

# Assessing factors supporting the sustainable long-term application of SODIS in Nepal and Indonesia

April 2011

**Sandec**  
Water and Sanitation in  
Developing Countries



## The SODIS Sustainability Study – Indonesia

Andrea Tamas & Flavia Wehrle



In cooperation with Yayasan Dian Desa (YDD), Yogyakarta, Indonesia, and Yayasan Masyarakat Peduli (YMP), Lombok, Indonesia.

## Executive summary

The SODIS sustainability study was designed to close an important knowledge gap – to collect information on the sustainability of HWTS/SODIS promotion projects at household and institutional levels. Several information sources were included: interviews using standardized questionnaires at household level, with previous promoters, and with previous implementing partner organizations as well as general stakeholder in the water sector. The SODIS sustainability study compares three countries where SODIS promotion at household and institutional level had taken place since several years.

This second report of the SODIS sustainability study presents the data collected in Indonesia. SODIS has been promoted in Indonesia since 2003 by a national NGO called YDD and its local partner, YMP. Main activities of YDD and YMP took place on the islands of Flores and Lombok, comprising urban, periurban and rural areas of different characteristics. Implementing partners were local health clinics. In parallel, between 2005 and 2007 a larger government run project on Water and Sanitation for Low Income Communities (WSLIC) took place in East Lombok.

Data was collected on Lombok and Flores in 1014 households of 20 communities of 5 different project phases (from 2003 to 2010). These 20 communities comprised 14 rural, 3 periurban and 3 urban areas. 2 of these 20 communities had had HWTS promotion within the government program; the remainder had had promotion from YDD or YMP.

Results at household level show that 73% of the total sample is entirely consuming safe water. The biggest success was achieved on Flores, where in some communities only a small minority still consumes untreated water. In contrast, on Lombok still more than one third of the population consumes untreated water, preferably in rural and periurban areas. The most popular treatment options used are boiling (73%), followed by SODIS (19%), and buying bottled or refilled water (12%). Filter and chlorination were rarely found.

Promoters and household visits have proven to have 80% of the households informed about SODIS and out of those 90% trying it out. However, over 70% of those who once started stopped again after some time. The main reason was a perceived lack of bottles. Indeed, as special bottles had been given out for free during the project (with very few exceptions), at some point the stock of these bottles was used up. People then kept demanding bottles for free instead of buying used or new ones available at the market. In those villages where nowadays people still use SODIS either bottles are sold at regular prices by previous promoters from the health clinics or they still have them at stock and still give them out for free. However, only in the first case the mode of bottle supply can really be called sustainable.

Other motivational factors to consume a certain type of water are of emotional and social nature. Creating positive emotions (e.g. liking the taste of a certain water type), stimulating social influence and social exchange in form of communication are needed. Additionally, habit supporting interventions like reminders can help sustaining water treatment behaviors. Also, the adverse health effects of untreated water have to be made salient.

As a result of a target advocacy action within a multi-stakeholder project, a strong commitment of the government to support HWTS has already been achieved. However, at local health level, support is still perceived to be quite weak. Governmental support therefore needs to be strengthened in terms of making resources available and increasing commitment among health clinics to promote the new program.

## Glossary

Eawag	Swiss Federal Institute of Aquatic Science and Technology
HWT	Household Water Treatment
Kader	Voluntary Health Worker
NGO	Non-governmental Organization
Pukesmas	local health clinic
Sanitarian	Environmental Health Officer
SODIS	Solar Water Disinfection
YDD	Yayasan Dian Desa (engl. institution which brings light to the village); NGO located in Yogyakarta, Java, Indonesia
YMP	Yayasan Masyarakat Peduli (engl. institute for community care); NGO located in Mataram, Lombok, Indonesia

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# 1 Introduction

Every year, 1.8 million people, mainly children under the age of five, die of diarrhea. Roughly one third of diarrheal diseases in developing countries are caused by contaminated drinking water. In places, where no central and safe water supply systems exist, point-of-use water treatment at the household level becomes essential. Point-of-use water treatment methods, such as Solar Water Disinfection (SODIS), reveal a great potential to reduce the diarrhea burden by disinfecting drinking water. Comprehensive microbiological research has demonstrated the effectiveness of SODIS to destroy diarrhea-causing pathogens in contaminated drinking water. Several health impact studies have shown that the diarrhea incidence of SODIS users has dropped by 16-57%.

SODIS promotion activities take place since the year 2000, many of them initiated by Eawag/Sandec. Looking at the uptake of the SODIS method at grassroots (household) level one year after project implementation, 40-80% of the trained people used SODIS on a regular basis. In many cases, NGO partners report that the SODIS method is not self-sustainable after its initial introduction into a community, although in a few cases self-promotion has been observed after a SODIS promotion had taken place.

**No information had been gathered so far on the level of continued long-term application of SODIS in the field, several years after the promotion project has been terminated.** Correspondingly, we identified a knowledge gap which we intend to close with this project. The aim of this project was to evaluate the sustainability of SODIS application in Nepal, Indonesia and Bolivia several years after project termination. In particular, we wanted to assess project strategies, local conditions and factors that support or hinder the long-term success of SODIS projects and quantify the level of continued long-term application at grassroots level.

The project used three different information sources:

- 1) Quantitative questionnaires for the assessment of long-term SODIS use on the household level and individual influence factors.
- 2) Quantitative questionnaire with former promoters for the assessment of former SODIS promotion strategies.
- 3) Qualitative semi-structured interviews with HWTS stakeholders for the assessment of institutional change processes initiated by the SODIS promotion activities and commitment at the institutional level.

The know-how gained during this investigation will be used to adjust the future SODIS promotion and dissemination strategy of Eawag/Sandec.

**This second report represents the results of the SODIS sustainability study in Indonesia.**

## 2 Methods

As just mentioned above, the sustainability study relied on 3 different information sources, assessed each with different tools and methods (Table 1).

**Table 1.** Overview of information sources and applied methodological tools.

Information source	Tool	Topics
Households (approx. 50 per community– total 1014)	Quantitative questionnaire applied by specially trained interviewers in Indonesian	<ul style="list-style-type: none"> <li>– Household demographics</li> <li>– Health status and risk awareness</li> <li>– Water consumption</li> <li>– Motivations related to different consumed water types</li> <li>– Habits related to SODIS water consumption</li> <li>– Promotion campaign perception</li> <li>– Communication</li> </ul>
Promoters (1-2 per community – total 20)	Quantitative / qualitative questionnaire applied by main investigator in English (with simultaneous translation to Indonesian)	<ul style="list-style-type: none"> <li>– Community demographics</li> <li>– Project details and evaluation</li> <li>– Training of the promoters</li> <li>– Promotion and follow-up activities of the households</li> <li>– Bottle supply scheme</li> <li>– Knowledge of SODIS</li> </ul>
Institutions – Implementing health clinics and district health department (total 10)	Semi-structured interview applied by main investigator in English (with simultaneous translation to Indonesian if necessary)	<ul style="list-style-type: none"> <li>– Organizational structure and main activities</li> <li>– Commitment related to HWTS</li> <li>– Network with other organizations</li> <li>– Description and evaluation of promotion activities</li> <li>– Community demographics</li> <li>– Lessons learnt for the institution</li> </ul>
Institutions – Central health department and other NGOs (total 4)	Semi-structured interview applied by main investigator in English (with simultaneous translation to Indonesian if necessary)	<ul style="list-style-type: none"> <li>– Organizational structure and main activities</li> <li>– Commitment related to HWTS</li> <li>– Network with other organizations</li> </ul>

Note: Relevant questions for this report are cited in the footnotes or the respective tables.

### Household level interviews

The questionnaires conducted at the household level contained closed questions for acquiring the quantitative information (demographical data, quantity of consumption of different water types, opinions about SODIS, knowledge level about SODIS) and some open questions for qualitative information (reasons for use/non-use of water treatment, participation in promotion events). These questionnaires were filled in during an interview conducted by a trained Indonesian interviewer (NGO staff, health clinic staff and students). The questions were read out to the interviewee and the interviewer then indicated an answer on a scale. Often people only answer yes or no – then the interviewer was trained to ask further for a more detailed answer. The interview did not last longer than 30 minutes. In most cases, the interviewed person was the person responsible for water (treatment) in the household. In each community, 50 households were interviewed. Selection depended on the size of the village: in bigger villages, every third household was interviewed while in smaller villages every household available had to be interviewed to reach 50 households.



### Interviews with the promoters

With the promoters, a short questionnaire was filled out when the community was visited. The promoters' questionnaire left more space for talking about experiences and problems than the one for the households. Some questions required scaled answers; these were obtained in a similar way as described for the household level interviews.

### Institutional interviews

All of the interviews with the institutions were carried out after finding a suitable date and time. Usually, the institutional representative was visited at his/her office at the institution. A semi-structured expert interview was carried out. In case of an interview with a formerly implementing institution, the interview was lead more structured whereas in case of an interview with a general stakeholder, mostly room was given to their own preference of topics. All interviews were voice recorded for later transcription.

## 3 Indonesia

For Eawag/Sandec, the main partner for SODIS and HWTS promotion in Indonesia is YDD (Yayasan Dian Desa), based in Yogyakarta, and its local partner NGO, YMP (Yayasan Masyarakat Peduli) based in Lombok. In 1996, Eawag/Sandec started field tests of SODIS under Indonesian conditions in Java, which were finished in 1997. Already at that time, YDD was identified as a good partner being known as an NGO having its key interest in the water sector. After the testing in 1997, a national workshop provoked neutral reactions from the Central Health Department. In the following two years, 1998/99 Eawag/Sandec provided small funds for advocacy activities to develop a SODIS network in Indonesia. During this period, YMP in Lombok was founded and identified as a reliable partner.

During the years 2000-2002, SODIS was promoted to more organizations in Java, Madura, East Nusa Tenggara, and West Nusa Tenggara. Furthermore, SODIS materials were developed and **small initiatives fund to any interested organizations provided to promote SODIS in the field**. Finally, it was decided to work together with YMP, also because YMP held close ties with governmental institutions.

Starting in April 2003, SODIS promotion activities took place, first with a project in the district of East Lombok (Lombok Barat) on Lombok Island with a funding from the Georg Fischer Foundation. This area at that time had a massive lack of safe drinking water with people consuming largely untreated water as well as an above-average diarrhea incidence rate. YMP was the implementing partner under the supervision of YDD. The promotion activities went on for about 12 months until mid of 2004. In 2005-2006, with a new funding from SIMAVI Netherlands, further SODIS promotion activities were implemented in Lombok, but in different communities. Parallel, in 2005-2007, SODIS promotion activities as tested in Lombok were replicated in communities in a second district, Sikka, on Flores Island. In Sikka, infrastructure was virtually non-existent at that time. Here implementation was realized by a branch-office of YDD, YDD-NTT, supervised by YDD.

About 250.000 bottles were funded and mostly provided for free to the health centers with the idea to establish a rotating fund for selling bottles. During actual project implementation however, the households in most villages on both islands, Lombok and Flores received the bottles for free. Parts of these bottles are still in stock with YDD.



In their SODIS promotion projects, YDD first approached the District Health Department to present and introduce their project. Then 1-2 villages per sub-district were selected out of 14 sub-districts in Sikka, Flores and 18 in East Lombok, Lombok. The field work was always realized together with the local health clinics, (*puskesmas*), in particular the head of a health clinic and the 1 or 2 Environmental Health Officer (*sanitarian*) each clinic has. The *sanitarian* is the person responsible for all health issues related to the environment within a health clinic like Malaria, Diarrhea, or other issues. The *sanitarians* took the role of conducting community trainings together with YDD staff and Voluntary Health Worker (*kader*). The *kaders* were trained to realize the monitoring activities, 1x per week for one year.

In addition to these Eawag/Sandec driven projects carried out by YDD, in 2005-2007 a larger project called WSLIC-2 (Water and Sanitation for Low Income Communities, phase 2) took place, funded by the World Bank and the Government of Indonesia. This project took place in 5 provinces with 2.000 villages. East Lombok was one of these target districts. The project rather targeted water supply (wells, water tanks, water pipes) than treatment; however, during community trainings household water treatment options were presented, amongst others SODIS. These trainings were realized by professional promoters. Often, some bottles were also distributed. In contrast to the YDD run projects, no follow-up and monitoring program on household level existed on SODIS (or other HWTS) use.

While promotional efforts at household level in Lombok have ceased after 2005 due to a lack of funding, continuous promotion of SODIS as an integral part of a water and sanitation project in Flores funded by SIMAVI Netherlands is guaranteed until 2012. Also in this project, like in the WSLIC project, the main project focus is water and sanitation infrastructure with HWTS as supplementary information.

### 3.1 Investigated communities

In the following Table 2, the communities selected for the sustainability analysis are presented. Selection criteria were promotion year, implementing organization, and urbanization. It was tried to have as much variety as possible. The SODIS sustainability study focused on communities on the islands Lombok and Flores.

As mentioned above, the communities were selected based on 4 criteria: year of promotion activities (2003-2010), implementing organization (YMP, YDD, or Government), and urbanization level (rural, periurban, or urban). As can be imagined, we were by far not able to investigate all combinations. Promotion during the years 2003 and 2004 only took place in Lombok, whereas promotion during 2006 to 2010 only took place on Flores. YMP and the government only worked on Lombok, whereas YDD is an NGO based in Flores. All combinations we were able to find are presented in Tables 2 and 3. In general, the majority of communities were located in low income rural areas who had received HWTS promotion by an NGO working closely together with the local health clinics. A detailed list with all community names can be found in the Annex (Table 10).

**Table 2.** Combinations of promotion phase, implementing organization, and urbanization as well as island. Number of households (N) and percentages (%) of total N are given.

Promotion phase	Organization	Urbanization	Island	N	%	Area Code <sup>a)</sup>
2003	NGO & Government	rural	Lombok	51	5%	1
2003	NGO & Government	urban	Lombok	52	5%	2
2004-05	NGO & Government	rural	Lombok	148	15%	3-5
2005	NGO & Government	rural	Lombok	104	10%	6, 7
2005	NGO & Government	periurban	Lombok	52	5%	8
2005	Government	rural	Lombok	101	10%	9, 10
2005-06	NGO & Government	rural	Flores	251	25%	11-15
2005-06	NGO & Government	periurban	Flores	49	5%	16
2005-06	NGO & Government	urban	Flores	49	5%	17
2007-10	NGO & Government	rural	Flores	49	5%	18
2007-10	NGO & Government	periurban	Flores	55	5%	19
2007-10	NGO & Government	urban	Flores	53	5%	20
				1014	100%	

Note: NGO = Non-Governmental Organization, a) refers to the area code used in the Annex (Table 10).

**Table 3.** Summary of Table 2, containing total number of households (N) and percentages (%).

Promotion phase			Organization			Urbanization			Island		
N	%	Category	N	%	Category	N	%	Category	N	%	Category
103	10%	2003	913	90%	NGO/Gov	704	69%	rural	508	50%	Lombok
148	15%	2004-05	101	10%	Gov	156	15%	periurban	506	50%	Flores
257	25%	2005				154	15%	urban			
349	35%	2005-06									
157	16%	2007-10									

Note: Cat. = Categories, Gov = Government, NGO = Non-Governmental Organization.

## 3.2 Demographics of the investigated communities

In the following, some selected demographic information is given: age, gender and education of the interviewed person as well as rooms available per household, household size, existence of children below 5 years of age, socioeconomic status defined as rooms per person, and income (Table 4). However, it has to be noted that the question about household income was only answered by about 80% of the sample, so data about income may be biased.

Overall, we find significant differences between the 2 islands for all demographic indicators, but also within each island a considerable range was observed. Therefore, demographic indicators are given separately for each island, including its range.

Comparing Lombok and Flores, we find that in Lombok the interviewed person is 2.2 years younger, 15% more women were interviewed, and education level is 2 years lower than in Flores. People's houses have similar sizes (3.4 and 3.3 rooms, respectively). Household size is bigger in Flores with 5 persons per household compared to 4 in Lombok and 12% more households have one or more children below 5 years of age. The resulting socioeconomic status as well as the income per household is higher in Lombok than in Flores.

**Table 4.** Means (M) and standard deviations (SD) of demographic indicators, calculated separately for Lombok and Flores.

Demographic indicator <sup>a)</sup>	Lombok					Flores					p
	N <sup>b)</sup>	<b>M</b>	SD	Min	Max	N <sup>b)</sup>	<b>M</b>	SD	Min	Max	
Age	494	<b>40.2</b>	11.6	36.1	44.3	504	<b>42.4</b>	12.4	38.1	45.5	0.003
Gender	498	<b>80%</b>	40%	62%	92%	499	<b>65%</b>	48%	53%	81%	0.000
Education	508	<b>4.96</b>	4.64	2.83	7.25	494	<b>6.93</b>	3.358	5.81	8.11	0.000
Rooms	487	<b>3.41</b>	1.27	3.12	3.71	498	<b>3.18</b>	1.173	2.42	3.56	0.004
Household size	507	<b>4.14</b>	1.71	3.46	4.66	506	<b>5.21</b>	2.151	4.79	5.68	0.000
Children	505	<b>36%</b>	48%	25%	48%	506	<b>48%</b>	50%	42%	58%	0.000
Socioeconomic status	486	<b>.94</b>	.50	0.82	1.19	498	<b>.71</b>	.38	.57	.86	0.000
Income (x 1000)	409	<b>653</b>	669	413	952	377	<b>498</b>	489	280	817	0.000

Note: M = mean (highlighted bold), SD = standard deviation, N = Number of cases, Min = minimum mean of island, Max = maximum mean of island, p = significance level (p) of a t-test, which was calculated to obtain significance levels between the 2 islands. <sup>a)</sup> age: of the interviewed person in years; gender: of the interviewed person, % women; education: of the interviewed person in years; rooms: number of rooms in which the family lives (without bathroom and small kitchen); household size: number of persons per household; children: % of households with children below or equal to 5 years of age; socioeconomic status: calculated rooms/person; income: in 1000 Indonesian Rupiahs (1USD=9'300IDR, November 2009). <sup>b)</sup> there is always some missing information, which causes variation of N.

Within the island of Lombok, significant differences between the 10 villages are found for age, gender, education, household size, and socioeconomic status. The mean age of the interviewed person ranges from 36 years in Pohgading to 44 years in Dasan Lekong (p=.019). Percentage of women among interviewed persons ranges from 62% in Sukamulia to 92% in Pringgabaya (p=.003). Education varies considerably: the villages of Panede Gandor and Kalijaga Timur have the highest education standards with 7.3 and 6.7 years, respectively, which is more than double the amount of the village with the lowest education standard, Sepit (2.8 years; p<.001). The number of rooms a household lives in is quite similar in all villages and ranges from 3.1 to 3.7 rooms per household. However, the household size varies significantly between villages from 3.5 to 4.7 persons per household, which in turn results in significant differences of socioeconomic status, defined as rooms available per person, ranging from 0.8 in Sukamulia to 1.2 in Suangi (p=.008). The percentage of families having one or more children below 5 years of age shows quite a range between villages (25% to 48%), but no difference was found to be significant. Household income shows a considerably large range from 413'000 IDR in Kalijaga Timur to 952'000 IDR per month in Sakra.

Comparing the 10 villages of the island Flores with each other, significant differences were found for education, rooms, socioeconomic status, and income. Age varies insignificantly between 38 years in Ngolo and 46 years Watuliwung, as well as percentage of interviewed women from 53% in Nawateu to 81% in Bebeng. Education shows a larger range, however, not as large as it was observed for Lombok. The lowest education level was found in Ngolo with 5.8 years and the highest one in Waioti with 8.1 years (p=.036). The number of rooms a household lives in is lowest in Ngolo with only 2.4 rooms per household, resulting also in the lowest socioeconomic status of only 0.57 rooms per person. Paga 1 has the highest number of rooms per household with 3.6, but the highest socioeconomic status was found for Ipir with 0.86 rooms per person. Household size and percentage of families having children varies only insignificantly between villages. In Ipir we find the lowest household size with 4.8 and in Ubamoro we find 5.7 persons living in one household. Between 42% (Watuliwulung) and 58% (Bebeng) of the families have children below 5 years of age. Income certainly is the one indicator that shows the largest range from 280'000 IDR in Ipir to almost three times as much (817'000 IDR) in Waioti.

A complete table with mean values listed for each village separately can be found in the Annex (Table 10).

Overall, Flores has a higher education level but also larger household sizes, more children below 5 years of age, as well as lower socioeconomic status and income. However, large variance was also found within each of the islands.

### 3.3 HWTS promotion strategies used by our Indonesian partners

The following descriptions and data are mainly from the interviews with previous promoters. One promoter per area was interviewed. In 2 areas, Watuliwung and Watuwoga, 2 promoters were interviewed. All numbers given in the following are based on 20 promoter interviews. In the two areas with government promotion, Sakra and Dasan Lekong on Lombok, no promoter was possible to be interviewed. Therefore, the following information only reflects promoters' opinions of the areas with YDD and YMP promotion activities.

In case of the promotion through the government within the WSLIC project (areas Sakra and Dasan Lekong on Lombok), three hired professional community facilitators introduced the project (where HWTS and SODIS was one part of it) to the community. No monitoring to the households took place.

The promotion strategy applied in the Indonesian YDD/YMP SODIS projects was first developed and tested on Lombok and then replicated in Flores. Therefore, all areas (except the 2 ones with only government promotion) received the same promotion strategy. First, YMP and YDD approached the district health department to present the project. Then they held a **stakeholder workshop**, inviting heads of the local clinic, heads of villages, and local NGOs to inform about the planned project and SODIS in particular. After the stakeholder workshop, a TOT (**Training of Trainers**) to local *sanitarians* and their local staff was given. The *sanitarians* together with YDD/YMP staff were responsible for **training the future promoters**, the *kaders*, and to carry out the **community trainings**. After the community training, the *kaders* were responsible for the **follow-up monitoring** to the households. Supervision of the *kaders* was realized by the *sanitarians*.

*Kaders* are mostly women who already promote health topics in their community and get appointed by the local health clinic. They got paid very little (approx. 25'000 IDR per year) and were responsible for 30-40 households each. They were expected to visit the households once every week during one year after the initial community training.

#### 3.3.1 Training of the sanitarians (TOT) and kaders

The TOT to the *sanitarians* lasted three days and was conducted by central YDD staff. SODIS and HWT was introduced and it was discussed how the community trainings would be best implemented in a given community.

The *kaders* were trained by the *sanitarians* during one day in their villages. Participation in these trainings was enjoyed quite a lot by the interviewed promoters<sup>1</sup> (M=3.3, SD=0.8), they found it

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<sup>1</sup> Did you enjoy participating in the trainings? 0 = not at all, 4 = very much

interesting<sup>2</sup> (M=3.1, SD=0.8) and learned enough about SODIS to be a good promoter<sup>3</sup> (M=3.4, SD=0.8).

### 3.3.2 Community training

Community trainings were held on sub-sub-village basis, covering 30-50 households. If more households lived in an area, several trainings were held. All households of the respective area were invited. Usually, women came to attend the trainings. The trainings were conducted by *sanitarians* and/or YDD/YMP staff. These community trainings were conducted as a first mean of information transmission to the households, which is surely more time-efficient than addressing each household individually.

At the beginning of the training, leaflets were distributed. In a game, water pollution routes and where they can be disrupted were identified. Then SODIS as a new water disinfection method was introduced with flip charts. Preparing the bottles was demonstrated by the trainer and practiced by the participants. Tasting opportunities of different water types were provided and concluding, advantages and disadvantages of each HWT method were discussed. At the end of the training, 7.8 (SD=4.2) bottles per household were distributed, therefore, bottles were not judged to be a problem during the project time<sup>4</sup> (M=0, SD=0).

Using group trainings as a first entry point to communities seems to be time-efficient and accepted by the people and can be recommended further. However, it was repeatedly reported that initially providing bottles for free to the households resulted in people expecting further free provision of bottles and willingness to pay was very low. Consequently, once the given bottles were damaged, people stopped preparing SODIS water. It is recommended that future projects should never provide any HWTs products for free (e.g. SODIS bottles, filter units, chlorine tablets). If it is assumed that people cannot afford buying those products, subventions specifically targeted to poor households may be an option.

### 3.3.3 Monitoring (= follow up)

As a follow up and monitoring strategy, households were visited one by one during the months after the community training by the promoters. This type of monitoring often already is part of their work; they simply integrate the new topic. Frequency and duration of the monitoring varied across areas from approx. once per month to several times per week. On average, households were visited 4.8 times per month (SD=2.8). Probably, the frequency was only high during the beginning of the project, but not during the entire project duration of 12 months. Each promoter was on average responsible for around 30 households (SD=10), with the exception of some promoters with a supervisor function who handled up to 200 households. In 50% of the areas, SODIS is sometimes still a topic during household visits or private conversations of the promoters.

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<sup>2</sup> Were your SODIS trainings interesting? 0 = not interesting at all, 4 = very interesting

<sup>3</sup> Did you learn enough about SODIS in the trainings? 0 = not enough at all, 4 = clearly enough

<sup>4</sup> Do you think bottle availability was a problem for the people during the project? 0 = no problem, 4 = a very big problem

In 90% of the cases, the promoters received some incentives or payment for at least a part of their work. However, those incentives were not perceived as adequate<sup>5</sup> (M=1.1, SD=1.0).

Summarizing, monitoring is certainly a good tool to support people's development of a new behavior. However, if promoters do not feel adequately rewarded, motivation is not expected to last very long. Giving incentives does not always imply monetary payments, also work certificates or some kind of public recognition would surely be appreciated.

### 3.3.4 Evaluation of the promotion strategy

The interviewed promoters judged the applied strategy as generally being good<sup>6</sup> (M=2.6, SD=1.1) and liked by the promoters<sup>7</sup> (M=3.2, SD=1.1). For most targeted people the application of SODIS was not hard to understand<sup>8</sup> (M=3.1, SD=1.2) and informative<sup>9</sup> (M=3.4, SD=0.7). Also, convincing people was quite easy<sup>10</sup>, because the local health clinic was involved (M=3.3, SD=0.5) and the promotion itself was attractive for the people<sup>11</sup> (M=3.4, SD=0.5).

The promoters estimated on average that after the promotion phase between 50% and 100% of the people started to use SODIS (M=89, SD=15), whereas current SODIS use (at the time of the interview) was estimated to be only around 23% (SD=27). Both estimations seem to be quite accurate according to the data we collected from the households. According to their own statements, 90% of those who were informed about SODIS had started using it at some point after the promotion phase and currently 26% use SODIS at least irregularly.

The project work was liked only at a medium level by the promoters<sup>12</sup> (M=2.1, SD=1.4), institutional support was perceived as good<sup>13</sup> (M=3.2, SD=1.0), and promoters felt competent to promote SODIS<sup>14</sup> (M=3.2, SD=1.0). The latter perception was supported by their knowledge about SODIS, which was rated to be overall good and profound<sup>15</sup> (M=3.2, SD=0.7). 75% of the promoters believed that SODIS removes all bacteria in the water, and water was seen as more important compared to other health topics.

Summarizing, the promotion strategy (training + monitoring) seems to be good, it was liked by the promoters, and can therefore be recommended further. However, only moderate liking of the overall project work was expressed by the promoters. The reasons need to be explored further since higher current SODIS use was observed when promoters expressed stronger liking of previous project work. In addition, more current SODIS users were observed if the promoters had felt more competent to promote SODIS, and if they gave water a high importance among health topics. Consequently, it

<sup>5</sup> Did you feel the incentives (includes money) you received were adequate? 0 = not adequate at all, 4 = very much adequate

<sup>6</sup> How good or bad do you think was this promotion strategy? -4 = very bad, 4 = very good

<sup>7</sup> Did you like or dislike the promotion strategy? -4 = disliked very much, 4 = liked very much

<sup>8</sup> Do you think SODIS is hard to understand for the people? 0 = not at all, 4 = very hard to understand

<sup>9</sup> Do you think the household visit is informative for the people? 0 = not at all informative, 4 = very informative

<sup>10</sup> How convincing do you think was this promotion strategy? 0 = not at convincing, 4 = very convincing

<sup>11</sup> Do you think this promotion strategy was attractive for the people? -4 = very unattractive, 4 = very attractive

<sup>12</sup> Did you like or dislike the project work? -4 = disliked very much, 4 = liked very much

<sup>13</sup> Did you feel well supported by your local NGO/sanitarian/puskesmas? 0 = not well supported at all, 4 = very well supported

<sup>14</sup> Did you feel competent enough to be a good SODIS promoter? 0 = not competent at all, 4 = very competent

<sup>15</sup> Interviewer: Please rate the level of knowledge on a scale! 0 = no knowledge, 4 = very profound knowledge

should be assured that promoters enjoy the project work, are trained well enough to feel competent for the promotion task and value the topic they promote as very important.

### *3.3.5 Problems and reasons for non-use of SODIS as perceived by promoters*

The main problem mentioned by almost every single promoter is the current bottle supply. After the community trainings, sufficient bottles were given for free to the households (M=8 bottles per household, SD=4). Later, the promoters received bottles from YDD and were instructed to sell them. This, however, worked only moderately well. Problems related to the bottle supply are manifold, some people think only the originally distributed bottles from YDD are the "real" SODIS bottles and refuse to use ordinary water bottles, others do not show any willingness to pay although bottles are available (even the original YDD bottles in some areas), some people claim the market is too far away to buy bottles, and others suspect the promoters to make a lot of money when they sell the bottles.

Additional reasons for non-use of SODIS were the use of gallon water as the economic situation improves, no time to prepare the bottles, and lack of monitoring.

One rather questionable reason to stop SODIS was that people returned to boil water, because recently wood was started to be given out for free. In contrast, during the project time, wood or kerosene used to be quite expensive. Since returning to burning fossil fuels instead of using free solar radiation is rather a step backwards, such policy should be questioned.

### *3.3.6 Characteristics of the promoters*

The promoters across all areas were quite a homogenous group of people already having been involved in health promotion and household monitoring for some time. The average age was 44 years (SD=10) and mostly women were working (80%). All promoters were local community people.

## **4 Water consumption pattern**

In this section, an overview is given about which types of water people consume, which combinations of different consumed water types exist, and what are the proportions of the different consumed water types. In a second part, the water consumption pattern is related to the demographic indicators, as well as situational variables like promotion phase, and urbanization level, implementing organization and island.

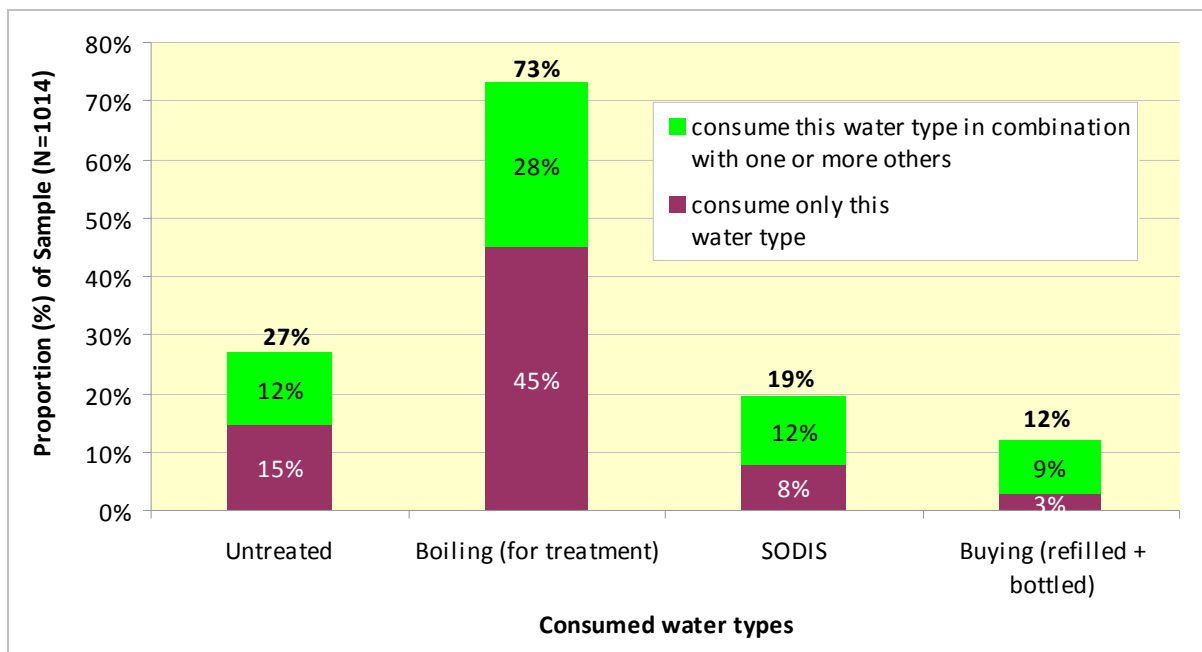


## 4.1 Description of water consumption

Out of 1014 households, 275 (27%) stated to have consumed untreated water during the last 2 weeks<sup>16</sup>. Of the water treatment options, boiling was by far most common (N=742, 73%), followed by SODIS (N=197, 19%). 123 (12%) households buy their water; 72 households (7%) consume so called *isi ulang* (refilled water) and 65 households (6%) buy bottled water. Chlorine is used by only 7 households (1%), and operating filters were only found in 1 household.

These percentages, because they add up to more than 100%, imply that a considerable amount of households consume not only one water type (see Figure 1). A detailed list of all combinations is given in Table 5.

**Figure 1.** Water consumption pattern. Proportions of households (N=1014) only consuming one water type and proportions of households consuming two or more water types are given.



<sup>16</sup> Did you consume during the last 2 weeks: water direct from the source (untreated), boiled water (like coffee, tea etc.), boiled water for drinking, bought (water, soft drinks), refilled water (*isi ulang*), filtered water, chlorinated water, SODIS water, other. 0 = no, 1 = yes

**Table 5.** Water consumption pattern. Number of households (N) and percentages (%) of total N are given as well as proportions of consumed water types.

Consumed water types last 2 weeks (% yes)	N	%	Proportions of different water types (100% = amount of total daily water consumption)
<b>Boiled</b>	456	45%	100% boiled water incl. 16% for tea/coffee
<b>Untreated</b>	149	15%	84% untreated water, 16% boiled water for tea/coffee
SODIS + Boiled	91	9%	49% SODIS water, 51% boiled water incl. 12% for tea/coffee
Untreated + Boiled	90	9%	40% untreated water, 60% boiled water incl. 16% for tea/coffee
<b>SODIS</b>	80	8%	89% SODIS water, 11% boiled water for tea/coffee
Bought + Boiled	64	6%	31% bought water (24% refilled + 7% bottled), 67% boiled water incl. 16% for tea/coffee
<b>Bought</b>	27	3%	89% bought water (58% refilled + 31% bottled), 11% boiled water for tea/coffee
Untreated + Bought + Boiled	13	1%	25% untreated water, 27% bought water (15% refilled + 12% bottled), 47% boiled water incl. 12% for tea/coffee
Untreated + SODIS + Boiled	9	1%	N too low for calculation
Untreated + Bought	7	1%	
Other combinations, each N<5	28	3%	
<b>TOTAL</b>	<b>1014</b>	<b>100%</b>	

Note: N = number of households.

**Untreated water:** Out of the 275 households consuming untreated water (27% of total sample), more than half (54%, N=149) consume entirely untreated water (apart from a small part of the water that is boiled for hot beverages). The other half of untreated water consumers (46%, N=126) combines the consumption of untreated and treated water. Most commonly, these households boil some of their water (42%, N=116).

**Boiled water:** Boiling – the by far most common HWT option – was practiced by 742 households (73% of the population). Almost two thirds of them (61%, N=456) boil all the water they consume. 16% of boiled water consumers (N=116) drink untreated water in addition and 26% (N=196) combine boiling with other HWT options, mainly SODIS (N=111, 15%). A known drawback of boiling, however, is its high costs and a lack of safe storage after boiling.

**SODIS water:** A total of 197 households (19%) stated to consume SODIS water. 80 (41%) of them consume exclusively SODIS water, most of the other 117 households consume SODIS water in combination with boiled water (N=111, 56%). Only 15 households (8%) of those consuming SODIS water also consume untreated water.

**Bought water:** Buying water also is quite common in Indonesia. Apart from buying bottled water, so called 'refilled water (*isi ulang*)' can be purchased in small stores. The water is treated with a filter system in the shop and sold in gallons. As these gallons can be refilled, this option is less costly than bottled water. Buying *isi ulang* is considered more prestigious than boiling water. However, maintenance of the filter systems in the shops is of varying quality and there is no monitoring system in place. In a field test of *isi ulang* conducted by YDD in and around Yogyakarta, 30% of the samples showed microbiological contamination. In our sample, 123 households (12%) buy either refilled or bottled water, or both. 72 households (7%) use *isi ulang* and 65 (6%) buy bottled water. 17 households (14%) consume exclusively *isi ulang* while only 9 households (7%) exclusively rely on bottled water. The majority of those buying water also boil parts of their water (N=85, 69%). 21 households (17%) of the ones buying water also consume untreated water.

**Chlorine:** Chlorine is used by only 7 households (1%), and operating filters were only found in 1 household. Mostly, chlorine is used in addition to other treatment options (N=6, 86%). Some households (N=12, 1%) consume other liquids like coconut milk in addition to water.

Summarizing, 15% drink only untreated water (N=149), 12% drink untreated water in addition to treated water (N=126), 56% use only one water treatment option for all their water (N=564), and 17% use 2 or more different water treatment options (or a combination) for all their water (N=175). If we consider *isi ulang* as safe water, we can define 56+17%=73% as complete safe water consumers (**SWC**) and 15+12%=27% as unsafe water consumers (**UWC**).

Interestingly, if water is treated, people tend to decide for one treatment option. Most prevalent, exclusive boiling is used by 45% and exclusive SODIS by 8%. One quite popular combination is SODIS and boiling (9%), where people boil half of the amount of water they consume and treat the other half with SODIS. Both water types are consumed on a daily basis. In contrast, if people consume untreated water, they often do so in addition to treated water. So, only 15% exclusively consume untreated water and have to be considered quite resistant to previous HWTS campaigns.

## 4.2 Safe water consumption related to demographic indicators

Often, safe water consumption (SWC) is suspected to be related to demographic indicators. Here, the relation to the age of the interviewed person, his/her education level, number of rooms per family, number of total people living in one family, if the family has children below 5 years of age, and the socioeconomic status (rooms/person) were investigated.

Table 6 shows that only for age and education there is a notable difference between UWC and SWC – SWC are on average 3 years older and have 2 years more education than UWC ( $p < .001$ ). Accordingly, also in the logistic regression including all demographic indicators, only age and education turn out to be a significant predictor of SWC (OR=1.03 per year of age,  $p < .001$  and OR=1.14 per year of education,  $p < .001$ , respectively). So, being older and having a higher education level increase the chance of being a SWC.

**Table 6.** Odds ratios for safe water consumers (SWC; N=689) compared to untreated water consumers (UWC; N=256) regarding various demographic indicators.

Variable	UWC	SWC	OR	Lower C.I.	Upper C.I.	p
Age in years	39	42	<b>1.03</b>	1.015	1.043	.000
Education in years	4.66	6.45	<b>1.14</b>	1.091	1.182	.000
Number of rooms in which the family lives (without bathroom and small kitchen)	3.20	3.32	0.98	.803	1.201	.859
Number of persons per family	4.39	4.75	1.06	.918	1.220	.438
% of families with children below or equal to 5 years of age	41%	43%	1.08	.774	1.524	.632
Socioeconomic status: calculated rooms/person	0.84	0.81	0.98	.524	1.816	.938

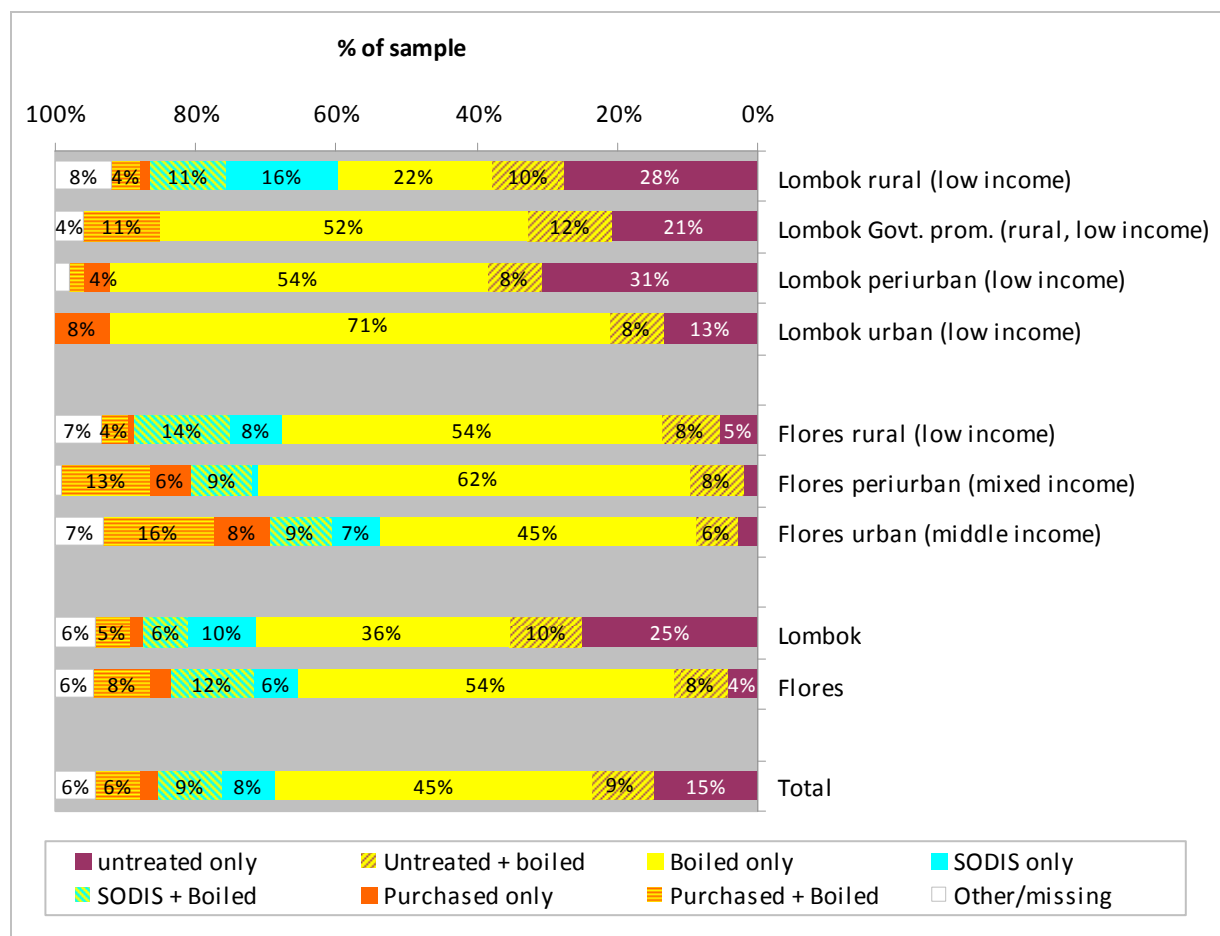
Note: UWC = Unsafe water consumers, SWC = Safe water consumers, OR = Odds ratio (significant OR at  $p < .05$  level are marked bold), C.I. = Confidence interval of OR, p = Significance level. All OR were calculated with one multivariate logistic regression using the entire sample (N=954 due to listwise deletion of missing values); a constant was included in the models. Explained variance of the dependent variable is 8.4% (Nagelkerke).

Higher age and education level increase the chance of being a SWC by 6% per year for age and 14% per year of education. The other demographic indicators – number of rooms per family, number of total people living in one family, if the family has children below 5 years of age, and the socioeconomic status (rooms/person) – do not have an impact of SWC.

### 4.3 HWTS use across different investigated areas

In the following, water consumption is split up across different types of communities. The 20 areas are clustered into 7 categories according to the criteria island (Lombok = early promotion; Flores = late promotion), implementing organization (all NGO, except one community on Lombok), and urbanization. HWTS promotion on Lombok has taken place in earlier years (2003-2005) than on Flores (2005-2010). The difference in water consumption on the two islands is therefore influenced by the fact that much more time has passed since promotion at household level stopped on Lombok than on Flores. Figure 2 displays the most common usage statistics of untreated water consumption, HWTS options and combinations.

**Figure 2.** Distribution of untreated water consumption, HWTS use and combinations across community clusters.



Quite a range of different water consumption pattern was observed. The main trends we observe are:

- Almost three times as many people on Lombok consume untreated water compared to Flores.
- Exclusive boiling is the dominant HWTS option on both islands.
- Combinations of SODIS or purchasing water with boiling are equally attractive on both islands.
- In urban areas on Lombok, fewer households consume untreated water than in rural and periurban areas.
- SODIS use does only occur in rural areas on Lombok while on Flores SODIS is used across all urbanization levels
- Governmental promotion has not lead to the use of SODIS. Instead, an above-average amount of households consumes purchased together with boiled water.
- On Flores, more periurban and urban households purchase water compared to Lombok periurban and urban areas.
- Purchasing drinking water is not very common among rural households on both islands.

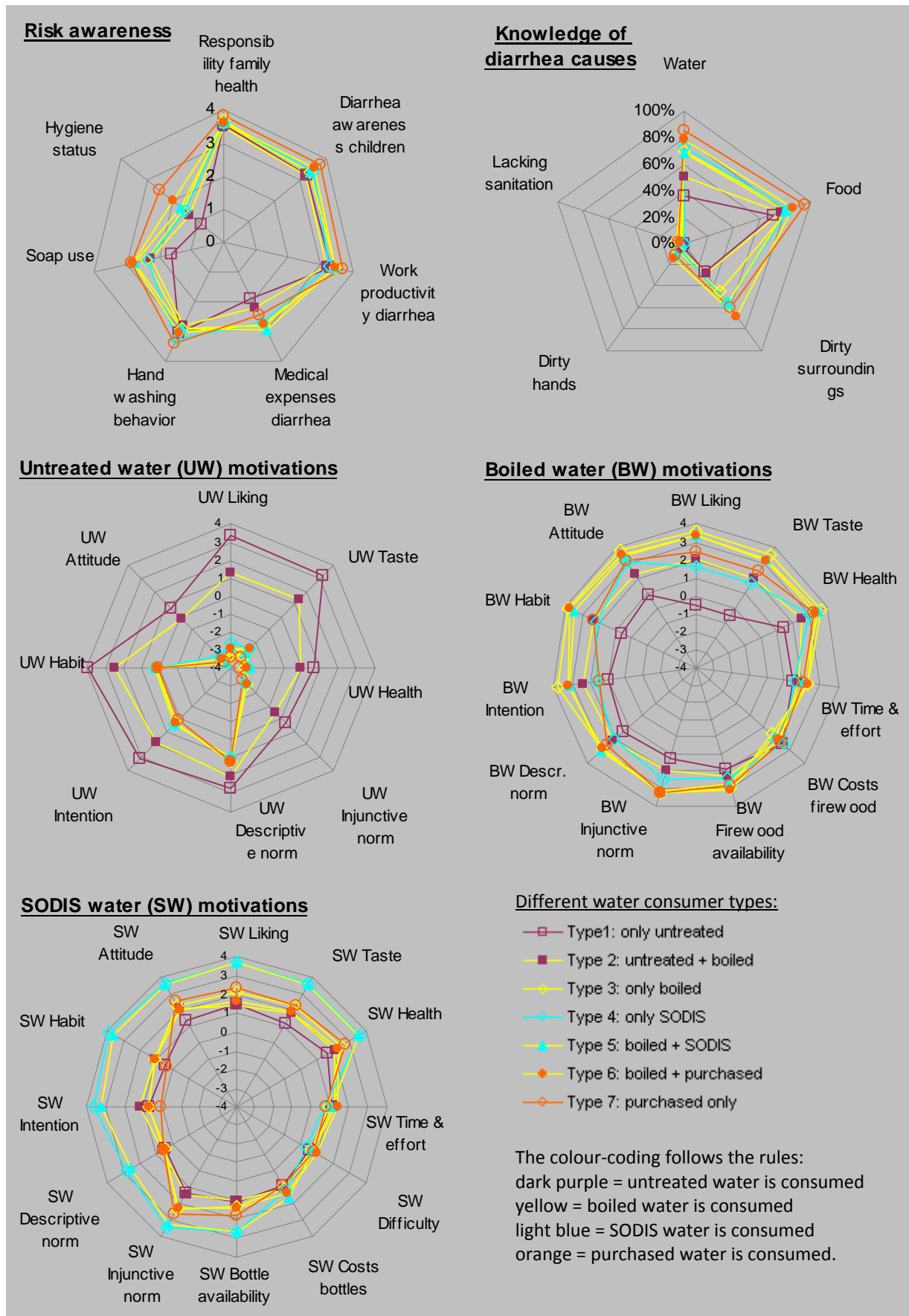
Summarizing, on Lombok the need is greater for further HWTS promotion activities as more households rely on untreated water. Since boiling is still very common across all communities, attention should be paid to ensure safe water storage at people's homes. Purchasing water seems to be a new alternative, gaining popularity. Here special attention must be paid to water quality monitoring in shops selling such water. SODIS is a feasible alternative in some communities, while in others no one seems to be particularly interested in the method. The type of bottle supply scheme (free vs. paid) has played a role here.

## 4.4 Motivations underlying HWTS use

Different motivations underlying the use of boiling and SODIS were investigated to know which ones are the real drivers of people HWTS use behavior. Additionally, people's motivations to consume untreated water, their general risk awareness and knowledge of diarrhea causes were also assessed. The motivations are derived from theories of behavior change. For more details on theoretical background, see Annex.

Motivations are presented for different types of water consumers. The groups are defined according to Figure 2. We differentiate between consumers of: untreated water only, untreated and boiled water, boiled water only, SODIS water only, SODIS and boiled water, purchased and boiled water, and purchased water only. The profile related to the topics risk awareness, knowledge of diarrhea causes, motivations related to untreated water, motivations related to boiled water and motivations related to SODIS water of all groups can be found in the following 5 spider diagrams, Figure 3.

**Figure 3.** Profiles of the 7 most common water consumer types (defined in Table 5).



Note: Exact wording of items, scale end points and all values depicted in the diagrams can be found in the Annex.

#### 4.4.1 Risk awareness and knowledge on diarrhea

All people, independent of the water they consume, feel responsible for their family's health, they are aware that diarrhea is a severe disease for young children and they know their work productivity is reduced when they have diarrhea. However, those consuming untreated water (types 1 and 2) have a slightly lower awareness that water treatment can reduce their medical expenses. Although all people quite regularly wash their hands before eating and after the toilet, soap is used a bit more frequently by those who consume treated water (types 2 to 7). Also, the hygiene status of those consuming only treated water (types 3 to 7) is somewhat higher.

People not consuming any untreated water (types 3 to 7) have a better knowledge of the main causes of diarrhea: contaminated water, food and dirty surroundings. Dirty hands and lacking sanitation was only mentioned by very few people.

#### 4.4.2 Motivations to consume untreated water

Clearly, people *only* consuming untreated water (type 1) have the most positive perception of untreated water. They strongly like the consumption and taste of untreated water, they perceive many of their social contacts also drinking untreated water, they have a medium intention and habit to consume untreated water, they have a slightly positive attitude towards untreated water consumption, they are completely unaware of the negative health impact of untreated water, and they think neutral about others consuming untreated water. People consuming boiled water in addition to untreated water (type 2) already think a little bit more negatively about untreated water consumption, but still mostly think positively about it. In contrast, all those who never consume untreated water have medium to strong negative perceptions of untreated water, are aware of its negative health impacts, have no intention and habit for future untreated water consumption and perceive only few others around them consuming untreated water.

Overall, the differences between untreated and treated water consumers are very pronounced for all motivational indicators, except the perception of the social norm. Here the difference, although significant, is less pronounced.

#### 4.4.3 Motivations to boil water

Almost all people boil water, however, to a varying degree. Some boil only small parts of their drinking water to make coffee or tea, others additionally boil water for treatment but still not 100% of the water they consume and others boil 100% of it. We consider as "people who use boiling" those people who use boiling for water treatment of either parts or all of their drinking water.

The most positive motivations to consume boiled water are found among people consuming exclusively boiled water or boiled water in combination with another treated water type (i.e. SODIS or purchased water; types 3, 5 and 6). These people strongly like the consumption and taste of boiled water, they think it's healthy, firewood is perceived to be available, the social norm to consume boiled water is high as well as their intention to consume boiled water also in the future, their habit and overall attitude. In contrast, if people in addition to boiled water also consume untreated water (type 2), their motivations, intention and habit related to boiled water are less positive or strong. People consuming only purchased or only SODIS water (type 4 and 7) also perceive boiled water as



only medium positive and have a low intention for future consumption of boiled water. The least positive – though not negative – motivations related to boiled water are found among untreated water consumers (type 1). Interestingly, as a tendency, people who consume boiled water perceive it as more time consuming and effortful than those who don't use boiling at all. Firewood is universally perceived as medium costly, except by those who exclusively consume boiled water (type 3).

Overall, the largest differences and thus the most important motivations to use boiling for treating drinking water are a stronger liking of boiled water and its taste, a stronger intention to use boiling also in the future, a stronger habit to boil water and a more positive overall attitude towards boiling.

#### 4.4.4 Motivations to use SODIS

Motivations related to SODIS use are more positive among those people who also use it, either as the only HWTS method (type 4) or in addition to boiling (type 5) compared to those who do not use SODIS. Current SODIS users strongly like the consumption and taste of SODIS water, they perceive a strong health benefit in drinking SODIS water, they think well of other people who also use SODIS, they think that more than half of the people in their community use SODIS, they have a stronger intention to continue using SODIS, it is much more their habit to use SODIS and in general, they strongly believe that using SODIS is something good. Interestingly, SODIS users and non-users have similar perceptions that SODIS is not time consuming, effortful or difficult to use. SODIS bottles are perceived to be affordable, but their availability is judged lower by those who don't use SODIS.

Overall, the largest differences and thus the most important motivations to use SODIS for treating drinking water are a stronger liking of SODIS water and its taste, a stronger intention to use SODIS also in the future, and a stronger habit to use SODIS. Also, perceptions of health benefit, social norm and bottle availability are somewhat stronger among SODIS users. Interestingly, no differences were found for rational beliefs like effort, difficulty and time it needs to prepare SODIS as well as costs of bottles.

## 5 SODIS water consumption

In this section, more details are described related to SODIS use. Especially, the use of SODIS during project time and afterwards is analyzed. As SODIS had been a novel approach to treat drinking water at the time of the projects, a closer look is taken into how knowledge about the method was sustained, whether people tried out the method, why they stopped again and what are their current motivations to continue using it.

## 5.1 Development of user percentages

Of the 808 households who had received information about SODIS and knew the method to at least some degree, only 12% (N=95) never tried out the method. The majority of 713 households (88%) started to use SODIS. However, 71% (N=505) of those who once started are not currently using SODIS anymore. Only 29% of those who once started or 26% of all who heard about SODIS, respectively, continued to use the method. Out of these households, almost all stated to be regular SODIS users (daily SODIS water consumption), treating on average 66% of their water with SODIS. Only 11 households stated to use SODIS on an irregular seasonal basis. Table 7 summarizes the different SODIS non-user and SODIS user categories we will look at in the following.

**Table 7.** Number of households and percentages of total sample of different SODIS non-user and user categories.

Category	N	%	Knowledge level <sup>a)</sup>	Previous SODIS use	Current SODIS use
Non-knower	206	20%	no	no	no
Non-user	95	9%	1.8*	no	no
Relapser	505	50%	2.4*	yes	no
User	208	21%	3.0*	yes	yes
TOTAL	1014	100%			

Note: N = number of households, \* = significantly different from other values in the same column, <sup>a)</sup> knowledge level as judged by the interviewer after the SODIS process was explained, scale range 0 to 4.

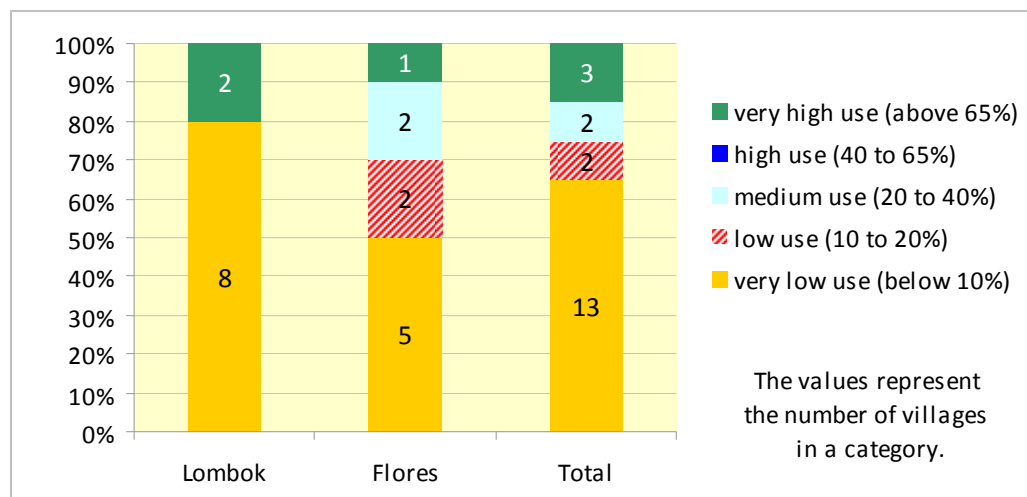
Over 70% of those who once started SODIS stopped after some time.

### 5.1.1 Current SODIS use

Looking at the different investigated villages, large differences in current SODIS use are obvious (Figure 4). Only in 20% of villages on Lombok (N=2) and 10% of the ones on Flores (N=1), more than 70% of the people use SODIS while in all other villages on Lombok (80%; N=8) and 50% (N=5) of the villages on Flores, SODIS is used by around 10% or less of all households. In the remainder of the villages on Flores (N=4), SODIS is used by between 18% and 49% of all households. All details are listed in the Annex (Table 10).

SODIS use varies greatly by village. 3 villages have user rates above 70%; 13 villages have user rates below 10%.

**Figure 4.** Village levels of current SODIS use on Flores and Lombok.



### 5.1.2 Previous SODIS use

After people had been trained about household water treatment and SODIS during the projects, in almost all investigated villages (70% on Flores and 80% on Lombok) around 90% of the people started to use SODIS. In 30% of the villages on Flores (N=3) and 10% on Lombok (N=1), SODIS was taken up by slightly lower numbers of people, around 70-80% of the households. Only in one village on Lombok (10%), initial SODIS uptake reached only 45%.

On both islands, high percentages of relapse were observed. Of those who started, 74% on Lombok and 67% on Flores stopped using SODIS. However, duration of the try-out period was significantly different. While on Lombok, average SODIS try out duration was only 7 months, on Flores people tried out SODIS for almost twice as long. Overall, 51% of the people used SODIS for around 3.5 months or less. 28% used SODIS for around one year and 16% used it longer than 1 year (up to 5 years) before they stopped.

Reasons for why people stopped using SODIS are investigated below.

During the projects, 90% of all trained people started to use SODIS. People, who stopped using SODIS, used it either for a shorter time of 3.5 months (51% of households) or around one year or longer. The reason for this difference is not known.

## 5.2 Influence of previous SODIS use on various factors

To obtain a more differentiated picture of the consequences of previous SODIS use, the same motivational factors as in chapter 4 are analyzed again. This time, we do not look at different types of current water consumption (untreated or HWTS use or combinations), but focus on previous SODIS use. The three groups 'never used SODIS', 'tried but stopped SODIS use' and 'current SODIS user' are compared. 'Current SODIS user' are obviously types 4 and 5 of the analysis in chapter 4. People who have 'never used SODIS' or people who 'tried but stopped SODIS use' are quite equally spread among types 1, 2, 3, 6 and 7 (Table 8). Additionally, the effect of trying out SODIS on SODIS knowledge is analyzed.

**Table 8.** Distribution of previous SODIS non-users and users across different types of current HWTS non-users and users.

Types of current water consumers	Types of previous SODIS users	
	never used SODIS (but know SODIS)	tried but stopped SODIS use
Type1: only untreated	21%	79%
Type 2: untreated + boiled	22%	77%
Type 3: only boiled	12%	86%
Type 6: boiled + purchased	18%	80%
Type 7: purchased only	14%	86%
Total	12%	64%

### 5.2.1 Knowledge

During the various projects, the vast majority of households in the different communities received information about SODIS. 80% (N=808) of the investigated households received information about SODIS. One exception is the communities which had HWTS promotion by the government. Here only 36% of the people had knowledge of SODIS.

Knowledge of how to prepare SODIS was developed quite well. Responding to an open enquiry of how to describe the SODIS process<sup>17</sup>, almost all people mentioned the two core elements of the SODIS method, plastic bottles and sun exposure. Correct duration of sun exposure (6hrs during sunny days), cleaning the bottles and horizontal exposure of bottles was mentioned by around half of the people. However, only few people mentioned that bottles need to be exposed for two days if the weather is cloudy, that bottles should not be scratched and that the water needs to be filtered with a cloth filter in case of increased turbidity. 19% of people still remembered that the bottle should be placed on a black cloth or be painted half black, which is an old instruction which was still given at the time of the projects.

Knowledge of why SODIS works was less developed. Only 35% mentioned that the water becomes disinfected or that bacteria are killed and only 13% know that solar UV-rays are responsible for the disinfection process. Instead, 45% think that increased temperature is responsible for why SODIS works. Although higher temperatures support water disinfection, the UV process is the important one. Interviewer rated people's overall knowledge<sup>18</sup> to be at a medium level (M=2.5).

Alarming differences in knowledge depth were found between people who had never used SODIS, people who had tried out SODIS but stopped and current SODIS user (see Table 9). Especially among relapsers (people who had stopped SODIS use after some time), who could potentially be convinced to re-start SODIS use, knowledge about some aspects of the SODIS method should be improved with further training.

<sup>17</sup> Could you please explain SODIS to me (what it is and how it works)? open answer

<sup>18</sup> Interviewer, please rate the level of knowledge on a scale! 0 = no knowledge, 4 = very profound knowledge

**Table 9.** Level of knowledge about the SODIS method among different groups of SODIS non-users and users.

It was mentioned that:	Never used SODIS (N=95)	Tried but stopped SODIS (N=505)	Still use SODIS (N=208)
– plastic bottles are needed	89%	94%	97%
– bottles are exposed to the sun	93%	96%	98%
– bottles have to be cleaned	27%*	46%*	75%*
– bottles have to be exposed horizontally	23%	34%	61%*
– 6hrs or 1 day of sun exposure	40%*	70%	79%
– 2 days of sun exposure when it is cloudy	9%	18%	32%*
– bottles must not be blurred/scratched	6%	11%	41%*
– water disinfection or treatment or it kills bacteria	23%	34%	42%
– UV radiation kills bacteria	7%	12%	19%*
– increased temperature kills bacteria	31%	43%	57%*
Overall rating of knowledge by interviewer (0 to 4)	1.84*	2.41*	3.00*

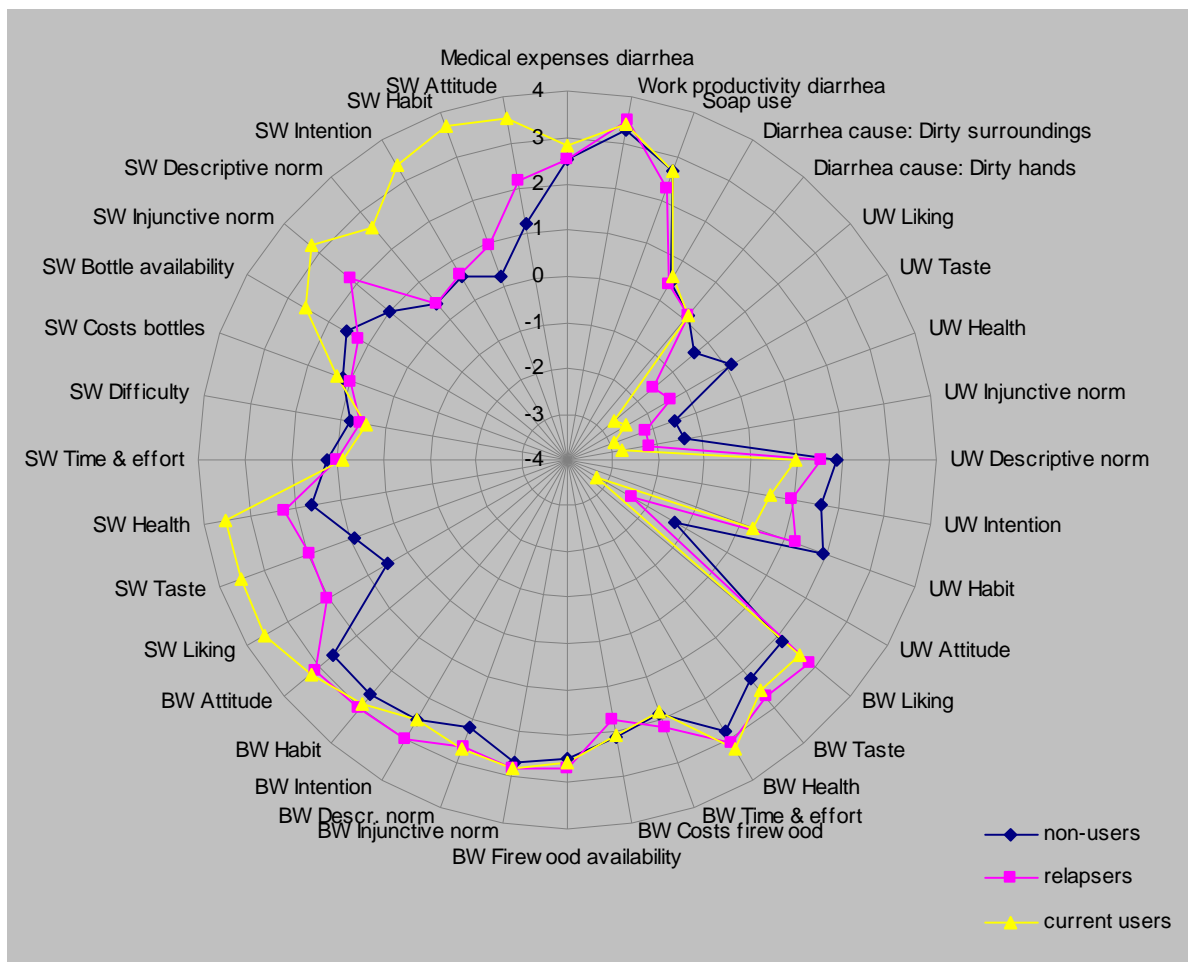
Note: \* = this value is significantly ( $p < .05$ ) different from the other two values in the same row (for example, if each value in one row has a \*, all three values differ significantly from each other).

### 5.2.2 Risk awareness, knowledge of diarrhea causes, and motivations to consume untreated, boiled and SODIS water

The positive effects of current SODIS use on motivations related to SODIS water itself but also related to boiled water were shown already in chapter 4. In the following, the main focus is the added value achieved through a trial-out period of SODIS use. Although these people stopped again after some time, they may have changed some of their perceptions and motivations relevant for HWTS use.

Figure 4 displays the profiles of people who never used SODIS, people who tried but stopped after some time, and people who still use SODIS. The profile includes risk awareness indicators, knowledge of diarrhea causes and motivations related to untreated water, boiled water and SODIS water consumption. Some risk awareness indicators and some mentioned causes for diarrhea are not displayed because no differences were found between the three groups of people. The full list of indicators and detailed statistics can be found in the Annex (Table 11).

**Figure 5.** Profiles of people who never used SODIS (non-users), people who tried but stopped after some time (relapsers) and people who still use SODIS (current users).



Note: Exact wording of items, scale end points and all values depicted in the diagrams can be found in the Annex (Tables 11 and 12).

Risk awareness and knowledge of diarrhea causes is very similar for all three SODIS user groups (non-users, relapsers, and current users). Differences between non-users and relapsers are found for motivations related to untreated water, boiled water and SODIS water. People who have previously tried out SODIS compared with those who have never tried SODIS like untreated water and its taste less strongly, are more negative towards others consuming untreated water, have a lower intention and habit for untreated water consumption and a more negative attitude. Instead, SODIS relapsers like boiled water more, have a stronger intention to consume boiled water in the future and a more positive attitude than those who never used SODIS. Not very unexpectedly, relapsers also have more positive perceptions of SODIS water than non-users; however, their motivations to SODIS use are mostly well below those of current users. Relapsers compared with non-users have a stronger liking of SODIS water and its taste, a stronger perceived health benefit of SODIS water, they think more positively about others using SODIS and they have quite a positive attitude. However, their intention and habit to use SODIS in the future is very low as well as their perception of existing social norms. Moreover, bottle availability is judged to be low by both non-users and relapsers compared to current users.

Overall, previous SODIS use has resulted in a more critical perception of untreated water and a more positive perception of SODIS use. Boiled water is also perceived slightly more positive. This interesting result points into the direction that even stopped use is important during the behavior change process for developing more positive motivations towards HWTS use. It is expected that after some trial-and-stop periods, people will eventually refrain permanently from untreated water consumption, because their perceptions of untreated water will have become sufficiently negative. This is an important insight as it calls for and justifies repeated promotional efforts in the same communities.

## 5.3 Why have people stopped using SODIS?

This section more deeply investigates the reasons behind relapse from SODIS use.

### 5.3.1 Bottle availability and price

Lack of bottles was mentioned<sup>19</sup> by 63% of the people to be the reason why they stopped SODIS. Only in the 3 villages, where SODIS is still being used by more than 70% of the people, bottles were not mentioned as the main reason why people stopped using SODIS. Correspondingly, bottle availability was judged<sup>20</sup> to be good (M = 2.5 to 3.1) in those three villages. Two different mechanisms are responsible for the success in these villages: In the one village on Flores, bottles have always been and are still sold by the local health clinic. The responsible person is very motivated and assures regular supply with new bottles. In the two villages on Lombok, YDD bottles are still available and are given out for (almost) free. It is questionable if people are still going to use SODIS if the village runs out of bottles (as it has already happened in other villages).

In the other villages (N=17) the bottle supply systems do not function very well. Bottle availability was judged to be very low by people who stopped SODIS (M=1.1) in contrast to a more moderate judgment made by current SODIS users in the same villages (M=2.2). It seems that current SODIS users may have found their ways to get bottles; however, bottles don't seem to be visually available to those not using SODIS at the moment.

According to the stakeholder interviews<sup>21</sup>, bottles are available if previous promoters still have them at stock from the project time and sell them at very low prices or still give them for free. In addition people might get their own bottles from the market. However, in one village it was reported that only the original YDD bottles are the "real" ones for SODIS; in another village promoters were suspected to make money themselves from selling the bottles at increased price.

No differences of bottle availability were found with regards to different types of urbanization (rural, periurban or urban).

**Price of bottles:** Currently, people pay on average 600 Rupees for a used or new bottle on Lombok, while on Flores a used bottle on average costs 930 and a new bottle 1540 Rupees. If asked, how much people would be willing to pay for a new bottle, on Lombok people are willing to pay only 350

<sup>19</sup> Why did you stop using SODIS? open answers

<sup>20</sup> Are bottles easily available? 0 = never, 4 = always

<sup>21</sup> Interviews with previous promoters



Rupees while on Flores people say they would pay 930 Rupees for a new bottle. The averages for costs and willingness to pay for Lombok includes 2 villages where normal market prices are paid for empty (?) bottles (around 1000 Rupees), but also 3 villages where bottles are given for (almost) free of charge. On Flores, in all villages people seem to pay market prices for bottles. Correspondingly, willingness to pay for a new bottle is much lower on Lombok than on Flores. Interestingly, the current price people pay is not perceived to be overly expensive. On Flores, average rating of expensiveness<sup>22</sup> is 1.8 and on Lombok it is 0.6 out of 4.

Though some stakeholder report that the price of the bottle is the hindering factor for people to use SODIS, it rather seems to be the problem that previously bottles had been handed out at no or very little cost and people have not accepted the *increase* in price. If bottles would have been introduced at their real market price from the beginning, those problems would probably not have occurred. Therefore, we think the current pricing to be acceptable if people are really interested and motivated to use SODIS. However, the shift in paradigm – at first bottles for free and then at market price – would have needed to be accompanied by a new campaign.

### 5.3.2 Other reasons to stop SODIS use

Other, minor reasons of stopped SODIS use are: doubts that the method works well (8%), bad taste (6%) and difficulty of preparation (7%). Doubts may be related to the low knowledge about why SODIS works and must be addressed through better informing people of the disinfection mechanism. Doubts can be very critical as they spread easily through social networks and even a small doubt may lead to stopping a behavior.

The potential that lies in relapsers is huge. More than two thirds of those who started stopped after some time. A substantial number of people stopped using SODIS only after one year's time or even later. Moreover, through their trying out SODIS, relapsers have developed a more negative view of untreated water and a more positive one of SODIS and partly boiled water. These relapsers should easily be convinced to become SODIS users again if their main concern, bottle availability, would be addressed adequately. Consequently, in all the many communities, where currently bottles are perceived to be unavailable, some serious improvements have to be made to establish a functioning, well-priced, accepted and visible market driven bottle supply system as perceived availability of bottles correlates with SODIS use ( $r=.413$ ,  $p<.000$ ). For future HWTS campaigns, it is recommended to introduce products at their real cost if people are expected to pay for the products later on. Giving out vouchers to receive a product at a lower price as a one time opportunity at the start of a campaign may be useful to lower initial reluctance, but still makes people aware of the real value of the product.

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<sup>22</sup> Do you think SODIS bottles cost a lot of money? 0 = not at all, 4 = a lot of money

## 6 Institutionalization of HWTS in Indonesia

Currently, the government runs a CBTS program (community based total sanitation). This program has 5 pillars: stop open defecation, hand washing with soap, **household water treatment and safe storage**, solid waste management, and domestic sewerage system. The target area is 10.000 villages; the organizational lead is with the Environmental Health and Disease Control-Sector of the Central Health Departments. Within this program, so-called role-outs are realized with the health sector. Basically, a responsible person from the Central Health Department presents the different aspects of the program, including the various HWTS options. Afterwards, responsibility is left with the local health clinics, not much further support from the central unit is provided. It is assumed that demand will develop and supply will be realized by the private sector. Additionally, other NGOs and institutions have taken up HWTS promotion into their programs.

The current status of integration of HWTS in formal policies of the Ministry of Health is the result of a 5 year (2005-2010) advocacy effort lead by the John Hopkins Bloomberg School of Public Health together with local HWTS networks, USAID, WHO and others. It is a great success that HWTS is now integrated in formal policies related to safe water. No formal strategy on safe water other than the recommendation of boiling had been in place before.

The NGOs YDD and YMP still seem to be the only ones with key technical background on SODIS in Indonesia. Their experiences within the projects on Flores and Lombok as well as their advocacy efforts have played an important role in having SODIS formally adopted as one of a handful of HWTS methods by the Indonesian government. However, operational support of HWTS promotion by the government itself is still quite limited (apart from the above mentioned type of role-outs to health clinics). Therefore, YDD and YMP are still the only NGOs currently actively promoting SODIS. Sometimes, previously trained staffs from health centers also continue promotion.

## 7 Outlook and recommendations for the future

### 7.1 Training approach

80% of all investigated households knew about SODIS at the time of the interview. So, information dissemination had been very successful. During the projects, 90% of all trained people had started to use SODIS. However, over 70% of those who once started SODIS stopped after some time. Half of them stopped using SODIS after about 3.5 months (51% of households), the others used it around one year or longer. However, SODIS drop out and current user rates vary greatly by village. While 3 villages have user rates above 70%, 13 villages have user rates below 10%.

Group trainings as a first entry point to communities seem to be time-efficient and accepted by the people. Regular monitoring can be a good tool to support people's development of a new behavior. However, if promoters do not feel adequately rewarded, their motivation to continuously perform the monitoring visits is not expected to last very long. Giving incentives does not always imply monetary payments, also work certificates or some kind of public recognition would surely be appreciated. This may be the reason that only moderate liking of the overall project work was expressed by the promoters. The reasons need to be explored further since higher current SODIS use

was observed when promoters expressed stronger liking of previous project work. In addition, more current SODIS users were observed if the promoters had felt more competent to promote SODIS, and if they gave water a high importance among health topics. Consequently, it should be assured that promoters enjoy the project work, are trained well enough to feel competent for the promotion task and value the topic they promote as very important. However, the main difference is not suspected to be related to the promotion efforts, rather to the type of bottle supply (see below).

## 7.2 Current water consumption

Overall, 27% of all households still consume untreated water either as their only water source (15%) or in combination with treated water (12%). On Lombok, more households rely on untreated water (Lombok: 39%, Flores: 15%).

In case a HWTS option is used, people tend to decide for one treatment option. Most prevalent, exclusive boiling is used by 45% and exclusive SODIS by 8%. One quite popular combination is SODIS and boiling (9%), where people boil half of the amount of water they consume and treat the other half with SODIS. Both water types are consumed on a daily basis.

## 7.3 Main motivations for HWTS use

Higher age and education level increase the chance of only treated water consumption in a household. Those who never consume untreated water have a higher awareness of reduced medical expenses when using HWTS and have better knowledge of diarrhea causes. Moreover, people who still consume untreated water also have much more positive perceptions of untreated water than those who do not consume untreated water. Untreated water consumers like taste of untreated water, they don't think it's unhealthy, they think that other people also drink untreated water, they have a stronger intention to continue drinking it in the future and they have a very strong habit which seems hard break.

Using boiling and SODIS for water treatment is influenced by a stronger liking of the treated water and its taste, a perception of a social norm to use boiling or SODIS water, a stronger attitude and intention to treat water as well as a better integration of the used method into daily habits.

## 7.4 Implications for campaigns

During future campaigns it seems crucial to address lacking risk awareness knowledge among untreated water consumers, put into perspective their positive perceptions of untreated water, their intentions and habits. At the same time, perceptions, norms and habits related to treated water must be positively influenced.

We have found that besides of risk awareness, people's water consumption behavior seems mainly to be driven by emotions (liking, taste), social norms, their intentions and habits. Means to influence emotions of untreated water negatively are making people aware of possible contamination sources such as feces or wastewater from agriculture, for example. Opportunities to taste treated in comparison to untreated water may have a positive effect on the taste perception of treated water types. Making people aware of how many other people are already using water treatment in their community using social activities and discussion rounds can increase normative pressure. Intentions

can be made explicit by requesting verbal or written commitments from people, e.g. signing a paper stating "Next month I will not drink untreated water" and hanging it above their door. After motivations and intentions are positively developed in favor of using HWTS methods, habit development must be supported through recurring promoter visits, written prompts to be placed inside people's homes or radio jingles reminding people of using HWTS. Social activities like experience discussion rounds among users, small competitions between villages about which has the most users and symbolic awards for consistent HWTS users can round off a campaign.

## 7.5 Resource availability for water treatment

Boiling needs kerosene. Starting in 2007, kerosene prices have increased substantially. Therefore, people are more and more looking for alternatives. In 2008, costs per 10 liter boiled water were estimated to be as high as 3000 IDR (Source: John Hopkins Bloomberg School of Public Health, [http://www.worldwaterweek.org/documents/WWW\\_PDF/2010/sunday/T6/HWT\\_Indonesia.pdf](http://www.worldwaterweek.org/documents/WWW_PDF/2010/sunday/T6/HWT_Indonesia.pdf)).

SODIS bottles are available at a price of around 800 IDR for a used bottle and 1300 IDR for a new bottle. However, it was repeatedly reported that bottles were provided for free to the households. In some cases, free bottle supply is still ongoing. As a result, people expect further free provision of bottles and willingness to pay is very low. Consequently, once the free bottles were damaged, people stopped preparing SODIS water.

The potential that lies in these relapsers is huge. More than two thirds of those who started stopped after some time. A substantial number of people stopped using SODIS only after one year's time or even later. These relapsers should easily be convinced to become SODIS users again if their main concern, bottle availability, would be addressed adequately.

For all HWTS products, it is necessary to establish a functioning, well-priced, accepted and visible market driven product supply. Introducing products at their real price from the beginning, maybe facilitating first time use with a voucher or winning-a-price systems, and if really necessary, targeting subsidies to the part of the population at the bottom of the income pyramid is needed in future campaigns.

## 7.6 Institutional involvement

As a result of a target advocacy action within a multi-stakeholder project, a strong commitment of the government to support HWTS has already been achieved. However, from local health clinics real support is still perceived to be quite weak. Certainly, governmental support also needs to be strengthened in terms of making resources available and increasing commitment to promote the new CBTS program. Only role-outs as currently practiced are not viewed as very sustainable.

## 8 Annex

### 8.1 Introduction to behavior change models

*Risk awareness and hygiene habits* describe the awareness and understanding of a problematic situation (i.e. that untreated water may cause diarrhea), and a certain need for a new behavior must be developed (Rogers, 1995, p. 164<sup>23</sup>). Then, at some point, the individual has to realize that there exists a solution to the problem (i.e. the SODIS method or any other HWTS). One indicator of how much awareness towards hygiene and health already exists is existing hygiene habits.

An *attitude* is the result of a general internal evaluation of pros and cons of the new behavior (i.e. using SODIS). These pros and cons cannot only be "rational" facts, but also the "emotional" evaluation plays an important role (Heri & Mosler<sup>24</sup>, 2008; Tamas, 2009, p. 75<sup>25</sup>). For example, rational facts can be arguments like: SODIS is easy; SODIS does not cost a lot of money etc. The emotional side of attitude is more linked to feelings like: I like the idea of using SODIS, or SODIS water tastes good.

*Social influence* always takes place – humans rarely decide solely on their own. We all have ideas about which behaviors are approved or disapproved by our social environment and which behaviors are performed by a majority of the people. Usually, we are more likely to perform a behavior that is approved and performed by many others (i.e. SODIS is an accepted method by my friends and neighbors, and at least some are also using it).

Risk awareness, attitude and social factors together form the *intention* to perform a certain behavior. The intention is a kind of decision to at least try out the behavior in the near future. After an intention is formed, usually the necessary preparatory steps are undertaken, i.e. where can I obtain SODIS bottles, when is a good time to prepare them etc. Intention, in turn, is one strong predictor of *behavior*.

Of course, not only awareness, attitudes and social influences are influencing our intentions and driving our behaviors. We also need to have a confidence that we are able to perform the behavior, which includes the necessary *knowledge* (i.e. the steps how to use SODIS are known) as well as the necessary *resources* must be available (i.e. bottles and sunny spaces for SODIS). These factors are said to influence both, intention and behavior.

After the behavior has been started (i.e. the person started using SODIS), it is important to maintain behavior performance and not to stop again. Moreover, it is important to regularly use SODIS or any kind of water treatment to benefit from positive health impacts. Here *habit* related factors are playing an important role, such as regularity of behavior performance, automaticity, not forgetting the behavior, and duration of behavior performance.

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<sup>23</sup> Rogers, E.M. (1995). *Diffusion of Innovations (4th ed.)*. New York: Free Press.

<sup>24</sup> Heri, S. & Mosler, H.-J. (2008). Factors affecting the diffusion of solar water disinfection: A field study in Bolivia. *Health Education & Behavior*, 35(4), 541-560.

<sup>25</sup> Tamas, A. (2009). *Successful promotion of Solar Water Disinfection (SODIS)*. PhD Thesis, University of Zurich, Zurich.

## 8.2 Complete list of investigated communities

**Table 10.** Complete list of investigated communities with demographic and water use key data.

Island	Implementing organization	Year(s) of promotion	Income level	Urbanization level	Code and name of community ( <i>dusun</i> )	Total No. of households (approx.)	Interviewed households (N / % of community)	Participated in HWTS training <sup>b)</sup>	Household size	Demographic indicators					
										Children <5 years	Socio-economic status	Income (IDR *1000)			
Lombok	YMP & health clinics	2003	low	rural	01 Labuhan Haji, Panede Gandor	170	51 / 30%	88%	3.65	25%	1.05	654			
				urban	02 Sukamulia, Sukamulia	731	52 / 7%	90%	4.35	31%	0.82	801			
		2004-05	low	rural	03 Aikmel, Kalijaga Timur	243	47 / 19%	98%	4.57	39%	0.87	453			
					04 Pringgabaya, Pringgabaya	630	53 / 8%	92%	4.66	38%	0.82	799			
					05 Pringgabaya, Pohgading	298	48 / 16%	83%	4.21	36%	0.96	520			
	2005	low	rural	06 Sakra, Suangi	289	52 / 18%	98%	3.46	31%	1.19	560				
			periurban	07 Keruak, Sepit	368	52 / 14%	98%	4.12	48%	0.85	413				
	Government <sup>a)</sup>	2005	low	rural	08 Labuhan Haji, Ijo Balit	179	52 / 29%	92%	4.37	40%	0.96	777			
					09 Sakra, Sakra	n.d.	52 / n.d.	19%	4.33	42%	0.84	952			
	Flores	YDD & health clinics	2005-06	low	rural	10 Sukamulia, Dasan Lekong	n.d.	49 / n.d.	53%	3.69	33%	1.06	614		
11 Bola, Ipir						130	48 / 37%	63%	4.79	48%	0.86	280			
12 Paga, Paga 1						100	52 / 52%	67%	5.31	44%	0.79	451			
13 Mego, Ubamoro						90	50 / 56%	74%	5.68	46%	0.72	344			
14 Magepanda, Nawateu						110	53 / 48%	77%	5.13	45%	0.71	376			
middle						periurban	15 Gunung Sari, Ngolo	110	48 / 44%	96%	4.94	52%	0.57	424	
						urban	16 Kangae, Waipare A	120	49 / 41%	80%	5.18	55%	0.61	517	
2007-10						low	rural	17 Alok Timur, Waioti	120	49 / 41%	76%	5.51	45%	0.73	817
							periurban	18 Magepanda, Watuwoga	120	49 / 41%	84%	4.84	45%	0.72	411
							urban	19 Kangae, Watuliwung	120	55 / 46%	75%	5.33	42%	0.71	660
middle	20 Alok Barat, Bebeng	90	53 / 59%	91%	5.38	58%	0.65	726							
Lombok						n.d.	508 / n.d.	95%	4.14	36%	0.94	653			
Flores						1110	506 / 46%	64%	5.21	48%	0.71	498			
Total						n.d.	1014 / n.d.	80%	4.68	42%	0.82	579			

Note: <sup>a)</sup> Government program WSLIC-2 (Water Supply for Low Income Communities); <sup>b)</sup> % of interviewed households which participated in the HWTS training during project time; <sup>c)</sup> % of interviewed households using the HWTS method at the moment. n.d. = not defined.

Island	Implementing organization	Year(s) of promotion	Income level	Urbanization level	Area Code	Demographic indicators				Use of HWTS options <sup>b)</sup>				
						Age (years)	Gender (% women)	Education (years)	Rooms per household	Boiling	SODIS	Purchase water	Consume treated water only	
Lombok	YMP & health clinics	2003	low	rural	01	42.6	76%	7.25	3.37	76%	6%	14%	59%	
				urban	02	43.7	62%	3.63	3.20	79%	0%	8%	79%	
		2004-05	low	rural	03	42.7	83%	6.68	3.57	66%	68%	11%	83%	
					04	37.7	92%	4.92	3.37	32%	8%	17%	32%	
				05	36.1	79%	5.69	3.67	54%	0%	17%	17%		
	2005	low	rural	06	36.6	83%	3.81	3.71	46%	8%	6%	52%		
			periurban	07	39.2	91%	2.83	3.12	35%	92%	4%	94%		
	Government <sup>a)</sup>	2005	low	rural	09	39.7	77%	4.81	3.32	69%	0%	15%	60%	
					10	44.3	65%	4.69	3.13	86%	0%	14%	71%	
	Flores	YDD & health clinics	2005-06	low	rural	11	44.2	67%	6.02	3.45	100%	0%	6%	96%
12						44.3	67%	7.68	3.56	75%	8%	4%	48%	
13						45.1	56%	7.08	3.45	92%	18%	2%	86%	
14						41.8	53%	6.25	3.21	100%	8%	9%	89%	
15						38.1	67%	5.81	2.42	60%	88%	4%	88%	
2007-10			middle	periurban	16	41.8	59%	6.91	2.88	86%	14%	24%	86%	
					urban	17	42.5	67%	8.11	3.47	86%	2%	41%	94%
				low	rural	18	41.9	75%	6.54	3.10	88%	35%	10%	96%
					periurban	19	45.5	60%	7.56	3.21	96%	7%	13%	93%
					urban	20	38.8	81%	7.27	3.06	75%	34%	17%	79%
					Lombok	40.2	80%	4.96	3.41	60%	18%	11%	61%	
					Flores	42.4	65%	6.93	3.18	86%	21%	13%	85%	
					Total	41.3	72%	5.93	3.29	73%	19%	12%	73%	

Note: <sup>a)</sup> Government program WSLIC-2 (Water Supply for Low Income Communities); <sup>b)</sup> % of interviewed households which participated in the HWTS training during project time; <sup>c)</sup> % of interviewed households using the HWTS method at the moment.



### 8.3 Complete list of motivations related to untreated and treated water consumption

**Table 11.** Mean values of indicators on risk awareness, percentages of people mentioning listed diarrhea causes, and mean values of all indicators related to untreated, boiled and SODIS water. Values are presented separately for 7 different types of water consumers as well as for the entire sample.

	Indicator	Type 1: only un- treated	Type 2: un- treated + boiled	Type 3: only boiled	Type 4: only SODIS	Type 5: boiled + SODIS	Type 6: boiled + pur- chased	Type 7: pur- chased only	All cases	ANOVA Types 1 to 7
Risk awareness	<b>Responsibility:</b> Do you feel responsible for your own and your family's health? 0 = not at all, 4 = very much	3.55 <sub>ab</sub>	3.46 <sub>a</sub>	3.68 <sub>b</sub>	3.60 <sub>ab</sub>	3.60 <sub>ab</sub>	3.61 <sub>ab</sub>	3.81 <sub>ab</sub>	3.62	.010
	<b>Diarrhea awareness:</b> How dangerous is diarrhea for young children? 0 = not at all, 4 = very dangerous	3.22 <sub>a</sub>	3.19 <sub>a</sub>	3.36 <sub>a</sub>	3.48 <sub>a</sub>	3.36 <sub>a</sub>	3.53 <sub>a</sub>	3.74 <sub>a</sub>	3.36	.013
	<b>Work productivity:</b> Do you think diarrhea reduces work productivity? 0 = not at all, 4 = very much	3.33 <sub>ab</sub>	3.17 <sub>a</sub>	3.47 <sub>b</sub>	3.29 <sub>ab</sub>	3.44 <sub>ab</sub>	3.46 <sub>ab</sub>	3.70 <sub>b</sub>	3.41	.007
	<b>Medical expenses:</b> Do you think that water treatment reduces your medical expenses? 0 = not at all, 4 = very much	1.87 <sub>a</sub>	2.20 <sub>ac</sub>	2.79 <sub>b</sub>	2.68 <sub>bc</sub>	2.96 <sub>b</sub>	2.76 <sub>bc</sub>	2.48 <sub>ab</sub>	2.58	.000
	<b>Hand washing:</b> How often do you wash your hands before eating and after the toilet? 0 = never, 4 = always	3.07 <sub>ab</sub>	2.78 <sub>a</sub>	2.87 <sub>ac</sub>	3.22 <sub>bc</sub>	2.94 <sub>ab</sub>	3.07 <sub>ab</sub>	3.41 <sub>bc</sub>	2.96	.001
	<b>Soap use:</b> How often do you and your family use soap (or an equivalent) when you wash your hands? 0 = never, 4 = always	1.62 <sub>a</sub>	2.26 <sub>b</sub>	2.40 <sub>b</sub>	2.32 <sub>b</sub>	2.79 <sub>b</sub>	2.83 <sub>b</sub>	2.89 <sub>b</sub>	2.35	.000
	<b>Hygiene status:</b> Rating of the hygiene status of the household (kitchen, appearance of interviewee, surroundings, house). -4 = a lot dirtier than average, 4 = a lot cleaner than average	.87 <sub>a</sub>	1.30 <sub>b</sub>	1.58 <sub>c</sub>	1.47 <sub>c</sub>	1.65 <sub>bc</sub>	1.97 <sub>bc</sub>	2.45 <sub>c</sub>	1.49	.000
Diarrhea causes	<b>Causes for diarrhea in children:</b> Mentioned contaminated water	36% <sub>a</sub>	50% <sub>b</sub>	70% <sub>c</sub>	73% <sub>c</sub>	68% <sub>bc</sub>	79% <sub>c</sub>	85% <sub>c</sub>	63%	.000
	<b>Causes for diarrhea in children:</b> Mentioned contaminated food	71% <sub>a</sub>	76% <sub>ab</sub>	83% <sub>b</sub>	83% <sub>ab</sub>	81% <sub>ab</sub>	87% <sub>ab</sub>	96% <sub>b</sub>	81%	.006
	<b>Causes for diarrhea in children:</b> Mentioned dirty surroundings	26% <sub>a</sub>	28% <sub>abd</sub>	45% <sub>be</sub>	56% <sub>ce</sub>	55% <sub>ce</sub>	67% <sub>c</sub>	59% <sub>cde</sub>	44%	.000
	<b>Causes for diarrhea in children:</b> Mentioned dirty hands	2% <sub>a</sub>	6% <sub>ab</sub>	7% <sub>ab</sub>	6% <sub>ab</sub>	11% <sub>ab</sub>	14% <sub>b</sub>	11% <sub>ab</sub>	8%	.027
	<b>Causes for diarrhea in children:</b> Mentioned lacking sanitation	0% <sub>a</sub>	1% <sub>ab</sub>	6% <sub>b</sub>	0% <sub>ab</sub>	2% <sub>ab</sub>	3% <sub>ab</sub>	4% <sub>ab</sub>	3%	.005
Untreated water motivations	<b>UW Liking:</b> Do you like or dislike drinking untreated water? -4 = dislike very much, 4 = like very much	3.34 <sub>a</sub>	1.31 <sub>b</sub>	-3.22 <sub>c</sub>	-2.63 <sub>c</sub>	-2.85 <sub>c</sub>	-2.89 <sub>c</sub>	-3.44 <sub>c</sub>	-1.58	.000
	<b>UW Taste:</b> Do you think untreated water tastes good or bad? -4 = tastes very bad, 4 = tastes very good	3.21 <sub>a</sub>	1.36 <sub>b</sub>	-2.99 <sub>c</sub>	-2.47 <sub>c</sub>	-2.82 <sub>c</sub>	-2.54 <sub>c</sub>	-3.15 <sub>c</sub>	-1.41	.000
	<b>UW Health:</b> Do you think untreated water is good or bad for your health? -4 = it's very bad for my health, 4 = it's very good for my health	.64 <sub>a</sub>	-1.14 <sub>b</sub>	-3.27 <sub>c</sub>	-3.01 <sub>c</sub>	-2.95 <sub>c</sub>	-3.06 <sub>c</sub>	-3.48 <sub>c</sub>	-2.25	.000

		Type1: only un- treated	Type 2: un- treated + boiled	Type 3: only boiled	Type 4: only SODIS	Type 5: boiled + SODIS	Type 6: boiled + pur- chased	Type 7: pur- chased only	All cases	ANOVA Types 1 to 7
Utreated water motivations	<b>UW Injunctive norm:</b> How do you think of other people if they drink untreated water? -4 = very bad, 4 = very good	.26 <sub>a</sub>	-.43 <sub>a</sub>	-2.79 <sub>b</sub>	-2.86 <sub>b</sub>	-2.85 <sub>b</sub>	-2.75 <sub>b</sub>	-3.04 <sub>b</sub>	-2.09	.000
	<b>UW Descriptive norm:</b> Please estimate, how many people in your village drink untreated water? 0 = nobody, 4 = everybody	2.66 <sub>a</sub>	2.04 <sub>b</sub>	1.16 <sub>c</sub>	.95 <sub>c</sub>	.92 <sub>c</sub>	1.16 <sub>c</sub>	1.19 <sub>c</sub>	1.45	.000
	<b>UW Intention:</b> How much untreated water you intend to drink in the near future (next month)? 0 = nothing, 4 = 100%	3.13 <sub>a</sub>	1.88 <sub>b</sub>	.27 <sub>c</sub>	.43 <sub>c</sub>	.43 <sub>c</sub>	.28 <sub>c</sub>	.00 <sub>c</sub>	.94	.000
	<b>UW Habit:</b> Is drinking untreated water a habit for you? 0 = not at all, 4 = a very strong habit	3.89 <sub>a</sub>	2.40 <sub>b</sub>	.12 <sub>c</sub>	.21 <sub>c</sub>	.22 <sub>c</sub>	.02 <sub>c</sub>	.00 <sub>c</sub>	1.14	.000
	<b>UW Attitude:</b> How good or bad do you think is consuming untreated water? -4 = very bad, 4 = very good	.61 <sub>a</sub>	-.23 <sub>b</sub>	-3.60 <sub>c</sub>	-3.07 <sub>c</sub>	-3.70 <sub>c</sub>	-3.30 <sub>c</sub>	-3.60 <sub>c</sub>	-2.47	.000
Boiled water (BW) motivations	<b>BW Liking:</b> Do you like or dislike drinking boiled water? -4 = dislike very much, 4 = like very much	-.56 <sub>a</sub>	1.98 <sub>b</sub>	3.61 <sub>c</sub>	1.59 <sub>b</sub>	3.33 <sub>c</sub>	3.33 <sub>c</sub>	2.46 <sub>bc</sub>	2.58	.000
	<b>BW Taste:</b> Do you think boiled water tastes good or bad? -4 = tastes very bad, 4 = tastes very good	-.51 <sub>a</sub>	1.84 <sub>b</sub>	3.47 <sub>c</sub>	1.60 <sub>b</sub>	3.15 <sub>c</sub>	3.06 <sub>c</sub>	2.44 <sub>b</sub>	2.48	.000
	<b>BW Health:</b> Do you think boiled water is good or bad for your health? -4 = it's very bad for my health, 4 = it's very good for my health	1.36 <sub>a</sub>	2.47 <sub>b</sub>	3.65 <sub>c</sub>	2.93 <sub>bd</sub>	3.44 <sub>d</sub>	3.28 <sub>d</sub>	3.19 <sub>bcd</sub>	3.06	.000
	<b>BW Time &amp; effort:</b> Do you think preparing boiled water costs a lot of time and effort? 0 = not at all, 4 = a lot	1.41 <sub>a</sub>	1.80 <sub>ad</sub>	2.30 <sub>b</sub>	1.52 <sub>ac</sub>	2.02 <sub>bcd</sub>	2.28 <sub>bd</sub>	2.04 <sub>abc</sub>	2.01	.000
	<b>BW Costs firewood:</b> Do you think combustibles for boiling cost a lot of money? 0 = not at all, 4 = a lot	2.32 <sub>a</sub>	2.08 <sub>ac</sub>	1.53 <sub>b</sub>	2.40 <sub>a</sub>	1.80 <sub>bcd</sub>	1.98 <sub>ab</sub>	2.30 <sub>ad</sub>	1.86	.000
	<b>BW Firewood availability:</b> Are combustibles easily available? 0 = not at all, 4 = always	1.85 <sub>a</sub>	2.24 <sub>ad</sub>	2.95 <sub>b</sub>	2.35 <sub>cd</sub>	2.71 <sub>bd</sub>	3.00 <sub>b</sub>	2.74 <sub>bd</sub>	2.64	.000
	<b>BW Injunctive norm:</b> How do you think of other people if they drink boiled water? -4 = very bad, 4 = very good	1.17 <sub>a</sub>	1.92 <sub>b</sub>	3.21 <sub>c</sub>	2.42 <sub>bd</sub>	3.06 <sub>cd</sub>	3.21 <sub>c</sub>	3.19 <sub>cd</sub>	2.68	.000
	<b>BW Descriptive norm:</b> Please estimate, how many people in your village drink boiled water? 0 = nobody, 4 = everybody	1.40 <sub>a</sub>	2.14 <sub>b</sub>	2.94 <sub>c</sub>	2.04 <sub>b</sub>	3.02 <sub>c</sub>	2.87 <sub>c</sub>	2.52 <sub>bc</sub>	2.55	.000
	<b>BW Intention:</b> How much boiled water you intend to drink in the near future (next month)? 0 = nothing, 4 = 100%	.94 <sub>a</sub>	2.36 <sub>b</sub>	3.78 <sub>c</sub>	1.59 <sub>d</sub>	3.07 <sub>e</sub>	3.14 <sub>e</sub>	1.46 <sub>ad</sub>	2.85	.000
	<b>BW Habit:</b> Is drinking boiled water a habit for you? 0 = not at all, 4 = a very strong habit	.52 <sub>a</sub>	2.24 <sub>b</sub>	3.80 <sub>c</sub>	2.08 <sub>b</sub>	3.46 <sub>de</sub>	3.78 <sub>ce</sub>	2.27 <sub>b</sub>	2.93	.000
<b>BW Attitude:</b> How good or bad do you think is consuming boiled water? -4 = very bad, 4 = very good	.89 <sub>a</sub>	2.19 <sub>b</sub>	3.73 <sub>c</sub>	3.03 <sub>d</sub>	3.39 <sub>cd</sub>	3.50 <sub>cd</sub>	3.07 <sub>cd</sub>	3.01	.000	

Indicator	Type1: only un- treated	Type 2: un- treated + boiled	Type 3: only boiled	Type 4: only SODIS	Type 5: boiled + SODIS	Type 6: boiled + pur- chased	Type 7: pur- chased only	All cases	ANOVA Types 1 to 7
<b>SW Liking:</b> Do you like or dislike drinking SODIS water? -4 = dislike very much, 4 = like very much	1.43 <sub>a</sub>	1.41 <sub>a</sub>	2.06 <sub>a</sub>	3.70 <sub>b</sub>	3.68 <sub>b</sub>	1.64 <sub>a</sub>	2.32 <sub>ab</sub>	2.29	.000
<b>SW Taste:</b> Do you think SODIS water tastes good or bad? -4 = tastes very bad, 4 = tastes very good	1.13 <sub>a</sub>	1.76 <sub>ad</sub>	2.15 <sub>bd</sub>	3.61 <sub>c</sub>	3.56 <sub>c</sub>	1.89 <sub>ad</sub>	2.28 <sub>abc</sub>	2.31	.000
<b>SW Health:</b> Do you think SODIS water is good or bad for your health? -4 = it's very bad for my health, 4 = it's very good for my health	1.62 <sub>a</sub>	2.05 <sub>ad</sub>	2.38 <sub>bd</sub>	3.61 <sub>c</sub>	3.55 <sub>c</sub>	2.19 <sub>ad</sub>	2.63 <sub>abc</sub>	2.53	.000
<b>SW Time &amp; effort:</b> Do you think preparing SODIS water costs a lot of time and effort? 0 = not at all, 4 = a lot	1.06 <sub>ab</sub>	1.20 <sub>ab</sub>	.95 <sub>ab</sub>	.66 <sub>a</sub>	1.04 <sub>ab</sub>	1.41 <sub>b</sub>	.79 <sub>ab</sub>	.99	.004
<b>SW Difficulty:</b> Do you think preparing SODIS water is difficult? 0 = not at all, 4 = very much	.55 <sub>ab</sub>	.66 <sub>ab</sub>	.56 <sub>ab</sub>	.28 <sub>a</sub>	.65 <sub>ab</sub>	.89 <sub>b</sub>	.72 <sub>ab</sub>	.56	.003
<b>SW Costs bottles:</b> Do you think SODIS bottles cost a lot of money? 0 = not at all, 4 = a lot	.87 <sub>a</sub>	1.06 <sub>ab</sub>	1.07 <sub>a</sub>	1.13 <sub>ab</sub>	1.54 <sub>b</sub>	1.33 <sub>ab</sub>	.80 <sub>ab</sub>	1.12	.002
<b>SW Bottle availability:</b> Are bottles easily available? 0 = not at all, 4 = always	1.09 <sub>a</sub>	1.02 <sub>a</sub>	1.28 <sub>a</sub>	2.68 <sub>b</sub>	2.63 <sub>b</sub>	1.40 <sub>a</sub>	1.80 <sub>ab</sub>	1.65	.000
<b>SW Injunctive norm:</b> How do you think of other people if they drink SODIS water? -4 = very bad, 4 = very good	1.30 <sub>a</sub>	1.39 <sub>ad</sub>	2.33 <sub>b</sub>	3.42 <sub>c</sub>	3.20 <sub>c</sub>	2.17 <sub>bd</sub>	2.61 <sub>bc</sub>	2.34	.000
<b>SW Descriptive norm:</b> Please estimate, how many people in your village drink SODIS water? 0 = nobody, 4 = everybody	.35 <sub>a</sub>	.57 <sub>a</sub>	.45 <sub>a</sub>	2.85 <sub>b</sub>	2.48 <sub>b</sub>	.52 <sub>a</sub>	.53 <sub>a</sub>	1.02	.000
<b>SW Intention:</b> How much SODIS water you intend to drink in the near future (next month)? 0 = nothing, 4 = 100%	.71 <sub>ab</sub>	1.12 <sub>b</sub>	.64 <sub>a</sub>	3.61 <sub>c</sub>	3.24 <sub>c</sub>	.68 <sub>ab</sub>	.06 <sub>a</sub>	1.41	.000
<b>SW Habit:</b> Is drinking SODIS water a habit for you? 0 = not at all, 4 = a very strong habit	.40 <sub>ad</sub>	1.03 <sub>b</sub>	1.09 <sub>b</sub>	3.84 <sub>c</sub>	3.64 <sub>c</sub>	1.00 <sub>bd</sub>	.31 <sub>bd</sub>	1.67	.000
<b>SW Attitude:</b> How good or bad do you think is consuming SODIS water? -4 = very bad, 4 = very good	1.28 <sub>a</sub>	2.05 <sub>ad</sub>	2.27 <sub>bd</sub>	3.62 <sub>c</sub>	3.55 <sub>c</sub>	1.91 <sub>ad</sub>	2.53 <sub>abc</sub>	2.44	.000
N	149	90	456	80	91	64	27	1014	957
N SODIS water motivations (only those knowing SODIS)	108	65	343	80	91	49	21	808	757

Note: Color coding: dark orange = critical to very critical value, light orange = slightly critical value, light green = slightly good value, dark green = good to very good value. All values in one row sharing one or more of the same subscripts are not significantly different from each other; values not sharing any subscript within in the same row are significantly different from each other at least at p<.05 level. Due to low number of cases for Type 7 (purchased only) some differences did not become significant. ANOVA = Analysis of Variance, test for significant differences between types 1 to 7.

## 8.4 Complete list of motivations related to previous and current SODIS use

**Table 12.** Mean values of indicators on risk awareness, percentages of people mentioning listed diarrhea causes, and mean values of all indicators related to untreated, boiled and SODIS water. Values are presented separately for SODIS non-users, relapsers (tried but stopped) and current users.

Indicator	non-users	relapsers	current users	ANOVA
Responsibility family health	3.69	3.67	3.62	.419
Diarrhea awareness children	3.40	3.41	3.41	.988
Work productivity diarrhea	3.30	3.49	3.41	.071
Medical expenses diarrhea	2.54	2.54	2.83*	.009
Hand washing	3.09	3.03	3.05	.816
Soap use	2.67	2.26*	2.63	.000
Hygiene status	1.43	1.52	1.57	.760
Diarrhea cause: Water	63%	65%	69%	.783
Diarrhea cause: Food	83%	83%	82%	.969
Diarrhea cause: Dirty surroundings	45%	41%	55%*	.002
Diarrhea cause: Dirty hands	12%	6%*	12%	.012
Diarrhea cause: Lacking sanitation	2%	5%	3%	.311
UW Liking	-.40*	-1.56*	-2.67*	.000
UW Taste	.12*	-1.42*	-2.52*	.000
UW Health	-1.55	-2.18	-2.90*	.000
UW Injunctive norm	-1.42*	-2.19*	-2.81*	.000
UW Descriptive norm	1.85*	1.52*	.95*	.000
UW Intention	1.58*	.95*	.49*	.000
UW Habit	1.90*	1.24*	.27*	.000
UW Attitude	-1.35*	-2.38*	-3.29*	.000
BW Liking	2.11	2.87*	2.57	.002
BW Taste	2.16*	2.70	2.54	.044
BW Health	2.81	3.13	3.23	.055
BW Time & effort	1.84	2.18*	1.81	.000
BW Costs firewood	2.09	1.72*	2.04	.001
BW Firewood availability	2.48	2.68	2.55	.194
BW Injunctive norm	2.63	2.78	2.77	.688
BW Descriptive norm	2.18*	2.59	2.66	.003
BW Intention	2.51	3.00*	2.51	.000
BW Habit	2.66	3.01	2.90	.099
BW Attitude	2.61*	3.09	3.22	.005
SW Liking	.47*	2.02*	3.60*	.000
SW Taste	.90*	1.98*	3.53*	.000
SW Health	1.65*	2.24*	3.54*	.000
SW Time & effort	1.19	1.01	.86	.065
SW Difficulty	.77	.58	.46*	.018
SW Costs bottles	1.15	1.01	1.32*	.007
SW Bottle availability	1.52	1.21	2.58*	.000
SW Injunctive norm	1.03*	2.16*	3.24*	.000
SW Descriptive norm	.39	.45	2.56*	.000
SW Intention	.58	.66	3.35*	.000
SW Habit	.24*	.97*	3.71*	.000
SW Attitude	1.19*	2.14*	3.55*	.000
N	95	505	208	808

Note: \* = this value is significantly ( $p < .05$ ) different from the other two values in the same row (for example, if each value in one row has a \*, all three values differ significantly from each other). Wording and scaling of all indicators can be found in Table 11.



### The SODIS Sustainability Study

Funding by the Velux Foundation, Zürich, Switzerland and the SODIS Reference Center at the Swiss Federal Institute of Aquatic Science and Technology (Eawag), Dübendorf, Switzerland.

Data collection in Indonesia in cooperation with Yayasan Dian Desa (YDD), Yogyakarta, Indonesia, and Yayasan Masyarakat Peduli (YMP), Lombok, Indonesia.

### Authors

Andrea Tamas, Swiss Federal Institute of Aquatic Science and Technology (Eawag), Department of Water and Sanitation in Developing Countries (Sandec), Dübendorf, Switzerland

Flavia Wehrle, University of Zurich, Department of Social Psychology, Zurich, Switzerland

Reviewed by Regula Meierhofer, SODIS Reference Center at the Swiss Federal Institute of Aquatic Science and Technology (Eawag), Dübendorf, Switzerland

### Photos by Flavia Wehrle

Cover top left: Traditional houses in Sikka District, Flores, Indonesia.

Cover top middle: Community well in Kalijaga Timur, Lombok, Indonesia.

Cover top right: Community in periurban area Pohgading, Lombok, Indonesia.

Cover bottom and back: SODIS bottles exposed at different locations on Lombok and Flores, Indonesia.