ENGLISH (EN)

COOPERATING ORGANIZATION MEMORANDUM OF UNDERSTANDING

An agreement between

Rotary Club Bandung, District 3410, Indonesia, "Host Sponsor,"
Rotary E-Club of 3310, District 3310, Singapore, "International Sponsor,"
Safe Water Gardens Pte Ltd, Singapore, "Organization 1," and
Institut Teknologi Nasional Bandung (ITENAS), Indonesia, "Organization 2"

Note: The Foundation needs to receive this memorandum of understanding (MOU) in this exact form. Complete the form fields but do not edit any other text. If you aren't sure how to complete the fields, refer to the tips at the end.

1. SUBJECT

Global Grant #GG2121887, Safe Water Garden Indonesia, in Bandung West Java, Indonesia, the "Rotary Grant."

2. DEFINITION

A cooperating organization is any reputable non-Rotary organization that provides expertise, infrastructure, advocacy, training, education, or other support for the grant project. Cooperating organizations must comply with all reporting and auditing activities required by The Rotary Foundation and provide receipts as requested.

3. PURPOSE

This document establishes an agreement between the parties listed above to implement a project funded by a Grant from The Rotary Foundation. This document may also be used with other groups that are participating in the project, such as beneficiary organizations, nonprofit contractors, or government agencies.

4. PROJECT OBJECTIVES

All parties listed in this agreement will collaborate to achieve the following project objectives:

a. to provide a self-sustainable sanitation solution for a rural village community in Bandung West Java

b. to implement Safe Water Garden (SWG) solution for the pilot village with the aim to further research and developing SWG as a sanitation solution suitable for wider use in rural Indonesia

c. to research and develop best practices for engaging and promoting hygiene awareness to villagers in rural Indonesia

5. HOST SPONSOR RESPONSIBILITIES

Describe the specific responsibilities of the Host Sponsor. The Host Sponsor will:

a. Conducts community assessment

b. Manages overall project implementation, budget and payments

c. Consolidates project reports required for grant

6. INTERNATIONAL SPONSOR RESPONSIBILITIES

Describe the specific responsibilities of the International Sponsor. The International Sponsor will:

a. Provides fundraising assistance

b. Supports host club with project planning

7. ORGANIZATION 1 RESPONSIBILITIES

Describe the specific responsibilities of Organization 1. Organization 1 will:

a. Provides expertise to execute on-site implementation of the SWG solution for the pilot village

b. Provides training for the local villagers to install the SWG

c. Co-research and develop sanitation and hygiene educational program for the villagers

8. ORGANIZATION 2 RESPONSIBILITIES

Describe the specific responsibilities of Organization 2. Organization 2 will:

a. Supports host club in Community Assessment

b. Provides local support in community engagement, and to co-research and develop sanitation and hygiene educational program for the villagers

c. Supports collection of data for project reporting

9. MUTUAL UNDERSTANDINGS

All parties agree that:

a. The Rotary Grant, if approved, will be awarded to the Host Sponsor and International Sponsor.

b. The Host Sponsor and International Sponsor will control and manage the Rotary Grant.

c. The Host Sponsor and International Sponsor will be involved in all stages of the project.

d. The Host Sponsor and International Sponsor will each have a grant project management committee with at least three members, responsible for managing the project on their behalf.

e. The Host Sponsor and International Sponsor and the Organizations will abide by the Terms and Conditions for Rotary Foundation District Grants and Global Grants.

f. The Host Sponsor and International Sponsor affirm that the Organizations are reputable and responsible and act within all laws of the project country.

g. All grant funds will be received and managed by the Host Sponsor or the International Sponsor and will not be managed by the Organizations.

h. Grant funds will remain in the designated Rotary Grant bank account until they are needed to pay a vendor or reimburse a purchase.

i. All payments to vendors and reimbursements to Organizations will be supported by receipts, paid invoices, vouchers or written agreements.

j. The Organizations may contribute funds toward the project, but The Rotary Foundation does not match these funds.

k. The Organizations' project-related documentation may be subject to independent financial and operational review by The Rotary Foundation.

l. In their separate club or district qualification memorandum of understanding, the Host Sponsor and International Sponsor have agreed to:

- Ensure that all grant activities, including the conversion of funds from one currency to another, comply with local law
- Ensure that the project adheres to The Rotary Foundation's stewardship measures and grant management practices
- Ensure that all people involved in a grant conduct their activities in a way that avoids any actual or perceived conflict of interest
- Report to the district any potential or real misuse or mismanagement of grant funds
- Cooperate with any financial, grant, or operational audits
- Maintain a standard set of accounts, which includes a general ledger and a complete record of all receipts and all disbursements of grant funds
- Disburse grant funds in accordance with the Terms and Conditions for Rotary

Foundation District Grants and Global Grants

- Maintain records for items that are purchased, produced, or distributed through grant activities
- Maintain a dedicated bank account to be used only for receiving and disbursing grant funds
- Have a minimum of two Rotarian bank account signatories from the sponsoring clubs or districts for disbursements
- Maintain a separation of duties for handling funds so no one person is solely in control of them
- Maintain a written plan for transferring custody of bank accounts in the event of a change in signatories
- Retain bank statements to substantiate the receipt and use of grant funds
- Retain grant documents in a location known by and accessible to club and district officers
- Retain grant documents for a minimum of five years, or longer if required by local law

10. CONFLICTS OF INTEREST

Any real or perceived conflicts of interest must be disclosed to The Rotary Foundation, in compliance with The Rotary Foundation's Conflict of Interest Policy for Program Participants in the Terms and Conditions for Rotary Foundation District Grants and Global Grants. This includes any instances of Rotarians acting as vendors or serving as trustees, directors, officers, or staff of one of the Organizations. If in doubt, any potential conflict should be disclosed.

Identify any real or perceived conflicts here:

[Names, roles]

11. MODIFICATION

Modifications to this document will be made by mutual consent of the parties. A written modification, signed and dated by all parties and approved by The Rotary Foundation, must be issued before acting on any changes.

12. CONTACT INFORMATION

Your privacy is important to Rotary International and The Rotary Foundation (collectively, "Rotary") and the personal data you share with Rotary will only be used for official Rotary business, such as in relation to the Rotary Grant. Personal data collected on this form is subject to Rotary's privacy policy.

13. AUTHORIZATIONS

By signing below, the parties agree to the terms of this memorandum of understanding.

Host Sponsor authorization:

Signature: _____ Date: Date

Printed Name: Printed Name Position: Position

Postal Address: Postal Address

Phone: Phone Email: Email

International Sponsor authorization:

Signature: _____ Date: Date

Printed Name: Printed Name Position: Position

Postal Address: Postal Address

Phone: Phone Email: Email

Organization 1 authorization:

Signature: _____ Date: Date

Printed Name: Printed Name Position: Position

Postal Address: Postal Address

Phone: Phone Email: Email

Organization 2 authorization:

Signature: _____ Date: Date

Printed Name: Printed Name Position: Position

Postal Address: Postal Address

Phone: Phone Email: Email

TIPS FOR COMPLETING THIS FORM

GENERAL

If you're working with just one organization, provide information for Organization 1 only. Always include the Rotary Host Sponsor and International Sponsor.

PROJECT OBJECTIVES

In this section, project partners outline the overall goals of the project that all partners hope to achieve together.

For example:

- Improve the quality of education students receive at Community Primary School
- Improve the quality of care for cancer patients at Community Hospital
- Increase farmers' yields by 10% through drip irrigation

RESPONSIBILITIES SECTIONS

Meeting with all project partners to assign responsibilities and record them in writing can prevent conflicts and increase your project's chances of success. It helps ensure that everyone agrees on the basics of the project plan and prevents confusion during implementation. When you define the responsibilities of each partner, carefully consider their resources and skills. Remember that each project has its own unique roles and responsibilities that are essential for effective implementation. List detailed and specific responsibilities for your project.

Questions to consider when determining responsibilities:

- Who will provide technical and professional services? What specific services will be provided, or what specific skills are needed?
- What types of staffing, infrastructure, or equipment is required, and who will provide those?
- Who will provide training, mentoring, education, advocacy, and financial review?
- Who will direct and coordinate local community education and public relations?
- Who will seek community support and resources for the project?
- Who will manage the grant funds and pay suppliers, vendors, and contractors?
- Will cooperating organizations submit itemized expense statements and receipts before they receive grant funds?
- Who will direct and coordinate fundraising efforts?

- Who will pay for long-term equipment maintenance, operations, programming, and staffing after Rotary Grant funding ends? (Note that Rotarians may continue to support the project, but the project should not depend solely on that support.)
- Who will prepare Rotary Grant reports? Who will collaborate on reporting?
- How will financial records be stored? Who will maintain these records? What is the document retention plan?
- Who will measure and evaluate the project's outcomes? How will they do this? Who will collect results? How will the outcomes be shared?

MUTUAL UNDERSTANDINGS

For legal reasons, the Foundation needs this section to remain as it is. It must not be added to or edited. We understand that, for certain relationships, Rotarians may need to sign a second MOU or contract to comply with local laws. Even in such cases, however, the Foundation needs this MOU to be submitted with your grant application.

AUTHORIZATIONS

Make sure that all parties have signed the MOU. If any signature is missing, it will be considered incomplete. Each sponsor and organization should decide who will represent it as a signatory.

If you have any concerns or questions, your regional grants officer can review your MOU before it is signed to make sure it's complete.

Safe Water Gardens
Clean. Affordable. Essential.

Safe Water Gardens (SWG) Pte Ltd

Business Reg No: 201942778Z
c/o 20A King Albert Park, Singapore, 598324

Attention to: the Rotary Club of Bandung

Invoice: SWG RC 10/2020
Date: 26 Oct 2020

Item	GST	Total
Sanitation project near Bandung, Indonesia: 30 Safe Water Gardens	Nil	USD 45,000 (Rp 675 jt)

Description item:

The project: Our company and its partners (which include NUS, UGM and other top universities) developed, over the last 5 years, the world's most cost-efficient 2 stage autonomous sanitation solution, the *Safe Water Garden* (*SWG*). The SWG was officially recognized by the Indonesian government (Puskim) as part of its national standards in March 2020, and Puskim is keen to promote the SWG as a viable solution to Indonesia's national sanitation issue. As such, Puskim has suggested to do a pilot project in the Citarum area near Bandung, an area with 25 million people, identified by the central government as having an acute problem with lack of sanitation. *As such, this is both a social and a fundamental research program*.

Executed in partnership with the local communities: The project will, in partnership with Puskim, identify around a 100 local households which will share 30 SWGs and get them ready to help us construct the SWGs (the transfer of construction knowledge to the communities is a crucial part of a nationally successful campaign). The whole event should take no more than 2 months and it will be scientifically documented and published as part of a national rollout campaign. Active partners in the project will be the LooLa Eco Adventure Group (initiator of the SWG project and on the ground experience with the construction and necessary social engineering), Universitas Gadjah Mada (for scientific documentation), Puskim (to highlight the national importance) and the local communities (who will provide the manpower and to whom ownership will be transferred).

Project cost breakdown (in USD)	
Materials & transport cost for 30 complete sanitation systems, incl SWG (@$450), renovate or build a toilet & shower (@$200), construct a kitchen sink (@$50). This includes securing a reliable local material pipeline, as advised by local village elders. Total @$700 x 30 units	21,000 (Rp 315 jt)
Transport, local labour costs & food for local people (approx 20 people for 30 days of labour spread out over 2 months) and sourcing/securing such reliable labour @$450 x 20	9,000 (Rp 135 jt)
Day-to-day construction and quality control supervision for 2 months by SWG construction experts & scientific teams, plus scientific logging, research and reporting of results via PPT	10,000 (Rp 150 jt)
Sanitation and hygiene educational materials production and training activities; media engagement for public education, awareness building and advocacy for the WASH cause	5,000 (Rp 75 jt)

Payment schedule	To start project	USD 30,000 (Rp 450 jt)
	Upon completion	USD 15,000 (Rp 225 jt)

Bank details:

Bank name: *OCBC Bank, Singapore*
Bank address: *4 Battery Road, Bank of China Building, Singapore 588996*
Account name: *Safe Water Gardens (SWG) Pte Ltd*
Account no.: *601179294201 (USD current account)*
Bank no.: *7339*
Branch no: *601*
SWIFT CODE: *CHASUS33*

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Final Report of Safe Water Garden (SWG) Sanitation Project Nagrak village, Bandung Regency, West Java

TOWARDS

SCALING LOW-COST SANITATION for all Indonesian villagers by 2027

Language of this report

Since international and Indonesian group of sponsors and stakeholders are involved, this is a bilingual report, with each key section in both English and Bahasa Indonesia. Certain sections, such as the results of local surveys amongst village people, are almost exclusively in Bahasa.

Table of content

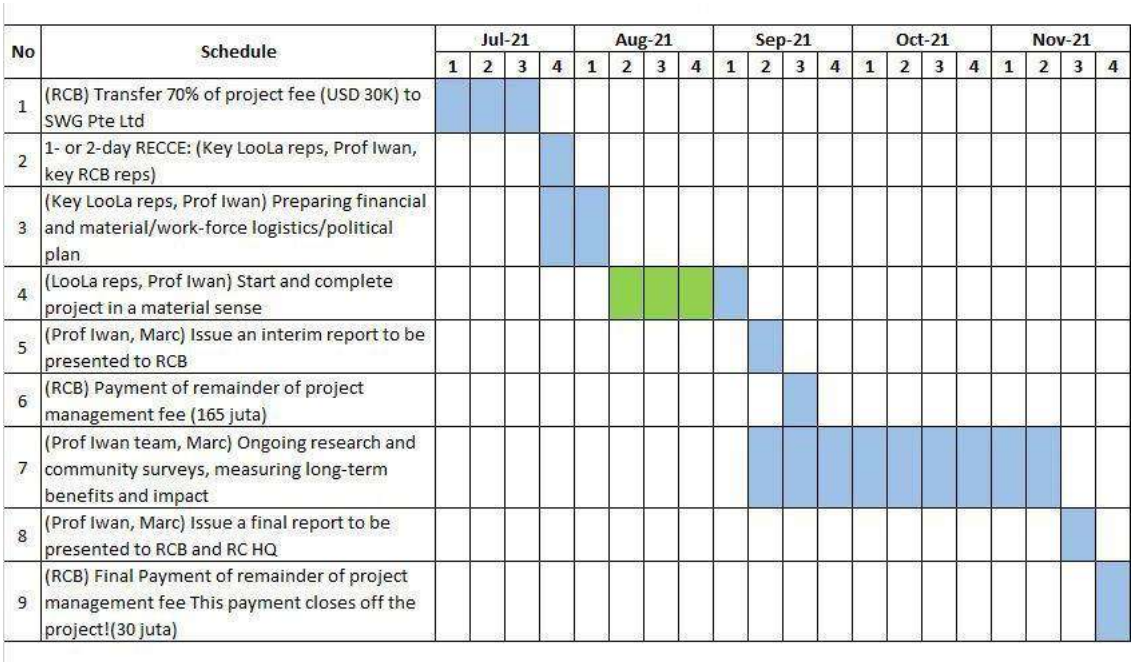
List of abbreviations

SWG = *Safe Water Garden*
W.A.S.H = *Water, Sanitation, Hygiene*
SNI = *Standar Nasional Indonesia,* (the Indonesian National Standards)
PUPR = *Pekerjaan Umum dan Perumahan Rakyat*, (Ministry of Public works and Housing)
RW = *Rukun Warga*, a village chief
RT = *Rukun Tetangga*, a village chief
CSR = *Corporate Social Responsibility*
ESG = *Environmental, Social, Governance*

EXECUTIVE SUMMARY

The Rotary Grant called, within the timeline as per graphic below, for the following project in the WASH-stressed village Nagrak, based in one of the world's most polluted river-shed areas, the Citarum area in Java, Indonesia:

1. 30 complete sanitation systems, including Safe Water Gardens (SWG), and the renovation or new building of toilet & shower and kitchen sinks where necessary to support the 30 SWGs
2. Planning this milestone event together with the village people
3. Full transfer of ownership over the SWGs
4. Engaging the whole village in the transformational nature of the project
5. Basic hygiene reminders on how to deal with water, sanitation and hygiene for all participants.



No	Schedule	Jul-21				Aug-21				Sep-21				Oct-21				Nov-21			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1	(RCB) Transfer 70% of project fee (USD 30K) to SWG Pte Ltd																				
2	1- or 2-day RECCE: (Key LooLa reps, Prof Iwan, key RCB reps)																				
3	(Key LooLa reps, Prof Iwan) Preparing financial and material/work-force logistics/political plan																				
4	(LooLa reps, Prof Iwan) Start and complete project in a material sense																				
5	(Prof Iwan, Marc) Issue an interim report to be presented to RCB																				
6	(RCB) Payment of remainder of project management fee (165 juta)																				
7	(Prof Iwan team, Marc) Ongoing research and community surveys, measuring long-term benefits and impact																				
8	(Prof Iwan, Marc) Issue a final report to be presented to RCB and RC HQ																				
9	(RCB) Final Payment of remainder of project management fee This payment closes off the project!(30 juta)																				

Overall, the project was a resounding success:

1. We far exceeded the material requirements: instead of doing 30 sanitation systems, we ended up doing 30 SWGs in Nagrak, 23 new toilets and a whopping 54 kitchen sinks (serving 93 families). *In addition*, we constructed 2 new deep wells plus two water towers and we brought running water to altogether 50 families while 49 families (plus Kadus office) received Nazava water filters (see installation tables on next pages). Lastly, an additional research SWG was built (ref point 3 below).
2. We successfully engaged the whole community and all local stakeholders in the project execution and in the overall WASH education, and after-project surveys in Dec 2021 and Jan 2022 (also by professional teams from the East Java Water Agency) showed complete and very high user-satisfaction, while we learned some valuable lessons on how this engagement and empowerment process could be executed even more successfully next time (see section 12).
3. The knowledge transfer to Itenas students was a complete success, and we contributed to global sanitation science by designing –at the request of the standards board– a "small scale SWG" (for people who don't have much land) and subsequently trying it out successfully at Itenas campus.
4. We started the project later than scheduled (on account of COVID restrictions), but we finished the whole project well within 3 months (instead of the 4 months as per time schedule above).

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No	Family Name	New Toilet	New Kitchen Sink	Well Upgrade	SWG	Agrifund	Recipient of Nazava
1	(Ibu Heni/Pa Adang)		✓		A2 (2-share)	✓	Ayet Anwar
2	(Irfan)				A2 (2-share)	✓	Ani
3	(Pa Darsono)	✓	✓		B3 (3-share)	✓	Suparman
4	(Bu Eni)		✓		B3 (3-share)	✓	Eutik
5	(Pa Hendar Suhendar)				B3 (3-share)	✓	Popon
6	(Atet Ismail)		✓		C	✓	Atik
7	(Pa Wawan/Bu Lim)		✓		D2 (2-share)	✓	Iim
8	(Pa Anwar/Bu Yuyun)				D2 (2-share)	✓	Ayi Wahyudi
9	(Pa Enjang)		✓		E2 (2-share)	✓	Ujang Oma
10	(Pa Dede)		✓		E2 (2-share)	✓	Ace Sumarna
11	(Pa Marna/Ibu Ika)				F2 (2-share)	✓	Jajang
12	(Pa Omo)	✓	✓		F2 (2-share)	✓	Ilma
13	(Bu Ida)		✓		G2 (2-share)	✓	Kartiwa
14	(Bu Deti)		✓		G2 (2-share)	✓	Wawan
15	(Endang Besi)		✓		H2 (2-share)	✓	Osa
16	(Caca)		✓		H2 (2-share)	✓	Andri
17	(Pa Endang/Bu Tini)		✓		I2 (2-share)	✓	Heni
18	(Pa Ade/Bu Mai)	✓	✓		I2 (2-share)	✓	Tati
19	(Pa Yoyo)	✓	✓		J	✓	Ambu
20	(Nandan)		✓		K5 (5-share)	✓	Heni.H
21	(Endang)		✓		K5 (5-share)	✓	Imas
22	(Emi)		✓		K5 (5-share)	✓	Iyan
23	(Didi)				K5 (5-share)	✓	Repatunissa
24	(Yayan)				K5 (5-share)	✓	Dadan
25	(Pa Tatang)		✓		L3 (3-share)	✓	Iyan
26	(Pa Tarmid)		✓		L3 (3-share)	✓	Rifdi
27	(Pa Ecep)	✓	✓		L3 (3-share)	✓	Fahmi
28	(Pa Kades Suparman)				M	✓	Enung
29	(Ibu Popon)				N4 (4-share)	✓	Lela
30	(Ibu Leni)				N4 (4-share)	✓	Dede
31	(Pa Tony/Ibu Edah)	✓			N4 (4-share)	✓	Ano
32	(Pa Enjang)				N4 (4-share)	✓	Minatik
33	(Ibu Noneng)				O3 (3-share)	✓	Nia
34	(Pa Ade Suhendar)		✓		O3 (3-share)	✓	Oman

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No	Family Name	New Toilet	New Kitchen Sink	Well Upgrade	SWG	Agrifund	Recipient of Nazava
35	(Ibu Lilis)		✓		O3 (3-share)	✓	Apon
36	(Ibu Rita/Pa Edip)				P2 (2-share)	✓	Iis
37	(Pa Kaniwa/Ibu Titin)		✓		P2 (2-share)	✓	Agus
38	R42 (Pa Heri Mulyana/Ibu Nanih)	✓			Q3 (3-share)	✓	Atep
39	(Pa Asep)	✓	✓		Q3 (3-share)	✓	Asep Nurdin
40	(Ibu Cucu)	✓	✓		Q3 (3-share)	✓	Asep Suryana
41	(Pa Iyus)		✓		R2 (2-share)	✓	Nandang
42	(Pak Endang/Ibu Elis)		✓		R2 (2-share)	✓	Ade Elin
43	(Pa Ucu/ Ibu Nur Agustin)	Upgrade	✓		S3 (3-share)	✓	Rodian
44	(Pa Erwin/ Inu Heni	✓	✓		S3 (3-share)	✓	Salamah
45	(Pa Edeh/Ibu Empon	✓	✓		S3 (3-share)	✓	Didin
46	(Pak Jujun / Ibu Risma)	✓	✓	✓	T5 (5-share)	✓	Heni
47	(Pak Aji / Ibu Kokom)	✓		✓	T5 (5-share)	✓	Wiwin
48	(Pak Asep / Ibu Titin)			✓	T5 (5-share)	✓	Mimi
49	(Pak Entang / Ibu Eti)		✓	✓	T5 (5-share)	✓	Muarif
50	(Pa Dede / Ibu Onih)			✓	T5 (5-share)	✓	
51	(Pa Utep / Ibu Yati)	✓	✓		U3 (3-share)	✓	
52	(Pa Maman / Ibu Yuyun)				U3 (3-share)	✓	
53	(Pak Iyi / Ibu Eneng Aisyah)	✓	✓		U3 (3-share)	✓	
54	(Ibu Ai Rosita / Gugun Gunawan)		✓	✓	V6 (6-share)	✓	
55	(Pak Utep)			✓	V6 (6-share)	✓	
56	(Pak Dadi / Ibu Ai Mimi)			✓	V6 (6-share)	✓	
57	(Pak Joni / Ibu Rani)			✓	V6 (6-share)	✓	
58	(Pak Rosid / Ibu Apong)	✓	✓	✓	V6 (6-share)	✓	
59	(Pak Rosyid)			✓	V6 (6-share)	✓	
60	(Pak Yayat / Ibu Nurfitriani)	✓	✓		W6 (6-share)	✓	
61	(Pak Maman Rohman)		✓		W6 (6-share)	✓	
62	(Pak Ano)	✓	✓		W6 (6-share)	✓	
63	(Pak Enjang Wihama / Ibu Lilis)		✓		W6 (6-share)	✓	
64	(Pak Asep Rahman / Ibu Dede)		✓		W6 (6-share)	✓	
65	(Pa Yayan / Ibu Sri)		✓		W6 (6-share)	✓	

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No	Family Name	New Toilet	New Kitchen Sink	Well Upgrade	SWG	Agrifund	Recipient of Nazava
66	(Pak Tarwaya / Ibu Dedenani)	✓	✓		X4 (4-share)	✓	
67	(Pak Sario / Ibu Apon)		✓		X4 (4-share)	✓	
68	(Pak Ujang / Ibu Siti)				X4 (4-share)	✓	
69	(Pak Budiman / Ibu Wulansari)	✓			X4 (4-share)	✓	
70	(Pak Asep /Ibu Juju)	✓	✓		Y4 (4-share)	✓	
71	(Pak Didin)				Y4 (4-share)	✓	
72	(Pak Adang)				Y4 (4-share)	✓	
73	(Pak Encang / Ibu Tini)	✓	✓		Y4 (4-share)	✓	
74	(Pa Ayat / Ibu Mimin)		✓		Z3 (3-share)	✓	
75	(Pa Toto / Ibu Yeti)		✓		Z3 (3-share)	✓	
76	(Ibu Emi)		✓		Z3 (3-share)	✓	
77	(Dadan)	✓	✓		AA7 (7-share)	✓	
78	(Bapak Endu)				AA7 (7-share)	✓	
79	(Bapak Ana)				AA7 (7-share)	✓	
80	(Ibu Inin)				AA7 (7-share)	✓	
81	(Pa Yayan)				AA7 (7-share)	✓	
82	(Pa Sandi)				AA7 (7-share)	✓	
83	(Pa Jejen)				AA7 (7-share)	✓	
84	(Pa Engkus)				AB6 (6-share)	✓	
85	(Pa Tatang dan Pa Enji)				AB6 (6-share)	✓	
86	(Pa Waras)				AB6 (6-share)	✓	
87	(Ibu Nyai Tati)				AB6 (6-share)	✓	
88	R92 (Ibu Nani)				AB6 (6-share)	✓	
89	(Pa Dadang / Ibu Yanti Sumartini)				AB6 (6-share)	✓	
90	(Pa Didin Rusdiana)		✓		AC (3-share)	✓	
91	(Pa Dadang Rudiana/ Ibu Yusi)		✓		AC (3-share)	✓	
92	(Pa Abin)				AC (3-share)	✓	
93	(Pa Ayet)		✓		AD	✓	

Safe Water Gardens
Clean. Affordable. Essential.

1. INTRODUCTION TO THE SAFE WATER GARDENS

The solution to the world's rural sanitation problem

1.1 The Issue

- In tropical villages, wastewater is typically released untreated into the environment.
- The result is a health tragedy: worldwide, 2000 children die every day as a result, 370 in Indonesia alone.
- Furthermore, developing countries suffer a huge economic and social toll.
- Finally, it's a global environmental catastrophe: the untreated release of wastewater leads to oxygen depletion in the world's water systems, threatening fish stocks and coral reefs worldwide.

1.2 The Solution – the world's most cost-efficient sanitation system*

Inspired by the life-saving work of UNICEF after Aceh's tsunami, *LooLa Adventure Resort* – crowned *World #1 Responsible Tourism Operator in London 2015* – formed a coalition with governments, world-class universities, and companies to optimize the solution and make it even cheaper and easier to build locally.

In 2019, after 3 years of extensive research, we had our result, the "Safe Water Garden" (**SWG**). It features 4 main components: a closed tank, a leach field (the garden), a pipe system connecting the parts, and a separate kitchen sink (not pictured). The Indonesian government quickly recognised the SWG's potential to address the rural sanitation issue and declared it fit for use in Dec 2019, making the SWG officially the world's most cost-efficient sanitation system* and paving the way for a national rollout.

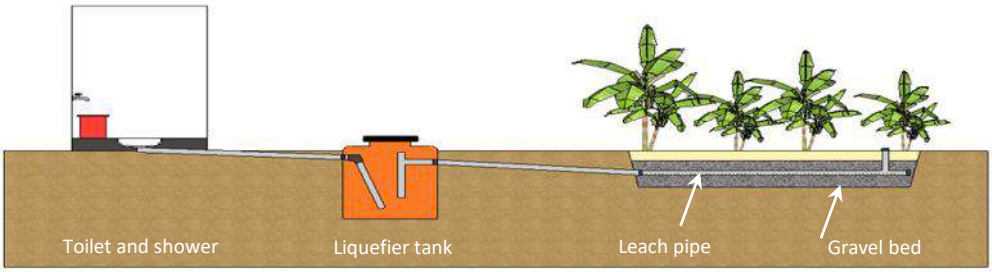


Figure 1.1 Basic schematic model of the *Safe Water Garden* (SWG)

1.3 The SWG: a complete rural wastewater management solution – and more

Provided users are informed of the simple maintenance rules, the SWG offers immediate benefits because it …

- prevents diseases resulting from open-air contact with human waste
- lifts social status – the houses no longer smell and feature a beautiful garden
- improves life quality – the system is maintenance-free and children can safely play in the garden
- enhances spiritual well-being – a clean environment and clean public facilities speak to religious beliefs
- generates a steady income – the garden pays itself back within 2 years on account of cash crops
- imparts household-savings of 5–20 % – from garden income and reduced medical/maintenance bills
- positively impacts the global environment – the system reduces the release of organics and nutrients
- promotes local ownership – buildable in one day, the SWG is an asset for life for a rural family/school
- is affordable to everyone – a one-off material cost below € 300 is well within national public budgets

* According to the minimal standards set by UNICEF for rural sanitation systems, see https://safewatergardens.org/cost-efficiency/

2. A HISTORY OF SUCCESS

and a vision for future success

2.1 The SWG history – and the organisations behind it

In 2014, after the infant daughter of LooLa's cook died because of inadequate sanitation at her home, *LooLa Adventure Resort* decided to leverage its status as a world leader in ecotourism to start building UNICEF-inspired sanitation systems together with its guests, for village homes and schools in Bintan (Indonesia).

2017 marked the start of an international **scientific effort** –the largest systematic study to date– jointly led by: *LooLa*; Indonesia's oldest and largest university *Universitas Gadjah Mada*; one of Europe's best research universities *Eindhoven University of Technology*; and SE Asia's top university *National University of Singapore*, represented by Singapore's best-known water researcher, Prof Ng How Yong.
The study was sponsored by the Dutch government (*Nuffic*), Palm Oil leaders *Sinarmas* and *Musim Mas*, Plastics leader *Borouge*, as well as many schools, smaller companies, and passionate individuals.

Its purpose: to optimise UNICEF's system in terms of cost, performance, buildability, and –crucially– its capacity to connect to local people's experiences and to achieve the benefits listed above.

The research resulted in a new blueprint for an optimized system –the SWG– that is affordable to even the poorest of households or local schools. If village households are ready to share, the cost can be as low as € 100 per household: a *one-time cost* for a lifelong life-saving sanitation system that keeps yielding economic benefits.

Recognising the SWG's potential to address the rural sanitation issue, the Indonesian government swiftly declared the SWG fit for use in 2019 (in line with the rollout vision we outlined in 2017, ref to App 3), making the SWG officially the world's most cost-efficient sanitation system* and paving the way for a national rollout.

2.2 The SWG future in summary – a public-private partnership to achieve a global scale-up of sanitation, food-security, and health

One of our corporate partners, *Shell*, finished an Open Source "LEGO-like" *construction manual* (to be printed in 6 different languages) so we can share knowledge efficiently. *Rucika*, Indonesia's biggest pipe manufacturer came on board and designed a standard plug-n-play set to facilitate a national rollout. The rollout is planned as a private-public partnership that transfers full ownership to the local communities:

The Palm oil sector will lead the way for *private* companies in facilitating the rollout in its adjacent communities. Meanwhile, the (local) Indonesian government can fund a *public* rollout that is executed at the village level by the village communities themselves. Using funds that we raised privately, we demonstrated the public rollout model early in 2021 when we successfully transferred knowledge to a whole village community. The villagers subsequently installed the SWGs themselves for all homes in the village. For more details on the scale-up model and why the Indonesian government has the funds for a national rollout, refer to the pages below.

Parallel to the rollout –and in full collaboration with the Indonesian government– we will conduct further public-private research in several areas that will significantly advance global sanitation science:

- optimize the SWG's crop output, notably chili (rice and chili are Indonesia's most important food items);
- further optimize the plastics standard set (refer to picture next page) that can be locally produced (in collaboration with the local plastics industry);
- expand existing research that showed that the quality of village water wells can be drastically improved by preventing chicken from defecating in the well;
- demonstrate that the SWG also works in sub-optimal conditions, such as flood-prone or very dry areas, possibly by doing some minor adjustments.
- show that the SWG works globally: the SWG is expected to work not just in Indonesia, but in all warm countries (not exposed to frost at any time of the year) around the world.

3. OVERVIEW OF THE PROJECT PROPOSAL

and the project stakeholders

3.1 Recap of project objectives, stakeholders and timelines

We refer to the earlier agreed time schedule below, as well as the objectives listed in the original Rotary grant, as well as a list of stakeholders in this project, all listed below:

Project objectives:

1. 30 complete sanitation systems, including SWG, renovate or build toilet & shower and kitchen sinks
2. Planning this milestone event together with the village people
3. Full transfer of ownership over the Safe Water Gardens
4. Engaging the whole village in the transformational nature of the project
5. Basic hygiene reminder on how to deal with water.

Project stakeholders:

A. Rotary Club Singapore (Grant giver) and RCB (Grant manager)
B. Safe Water Gardens / LooLa team (henceforth ***SWG Team***, project managers)
C. Itenas student team (led by Dr Iwan) and UGM (Prof Lilik), our academic partners
D. The village chiefs at Nagrak village
E. The community at Nagrak village
F. The SNI office senior team, officially led by Pak Sabbath but in essence driven by Ibu Elis
G. The Governor's office
H. The Bupati office
I. The provincial and district offices of PUPR (Public housing and utilities board)
J. The provincial and district offices of the Environmental agency

No	Schedule	Jul-21				Aug-21				Sep-21				Oct-21				Nov-21			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1	(RCB) Transfer 70% of project fee (USD 30K) to SWG Pte Ltd																				
2	1- or 2-day RECCE: (Key LooLa reps, Prof Iwan, key RCB reps)																				
3	(Key LooLa reps, Prof Iwan) Preparing financial and material/work-force logistics/political plan																				
4	(LooLa reps, Prof Iwan) Start and complete project in a material sense																				
5	(Prof Iwan, Marc) Issue an interim report to be presented to RCB																				
6	(RCB) Payment of remainder of project management fee (165 juta)																				
7	(Prof Iwan team, Marc) Ongoing research and community surveys, measuring long-term benefits and impact																				
8	(Prof Iwan, Marc) Issue a final report to be presented to RCB and RC HQ																				
9	(RCB) Final Payment of remainder of project management fee This payment closes off the project!(30 juta)																				

Figure 3.1 Skeleton Schedule for the Citarum Project, by Key Milestones

4. RECCE TRIP: AN IMPRESSION OF THE W.A.S.H CONDITIONS

4.1 About Nagrak Village

Nagrak Village is located in Pacet District, Bandung Regency with an area of 798,155 hectares, of which 8% of the land is rice fields and the remaining 738,155 hectares is land. There are 3 hamlets in Nagrak Village, where each hamlet consists of 4-6 Rukun Warga. The land use condition in Nagrak Village has 60 hectares of rice fields, with the following territorial boundaries:

- North side: Tanjung Wangi Village
- East side: Cikawao Village
- South: Forestry
- West: Mandalalahaji Village

The map of Nagrak Village can be seen in the figure below.

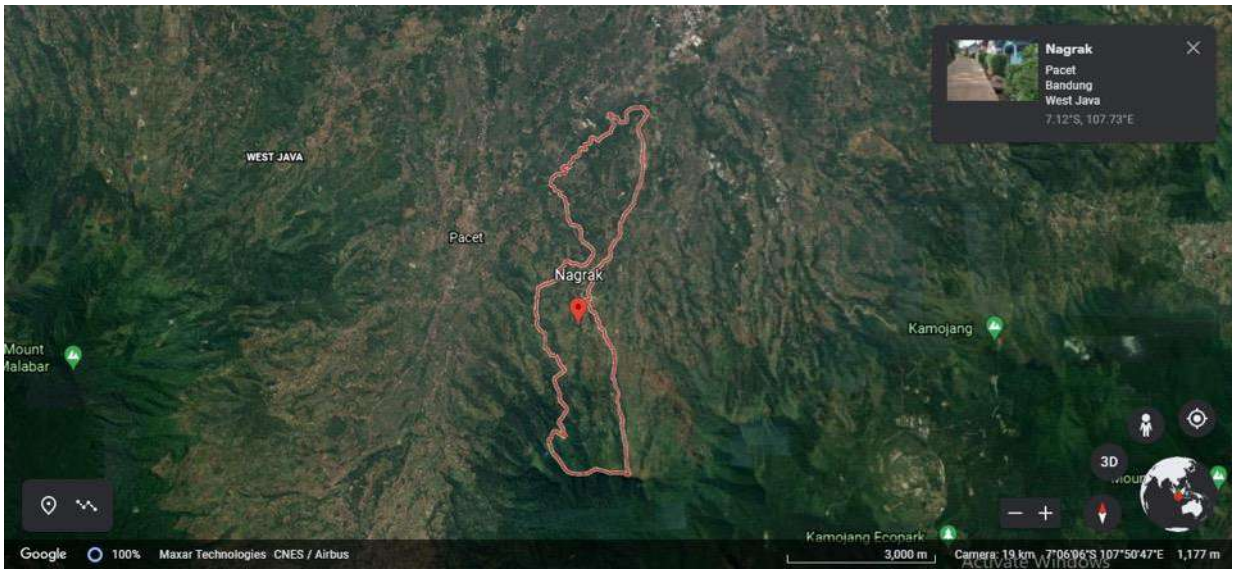


Figure 4.1 Nagrak Village Area Boundary

The area of Nagrak Village is demographically divided into 3 hamlets including Hamlet I consisting of RW 01, 02, 10, and 12. Hamlet II consists of RW 06, 15, 03, 14 and 08. The last hamlet, Hamlet III, consists of RW 09, 04, 11, 13, 07, and 05. The total population of Nagrak Village is ± 10,457 people (Saputri et al., 2020).

Communities whose main livelihoods are in farming, fisheries, livestock, or a combination of these, and their cultural and social systems that support community livelihoods (Saputri et al., 2020).

4.2 Social-Economic-Environment Conditions of Nagrak Village

In this part, general conditions of social, economic and environmental issues of Nagrak Village are presented. The summary below is the results of interviews with the potential households as SWG awardees. The respondents of the interviews were 93 families as the SWG awardees, initially chosen with the recommendation of village officials. These 93 families were chosen for their poor ~~low~~ sanitation facilities. However, for the socio-economic conditions, these 93 families fairly represent the populations in Nagrak Village as a whole.

4.2.1. Socio-Economic

The age groups of the respondents participated in the interview can be seen in **Figure 4.2.** Here, of the 93 respondents, it shows that 79% of them fall in the age group of 19-59 years old, while 21% of them are 60 years or more. This means, the overall population in Nagrak Village is in their productive age, and are potentially willing to be involved in this project. Here, it can also be seen a mother in the range of 19-59 age group is being interviewed. The interview itself was undertaken by Itenas students, as the main academic partner in this project.

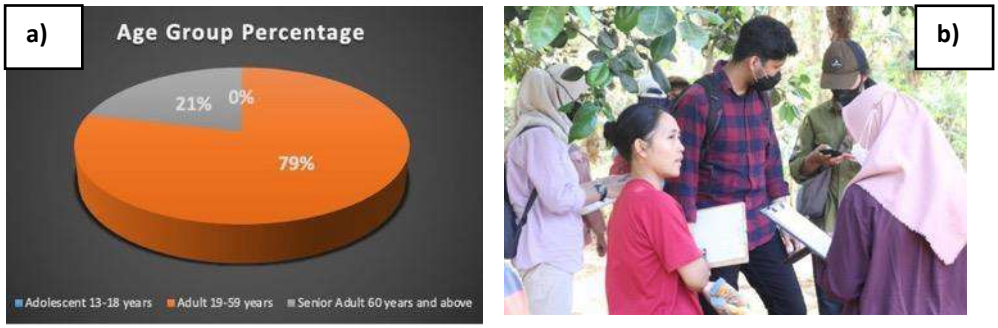
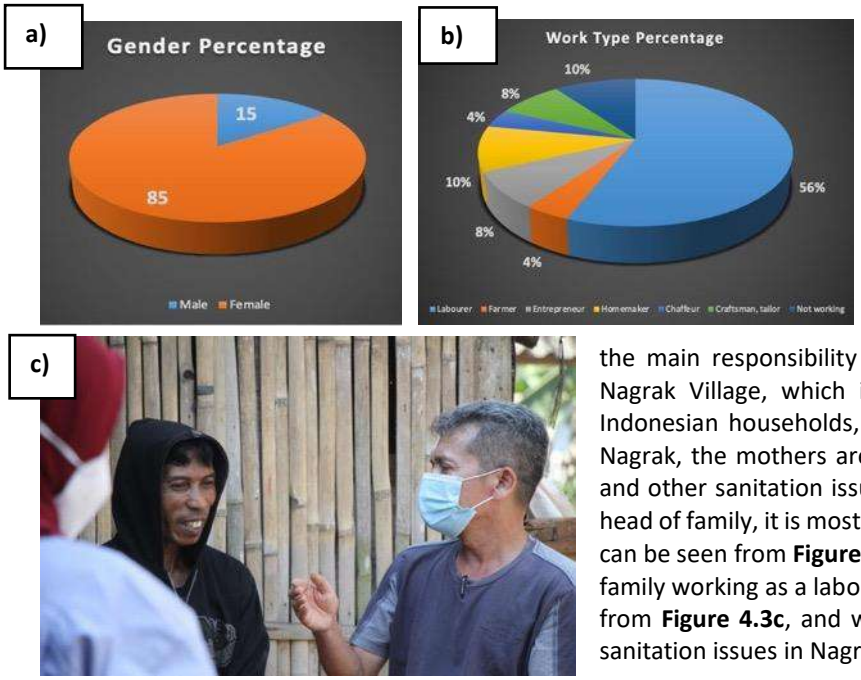
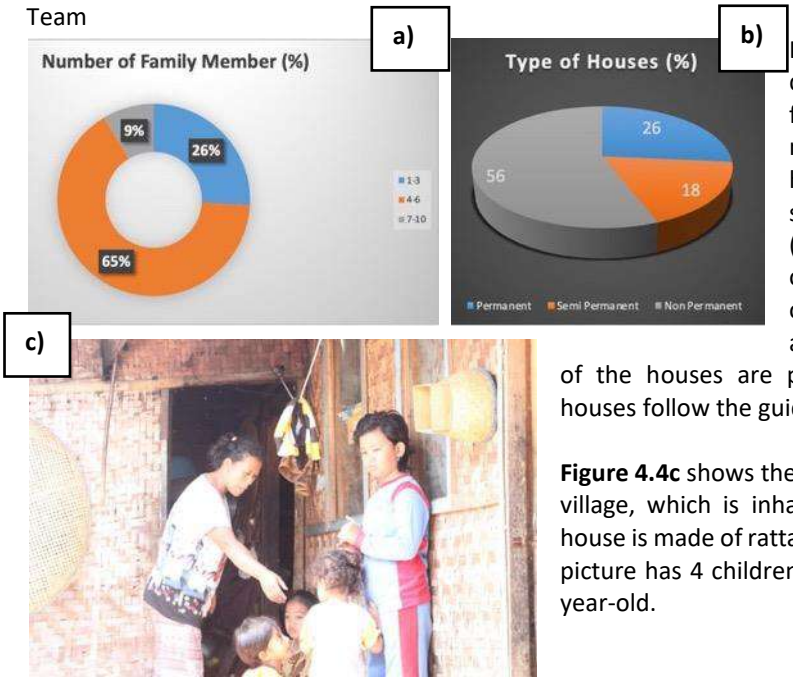


Figure 4.2 a) Percentage of Age Group; b) Stage of Education and Community Interview by Team



Another characteristic worth mentioning is the gender percentage of respondents. Of the total 93 respondents, 85% of them are female. This is typically normal in Indonesia, as most male are working during the day. This information is also relevant to the SWG project, as it provides valuable information on who has the main responsibility in water and sanitation issues in Nagrak Village, which is the mothers. In most cases of Indonesian households, particularly in rural areas such as Nagrak, the mothers are responsible for washing, cooking and other sanitation issues. As for the type of jobs for the head of family, it is mostly dominated by labourers (56%), as can be seen from **Figure 4.3b**. Here we capture one head of family working as a labourer being interviewed can be seen from **Figure 4.3c**, and was asked about his opinion about sanitation issues in Nagrak area.

Figure 4.3 a) Gender Percentage; b) Work Type Percentage; c) Stage of Education and Community Interview by Team



In Nagrak Village, through the questionnaire distribution can be seen from **Figure 4.4a**, it is also found that the number of family members for one household is 4-6 persons (65%), with some having 7-10 persons in a house (9%). **Figure 4.4b** shows the percentage of house type in Nagrak Village, with 56% of the houses are non-permanent, 18% are semi-permanent, and the other 26% of the houses are permanent. The classification of these houses follow the guidelines of the national standard.

Figure 4.4c shows the typical non-permanent house in Nagrak village, which is inhabited by 4-6 persons on average. The house is made of rattan wicker. This young family shown in the picture has 4 children, with the eldest daughter being only 9 year-old.

Figure 4.4 a) Number of Family Number; b) Type of Houses; c) Examples of a Permanent House in Nagrak Village

4.2.2. WASH-related

With regards to the facility for dishwashing, in Nagrak Village, can be seen on **Figure 4.5a** 30% of the respondents do not have the facility and 32% use the toilet area for dishwashing. This figure shows at least 62% if the respondents do not have proper facilities to wash their dishes. Consequently, the waste water from the dishwashing activity might be discharged to different outlets, such as to a creek, small pond near the house, or even to a nearby river. As can be seen from **Figure 4.5b**, even though 52% of the respondents have separate black water and grey water treatment, the other 48% of the respondents either have joined black and grey water treatment or not have the waste water treatment at all. **Figure 4.5c** and **4.5d** show the typical area people in Nagrak use for washing the dish. They are commonly found just in front of or near their houses, with no proper facility. In many cases, the area does not have running water, but instead they bring the water in a bucket from other places.

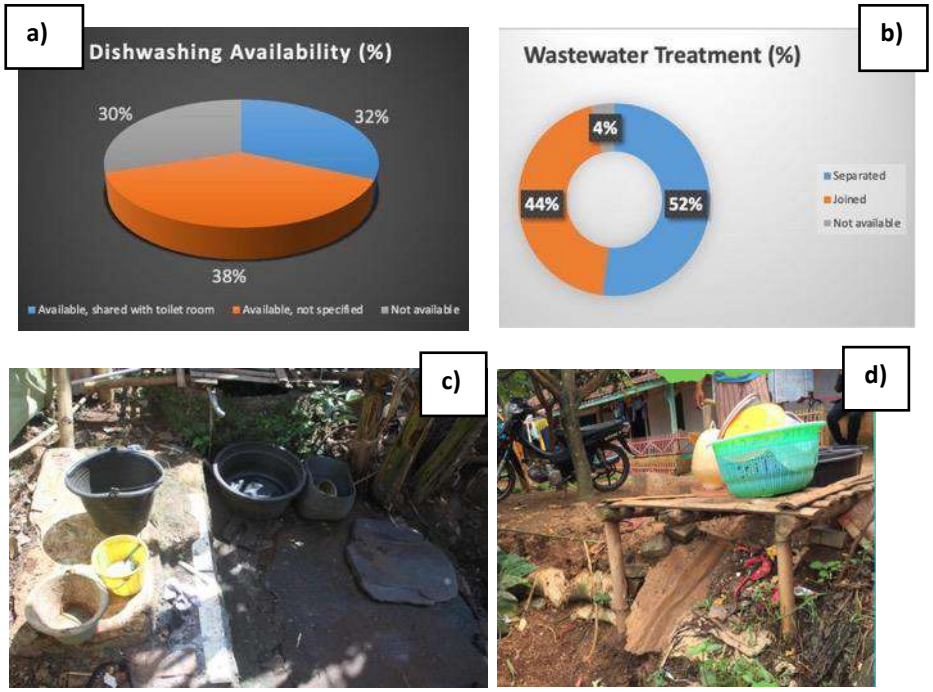
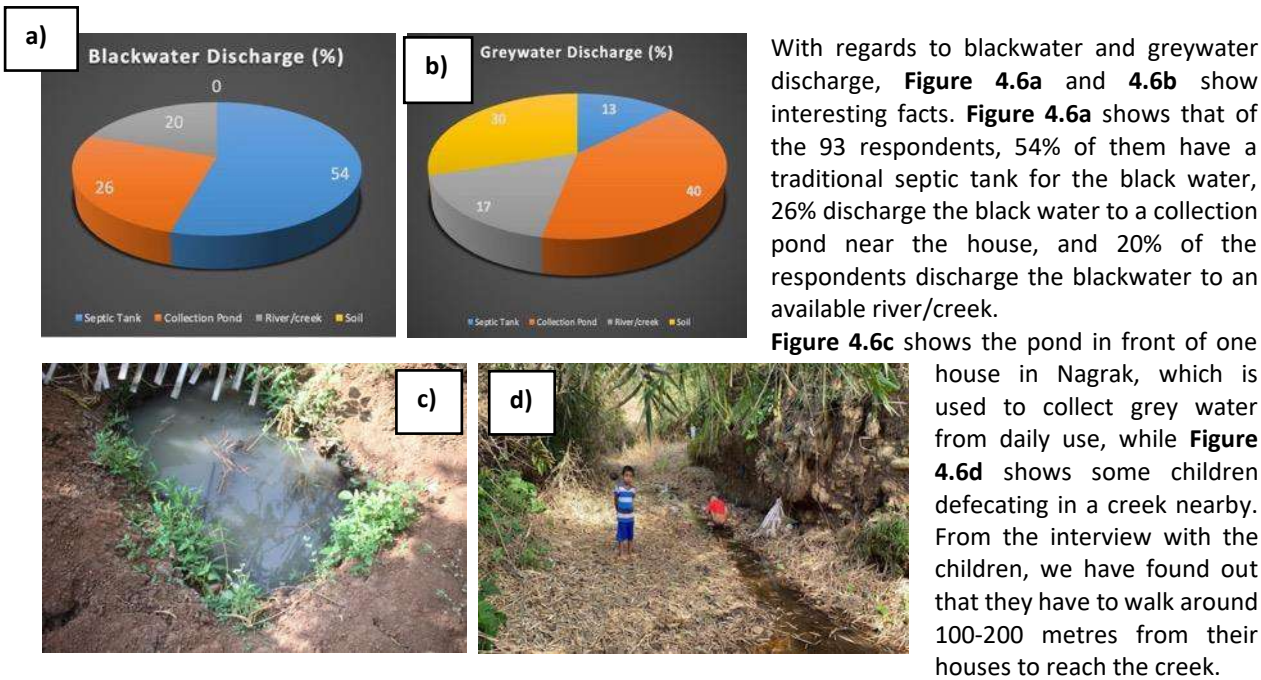


Figure 4.5 a) Dishwashing Availability; b) Wastewater Treatment; c) Example typical of Area Toilet; d) Example Typical of Area Dishwasher



With regards to blackwater and greywater discharge, **Figure 4.6a** and **4.6b** show interesting facts. **Figure 4.6a** shows that of the 93 respondents, 54% of them have a traditional septic tank for the black water, 26% discharge the black water to a collection pond near the house, and 20% of the respondents discharge the blackwater to an available river/creek.

Figure 4.6c shows the pond in front of one house in Nagrak, which is used to collect grey water from daily use, while **Figure 4.6d** shows some children defecating in a creek nearby. From the interview with the children, we have found out that they have to walk around 100-200 metres from their houses to reach the creek.

Figure 4.6 a) Blackwater Discharge; b) Grey Discharge; c) Example Typical of Area Greywater; d) Children and open defecation in Nagrak

During the joint recce trips by LooLa and Itenas, conducted during September 2021, it was also found that regarding water sources, 79% has pump wells, 10% has traditional wells, and the other 11% using water springs located far away from their houses. As for drinking water, see **Figure 4.7a**, 84% consumed boiled water and 16% of the respondents consume mineral water. Lastly, during the recce trip, it also collected information on the most disease suffered by the villagers in Nagrak, as seen in Figure **4.7b**. Here, it shows that 36% of the respondents have gastrointestinal issues, 27% have diarrhoea and 2% have itch problems. All these diseases might have a strong relationship with the quality of water and sanitation in their houses.

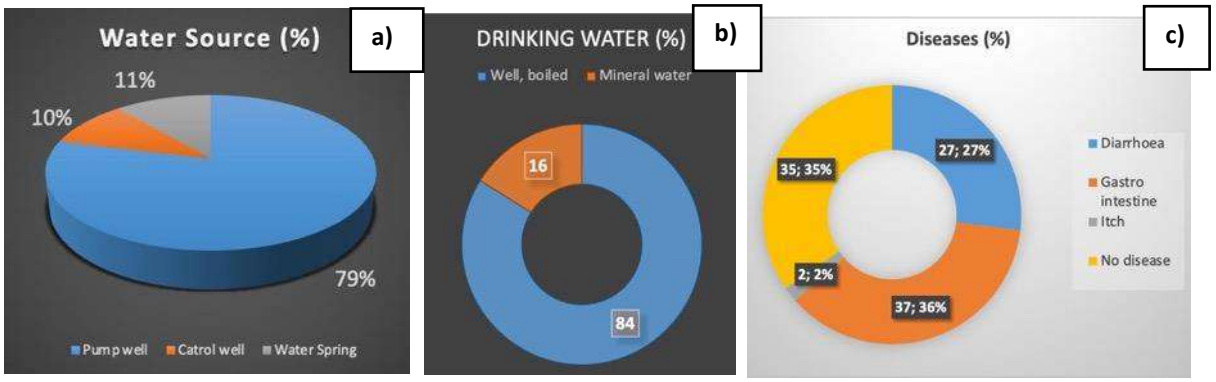


Figure 4.7 a) Percentage of Clean Water Sources of Nagrak Village Community; b) Percentage of Nagrak Village Drinking Water Source; and c) Percentage of Nagrak Village Water-borne Illness

4.3 Recce Trip Summary

On account of unexpected COVID lockdowns caused by Delta, we faced a 5-week delay in the earlier planned schedule. As soon as the SWG team received green light to travel, the SWG recce team made up of *Pak Jaya* and *Pak Tatang* (who comes from this area and speaks the local dialect) travelled to Bandung on 1 September to conduct an exploratory trip to plan the entire project. They met Itenas team that same evening and went to Nagrak village to meet with the villagers and the SNI office the next morning.

Exactly 2 weeks later, on 14 September, precisely on schedule, Jaya returned to Bintan (Tatang stayed behind to look after some last minor details), having achieved all objectives of the recce trip – and more.

All stakeholders were lined up for an official project opening on 2 Oct 2021, two weeks after which all systems were expected to be delivered as per project schedule – and they were!

Figure 4.8 SWG locations overview

How the objectives were met and all stakeholders were engaged

After meeting with Itenas team, lead by Dr. Iwan Juwana, on the evening of 1 Sep, the next morning the SWG team went over to Nagrak and stayed in the village for the entire 2 weeks, forging close bonds with the village communities.

The relations between the SWG team and the Itenas team have been superb from day 1, with wide open and highly functional communication lines, daily operated, especially after our staff changed their SIM cards to IndoSat cards, giving them reliable 4G (WhatsApp) connections in Nagrak.

Excellent communication lines were also established between the SWG team, Dr. Iwan and Ibu Elis of SNI, who continue to advocate for our project in the strongest possible terms.

The Itenas team came over several times to Nagrak during crucial moments, first to support the SWG location identification (see the satellite maps above and below), and then to gather social data on the number of families, sanitation conditions, clean water facilities, WASH habit of the families, solid waste conditions, and so on. On 17 Sept, there was a successful sosialisasi on the Safe Water Bricks (SWB) with the mothers of all 91 households, see section 5 below for more details on the SWB.

When the SWG team arrived in Nagrak on 2 Sep, they found themselves in the midst of a (not unexpected) social conundrum. Someone (we don't know quite who) had told the villagers that one particular sub-village (out of the total number of 17 sub-villages) would receive 30 toilets and SWGs, leading to the (fully expected) discontent of the other sub-villages (each under their own RT).

The SWG/Itenas team quickly recognised Pak *Kadus (*a village chief somewhere between RW and Kepala Desa, in charge of 5 RW's and 17 RT's) as a very fair-minded man who realised that it would not be a good idea to concentrate the whole project in one sub-village, but that it was better to identify the most needy families across 9 different RT communities, with each RT getting 3 – 4 SWG's, refer to the map in **Figure 4.8** above.

Ever since approving the SWG, the SNI office had been asking the SWG team to try out a sharing model for the SWG, believing that if families can share the SWG, the SWG will prove to be the financially feasible solution to Indonesia's rural sanitation problem. Combining the wishes of the SNI office and those of the local villagers and the local village chiefs, we then identified 91 families who would benefit from 30 sanitation systems (see Figure 1), with some larger clusters of families sharing one SWG (see **Figure 4.9** below).

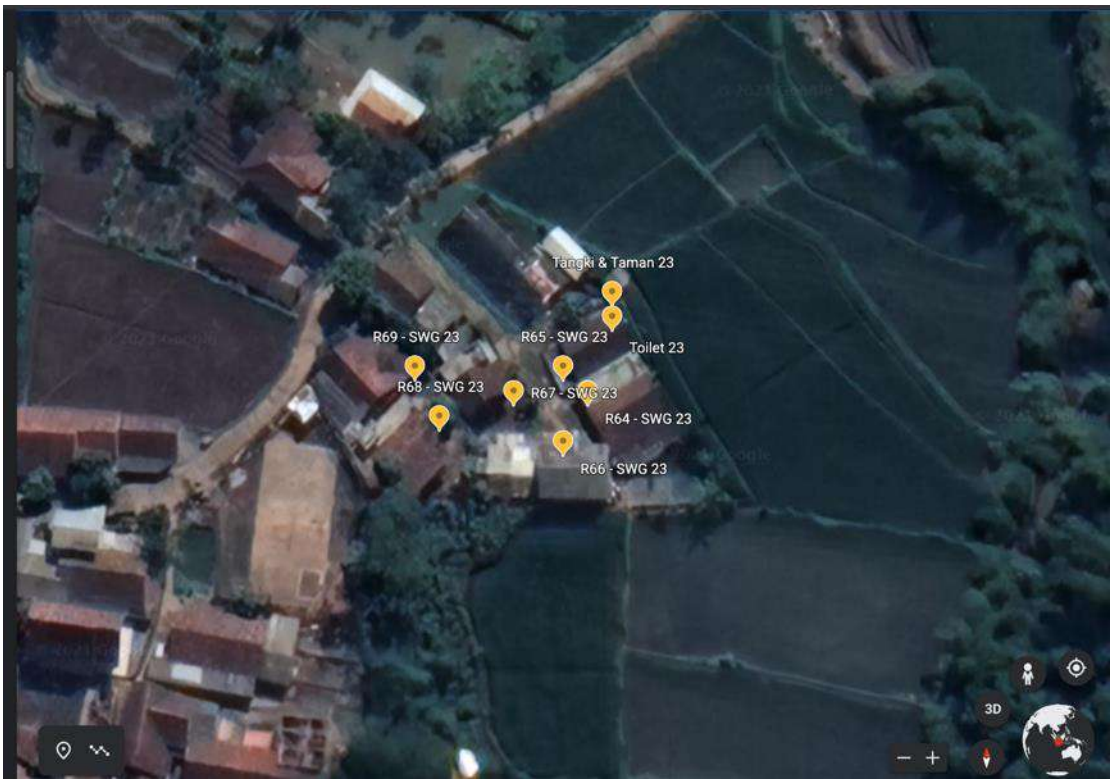


Figure 4.9 SWG sharing in close-up: several houses sharing one SWG facility, as advocated by SNI office

The SNI office had done well to suggest Nagrak as a pilot project site: sanitation and water is indeed a huge problem here, with open defecation in creeks and a severe problem with access to water (sometimes as far as 700 meters away from the house). The SWG and Itenas teams found that access to an SWG is fairly meaningless if there is no access to water, so we realised that for the worst cases, we had to organise easy access to water as well. As such, two deep wells (up to 20 meter deep) were planned as well as 2 water towers (to be connected to these deep wells), serving altogether as many as 50 families.

To prevent jealousy amongst the 91 families and keep everyone happy and excited, everyone who needed a new toilet or kitchen sink was promised one. After a detailed inspection, this meant we had to build 54 new kitchen sinks and 23 new toilet/washroom units (and we subsequently agreed to have these units built by locally trusted contractors, and they were all indeed finished in September, before our project teams arrived). Meanwhile, 1 of the 30 selected sites for SWG dropped out on account of the home-owner not owning the land (but we had up to 3 replacements at hand, as discreetly selected by Kadus, and we later selected another site for SWG #30).

All the necessary materials for the toilets, kitchen sinks and wells were procured and handed over to the villagers, with SWG's Pak Tatang and Kadus safeguarding the quality control of the construction process (which was transparently delegated to local teams who will be liable for long-term accountability towards the communities). All the other materials arrived at Kadus' house before the SWG teams. The whole community was excited and happy with the project, and proud that they have been selected for this pilot project.

Ibu Mira from RCB came over to meet with the SWG team, Dr. Iwan, and the village teams and could verify for herself that we had established a great working relationship. The Itenas teams, meanwhile, were also already successfully engaged the communities about Safe Water Bricks (see section 6), and they have also successfully conducted percolation tests which are important to make the SNI team happy.

Securing top level political support for official opening on 2 Oct

To approach the governors and high government officials (very important to gain visibility for this milestone event), the SNI office provided the contacts. It was then quickly decided that Pak Kadus would be the best person to send the invitations. Within a few days, Kadus managed to secure commitments to attend from both the deputy governor of Bandung and the Bupati of this area for an official opening on **2 October 2021**. This is a huge political feat – refer again to appendix 1 to understand the roles and importance of governors and Bupati's.

Meanwhile, on the recommendation of the SNI office, Kadus has also successfully invited the following very important public offices, the environment and public housing boards, both at the district and the provincial level:

1. Dinas Perumahan Rakyat Kawasan Permukiman dan Pertanahan Kabupaten Bandung
2. Dinas Lingkungan Hidup Kabupaten Bandung
3. Dinas Perumahan dan Permukiman Provinsi Jawa Barat
4. Dinas Lingkungan Hidup Provinsi Jawa Barat
5. Kepala balai teknologi sanitasi, dirjen cipta karya, kementerian pupr
6. Direktur bina teknis permukiman dan perumahan, dirjen cipta karya, kementerian PUPR

RCB announced they can be there as well. Altogether, it meant that we had secured fantastic visibility and impact for this project. By the time these teams arrived, the toilets and most of the kitchen sinks were built, as well as two deep wells and water towers, as well as several SWGs, so the politicians and high officials were able to see first-hand how great, life-changing and (financially and socially) feasible these W.A.S.H systems are.

The importance of access to water

The problem with access to water was a new phenomenon for the SWGT team; we had seen problems with access to water before, but never as severe as in this area. As mentioned before, it makes no sense to deliver a sanitation system that requires water (the SWG) if there is no water, so we realised we had to secure water access first.

To our surprise, however, the local people have remarkable solutions to secure access: for under $ 400 (4 million Rupiah), they dig wells as deep as 20 meters until they hit the water table. For another $ 400 or so, we can then construct a water tower, after which a whopping 20 – 30 families gained easy access to water.

This is an incredible fact: were able to show the authorities that for less than $ 40 per family, it is possible to secure running water.

5. SAFE WATER GARDEN TRAININGS

for the locals and university students

As one of the efforts in realizing the condition of improving affordable sanitation for all Indonesian villagers by 2027, the SWG team provided training to several communities and three students of Itenas (National Institute of Technology) who were accompanied directly by Dr Iwan as a form of knowledge transfer, so future projects in Indonesia, particularly in Nagrak Village and its surroundings, the community will be able to install their own SWG. Besides that, as a form of increasing the number of experts, if in the future there are projects in other areas (especially Java), the SWG team can cooperate with the community and Itenas students who have attended training and are certified by the SWG team. In delivering to the training participants, the SWG team was assisted by Dr. Iwan to facilitate delivery by translating Indonesian into Sundanese. The training provided includes technical and non-technical consisting of several main stages, namely pre-installation, installation and construction, and post-installation. To facilitate the training process, the SWG team distributed teaching materials to training participants. In these materials, there is information about the materials and tools used in the SWG installation, as shown in **Figure 5.1**

CHECKLIST JUST BEFORE CONSTRUCTION STARTS

checker name : 2" connector missing
date of check :

Action item to be checked		*check*	*comment*
House owners engaged?			
– Local recipient informed completely /what plants they want			.....
– They know when we arrive and have they agreed to be present?			
– All construction staff ready?			
– Clients informed and ready?			
Check that the pre-installation checklist is all done			*If not, do that first!*
Check the material check list below!			**Leftover material?**
- Plastic tank (500 liters)	1	Y	*Leftover:*
- Filter for shower water	2	Y	*Leftover:*
- 4" → 3" connector (pipe to pipe)	1	Y	*Leftover:*
- 3" → 2" connector (pipe to pipe)	2	Y	*Leftover:*
- 3" pipe (4 meter long) SECOND quality (red WAVIN)	4	Y	*Leftover:*
- 2" pipe (4 meter long) SECOND quality (red WAVIN)	2	Y	*Leftover:*
- 1.5" pipe (4 meter long) HIGH quality (blue WAVIN)	2	Y	*Leftover:*
- ¾ " pipe (4 meter long) HIGH quality (blue WAVIN)	1	Y	*Leftover:*
- 4" cap (dop)	1	Y	*Leftover:*
- 3" cap (dop)	3	Y	*Leftover:*
- 3" screw dop + 3" socket	2	Y	*Leftover:*
- 2" screw dop set (includes T-joint, for U-bend)	1	Y	*Leftover:*
- 3" screw drat connector set (to secure outlet pipe)	1	Y	*Leftover:*
- Extra 2" and 3" elbows	6	Y	*Leftover:*
- ¾ " screw drat connector set (to secure air pipe)	1	Y	*Leftover:*
- 3" T-joint	3	Y	*Leftover:*
- 2" T-joint	2	Y	*Leftover:*
- 1.5" T-joint	1	Y	*Leftover:*
- 3" 45 degree elbow:	3	Y	*Leftover:*
- 2" 45 degree elbow:	2	Y	*Leftover:*
- 1.5" 45 degree elbow:	1	Y	*Leftover:*
- 3" 90 degree elbow	1	Y	*Leftover:*
- 2" 90 degree elbow	6	Y	*Leftover:*
- 1.5" 90 degree elbow	4	Y	*Leftover:*
- ¾ " 90 degree elbow	1	Y	*Leftover:*
- 3" connector (to connect two 3" (pipes if need be)	3	Y	*Leftover:*
- Half truck of tiny stones (1.5 cubic meter)		Y	*Leftover:*
- Half truck of white sand (1.5 cubic meter)		Y	*Leftover:*
- Bricks for small walls	250	Y	*Leftover:*
- Waskom (kitchen)	1	Y	*Leftover:*
- Bag cement	1	Y	*Leftover:*
- Banana trees	2	Y	*Leftover:*
- Chili plants / egg plants / boontjes (check with owner)		Y	*Leftover:*
- Glue Tin	1	Y	*Leftover:*
- Gloves	15	Y	*Leftover:*
- Net (jaring) to protect garden from chicken and goats		Y	*Leftover:*
- Spades	4	Y Y	*Check to bring back these*
- Chankol	3	Y Y	*"double yes" items and fill*
- Hammer to knock hole in the wall	1	Y Y	*in the second Y on return!*
- Hammering pin to make this hole	1	Y Y	
- Parang to cut tree	1	Y Y	
- Big long sharp metal stick to move big stone deep down	1	Y Y	
- Saw	2	Y Y	
- Waterpas	1	Y Y	
- Transparent slang	1	Y Y	
- Drill 8mm + drill bits + drill knives	1	Y Y	
- Screw drivers to fix Waskom	1	Y Y	
- Extension listrik chord	1	Y Y	
- Wheelbarrow	4	Y Y	
- Meter Tape	2	Y Y	
- Flat bucket to remove soil (pungkis)	4	Y Y	
- Bucket for cement	2	Y Y	
- Metal triangular spoon to handle cement	2	Y Y	
- Water gallon is available	2	Y Y	

Figure 5.1 Checklist Sheet for SWG Installation

5.1 Pre-installation

At this stage, as indicated in **Figure 5.1**, the training participants were given an overview of the early stages in planning a SWG installation, both technically and non-technically, which includes checking the willingness of the homeowner to support the program, the feasibility of the location, and the feasibility of the house. In this training, the training is carried out by direct practice in the field. Thus, all the steps that must be carried out are carried out immediately during the training.

Figure 5.2. Short briefing to participants prior to the training

5.2 Installation and Construction

Before carrying out the installation and construction process, the training participants were briefed on the importance of checking the need for tools and materials to build a domestic wastewater treatment system with the SWG system which can be seen in **Figure 5.2.**

After checking that the tools and materials are in accordance with the needs, the SWG team invited the training participants to see and participate directly in the installation and construction process. There are several steps that needed to be done, namely:

1. Digging holes for septic tanks and gardens. At this stage the hole must be adjusted to the diameter of the septic tank so that it remains above ground level, where the diameter of the hole dug is 1 meter and the depth is 1.2 meters. For the garden, a rectangular excavation is made with an area of 2 m x 3 m and a depth of 0.5 m.

Figure 5.3. Preparation of SWG Installation

2. Assemble the inlet pipes. At this stage, we measure the distance between the toilet and the septic tank, then multiply by 3 cm to get the minimum slope (3% or 3 cm/m) down (depth) from the inlet pipe to the septic tank. Next, mark the depth of the inlet pipe, where at least the inlet pipe must be as deep as the location of the point. There are two pipes used as inlet pipes, a 3-inch pipe for the drain from the toilet and a 2 inch pipe for the drain from the bathroom.

3. Assemble the pipes in the septic tank. At this stage, each part of the pipe connection to be installed in the septic tank must be glued. the stages of preparing the pipe in the tank, including making 5 holes (8mm) at the top of the 45^{o} elbow. Glue the elbow with the outlet pipe, then glue the connection to the inlet pipe (laying a maximum of 10 cm from the tank wall. Install the pipe (without holes) and cut the pipe so that it is 15 - 20 cm apart from the bottom. Make a vertical hole with a diameter of 8 mm with a distance of 5 cm in the vertical outlet pipe, this is done because if the hole made is too large, then solid waste faeces can enter the outlet pipe. But if it is too small in size, it may become clogged. For the part of the outlet pipe that is in the septic tank, glue the T joint, the pipe leading down and the cap (dop cap) with glue. Then use a little glue for the horizontal pipe so that 1 set of outlet pipes is glued together with glue. The last step, clean 1 set of outlet pipe, then connect it with the pipe. Take it out and glue it in. Make sure the septic tank is clean of any scraps of plastic that may have been left in the tank.

Figure 5.4 (a) The Process of Marking the Location of the Hole; (b) The process of making holes; (c) Tank Placement Process

Figure 5.5 Team Moves Goods to SWG Location

Figure 5.6 Local team Performs SWG Pipe Installation

Figure 5.7 Local team and Team Install SWG Tank

Figure 5.8 Position of Pipes that have been installed

4. Garden arrangement and installation. Before going to this stage, check how deep the infiltration pipe is (If necessary, adjust the depth of the garden excavation so that the bottom of the garden is exactly 25 cm below the infiltration pipe). At this stage, start filling the garden excavation with gravel to exactly 20 cm below the infiltration pipe, then make 3 rows of small holes on the bottom surface of the infiltration pipe (8 mm) with a distance of 5 cm on the 3 inch pipe along the garden as shown in the picture below.

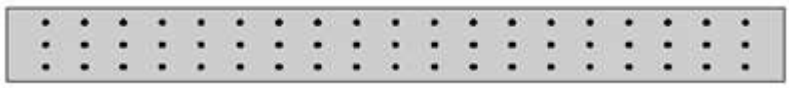


Figure 5.9 Illustration of Small Holes on the Surface of the Pipe

Next, make a flush pipe, which is a T connection with 1 horizontal pipe that goes into the septic tank so that it can be used to clear the blockage (the vertical pipe must be at least 50 cm high to get a strong push to clear the blockage). Connect the flush pipe to the 3-inch outlet. After that, place the bricks to support the infiltration pipe so that the infiltration pipe is in a hanging position and connect the infiltration pipe, but do not use glue so that the installation can be removed easily if needed, then hang the pipe above the bricks and make sure the water flow will drip onto the gravel below leach pipe (make sure the pipe remains horizontal). Put a cap at the end of the infiltration pipe but do not use glue. Then the septic tank is filled to the brim with water and there is a visible flow of water coming out of the infiltration pipe (water filling is also done so that when it rains the septic tank does not lift upwards). Cover the connection between the garden and the septic tank with bricks, where the bricks are arranged loosely to create a trench around the infiltration pipe, alongside the top and the side of the pipe. Bricklaying is carried out until the ground level is reached, which is usually with two horizontal layers of bricks at the top reaching the surface (make sure the second layer covers the gaps of the first layer so that sand cannot enter from above). This is done so that if in the future there is a problem with the infiltration pipe, it will be easy to access the pipe if needed. Next, add more gravel to protect the brick wall by forming a gravel hill around the bricks. Fill the remaining 20 cm of the garden excavation with sand until it is saturated, then fill the top with 10 cm of soil (use the top layer of soil that has been stored during excavation, to help provide early nutrients for plant growth). The last step is to adjust the soil layer so that it still forms a hill at the bottom. along the infiltration pipe and make sure the soil can't get into the brick arrangement and cover the infiltration pipe area. Also make a small wall around the garden to protect it from puddles/floods and cover the garden area using a net to avoid disturbance by animals such as chicken and dogs etc.

Figure 5.10 Connecting the pipes to the tank

Figure 5.11 The Process of Installing Perforated Pipes from the Tank to the SWG Garden

Figure 5.12 Process of distributing the Gravel at the bottom of the SWG garden

Figure 5.13 The Process of Installing Bricks Around Perforated Pipes

Figure 5.14 SWG Condition After Brick Installation

Figure 5.15 Process of adding sand (in between gravel and soil) by The Community and Team

During the training, in the midst of a typical hot day during the day, the team saw that there were several coconut trees and immediately asked Pak Kadus about the ownership of the tree. It turned out that one of the coconut trees was Pak Ayet's area and he immediately offered the team for the coconut. Together with the student team and Dr. Iwan, Pak Kadus and one of the local trainees (named Pak Ano), walked to the location of the coconut tree. Quickly, Pak Ano climbed a coconut tree and took approximately 15 coconuts to be enjoyed with the team. As the tree was located in the middle of the rice field, it required Pak Ayet to be bathed in mud to pick it up. The cheerful atmosphere made the team laugh out loud while helping to collect coconuts, after all the coconuts were collected, the team took Mr. Ayet's house and enjoyed the coconuts.

Figure 5.16 Activities to Take Coconut Fruit

Figure 5.17 Coconuts from Nagrak Village Community Garden

5. Make the piping system for the kitchen sink. We must ensure that the wastewater from the kitchen does not enter the septic tank to avoid fat and oil, which is why the kitchen sink must be connected to its own separate little leach field. As an illustration, the scheme of the piping from the kitchen is shown below.

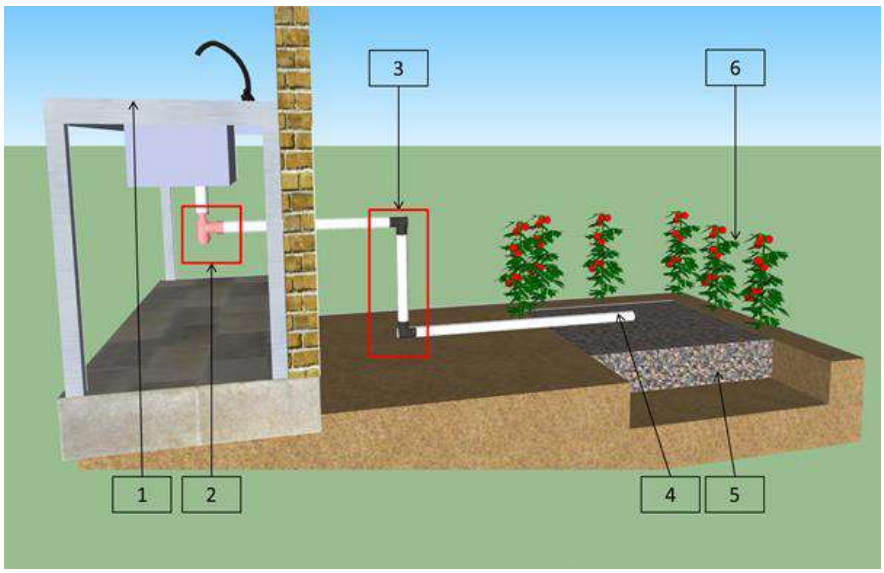


Figure 5.18 Kitchen wastewater treatment scheme

After being given explanations and examples, it can be seen in **Figure 5.3** that the training participants were directed to do the installation themselves, but still under the guidance of the SWG team. At this stage, technically all participants are able to understand the process and carry out the installation according to the example.

Figure 5.19 SWG Installation Process by Trainees accompanied by SWG Team

5.3 Post Installations and Constructions

After the SWG unit was completed, the training participants were briefed on the next steps to take after installation and construction. These stages include completing the garden until they are planted with vegetations that suit the needs of the homeowner (except tuber plants as these could be contaminated by E-coli). We then signed a contract agreement with the owner to do several things that will be useful to keep the SWG in accordance with its function, such as not throwing paper or other garbage in the toilet. After that, the trainees were informed of the following maintenance procedures:

1. Homeowners must be present during the installation of the SWG so that they can understand how this system works in a simple way, how to maintain the sustainability of this system, and how to maximize the garden.
2. Follow the installation procedure correctly, especially that all pipes entering the septic tank must have a slope of at least 3 degrees (3 cm drop for every 1 meter of pipe).
3. At the beginning of using the SWG, make sure that the septic tank is completely filled with water. This can be shown if there is already water flow in the infiltration pipe to the garden.
4. It is strictly forbidden to dump kitchen waste and plastic waste into the septic tank. Also try to prevent a large amount of hair from entering the septic tank by installing a filter in the shower drain. In general, if this can be prevented then the septic tank never needs to be emptied.
5. If the pipe is clogged, use a vertical flush pipe to push the plug with water. If after that there are still blockages, especially in the infiltration pipe to the garden, open the brick arrangement and remove the pipe to clean. After cleaning, reinstall the pipe and cover it with the brick arrangement as before.
6. In case the septic tank would ever be full (on account of improper use), open the tank cap and empty it. Once emptied, refill the septic tank with water until it is full, before closing it again and re-use it.
7. Put a net around the garden to prevent animals from damaging the plants (example: chickens).
8. Do not plant at least 1 (one) banana tree or papaya tree inside the SWG garden (as the roots may clog the leach pipe in the future!). Planting other plants with short roots such as chili, however, is welcome. Home-owners can, however, plant banana trees just outside the garden to benefit from the nutrient release in a position near the infiltration pipe.
9. Sometimes, in the dry season, plants will need additional water and fertilizer to grow.
10. Enjoy your maintenance-free sanitation system and happy gardening!

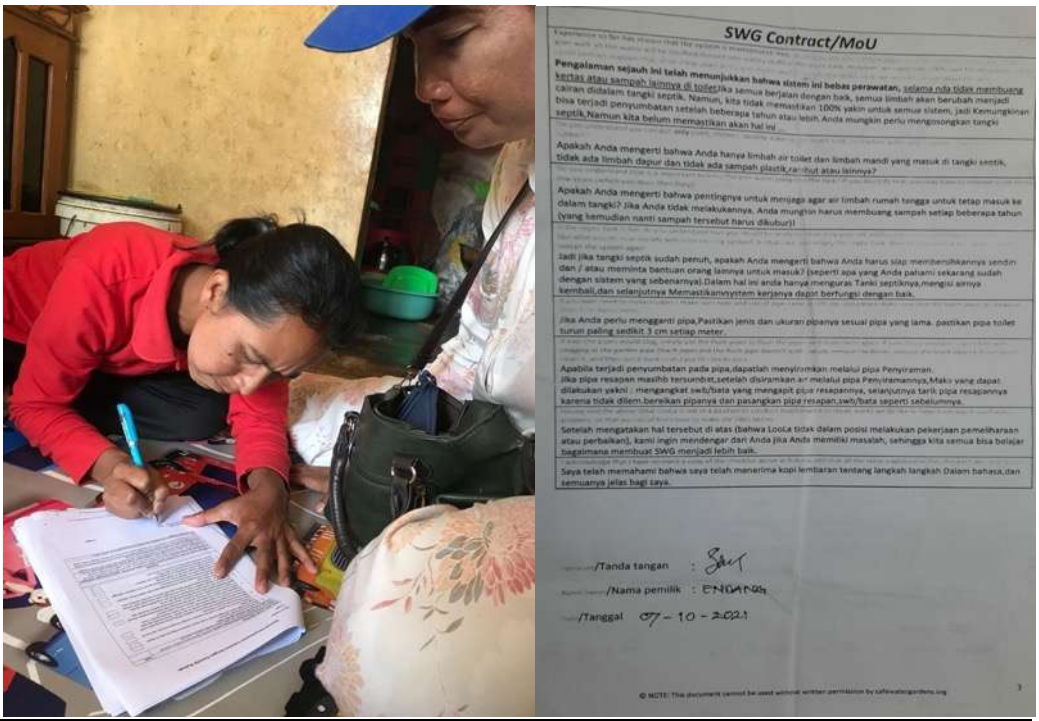


Figure 5.20 One of the SWG Owners Signed the Contract Paper

SWG Contract/MoU

Experience so far has shown that the system is maintenance-free, as long as you don't throw paper or other rubbish in the toilet. If all goes well, all the waste will be liquified (turned into watery stuff) in the septic tank. However, we cannot be 100% sure for all systems, so it could perhaps happen that, after a few years or so, you might need to empty the septic tank, we are not certain about this yet ...

Pengalaman sejauh ini telah menunjukkan bahwa sistem ini bebas perawatan, selama nda tidak membuang kertas atau sampah lainnya di toiletJika semua berjalan dengan baik, semua limbah akan berubah menjadi cairan didalam tangki septik. Namun, kita tidak memastikan 100% yakin untuk semua sistem, jadi Kemungkinan bisa terjadi penyumbatan setelah beberapa tahun atau lebih.Anda mungkin perlu mengosongkan tangki septik,Namun kita belum memastikan akan hal ini ...

Do you understand you can put **only** toilet, shower, laundry water in the septik tank, no kitchen water and no plastic, hair, or other rubbish?

Apakah Anda mengerti bahwa Anda hanya limbah air toilet dan limbah mandi yang masuk di tangki septik, tidak ada limbah dapur dan tidak ada sampah plastik,rambut atau lainnya?

Do you understand that it is important to keep the grey water going into the tank? If you don't do that, you may have to remove scum every few years (which you must then bury)!

Apakah Anda mengerti bahwa pentingnya untuk menjaga agar air limbah rumah tangga untuk tetap masuk ke dalam tangki? Jika Anda tidak melakukannya, Anda mungkin harus membuang sampah setiap beberapa tahun (yang kemudian nanti sampah tersebut harus dikubur)!

If the septic tank is full, do you understand that you should be ready to clean it by yourself and/or ask professional help to come in? (just like what you do now already with your existing system). In that case, just empty the septic tank, then fill it up with water again, and then restart the system again

Jadi jika tangki septik sudah penuh, apakah Anda mengerti bahwa Anda harus siap membersihkannya sendiri dan / atau meminta bantuan orang lainnya untuk masuk? (seperti apa yang Anda pahami sekarang sudah dengan sistem yang sebenarnya).Dalam hal ini anda hanya menguras Tanki septiknya,mengisi airnya kembali,dan selanjutnya Memastikanvsystem kerjanya dapat berfungsi dengan baik.

If you ever need to replace pipes (make sure type and size of pipe same as old one and please make sure that the toilet pipes go down at least 3 cm every meter.

Jika Anda perlu mengganti pipa,Pastikan jenis dan ukuran pipanya sesuai pipa yang lama. pastikan pipa toilet turun paling sedikit 3 cm setiap meter.

If ever the pipes would clog, simply use the flush pipes to flush the pipes and clean them again. If ever there would be a problem with clogging at the garden pipe (leach pipe) and the flush pipe doesn't work, simply remove the bricks, remove the leach pipe (it is not glued), clean it, and then put it back in and put the bricks back.

Apabila terjadi penyumbatan pada pipa,dapatlah menyiramkan melalui pipa Penyiraman.
Jika pipa resapan masihb tersumbat,setelah disiramkan air melalui pipa Penyiramannya,Maka yang dapat dilakukan yakni : mengangkat swb/bata yang mengapit pipa resapannya, selanjutnya tarik pipa resapannya karena tidak dilem.bereikan pipanya dan pasangkan pipa resapan,swb/bata seperti sebelumnya.

Having said the above (that LooLa is not in a position to conduct maintenance or repair work) we do like to hear from you if you have a problem, so that we can all learn how to make the SWG better.

Setelah mengatakan hal tersebut di atas (bahwa LooLa tidak dalam posisi melakukan pekerjaan pemeliharaan atau perbaikan), kami ingin mendengar dari Anda jika Anda memiliki masalah, sehingga kita semua bisa belajar bagaimana membuat SWG menjadi lebih baik.

I acknowledge that I have received a copy of the checklist above in Bahasa, and that all the steps explained in this checklist are clear to me.

Saya telah memahami bahwa saya telah menerima kopi lembaran tentang langkah langkah Dalam bahasa,dan semuanya jelas bagi saya.

Signature/Tanda tangan

Name owner/Nama pemilik

Date/Tanggal

Figure 5.21. Finish with owners/contract page

Figure 5.22 Educational Process Related to Installation and Maintenance of SWG Community with SWG Team

6. SAFE WATER BRICKS (SWB) AND OTHER SOLID WASTE MANAGEMENT ISSUES

Figure 6.1 Collection of Safe Water Brick (SWB) (work by the Community of Nagrak Village)

Solid waste is the leftover of human use that is no longer used. The National Regulation No. 18 of 2018 requires all parties to reduce solid waste as much as possible. As an effort to reduce the waste, the law recommends the reduce-recycle-reuse (3R) principle:

- Reduce: to produce as little waste as possible;
- Reuse: if the waste is generated, if possible, re-use the waste directly; and
- Recycle: residue or waste that is left or cannot be used directly, attempt to recycle it, either as raw materials or as energy sources.

Plastic waste is the most difficult waste to manage because it takes a long time for plastic to decompose. One of the innovative ways in the Safe Water Garden system of reusing plastic waste is by making Safe Water Bricks (SWB). SWB is a substitute material for bricks for the construction of the Safe Water Garden (SWG). The materials used for the manufacture of SWB consist of bottles, plastic waste, cloth residue (optional residue) and sand. The principle of SWB is the same as ecobricks, except that the SWB can put any waste in it, and must be weighed down so it is heavier than water and won't float. Based on the results of surveys and interviews in the study area, the Nagrak Village, waste management in Nagrak Village is still poor. The main cause of the poor waste system in the village is because there is no Transfer Station for the local area. In addition, the poor solid waste management is also shown by the lack of functioning of the Waste Bank. Thus, currently the people of Nagrak

Village dispose their waste directly to nearby disposal or by burning the waste. In some families, people dispose of their organic waste directly into the environment or give it as animal feed. Burning this waste is very dangerous for public health and causes pollution to the environment. Therefore, the SWG Team invites the community to help manage their waste, one of which is by making SWB. Since Nagrak features much textile waste, we told the villagers they can pick up and use both plastic waste and fabric residue in their SWG. Previously, the people of Nagrak Village were given education regarding the importance of managing waste, the dangers of burning waste (especially plastic).

To produce SWB, the tools and materials used are:

1. Shovel
2. Funnel
3. Sand
4. 1.5 liter mineral water bottle (as a medium / place to make SWB)
5. Plastic waste (snack packaging, coffee packaging, or plastic waste in your environment) be it whole plastic waste or plastic waste that has been cut
6. Water as much as 3 glasses of mineral water size 220 ml
7. Wood/chopsticks/bamboo/small crowbar Safe Water Brick (SWB)
8. Scales
9. Unused patchwork/fabric (cloth cut into small sheets)
10. Ruler and marker

Steps to produce the SWB are:

1. Measure the height of the 1.5 liter mineral water bottle into 3 parts using a ruler and mark with a marker, the 3 parts of which are the bottom = 6.5 cm which will later be filled with sand in the middle = 15 cm filled with plastic waste and cloth waste and the top = 8.5 cm which will be filled back with soil;
2. After marking the 1.5 liter mineral water bottle then open the bottle and enter the sand into it with the help of a small shovel and funnel up to the marked limit, to make sure the sand is solid it can be done with a bottle truck until the sand is solid if after being dumped the sand drops then fill again with sand up the mark;
3. Pour half a glass of mineral water measuring 220 ml, then stir the sand with the help of wood / chopsticks / bamboo / small crowbar if the sand is not solid then add more sand until the sand is solid and evenly distributed (to see if the sand is solid or not, check by pressing the bottom of the bottle if already solid the bottom will become hard);
4. Then put in the plastic waste (uncut / cut / cloth waste) so that it looks like it covers the 1.5 liter mineral water bottle, then compact the waste by pushing it using wood / chopsticks / bamboo / small crowbar (how to compact the included garbage is by pushing in, especially on the sides of the bottle), if the garbage looks solid, put it back in and compact it up to the middle limit, which is 15 cm high;
5. After the solid waste, add water (the remaining half a glass + 1 more cup);
6. Add the sand as the top layer, add the sand with the help of a shovel and funnel until it is full, compact it with the help of wood/chopsticks/bamboo/small crowbar and a truck;
7. When the top sand is compacted, close the 1.5 liter mineral water bottle;
8. Throw the bottle in a bucket of water and make sure it sinks Then weigh the SWB and make sure the minimum weight of the SWB is 1.7 kg;
9. Prepare a bucket and fill it with water; and
10. Test that the SWB is heavier than water (so it won't start floating after installation) by submerging the SWB in a bucket filled with water and checking that it sinks (refer to picture 6.3)

In addition to reducing the generation of plastic waste and tackling poor waste management, the SWB can also be an innovation to replace bricks. The SWB can be sold by the community to add economic value: stone bricks typically cost around Rp 1,500 each, so we might as well pay the local community to clean up their own village waste!

Figure 6.2 Example of SWB Installation in SWG Construction

The SWB Training for the Nagrak People

Before the actual SWB production, community training was needed. During the training, the Itenas students explained to the community about the purpose, benefits, functions, procedures and materials for producing SWBs. Before the implementation, the Itenas' team also conducted experiments to find the right and accurate composition for the SWB. The following steps were carried out during the community training of SWB:

- Preparation Stage

The plastic composition for SWB requires repeated experiments. The experiment was conducted in the Itenas campus area. Experiments on the use of plastic varied, ranging from whole plastic, ones that were cut into smaller pieces, and combined with cloth. The height of the plastic in the bottle was also tested with different variations. After getting the right composition then the SWB bottle is ready to be tested. The thing that needs to be considered as an indicator of success is the sinking of the SWB bottle in the water (not floating in water).

Figure 6.3 Tools and Materials for Preparation of SWB Trials

Figure 6.4 An SWB Bottle sinking in the Water – which means it passes the “sink test”!

Figure 6.5 SWB Bottle Sinking Trial

- Dissemination Stage (Training for *Safe Water Brick*)

Dissemination is an important stage of the overall project as it provides required information on how to produce SWB to the people of Nagrak Village. The dissemination was carried out on Friday, September 17, 2021 as a form of training to the community on how to make SWB. The location of the dissemination was carried out at the Village Hall. The people attending the training were representatives of each RW in Nagrak Village and mainly were the recipients or owners of the SWG. Training is dominated by women. The material presented begins with the importance of managing the waste produced by each individual, the dangers of waste and the impact of waste. The waste discussed in the dissemination was mainly plastic waste, because the initial goal was to reduce waste in the Nagrak Village area and minimize waste burning. In addition, the material presented at the time of dissemination was about the stages of making SWB, starting with the preparation of tools and materials used, how to make them, what things need to be considered and indicators of success. This dissemination activity was also assisted by the Itenas team to provide examples of how to do it properly. The high enthusiasm of the community gave positive energy to all the team committees. It was great to note that the village people even started to sing their village songs! In short, the community cooperated and was very willing to make SWB. During the training period, participants were actively asking questions to find out how to make SWB.

Figure 6.6 Situation of SWG Introduction Socialization and SWB Training

Information Provided During the Training (Dissemination)

In the training, participants were given information regarding the importance of protecting the environment, one of which is reducing plastic waste. As mentioned earlier, waste management in Nagrak Village is still not adequate, one of them is indicated by the burning of the waste. Thus, Itenas team delivered the following during the training:

- The importance of managing waste (especially plastic)
- Introduction to Safe Water Garden (SWG) and Safe Water Brick (SWB)
- Stages of making Safe Water Brick (SWB)
- Tools and materials for making Safe Water Brick (SWB)
- Benefits of Safe Water Brick (SWB)
- Providing examples/simulations of making Safe Water Brick (SWB)

Figure 6.7 SWG Introduction Stage and SWB Making Tutorial by Itenas Team

Enthusiasm of Participants

The implementation of the training by the Itenas team was very well received by the people of Nagrak Village. The community actively asked questions during the training day. As an effort to ignite the enthusiasm of the community, an ice-breaking was held for the participants. The women group of Nagrak Village (known as PKK) trained in certain dances for participants. Then, all participants were given the opportunity to make SWB. To do this, they were divided into 4 major groups. Each group consists of ± 8 - 12 people. The high enthusiasm of the community can be seen from the following:

- People bring the requested pieces of equipment
- Participants actively asked questions in all training activities
- They participated in the ice-breaking (the women sang and danced)
- The community is excited in the experimental stage of making SWB (mothers compete with each other in each group!)

Figure 6.8 Community Trying to Make SWB in Groups

Figure 6.9 Community Trying to Make SWB in Groups

People brought equipment such as wooden/bamboo sticks that they made themselves, brought pieces of cloth, leftover packaging (plastic waste) such as coffee wrappers, and other materials. Other materials the Itenas team provided were bottles, sand, trash, water, ruler, and pens. The high enthusiasm of the participants in the training resulted in results that were beyond initial expectations. During the experiments earlier, it takes ± 1 - 1.5 hours to complete 1 SWB. However, based on the form of group collaboration of participants from the Nagrak Village community and their high enthusiasm for competing, participants were able to make 2 SWBs in a short time of ± 45 minutes. The community is also enthusiastic and they put a mark on the results of their SWB bottles.

Figure 6.10 Bottles of SWB made by the Village Community during the Training at the Nagrak Village Hall

As a form of gratitude and appreciation from the team, the participants were given an award in the form of a certificate. The certificate was given symbolically at the opening ceremony which was held on October 2, 2021. Mrs. Apon was one of the community representatives who took part in the training and she made 13 SWBs:

Figure 6.11 Giving Certificate to Mrs. Apon as Representative of Socialization Participants

Monitoring of *Safe Water Brick* (SWB) Making

After one week from the time of the SWB training, monitoring by the IItenas team was conducted. It was found that most of the participants continued making SWB, and they showed their work to Itenas team. People can make 3-5 bottles of SWB in one day depending on the activity they are doing. For instance Ibu Apon managed to make 8 bottles of SWB in 2 days. The difficulties experienced by the average community in dealing responsibly with waste including the difficulty of collecting the remaining plastic packaging (garbage), is because they are used to burning their waste. However, the community took the initiative to suggest to add waste from local textile companies to the contents of the bottle. Because in the Nagrak Village area there are many doormat craftsmen, usually they have a lot of leftover cloth that is not processed and ends up being burned. So they can now take advantage of it by making it one of the contents of the SWB bottle!

Figure 6.12 (a) and (b) The process of making SWB by Mrs. Apon

Figure 6.13 Example of a SWB Bottle Made by Mrs. Apon

7. TOILETS, KITCHEN SINKS AND SWG CONSTRUCTIONS

Prior to the implementation of the SWG construction and installation stages, a survey stage was conducted to determine the location of the SWGs. The criteria in question are based on ground elevation, where it is expected that domestic wastewater can flow only with the help of gravity to the SWG unit. In addition, checks on sanitation facilities available in the community were also carried out. Based on the results of the preliminary survey, it can be seen in the figure below that the condition of the sanitation facilities (toilet) is poor. In addition, as previously stated, for dish washing facilities in Nagrak village, 30% of respondents do not have these facilities and 32% use the toilet area to wash dishes. The habit of people washing cutlery in the toilet is also a condition that must be addressed, considering that there are many diseases that can infect the community (especially diarrhea).

Figure 7.1 Condition of the Toilets or Latrine of the Nagrak Village Community

As can be seen in the picture above, the condition of inadequate sanitation facilities requires the SWG team to help the community to get proper facilities, including making new toilets or renovating them and making dishwashing facilities separate from the toilets so that the wastewater from the kitchen does not go to the SWG system. Most of the people of Nagrak Village use toilet facilities together, and this made it easier for the SWG Team to help the community because there is no need to make changes in each resident's house. The total number of toilets built or renovated was 23 units and we constructed as many as 54 kitchen sinks (to serve all the 93 families who benefited from the 30 SWG that were built). Below are some pictures of a new or renovated toilets and kitchen sinks.

Figure 7.2 Condition of the Toilets of the Nagrak Village Community that have been Renovated/Reconstructed by the Team

Figure 7.3 Example of a Kitchen Sink made by the Team for One of the SWG Owner's Houses

8. WELLS AND RUNNING WATER SYSTEMS

The problems that occur in the village of Nagrak are not only sanitation problems, in some areas access to water is a problem that requires sufficient attention (without water, you can't run a sanitation system). As previously stated, 79% of Nagrak villagers' water sources are from pump wells, 10% from traditional wells, and the other 11% from springs which are located quite far from their homes (± 300 meters). The condition of the springs, which is quite far away, prompted the SWG Team and the Itenas Team to plan building two deep wells with a depth of 12-20 meters. For each location a water tower was also built to make it easier for the community (a total of 50 families) to get the water. The process of making wells is done manually by two local diggers at a fairly low cost (only about 3.5 million for up to 20 meter deep wells!). The location of the first deep well is in the Kampung Beutah RW 14 area which can be seen in Figure 8.1. The second well is located in the Kampung Cilebak RW 06 area which can be seen in Figure 8.2. The water is pumped directly from the well, then the water is stored in a water reservoir with a capacity of 1100 liters. From the storage tower, water is channelled directly to the toilet facilities made by the SWG Team. The water supply system can be seen in **Figure 8.3.**

Figure 1. SWG locations overview

1. **The First Well**

   The first well is located in Beutah Village, RW 14, Nagrak Village. Initially, before the wells were built, the community got water from the closest river, where people need to walk ± 300 meters. In addition to being quite far away, the existence of the spring is located on the slopes of a mountain where the access is a fairly steep path with sandy soil conditions. The spring flows directly into the river body. People use water for their daily needs, starting from bathing, washing and toileting. Previously, communities did their washing, bathing, and other cleaning activities in the river. On their way home, people bring water with various containers such as buckets and jerry cans. Not only adults, children also help fetch water to meet their daily needs. As they go to the river, in many occasions they bring also rubbish to dump into the river as the pictures below show.

Figure 8.1 Condition of Initial Water Source in Kampung Betah RW 14

The Digging of the Well

The well digging process was carried out for approximately 2 weeks. The wells were dug by several local people. Water was found at a depth of 17 m (following their prediction to find water between 15-20 meter, after which excavation then continued to ± 20 m for ensuring the continued availability of water. The digging was done manually with a shovel and buckets. Once the water is available, it is pumped by an electric pump (supplied by our team) to supply people's needs.

Reactions about Well

Figure 8.2 Happiness after the running water systems were built near Residents' Houses

After the well was built, the community was very happy and expressed their gratitude. Mrs. RT, as a community representative, said that with the well, it was much easier for the community to access water.

2. The Second Well

The second well is located in the village area of Cilebak RW 06, Nagrak Village. The condition of this second location was not much different from the other one, in terms of the difficulty of access and the long distance of water sources. Here, water was found at a depth of approximately 12 meters.

Figure 8.3 Condition of Well Excavation in Kampung Cilebak RW 06

9. NAZAVA FILTERS

Clean drinking water is a basic need for all human beings. Community's condition in Nagrak Village, ± 98% are using wells to fulfill their drinking water needs (after which the water must be boiled to make it drinkable). Around 2% of the community buy mineral water from shops or local vendors. Thus we decided to help the office of Kepala Desa + 49 families by giving them each a Nazava Filter, a W.H.O and SNI certified water filter which safely filters river or well water. Symbolically, the water filter was presented at the opening ceremony of the SWG project, as seen in **Figure 9.1**.

Figure 9.1 Symbolic Handover of Nazava Filters to the Nagrak Village Community

In addition, the recipients of the Nazava Filter also had the opportunity to interact with students from Singapore to find out the living conditions of the people of Nagrak Village, as part of showing to the world about the Nagrak project.

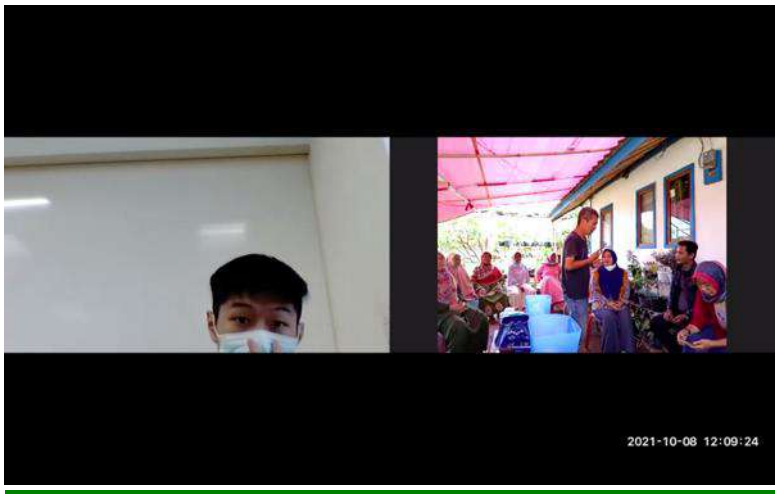


Figure 9.2 Zoom Meeting Conference of the Nagrak Village Community with Students from Singapore

Figure 9.3 Socialization of the Use of Nazava Filters

The method of using this Nazava filter is very simple: people only need to pour their well water into the top part of the filter, which is connected to the bottom part of the filter via a ceramic filter. After a couple of hours (typically done overnight), the well water ends up in the bottom part, fully filtered and ready to drink. With the Nazava filter a family can get ± 17 liters of potable water fully compliant with drinking water quality standards.

The founders of the Nazava filters factory (based in Bandung) informed us that the filter contains traces of silver and carbon, which give the water a crispy and clean taste. And indeed, when the students from Singapore asked people what they thought of the taste, people said they love it!

10. THE OPENING CEREMONY

The opening of the Global Grant Safe Water Garden (SWG) project in Nagrak Village was held on Saturday, October 2, 2021. The event organized by our team, invited various agencies. Due to the current conditions during the Covid-19 Pandemic, the public and invited guests who attended the opening ceremony were limited and they were required to attend with the government-regulated health protocol.

Preparation Phase for Global Grant Safe Water Garden (SWG) Project Opening

The preparation for the opening of the SWG project was carried out starting from H-5 implementation. Communities work together to help each other in the preparation process. The women in Nagrak Village were coordinated by the Head of Dusun 1 to help each other in terms of food and souvenirs. They shop at the market, buying potatoes, bananas, chicken and spices by renting a car. After that, the mothers cooked together according to their roles, some cooked fish, rice and other side dishes. In addition, mothers prepare souvenir bags containing special foods from Nagrak Village such as *ranginang, renggining, kicimpring* chips and others (as is the local custom when receiving VIPs). The purpose of mothers giving special food is to introduce the work of the community and help the community's economy as well. On the technical side, the village men helped each other prepare the location for the opening by helping to build the welcome tent. The SWGs used as examples to show the VIPs were the SWG at Pak Kadus and the SWG #1 which is located near Pak Ayet's house. The one at Pak Kadus (the village chief who was our main liaison in Nagrak) is showing the fully-functioning SWG, while the other one is the half-done SWG (so as to show the VIP how the SWG works). At both SWGs, the SWG team explained how the operating system works, and how to maintain and function plants with the types of plants that can be planted.

The Project Opening

The opening of the SWG project was carried out in one of the fields close to the location of SWG #1. The opening ceremony was attended by various agencies including representatives from the West Java Provincial Government (representing the Governor), representatives from the Bandung Regency Government (representing the Regent), representatives from Rotary, representatives from the Provincial Health Office, representatives from the Environment Service, representatives from the PUPR Service, The SWG expert team from LooLa Bintan, the Nazava Filters Team, the Itenas Team, representatives from Gadjah Mada University, the Head of Nagrak Village, the Women Group of Nagrak Village, representatives of the community receiving the SWG project, representatives from the Nagrak Village Health Center and other village officials. After the opening by Pak Jaya from LooLa, a representative of each of the groups above made a short speech. In the remarks, speakers explained the importance of sanitation, the sanitation crisis in Indonesia, the background of the Global Grant Safe Water Garden (SWG) project, what are the goals, benefits, and impacts that may occur, how to leverage on the new systems, and stressing the important role of the participation of the recipient community.

Figure 10.1 Welcome speeches from invited guests

In addition, the event also featured performances from representatives of the Women Group of Nagrak Village who sang the song Mars Desa Nagrak, a song to keep the village clean, and the women group danced happily together providing entertainment for the invited guests. Then there was a symbolic handover of SWG, the SWG Training Certificate to selected villagers who passed the SWG examination, the SWB training certificates and the Nazava Filter.

Figure 10.2 Appearance of PKK Women in Nagrak Village

Figure 10.3 Symbolic Giving to Community Representatives and Itenas Students

After the symbolic handover, the event continued with an introduction to the construction sites, including the half-finished and fully finished SWG system. The explanation was carried out by the team to the invited guests. It can be seen in the picture that the guests were very enthusiastic about listening to explanations, and actively asked questions in terms of safety, SWG operations, and other maintenance.

Figure 10.4 Location Introduction to Pilot project SWG Points

The Enthusiasm of the Community

The people of Nagrak Village have a high level of enthusiasm. They work together to help make the SWG program a success. Starting from helping to make SWB, assisting with the construction and installation of SWG units, digging wells for 2 locations in Nagrak Village, namely Beutah village and Cilebak village, cooking activities to other preparations. Many people took pictures and followed the entire event. Likewise, with receiving assistance from Nazava Filters, the public took pictures with Guido (one of the founders of Nazava). The community declared that they found it very helpful that with the Nazava filter unit, they don't need to boil well water anymore, thus saving on burning/cooking costs as well as time. According to Mr. Ayet Anwar, as a team that helps in every progress of the Village SWG development, many people are grateful and helped by this program. The opening ceremony was held from 10.00 WIB to 16.00 WIB. People sang and enjoyed the event together.

Figure 10.5 Enthusiasm of Invited Guests and Community in the Implementation of the SWG Opening Ceremony in Nagrak Village

11. PERCOLATION TESTS AND "SMALL-SCALE" SWGs

The SWG is a domestic wastewater treatment system where the final wastewater is channelled to the soil under the garden. One of the things that need to be considered in making a domestic wastewater treatment system with advanced treatment is the percolation test. In the design of the SWG, it is stipulated that the percolation rate must be at least 5 cm/hour. But the representatives of the Indonesian standard office told us they are very interested to know if the SWG garden can be made even smaller at high percolation rates (as this would further widen the applicability of the SWG, even in villages or city areas where there is not much garden space). The Itenas students subsequently performed percolation tests around Nagrak so that we would be able, later on, to test some "small-scale SWGs"

The percolation test in Nagrak Village was carried out by the Itenas student team at 30 SWG locations. The test was in accordance with SNI 2398:2017. There are several stages in conducting a percolation test, including:

1. Determine the location and number of test holes. At this stage, the location of the percolation test is carried out at every location of the designated SWG

Figure 11.1 Percolation Testing at SWG Point Location

2. Dig a test hole. At this stage, test holes were made with a soil drill for biopores or other possible tools. The test holes were made with a diameter of 150 mm and a depth of 500 mm.

Figure 11.2 The Process of Making Percolation Test Holes by the Team and Several Communities Helping the Itenas Team

3. Saturating the soil. At this stage, the test hole must be filled with water carefully so that the soil is saturated or by allowing water to seep into the soil until all is saturated (if possible done as many as 3 times).

Figure 11.3 Process of Saturating the soil with Water

4. The measurements. At this stage, the test hole was refilled with water as high as 300 mm from the bottom of the hole and the time of the water level decreased every 50 mm until the water level was 50 mm from the bottom of the hole.

Figure 11.4 Measurement Process with Bamboo Measuring Instruments adjusted to the size provisions

5. Perform calculations. At this stage, all the data obtained are accumulated and from the water level subsidence data, it is necessary to calculate the water level in units of m/hour. Then calculate the value of the soil absorption power in units of cm/hour.

The Percolation Test was carried out for 6 days on account of the number of locations and the saturating time of the soil. While waiting for saturation and measurement, students usually chatted with local people who are curious about what they are doing, or vice versa where students ask about conditions in the village of Nagrak. Often there are people who take the initiative to help students in the process of making holes, some made spontaneously snacks from their farms, such as fried cassava, kicimpring, fried sweet potatoes, and other processed foods made from the community farms. The friendly and kind attitude of the community made the student team remain enthusiastic in conducting the percolation test. The students felt that this was an experience that was rarely encountered in their daily lives. In addition, the conditions in the field (especially sanitation and clean water facilities), encouraged students to be grateful for what they currently have.

Table 11.1 Infiltration Rate (cm/hr**)**

SWG Location	**Infiltration Rate (cm/hr)**
SWG 1	8.58
SWG 2	12.79
SWG 3	11.35
SWG 4	28.11
SWG 5	8.38
SWG 6	26.67
SWG 7	19.75

SWG Location	Infiltration Rate (cm/hr)
SWG 8	14.63
SWG 9	55.87
SWG 10	14.07
SWG 11	50.59
SWG 12	34.76
SWG 13	37.55
SWG 14	15.83
SWG 15	18.54
SWG 16	43.08
SWG 17	8.86
SWG 18	11.07
SWG 19	17.48
SWG 20	49.89
SWG 21	49.70
SWG 22	48.62
SWG 23	17.10
SWG 24	22.63
SWG 25	24.58
SWG 26	18.75
SWG 27	14.66
SWG 28	18.10
SWG 29	28.73
SWG 30	18.92

In response to the request of the authorities to produce a table that defines the minimum size for the SWG garden, we produced a document (refer to appendix 2), which was received with great enthusiasm by the authorities, as the garden can be as small as 1 x 1 meter for small families and high percolation rates (see the appendix).

Small-scale test system at Itenas university site

We decided that we should try out a few of these small scale SWGs under controlled conditions. We decided to put one research SWG at Itenas's campus but we hooked up with the SNI office to see if they could recommend some sites close to Itenas/Bandung where we would be able to install such small SWGs at people homes and test them easily. One of the things we wanted to test is groundwater pollution levels and for this, it is good to have a very high water-table.

So we wanted to find homes in such areas. It took a while to get the right contacts and locations, also because the SNI office wasn't entirely sure. In the end, all the tips regarding homes near high water table did not work out. We did initially find a group of families near the river who had told the SNI office they were ready to receive SWGs, but when we then announced we were ready to move ahead and install the systems, it turned out one of the families had backed out and had built a small house extension in the meantime. These events further drove home one of the main learning points (see next sections): the selection of families and initial introductions really have to come from teams who have expert skills with sosialisasi.

So, in the end, we decided that we would conduct more of the small-scale SWG in Bintan, close to LooLa, but that we would continue with the small-scale SWG at Itenas campus.

The students checked out the overall daily water use of one of Itenas public toilets and then tested the percolation rate. These values were 912 liters/day and 11.71 cm/hour, and hence the size of the garden was calculated to be 3.89 m^2. For photos of this construction, see below.

Figure 11.5 Preparation of the location at Itenas site

Figure 11.6 Preparation of the location at Itenas site (2)

Figure 11.7 Preparation of piping systems for SWG at Itenas site

Figure 11.8 Installation of the tank and piping systems at Itenas site

Figure 11.9 Connecting SWG to existing wastewater system at the building of Environmental Engineering Department of Itenas

In terms of evaluation, we have indeed not seen any flooding of the system and when we opened the tank and checked for sediments, we found none so far, 2 months after installation, and the system behaves exactly as expected, completely flaw-free. Here in Itenas, chili trees also planted, they grow well, maybe need few more months until they are ready to be harvested.

Figure 11.20 Checking the tank of SWG at Itenas site

Figure 11.21 Checking the tank of SWG at Itenas site (2)

Figure 11.22 Sediments are not found in the tank

Figure 11.23 Chili trees grow well at SWG of Itenas site

12. EVALUATION STAGE

Basically, the evaluation stage here is explained from two major events:

1. A visit from a team of 12 water experts from the Centre of Water Resources of East Java
2. Evaluation Questionnaires from SWG Recipients conducted by Itenas students

The detailed information on these two events are given below.

1. Visit from Centre of Water Resources of East Java

In mid-November, information was obtained that there would be a visit from the East Java PUSDA Service to Bandung City to review the implementation of the domestic wastewater management system with Safe Water Gardens (SWG) in the Nagrak Village Area, Pacet District, Bandung Regency. The East Java PUSDA Office team coordinated with SWG and Itenas for planning related to the planned visit.

Figure 12.1 Photos Itenas Team and East Java PUSDA Service Team

On November 25, 2021, the East Java PUSDA Service Team travelled to Bandung and arrived in Bandung City at night. Previously, it was planned that a meeting with the Itenas Team would be held that night, but as it was late, the plan for the meeting was shifted to the next day (26 November 2021) at 07.30 WIB in the morning. At the meeting, the Itenas Student Team was introduced to the East Java PUSDA Service Team, after which the Itenas Team gave an explanation of the general description of SWG and the implementation of the SWG installation in Nagrak Village.

After discussion, the East Java PUSDA Service Team –accompanied by the Itenas Student Team– travelled to Nagrak Village. The first location they visited was The Nagrak Village Office, where the usual warm welcome was provided by the Nagrak Village officials to every guest present. At the Nagrak Village Office, the Team met with Pak Suparman (Head of Nagrak Village) and conveyed the purpose of the visit. Furthermore, the village head gave a brief description of the SWG-making activities that had been carried out in September – October 2021.

Figure 12.2 East Java PUSDA Service Team in Nagrak Village Office

The meeting at the Nagrak Village Office ended with the giving of souvenirs from the East Java PUSDA Service Team which was delivered by the Team Coordinator to the Village Head. Furthermore, a group photo was carried out as a documentation of the visit activities.

Figure 12.3 East Java PUSDA Service Team in Nagrak Village Office

Next, the East Java PUSDA Service Team and the Student Team moved to the location of the SWG point which was around Pak Ayet Anwar's house (also referred to as Kadus). As usual, with a big smile, Mr. Ayet welcomed anyone who visited his house in a very friendly manner. Before reviewing the location of the SWG point, the Team made a friendly gesture while enjoying the treats that had been provided by Mr. Ayet and his wife. The team introduced themselves and conveyed the purpose of the visit to several residents who were at Pak Ayet's place. After conducting a friendly meeting, the East Java PUSDA Service Team accompanied by the Student Team and the Nagrak Village Community visited the location of the SWG point. On this occasion, the PUSDA Service Team discussed with the Student Team or the Community regarding the domestic wastewater treatment system with SWG. There was enthusiasm from the PUSDA Service Team when asking questions about the operation of the SWG and also from the Student Team who answered the questions and explained matters related to SWG.

Figure 12.4 Sharing about SWG from Itenas Student and East Java PUSDA Service Team in Nagrak Village

The East Java PUSDA Service team also interviewed the community that owns the SWG WWTP, represented by Pak Ayet and Ibu Mira regarding the impression they got after using the SWG WWTP.

Figure 12.5 Discussion with East Java PUSDA Service Team in Nagrak Village with Mr. Ayet and Team Student Itenas

After reviewing the SWG WWTP system, Mr. Ayet and his wife invited the whole team to have lunch together, serving the typical food of Nagrak Village to the PUSDA Service Team. After that, the PUSDA Service Team gave special Surabaya souvenirs to Mr. Ayet. At the end, a documentation session was held to capture the moment.

Figure 12.6 Documentations Session East Java PUSDA Service Team in Nagrak Village

1. Pak Bagus = Pak Bagus Akbar/Staf Perencaaan SDA
2. Pak Wawan = Agung Wirawan/Kasi Pemeliharaan UPT Pasuruan
3. Pak Ayet Anwar (Kadus) from kampung Nagrak
4. Linggu, Itenas student
5. Mujahid, Itenas student
6. Fahira, Itenas student
7. Bu Esty = Esty Andayani/KTU UPT Pasuruan
8. Pak Hizbul = Hizbul Maulana/Staf Hidrologi dan Kualitas Air
9. Pak Harto = Soeharto/Kasubag Keuangan
10. Pak Dede Suhendar (RT), kadus staf.
11. Pak Aan, Aan Yulianto/Staf Perencanaan SDA
12. Bu Ari = Catur Arik, the head of Water Quality and hydrology, also a group leader of this visit
13. Pak Muhsinin = Muh Muhsinin/Staf Perencanaan SDA
14. Pak Rizal = Rizal Nur Hidayat/Korwil Madiun
15. Ibu Atik, Pak Kadus wife
16. Ibu Dian = Dian Permatasari, SSI from Balai Sanitasi, PUPR
17. Ibu Sofia = Sofia Nur Fauziah, ST, from Balai Sanitasi, PUPR
18. Ibu Era = Era Silvia/Staf Irigasi
19. Pak Ano, key SWG assistant and construction expert Nagrak
20. Ibu Anissa (Pak Fauzy's wife😊) = Annisak Laila /Staf Sungai dan Pantai

2. Evaluation Questionnaires from SWG Recipients

From September to October 2021, 30 units of SWG installation and construction activities were carried out, as well as the provision of sanitation and clean water facilities (23 toilet units, 54 kitchen sinks, and 2 dug wells) in several areas of Nagrak Village, Pacet District, Regency Bandung. Based on this, on December 9, 2021, a survey was conducted by Itenas students by giving questionnaires to village recipients, so as to determine the level of satisfaction of the community receiving the facilities.

The students checked 35 recipient households (for each SWG we selected at least 1 beneficiary family from the altogether 93 households who benefitted from the 30 SWGs). When we analyzed the results together in the third week of December, however, we realised that something had gone wrong: several households remarked that the systems smelled bad and that the shower water didn't flow well. The LooLa teams knew, from long experience, that this is simply not possible if the systems are constructed as per design –but clearly, the students who went out to do the survey had not yet attained that level of knowledge. Secondly, we realised, once again, that doing surveys amongst kampung people is a special skill that must be taught beforehand. For example, village people have a tendency to answer very literally and one-dimensionally to questions asked, so if you ask them "did you have any problems with your new systems", they will answer "yes", even if the problem was something like removing a plastic bag that was accidentally left and blocked a pipe.

If you ask them “are you happy with the systems”, they could tell you “so so”, simply because the neighbour received a water tower when they did not (an issue that goes back to sosialisasi: when people are well-informed at the start and they know about the financial constraints about a project, they are always very understanding). So we realised we had to do the survey completely again, but this time, we had to think very carefully between the senior LooLa team and Dr Iwan about the design of the questions and how the questions should be asked, and we realised that it is important that our best village installer, Pak Ano, who also has a very close contact with the households and is well respected, should join in with this survey to make sure we really get the answers we are looking for. The updated questionnaire is listed below, but before running this questionnaire, we first had to find out what the problems were that the first survey had revealed.

So, in the days between 20 – 27 Dec, the students went back to Nagrak and Pak Ano joined them. Upon re-inspection, it turned out that:

1. In three houses, where the people had offered to make their own toilets/mandi back in early October, they had made two mistakes that were not easy to spot at first sight by our teams:
    a. they had removed the anti-smell U-pipe under the toilet bowl (this U-pipe facility ensures that there is always water at the bottom of the toilet so as to prevent any smell from travelling back) and they had proceeded to connect the toilet via a straight pipe to the SWG, with the expected result: they got a big smell coming back.
    b. In two of these houses, the mandi floor was also not well constructed so the shower water did not flow properly in the drain and left puddles, plus they had not put a drain filter, see photos below (before and after we fixed it)

2. In two other houses, the (locally empowered) installation teams had not installed the p-traps in the shower pipe because they thought the water would not flow if they installed the p-traps.

Of course, a big learning point for us was that it is too optimistic to expect that average village people fully understand the entire system and that we can leave the construction to them without very carefully checking every detail. The good thing was to note that Pak Ano **had** fully understood; he just wasn’t aware of the issues until the first student survey brought them to light. With the help of Pak Ano, these problems were fixed in the week of 20 Dec and everybody understood the principles behind these U-traps and p-traps.

Figure 12.7 Wrongly constructed shower drain (before and after we fixed it) and newly installed p-traps

In light of the difficulties described above, here are the new survey questions:

Introduction to the surveyed families (*in order to reset some of the lingering misperceptions that had arisen from the first visits by Pak Engkos, who did not represent the SWG team*)
In this project, within the limited amount of money we had, we tried to help villagers in Nagrak to gain access to WASH (Water, Sanitation and Hygiene) facilities, and we tried a few things, including new and upgraded toilets, new kitchen sinks, new sanitations systems (Safe Water Gardens), Nazava water filters, a well close-by your house, a running water system delivering running water in or close to your house, a garden hose for micro-farming and chili growing, and "Safe Water Bricks" to give you an opportunity to clean up the village and get some money for it.

Our questions to you (and please answer them freely, telling us exactly how you feel, because we want to learn from you!)

(1) In general, do you feel that good WASH (Water, sanitation and Hygiene) is important in your life and the life of your family? (1 = not important, 2 = somewhat important, 3 = important, 4. =very important)

(2) **Before** you received the new WASH upgrades from our project, do you feel your family had adequate WASH facilities? (1 = no, completely not adequate, 2 = somewhat inadequate , 3 = not great, but it was adequate, 4 = it was adequate)

(3) Would you be ready to contribute to getting such <u>complete</u> WASH systems if you were able to get a loan for say, 2 – 3 juta, and you can pay back at
   (a) Rp 100,000 a month for a period of 2 years (yes/no)
   (b) Rp 50,000 a month for a period of 2 years (yes/no)
   (c) I want these WASH systems but I feel the government should pay for all of it
   (d) I don't care all that much for these WASH systems
   (e) I already have all the WASH systems so this question does not apply to me

(4) We thought that it was a good idea if we asked the villagers to take ownership, and teach them how to make and maintain their own system. Do you agree with this? (1 = no, a tukang should do it and then we can call them if there are any problems – even if it means we have to pay the cost of maintenance then, 2 = we like take ownership and to understand the systems, but we want local experts to be around who can help us fix the systems if there is an issue, 3 = we like to be fully in control so my own family or friends can solve whatever issue needs to get fixed).

(5) We did not have enough money to give everybody all WASH systems. We know you may have liked to receive more WASH systems, but for the systems that you **did** receive, can you please
   (a) let us know which item you received/participated in (circle the relevant letter below)
   (b) how do you like these systems you did receive (1 = I don't like it, 2 = I'm OK with the systems, 3 = I like them, 4 = I like them a lot!)

A.	new toilet/mandi	1	2	3	4
B.	new kitchen sink	1	2	3	4
C.	new good sanitation system that does not smell, reduces water puddles and flies, and is maintenance-free (Safe Water Garden)	1	2	3	4
D.	Nazava water filters	1	2	3	4
E.	a well close-by your house	1	2	3	4
F.	a running water system delivering running water in or close to your house	1	2	3	4
G.	a garden hose for micro-farming and chili growing	1	2	3	4
H.	"Safe Water Bricks" to give you an opportunity to clean up the village and get some money for it.	1	2	3	4

(6) How would you rank the different systems, with the one you like best (or you think is the most important) on top?

(7) (**only ask to those who received a SWG and remember to make photos of successful chilli gardens with owners on photo as well).**
   (a) Is the chilli growing a success (yes/no), and if no, why not?
   (b) if not a success the first time, would you like to try again? (yes/no)
   (c) If the chili growing was a success, does this inspire you to try micro micro-farming? (yes/no)

The results from this second survey are as follows

1. The importance of WASH Facilities

Figure 12.8 show that 87% or 26 respondents from the total respondents believe that WASH is **very important**, because WASH facilities are needed for daily activities, as well as they support comfort, hygiene and public health. The rest of the respondents (13%) inform that are **important**, for similar reasons. None of the people stated that WASH facilities were "rather important" or "not important". This shows that the community is aware of the importance of WASH facilities for their daily needs.

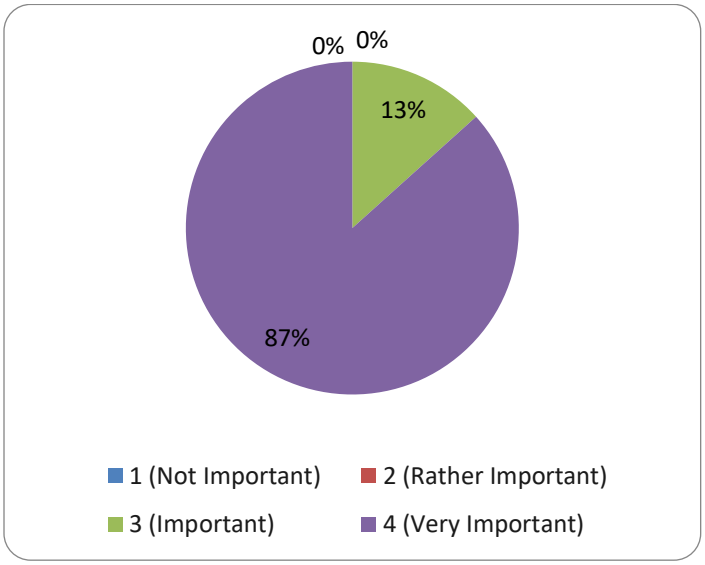


Figure 12.8 Results on the importance of WASH facilitiies

2. Adequacy of WASH Facilities Before the Programme

The results of the questionnaires on the adequacy level of the community WASH facilities before the programme are shown below. The figures illustrate that 13.3% or 4 respondents from the total respondents said that previous WASH facilities were **completely not adequate**, with regards to poor conditions or inavaibility of facilities for bathing, defecation and washing. For some families, they have to walk a long distance to get to the WASH facilities.

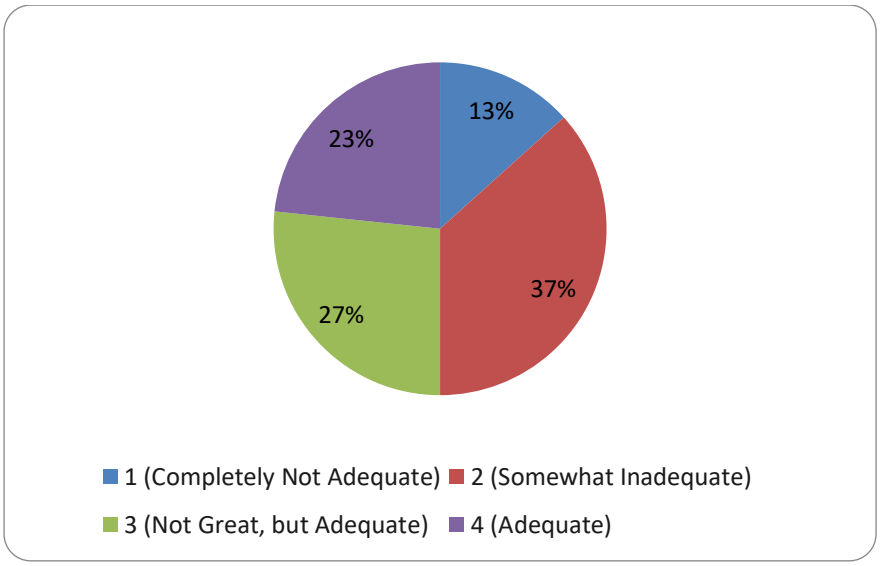


Figure 12.9. Adequacy of WASH Facilities Before the Programme

As many as 36.7% of the total respondents or 11 families said it was **somewhat inadequate**. This is because the limited WASH facilities require the community to take turns with their neighbors, and the condition of the toilets is only covered with cloth (in some areas they are completely open). In some other families, the wastewater disposals were only in the form of simple ponds or open holes, resulting in pollution of the surrounding environment.

As many as 26.7% of the total respondents or 8 families said it was **not great but adequate**. This is because even though the WASH facilities are minimal, they can still use them. As with toilets that do not have a roof, the drainage system causes puddles so that there are often lots of mosquitoes, and also insufficient clean water facilities.

The other 23.3% (less than a quarter!) of the total respondents (7 families) said their previous facilities were **adequate**, as the basic WASH facilities were present.

3. Willingness to Contribute to the WASH Facilities

To facilitate a rapid national rollout, it always helps if various parties are ready to contribute financially, and it is very powerful if local people say that they are ready to contribute. Previously, in similar surveys in Bintan, we found that over 90% of village people are ready to contribute between Rp 50,000 150,000 (€ 3 – 10) every month for a period of 2 years if that means they get key WASH facilities. So in this question, we measured the attitudes in Nagrak.

The results are quite similar in Nagrak: First off, 46.7% of the total respondents or 14 families (Bu Heni, Pa Danang, Bu Apon, Teh Devi/ Bu Ika, Pa Endang/Bu Aminah, Pa Suparman, Bu Titin Supriatin, Bu Nanih, Bu Elis Karnengsih, Bu Onih , Bu 'Ai Rosita, Pa Ano, Pa Toto, and Pa Tatang), said that they already have a complete WASH system so this question does not apply to them, so they are not counted in this analysis.

5 families, making up 17% of the total but 31% of the relevant survey returns, said they were ready to contribute, with loan and pay Rp 100,000,-/month within a period of 2 years. Another 5 families said they were ready to contribute and pay Rp 50,000/month within a period of 2 years. These families, which make up 63% of the total, feel the complete WASH systems are so badly needed that they are willing to contribute. The remaining 6 families (Mrs. Ai Waliyah, Pa Tarmid, Mrs. Tasirah, Mrs. Tina, Mrs. Empon, and Mrs. Dede Nani), making up 37% of the total respondents said they wanted a complete WASH system but the government had to pay. This is because people find it difficult to repay for the loan.

Nobody said that they did not care about WASH. So, in conclusion, it is safe to say that at least two-thirds of the people are ready to contribute through micro-loans, and it seems that those who say they don't is purely because they are worried about their ability to repay (which is less of an issue in Bintan where incomes tend to be a little bit higher). So altogether, it appears that indeed, across Indonesia, villagers are ready to contribute financially to receiving WASH systems, which is wonderful news.

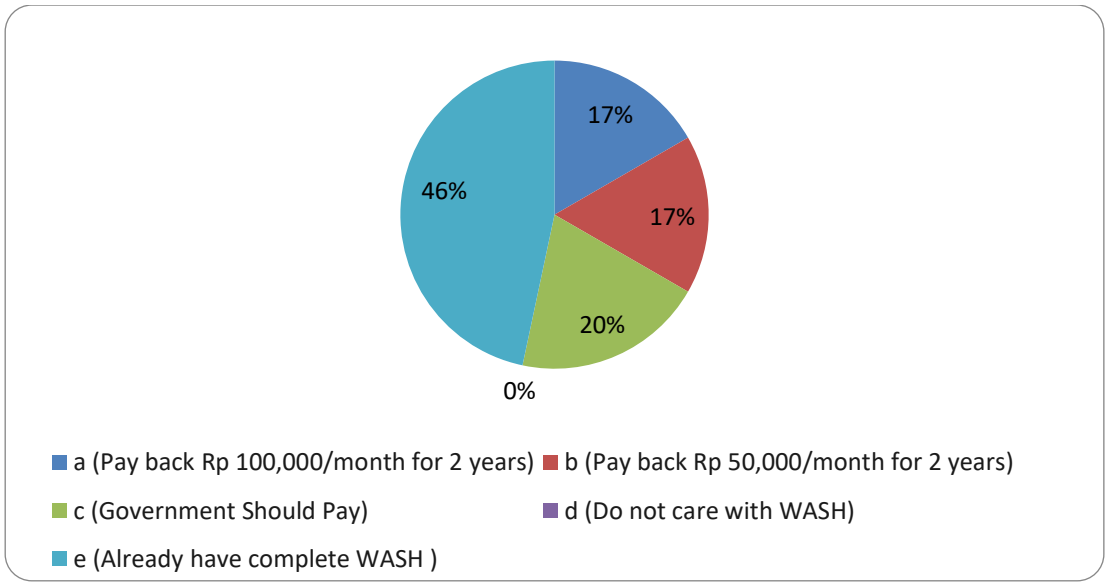


Figure 12.10. Willingness to Contribute to the WASH Facilities

4. Ownership & Maintenance

The survey results of the community's willingness to be trained and take ownership over their WASH systems is another phenomenal success that reflects the findings of a 2020 WorldBank report. **Nobody** reported that they wanted someone else to do it and take no ownership: everyone wants a significant form of ownership.

A stunning 11 families, or over one third of the respondents (Bu Heni, Pa Atet, Bu Yuyun/Pa Anwar, Bu Ida, Bu 'Ai Waliyah, Pa Tarmid, Bu Tina, Bu Nanih, Kang Utep, Pa Ano, and Pa Ayet) said they liked to be fully in control and maintain their own WASH system, after having being taught and trained by the LooLa and Itenas teams.

19 families, or around two thirds (Bu Wiwin, Bu Apon, Teh Devi/Bu Ika, Bu Tini, Pa Yoyo, Pa Endang/Bu Aminah, Pa Suparman, Bu Tasirah, Titin Supriatin, Elis Karnengsih, Empon, Onih, Ai Rosita, Dede Nani, Eros Rosita, Toto, Pa Endu, Tatang and Euis) said they wanted to maintain their own WASH system but they wanted local experts around who can help when there is a problem with the system (This group of respondents are simply worried that if there is a big problem in the system that cannot be handled, they need experts who can help them).
This is exactly the model that we offer: we trained local experts like Pak Ano to take up this role.

So altogether, the model that we deployed, training a few local experts to become totally familiar with the systems, while teaching local families all the basics, is a ringing success. Two thirds of the people feel that this model is exactly right, and one third is so content with the trainings that they are confident they can solve their own problems.

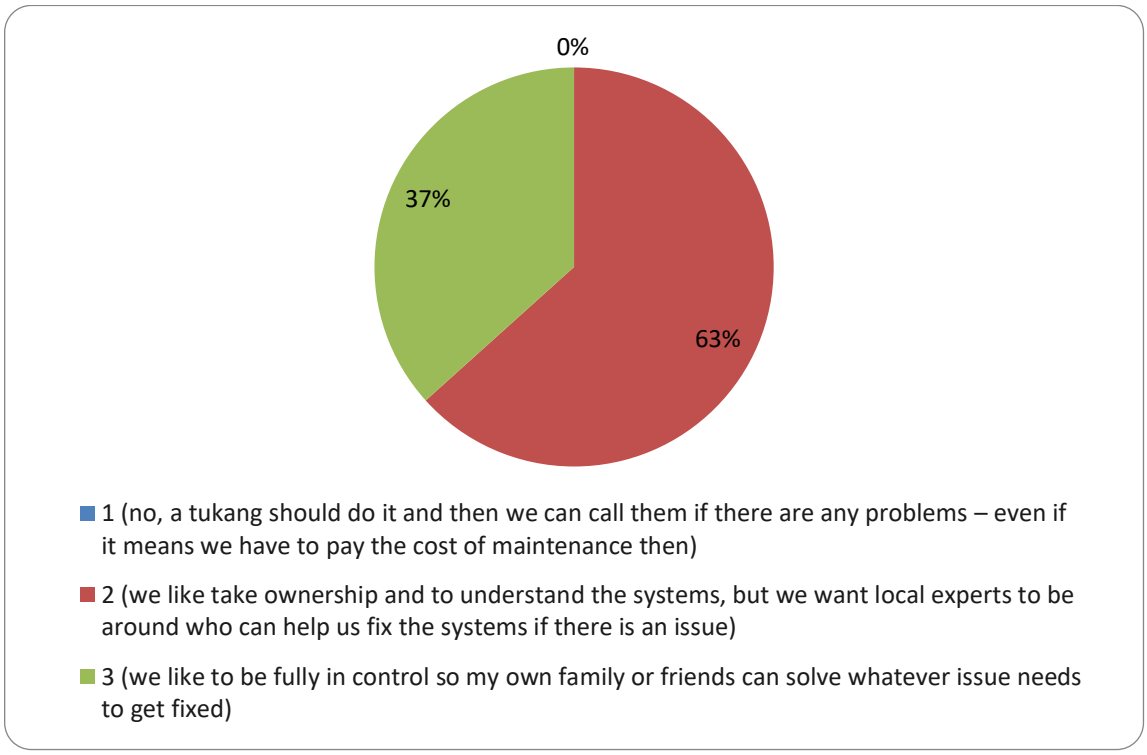


Figure 12.11. Ownership & Maintenance

5. Rating the separate WASH systems

(Note: surveys amongst those who received the systems in question)

A. Views on having new toilets/washrooms (survey amongst 20 recipients)

The survey revealed the same as what we measured in Bintan: everyone likes having a new toilet/washroom, the difference is only between liking them a lot or simply liking them: For the 20 families who did receive a new toilet/washroom, 16 families (80%) said they really liked them, while 20% said they liked them.

The 16 families were: Bu Wiwin, Pa Atet, Teh Devi/Bu Ika, Bu Ida, Pa Tarmid, Bu Tasirah, Bu Nanih, Bu Empon, Bu Onih, Bu 'Ai Rosita, Pa Ano , Mrs. Dede Nani, Mrs. Eros Rosita, Pa Toto, Pa Endu, and Pa Ayet. The reason they loved them is because they feel it is very helpful that there is no need to queue for a long time, no need to walk far to go to the toilet and it is more comfortable to use.

The 4 families are Bu 'Ai Waliyah, Bu Tini, Pa Yoyo, and Kang Utep. The reason for their answer is because, while they feel that it is helpful for the toilet to be closed, they would like to have a larger toilet.

On other words, if the question would have been: how do you like having a larger-size toilet/washroom, the response would have been a unanimous “we’d love that”.

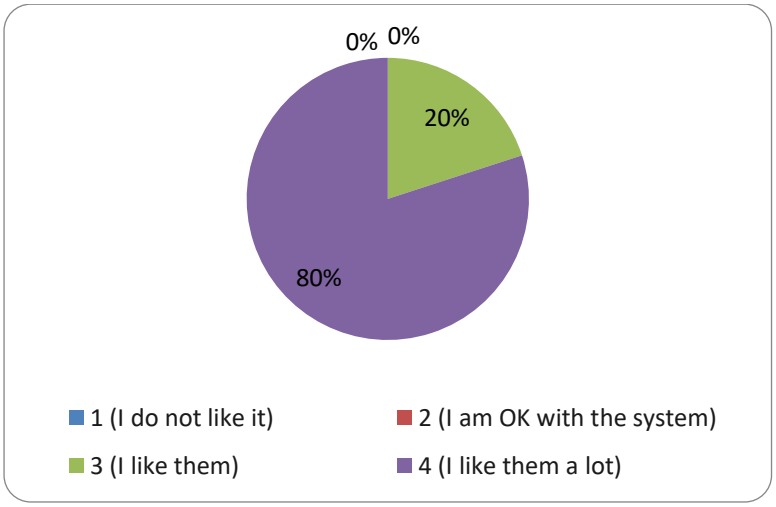


Figure 12.12. Views of the New Toilets

B. Views on the New Kitchen Sinks (survey amongst 23 recipients)

Again, very similar results to what we measured in Bintan. The vast majority (over 70%) likes them or likes them a lot . For those that love the systems (close to 60%), they report they feel this way because washing dishes become closer, easier and it is more neat. Of those who said they quite liked the system (6 families or 26%), the reason they did not rate the systems higher is because they don’t have access to running water yet. The names of the families who said they really liked it are (Mrs. Wiwin, Ms. Apon, Teh Devi/Ms. Ika, Ms. Ida, Ms. Tasirah, Ms. Titin Supriatin, Ms. Nanih, Ms. Elis Karnengsih, Ms. Empon, Ms. 'Ai Rosita, Mrs. Pa Ano, Pa Toto, Pa Endu, and Bu Euis)

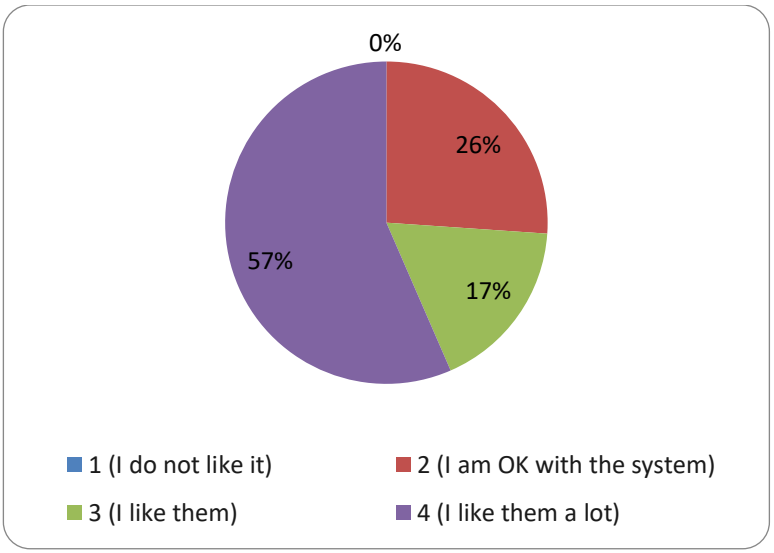


Figure 12.13. Views of the New Kitchen Sinks

C. Views on the SWGs (survey amongst 30 recipients)

Once again, the results mirror those in Bintan. Everyone likes the systems, 77% **like it a lot**, while 7 families (Bu Heni, 'Ai Waliyah, Bu Tini, Pa Yoyo, Bu Tina, Kang Utep, and Pak Toto) **liked** the SWG. The group who really liked the SWG feels this way because they feel it has helped them to have a proper, complete and smooth disposal system, which is healthier than discharging the wastewater into the river or into the ground.

Of the group who said they liked it, they mentioned that the environment has become more tidy and organized. In addition, they like it that there is no smell and nomore puddles from toilet/washroom waste disposal.

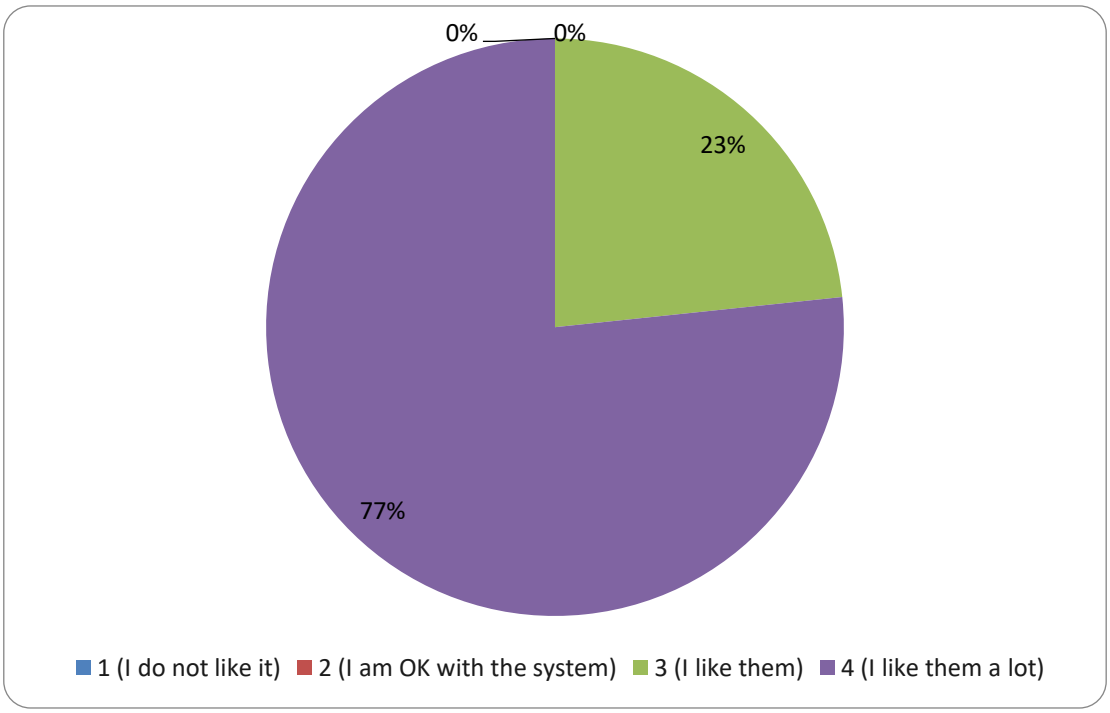


Figure 12.14. Views of the New SWG

D. Views on the Nazava filters (survey amongst 5 recipients)

The reason we did not have so many respondents here is because it was earlier decided, during the sosialisasi phase, to give the Nazava filter to some of those who had not received a new SWG. But the results of the survey again mirror those in Bintan: 4 out of 5 (80%) say they really like it, while 1 family (20%, (Pa Endang)) say they like it. The reasons are because the Nazava water filter is very practical as they do not have to boil water anymore. In addition, water filtered with a Nazava taste the same or better than boiled water.

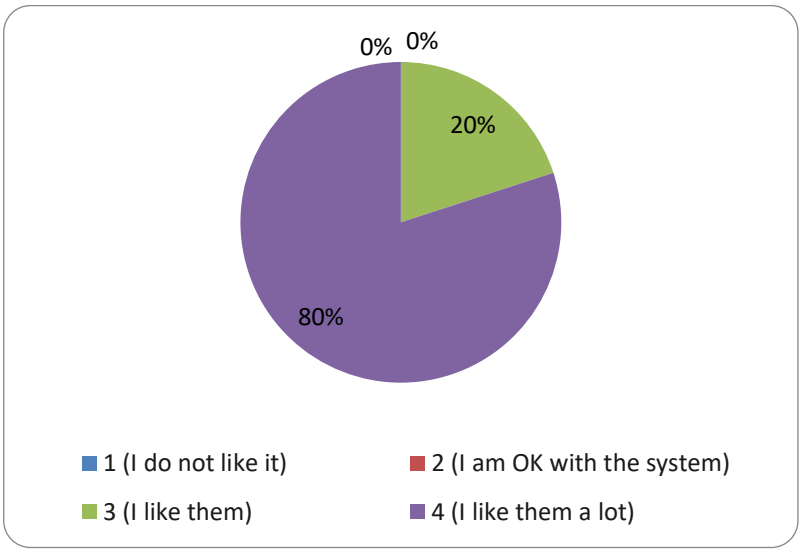


Figure 12.15. Views of Nazava Filter

E. Views on the wells (survey amongst 10 recipients)

A limited number of families received a deep well and a water tower. As we had especially selected these families because their previous access to water was a problem (they had to walk a couple of 100 meters over a hill), it was no surprise to note that 100% of the recipients was very happy with the new close-by facility.

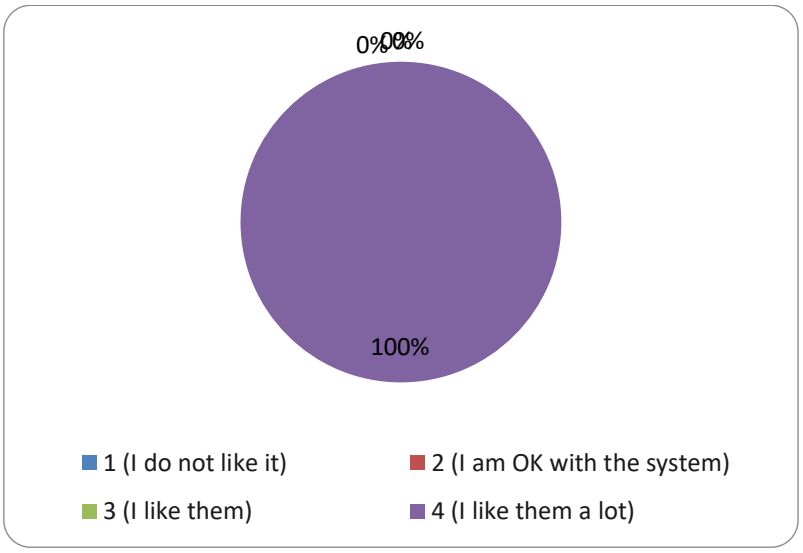


Figure 12.16. Views of the Well

F. Views on Running water systems (survey amongst 10 recipients)

Those families who received a deep well also received a water tower connected to that well – which then delivered running water. The results are therefore the same as in the previous point.

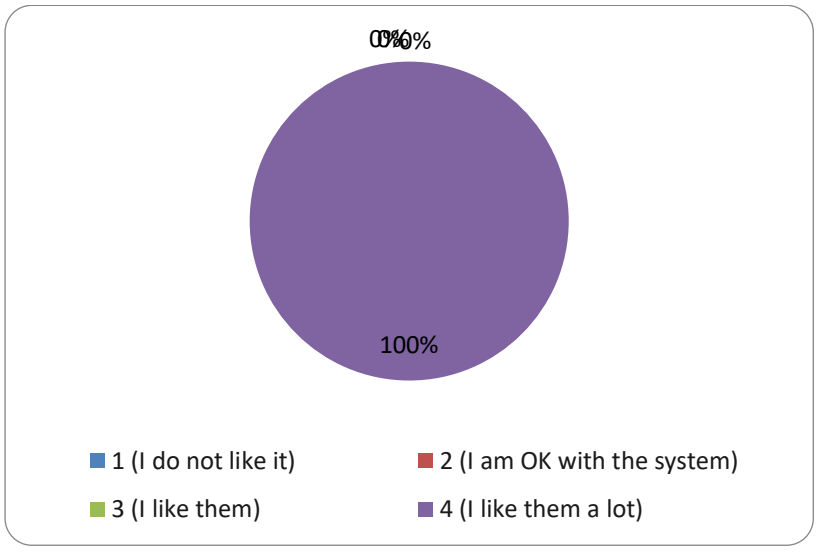


Figure 12.17. Views of the Water Distribution System

H. Views on the Safe Water Bricks

This is the first time we ever surveyed people on how they felt about the Safe Water Bricks experience, and we are delighted with the results. Nobody thought the exercise was a waste of time, and more than 80% said they liked or really liked the experience. The reason is that they feel happy to had a chance to clean up the environment and get some money for it at the same time. Some people also reported that liked having learned about this technique of recycling waste into sanitation parts.

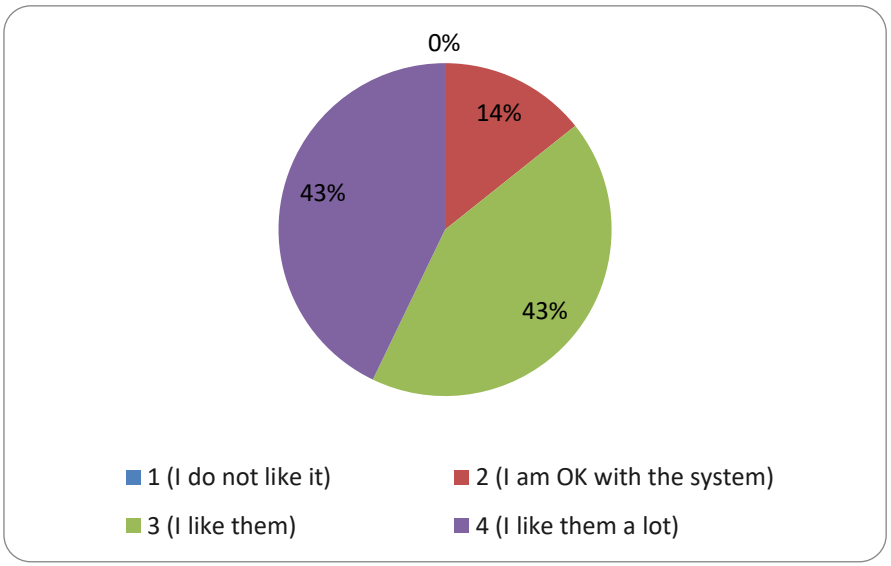


Figure 12.18. Views on the experience of making Safe Water Bricks

6. Overall ranking of the several WASH facilities

The respondents were also asked to rank the WASH facilities according to their preferences. Once again, the results mirror those in Bintan: having easy access to (running) water is a favorite for half of the people, while the other half ranks having a toilet and/or a sanitation system as the best WASH facility

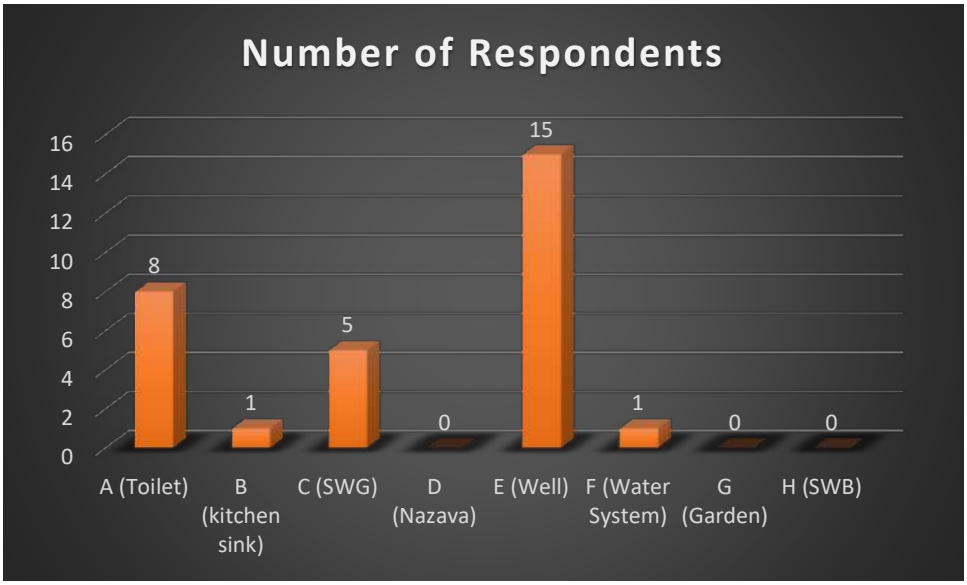


Figure 12.19. Preference on the Best Facilities

7. Feedback on the Chili Garden/micro-farming (survey of 30 SWG recipients)

Our SWG team's historic experience with planting chili has been as follows. In the beginning, when we simply suggested that people could use the SWG garden to grow their own chili and then we'd leave the family with a dozen chili seedlings, we typically had a success rate of 50%. But we noticed that when we actively engaged the villagers in the chili planting, and we told them that we wanted to learn from their experiences and that they should promise to commit to trying to plant chili, we reached success rates of 100% (although admittedly, such families had also received running water, making it easier to water the crops).

In Nagrak, we were so focussed on the new aspects of the sharing systems where many of the SWGs were shared by various households, that we did not pay much attention to the aspect of chili growing. There was also an issue of how we obtained the chili. We first agreed that we would buy the chili seedlings from a shop, but then kadus told us that there is a villager who could grow the chili himself. However, by the time we were ready to plant the chili, it turned out the seedlings were still too small to be moved to the SWG gardens.

This is why we very keen to learn how things had developed in Nagrak, as compared to our previous experiences in Bintan, and whether the conclusions are similar or not. Our survey, therefore, asked the following questions:

(a) Is the chilli growing a success (yes/no), and if no, why not?
(b) if not a success the first time, would you like to try again? (yes/no)
(c) If the chili growing was a success, does this inspire you to try micro micro-farming? (yes/no)

(a) Is the chilli growing a success (yes/no), and if no, why not?

30% of the total recipients (30 locations) or 9 families reported no success in growing the chilli. This is because the community feels that the soil in the garden is less fertile and there are disturbances from livestock (chickens). But 70% of the total recipients or 21 families conveyed that chili planting was a success, and they are expecting the results in the coming months.

Comparing this to our experiences in Bintan, these results are actually a bit better than our first tests in Bintan (which saw a 50-50 success rate). The problems with chicken can be overcome by putting a net and people in Bintan found that the problems with bad soil could be addressed by using extra water and fertilizer (see next point). But since the success of chili planting so much depends on the individual families, this is something we should keep testing in other Indonesian test sites

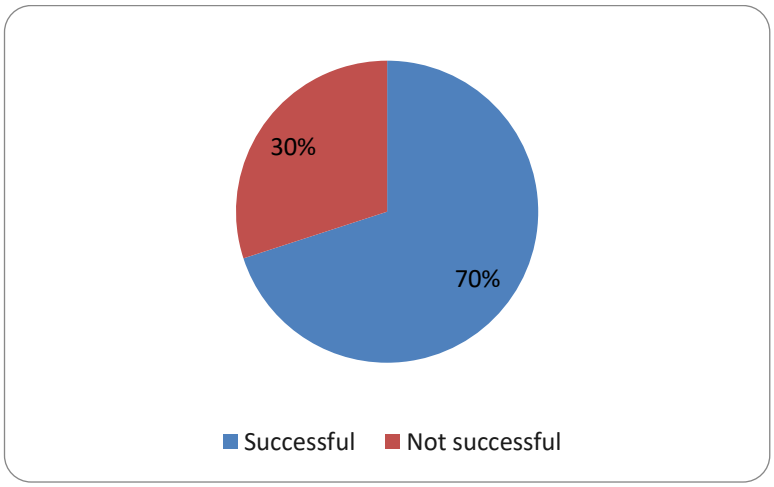


Figure 12.20. The success of Chili Garden

(b) if not a success the first time, would you like to try again? (yes/no)

We are very happy with the outcome of this question, because it showed that everyone is ready to try again: 7 out of the 9 recipients whose first planting was not successful said they wanted to replant. This is because they felt that the problems listed above could be overcome the next time they plant. The other two families did not want to replant chilli, but they are willing to try other plants, which is great, and which mirrors another finding from Bintan: that micro-farming is a highly personal business where people end up choosing very different crops depending on their own family (members) preference.

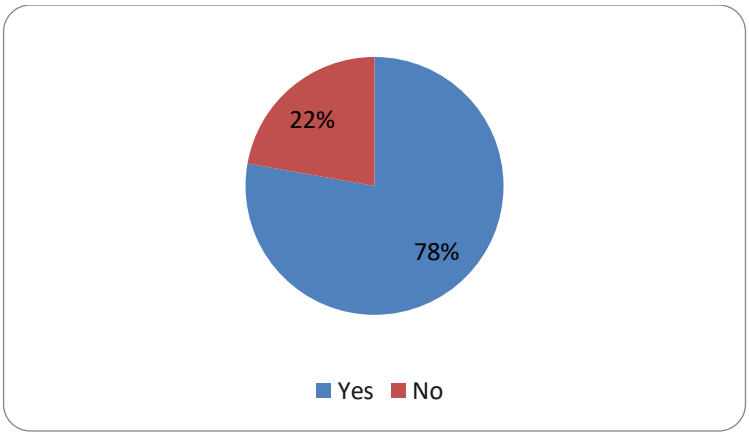


Figure 12.21. The willingness of re-planting

(c) If the chili growing was a success, does this inspire you to try micro micro-farming? (yes/no)

Despite the statistics below, a full 100% of people are interested in more extended farming (which mirrors the results we have found in Bintan):
50% of the households said they wanted to continue the micro-farming because they realised it is possible and very good to make use of the small land they have. The 50% who said they were not interested in micro-farming reported this because they already have a larger agricultural land (so it makes little sense to put extra effort in a really small space).

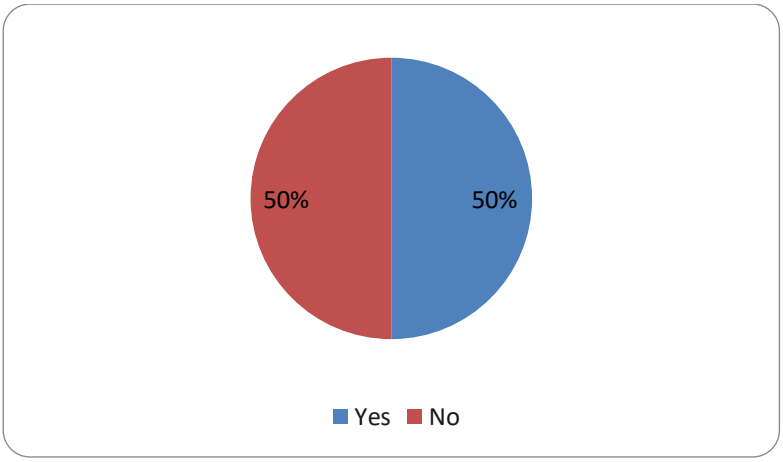


Figure 12.22. The willingness for micro-farming

Some of the chili trees and other plants are shown in the pictures below …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13. LESSONS LEARNED FROM THE OVERALL PROJECT

It is the key for future improvement that from every experience, there are lessons to be learned.
On the whole, the project was a great success, with all the major objectives achieved or exceeded.
We know now that the family-sharing system does work and that we can work very fast to empower villagers to make their own systems, and we also know that all the opportunities-to-improve that we identified **can** be improved in the future.

The key learning points were these:
We realised that, if there is not sufficient quality checking at the very end, village people will make mistakes and that there is always some room for misunderstanding. This is why a next project should start by setting all the expectations right and that it should finish by verifying, at the end, that all installations have been correctly done and that all the users have the correct understanding of their own role in maintaining the systems.

Another major learning point is that we (re)learned that doing surveys is a special skill and that we should spend more time grooming the university students to master this skill. It turned out, however, that, after a first survey which we couldn't really use, all it took is an e-meeting with Dr Iwan, who was then able to stress the finer points of survey taking to the students, after which we had a great survey.

A last practical learning point is that we now realise that it is good to have a university close-by the test site (as we have in Bintan). For the Itenas students, they needed about 3-hour travel (up and down) in one day to visit Nagrak and this makes it quite a challenge to get the whole team ready.

In greater detail, here are the key lessons learned by the teams following the Nagrak experience.

1. Clear communication and "sosialisasi": before, during & after the construction
One of the biggest concerns with projects involving people is to ensure that the people are only given information which is already confirmed. Here in the Nagrak project, we were dealing with a legacy misunderstanding among the community. Before the technical team of SWG did the technical survey, there was an initial survey to the community performed by a Pak Engkos, a well-meaning community organiser known to Ibu Elis from the SNI office, who had done a good job in earlier pilot projects in Bandung with our teams. During this initial survey, some families were given the impression that they were already chosen as the recipients of SWG. Others were led to understand that they could expect new toilets with beautiful ceramic floors and that all these systems would be installed for them.

Such situations should be avoided, as the decision of SWG recipients should be based on a technical survey, conducted by a team with a lot of sosialisasi skills. Such teams must also clearly inform people beforehand on the financial and project constraints, as well as the mutual expectations such as full engagement and the need to work together and transfer all knowledge. If such sosialisasi is well-done, our experience shows that it is easy to obtain full consensus and to align all expectations correctly.
But in our case, when our technical team did our initial survey, and recommended SWG recipients that were different from those picked by Pak Engkos before, it led to an awkward situation, also because Pak Engkos appeared to have promised that people could get new toilets with ceramic floors etc. In the end, to reduce the potential social difficulties in the future after the project, the recipients of SWG were more or less the same as per initial survey, even though they were not necessarily the best choices, technically, in view of the fact that we had wanted to test the sharing-system widely.

The lesson for future projects is to ensure that the initial survey must be conducted by people with plenty of technical WASH skills as well as social skills, and that we must obtain complete consensus about expectations, who receives what and who does what.

2. Right from the start, build strong connections with people, local institutions, sponsors
The next lesson from this project is on the importance of building strong relationships with all relevant stakeholders. In this project, this was done well. Since the beginning of the project, SWG team from Bintan, Itenas Bandung and the key people of Nagrak built strong relationships. The interaction with sponsors and local authorities also developed very well. This strong connection of the main actors led to the overall success of the project.

3. Stay humble, get as much knowledge while sharing own knowledge
Even though the SWG team and some of Itenas members already know SWG and the wastewater concepts very well, it is important to stay humble and be ready to learn from the community. The community, indeed, has local knowledge and wisdom that everyone should learn from. Having this mental attitude ensures that everyone feel welcome and willing to contribute to the completion of the project. Indeed, our teams fully relied on the local community when it came to toilet construction, kitchen sink construction, and especially the digging of the very deep wells. Once villagers feel their knowledge is respected, they respond in kind and the project becomes a true joint project, as our project was. Such an attitude gives the teams the social capital to fix any social issue that may arise later on, as was demonstrated when we had to go back and do the necessary fixes after our first survey.

7. Empower local people, but do quality control at the end.
While it is very good and important to respect local people's knowledge, we have now learned that we cannot assume that the villagers we train to construct the systems (or the villagers who offer to build their own systems) 100% understand these systems in all its details (especially in terms of construction errors that must be avoided). So, before the lead teams leave, a careful inspection of each system must be done by a senior team together with the lead village SWG Master (see next section) to make sure there are no immediate flaws like we discovered during our December survey. The WASH systems have this nature: either they are installed correctly, and you won't have any issue, or a construction error has been made and this can be spotted and fixed immediately. So, the lead teams should only leave the project once they and the village SWG Masters are confident every single system has been correctly installed and very family knows that if there is any issue at all, they should first fix it themselves and if they can't, they must immediately alert the village SWG masters.

4. Make sure that you train at least two very able local "SWG Masters" in each village
This was very well-done. One should groom and train *SWG Master Builders* who understand all the technical things as well as we do, and who also have the social skills to communicate effectively with the end users. Every village has such people and in Nagrak, these two people were Kadus and Pak Ano.
Pak Ano and Kadus could be fully relied upon to do all the necessary fixing via simple phone calls from the team. You really only need 2 such people in each village to solve whatever problems might pop up post-installation.

As we noted earlier, it is not possible for installation/training teams to ensure that every single household fully understands all the concepts (this can only be ascertained by local village leaders who know the families well). But we must make very clear in the future is that all users know that if there *are* any issues that they cannot solve effectively by themselves, they must immediately report this issue to the village SWG Masters, and these SWG Masters must know that they should report back to senior SWG management teams (such as Itenas or the LooLa teams) if need be. We had not made this clear initially, but in the end, it turned out that our contact with the SWG masters was so good that any remaining issues could be settled by them after a few phone calls.

In a next project, right from the start, we should explicitly inform the "local SWG Masters") that their role goes beyond the direct project completion date; and that they should continue to monitor, especially in the first days and weeks after installation and report back to us on any significant actions they have to take. The villagers must be made to understand that they can –and should– immediately report to the local SWG Masters if anything unexpected happens. In Nagrak, this is now completely –and happily!– understood by everyone.

5. Use technology and online facilities: Google Earth, My Altitute App, etc
Available technologies, facilities and applications these days are abundant. The team seeks to make the most of those available resources. For example, the Google Earth and My Altitude allowed the team to provide coordinates of SWG location, toilets, gardens, and other important facilities, and we could put this to good use in constructing the satellite maps as presented in this report

6. Photos, videos at all times
Documentation of the activities is one of the most important of all the activities because we must assume there will always be end-sponsor who needs a transparent report. Equally important, we must learn from every village project how to do even better the next time (just like we do in this report) and such improvements are best done on the basis of hard data and clear documentation. This was well done in this project; the teams successfully ensured that each activity was documented, either through photos or videos.

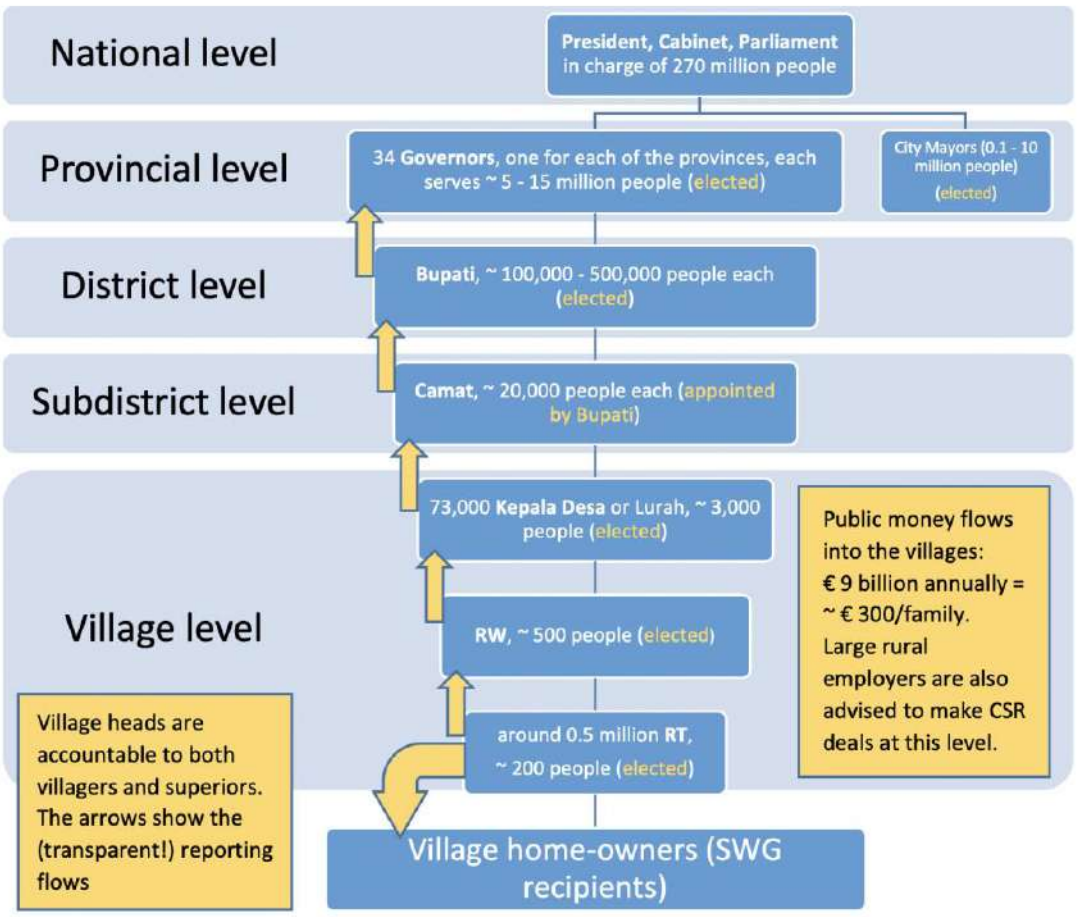
7. For chili growth and micro-farming, spend more time on sosialisasi and on local solutions
Our teams know from our experiences in the last 5 years: if you simply inform the local users that they can use the SWG for growing chili, about half of the gardens will fail to grow chili. But engage the local people well and you can ensure high success rates.

Appendix 1

Public money is allocated to the village chiefs (Kepala Desa, RW, RT) through the Kepala Desa (refer to diagram below), typically in the order of € 80 per person per year (€ 300 per family per year)[3]. They can spend this money on local housing upgrades (such as roof repairs, building of extra rooms) or on local road building, etc, but it must be approved both by the communities (through town hall meetings with the RTs) *and* by their superiors[3].

To gain superior approval is where the national standards certification (SNI) plays a critically important role. Sanitation is recognized as a matter of national importance, so if a village chief wants to implement an SNI-approved sanitation solution it is virtually automatically approved. Having the support of the national and regional PUPR (ministry of public works) offices makes such approval even easier, and the very transparent cost of a SWG (including the fact that the villagers can construct the SWGs themselves with local materials without needing an outside contractor) ensures everyone that the process is corruption-free. So the key to the success of the SWG project is for the village chiefs to convince their communities that the public money is well spent on a SWG – a very easy sale since village people know their sanitation situation is substandard and they are very keen to obtain a maintenance-free system that helps them grow chili.

The key to start a public scale-up is, therefore, to convince the regional PUPR boards to alert the village chiefs to the opportunities to obtain lifelong sanitation (hence the critical importance of the pilot villages in phase 3), and in the private sphere, to convince large employers to equip their adjacent communities. In both cases, the next step is to educate the local village chiefs to start executing this project that makes everyone a winner.



Appendix 2

Scaling the SWG for smaller land plots

We recall the reasons for the size and dimension of the SWG garden:

1. It must be large enough to absorb all the wastewater and dispense it to the soil
2. It must be minimal 50 cm deep to accommodate the leach pipe, but we should aim to keep the garden shallow so as to keep the leach pipe accessible, to reduce digging efforts and to keep as far away from the ground water so that that soil can perform its biological action in removing the organics and harmful bacteria. This is why we aim for the SWG to be 50 cm deep.
3. A 2 x 3 meter garden turns out to be the minimum size to successfully grow chili for a family of 4, and for the SWG garden to act as a catalyst towards extended micro-farming

But of course, many villages in Indonesia are space-constrained so we sketch below the **minimum** dimension of a SWG garden plot so that it satisfies conditions 1 and 2 above (only to be used when space is an issue).

Notes:

a) The SWG garden depth is always kept at 0.5 meter (50 cm), for reasons given in point 2 above

b) When we say SWG, we mean the preferred standard size of 6 m^2 (2 x 3 meter) as in point 3.

c) We will use a minimum percolation rate p of 5 cm/hour at 50 cm depth. This percolation rate is equivalent to the number proposed in the UNICEF paper, and it is about 5 times above the SNI (Indonesian national standards) recommendation, refer to page 19 in (6).

d) A percolation rate of 1cm/hour would mean that 10 liter is absorbed per hour per m^2.

e) Simple experiments show that a garden filled with an equal mixture of gravel and stones can hold at least 20% of its volume in water.

f) Compared against a rich world average of 150 liter a day, a typical Indonesian village family appears to be using around 75 liter per person per day (less if water is scarce, a bit more if water is abundant).

g) Normally, around 80% of the water used will end up in the sanitation system (the rest will be consumed or used for washing motorbike etc), but we will use 100% throughout as a safety margin.

h) Peak water use is in the morning around 8 and in the afternoon around 4 (minimal 7 hours in between). We will assume, conservatively, (1) that half of all the daily water will be used in 1 hour time and that (2) all that water must be absorbed in 5 hours time. In the table below, the values are calculated so that the garden will (1) never overflow, and (2) half the daily volume will disappear in 5 hours maximum.

i) This means that the <u>minimum garden area</u> **A = V**/200 for p < 10 and **A = V**/20**p** for **p >=** 10 [1]

j) The green coloured sizes are the standard SWG sizes (6 m^2) which allow for chili growing for one family

Family daily usage **V** (liters ..... Percolation rate **p**(cm/hr)	150 (2 pax)	200 (3 pax)	300 (4 pax)	400 (5 pax)	500 (7 pax)	750 (10 pax, 2 family)	1000 (13 pax, 3 family)	2000 (26 pax, 6 family)	3000 (40 pax 10 family)
5 (formula is **A** > **V**/200)	1	1	1.5	2	2.5	4	SWG (6)	2 SWG	3 SWG
10 (formula is **A** > **V**/200)	1	1	1.5	2	2.5	4	SWG (6)	2 SWG	3 SWG
15 (formula is **A** > **V**/300)	0.5	1	1	1.5	2	3	4	SWG (6)	2 SWG
20 (formula is **A** > **V**/400)	0.5	0.5	1	1	1.5	2	3	SWG	2 SWG
30 (formula is **A** > **V**/600)	0.5	0.5	0.5	1	1	1.5	2	4	SWG
40 (formula is **A** > **V**/800)	0.5	0.5	0.5	0.5	1	1	1.5	3	4
50+ (form is **A** > **V**/1000)	0.5	0.5	0.5	0.5	0.5	1	1	2	3

Fig 5. <u>*Minimum SWG garden area*</u> *A (in m^2) for the SWG to retain its key functionality, using the simple formula (i) above. (Standard) SWG = 6 m^2, and for any size between 5 and 7 m^2, we simply take the standard SWG*

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[1] No overflow at A > V/200: Following (h1), half the daily consumption is 0.5V liter, which should be, according to (e) less than 20% of the total garden volume, which means the total garden volume must be at least 0.5V x (100/20) liter, or 0.5V x (100/20)/1000 = 0.5V/200 m^3. To calculate the minimum area A associated with that (at 0.5 meter deep garden), it means you divide by 0.5m to get A > (0.5V/200)/0.5 = V/200. Following (h2), half the volume V should be absorbed in 5 hours, which means absorption rate must be at least 0.5V/5 = V/10 liters per hour. When the percolation rate is p cm, then (see (d)) every m^2 absorbs 10p liters, so, if the area is A m^2, the garden can absorb 10pA liters, so we must have that 10pA > V/10, in other words, A > V/100p (*) which is automatically satisfied when A > V/200 for p > 2 (as is the case). But re-calculating formula (*), half of V will dissipate in 1 hr when A > V/20p, and when this number is greater than V/200 (which happens when p >= 10) it means there is no overflow either and then A > V/20p is the formula to take, as we do in the table.

Adjusting the table to take rainfall into account

Rainfall in the tropics can be sudden and quick. When constructing the SWG, care must be taken not to put the SWG in the lowest part of the garden (where it could collect rainwater) or under a roof (so that it gets an excess of rainwater).

Once these precautions have been observed, here is how rainfall comes into play.

Singapore and Indonesia are both in the top 15 countries in terms of rainfall, with 2,500 – 2,700 mm per year, i.e less than 0.8 cm per day on average (even in the wettest month the average does not go above 1 cm/day) Looking at Singapore's detailed statistics we can see that there are around 40 days a year that the daily rainfall is between 2 – 5 cm, with less than 10 days a year that the rainfall exceeds 5 cm, and only 1 day a year that it goes above 10 cm/day. Even during extreme these rainfall events, the rainfall does not exceed 6 cm in a 2-hour space. For very extreme events (very occasionally there is a torrent of 20 cm per hour or more), we note that flooding is likely to take place. But it is important to note that, in that case, the flow-direction of water is still down (under the effect of gravity), and not up. So there is no reason for E-coli from the SWG leach pipe (under 40 cm of sand + soil) to rise to the surface. And even if there were some E-coli bacteria rising to the surface, they would would have to pass through 20 cm of soil (which is on top of the SWG garden), where most of the E-coli would get stuck to the soil particles. Lastly, even if a few E-coli would still make it through to surface level, this would be insignificant compared to the E-coli contributed by chicken-poo.

In other words, the health effects of the very occasional overflow/flooding due to extreme weather are not a real concern, but we do want to make sure that overflow of the garden does not become a *regular feature*. **To prevent regular overflow**, we need to look at the regular rain fall, which is below 1 cm/day. 1 cm of rainfall equates to 10 liter per m^2. For a SWG of 6 m^2, this equates to 60 liter. Let's double that to 100 liter and simply add this to the daily volume **V**, even when the gardens are smaller than 6 m^2 (which means that for small gardens, we are very conservative).

In that case, the adjusted SWG-size table becomes like this:

Family daily usage **V** (liters) including 100 liter of rainwater …… Percolation rate **p** (cm/hr)	250 (2 pax)	300 (3 pax)	400 (4 pax)	500 (5 pax)	600 (7 pax)	850 (10 pax, 2 family)	1100 (13 pax, 3 family)	2000 (26 pax, 6 family)	3000 (40 pax 10 family)
5 (formula is **A** > **V**/200)	1.5	1.5	2	2.5	3	5	SWG (6)	2 SWG	3 SWG
10 (formula is **A** > **V**/200)	1.5	1.5	2	2.5	3	5	SWG (6)	2 SWG	3 SWG
15 (formula is **A** > **V**/300)	1	1	1.5	2	2	3	4	SWG (6)	2 SWG
20 (formula is **A** > **V**/400)	1	1	1	1.5	1.5	3	3	SWG	2 SWG
30 (formula is **A** > **V**/600)	0.5	0.5	1	1	1	1.5	2	4	SWG
40 (formula is **A** > **V**/800)	0.5	0.5	0.5	1	1	1.5	1.5	3	4
50+ (form is **A** > **V**/1000)	0.5	0.5	0.5	0.5	1	1	1	2	3

Fig 6. Rainwater adjusted *Minimum SWG garden area* ***A*** *(in m^2) for the SWG to retain its key functionality. (Standard) SWG = 6 m^2, and for any size between 5 and 7 m^2, we simply take the standard SWG*

Appendix 3

SWG national scale-up vision and current partners

The Rotary-funded project was the second pilot village in phase 3 and as such, crucial to the national scale-up plans.