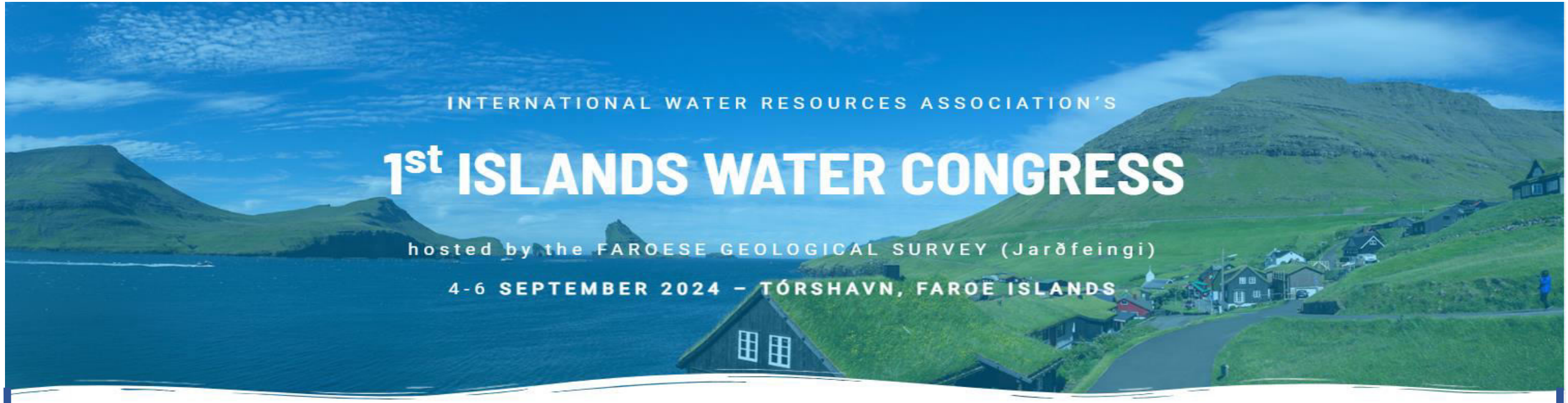

Freshwater and Islands: Administration, Collaboration, and Innovation

Every Drop of Freshwater on Islands Counts for Sustainability, Survivability, Buildability and Livability

By

Kian Heng Liew

and

Yuqi Liew

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ABSTRACT

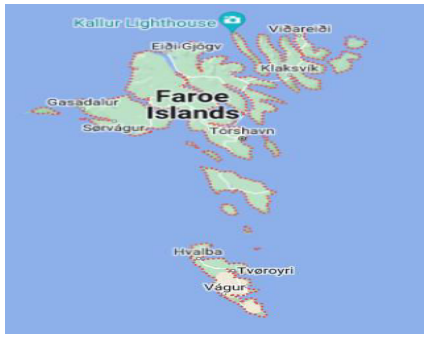
Islands

United Nation members and **sovereign states** while a smaller number of islands are termed **dependencies** and other **territories**.

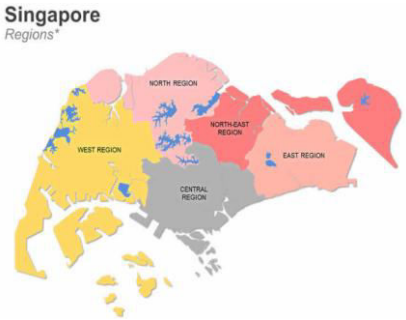
Indonesia largest island country of **1,904,569 km2** (density 142 per km2),

Australia largest island continent of **7,692,020 km2** (3.45 per km2)

Smallest being **Cocos Island** of **14 km2** (density of 42.6 per km2).



Faroe Islands has **1,393 km2** (density 35.5 per km2)



Singapore with **728 km2** (density 7831 per km2)

Big or small in land area or **multitude of islands** in a country or a **single main island** of very big population density Problems face on **freshwater sufficiency and inundation is common**. The degree and variation of challenges on these islands could differ due to **geography/geology, governmental-societal actions** and **state of technologies** Common mitigation is on **the climate change impacts affecting all islands** – sovereign, dependencies and territories.

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ABSTRACT

Administration, Collaboration, Innovation

In the paper "*Every drop of water footprint counts for humanity*" (Liew Kian Heng and Liew Yuqiang 2020)

"*Every drop of water and food footprints count for humanity*" (Liew Kian Heng and Liew Yuquan 2022) emphasized the need for **life-long listening and learning on sustainable water footprint** as laid out by United Nations **Sustainable Development Goals 2030**.

The tri-factor : **Administration, Collaboration, Innovation**
relating to freshwater on islands could take on a **fresh approach** in **meeting challenges by island countries**.

Freshwater from rain precipitation is a **precious natural resource** with or without climate change impacts

The big variations **in average rainfall which affects the amount of runoff** on land surfaces and **water table levels** beneath

Each island may need **bespoke unique ecosystem** to overcome challenges on collection, storage, processing and conflicting/competing uses;

Precious freshwater from rainfall precipitation however would simply be **wastefully drained** into the surrounding seas easily from the islands. On the other hand, such islands could be **inundated by heavy detrimental floods** destroying homes, farms, facilities, etc. of entire village and biodiversity. **Survivability is at humanity scale**.

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ABSTRACT

Sustainability, Survivability, Buildability and Livability

Solutions on to a **deep personal-individual level administration**; **deep-root close-loop collaboration** and **simple back-to-basic frugal innovation**.

All these ideas and solutions are easily implemented with the will (societal and political) **at local buildability levels** without the need for much **United Nations** COP pact/convention high level interventions

Individual at grass roots tapping on readily available **practical frugal engineering** and **local sustainable materials** with **watered-down regulations** by encouraging public **participation/collaboration** of **youngsters** at private firm - Institute of Higher for life-long Learning.

Unlike **Singapore**, most island countries may not have the economic **resources at local level** that faces the environmental flooding or drought head-on **impacts of freshwater** and **sea level rise**.

Island countries need to have **unique bespoke solutions** for **sustainability**, **survivability**, **buildability** and **livability** outcomes.

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INTRODUCTION

Administration

Impacts of **Administration**, **Collaboration** and **Innovation** to **ensure safety and security of freshwater** play crucial roles in Sustainability, Survivability, Buildability and Livability outcomes **for humanity on planet earth**.

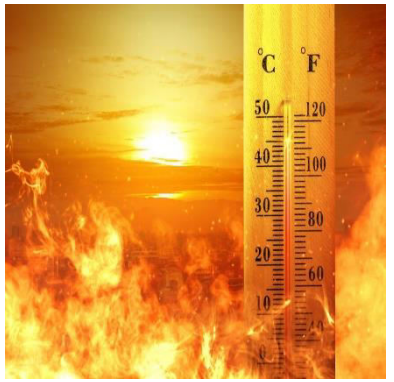
All nations big and small are facing **insurmountable vagaries of unprecedented proportions.**

shortage in droughts

inundated in floods

fresh & seawater rising

extreme forest fires



extreme temperatures

melting ice caps/glaziers

Less endowed nations hope to receive **international Administration support**;

Better endowed nations cope to control, improve and **safeguard freshwater footprints by government agencies**

Singapore national Administration has **strategic planning** on increasing potable water means with the **"Four taps"** and strict consumption regimes on decreasing to **130 litres/day/capita by 2030** with punitive tariffs.

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INTRODUCTION

Collaboration

Collaborations by all stakeholders play important roles in concerted efforts to scour, source and **squeeze out every drop** available including seeking amicable high levels water **understandings and arrangements** between nations eg **Singapore-Johor water agreement**.

Every individual, institution, company, NGOs, etc. up to the national level can contribute their part on **safety and security of freshwater.**

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INTRODUCTION

Innovation

Innovation from making collection to final treatment of freshwater in benefitting islands to overcome droughts and mitigate floods has to rely on the **state of technology available**. No need of **high engineering technology** as long as freshwater can be made beneficial and met at all levels of society.

Simple frugal innovation derives **immediate benefits** at **local domestic level** rather than awaiting big technological solutions by the authorities. **Big investments on innovations** need **economic prowess** and take **long time** to accomplish and the problem would have **changed** by then.

"***Bridge to Nowhere***" called **Choluteca Bridge** in Honduras. A hurricane named Mitch came upon commission of the completed by Japanese engineers in 1998 and ditching **the mighty bridge standing still without the river**!

The ancient Chinese saying

"**谋事在人，成事在天**"

Literarily is

"***Man Proposes, God Disposes***"

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INTRODUCTION

Innovation

Mother earth evokes many lessons in **Nature to invoke humanity**. It gives birth to life on earth through **generations of iterations, revisions and versions** and created what we have now the **ecosystem of the human race** for many civilisations.

Nature's dire wrath soon to become extinction as **human** "***beens***". The renewed call for ***Ecosystem Adaptation***, ***Nature-based Solutions*** etc. so intelligently propounded, preserved and revered by **ancient tribes, aborigines** and most civilisations are knocking on the doors of our over **technologically exploitive modern societies**

Tie-wearing man is now seeking solace and forgiveness of wrong doings from the **half-naked loin-clothed bearing shamans** and **gurus**

2024 **World Economic Forum** in Davos of "***Rebuilding Thrust***" the opening on stage was preceded with the world elites listening to "***Voice of the Forest***" performed by an Amazon shaman chieftess named Puttany.

"we can join our hands, unite our hearts, unite our thoughts in the same direction, for the healing of the planet and spiritual healing" while assuring that "when we unite in our thinking and our heart, our ***Mother Earth will listen to us****."*

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INTRODUCTION

Administration, Collaboration, Innovation

May all the Administration, Collaboration and Innovation take heed with all our hands, hearts and thoughts to **heal Mother Earth** by first "***learn to listen and listen to learn***" life-long.

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CONNOTATIONS

Sustainability, Survivability, Buildability, Livability

Every drop of freshwater shall count for the outcomes of the **islands for humanity**. The interplay of Administration, Collaboration and Innovation at various intensity and different levels with every stakeholder's participation would enhance the **outcome for the ever changing environment**.

The **vulnerable and susceptible ecosystem** within an island is very sensitive to environmental changes and destruction. Therefore it is paramount that any solutions on freshwater shall take the following into **utmost outcome considerations**:

Sustainability, **Survivability**, **Buildability**, **Livability**

Even in large continent islands and massive landmasses there is **volatility and vulnerability** on any of the four outcomes. The sources of water such as from the **Nile, Ganges, Tigress, Euphrates, Jordan, Amazon, Danube, Yellow, Yangtze, Mekong Rivers** etc. which serve civilizations for thousands of years for sustainability, survivability, buildability and livability are **now ridden with calamities and disasters**.

The "**cradles of civilization**", "**the rivers of paradise**", "**the biblical rivers**", "**the rivers of life**", etc. are names with ensuing meanings of giving humanity the life of civilizations all have watery beginnings till today

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CONNOTATIONS

Sustainability, Survivability, Buildability, Livability

"***The Cradle of Civilization Is Drying Up*** **-** *Climate change endangers the* ***Tigris and Euphrates*** *- but it's not the only reason the rivers are vanishing*". (Winthrop Rodgers 2023)

"*Jordan River has finally dried up and something terrifying is happening".*(Beyond Discovery Joe Rogan Experience 2024)

"***Mekong Drought Enters Fourth Year****; Worst Conditions in 60 Years*". (Luke Hunt 2022)

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CONNOTATIONS

Sustainability, Survivability, Buildability, Livability

a. Sustainability

Sustainability is a keyword originating from United Nation website:

"In 1987, the United Nations Brundtland Commission defined sustainability as:

> *"**meeting the needs of the present without compromising the ability of future generations to meet their own needs**."* (United Nations Academic Impact 2024)

b. Survivability

Survivability *"**is the ability to remain alive or continue to exist**"* in accordance to Wikipedia. From the United Nations World Water Development Report 2023:

> "***Water is the lifeblood of humanity***. *It is vital for survival itself and supports the health, resilience, development and prosperity of people and planet alike. But humanity is blindly travelling a dangerous path.* ***Vampiric overconsumption*** *and* ***overdevelopment, unsustainable water use, pollution and unchecked global warming are draining humanity's lifeblood***, ***drop by drop***". (FAO 2023)

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CONNOTATIONS

Sustainability, Survivability, Buildability, Livability

c. Buildability

There are several versions in the definition:

"***The ease with which a design can be built***" is as defined by Oxford Reference.

"***The quality of being buildable***" is defined by Wiktionary and "***buildable***"

is defined as "***Suitable or available for building***" by Your Dictionary.

d. Livability

This is defined as "***suitability for human living***" as given by Meriam Webster dictionary. The level and standard of living vis-à-vis the costs of living would vary from societies and island to island nations. Nevertheless, the amount of freshwater recommended by **United Nations** for **basic needs** such as drinking, cooking, washing and maintaining proper hygiene is **50 litres/person per day**.

The **livability standard** of any human being on freshwater is given by UN SDG for water as the number 6 goal:

Ensure access to water and sanitation for all -

"***Access to safe water, sanitation and hygiene is the most basic human need for health and well-being***". (The Sustainable Development Goals Report 2023)

ADMINISTRATION-COLLABORATION-INNOVATION IN SYNERGY

Super Well Point (SWP)

Make "***every drop of freshwater on islands counts***" outcome. This paper outlines seven **frugal innovation** solutions with **intellectual property** close to the "***thinking and heart***" of the author.

This innovation called ***SWP*** extracting any fluid from water courses and underground aquifers relying on a **patented vacuum technology**.

Joint patent held by **Asahi Technology Corp**.

the author **Kian Heng Liew**

National University of Singapore

The ubiquitous submersible pump used in extracting water from deep wells for freshwater use is slow and inefficient. *SWP* taps on creating a vacuum in a sealed steel tube inserted into underground to draw freshwater and then pumped up **lowering the water table** and hence **reducing soil moisture**.

This ***first-of-its-kind*** **dewatering technology** is a ***back-to-basic*** **idea in providing freshwater from deep in the ground** and yet simultaneously **improve idling soggy land** into valuable habitable "**Nuland**".

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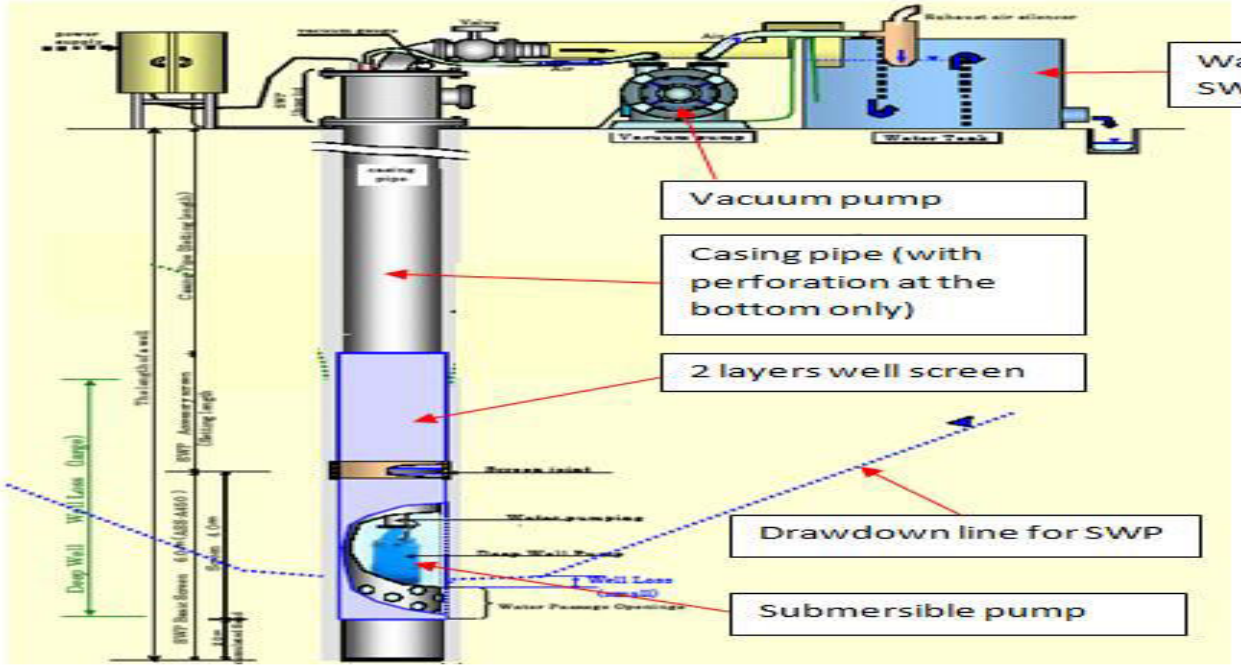
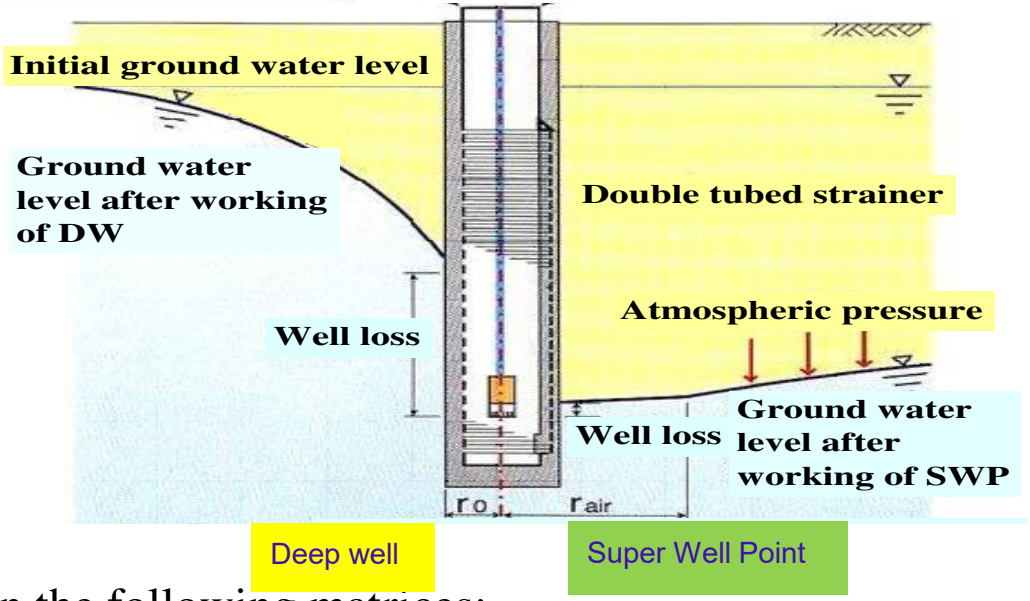
ADMINISTRATION-COLLABORATION-INNOVATION IN SYNERGY

Super Well Point (SWP)





The impacts and outcomes of ***SWP*** can be summarized in the following matrices:

	Impact		Outcome
Administration	Moderate	Sustainability	Moderate
Collaboration	Moderate	Survivability	High
Innovation	High	Buildability	High
		Livability	High

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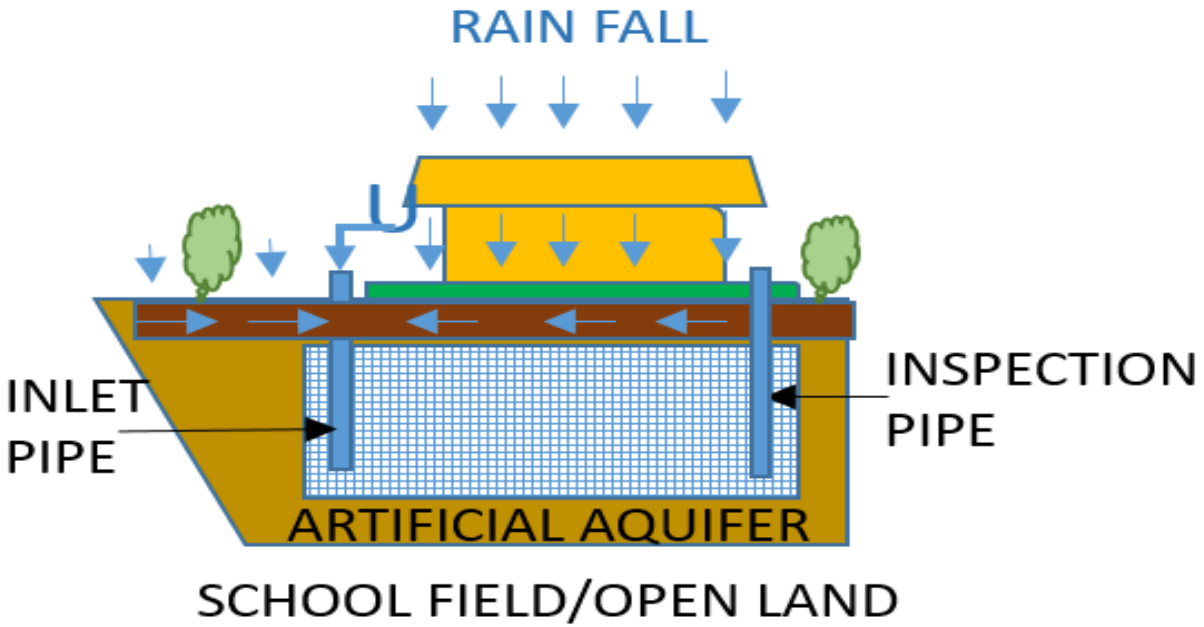
ADMINISTRATION-COLLABORATION-INNOVATION IN SYNERGY

Artificial Aquifers (AA)

Natural aquifers are geologically formed in porous sandy or rocky stratum allowing rainwater to infiltrate enabling long term underground storage. Many aquifers are **drying out** because of poor or **no recharge of rainwater**.
A **frugal innovation** to **create underground collection** even where devoid of natural porous stratum with replacement of **high strength** light weight **lattice modules** in the **ground artificially:**



*land above such system is **unaffected** in use loading capacity of **450 kN/m2***

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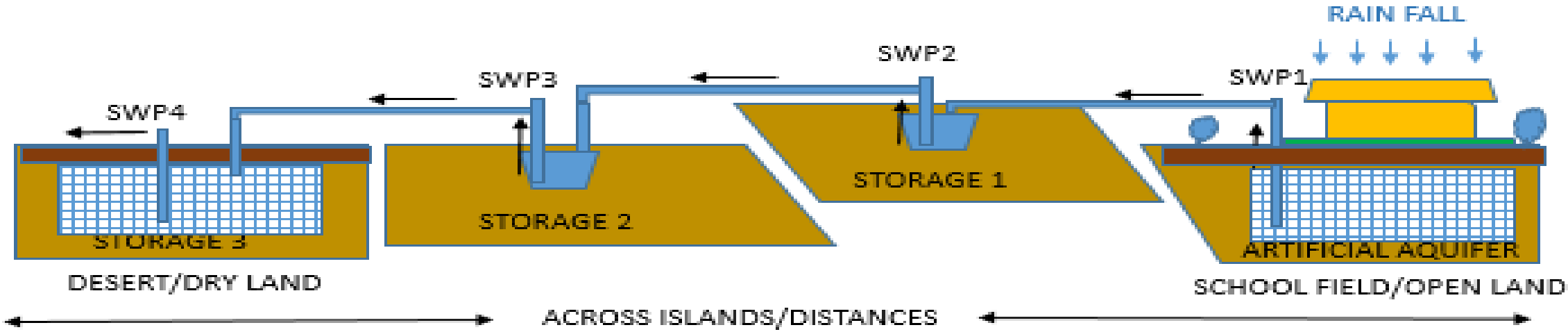
ADMINISTRATION-COLLABORATION-INNOVATION IN SYNERGY

Artificial Aquifers (AA)



The impacts and outcomes of ***Artificial Aquifers*** can be summarized in the following matrices:

	Impact		Outcome
Administration	Moderate	Sustainability	Moderate
Collaboration	High	Survivability	High
Innovation	High	Buildability	High
		Livability	High

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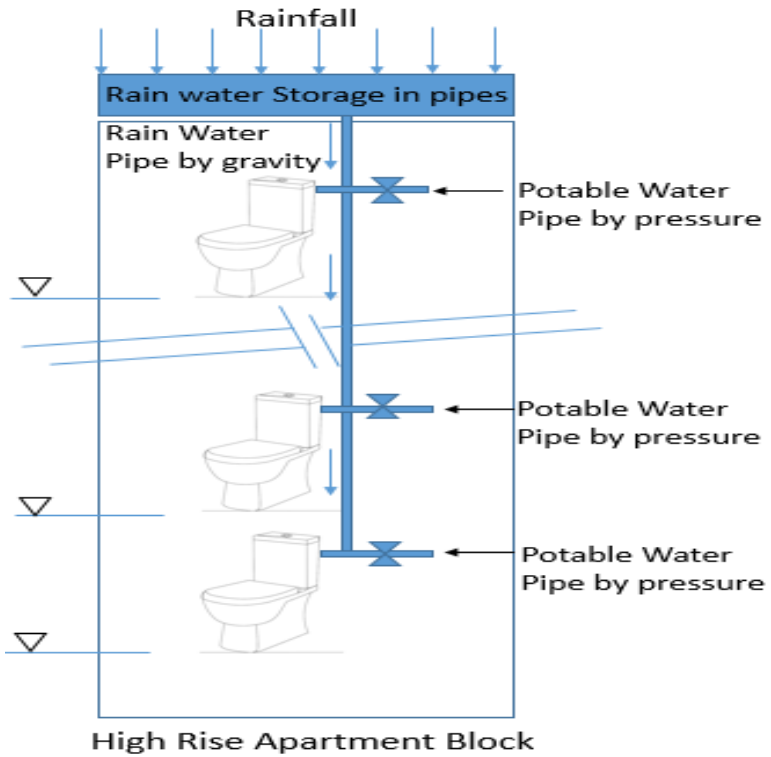
ADMINISTRATION-COLLABORATION-INNOVATION IN SYNERGY

Rain Water Harvesting (RWH)

A **100 ml of urine** is accompanied by **waste of 6 life blood litres** flush of precious water in the name of good sanitation



Each dweller wastes 5 X 4.5 litres = 22.5 litres/day
An apartment block wastes 100 units X 4 dwellers X 22.5 litres = 9000 litres per block/day = 9 m3 per block/day.

The **annual rainfall in Singapore** is about 2.5m.
Average roof top area for a block is about 1000m2.

Amount of rain water harvested on roof top = 2500 m3/block/yr = 6.8 m3/block/day.
Total rainfall can **save** 6.8/9X100 = **75% of good drinkable water**.

This **out-of-the box frugal innovation** does not cause cross contamination of water yet rain water harvesting at the **roof level** and piped directly by gravity to the toilets in a **close-loop system** is **free from mosquito breeding**

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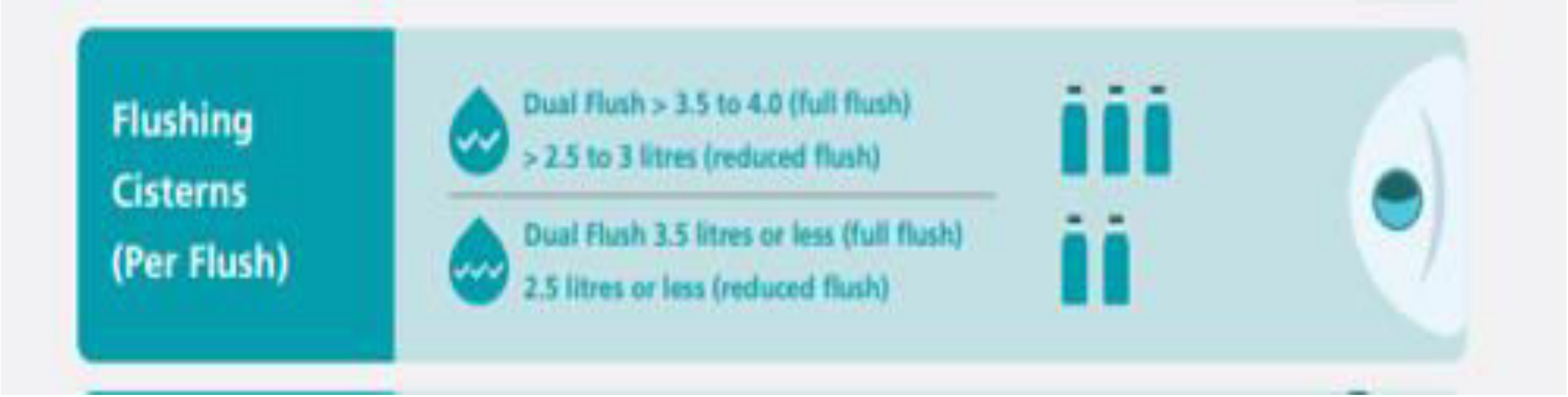
ADMINISTRATION-COLLABORATION-INNOVATION IN SYNERGY

Rain Water Harvesting (RWH)



The impacts and outcomes of *Rain Water Harvesting (**RWH**)* can be summarized in the following matrices:

	Impact		Outcome
Administration	High	Sustainability	High
Collaboration	Low	Survivability	Low
Innovation	Moderate	Buildability	High
		Livability	Moderate

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ADMINISTRATION-COLLABORATION-INNOVATION IN SYNERGY

Personalised App for Digital Water Counter (DWC)

The awareness of **precious fresh water footprint WF** must take its roots individually especially starting with the **youngsters**. **Individual personal WF** recording can inculcate to take **personal responsibility and ownership**.

The impacts and outcomes of ***DWC*** can be summarized in the following matrices:

	Impact		Outcome
Administration	Low	Sustainability	Moderate
Collaboration	Moderate	Survivability	Low
Innovation	Moderate	Buildability	High
		Livability	Low

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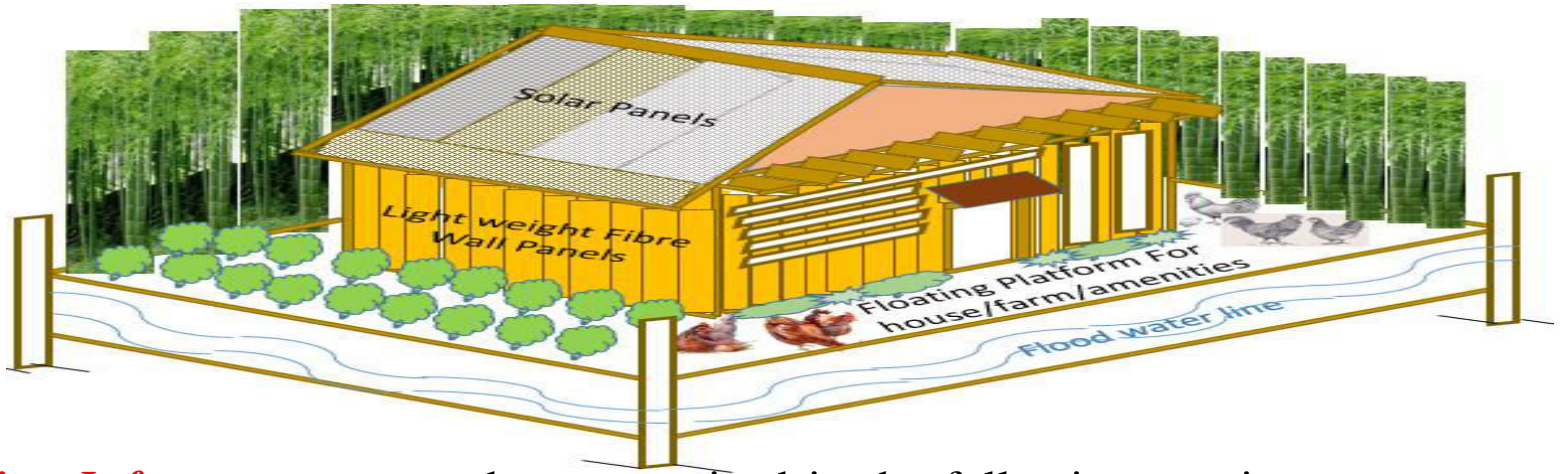
ADMINISTRATION-COLLABORATION-INNOVATION IN SYNERGY

Floating Infrastructures (FI)

The author has **intellectual property** in **Frugal Innovations** to create **low cost floating infrastructures** of "***floating houses, amenities, bridges and farms for sustainable growing and breeding***" to overcome flooding disasters. Floating farms by ancient Aztec in Mexico called ***Chinampas*** were in existence a thousand years ago.



The impacts and outcomes of ***Floating Infrastructures*** can be summarized in the following matrices:

	Impact		Outcome
Administration	High	Sustainability	High
Collaboration	High	Survivability	High
Innovation	High	Buildability	High
		Livability	High

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ADMINISTRATION-COLLABORATION-INNOVATION IN SYNERGY

Hydropower (HP)

Mini, micro and pico **hydro powers** could be installed along the water courses such as the perennial spring ground water, cascading water, channel water or even swale water are **sustainable free energy sources** as below.

a. Groundwater

b. Cascading water

c. Channel water

d. Swale water

Hydro Category	Power Range	No. of Homes Powered
Pico	0 kW – 5 kW	0 – 5
Micro	5 kW – 100 kW	5 – 100
Mini	100 kW – 1 MW	100 – 1,000

The impacts and outcomes of *Mini/Micro/Pico* ***Hydropower*** can be summarized in the following matrices:

	Impact		Outcome
Administration	Moderate	Sustainability	High
Collaboration	Moderate	Survivability	Moderate
Innovation	High	Buildability	High
		Livability	Moderate

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ADMINISTRATION-COLLABORATION-INNOVATION IN SYNERGY

Other Innovations

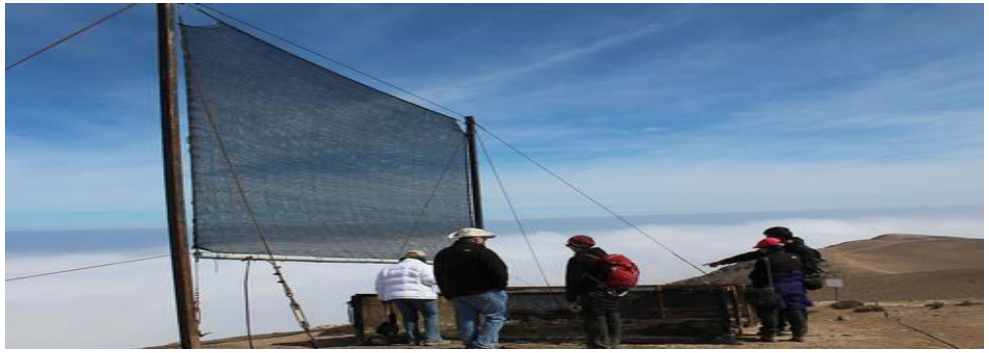
1. WateRoam (WR)

A Singaporean innovation has won the award cited by World Economic Forum as one of the 10 selected Top Innovators on the *Uplink Global Freshwater Challenge*

"***To improve the life, living and livelihood of every individual globally through clean water access***."

2. Freshwater from Air (FWA)

Generally, **atmospheric air** contains about **0.04% moisture** that is from evaporation of earth fresh water resources. The total amount of fresh water in the form of **vapour** is astonishingly huge at 12,900 km3 or 12,900 billion m3 or **12.9 trillion litres.** Fog or mist is water vapour at lower altitude and could be easily harvested for freshwater ***out of thin air***.



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COROLLARY

Positioning

The Administration (Adm), Collaboration (Col), Innovation (Inn) tri-factor **impacts** and the Sustainability (Sus), Survivability (Sur), Buildability (Bui) and Livability (Liv) **outcomes** for the above six frugal innovation solutions could be evaluated by **quantitative analysis**.

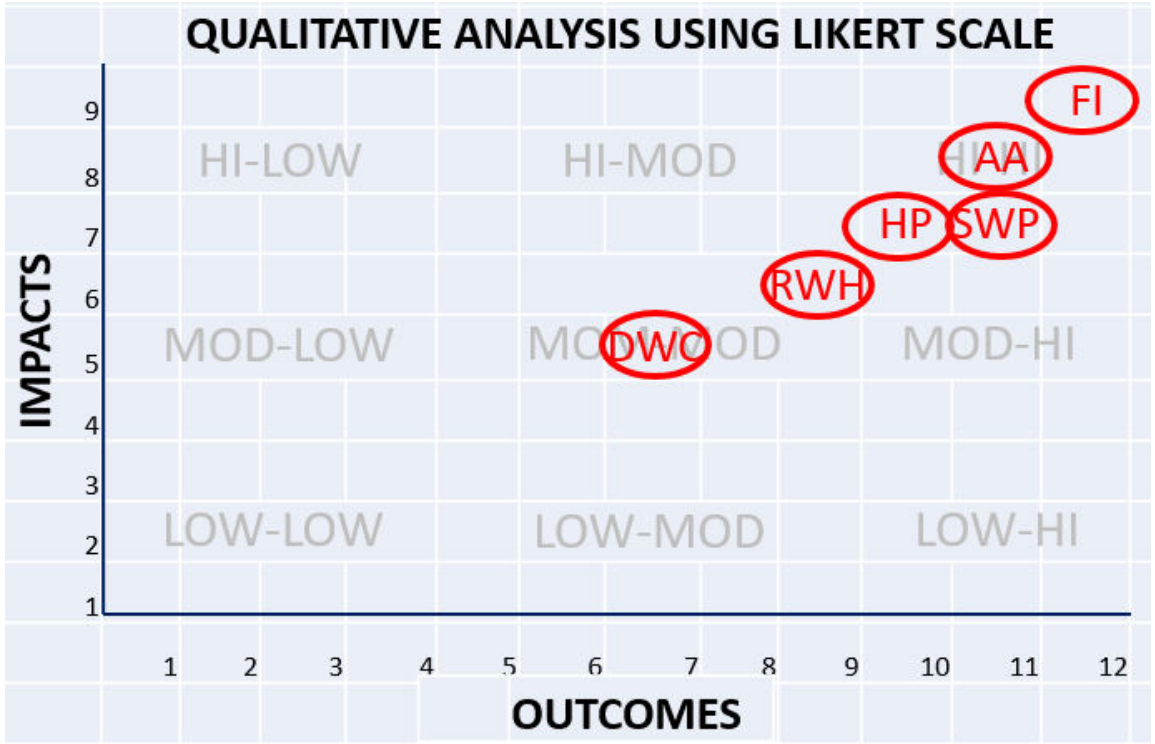
In assigning Low =1, Moderate (Mod) =2, High (Hi) =3, a **Likert Scale** for the each of the **impacts and outcomes** could be derived and compared.

Solution	Impacts			Total	Outcomes				Total	POSITION
	Adm	Col	Inn		Sus	Sur	Bui	Liv		
a. SWP	2	2	3	**7**	2	3	3	3	**11**	**HI-HI**
b. AA	2	3	3	**8**	2	3	3	3	**11**	**HI-HI**
c. RWH	3	1	2	**6**	3	1	3	2	**9**	**MOD-HI**
d. DWC	1	2	2	**5**	2	1	3	1	**7**	**MOD-MOD**
e. FI	3	3	3	**9**	3	3	3	3	**12**	**HI-HI**
f. HP	2	2	3	**7**	3	2	3	2	**10**	**HI-HI**

COROLLARY

Impact Vs Outcome matrix

The relative **positioning** of each solution in the **Impact Vs Outcome matrix** could be **graphically** shown below:



Hence, in **prioritizing** the solution on fresh water in the islands, the **order of decision** made could be as follows:

1. FI - Floating Infrastructure
2. AA - Artificial Aquifer
3. SWP - Super well point and HP - Hydro power
4. RWH - Rain Water Harvesting
5. DWC - Digital Water Counter

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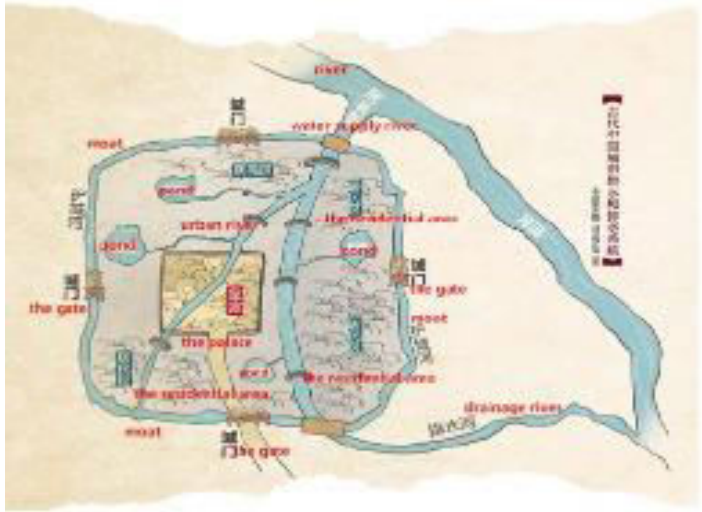
CONCLUSION

The Han Sewer System

Whether is continent islands or small state islands, the continuing **mantra of "*life-blood, life-long listening and learning*"** must **not be truncated** by any one selfish generation. We must continue to **evolve and involve** in **learning even from ancient civilisations** thoughtful **sustainable** water management systems.

There is one "***The ancient urban water system construction of China: The lessons from history for a sustainable future***" *paper on "**China 4000 years underground water system**".*



a. Ancient map of the Han system

b. Brick underground sewer

c. Part of Sewer inside

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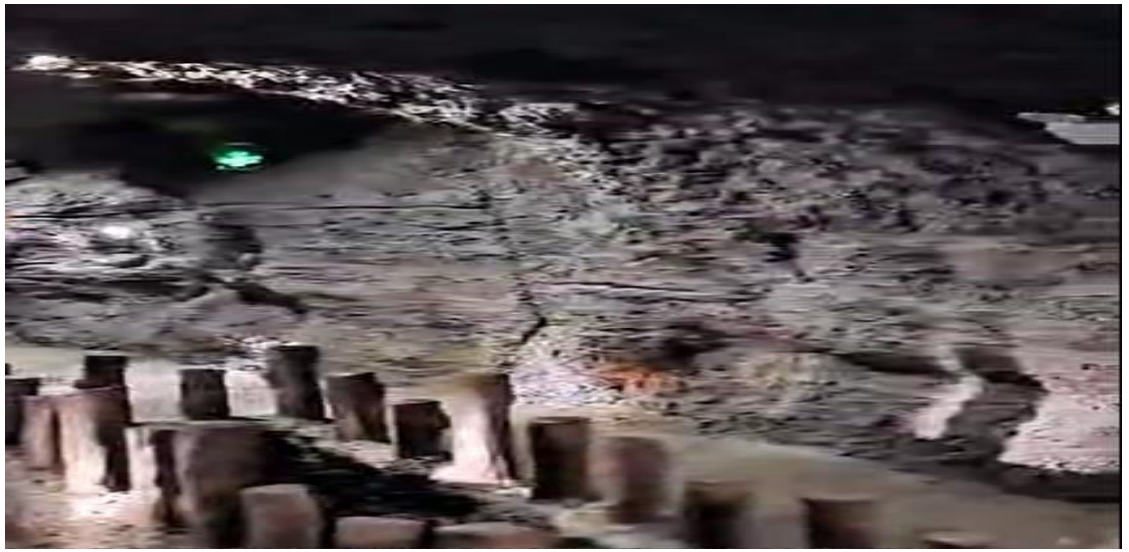
CONCLUSION

The Karez Well System

The **Karez Well System** is an important ancient irrigation system that is still used in Turpan, **Xinjiang**, in Northwest China. (Karez is the **Uyghur** word for '**well**', from the Persian for 'channel' **3000 years ago**.)

The tunnel system provides water for local people to drink as well as to water their crops. Locals dug wells and tunnels to transfer ***water from mountains miles away from their farmland***.

a. Layout of the Karez system



b. Underground tunnels and wells

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CONCLUSION

Fresh water foot print for Humanity

The **out-of-the-box Administration**, the **deep-root close-loop Collaboration** and the **back-to-basic frugal Innovation** were discussed in this paper of fresh water on islands.

Each of the **frugal innovation** solution better captures the value of fresh water on islands that can be replicated and applied globally on "***every drop of fresh water on islands counts for Sustainability, Survivability, Buildability and Livability***".

The ancient civilizations have shown the pathways for millenniums, it is at this **1st Island Congress at Faroe Islands** that our generation shall **refresh** to ensure

fresh water foot print on islands is **forever about humanity.**

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CONCLUSION

Thank you

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