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Rainwater Harvesting in Thailand: Learning from the World Champions

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Executive Summary

An explorative study was done to collect information and analyse the experiences of the promotion of domestic rainwater harvesting (DRWH) in Thailand. A rapid review of evidence was combined with a field trip to collect information from a wide variety of actors. This report summarizes the main findings of the study.

Thailand was chosen as a study country because it currently has the highest percentage of the rural population relying on rainwater as main source of drinking water of any country in the world (currently about 40%, according to the Joint Monitoring Programme).

The analysis of existing documents, combined with visits to production sites and interviews with key actors, revealed a number of factors that made the promotion of rainwater harvesting an exceptionally successful case of diffusion of an innovation.

Regarding the **cultural factors**, it became evident that rainwater harvesting is deeply embedded in Thai society: it is culturally not only accepted but desirable to collect rainwater and use it for domestic purposes, including drinking. In rural areas, rainwater is being collected at almost every house and was traditionally offered to visitors and by-passers because it was considered the purest form of drinking water.

When analysing the **economic and market factors**, our analysis led to the conclusion that the government programme launched in the 1980s was the ignition of a dynamic process, which later was taken over by the private sector. However, this was only made possible because several key market forces played in favour of this development. These included: previously existing demand, fully developed supply chains, no need for behaviour change, and a good price point of storage vessels and of roofing/plumbing materials. Moreover, the high rate of labour force participation of women meant that the household investments in DRWH infrastructure paid off financially within a short time, thus further accelerating the dynamic process of diffusion.

The dynamic development described here was favoured by factors related to **geography, climate and hydrogeology**: Thailand is mostly flat, allowing for ease of transport of people and goods and for enough space to place the water jars. Moreover, most parts of the country receive sufficient amount of rainfall to make its collection and storage technically feasible and economically viable. Groundwater is often saline or otherwise contaminated, making rainwater an attractive and readily accessible source of drinking water.

Our research also showed that it was key to have simple yet effective **policies** in place, with government at all levels committed to their enforcement. One policy focused on DRWH and it was maintained with little changes over time. This enabled a wide range of government agencies to align to it.

The key conclusions of this study are:

- In Thailand, a large number of factors led to an **enabling environment** including policies, culture, habits, leadership, price, product, accessibility, demand and supply, which made the government programme effective and which led to a dynamic process driven by the private sector, bringing the jars into mainstream culture and practice.
- The Thai success story in promoting DRWH is an excellent example of the great potential of Self-Supply initiatives implemented at scale.
- Replicating the Thai jar experience in other contexts is a complex challenge as many factors have to come together. Most of them cannot be changed by one actor alone, and even resourceful organizations have failed to replicate Thailand's success story in other contexts.

Contents

1. Introduction

Domestic rainwater harvesting (DRWH) refers to the collection, storage and use of rainwater at household level for drinking, cooking, cleaning, small-scale agriculture and livestock rearing. It can be the sole water source for a household or supplementary to other sources. DRWH dates back at least to the third millennium BC in India and was utilized extensively in the Mediterranean and Middle East (Smet 2003).

In Thailand, rainwater harvesting has found its way into mainstream culture and practice. The earthenware jars and the large jars made of mortar, which have been constructed by the millions over recent decades, are part of everyday life in rural areas. The "Thai Jar Programme" was a government programme in the 1980s and a turning point for the development and promotion of DRWH. At the end of

Country information	
Kingdom of Thailand	
Capital:	Bangkok
Population:	69.9 million
Area:	513,115 km^2 (198,115 miles^2)
Major language:	Thai
Major religion:	Buddhism
Sources:	UN, WorldBank, Wikipedia

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the programme, the private sector took over the further development and promotion of these jars, leading to increased uptake and sustained use of rainwater harvesting since. This report summarises these developments, commonly referred to as the "Thai Jar Experience".

2. Methodology

For the current research, we combined a rapid review of evidence with an on-site visit and interviews with twelve people from governmental organisations, private sector, non-governmental organisations and civil society. Additionally, international experts on rainwater harvesting were interviewed. A series of relevant documents were identified; most of them focusing on the Thai Jar Programme (see references at the end of this report). The main results of this study also were presented during a webinar on 17.11.2015, hosted by the Rural Water Supply Network (RWSN).

3. Historic development

Thailand is a country where rainwater has been collected for thousands of years, mostly for drinking and other domestic purposes. Traditionally, rainwater was collected in earthenware jars. These jars, usually of volumes of 50-300 litres, were imported from China, and their characteristic design (showing a dragon – therefore the common term of "dragon jar") is largely unchanged until today.

After World War II, the import of these jars from China became more difficult and a local potter industry evolved, started by a small group of Chinese immigrants. At some point, more than 200 potteries (mostly dedicated to the production of rainwater jars) existed in the town of Ratchaburi alone, each of them producing dozens of jars per day. This industry of earthenware jar producers was the foundation for subsequent developments of alternative products. Even today, 40-50 factories of earthenware jar producers continue to exist, but they have diversified production (flower pots, decorative items and other ceramic products such as bottles for fish sauce).

Figure 1: One of the first ceramic jars produced in Thailand in the 1960s. The design has only changed slightly over the past 50 years.

Figure 2: Raw earthenware "Dragon jars" at a factory in Ratchaburi, where the iron-rich soil gave the jars the right colours for the local market.

Figure 3: Finished traditional "Dragon jars" are produced at the rate of several hundred jars per week at this factory.

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In the 1980s, triggered by the "International Water Decade" declared by the United Nations, a large-scale government programme was launched to provide at least one jar per family to millions of people in rural areas. This was in line with a clearly defined, simple government policy focusing on decentralized infrastructure in rural areas. The jars, commonly referred to as "Thai Jar", were of a larger size (usually 1,000-2,000 litres) than the earthenware jars and made of cement mortar (EnterpriseWorks/Vita 2008), providing more volume at a lower cost-per-volume ratio. Thanks to this design innovation, combined with a clear focus on a few technologies, a strong engagement by political leaders and sufficient funds, the programme was a large-scale success: Between 1981 and 1992, more than 8 million jars had been constructed (UNEP/IETC 1998). About 6 million jars were constructed under the government programme between 1982 and 1988, the rest were constructed by the private sector who took over the leadership on the promotion and construction of jars once the government programme ended (UNEFP/IETC 1998). During the 1990s, the rapid diffusion of the mortar jars continued, leading to a point around the year 2000 when about 50% of the rural population were using rainwater as their main source of drinking water (see figure 1). This is equivalent to about 21 million people.

As can be seen in figure 5, the rapid diffusion of jars in the 1980s and 1990s went in parallel to an improvement in coverage of improved water sources, suggesting that the dynamic diffusion of jars was accountable for a large part of the overall progress in the drinking water sector.

Figure 4: Example of a mortar jar in Western Thailand. Such jars were produced and sold by the millions and continue to be used today for storing rainwater.

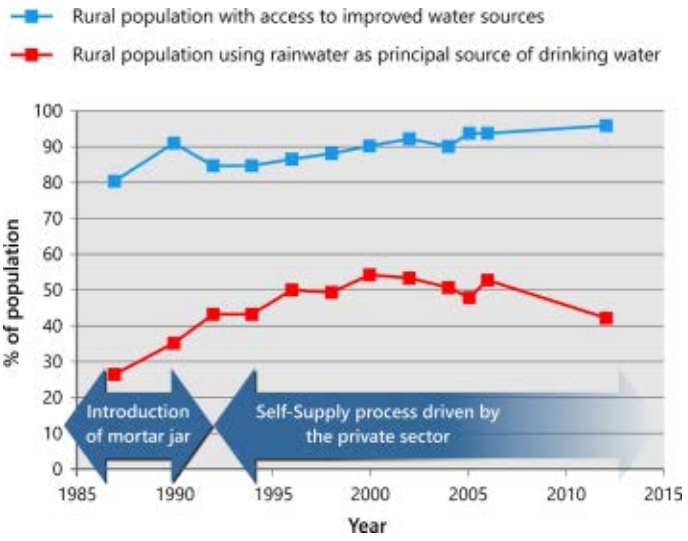

Figure 5: Percentage of the rural population of Thailand using rainwater as main source of drinking water and having access to improved sources of drinking water, 1988-2012 (source: JMP, 2015). **Please note that between 2006 and 2012 no data is available.**

After the year 2000, the percentage of people in the rural sector relying on rainwater as their main source of drinking water dropped to about 40%. The use of bottled water experienced a sharp rise in the same time, and piped networks became increasingly common. However, even today a large part of the rural population continues to collect and use rainwater for various domestic purposes.

Thanks to the developments described here, Thailand was one of the first middle- or low-income countries to reach full coverage of access to improved sources of drinking water. Notably, this access has been reached across all income levels: 100% of the richest fifth of the population and 97% of the poorest fifth have access to an improved source of drinking water (which includes rainwater) – one of the most equitable distributions in the world (ESCAP 2009).

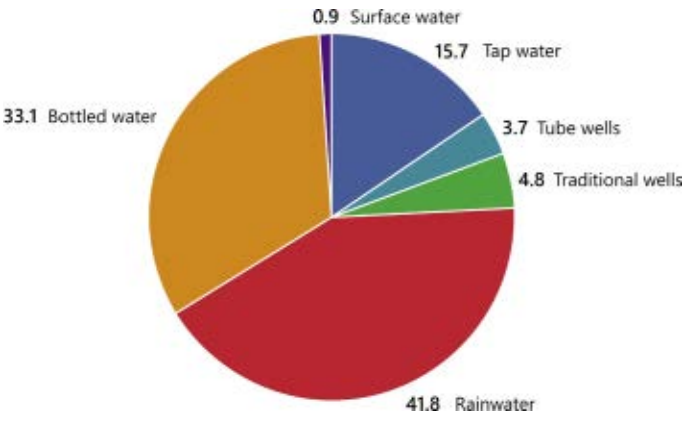

Figure 6: Percentage of the population using different sources of drinking water in rural Thailand in 2012 (source: JMP, 2015).

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Figure 7: Rainwater collection is common in rural areas. Young woman covering a rainwater storage tank in Western Thailand.

> **"I don't know of anyone who feels the need for promotion or rainwater harvesting - the technology is already embedded in the private construction sector and it's an idea that simply sells itself"** (J. Jones)

One of the surprising findings of the study was that currently there is no government or other agency promoting rainwater harvesting in Thailand explicitly. There are no marketing campaigns on billboards, TV or radio and there seems to be no dedicated lead actor for promoting DRWH. Nevertheless rainwater is being collected, stored and used for different purposes in large parts of the rural area. In fact, rainwater harvesting is so much entrenched into society that it can be left entirely to the private sector to satisfy the existing demand for storage vessels - the existing products and services probably are the best marketing campaign. In the words of one interview partner: "I don't know of anyone who feels the need for promotion or rainwater harvesting - the technology is already embedded in the private construction sector and it's an idea that simply sells itself" (J. Jones, personal communication, 24.10.2015).

4. Cultural importance and acceptance of rainwater

Thailand is a country where rainwater has been collected, stored and used for domestic purposes for thousands of years. Water is very important in Thai culture in general. For example, water is at centre stage during the most important festival of the year (Thai New Year). Water is present everywhere, and rainwater has historically been considered the purest form of water (this view is now changing, particularly among urban and young people). Water is used for many religious rituals including praying, bringing sacrifices, ritual cleansing, and washing of the dead, and it plays an important role in Buddhism (according to the latest census, 96% of Thai people are Buddhists).

Figure 8: Cultural embedding: Earthenware water vessel at the Maha That Worawihan Temple in Ratchaburi

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Figure 9: Water jars come in all shapes and sizes and it is very uncommon to find a house in rural Thailand without a vessel for rainwater collection and storage.

In rural areas of Thailand, particularly in the Northeast, there is least one water jar in front of almost every house. Sometimes, there are up to 10 water jars per household, all of which contain rainwater to be used for domestic purposes. Tigno (2007) notes: "In the Northeast of Thailand, a house is not a home if it does not have at least one huge rainwater jar". As rainwater by many people is considered the purest of all water sources, it is the water from these jars that traditionally was offered to visitors or by passers. Even today, with many people drawing from different sources of drinking water and increasingly buying bottled/packaged water for consumption, rainwater jars can be seen everywhere and continue to be an important aspect of domestic life.

"In the Northeast of Thailand, a house is not a home if it does not have at least one huge rainwater jar" (César Tigno)

The collection and consumption of rainwater is culturally well accepted in Thai culture. Indeed, several surveys found that for most Thai people rainwater is the preferred source of drinking water (Luong and Luckmuan 2002, EnterpriseWorks/Vita 2008). Thus, it is not only well accepted for cultural and religious reasons, but people also have become acquainted with the taste of rainwater and perceive it as high-quality drinking water. Therefore rainwater is not only accepted, it is desired as a source of drinking water by most people.

Figure 10: Drinking rainwater is very common in rural areas of Thailand.

Figure 11: Rainwater is being collected in many different types of vessels, not only in mortar jars.

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Related to these aspects of cultural importance is the fact that people have been collecting, storing and drinking rainwater for centuries. This meant that when the government launched its large-scale promotion and subsidy programme for the promotion of rainwater harvesting, people did not have to change behaviour – the mortar jars were simply a larger and cheaper version of the already established earthenware jars (the "dragon jars").

In Thai culture, like in many other cultures around the world, the task of obtaining, transporting and managing water for domestic purposes is the task of women and young girls. However, to the contrary to many other countries, women play a relatively active role in Thai society, including but not limited to politics, and they have good access to paid labour: women's Labour Force Participation Rate in 1980s was at 77%, well above other countries in the region (Bauer 2001). This meant that it was possible for many women to use the time saved through DRWH systems for productive tasks, allowing for the investments to pay off financially within a short time and providing a strong financial incentive for continued investments in these systems.

Additional cultural aspects of importance in the context of the Thai jar experience are the relative homogeneity of the country (e.g., 95% of the population is of Thai ethnicity, 95% are Buddhists), allowing for national campaigns to be developed under one concept, using one language and reaching the vast majority of the population. Moreover, the public support of rainwater collection by national champions, including the King, and the active involvement of opinion leaders in promoting rainwater harvesting raised the profile of the programme and further increased its acceptance.

5. Economic and Market Aspects

Here we provide an overview of some of the key economic aspects which made it possible for the Thai jar to become a mainstream product. They are grouped into factors related to the product, to the market, to funding and to local capacities.

Key figures:

- Price of a mortar jar in 1990: 15-20 USD for a 2,000 l jar
- Mean per capita income in 1990: 1,330 USD per year
- Amount of money invested by the government in the Thai Jar Programme (1986-1991): 67 million USD
- Number of jars built and distributed: 6-10 million jars between 1980 and 1990, several dozen millions between 1990 and 2015.

Sources: EnterpriseWorks/Vita 2008, CIA 2007, Luong and Luckmuang 2002, Sarntisart 2006

Related to the product:

- Very low price of the Thai Jars (15-20 USD for a 1,000 – 2,000 litre jar). This makes the product cheaper than existing alternatives (such as the Dragon Jars made of earthenware) and made it affordable to a wide sector of society.
- The low price and high quality of mortar, allowing for a long-lasting product. This is important as many people started with only one jar and based on the positive experiences decided to buy additional ones.
- Low price of corrugated metal sheets (roofing material), gutters and plumbing materials, leading to low overall costs for rainwater harvesting systems.

Related to the market:

- Ease of transport, leading to low transportation costs. The fact that Thailand's road infrastructure is fairly good made it possible to establish a few production sites and then transport the jars to the users (this is in contrast to hilly settings or those with poor road infrastructure, where transport is difficult and costly, forcing providers to construct jars/tanks at each household).
- The ease of transport, combined with the market size, the affordability of the product and the high demand made it possible to establish mass production, which in turn allowed for a further reduction of the price.
- Even though the government programme was focused on a relatively poor area of Thailand, it was targeted at a large proportion of society, not only the poor. This enabled the programme to grow quickly and reach out to millions of people.
- Mean per capita income in Thailand in 1990 was around 1,330 USD per year. This means that the initial investment of 20 USD was the equivalent of 1.5% of the mean per capita income at that time.
- The size of the market (millions of potential and actual clients) implies that dozens of millions of jars can be produced and sold.
- Given that within the government Programme thousands of artisans had been trained, this meant that once the subsidies from this Programme decreased, fierce competition started to kick in, keeping down prices and driving up productivity.

Figure 12: Thai jars at a jar factory in Khorat, Northeastern Thailand.

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Related to funding:

- Funds were available: Government and international cooperation agencies (e.g., KfW, JICA) invested considerable funds for the Thai jar programme (EnterpriseWorks/Vita [2007] indicate overall costs of 1,680 million THB between 1986 and 1991, the equivalent of about 67 million USD at that time). NGOs and the private sector also contributed, for example one company donating 2,500 tonnes of mortar (Luong 2002). Private households afterward took over as the main investors.
- Thailand's economy has been doing fairly well for the past 25 years (e.g., percentage of people living with less than 2 USD per day decreased from 37% in 1990 to 4% in 2010). This means that increasing amounts of funds from private households were available for buying products such as the Thai Jar.

Related to local capacities:

- Sufficient know-how was available in-country to make high-volume mortar jars, thanks to the government programme implemented in the 1980s.
- Strength of the private sector: After an initial push by the government programme to train thousands of artisans in producing the Thai Jars, the private sector (mostly SMEs and micro-entrepreneurs) was strong enough to fulfil existing demand.
- Economies of scale: It takes many producers, vendors and users of jars in order to develop a cluster of producers. Once such a cluster is established, competition sets in and enables the fittest actors to survive. Mass production further enhanced competition and increased delivery capacities of the private sector.

Figure 13: Pottery is an millenial art and tradition in Thailand.

6. Geography, Population and Climate

For obvious reasons DRWH relies on sufficient amounts of rainfall. Overall, there is sufficient rainfall for rainwater harvesting to be cost-effective throughout Thailand: the annual amount of rainfall varies from 800 mm in the Northeast to 4,000 mm in the South. Even in the drier Northeast of the country, the rainy season is relatively long (4-6 months). Interestingly, this is the region where DRWH is most common. This may be due to the initial promotion efforts being focused on this area because the needs were greatest there. However, one interview partner also pointed out to cultural factors of importance: In the South, people are used to consume large quantities of water every day for different purposes. In this context, promoting DRWH (which in this case happened during emergency relief efforts after the Tsunami of December 2004) proved to be difficult because people wanted more water than what typically can be stored in a rainwater jar, and because people were not used to this practice (Thammarat Koottatep personal communication, 26.10.2015). Thus, there seems to be a sweet spot (in terms of rain availability) for a rainwater harvesting culture to develop.

There are also a number of other environmental and demographic factors which helped the industry of jar production to develop a thriving market:

- Large parts of the population have access to paved roads and thus can be reached by transported goods (several Thai Jars can be transported on a small truck).
- The flat landscape and settlement patterns mean also that usually there is sufficient space close to rural houses for several rainwater tanks. In hilly topographies, this may not be the case and users may only have enough space for one jar, which in turn has to be larger and thus may be more expensive to construct and more difficult to transport.
- Size of population, which today stands at 67 million people and in 1980 was at 47 million people ('Demographics of Thailand' n.d.), making for an attractive market size and thus enabling mass production, competition and private sector investment.
- Moderate population density (131 persons per km^2, CIA 2007), making distribution of goods relatively cost-effective.
- In most parts of the country, groundwater is readily available. However, due to its high salinity, it is not adequate for drinking but still can be used for other domestic purposes. This implies that rainwater is used exclusively for drinking (and sometimes cooking), reducing the volume of water to be stored. The bad taste of groundwater also reinforces the common perception that rainwater is the purest form of water, independent of its actual micro-biologic water quality.

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7. Policies and Politics

Both policies and politics played a key role in DRWH promotion in Thailand. One key policy was put in place in the 1980s, when the government focus shifted to rural development and decentralized infrastructure. The policy specifically named three technologies to be promoted for the rural sector, which included DRWH. Moreover, the National Economic and Social Development Plans in the 1980s allowed for a dual system of water provision, with a limited amount of high quality water (five litres of water per person per day from sources such as rainwater and protected wells) and a larger amount of other domestic purpose water (e.g., springs and surface water) to be available (EnterpriseWorks/Vita 2008).

Apart from having a few hands-on policies in place, it also was crucial that there was a strong commitment to DRWH at all levels of government. Moreover, the same simple policies were maintained with little changes over a long period of time, which was necessary to allow for a wide range of government agencies to align to it (EnterpriseWorks/Vita [2008] estimated that a total of 26 different government agencies were involved in the promotion and implementation of DRWH).

Interestingly, the main funds for the Thai Jar Programme came through a job creation programme, not a water management or water supply programme. Therefore, the training of professionals (producers and vendors of the jars) was at the centre of this programme.

Furthermore, civil society aligned with the policies mentioned here. This was also important. For example, a highly respected opinion leader (Mechai Viravaidy), who started his career as a political leader but later established his own NGO, strongly promoted the collection and use of rainwater. Even the King, the most revered person in the country, backed the Thai Jar programme. These commitments created the trust and dynamics to keep the DRWH going even after the government funding ended.

Self-supply (i.e., market-driven supply) was not a stated goal of the government programme but it emerged naturally after the programme came to an end. Its development was facilitated by the high demand for the product, a strong private sector, and fully developed supply chains and production capacities.

Figure 14: A gigantic cement jar as part of a public fountain at the central market of Ratchaburi, also known as "Jar Town".

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8. Conclusions

Based on existing evaluations, presentations and other documents, complemented by conversations with different actors from Thailand and from the global rainwater harvesting community, the following conclusions can be drawn:

Programmatic aspects:

- A lot of the existing documentation and analysis of the Thai Jar Programme focused on the technological aspects. However, cultural and socio-economic factors are just as important, particularly the high acceptance and desirability of rainwater, as well as the market forces favouring further developments after funding from government agencies came to an end.
- The government programme in the 1980s ("Thai Jar Programme") was a start, but only its continuation by the private sector led to the mainstreaming and sustained use of rainwater jars by a majority of the population. The large amount of people trained during the Thai Jar Programme (which in its core was a job creation programme, not a WASH programme), among other factors, made this transition possible.
- Rainwater is the single most frequent source of drinking water for people in Thailand, and it is a significant contribution to the fact that Thailand achieved almost full access to improved sources of drinking water across all wealth quintiles.

Enabling environment

- In Thailand, a large number of factors led to an enabling environment (most notably policies, culture, habits, leadership, price, supply chains, and climate), which made the government programme effective and which led to a dynamic process, bringing the jars into mainstream culture and practice.
- Even before the Thai Jar Programme started, the collection and storage of rainwater for domestic purpose was common practice. Rainwater collection, its consumption and use have been deeply embedded in Thai culture for many centuries.
- The fact that people had been practising DRWH for centuries meant that there was no behaviour change needed to promote the new product (mortar jars) – it simply was a new design solution to the challenge of storing rainwater.
- In the mature phase of the initiative, the government agencies limited their role to setting and enforcing policies, building and maintaining transport infrastructure as well as enforcing the rule of law. Recently, this role was widened to include water quality surveillance, led by the Ministry of Health.
- No single factor was decisive; it was the joint occurrence of many of the factors mentioned above.

Product and market

- The Thai Jar is a well-designed, durable product at an affordable price point. Readily available low-cost roofing and plumbing materials completed the offer to make for an overall attractive DRWH package.
- Low price, combined with relatively high average income, menat that the Thai Jars were affordable for large parts of society.
- Sizing of the jars was not an important factor – rather than spending efforts on getting the right size of storage vessel for each family, it proved more effective to standardize the design and size, allowing for mass production and for a modular set-up of storage capacity.
- The positive attitude of most people and institutions in Thailand towards DRWH was a key factor to create demand, but also to allow government agencies as well as the private sector to spend money and other resources on this technology.
- Matching an existing demand with an attractive and affordable product made the dynamic market development possible, where the consumer and the private sector take centre stage. This development can be described as a Self-Supply approach (Olschewski 2016), and the experiences from the Thai Jar Programme may serve as an inspiration (but not a blue-print) for future Self-Supply projects and programs.

Replication of the experience

- Given the number and complexity of the enabling factors in place, we conclude that replicating the Thai Jar experience in other contexts is complex as many factors have to come together. Most of these factors cannot be changed by one actor alone.
- During the course of this study, we talked to many people who tried to replicate part of the Thai Jar programme elsewhere, using different approaches and product designs. However, the overall conclusion from these initiatives is that the success and scale of the Thai experience is very difficult to replicate elsewhere.[1]
- The Thai jar experience is not a blueprint for replication elsewhere but points out to the importance of cultural and economic aspects, as well as to an enabling environment in general.
- Promoters of rainwater harvesting should pay a lot of attention to context (including culture, policies, economic development, affordability, supply chains), apart from technical aspects.

[1] As an example, a quote from a message sent by John Gould, the author of several books on rainwater harvesting and a long-time promoter of DRWH: "At one of the annual International RWH Training Workshops in Lanzhou, China, a few years ago we did an exercise with participants to work out the approximate cost in each of the participants home regions / countries for the materials, labour, transport etc... required to build a 2000l Thai jar. We had over 40 participants from more than 25 countries. The results were very revealing the cost varied from about US$35 for North Korea to more than US$300 for rural Niger and Nuie (a remote raised atoll here in the South Pacific). No county came anywhere near the US$20 once experienced in Thailand." John Gould, personal communication, 02.12.2015.

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Figure 15/16: Modern ceramic objects at a factory outlet in Ratchaburi.

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The findings of this study were presented during a webinar (17.11.2015). The recordings of the webinar, including a Q&A session, can be found here: https://vimeo.com/146364519. The respective presentation (PDF) can be found here: http://www.rural-water-supply.net/_ressources/documents/default/1-651-34-1447857544.pdf

The recordings from additional webinars on DRWH can be found here: https://vimeo.com/album/3171105

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All other pictures: Matthias Saladin, Skat Foundation

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