

CLIMATE CHAINED

BY ALEXANDER LEE

As rising seawaters lap at their feet, citizens of the island nation of Tuvalu are experimenting with digital nationhood to preserve their identity and independence.





MOTORBIKES ARE the main mode of transportation on Funafuti, where most Tuvaluans reside. A shack sits near the water's edge in Funafuti, which is just a third of a mile at its widest point. Part of Tuvalu's digital transformation would be the replacement of its national currency with a virtual token, like bitcoin.

T

alk to anyone in Tuvalu, a 420-mile-long chain of coral islands located about halfway between Australia and Hawaii, and you will soon learn that the nation is sinking beneath the waves. It's a common topic of discussion among residents of Tuvalu, a specter constantly looming over the island nation's 10,000-odd citizens. In a country whose total area is roughly a quarter of Disney World's, spanning less than a third of a mile at its widest point, it is impossible to avoid the sight of the ever-encroaching ocean.

Technically, though, Tuvalu isn't sinking. Rather, rising sea levels fueled by climate change threaten to subsume the country, whose average elevation is only 6.5 feet above sea level. In fact, Tuvalu might be at greater risk of flooding than any other nation in the world. The average sea level surrounding the capital of Funafuti, a ring-shaped reef that harbors more than 6,000 citizens, has risen by over half a foot in the last 40 years. That might seem small to people at higher elevations, but in places like Funafuti, it means significant swaths of land that once jutted just above the water have vanished in a matter of decades.

Victoria Keener, a climate change research fellow at Honolulu's East-West

Center, says the projections for Tuvalu are consistent with the global average for sea-level rise, as rising global temperatures continue to melt ice sheets and glaciers into the world's oceans. "They're seeing their annual mean temperatures go up [and] their nighttime temperatures not going as low as they used to," Keener says. "So they're seeing more warm nights, more extremes, and then more intense tropical storms."

The Tuvaluan government has a grimmer view. "It is possible that, in 50 years' time, Tuvalu will still be there," says Karlos Lee Moresi, Tuvalu's former secretary of finance currently working as an advisor for the Pacific Islands Forum. "But in 100 years' time, it will

be underwater. That is the best-case scenario."

And while Tuvalu itself is shrinking, its population is rising. As a result, about 10 percent of Tuvaluan citizens live abroad, toiling on merchant ships or in phosphate mines in the nearby island nation of Nauru to send funds to their families back home. This phenomenon highlights another consequence of climate change for Tuvaluans: decreasing opportunities for domestic work. As far back as 2011, a *New York Times* report attributed the decline of Tuvalu's agriculture industry to increased flooding and soil salinity caused by rising sea levels. With more citizens and fewer job opportunities, many Tuvaluans have left

the islands to make a living. Funafuti is the location of the country's only hotel, airport and hospital, but within a century, there might not be enough citizens to justify even these basic services.

George Siosi Samuels is one product of this emigration. Raised in Australia by a Fijian-Indian father and a Tuvaluan-Samoan mother, Samuels has never set foot in Tuvalu. Instead, he grew up listening to tales of his homeland. "My mom always made sure that we knew where we came from," he says. Accordingly, a strong desire to preserve Tuvalu's culture has always guided Samuels' work. In 2008, he produced *Tales from Nanumea*, a series of short animations depicting traditional stories from Tuvaluan mythology. The first episode, "Pai & Vau," tells the story of the legendary warrior Tefolaha, who conquered the Tuvaluan island of Nanumea and is purportedly an ancestor of its leading families. "My family, we've all migrated to multiple different countries seeking a better life," Samuels says. "They don't require this of me, but I feel a sense of responsibility to give something back with the education and the life that I've been given."

Now an entrepreneur and blockchain expert, Samuels is working to help his ancestral homeland once again. This time, he hopes to aid Tuvalu in embracing emerging technologies that could allow it to survive as a digital nation

— and enable its citizens to maintain their cultural heritage — even if its islands are consumed by the waves.

WHEN SAMUELS READ a December 2019 *Washington Post* article about Tuvalu's authority over its online domain name, his curiosity was piqued. The URL-ending country code ".tv" was assigned to Tuvalu in 1996 for in-country use, much like Britain's .uk. Its chance similarity to the abbreviation for "television," however, would make it an unexpected economic asset; today, Tuvalu earns about 10 percent of its gross annual income by licensing its domain to tech companies. But the story made Samuels — whose Singapore-based company, Faiā, helps local communities acquire and adopt emerging technologies — realize that he could leverage his technical expertise to help Tuvalu step into an even more digital future.

Inspired by the *Washington Post* piece, Samuels self-published an article titled "A 5-Point Plan to Future-Proof Tuvalu" on Jan. 1, 2020. Samuels' article included a list of policy proposals centered around the potential benefits of blockchain technology. A blockchain is a

computer-to-computer network created by encrypted chains of digital records, or "blocks." These chains are then copied and distributed across every computer participating in the system, with each block in the chain containing information about those preceding it. This makes it nearly impossible to modify a part of the chain without completing the herculean task of altering the data in every subsequent block. Imagine a lock that can only be opened if thousands of keys are turned simultaneously; now imagine that a locksmith is constantly adding new keys to the set.

This decentralization and egalitarian data-sharing make blockchains highly resistant to corruption or modification, says Samuels, ideal for systems such as banking and government record-keeping. Tuvalu, Samuels wrote, could use this technology to undergo a digital transformation that would drastically

improve the country's internet infrastructure and help its economy go cashless, putting its government in a stronger position to continue operating if it's eventually uprooted.

When Samuels authored his five-point plan, he had no idea how quickly it would find its way into the hands



GEORGE SIOSI SAMUELS, entrepreneur and blockchain expert, hopes to "future-proof" Tuvalu by helping the country go digital.

PREVIOUS PAGE: ROMANE W/SHUTTERSTOCK; THIS PAGE: TODD HENRY (2)

FROM TOP: TON KOENE/ALAMY; JYOT BHALLA



TUVALU'S TOP DIPLOMAT, Simon Kofe, is welcomed by members of the local government in Nanumea, the country's northernmost island.

of the Tuvaluan government. “I put it out to my Facebook network,” Samuels says, “and almost all Tuvaluans are on Facebook.” The article rapidly went viral in Tuvalu — as viral as anything can go within a population of just above 10,000 — and eventually reached Timi Melei, a member of Tuvalu’s parliament and distant relative of Samuels. Melei shared the article with his colleagues, and the Tuvaluan government soon invited Samuels to join its newly formed Information and Communications Technology Task Force. Its mission: to determine how to preserve Tuvalu’s culture, maintain its economic assets, and enable the country’s government to conduct many of its functions digitally using the blockchain.

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THE FIRST STEP OF TUVALU'S REBIRTH IS THE DEVELOPMENT OF A DIGITAL NATIONAL LEDGER THAT WOULD EXIST ON THE BLOCKCHAIN.

THE IDEA OF a digitized nation is not exactly new. In 2014, Estonia announced the formation of “e-Estonia,” a system that allows individuals outside the nation’s physical borders to digitally vote, pay taxes, and do business within

Estonia without ever visiting the country. By all accounts, e-Estonia has been a success: In March 2020, it helped the Estonian government keep almost all of its services running continuously despite a pandemic lockdown, mitigating some of the impact of COVID-19 on the country. Still, Tuvalu’s recent efforts represent one of the first experiments with digital nationhood based entirely around the blockchain. The first step of Tuvalu’s rebirth is the development of a digital national ledger that would exist on the blockchain, thereby streamlining the processes of requesting Tuvaluan citizenship, for example, and maintaining a list of citizens. If this succeeds,

Tuvalu has its eyes on a slew of other potential uses, including the replacement of Tuvalu’s national currency with a virtual token built on the framework of bitcoin or another pre-existing cryptocurrency — though this stage of the initiative will happen far down the line, if at all. “For us, it’s an amazing use case,

because we can use blockchain technology to create this digital form of money,” says Simit Naik, director of commercial and strategy at nChain, a Swiss-based blockchain development and data integrity company aiding in the effort. “We can make it easier for the national bank, or individuals, to send money back and forth. It also makes sure that the national bank can see where money is [and] how much is circulating.”

If Tuvalu is eventually swallowed by the sea, its blockchain-based national ledger will also act as a back-up plan, preserving its statehood and independence for future generations. Though its government is committed to combating climate change, Minister for Justice, Communication, and Foreign Affairs Simon Kofe says that in the long run, the sinking of Tuvalu may be inevitable. If that happens, he says, the nation will be able to use this blockchain ledger to maintain its sovereignty and “secure ownership of [its] exclusive economic and maritime zones.”

Unlike Estonia, Tuvalu is not merely investing in a digital infrastructure to supplement the culture and economy within its physical borders. Tuvalu’s conversion to a blockchain infrastructure

can also be considered an act of survival, a preparation for a future in which entire nations can exist solely on the web, their sovereignty granted by the blockchain rather than geographic claims. “There are still economic resources [and] natural resources around the maritime boundary that can benefit Tuvalu’s citizens wherever they may be,” Moresi says. “Technology provides the opportunity to continue [Tuvalu’s] existence.”

Preserving Tuvalu’s sovereignty is not the only potential benefit of restructuring the country’s national infrastructure around the blockchain. Samuels envisions a future in which much of the “data” that makes up Tuvalu’s cultural identity — books, art, cultural traditions, and so on — is digitized and safeguarded on the blockchain. “We know that blockchain and bitcoin is very much all about the value of data itself,” he says. “If we can start that process of digitizing a lot of what Tuvalu has, and then digitizing all of this other information around citizens while allowing them to have ownership over their own data, it becomes very interesting.”

DESPITE THE POTENTIAL of its digital rebirth, Tuvalu hasn’t always

prioritized its own best interests when working with outside companies to harness new tech. The Virginia-based network infrastructure company Verisign continues to pay Tuvalu about \$5 million a year through its agreement to oversee the nation’s .tv domain name. But in a 2010 interview with Radio New Zealand International, Tuvalu’s then-minister for finance, Lotoala Metia, described Verisign’s annual payment as “peanuts” compared to what he believed the company was earning through the agreement.

As was the case for .tv, Tuvalu’s blockchain infrastructure initiative will also require some assistance. Along with Samuels’ company, Faiā, the project is administered by nChain and Elas Digital, an Australian software engineering company. “We don’t really see it as a technology project — we see it as a socioeconomic transformation project,” Naik says. “And everything that we’ve done to date has been to focus on what is it that [Tuvaluans] need.”

There are valid reasons for Tuvalu to approach this deal with caution. Past attempts to bring blockchain technology to disadvantaged nations haven’t always gone smoothly. The government of El

Salvador, for example, decided in June 2021 to adopt bitcoin as legal tender, sparking protests among citizens who felt their data was being collected and used against their will by blockchain firms. Pete Howson, a senior lecturer in international development at Northumbria University in the U.K., describes this phenomenon as “crypto-colonialism.” “Blockchain developers need to make sure they’ve got popular consent to intervene in people’s lives,” Howson says.

And, as groundbreaking as it is, Tuvalu’s push to develop a national blockchain infrastructure is not without its skeptics. As blockchain has become increasingly widespread, some observers have pointed out that these transactions require significantly more energy than normal computing. According to Christophe Schinckus, director of the business school at the University of the Fraser Valley in British Columbia, a single bitcoin transaction uses as much energy as an average American family over 58 days. The irony of this contradiction is not lost on Schinckus. He points out that most blockchain transactions use fossil fuels and take place in nations far from Tuvalu, like China and the U.S.

MARIO TAMAYO/GETTY

MINISTRY OF JUSTICE, COMMUNICATION AND FOREIGN AFFAIRS/GOVERNMENT OF TUVALU



IN TUVALU, where the average elevation is only 6.5 feet above sea level, rising seawater means that parts of some islands will be washed away, and others will be virtually uninhabitable.



TUVALU'S LIMITED landmass makes it incredibly difficult to manage excess waste and plastic. Trash is often dumped in "borrow pits" like those above, and poses significant environmental and health hazards.

"At the end of the day, it might contribute to the higher temperatures that might put Tuvalu below the sea," he says.

Schinckus is a firm believer in the potential of blockchain technologies to improve Tuvalu's national infrastructure. "The idea, generally speaking, is very good," he says. His skepticism stems from Tuvalu's use of what's known as the "proof of work" blockchain protocol. Under this protocol, when a new block is added to the chain, every computer in the system races to confirm the legitimacy of the transaction, ensuring that the chain remains incorruptible. This process uses immense amounts of energy, particularly when compared to other protocols like "proof of stake," which instead uses a defined set of rules to randomly determine which computer verifies the transaction.

But proof of stake's randomized, roulette-wheel approach makes it inherently less decentralized — and thus less secure — than proof of work, Naik says. For a nation like Tuvalu, this extra layer of security is critical. "If we can't guarantee the integrity of data, then the solutions we build are just of no value," Naik says. "And so, in order for us to guarantee integrity of data, we have to use proof of work." NChain's technology is built on the less-carbon-intensive BitcoinSV network; according to data

provided by the company, the platform uses 218 times less electricity per transaction than the more widespread Bitcoin Core network.

Tuvalu's government is well aware of the energy consumption costs of proof of work blockchains. "There are other projects we're looking at that hopefully can address that," Kofe says, including a plan to generate renewable hydrogen energy from seawater surrounding Tuvalu. Plus, in addition to investing in renewable alternatives, Samuels says that the proposed blockchain conversion will also save energy by reducing unnecessary expenditures caused by corruption and inefficiencies in Tuvalu's national



infrastructure. "Corruption costs the world billions, right?" he says.

Still, Schinckus remains skeptical about Tuvalu's ability to mitigate the increased energy consumption of a blockchain infrastructure, though he believes it will ultimately make the nation more efficient and competitive overseas. "They will save themselves from climate change from an economic perspective, yes," Schinckus says. "But from a global climate change point of view, no." Even if Tuvalu's new blockchain infrastructure helps its government outlast the encroachment of the Pacific, the uptick in energy costs required would directly fuel the country's impending fate.

IT MIGHT SIMPLY be too late for Tuvalu to worry about its own contributions to climate change. After all, the rising seawaters that threaten to drown Tuvalu are not really the South Pacific island nation's fault: China, the U.S., and the European Union alone belch 41.5 percent of global emissions responsible for climate change into the atmosphere. In 2002, Tuvalu went so far as to threaten a lawsuit against the U.S. and Australia for their roles in advancing climate change. (So far, the island nation has not yet gone through with the suit.) Compared to these behemoths, Tuvalu's

energy use is a drop in the bucket, even if it were to convert to a fully blockchain-based infrastructure. Perhaps all it can do is give itself a fighting chance to exist in a hundred years, whether or not its physical islands remain above the waves.

Keener, the climatologist, believes the people of Tuvalu may simply adapt to life in a partially submerged world. Moving furniture to their roofs on flood days, capturing rainwater, and breeding more salt-tolerant varieties of staple crops are some of the changes that Tuvaluans could make to avoid evacuating their homeland. Keener points to the example of Ubay Island, a tiny isle in the Philippines that was partially flooded during an earthquake in 2013. Since then, many residents have remained, building elevated walkways between houses even as seawater regularly covers their floors. "I feel like people are always going to adapt in order to stay in the places they love and call home," she says.

Plus, while sea level rise continues to threaten Tuvalu's existence, not all of its islands have been impacted equally. Over the past four decades, only one of the country's 101 islands has been entirely eroded, whereas 73 have seen a net increase in land mass, according to a 2018 study in *Nature Communications*. The study authors suggest that these inconsistent patterns of change may

stress Tuvaluans into resettling to less-low-lying islands.

Either way, adopting a blockchain infrastructure doesn't just give Tuvalu a chance to survive beyond the ravages of climate change — it may also help the world's fourth-smallest country punch above its weight as a technological innovator on the international stage. "Part of what we would like to do at nChain, alongside Faiā, is to take the learnings from Tuvalu and start looking at a Pacific-wide strategy," Naik says. Tuvalu may be the first country to undergo such a drastic digital transformation, but Naik believes it won't be the last, giving its government an opportunity to lead the world into a new era of techno-sovereignty.

With the first phase of Tuvalu's transformation complete, the second is now in full swing. As of late 2021, government officials have been continuing to coordinate with Samuels' company, Faiā, as well as nChain and Elas Digital to develop and implement a blockchain digital ledger to support Tuvaluans scattered across the Pacific and beyond. If this succeeds, more changes, such

as Samuels' proposed conversion to a cryptocurrency economy, are likely to follow.

Much like Samuels, Kofe believes strongly in Tuvalu's digital future. Though the project still requires formal approval from the Tuvaluan government, he is more than willing to lead

the charge. And despite blockchain technology's hefty environmental toll, and the inherent uncertainty that comes with collaborating with outside companies, Kofe believes Tuvalu must take this kind of gamble to ensure its survival. "It's not clearly defined what the criteria is for statehood," Kofe said. "We're trying to get other states to recognize that countries like Tuvalu, if we do go underwater

or we're forced to relocate, would still be able to maintain our identity on the international plane." Tuvalu may be the world's fourth-smallest country, but its diminutive size means it might just be nimble enough to outmaneuver the rising tides that threaten all of us. ▣

Alexander Lee is a writer and reporter based in New York City.

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KEENER, THE CLIMATOLOGIST, BELIEVES THE PEOPLE OF TUVALU MAY ADAPT TO LIFE IN A PARTIALLY SUBMERGED WORLD.

FROM TOP: ASHLEY COOPER/ALAMY; THE ASAHI SHIMBUN/GETTY

TODD HENRY