CASE STUDY

Opportunities of Linking Environmental Accounting and Digitization through Blockchain

Water Cycles and Water Accounting

There is a growing need for the water sector to address global water scarcity and water quality challenges and to innovate new approaches within each and every entry point of the water management cycle in industry, agriculture, and communities—which should be aligned and synchronized with hydrological cycles. For example, water utilities face acute challenges at a local scale to meet the needs of growing urban populations. Therefore, costly centralized systems might not have the relevant capacity to enable a sustainable way forward, and if the predicted trend towards *decentralization and digitalization come true*, then blockchain technology will become a fundamental instrument in this new digital water world. The ESCAP secretariat, meanwhile, is training member states on how to develop and use water balance sheets[1] through water accounting. This knowledge is instrumental in water management decision-making at the city, industry, and country level, and is built on integrated water management approaches that mimic the natural water cycles. The challenges of a static excel sheets rich with data could be addressed through real-data management systems that use the capacities of an affordable and appropriate technology platforms. Generally, identifying intervention points for investment within water cycles can unpack enormous opportunities to accelerate progress towards the achievement of SDG 6 targets and could contribute to multiple SDGs of 2030 Agenda for Sustainable Development.[2]

Examples and Lessons Learnt from an Innovative and Forward-Looking Approach

The global severity of the water crisis demands innovation and, to innovate forward, human approaches should be built on the success of the nature's evolutionary processes.

[1] See more at ESCAP Statistics website at: https://www.unescap.org/our-work/statistics

[2] "How to ease financing the achievement of Sustainable Development Goal 6 to "Ensure Availability and Sustainable Management of Water and Sanitation for All." Japan Water Forum (2019). Water Journal, Volume 3, Page 8

1) In this regard, one prime example is the Amazon rainforest. The water vapor generated by evapotranspiration[3] from the trees of the Amazon rainforest contains high levels of deuterium,[4] which is a heavy isotope of hydrogen. In normal conditions, this isotope if left behind in the sea during the evaporation process. However, when originated from groundcover in the Amazon, the precipitation will always fall back down to the rainforest because the deuterium, being heavier, generates low atmospheric pressure and pulls down all low-level clouds.

- Modern cities can replicate this process. Currently, there are 3.1 trillion trees to 7.5 billion people globally for an average of 422 trees per person. Trees with the most leaves and highest evapotranspiration potential would be instrumental. The leaves can also act as interceptors, catching the falling precipitation and, thus, increasing evaporation losses, causing more cloud formation. Also, interceptors decrease the rate in which water enters drainage systems, increase their capacity to deal with the overflow. Not only will urban rainforests create natural water, but they will also create more clean air in areas with high concentrations of leaves through the absorption of carbon dioxide and toxins and the release of oxygen.

- Some water cycles are impacted by deforestation. Forests can prevent droughts and, thus, water scarcity. In the time it takes to grow a new tree, it will not produce enough leaves to replace the lost evaporation ratio. Furthermore, it is also important that we become more aware of the true value of water and not treat it like an infinite resource. By 2025, an estimated 1.8 billion, or 1 out of 4 people, will be residing in water scarce regions. Statistics reveal that human's personal water usage only accounts for 8 per cent of the world's freshwater. Agriculture, meanwhile, dominates with 70 per cent of total consumption—the majority of which is used to maintain livestock.

Picture 1: Innovative Clean Water Solutions. Source. Photo credit: Leilah Clarke

[3] Evapotranspiration is an invisible process where water vapor is released from small pores on the underside of leaves, a byproduct of photosynthesis, and subsequently evaporates (note of the author)
[4] Deuterium is a chemical element, heavy isotope of hydrogen, which has one proton and one neutron (note from the author)

2) In 2011, Bangkok experienced a severe flood, which devastated the airport. Some plateau flat lands were spared because of proper computing and calculation in irrigation engineering. Complete formatting was thought out ahead of time at the planning stages of lakes, drainage, and pump back areas. Flood areas might have otherwise become contaminated with sewage.

3) Bearing these facts in mind, in 2015, the company AD NANO funded the "Water for Life" project in Iloilo, Philippines. This "water catchment", or water harvesting, project collects rainwater, which would normally result in flooding the campus of Iloilo National High School when left unattended. While working with the city government, the team constructed a drainage system that would connect the catchment to the Iloilo River, where the water would drain out. The rest of the once-flood zone was re-landscaped with the proper plant and tree species for the area and the remainder was complemented into a garden.

   - Through implementation, an awareness was developed for upland water systems and rigorous collection and sanitation of stormwater. This is necessary to ensure water quality and flow.
   - Wetland restoration takes into consideration the ecosystem services of habitats and guards against future floods and sea-level rise.

Towards Sustainability: A Way Forward

Currently, awareness and system build up around the interdependency of the water, food, and energy nexus remains critical. This includes the application of science and technology, combined with new knowledge obtained from private science centers, such as by SOL and AdNano in Thailand and others worldwide.

Urban design will need to be more efficient and include a variety of ready technologies that can improve the quality of natural resources such as water, soil, and air. Design principles should include rainwater cleansing, instead of a gutter system, and an absorbent rain garden with overflow collected and filtered into a basin for reuse as seen in the case of the Water for Life project. Parks and infrastructure can be designed with measurements made for water percolation through the soil and for the recharge of the water table—using a water accounting approach. The design of hydroponics, aeroponics and drip irrigation systems that utilize vertical space efficiently will need be implemented into urban and sub-urban farming alike.

This requires AI, big data, and the appropriate technology and financing. Financing services are also needed for data collection and monitoring, especially using modern smart technologies, taking advantage of what GIS mapping technologies and Earth Observations technologies offer. Decentralized applications of enterprise blockchain solutions and various developer tools are also being explored for development and offer a lot of opportunities.

Choice of Technology: Advantages of Blockchain 3.0

With the water sector moving towards smart city integration, internet of things (IoT), artificial intelligence, and the data economy, blockchain technology can provide a future-proof, integrated foundation for water utilities. Currently in IoT systems, all data goes to a single point of security intelligence, which is vulnerable to possible manipulation and hacking.

Blockchain removes this single point of failure in an IoT system, by enabling device networks to protect themselves in other distributed ways. The collaboration between *blockchain* and *IoT water network* changes the way we manage water, without compromising our safety.

The introduction of sensors and big data usage by utilities require data reliability, accessibility, and analytics which can partly be managed via blockchain systems. Digitizing asset management can be made more reliable with *this distributed ledger technology.*

Smart sensors can communicate with each other to identify unusual water consumption, leakages, and pressure. The system can help review and oversee water consumption clearly, helping with changes in behaviors, leading to great savings. Integration to mobile devices, for real-time active monitoring, alerting someone immediately if there is a water leak when homeowners are away is also feasible.

The possibility extends to shutting down the main water supply automatically, preventing further damage due to irregular pressures. Open data systems can help set up a basis for trustworthy utilities and blockchain can increase the speed.

Therefore, *blockchain as a technology* should be considered as a core component to the integration of the water sector within operations across utilities, cities, and basins to address the key challenges encountered in the 21st century, not only in high but low-income countries.

Three functional levels of blockchain technology that the project can utilized for development purposes:

1. The first level is the *storing of digital records in a controlled, secure, auditable and immutable way,* not simply of transactions but also of *digital representations of physical assets, such as a utility's water quality data.* By providing a common record of information relating to customers, blockchain allows companies to immediately access information and updates relating to client profile sheets, whether they are changes in address, payments, or water usage. This would all be stored internally and securely to improve customer service. Identification blockchain would enable utilities to securely and efficiently manage digital identities and private information while increasing transparency around their use of data and compliance with regulations.

2. The second level is *the exchange of digital assets* where people can transfer ownership in real time without the need for banks, stock exchanges, or payment processors. This can help mediate payments between producers and consumers, as well as record exact exchanges of water resource assets (first level) and payments through new digital financial systems like cryptocurrencies.

3. The third level is the execution of smart contracts which are contracts written in code to automate the rules, conditions, expiry dates and any other necessary information that are embedded in a blockchain and automatically execute when the conditions are met. Smart contracts allow

businesses to reduce the time spent on paperwork, enforcing contracts, and interacting with third parties. The terms of the smart contract are recorded into the code and subsequently implemented consensus through the shared network which monitors compliance and verifies the outcomes without the need of an intermediary. This includes payments to contractors wherein a smart contract would be possible for contractors only if it determines the business has enough funds to pay for the requested services.

Another example of the use of blockchain based smart contracts *is the trade of water rights in water markets*. This aids utilities, cities, and local authorities to reduce the cost of operations and with the demanding pressures on utilities to generate more with less, blockchain can help reduce costs by removing intermediaries and the expensive transaction fees that these entail, promoting transparency and leading to better citizens engagements. The most successful water utilities implementation will be dependent on the invisibility of seamless and user-friendly integration across all the digital water technologies, making it the final drop in water disruption.

In summary, these experiences indicate that universal sustainable management of water and sanitation services can be attained if local, nature-based solutions and decentralized water management systems are incentivized.

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