel vessel and plastic bottle (tap water, aqua guard water, and handpump water) are subject to extreme changes over time, which decreases the water quality. Oppositely, there is relatively less change in the water parameters in the clay pot, which not decreases the water quality³⁶.

Mr. Khalid Bux CBO Member in District Sujawal, Sindh Said, "I was skeptical about the Nadi filter at first, but seeing how efficiently it purified the floodwater and made it safe for consumption changed my mind. Its incredible how technology can aid in disaster recovery efforts."

3.3 Effects of Drinking Water from NadiFilter

3.3.1 Health & Nutrition

It is estimated that around 1082 children die every day due to diarrhea, which is symptom for multiple disease which arise with drinking contaminated water. Drinking water from AHD Nadi filter is best to prevent following waterborne diseases:

1. Cholera is commonly found in humanitarian emergencies or marginalized villages where poverty and poor sanitation are rampant. The disease is spread through contaminated water and causes severe dehydration and diarrhea.
2. Escherichia Coli (E. coli) is a bacteria with various strains, some dangerous and some beneficial. For example, E.coli bacteria is important in creating a healthy intestinal tract. The bacteria are also found in unsafe water sources around the globe where human water sources and cattle coexist.
3. Hepatitis A is a liver infection caused by consuming contaminated food and water or by coming in close contact with someone who has the infection.
4. Typhoid Fever is well-known in extremely poor parts of developing nations; it's estimated that up to 20 million people worldwide suffer from the illness each year.
5. The waterborne disease Giardia is shared through contaminated water, most often in ponds and streams, but it can also be found in a town's water supply, swimming pools, and more. Dysentery is intestinal infection, is a waterborne disease characterized by severe diarrhea as well as blood or mucus in the stool.
6. Dysentery is good reason to always wash your hands, as the disease is spread mainly through poor hygiene. It can be caused by bacteria, viruses, or



³⁶Porush Kumar and Dr. Vaibhaw Garg - Effect of Different Storage Vessels on Various Types of Water In Kota City. International Journal of Engineering Applied Sciences and Technology, 2020 Vol. 4, Issue 9, ISSN No. 2455-2143, Pages 485-490 Published Online January 2020 in IJEAST (<http://www.ijeast.com>)

parasites in unsafe food and water and by people coming in contact with fecal matter.

7. Salmonella cases come from ingesting food or water contaminated with feces. Most people don't develop complications, but children, pregnant women, older adults, and people with weakened immune systems are most at risk.³⁷

The Sustainable Development Policy Institute (SDP I) of Pakistan has claimed in its report that; purifying water from bacterial contamination through Nadi filters gave the target population some hope for accessing safe drinking water by an inexpensive way which does not require any fuel or chemical to clean water from bacteriological contamination.³⁸ And the 'Nadi Filters were the best answer to the "no clean drinking water" problem in rural Sindh'.³⁹ Because the 'Bio Sand Filters remove 95.0 to 99.0% of organic contaminants, including bacteria, viruses, protozoa, worms, and particles. Safe water produced by the filters is free of discoloration, odor, and unpleasant taste⁴⁰. AHD Nadi Filter has been accredited in the policy manual by United Nations Economic and Social Commission for Asia and the Pacific which writes: 'The Nadi Water Filter is unique solution to extract potable drinking water from contaminated water at the household level by using everyday objects such as clay pots and sand. This is accomplished by the utilization of biological water treatment through microbes⁴¹.

In June 2018 Pakistan Council of Research for Water Resources (PCRWR) report attributed 45 percent of infant deaths in Pakistan to diarrhea and about 60 percent to overall infectious waterborne diseases in Pakistan⁴².

We often think of a lack of food. But increasingly, the crisis is one not only of food insecurity, but also of clean water, sanitation and health care – especially disease prevention and treatment. Unsafe water and sanitation can lead to malnutrition or make it worse. "No matter how much food a malnourished child eats, he or she will not get better if the water they are drinking is not safe," says Manuel Fontaine, UNICEF Director of Emergency Programmes. Unsafe water can cause diarrhea, which can prevent children from getting the nutrients they need to survive, ultimately leading to malnutrition. Malnourished children are also more vulnerable to waterborne diseases like cholera. Inadequate access to minimum water, hygiene, and sanitation is estimated to account for around 50 per cent of global malnutrition.⁴³

According to a study 'on average a household had to pay the Pakistani Rupee (PKR) 1,725 (10.79 US\$) in peri-urban areas and PKR 1,094 (6.84 US\$) in urban areas for the treatment of waterborne diseases (Exchange rate as of 24/07/2021: 1 PKR = 0.0080 US\$). The cost ranged from as low as zero to over PKR 11,100 (69.42 US\$) in peri-urban areas and about PKR 14,900 (93.19 US\$) in urban areas. Furthermore, about 50% of the peri-urban residents and 90% of the urban residents are willing to pay PKR 100–1000 for quality/safe drinking water.⁴⁴

The people of Pakistan and all developing countries are recommended to adopt NadiFilter as a source for safe drinking water. And avoid taking economic burden; deteriorate their health and saving their children. Nadi Filter do not enhance economic burden like other forms of safe drinking water commonly used in homes; but provides

Mrs. Gul Bano from Tando Hafiz Shah recommends the adoption of AHD Nadi filter water for its importance in ensuring clean and safe drinking water for the community's health and well-being. She believes that by switching to Nadi Filter Water, the communities ensure a brighter and healthier future for our community.

³⁷Life Water - <https://lifewater.org/blog/7-most-common-waterborne-diseases-and-how-to-prevent-them/>

³⁸Sustainable Development Policy Institute - <https://sdpi.org/publications>

³⁹Algebra Engineers - <https://algebra.engineering/portfolio/nadi-filter>

⁴⁰Shaheen Ashraf Shah – Rewarding Innovation of Local in Sindh, Pakistan – email: content@eawater.com

⁴¹ United Nations Economic and Social Commission for Asia and the Pacific

<https://repository.unescap.org/handle/20.500.12870/75>

⁴²DAWN Newspaper - <https://www.dawn.com/news/1440240>

⁴³<https://www.unicef.org/stories/4-things-you-need-know-about-water-and-famine>

⁴⁴ National Center for Biotechnology Information – National Library of Medicine-

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8480852/>

solution for safe water for years at the very cheapest rates, less than one-month expenses of waterborne disease treatment.

3.3.2 Education & Gender

Just imagine: 200 million hours is 8.3 million days, or over 22,800 years,” said UNICEF’s global head of water, sanitation and hygiene Sanjay Wijesekera. “It would be as if a woman started with her empty bucket in the Stone Age and didn’t arrive home with water until 2016.”⁴⁵

When children don’t have access to water at home, they are often responsible for collecting it for their families. Sharing the burden with their mothers, children around the world spend 200 million hours each day collecting water. This takes time away from school. Access to safe water and sanitation gives kids time and health for school. Likewise, poor sanitation keeps kids, especially girls, from being able to go to school. Without access to safe water, water-related illnesses often keep children out of school. Access to safe water and sanitation is critical to the development of a healthy child and foundational to the education of children around the world. Girls who lack access to safe water and sanitation at home or at school face significant challenges. Water-insecure communities do not go to school. Access to water and sanitation changes this. If for instance in India, water and toilets were accessible to even 1% more girls in secondary school, the country’s GDP would raise more than \$5 billion. Further, on a global scale, for every year a girl stays in school, her income can increase by 15-25%.⁴⁶



According to the UNICEF, about 3.3 million children are engaged in child labor in Pakistan... in a country holding the world’s second-highest number of out-of-school children, with an estimated 22.8 million 5–16-year-olds not attending school, constituting 44 percent of the age group’s population⁴⁷.

Water and poverty are linked in education; preventable, water-borne disease keeps children out of school. An estimated 443 million school days are lost each year from water-related illness. In many cases, children are too sick with diarrhea and other water-borne diseases like typhoid, cholera, or dysentery to go to school or must care for sick family members instead of going to class. Children also must help their families retrieve safe water from long distances if it is not available nearby.⁴⁸

These numbers pose a dismal state of children especially girls. According to the UN, in a single day in 25 sub-Saharan African countries, women spend 16 million hours collecting water – often to the detriment of education or paid work – compared to only 6 million hours spent by men and 4 million hours spent by children. The lack of safe water makes women and girls vulnerable to gender-based-violence (GBV) in much of the developing world. Poor water connections force women to walk long distances in sometimes unsafe circumstances. Women have reported

⁴⁵United Nations Children Fund - <https://www.unicef.org/press-releases/unicef-collecting-water-often-colossal-waste-time-women-and-girls>

⁴⁶Water .org - <https://water.org/our-impact/water-crisis/childrens-and-education-crisis/>

⁴⁷The NEWS Newspaper - <https://www.thenews.com.pk/tns/detail/1055881-arresting-child-domestic-labour>

⁴⁸ The Life Water <https://lifewater.org/blog/water-poverty/>

systematic violent attacks and sexual abuse while completing these domestic tasks. Women and girls also face the threat of GBV when walking to shared sanitation facilities⁴⁹.

In 8 out of 10 homes without running water, it is women and girls who are tasked with fetching water. Besides the time wasted, and the physically demanding nature of performing this task, women and girls are often at risk of harassment, attack, or even kidnapping when they head out each day to obtain water.⁵⁰ But the 'communities that have benefited from the new water facilities have seen their school enrolment levels soar. Primary school enrolment in one village rose 30%; in another, it tripled among girls and grew 40% for boys.⁵¹

AHD Nadi Filter has triple effects on education and gender. By adaptation of Nadi Filter the school going children's health is improved. The males, after training and skills building on Nadi Filters are engaged to fetch water to pour in Nadi Filter, women are only encouraged to maintain Nadi Filter at home. In this way women and girls, through mobilization are engaged in home and at schools to prevent them from kidnapping, harassment and abuses.

3.3.3 Poverty

Whether self-employed or employed by another, we have to stay healthy to do our work and be productive. Moreover, in order to earn an income, we can't spend all our time caring for sick family members. For those who live without safe water, adequate sanitation, and effective hygiene practices, water-borne disease is a constant threat to health, keeping people out of the work force and in poverty. Over 40 billion productive hours are lost each year to fetching water in sub-Saharan Africa. About half of the developing world's hospital beds are occupied by people with water-related illness. In many countries preventable, water-borne disease keeps a large portion of the population in a cycle of illness, illiteracy, and poverty. The cycle of water and poverty continue where women must endure these experiences, as they are often excluded from productive or income-earning labor. Where women have access to a nearby source of clean drinking water, a toilet or latrine, and knowledge about good hygiene practices like hand washing, they and their families thrive. They can use the time saved to work in home-based businesses and agriculture as well as employment outside the home. More girls can attend school, and for longer. They can break the cycle of poverty and water-borne disease. Communities affected by disaster, either natural or man-made, are more resilient if they have access to safe water and sanitation. Communities with safe water have healthier members, whose bodies are more resistant to illnesses that come with disaster and displacement. Investment



Investment in WASH promises one of the highest rates of return of any development relating to water and poverty. It offers the most significant single opportunity for change in the lives of those in extreme poverty, its effects reaching to all other activities and relationships. A \$1 investment in WASH yields \$3-\$34 in economic return, but lack of WASH can cost up to 5% of a country's GDP. "In fact, no single intervention is more likely to have a significant impact on global poverty than the provision of safe water."⁵²

⁴⁹Organization for Economic Cooperation and Development - <https://www.oecd-ilibrary.org/sites/f315deeb-en/index.html?itemId=/content/component/f315deeb-en>

⁵⁰ TRIBUNE Newspaper -<https://tribune.com.pk/story/2325772/the-untenable-water-burden-borne-by-women-girls>

⁵¹Asian Development Bank -<https://www.adb.org/features/new-hope-women>

⁵²The Life Water <https://lifewater.org/blog/water-poverty/>

It is proved that, 'access to safe water improves physical health, which diminishes poverty. In developing countries, 80% of sicknesses are due to drinking and washing with contaminated water. When the family's income-provider dies from unsafe water, it's not only devastating for the family emotionally, but it can also plummet them into deeper poverty. Safe water can help eliminate these deaths, disease and poverty. Another way access to safe water diminishes poverty is by reducing the physical strain on the women who lug the water home after collecting it. On average, women carry more than 40 pounds of water for up to six hours every day when they don't have access to safe water systems nearby. Imagine the cumulative strain on their backs, neck, and knees. Access to clean water empowers women to spend the time they would have used collecting water to utilize their skills and talents in the workplace instead.⁵³

AHD Nadi Filter has proved solution for safe drinking water which prevents people from disease and people are enabled to work for the livelihood and keep space from vicious poverty cycle. Because access to safe water is a long-standing problem for rural and semi-urban communities in developing nations. Their time, efforts, money are invested for accumulating water for families from long distances, which compromise their health, education, livelihoods and security of women and girls and drags them to acute poverty. The families who have adopted AHD Nadi Filter:

- Their women and children have got their time back.
- Their women and girls are safe and positively engaged.
- They are free from diseases
- Education is promoted among them.
- They have improved nutrition.
- They have started livelihoods and economic growth.

3.3.4 Environment

In a world where environmental sustainability is becoming increasingly important, finding eco-friendly solutions for everyday needs is crucial. One area where sustainable practices can make a significant impact is water purification. Clay pots offer a sustainable water solution that reduces plastic waste, conserves energy, and promotes eco-friendly living⁵⁴. The porous nature of the clay allows impurities and toxins to be filtered out, resulting in clean and pure water. In addition, clay pots are free of chemicals and do not leach harmful substances into the water, unlike plastic or metal containers. We all are sure about that clay pots are indeed good for the environment. Clay pots are indeed good because if the pieces are broken then you can use one broken piece as a base to drain out the impurities from your plant. Also, when you are throwing away the broken bits of the clay pots then you are not doing something bad for the environment. These are clay pots and they are good for the environment since they are biodegradable. Unlike plastic pots, they do not cause any damage to the environment as a whole. 'The profound benefit of clay pot is it does not contaminate food with toxic compound. As they essentially come from soil, the pots easily get decomposed into it when we discard them'.⁵⁵

I am Babar Ali from UC Jhol District Sanghar, and I said that Nadi Filter not only provides us with safe drinking water but also contributes to the protection and preservation of our rural environment, making it an invaluable asset for our community.

3.4 International Recognition

Since its inception, AHD has built on the experiential learning and feedback from communities and started to support communities for innovative solutions for safe drinking water. The safe drinking water model which is contextually appropriate, easy to install, verified and internationally recognized; bio sand water filter through Nadi (a clay pitcher) has been product of the AHD.

⁵³Healing Waters <https://healingwaters.org/can-access-to-safe-water-diminish-poverty/>

⁵⁴Natural Spa Supplies -<https://naturalspasupplies.co.uk/blog/sustainable-water-solutions/>

⁵⁵TBS News <https://www.tbsnews.net/feature/panorama/return-clay-pots-can-save-health-environment-and-community-116374>

Nadi Filter - Safe Drinking Water Solution has been accredited and rewarded by:

- GlaxoSmithKline -UK, Healthcare Innovation Award -2018
- United Nations Economic and Social Commission for Asia and the Pacific -2015
- Energy Globe Awards - 2014 and 2019
- Asia Pacific Forum for Environment and Development - APFED Showcase-2007

4. Global Adaptation of Nadi Filter

AHD has taken efforts to promote Nadi Filter for access to safe drinking water to the people around the world. The Nadi Filters are adopted by people, communities, and individuals in following countries.

- Pakistan
- Nepal
- Bangladesh
- Malawi
- Ethiopia
- Kenya
- Mozambique
- Uganda
- Zimbabwe

5. Outcome and Scalability

AHD with generous support of donors, philanthropists, corporate companies, grant networks, UN agencies has reached to more than 03 million people around the world. There is huge gap in provision of safe drinking water to developing world, one person among three people do not have access to safe drinking water. This makes 02 billion people in the world. AHD recommends following actions for scalability of Nadi Filters to provide safe drinking water to the developing world:

1. Program Focus on Safe Water
2. Data Collection and Sharing
3. Allocation of Funds for Safe Drinking Water
4. Partnership and Networking
5. Communications and Storytelling

6. Endorsements of AHD Nadi Filter/Safe Drinking Water Initiative



We are encouraged by the training and equipping we see happening with the team at AHD. The Nadi filter offers an affordable, locally sourced path to clean water, and we are always happy to refer those in need to it!

Mary Conley Eggert, Co-Executive Director, Global Waterworks



Following AHD victory in winning the Healthcare Innovation Award, the organization is heading towards five African countries, I am pleased to acknowledge AHD as a highly trusted partner.

These efforts highlight the significance of the award in fostering collaboration and promoting sustainable safe drinking water solutions in the region.

**Azhar Qureshi Founder/CEO
ECO Conservation Initiative Pakistan**



"Nadi filters by AHD Pakistan excel in simplicity and affordability, making them a lifeline for communities in rural Pakistan and African countries. Designed with user-friendly, local materials, these filters offer a cost-effective solution, addressing the crucial need for clean water in resource-constrained regions."

**Alina Pelka
President & Founder YORGHAS Foundation**



A world without compassion is a world without Love. No Matter How Rich we are; if we have no compassion to others, then Our Lives become Meaningless. Everyone has right to Live their life Healthy and we serve Nadi filters in Remote areas to people who do not have access to Pure water so they have Pure Water with Organic Nadi Filters which results in good Health.

Saif UR Rehman Memon, Branch Manager, JS Bank Hyderabad, Sindh



Investing in Mozambique agricultural value chains gives food and income to 1000s of small-scale farmers. No matter how much we invest and deliver great results it is futile without clean water. That's why I have insisted on getting AHD to Mozambique with their cheap, locally produced and reliant water purification systems. We are ready!

**Karsten Gjefle
Senior Advisor
International Development, Norges vel**



AHD is an organization totally dedicated to the people of Pakistan. Their leader is completely committed to providing clean water Disaster Assistance and other humanitarian results for his beloved country. I am honored to work with Khurshid and AHD.

David A Dodd Sustainable Resilience Consultant USA



The work of the Association for Humanitarian Development (AHD) is improving the lives of the poor and disadvantaged in Pakistan and Africa. Under the leadership of A. Khurshid Bhatti, Chief Executive and Founder, tools such as the Nadi Water Filter are improving the quality of drinking water for many. I applaud and cheer the work of this organization.

Randy Shaw, PE Retired Manager of the Brackish Groundwater National Desalination Research Facility, USA

7. Frequently Asked Questions (FAQs)

1. How much does a single Nadi Filter unit cost?

A single Nadi Filter unit price in Pakistan is about PKR 5,000 to 6,500. This cost includes material and installation and transportation/travelling cost is not included in this. The Nadi Filter unit prices may vary country to country, depending on currency/exchange rate, however, this cost is calculated between 30 to 80 USD internationally.

2. How much time AHD Nadi filter unit could be used for drinking water?

The Nadi filter is a locally prepared from indigenous material clay and hill sand, it works through bios-and filtration process. AHD has observed people are using Nadi Filter for 20 years after installation. By working at national and international level, AHD has seen best pots in KPK Pakistan, Zimbabwe, Uganda and Kenya, which could sustain more than 20 years as well. AHD recommends use of Nadi Filter for 10 -15 years with proper maintenance, and cleaning.

3. What to do if filtered water flow gets slow?

If the flow of water turns slow, you need to clean the filter. Take-back the *matka* – round shaped clay pot from the Nadi -clay pitcher. Ensure that filter do not have water inside at that time. After putting off *matka*, remove two inches of hill-sand/clay from the upper surface of the hill-sand & wash it with water, till all dust/waste cleaned up. Then again put same sand into the Nadi & filter will be ready. This process could be repeated monthly or bimonthly, or when water flow from filter gets slow.

4. How much clean water could be extracted from Nadi filter in a day?

Nadi filters can produce 30 to 50 liters of water per hour; a family can get 50 to 100 liters of filtered water daily/or as per need. This filter generates clean water that is sweet in taste, odorless, transparent, and crystal clear in color, and the water remains cool without refrigeration. AHD recommends maximum water extraction from Nadi filter should not exceed more than 200 liters in 24 hours at an interval of every 08 hours.

5. What is the precaution for maintenance of the Nadi Filter unit?

To maintain the Nadi Filter Unit, the user needs to place the Nadi filter in the sunlight and ventilation. The ventilation is necessary for the development of good microbes to beat bad ones in the water. Further, clean the surrounding area where the Nadi filter is placed and cover it with cloth to prevent it from being infested with insects.

6. Which material is used for AHD Nadi Filter?

However, there are multiple bio-sand water filters available in the market. But AHD Nadi filter is made from indigenous material – clay pots and hill-sand. Apart from these other installation material and procedure is involved in making AHD Nadi filter at householder.

7. Could I myself install AHD Nadi Filter at my own?

One could install AHD Nadi filter after guidance from AHD trained staff/team. However, AHD recommends one time training for installation of AHD Nadi Filter. Because AHD team has two decades experience of Nadi filter, for its training, installation, material specification and quality and standards, they can best advice on installations, precautions and uses of AHD Nadi Filter.

8. What to do, if a Nadi is leaked, broken, or not cooling water?

In this case, leaked/broken Nadi could be repaired again by cement. And if Nadi is not cooling water place a thick rug after wetting it into water for sunlight/day hours.

9. How do I believe that AHD Nadi Filter water is good for health?

AHD has been experiencing Nadi Filter for 20 years in Pakistan and 05 years in Africa. AHD has got Nadi Water filter tested from accredited laboratories of Government of Pakistan. And international health champion GlaxoSmithKline has tested its water and awarded AHD with Healthcare Innovation Award, which is international accreditation and recognition of AHD Nadi Filter water is safe and good for health. Apart from this AHD has won five international awards on Nadi filter innovation from global companies/organizations.

10. Does Nadi Filter clean/filter all kinds of dirty water?

No, Nadi filter cleans only canal, river, pond, lake water which has not chemical and metallic contaminations.

11. Which types of contaminations are cleaned through AHD Nadi filter?

AHD Nadi filter is good only for cleaning biological contaminations.

12. Which waterborne diseases are reduced by using AHD Nadi filter water?

AHD Nadi Filter is best for reducing 07 waterborne diseases. These include Cholera, Escherichia Coli (E. coli), Hepatitis A, Typhoid Fever, Giardia, Dysentery, Salmonella.

08. References

1. World Wide Fund - <https://www.worldwildlife.org/threats/water-scarcity>
2. United Nations - Water - <https://www.unwater.org/>
3. United States Bureau of Reclamation - <https://www.usbr.gov/mp/arwec/water-facts-ww-water-sup.html>
4. United Nations Environment Programme - <https://www.unep.org/news-and-stories/story/globally-3-billion-people-health-risk-due-scarce-data-water-quality>
5. Everything Connects – Why Nature Matters - <https://www.everythingconnects.org/water-pollution.html>
6. World Health Organization (WHO) - <https://www.who.int/news-room/fact-sheets/detail/drinking-water>
7. Our World in Data - <https://ourworldindata.org/clean-water>
8. Science Direct - <https://www.sciencedirect.com/science/article/pii/S2049080122014698#bib4>
9. DAWN Newspaper - <https://www.dawn.com/news/1276429>
10. DAWN Newspaper - <https://www.dawn.com/news/1345508>
11. National Center for Biotechnology Information – National Library of Medicine- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5573092/>
12. Clean Water - <https://cleanwater.org/2020/07/29/bottled-water-human-health-consequences-drinking-plastic>
13. INDIA.DOT COM - <https://www.india.com/lifestyle/5-harmful-side-effects-of-drinking-from-plastic-water-bottles-5116887/>
14. World Health Organization (WHO) The impact of chemicals, waste and pollution on human health. SEVENTY-SIXTH WORLD HEALTH ASSEMBLY Agenda item 16.3, A76/A/CONF./224 May 2023
15. DAWN Newspaper - <https://www.dawn.com/news/1173628>
16. The World Bank – Blogs - <https://blogs.worldbank.org/opendata/world-water-day-two-billion-people-still-lack-access-safely-managed-water>
17. New Scientist Magazine - <https://www.newscientist.com/article/2365541-around-2-billion-people-dont-have-access-to-clean-drinking-water/>
18. DAWN Newspaper - <https://www.dawn.com/news/1712930>
19. National Center for Biotechnology Information – National Library of Medicine- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9811062/>
20. Water for Women Fund - <https://www.waterforwomenfund.org/en/learning-and-resources/resources/KL/Publications/Climate-Financing-for-WASH-Pakistan-Web.pdf>
21. The New York Times- <https://www.nytimes.com/2023/05/30/well/live/water-filter-bacteria-pfas.html>
22. Journal for Public Health and Emergency - <https://jphe.amegroups.org/article/view/4741/5523>
23. Clay Ground Collective - <http://www.claygroundcollective.org/clay-in-common/>
24. Northern Arizona University - <https://www2.nau.edu/~gaud/bio301/content/iscrst.htm>
25. Kulture Street – Blogs - <https://kulturestreet.com/blogs/blog/the-historic-significance-of-clay-pot-usage>
26. BBC - <https://www.bbc.com/culture/article/20210428-why-the-slow-mindful-craft-of-pottery-is-booming-worldwide>
27. <https://www.terrawaterindonesia.com/post/drinking-water-from-a-clay-pot-is-it-healthy-or-outdated>
28. <https://graamyam.com/the-incredible-benefits-of-using-terracotta-products/>
29. Maggy NB Momba, Department of Environmental, Water & Earth Sciences, Tshwane University of Technology and Gordon Nameni, University of Illinois, Urbana-Champaign, USA, Development of A Prototype Nanotechnology based Clay Filter Pot oo Purify Water For Drinking And Cooking In Rural Homes. WRC Report No. KV 244/10, ISBN 978-1-4312-0003-0, August 2010,
30. K Naddafi, AM Mahvi, S Nasser, M Mokhtari, H Zeraati - Evaluation of the Efficiency of Clay Pots in Removal of Water Impurities. Dept. of Environmental Health Engineering, School of Public Health,

- Tehran University of Medical Sciences, Iran, Dept. of Epidemiology & Biostatistics, School of Public Health, Tehran University of Medical Sciences, Iran. Iranian J Env Health Sci Eng, 2005, Vol.2, No.2, pp.12-16.
31. Hydrate Life - <https://www.hydratelife.org/the-nadi-filter/>
 32. Roger D. Lewis, PHD, CIH, Stephen D. Passman, and Tyler J. White, MPH- Point-of-Use Water Filtration for Arsenic:
 33. A Sustainable and Simple Solution in Resource-poor Settings. International Journal for Service Learning in Engineering Vol. 9, No. 1, pp. 79-91, Spring 2014 ISSN 1555-9033
 34. Jinyemiema, Tamuno k; Ledogo, Leera T; Esukuile, 4Awajiokinu. J.; and Amie-Ogan, Tekena G -
 35. Investigation Of Thermophysical Characteristics of Water in Clay Pot. International Journal of Scientific & Engineering Research Volume 11, Issue 8, August-2020 1623 ISSN 2229-5518. Email: kurotamuno2000@yahoo.com, tjinyemiema@gmail.com
 36. WatcharapornWongsakoonkan, TawachPrechthai and KraichatTantrakarnapaSuitable Types and Constituent Ratios for Clay-Pot Water Filters to Improve the Physical and Bacteriological Quality of Drinking Water. The international journal published by the Thai Society of Higher Education Institutes on EnvironmentAsia. Available online at www.tshe.org/EA Environment Asia 7(2) (2014) 117-123
 37. Life Water - <https://lifewater.org/blog/7-most-common-waterborne-diseases-and-how-to-prevent-them/>
 38. Sustainable Development Policy Institute - <https://sdpi.org/publications>
 39. Algebra Engineers - <https://algebra.engineering/portfolio/nadi-filter>
 40. Shaheen Ashraf Shah – Rewarding Innovation of Local in Sindh, Pakistan – email: content@eawater.com
 41. United Nations Economic and Social Commission for Asia and the Pacific <https://repository.unescap.org/handle/20.500.12870/75>
 42. DAWN Newspaper - <https://www.dawn.com/news/1440240>
 43. <https://www.unicef.org/stories/4-things-you-need-know-about-water-and-famine>
 44. National Center for Biotechnology Information – National Library of Medicine- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8480852/>
 45. United Nations Children Fund - <https://www.unicef.org/press-releases/unicef-collecting-water-often-colossal-waste-time-women-and-girls>
 46. Water .org - <https://water.org/our-impact/water-crisis/childrens-and-education-crisis/>
 47. The NEWS Newspaper - <https://www.thenews.com.pk/tns/detail/1055881-arresting-child-domestic-labour>
 48. The Life Water <https://lifewater.org/blog/water-poverty/>
 49. Organization for Economic Cooperation and Development - <https://www.oecd-ilibrary.org/sites/f315deeb-en/index.html?itemId=/content/component/f315deeb-en>
 50. TRIBUNE Newspaper - <https://tribune.com.pk/story/2325772/the-untenable-water-burden-borne-by-women-girls>
 51. Asian Development Bank -<https://www.adb.org/features/new-hope-women>
 52. The Life Water <https://lifewater.org/blog/water-poverty/>
 53. Healing Waters <https://healingwaters.org/can-access-to-safe-water-diminish-poverty/>
 54. Natural Spa Supplies - <https://naturalspasupplies.co.uk/blog/sustainable-water-solutions/>
 55. TBS News <https://www.tbsnews.net/feature/panorama/return-clay-pots-can-save-health-environment-and-community-116374>



Association for Humanitarian Development

Steps Towards Sustainable Development



Address: House # 39/B, 2nd Floor Block - B, Unit No. 2, Latifabad Hyderabad, Sindh, Pakistan.

Phone No: +92-22-3407819,

Email: info@ahdpak.org, ahdpak@gmail.com, Website: www.ahdpak.org