LAPORAN PENGUJIAN IPAL – SWG (*SAFE WASTEWATER) GARDEN*

KEGIATAN ADVIS TEKNIS

EXECUTIVE SUMMARY

This is the summary of the official Indonesian government evaluation of the SAFE WATER GARDEN.

It was conducted by the Indonesian national agency vested with the authority to set and review national sanitation standards:

Puskim PU - Pusat Litbang Perumahan dan Permukiman, Bandung
(Research Centre for Human Settlements, Ministry of Public Works),

The conclusion of the report is that the Safe Water Garden (SWG) satisfies the national standards, and can be used for 1 - 10 families.

Puskim further endorses a number of future research programs, notably:
(1) investigating opportunities to improve the (cost)efficiency of the SWG even further,
(2) establish a safe minimum distance of the well from the SWG, as this could well be lower than the currently recommended distance (10 meter) between a village sanitation system and a well.
(3) verifying that E-coli pollution in village wells chiefly derives from village chicken, but that putting a lid on water wells can eliminate this problem.

A copy of the full 62 page report can be found online on the Puskim website at

http://litbang.pu.go.id/puskim/berita/detail/1697/laporan--pengujian-ipal-%E2%80%93-swg-safe-wastewater-garden-kegiatan-advis-teknis

KEMENTERIAN PEKERJAAN UMUM DAN PERUMAHAN RAKYAT
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CHAPTER III – CONCLUSIONS AND RECOMMENDATIONS

3.1. Conclusion

The Safe Water Garden (SWG) is an on-site domestic wastewater treatment plant (WWTP), whose removal processes of pollutant wastewater are based on sedimentation, biological and adsorption processes. The result of our technology testing, carried out on the sample site in Bantul Regency, Yogyakarta, are :

a) The SWG system meets the technical requirements for planning, construction and management in accordance with the technical provisions SNI 2398-2017 (*Procedures for planning septic tanks with advanced treatment – infiltration wells, infiltration fields, up-flow filters, leach fields*) and SNI 8466: 2017 (*Procedures for planning of domestic wastewater treatment with a sealed anaerobic reactor system*).

b) The system performance assessment was carried out by reviewing the effect of the infiltration system on raw water sources such as groundwater or river water. The removal process for pollutant wastewater in the SWG is based on sedimentation, adsorption and biological processes. It was found that the SWG units does not pollute shallow groundwater wells that have a distance of <10 m from the SWG. The content of dissolved solid, organic or nitrate still meet the standard of Permenkes no.32, 2017, Permenkes no 492 of 2010 and water class I-PP 82 of 2010. The content of Coliform that slightly exceeded clean water standards according to Permenkes no 32/2017 was caused by cattle next to the well and well construction that did not meet the standards.

c) The SWG is a suitable technology option for on-site or decentralized wastewater management systems in rural areas for service of 1 - 10 households, or in housing estates which have a yard for agricultural / garden use.

When trying to enhance the performance of the SWG further while keeping pollution of the surroundings to a minimum, it is recommended that planners consider the parameters and recommendations listed in the test results and ensure that the SWG always meets the SNI requirements.

3.2. Recommendation

Suggestions for further enhancement of the SWG system and for further research:

a) Consider the selection of the Location, which must be 'dry' or placed above groundwater level so as to allow for safe wastewater processing and continuous garden cultivation.

b) The elimination capacity might decrease with time because mineral sedimentation becomes saturated in the infiltration system (the garden). Therefore one could

consider the following in the 500 liter pre-treatment tank, intended for filtering, separating, settling and anaerobic treatment in order to reduce sludge accumulation.

- Addition of another chamber in the tank, so that the effluent comes from the 'clear' zone (mid-height of mud accumulation and scum layer)
- Addition of natural material / plastic media for bacterial growth such as coconut shell pieces, bamboo, etc.

c) The infiltration unit (garden) design can be adapted to a different size or shape depending on the slope, soil type, groundwater and hydraulic loading.

d) Sludge that forms in the initial treatment tank after a certain period must be drained should it ever accumulate to around 30-50%. Desludging can be planned every 3-5 years, and the disposal of sludge in rural areas can be through:

- burrying it under soil, or soil of slope> 8%, covering it with soil (about 50 cm), respecting a minimal depth of 50 cm of ground water.
- combined treatment with organic waste or other biomass stabilization
- stabilization with lime (calcium hydroxide) to be safely discharged into the field, (it takes around 12-20 kg of lime for every 4000 L of stool sludge).
- disposal in a designated landfill

e) As with all rural sanitation systems, a minimum of 10 m from raw water sources (such as wells) for drinking water should be observed, but this distance can possibly be adjusted depending on the condition of the soil and the environment around the SWG. Research by the SWG team has indicated that under certain conditions, wells can operate safely at as little as 3 meters distance from the SWG. Rigorous nationwide testing (in collaboration with national authorities), could help establish a "safe radius", perhaps as a function of the soil type and local geography.

f) The use of septic tanks in the SWG can be adjusted to local conditions and/or in collaboration with local tank producers.

g) Further research could investigate whether grey water sources can be leached directly in the infiltration unit (the garden) instead of being combined with black water in the SWG septic tank.

h) The SWG research team showed that the greatest pollution in Bantul Regency and Bintan island's village water wells were on account of chicken defecating in or near the well, resulting in sometimes extremely high levels of Coliform in the wells. The solution (covering the well with a lid) is extremely cheap and appears to be very effective. It would be beneficial to extend that research (and testing its simple solution) to other parts of Indonesia.

Head of Research and Development Center for Drinking Water and Environmental Sanitation for Settlements

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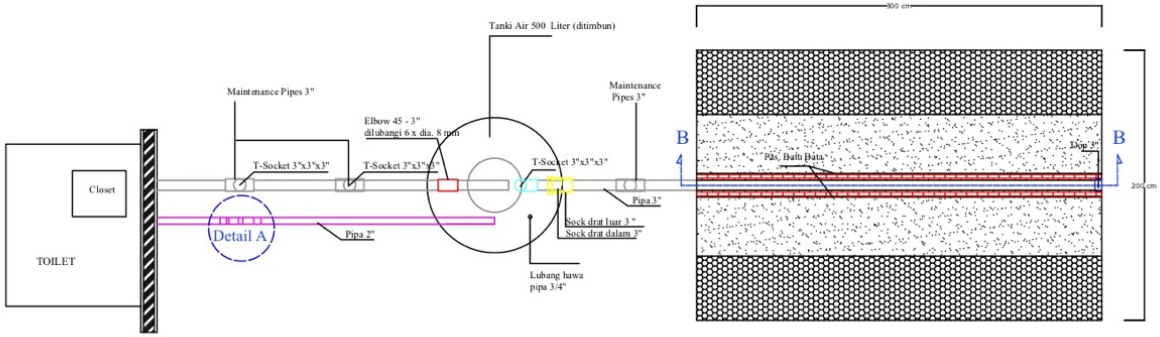

TAMPAK ATAS SEPTICTANK SWG

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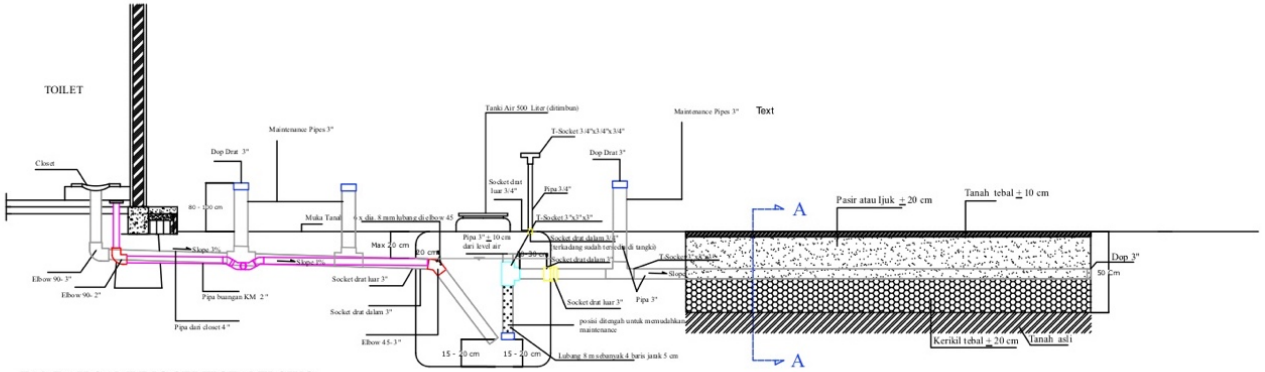


TAMPAK SAMPING SEPTICTANK SWG

1 : 25

Konsep desain SWG oleh Safewatergardens.org (LooLa Adventure Group, Universitas Gadjah Mada, National University of Singapore).

Perencana individu: Prof Lilik Soetiarso, Dr Francis Setyabudi, Dr Rudiati Evi Masithoh, Dr. Joko Nugroho, Prof How Yong Ng, Dr Marc van Loo, Henky Irawan, S.Pi, MP, M.Sc, Yudha Dwi Prasetyatama, M.Eng, Hanim Zuhrotul Amanah, M.Sc, Rizki Maftukhah, M.Sc.

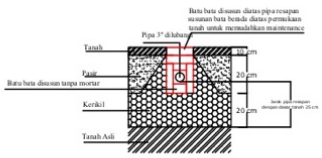
Pemeriksa: Prof Lilik Soetiarso, Prof How Yong Ng

Penelitian SWG dimungkinkan oleh LooLa Adventure Group, Borouge Pte Ltd, Nuffic (Belanda), Technical University Eindhoven, National University Singapore, Sinarmas Agribusiness and Food, Musim Mas, AS Schneider.

Gambar Teknik oleh Sinarmas Agribusiness and Food.

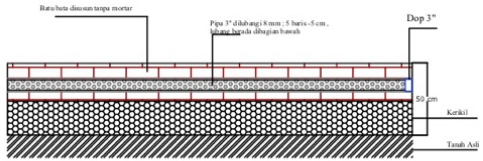
KETERANGAN :

- Semua pipa menggunakan pipa PVC
- Pipa di lem menggunakan lem PVC kecuali pipa di resapan untuk memudahkan maintenance
- Dimensi dalam cm



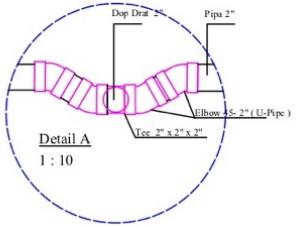
Potongan A - A

1 : 10



Potongan B - B

1 : 10



Detail A

1 : 10

REV. 1	DATE	DESCRIPTION
PROJECT	SAFE WATER GARDEN (S W G)	
PROJECT TITLE	TYPICAL SWG	
DRAWING TITLE	DETAIL TYPICAL SWG	
DRAWING NO : NON STANDAR		

PREPARED BY	CHECKED BY	APPROVED BY	ENDORSED BY

DESIGNED BY	DRAWN BY	SCALE	SHEET
	TI	AS SHOWN	31 OF 43

sinarmas agribusiness and food

REFERENCE : -

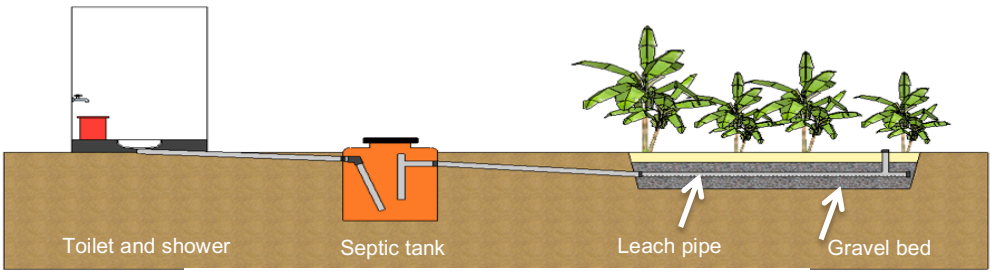
A3

Credits and contributors

Listing the people and organisations that made it happen

The History: a concept inspired by a UNICEF model

A combination of two well-known concepts in wastewater management, *septic tanks* and *leach-fields* (one set per household) has long been recognised as a viable sanitation solution. Using these concepts, *UNICEF, Red Cross* and others (notably *Norm van 't Hoff*) developed a practical and economical solution for Aceh's villagers after the 2004 tsunami.
Between 2014 and 2017, LooLa Adventure Resort built well over 200 such UNICEF-inspired systems together with its guests in Bintan island.
Inspired by UNICEF's life-saving work, our research team (below) further optimized their solution and made it even cheaper and easier to build locally. Our optimized solution is called a "Safe Water Garden" (**SWG**). It features 3 main components: a septic tank, a leach field (the garden), and a pipe system connecting the parts. By Jan 2020, more than 500 such systems have been built, in Bintan, Belitung, Yogyakarta, Bandung and Harau.



Basic schematic model of the Safe Water Garden

The researchers

The research was jointly led by: Indonesia's oldest university, *Universitas Gadjah Mada* (UGM), notably *Prof Dr Lilik Soetiarso*; Bintan's *Universitas Maritim Raja Ali Haji* (UMRAH), via *Henky Irawan, S.Pi, MP, M.Sc*; one of Europe's best research universities, the *Eindhoven University of Technology* (TU/e), notably its research lead *Mara Wijnker*; and Asia's highest ranked university, the *National University of Singapore* (NUS), represented by Singapore's best-known water researcher, *Prof Ng How Yong*.

LooLa Adventure Resort – crowned *World #1 Responsible Tourism Operator* (London 2015) and the initiator of the SWG project – coordinated the research and data collection through its founder *Dr Marc van Loo*, LooLa's 50+ Indonesian staff (in particular for the 450 SWGs LooLa has built to date in Bintan), and *Minttu Vainio*, independent research coordinator.

The Sponsors

AS-Schneider –through its super energetic MD *Tim-Frederik Kohler*– was the first company supporter. Borouge Pte Ltd, who wishes to demonstrate that plastic can be a force for good, was one of our earliest sponsors; it continues its support through its passionate representatives *Mr Yeo Lai Teck*, Borouge Indonesia Chief Representative; *Amos Tay*, Application Engineer; *KH Lou*, Application Manager and *Catherine Winata*, Market Development. Both Sinarmas Agribusiness and Food and Musim Mas have shown that the palm industry is ready to lead the way in deployment and by helping to finance some of the basic research. Shell, through its Bolivia country manager *Rik Sneep*, has agreed to produce the SWG construction manual. The WBCSD supported an important study tour that brought the SWG to the attention of big companies.

And then there are countless individuals, families, schools (in Indonesia and abroad) and smaller companies who have helped in so many ways and who continue to help us – making this a truly collaborative effort! In particular *Petra Meekers*, previously with Musim Mas, must be mentioned here.

Established* key benefits of the SWG

Prevents diseases that originate from polluted surface water
- Direct prevention: children are no longer in contact with polluted surface water
- Indirect prevention: fewer flies and rodents carry diseases near households

Social status improvement
- The houses no longer smell, have fewer insect and they feature a beautiful garden

Improves life quality
- When properly constructed and used, the system is entirely maintenance-free
- Children can play safely in the garden
- Enhances spiritual well-being, since a clean environment speaks to religious beliefs also

Contributes to food production and generates revenue
- Year-round growth of crop or spices in the gardens, which can be sold or consumed
- Fewer sick days, leading to lower medical bills and increased number of working days
- 10-15% household annual income saved through the above

Positive impact on the environment
- Nutrients no longer pollute rivers and sea: SWGs remove source of feed for algae, which contributes to killing marine life

Highly affordable and promotes local ownership
- The SWG is the world's cheapest autonomous sanitation system, and even further savings are possible if construction takes place at scale
- Fully affordable to local communities, and local people can assume full ownership
- The SWG is very easy & fast to build and requires no special construction skills

The SWG: suggested future research

1. Establish the maximum number of people that can safely use one SWG.
Our research showed that all the benefits above apply to households with up to 10 members, but we have very promising data (from Indonesian village schools in Bintan) that shows that the SWG may work for 30 pax as well (perhaps even more). It would be highly beneficial if village schools and groups of 3, 4, or 5 families could share one SWG, so future research can collect more data so as to establish the maximum safe number of users per SWG.

2. Research –and solve– the role chicken play in Coliform pollution of village water wells.
Our research showed that the greatest pollution in Bintan island's village water wells were on account of chicken defecating in or near the well, resulting in sometimes extremely high levels of Coliform in the wells.
The solution (covering the well with a lid) is extremely cheap (about Rp 100,000 per well) and appeared very effective. It would be beneficial to extend that research (and testing its simple solution) to other parts of Indonesia.

3. Investigate the "safe radius" (distance from the SWG where it is safe to put a well).
At the time of writing, the national standard says the well must be 10 meters away, but the data we have collected seem to indicate that 3 meter is safe in certain environments. Rigorous nationwide testing (in collaboration with national authorities), could help establish a "safe radius", perhaps as a function of the soil type and local geography.

4. Find a cheaper and more efficient way to procure high quality plastic components.
Work together with local governments and local Indonesian plastic producers, pipe makers and drum makers to see how the costs of an SWG can be further reduced (while retaining all the benefits listed above). For instance, one of the promising variations that have been tried in 2019 is using a flexible 3" input pipe (a 3" slang), which makes construction far easier. At the moment, such flexible pipes are expensive and hard to find, but things could change quickly if local plastic manufacturers would agree to mass production.

5. Testing the relative benefits of the "Aswat variant" of the SWG
The "Aswat variant" is a SWG version in which the grey water goes directly into the garden. The 2019 Research shows that the Aswat variant is good for crop growth (helping families with food production), but it seems that at high volume (more than 10 pax), there might be sediment build-up in the drum, which is worthy of further research.

6. Establishing the optimal conditions to grow chili in the SWG garden
The research to date suggests that it is very important to use the locally available chili, and that it helps to add a bit of extra water during the dry period and to add fertilizer. It would be beneficial to extend this research across different islands and geographies and check the role geography and local culture can play to make food production successful.

7. Extending the research to other countries, building on the experiences gained in Indonesia.
Indonesia is a great place to start because of the easy collaboration with local people and local authorities, and their willingness to try new systems together. The research results so far strongly indicate that the SWGs are not only suitable for Indonesia, but possibly for all warm countries (not exposed to frost at any time of the year) around the world, especially since the SWG costs less than the traditional soak pit.