LATAR BELAKANG
JENIS-JENIS
PERHITUNGAN

M6- SISTEM PENANGKAP
AIR HUJAN (SPAH)

SISTEM PENANGKAP AIR HUJAN (SPAH)
Wilayah pemakai atap pengumpul hujan:
- Air tanah yang tercemar akibat intrusi air asin (Gibraltar, Bermuda);
- Kualitas air sungai buruk dan jarak yang jauh (Australia);
- Daerah tropis dengan hujan tahunan tinggi dengan musim kering panjang (Thailand, Indonesia, Pasifik selatan);
- Daerah yang sangat butuh air bersih (Kenya, Tanzania).

SISTEM PENANGKAP AIR HUJAN (SPAH)
(RAIN HARVESTING)
- Rainwater that is captured and stored correctly is a safe, economical and sustainable source of quality water.
- Rainwater is as safe as any source of water, provided certain safety precautions are taken as part of water capture, storage and distribution.
- In fact some say that rainwater is safer than water supplied through mains or reticulated water systems.
- Our mains water is typically stored in dams, treated with chemicals such as chlorine to kill of bacteria and make it safe, and then pumped through a network of pipes throughout the community.
**Keuntungan SPAH**
- Kualitas air hujan sangat baik
- Sistem mandiri, sesuai untuk permukiman yang tersebar
- Bahan & keahlian lokal dapat digunakan
- Tanpa biaya untuk energi
- Mudah dipelihara
- Mudah & nyaman memperoleh air

**RAIN HARVESTING**
Other reasons for using rainwater
- Mains water is not available to your property
- to ensure a backup for other water supplies
- to store water at an economical cost
- to save money on your water bills
- the cost of water is already high and it is sent to rise substantially
- the value in pure fresh natural rainwater (Health reasons)
- No chemicals added to your drinking water
- Your water supply is salty or hard, has odours or contains heavy metals
- To prevent the impact of storm water run-off on the local environment (environmental reasons)
- rainwater is good for the garden

**Kekurangan SPAH**
- Biaya awal pembangunan besar
- Sangat tergantung pada curah hujan dan luas atap
- Rasa air yang tawar tanpa mineral

**The first Rain Centre in India**
SISTEM PENANGKAP AIR HUJAN (SPAH) (RAIN HARVESTING)

- There is no higher quality source of water available to us than rainwater. Unlike water captured in dams which requires an extensive treatment process to ensure a quality fit for human consumption, rainwater that is collected on roofs and stored appropriately represents a sustainable source of water ideal for use inside and outside the home.
- By using rainwater for toilet flushing, laundry and garden use alone, it can reduce mains water requirements of a typical household by 70%. If hot water systems are supplied with rain water, this reduction can be as high as 85%!

RAIN HARVESTING

Significant economic, social & environmental benefits can be achieved by using rainwater

- By using Rainwater Harvesting systems to supply water for some, or indeed all of our requirements, you can reduce your dependence on mains water. Our water supplies are falling and water restrictions are in place in many communities to reduce our overall water usage and protect our supplies.
- There is no better quality water available naturally than rainwater. Some say there are health benefits to using rainwater which is not treated with chemicals like our mains water is.
- Rainwater falls for free - once you have installed a rain harvesting system, you use less mains water and can reduce your water bill. Governments and Water Boards will increase water prices as they look to recover the true costs of providing water to the community.

Kelayakan SPAH

TEKNIK

EKONOMI

SOSIAL

RKh

Inside and outside the home

- Some jurisdictions have already moved to require the construction of new homes to include rainwater tanks to supply water for toilet flushing, laundry and outside uses (Australia). Many local Councils are providing rebates to homeowners that install rainwater systems into new or existing dwellings.

RAIN HARVESTING

- The cost to the community to supply mains or reticulated water services is becoming more expensive every year. The construction of dams, pipes and treatment plants is huge and ultimately as tax and rate-payers, we foot this cost.
- Rainwater Harvesting reduces the significant damage to our creeks, water habitats and organisms caused by stormwater runoff.

Kelayakan TEKNIK

- Masalah antara air hujan yang diperoleh dan kebutuhan:
  - Supply dari sistem tergantung pada besarnya curah hujan sepanjang tahun, disarankan untuk mempergunakan data curah hujan selama 10 tahun (minimum).
  - Kebutuhan penduduk kira-kira ± 15-30 liter/orang/hari
Kelayakan EKONOMI & SOSIAL

Ekonomi
- Harga tergantung dari bangunan struktur yang akan digunakan dan harga bahan bangunan setempat
- Bila harga mahal, gunakan fasilitas dana seperti koperasi, dll.

Sosial
- Perhatikan tradisi, kebiasaan masyarakat
- Teliti siapa yang akan memakai (anak-anak, ibu-ibu)
- Diskusi diperlukan, juga penyuluhan: pendidikan kesehatan, peran serta yang diperlukan, buat kesepakatan dengan mereka.

Perencanaan SPAH
(Menentukan volume penampung)

Kebutuhan pada musim kering
- Harus ditentukan lamanya musim kering; informasi penduduk, data iklim,
- Meteorologi, musim kemarau /tahun versus kebutuhan air
- Metoda ini sangat sederhana, harus memperhitungkan musim kemarau terpanjang dalam satu tahun

Perencanaan SPAH
(Menentukan volume penampung)

Analisis kurva massa (tabel dan grafik)
- Data curah hujan disarankan minimal 10 tahun
- Tentukan luas atap & koefisien run-off
  - Logam: 0,8-0,9
  - Bukan logam: 0,7-0,8
  - Atap jerami/ilalang tidak disarankan.
  - Jika tidak yakin dengan kualitas atap maka gunakan koefisien yang lebih rendah misalnya 0,7-0,75
- Hitung jumlah supply air

SUPPLY AIR = luas atap x koefisien run-off x curah hujan tahunan rata-rata

Q supply = A x C x h

LOCATION FOR THE TANK

In determining your tank size, first check the history of average annual rainfall in the area for the last 100 years or the longest period available. This information is usually available from the Bureau Of Meterology. It is important to also determine on average, the longest periods without rainfall. Some areas get a great deal of their yearly rainfall at a particular time of year. To satisfy such a situation, a larger storage capacity would be required.

Calculating the appropriate size

Use the following formula:

Roof Area X Annual Rainfall = Maximum Available for Capture

Then determine:

Most Days without Rain X Average Daily Water Use = Storage Volume Required on Day One of a Dry Spell

If for example, the most days without rain was 40 days, and the average daily usage was 400L, the volume on hand on Day One of 40 days would have to be 16,000L.

It is very difficult to predict the required volume, because often a dry period will start when the tank is not full. However, this method provides a guideline, and you can add a safety factor on top of this requirement.

When calculating how big the storage capacity should be, plan the tank area so that extra storage can be added later if required.
For example, in Tokyo, the average annual rainfall is about 1,400 mm. Assuming that the effective catchment area of a house is equal to the horizontal line of its roof surface area, and given that the roof surface area is 50 m², the average annual volume of rainwater falling on the roof may be calculated as 70 m³.

However, in practice, this volume can never be achieved since a portion of the rainwater evaporates from the roof surface and a portion may be lost to the drainage system, including the first flush. Furthermore, a portion of collected rainwater volume may be lost as overflow from the storage container if the storage tank has insufficient capacity to store the entire collected volume even in a heavy rain. Thus, the net usable or available amount of rainwater from the roof surface would be approximately 70% to 80% of the gross volume of rainfall. In the above example, the actual usable amount of rainwater would be about 49 m³ to 56 m³ in a year.

Steps to Rain Harvesting Sustainable Water

1. Ensure roof surface is suitable for collecting good quality rainwater? (Roof material selection..)
2. Gutter system (protection, prevent sediment build up)
3. Roof catchment area for single storey homes is usually greater than the floor area of the building if there are eaves.
4. Consider that each 1 mm of rain = 1 Litre of water per m² of roof area, then allow a 15% wastage factor.
5. Another rule of thumb: the smaller the catchment area the larger the tank.

Cara Kurva Massa

- Asumsi luas atap 25m²
- Run off koefisien : 0,8 (gutter buruk, bahan logam)
- Curah hujan rata-rata per tahun 1000 mm=1m
- Supply per tahun : 25 m² * 0.8 * 1m = 20m³
- Data curah hujan sbb :

<table>
<thead>
<tr>
<th>Periode Hujan</th>
<th>Luas Atap</th>
<th>Panjang</th>
<th>Lebar</th>
<th>Luas Permukaan</th>
<th>Curah Hujan Rata-rata</th>
<th>Supply Per Tahun</th>
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</table>

Tabel Keterangan kolom

- Kolom 1 : Data disusun mulai dari permulaan musim hujan
- Kolom 2 : Kolom 1 x luas atap x koef x curah hujan rata-rata
- Kolom 3 : Kumulatif kolom 2
- Kolom 4 : kebutuhan air per bulan, asumsi 50 l/hari maka kebutuhan perbulan = 50*30 hari = 1500 liter
- Kolom 5 : kolom 3-kolom 4
- Kolom 6 : Kumulatif kolom 5
- Kolom 7 : perbedaan nilai maks dan minimum di kolom 6
Cara Grafik

- Plot hasil perhitungan dari tabel (kolom 6)
- Plot kumulatif kebutuhan air per tahun
  - Asumsi kebutuhan perhari 50L/hari
  - Kebutuhan pertahun = 50*30*12 = 18m³
  - Kebutuhan ini merupakan 90% dari supply (20m³)
- Atur grafik kebutuhan hingga bersinggungan dengan grafik supply (dari tabel)
- Hitung perbedaan grafik supply dan demand

Mass Curve with Dimensionless Constant analysis

- Grafik dapat diolah lebih lanjut menjadi grafik % demand versus storage required (as % supply)
- Buat beberapa variasi %supply misalnya 10%, 30%, 50%, 70%
- Annual supply untuk : luas atap x koef x curah hujan rata-rata = (20 m³)
  - 10% x 20 m³ = 2 m³ dst
  - Sehingga diperoleh tabel sbb

<table>
<thead>
<tr>
<th>Demand (%)</th>
<th>Storage required (m³)</th>
<th>Storage required (as % of supply)</th>
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<tr>
<td>10%</td>
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<td>30%</td>
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<td>50%</td>
<td>2.8</td>
<td>40.5</td>
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<td>70%</td>
<td>4.1</td>
<td>54.5</td>
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<tr>
<td>90%</td>
<td>8.2</td>
<td>100%</td>
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</table>

Contoh perhitungan menggunakan grafik konstan

- Luas atap asumsi 30 m³
- Runoff coeffient : 0.7
- Average annual supply : 30 x 0.7 x 1m = 21m³
- Asumsikan bahwa kebutuhan pertahun : 15 m³/tahun
- Nyatakan kebutuhan sebagai % supply : 15/21*100% = 71.4%
- Plot 71.4% demand pada grafik diperoleh %storage =42%
- Volume tangki : 42% * 21m³ = 8.8 m³
Konstruksi

- Atap: luas cukup, kemiringan 40%, bahan yang mudah, murah dan memenuhi syarat (Cro>0,6)
- Sistem talang: ringan, tahan air, mudah disambung, lurus (bambu, seng).
  - Kemiringan (l) = 1 cm/m
  - Luas potongan talang (A) = 100 cm²
  - Kedalaman min. = 7 cm
- Penahan/penyangga secukupnya (tiap jarak 60 cm)

SISTEM PENANGKAP AIR HUJAN (SPAH)
(RAIN HARVESTING)

- Incorporating Gutter Systems
  - to help ensure gutters do not become blocked with leaves and debris; to prevent mosquito breeding habitats;
- Fitting Rain Heads at gutter downpipes - to separate leaves and debris from the flow of water; to keep mosquitoes out of pipe systems to the tank (especially in “wet” systems)
Konstruksi

Konstruksi pembilasan pertama "first flush", pada waktu hujan pertama, pembilasan kotoran pada atap (debu, daun, kotoran burung) +20 liter air hujan pertama yang mengalir keluar dari tangki.

- alat tambahan: katup penangkap pembuang air, saringan

Gambar: First flush traps

Tangki penampung/penyimpan

Perlu perhatian khusus:
- Rencana fungsional sesuai kondisi setempat
- Bangunan kedap air
- Tinggi maksimum 2 m (di bawah atap rumah terendah)
- Terlindung dari sinar matahari, kotoran
- Manhole dengan tutup yang aman
- Overflow gunakan kasa, hindari serangga
- Sistem penyaluran (perpipaan, kran di bagian bawah)

SISTEM PENANGKAP AIR HUJAN (SPAH)

- Regular Tank
  Maintenance of the tank, catchment system, roof and gutters, inlets to ensure a safe supply of water.
- Desludging may be required every 2-3 years, and whilst regular disinfection should not be necessary, can be undertaken if preferred
Variasi bentuk tangki

- Gentong semen 0.1-0.5 m³ (Thailand, Asteng, Afrika)
- Keranjang gentong tradisional h = 1.5 m, volume 2-3 m³.
- Tangki lingkaran cincin beton tuang, Ø 1.5 m, h = 0.6 m, vol = 7 m³.
- Tangki ferrosemen
- Tangki lembaran seng
- Tangki beton bertulang volume 12 m³.

TUGAS KELOMPOK

DATA HUJAN

<table>
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<tr>
<th>KELOMPOK</th>
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Tabel 3: Rainfall (mm) for Case A

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Tabel 4: Rainfall (mm) for Case B

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SOAL

- Hitung berapa volume tangki penampung air hujan dengan metode:
  - Tabel
  - Grafik
  - Gunakan Dimensionless graphic constant jika luas atap 40 m², bahan gutter non logam, dan kebutuhan per tahun 15 m³/tahun