

## Chapter 5

# A Critical Analysis on the Capacity of Blockchain-Based Parametric Insurance in Tackling the Financial Impact of Climatic Disasters

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### Abstract

Disaster insurance – such as parametric and microinsurance – are emerging financial products to mitigate the socioeconomic impacts of climate disasters. Yet, there remain major hurdles to its extensive adoption. The main barriers include inefficient claim administration, as well as the lack of transparency of insurance products and the respective data. Therefore, insurance providers have been reluctant to invest in scaling these products and roughly 70 per cent of all losses today are uninsured.

This study by the Blockchain Climate Institute (BCI) has shown that implementing parametric insurance on the blockchain can overcome efficiency and transparency gaps, and hence can scale up insurance penetration, especially in developing countries. Blockchain-based parametric insurance achieves this through disintermediation: it removes inefficiencies by automating the entire insurance cycle; and it increases the transparency of insurance data with secure, immutable distributed ledgers that transfer and aggregate data, and make that data publicly available.

Insurance uptake can also be improved through the easing of access to policies and claim pay-outs via mobile phones and mobile banking wallets. Private and public keys can be used to provide proof of cover and authenticate the validity of the policyholder, without the need for on-the-ground distribution of insurance products. Nevertheless, there are also barriers to the roll-out of blockchain-based parametric insurance (BBPI), including the lack of data, poor design, different regulatory approaches to insurance provider licensing and the potentially huge costs associated with the setting up of oracles. These can be resolved through continued research and development and collaborative approaches to regulation, such as the development of regulatory sandboxes.

### 5.1 Insurance for climate resilience

Climate disasters impact all countries and aspects of development: economic, social and environmental; with far-reaching effects, unprecedented in scope and scale. Evidence suggests that disasters like droughts, heat waves, floods, hurricanes

and wildfires have already increased or intensified over the last few decades due to climate change (V20 2015). Such phenomena translate into financial damages, equalling US\$181 billion annually today, with developing countries bearing a disproportionate burden – approximately US\$65 billion, or roughly 2.5 per cent of their gross domestic product (GDP) (Buhr et al. 2018). The Intergovernmental Panel on Climate Change (IPCC) has confirmed that a 1.0°C increase of warming has occurred, and it estimates a 1.5°C increase is likely *'between 2030 and 2052'* (IPCC 2018).

These societies are likely to become more vulnerable in a warming world. According to the Global Climate Risk Index (Kreft et al. 2015), the Vulnerable Twenty (V20) group of developing countries, such as small island developing states, least developed countries and African countries (Yamineva 2016), are most vulnerable and are most at risk to suffer weather and climate-related losses (UNISDR 2018). When considering V20 contributions to climate change being merely 2 per cent, by 2030, they will probably have absorbed more than half of the attributed economic cost (V20 2015; Tol 2018).

One such climate disaster was the 2011 monsoon season, which caused widespread damage across Thailand, Vietnam and Cambodia. More than 800 people died, 85 per cent of Thai provinces were declared flood disaster zones and over 20,000 square kilometres of farmland damaged (Holzheu and Turner 2017). Disruptions in business supply chains led to a shortage in components for electronics, vehicles and other goods. Total losses estimated by the World Bank amounted to US\$47 billion, of which less than 8 per cent was insured (Holzheu and Turner 2017). These floods can be linked to the increasing frequency of El Niño events that continue to impact food production by torrential rainfall, leading to landslides and waterlogging that kills crops and inundates infrastructure (Thirumalai et al. 2017).

Disasters like these represent the physical risk of climate change: the socioeconomic damages linked to the increased frequency and severity of climate- and weather-related events (Dafermos et al. 2018). The United Nations International Strategy for Disaster Reduction shows that from the period 2005–10, *'over 700,000 people have lost their lives, over 1.4 million have been injured and approximately 23 million have been made homeless as a result of disasters'* (UNISDR 2015). Climate change will only exacerbate both the frequency and impact of disasters by 130 per cent at 1.5°C and 340 per cent at the 2.0°C warming levels (Kharin et al. 2018). This will be potentially devastating for V20 countries, which are the least-resourced to adapt to such increasing risk and to fund independent recovery efforts (Fernandez and Schäfer 2018).

## 5.2 The 'protection gap'

Insurance can play a major role in offsetting negative financial impacts when disasters strike. It reduces risk exposure; increases financial resilience for individuals; mitigates the socioeconomic effects of climate change across communities; and assists countries in recovering from natural disasters. While insurance can speed up post-disaster recovery, up to 70 per cent of catastrophic losses caused by extreme weather events

over the last decade were uninsured. This is known as the ‘protection gap’ (IAIS 2018), which ClimateWise, a global network of 28 insurance organisations (Actuary 2017), estimates to be US\$1.7 trillion over the decade. For example, only a fifth of homeowners in the Greater Houston area had flood cover when Hurricane Harvey struck in August 2017, exacting US\$70–90 billion in damages (Lloyds 2018). Insurance coverage is even lower in The V20 – approximately 4 per cent – with Vietnam and Bangladesh, with less than 1 per cent, ranked the lowest for insurance penetration (Holzheu and Turner 2017). This leaves them highly exposed to climate disasters. When 2009 Typhoon Mirinae hit Vietnam, catastrophic flooding followed, causing US\$280 million in damages, of which only 3.6 per cent was insured (UNDP 2017).

When climate disasters strike countries with low insurance penetration, a decline in economic output and an increase in poverty follows. In Bangladesh, annual flood damage causes a 0.8 per cent reduction of the country’s GDP (Holzheu and Turner 2017). In Peru, from 2003 to 2008, climate disasters increased poverty rates by 16 to 23 per cent (World Bank 2016).

The protection gap is expected to get worse over the coming years, as the frequency of severe weather events increases. As a result, the majority of insurance shortfall is so far covered by governments, civil society, or borne by the individuals or corporations affected. In recognition of the changing risk landscape and ‘protection gap’, InsuResilience was formed at Conference of the Parties (COP) 21, aiming to provide coverage for 400 million people across the V20 countries by 2020 (MCII 2015). As Maurice Tulloch, chair of ClimateWise puts it: *‘The climate risk protection gap presents insurers with one of our industry’s most profound challenges, but the cost of extending sustainable insurance cover is simply not affordable in many places’* (Actuary 2017).

The United Nations Sendai Framework for Disaster Risk Reduction cites financial protection as a key element of building resilience to disaster risk through 2030 (UNISDR 2015). Yet, there are significant challenges when it comes to addressing the protection gap across the V20. The cost of insurance is prohibitively high (Observer 2017). Nearly half of the citizens of V20 countries live in extreme forms of poverty, i.e. living on US\$1.25 or less a day. On the demand side, many individuals neither have the ability to afford the ‘high premiums’ nor associated transactional costs of disaster-specific insurance (V20 2015). A lack of awareness in the value of insurance and trust in insurers are barriers to the widespread adoption of parametric insurance by households. On the supply side, the lack of reliable weather data, high rates of fraudulent claims and the reliance on government subsidies (Noy et al. 2017) widen further the ‘transparency and efficiency gaps’. These factors create an unfavourable investment environment, discouraging insurers from offering products that could help reduce the protection gap in the V20 (Surminski et al. 2016; Cohen et al. 2017).

### 5.3 The attributes of blockchain-based parametric insurance

Novel insurance products like blockchain-based parametric insurance (BBPI) have the potential to amplify coverage among climate-vulnerable households. Parametric insurance (PI) does not require on-the-ground inspections, as settlements are based on pre-determined triggers that are linked to independent, objective measures that

are correlated with damages. Integrating PI on the blockchain via ‘smart contracts’ benefits the insurers and policy-holders by automating claims, enhancing trust, increasing transparency and ensuring immutability on securely distributed ledgers (Cohn et al. 2017). Smart contracts are virtual contracts written in computer code that governs a step-by-step transaction (Knezevic 2018). The terms of the agreement are pre-programmed with the ability to self-execute and self-enforce independently without intermediaries. Smart contracts can streamline the insurance process, reducing contracts to simple ‘*if-then*’ statements, since the terms are easily converted to computer code and executed automatically (Cohn et al. 2017). Smart contracts have the potential to change the way we address climate and weather risks as well as how we respond to them. BBPI can, therefore, greatly reduce the cost of managing the claims process, hasten claims payments, enable payments to reach remote areas previously inaccessible (Greatrex et al. 2015), and improve access to the poor by allowing policies smaller than would otherwise be warranted under traditional disaster insurance (Noy et al. 2017).

BBPI can circumnavigate challenges that remain when insuring against climate change, such as a lack of reliable data, cost, high premiums for the poor, claims resolution disputes and delays in claim processing (UNDP 2017). Nonetheless, there are still a lot of unknowns relating to the development and uptake of BPPI. This chapter aims to:

1. assess the role of BBPI as a mechanism to address the efficiency and transparency gap concurrent in traditional insurance products;
2. highlight the emerging use-cases of BBPI in providing coverage for natural hazards with a feasibility assessment on effective coverage;
3. inform the community of insurers and reinsurers, policy-makers and the wider commercial sector of the potential of BBPI to address the ever-accelerating financial implications that climate change brings; and
4. recommend an action plan for mainstreaming BBPI into disaster insurance market.

## 5.4 The landscape of disaster response actions

Any feasibility assessment on BBPI to tackle the impact of climate-related disasters is necessarily an emerging topic. Highlighting the seminal contributions and use-cases in the related areas of disaster aid and catastrophe bonds, as well as parametric insurance, this section also describes the role of blockchain technology as it applies to parametric insurance. As this is a niche research subject which is complex in nature, a combination of semi-structured interviews and text-based surveys consisting of open-ended questions were utilised to enrich the knowledge base for stakeholders.

### 5.4.1 Disaster aid

Funding for disaster aid is disproportionately channelled to V20 countries. Experts forecast that this gap will widen as climate-related weather-events and shocks

compound. Disaster aid is leveraged through national contingency funds, social safety nets and charitable donations from domestic, regional and global humanitarian actors (OECD 2007). Disaster aid can take two forms: relief and reconstruction (UNISDR 2018). Relief emphasises the urgent but temporary nature of assistance, such as providing cash and materials, search and rescue, evacuation, food and water distribution, mostly as a humanitarian response by government, non-governmental organisations (NGOs) and the United Nations Central Emergency Response Fund (CERF). Reconstruction is typically managed by other development agencies and international financial institutions such as the World Bank for restoring infrastructure and the normal life of businesses with a long-term focus (Sawada and Takasaki 2017).

Reliance on disaster aid has drawbacks. First, it can ‘crowd out’ private coping mechanisms – such as insurance and reinsurance – supposed to minimise risk exposure and increase the resilience of communities to natural hazards. For example, a study on US homeowners impacted by flooding found that every dollar increase in aid granted decreased average insurance take-up by about US\$6 (Kousky et al. 2013). Second, recipient countries and agencies often experience high transaction fees and delays in receiving aid and reimbursement (Brandon 2011). The UK Parliament’s Select Committee on International Development notes that even when financial aid has been pooled and a robust pre-disaster action plan put in place, the fragmented landscape of agencies and poor co-ordination among them impedes disaster aid from reaching the areas that need it most in the aftermath of a disaster. These factors account for the ‘efficiency gap’.

Most significant, however, is the relationship between disaster aid and the extent to which pledges are upheld. When Hurricane Katrina struck the low-lying areas of Louisiana and New Orleans in 2005 causing flooding and damage to more than a million housing units, significant portions of disaster aid were diverted and unaccounted (Paul 2018). Further studies blame the mismanagement of funds, inadequate monitoring of project spending, high management costs and competing priorities (Sawada and Takasaki 2017). This lack of transparency and consistency in the monitoring and reporting of disaster aid is referred to as the ‘transparency gap’. The lack of accountability and valid data potentiate malpractice in post-disaster aid co-ordination (Connolly et al. 2018). The OECD recognises the importance of transparency, stating the need to ‘*enable transparency of aid flow; oversight, monitoring and evaluation; and effective anti-corruption enforcement to improve the efficiency, coordination and reduce disaster risk*’ (OECD 2007; UNISDR 2015).

#### 5.4.2 Catastrophe bonds

Catastrophe bonds (or CAT bonds) were first created and used in the mid-1990s in response to the devastation brought by Hurricane Andrew to Florida in August 1992. They emerged from the need of insurance companies to mitigate the risks they would face when a major catastrophe causing damages that could not be covered by invested premiums occurred. The insurance company issues bonds which are then sold to investors. If no catastrophe occurs, the insurance company pays a coupon to investors. Otherwise, the principal is forfeit and used to pay their claim-holders.

The notion of securitising catastrophic risks became prominent through the work of Richard Sandor (1992) and Kenneth Froot (1997), and a group of professors at the Wharton School who were seeking vehicles to bring more risk-bearing capacity to the catastrophe reinsurance market (Froot 1997). CAT bonds ultimately contributed more available and affordable insurance solutions to catastrophe-prone regions to the benefit of exposed individuals and business entities. They also mitigate systemic risks for insurers, reducing the burden on the government to ‘pick up the slack’.

However, 75 per cent of the global catastrophe reinsurance capacity is allocated to North America and Western Europe and it virtually does not exist for vulnerable developing economies (Welt 2010). In response to this imbalance, the World Bank launched in 2009 the MultiCat Program – an issuance platform that arranges CAT bonds for developing countries. Since then, it has covered climate-related events such as hurricanes and drought risks worth US\$2.5 billion, as well as other risks relating to earthquakes, tsunami and pandemics for countries such as Mexico, Malawi, the Philippines, Uruguay, the Pacific and the Caribbean regions (Levy 2017).

#### 5.4.3 Parametric insurance

Parametric insurance is a form of insurance that does not indemnify losses after the fact (i.e., pay based on the damage suffered), but provides an alternative where insurers agree to make a payment based on pre-determined metrics such as the occurrence and severity of a triggering event. One of the key features of parametric insurance is prompt claim payments. Unlike traditional indemnity insurance, where payments are made upon financial quantification of the damage, parametric insurance pays out based on the occurrence only. It does not require an on-the-ground assessment. The threshold of pay-outs is designed beforehand to be approximately proportional to the losses expected to be incurred post-disaster (World Bank 2007).

One of the first examples of this form of insurance was the Caribbean Catastrophe Risk Insurance Facility (CCRIF), which has paid more than US\$100 million since its inception in 2007 against hurricane, excess rainfall and earthquake perils (World Bank 2007; CCRIF 2017). Each pay-out was made within 14 days of a catastrophic event. According to the CCRIF CEO, Mr Isaac Anthony, *‘the injection of short-term liquidity that CCRIF provides when a policy is triggered is not intended to cover all the losses on the ground following a disaster, but it is designed to allow governments to reduce their budget volatility and to provide much-needed capital for emergency relief such as clearing of debris and other clean-up activities, restoring critical infrastructure, and most importantly, providing humanitarian assistance to the affected population, thereby reducing post-disaster resource deficits’*.

Similarly, the World Bank’s Sovereign Catastrophe Risk Insurance Programme provides the Philippines Federal Government with US\$206 million worth of aggregate coverage from typhoons and earthquakes, as well as typhoon insurance for 25 provincial governments (Bretton Woods Project 2017). Pay-outs under this scheme are also based on parametric triggers. This approach leverages the capacities of private insurance and investor markets to increase ‘pre-arranged’ disaster risk

financing (*ibid*), with added advantages over traditional insurance such as lower premiums (3–6%), faster pay-outs and substantially lower transaction costs. PI also fills part of the protection gaps left by indemnity-based insurance (such as deductibles, excluded perils, adverse selection) (Sawada and Takasaki 2017); and avoids the moral hazard of recipients not installing enough protection measures – recipients receive the same payment regardless of the damage incurred and thus, have an incentive to avoid damages if possible (Linnerooth-Bayer et al. 2018).

PI is also being offered on a smaller scale to individuals and households. A trial by the Feed the Future Innovation Lab for Assets and Market Access, a collaboration between USAID and the University of California, Davis (UCD) to introduce index-based insurance to 50 villages in Mali in 2011, found that index-based insurance contracts tend to encourage farmers to invest more (UCD 2013). Cotton farming in West Africa is lucrative but risky for small-scale farmers, given the region's volatile weather patterns. Unprotected farmers in the region often choose to minimise their exposure by limiting their cotton cultivation, and planting 'safer' but less profitable crops. The risk of losing everything in a bad year has discouraged them from investing in better seeds, more lucrative crops or fertiliser, despite the potential gains. Compared to the uninsured control group, insured farming households produced 19 per cent more cotton, using 15 per cent more productive inputs and 28 per cent more seed (UCD 2013).

That said, PI is not without drawbacks. ActionAid International suggests that bureaucracy and corruption are systemic to the nature of the structuring of PI policies and can prevent timely claims pay-outs. This proved the case with the PI policy held by the Malawi government and underwritten by African Risk Capacity (ARC). Even though Malawi experienced one of its worst droughts on record, it took three months for policy-holders to receive any recompense, which placed thousands of lives at stake and deepened the humanitarian crisis (Bretton Woods Project 2017).

Another criticism of PI is 'basis risk'. Basis risk refers to the relationship between the pre-selected parameter and damages. This is estimated in advance and the claims payments may therefore not reflect the losses incurred. This is an issue with PI due to underused pooled risk and inadequate comprehensive and reliable long-term data that impacts claims estimation (Observer 2017). Moreover, poorly designed index insurance may pay at times where there is no loss incurred, yet fail to pay at all following a disaster.

For example, torrential rainfall in Jamaica in May 2017 caused widespread flooding, resulting in an estimated economic impact of US\$385 million, but the excess rainfall parameters with CCRIF were not triggered (Artemis 2017). CCRIF does not offer flood cover, and the modelled damage of US\$100m based on rainfall parameters alone was below the payment threshold of US\$200m. This lack of payment has led to questions being raised about the benefit of policies that do not pay out despite significant damages. To cover flooding risk would require a redesign of the PI set-up: it would need to consider the relationship between excess rainfall and the resulting flooding effects on the built environment, land coverage, agricultural impacts and land use, among other factors, and estimate the damages from these.

Design failure is a major hurdle that PI providers are still addressing. As Michael Carter, a Professor of Agricultural and Resource Economics at UC Davis puts it, *'this kind of (poorly designed) contract is more likely to leave a farmer worse off for having bought it than it is to help them to achieve long-term stability and resilience'* (Russell 2018).

## 5.5 The role of blockchain technology in insurance

Blockchain is a distributed ledger technology in which transactions are recorded chronologically and publicly. It emerged to address the pitfalls of centralised databases, such as data manipulation, fraud, embezzlement and theft (Nakamoto 2008). Although the first major use-case was the cryptocurrency, Bitcoin, the blockchain technology that underpins it extends beyond currencies. Blockchain enables a near friction-free, inexpensive and transparent mechanism for peers to transact without an intermediary, and to monitor, report and verify on the validity of the transaction between members of complex networks. This facet ensures transparency and consistency in data channels, which is fundamental to providing transparent reporting of disaster aid and claims pay-outs.

Trust is established using a distributed consensus mechanism to check the validity of transactions, independent of intermediaries – for example, Proof of Work is used in the Ethereum blockchain. With blockchain technology, insurance data including policies, pay-outs, know-your-customer and anti-money laundering information can be recorded digitally on secure, incorruptible digital ledgers across a dispersed network of nodes. As the blockchain is open to writing and inspection, actors within the disaster aid landscape and insurance providers can be held accountable for their actions (Observer 2017). Further, the transfer of data is handled independently and automatically on-chain, removing manual routine and paper-based procedures.

Smart contracts can further streamline this process by codifying traditional insurance policies. Blockchain removes the need for a central authority, legal system or external enforcement mechanism by permitting a seamless and constant contract execution environment that renders transactions to be traceable, transparent and irreversible. Blockchain-enabled smart contracts, therefore, help build trust between policyholders and the broader ecosystem of insurance providers, regulators and other players since the risk of data tampering (fraud, theft and hacking) is considerably mitigated (Clyde and Co LLP 2018). Research suggests that the automatic handling of data also removes 30 days of administration time from the insurance/reinsurance cycle (ibid), providing efficiency gains to the industry.

Unlike traditional database operations, with the blockchain, individual-level data can be attached and processed in real-time – at a significantly greater speed and volume than what is currently possible. This allows insurers to offer customised pricing to individuals, based on frequent risk assessments. This acts to tailor long-term risk reduction strategies for different groups and thus, enhances the effectiveness of distribution through building trusted relationships and transparent, timely post-disaster claim processing (OECD 2018). Decentralisation has the potential to disrupt

the traditional insurance model, enabling new peer-to-peer models of insurance. Friendsurance, an InsurTech start-up in Germany, for example, allows customers with the same type of insurance to connect and share premiums, assess risks and claims, with reduced costs (Clyde and Co LLP 2018).

Currently, insurers are experimenting and modelling policies through the use of different blockchains. Ethereum is the most diffuse blockchain offering smart contract solutions, while others exist such as NEO, NEM, EOS and Cardano. The most notable blockchain consortium in insurance is the Blockchain Industry Insurance Initiative (B3i), operating R3 Corda – a permissioned-private blockchain. AXA, on the other hand, is experimenting with the platform-agnostic Hyperledger Fabric, a permissionless open-source blockchain. The use of different blockchains highlights the fact that InsurTech is still maturing and the market consolidating. Thus, it is important to maintain interoperability and flexibility based on minimum standards to ensure a collaborative environment to build capacity, develop partnerships and share best practices as to optimising policies or driving a revolution in accessing and scaling such policies to address the ‘protection gap’ (ibid).

## 5.6 BBPI – a faster, fairer and cheaper approach

As aforementioned, there are several problems with traditional approaches to disaster aid and traditional indemnity-based and parametric-based insurance offerings for climate-related disasters. Disaster aid crowds out private coping mechanisms such as insurance, which increases risk exposure, reduces resilience to climate disasters and increases the burden on government budgets post-disaster. Traditional payment methods incur high transaction fees and delays in delivering aid to those who need it most. Mismanagement of funds, high management costs and the lack of transparency in when, where and how disaster aid is channelled are perennial problems. This is also the case with traditional indemnity-based insurance and securities such as CAT bonds covering climate-related damage.

Even PI, which circumvents many of the issues associated with indemnity-based insurance, still requires a trustworthy provider to pay when disaster strikes.

### 5.6.1 Technical workings of BBPI

Blockchain-based parametric insurance (BBPI) is arguably a faster, fairer and cheaper approach to post-disaster response. As with PI, claims payments are tied to pre-determined index triggers based on independent, objective measures. With BBPI, once the premium is paid, the contract details are entered onto immutable blockchain software via a ‘smart contract’, to ensure the payment is made when pre-specified weather parameters are met. If a weather event occurs according to a trusted data source (e.g., if wind speeds greater than 100mph are recorded at the nearest weather station), a payment is automatically triggered. As with PI, there is no need for the recipient to make a claim – but in the case of BBPI, the technology does that for them.

Unlike conventional PI, however, new policies are created as entries within the smart contracts ledger, and the computational steps taken to reach an approval or

denial of claim are made and published on the blockchain. In this setting, policies secured by blockchain technology are available in the public domain and for regulatory inspection (Davis 2018). This instils confidence in the data, overcomes data access issues, and provides a much-needed layer of transparency to improve inter-organisational co-operation between insurers and reinsurers. As transparency is central to establishing trust, individuals can be certain that insurance providers operate with integrity and legitimacy and will thus be more inclined to take out policies.

Blockchain technology has the potential to remove significant disputes, such as whether: policies were issued; premiums were paid; the identities of policy-holders had gone through know your customer (KYC) and anti-money laundering (AML) checks; and that the data of policies is in the risk pool. The instant verification of these parameters, coupled with the ability of the blockchain to consolidate data points from third-party providers, provides conditions to improve the affordability of premiums due to the reduction of risk (Davis 2018). In each transaction, the data is validated over time on an immutable chain that is more secure and difficult to hack than traditional database solutions. It also helps mitigate the risk of delivery, because blockchains are easier to code than traditional solutions.

### 5.6.2 The role of oracles

In BBPI, payments are triggered based on commonly-agreed third-party information from reliable sources, such as weather index databases and data based on high-resolution satellite imagery. As ‘smart contracts’ are deterministic in nature, they rely on oracles to bring this external data into the blockchain. ‘Oracles’ are third-party information sources that supply data to blockchains for the creation and execution of smart contracts (Lamberti et al. 2017). For BBPI, oracles are used to monitor weather index databases and high-resolution satellite imagery to confirm whether certain parameters are met. Oracles can improve the pay-out of PI by increasing the accuracy and objectivity in the data sets.

However, for oracles to be effective, a trusted source of data is required (Lamberti et al. 2017). This can be an issue where the data is not available – a common problem for many small nation states where the data is patchy or of low resolution – or where the data source is not considered independent and the data is potentially subject to tampering. In most small states, there is a shortage of devices to monitor the weather. Some countries have only a single weather station located at the main airport. The shortage of devices to monitor actual conditions on the ground is a major barrier. The lack of a functional internet in the aftermath of a disaster can also make ground-based technologies problematic.

To counter this, satellite-based earth observation data and unmanned aerial vehicles could be used to complement weather-index parameters and indemnity assessments by monitoring areas directly in the aftermath of a disaster and assessing the claim pay-out in near real-time. In addition, new low-cost meteorological technology is being developed that could address this issue over time. This will help bridge the ‘data gap’ between the exposure of disasters, which currently favour high-profile

emergencies at the expense of less visible suffering far from the media or the political spotlight (Davis 2018). In addition, a combination of consensus-based oracles could be utilised, which monitor various index databases concurrently to arrive at a commonly agreed outcome and thus, initiate the execution of the smart contract. This payment mechanism therefore removes the discretion out of the decision to pay out through disintermediation and automation.

That said, as oracles are still in their infancy, transmitting data to the blockchain and performing the verification is costly, a major impediment to scaling BBPI (Van Der Llaan 2018).

Despite the higher cost incurred in data transfer and management with oracles, as a whole BBPI is more cost effective than traditional disaster insurance. BBPI is also more closely aligned to the Sendai Framework, which permits the need for tools to *'promote the collection, analysis, management and use of relevant data and practical information and ensure its dissemination, taking into account the needs of different categories of users'* (UNISDR 2015).

### 5.6.3 BBPI in the agriculture sector

Drought means disaster for most farmers, particularly in the developing world and is likely to increase in propensity. Low rainfall reduces crop yields, reducing food, income and the capacity to buy the seed and fertiliser required for future seasons (Russell 2018). Conventional crop insurance is too expensive for most smallholder farmers. For insurers, the relatively high cost of administration compared to the small-scale premiums, on top of disputes and fraudulent claims, mean that it has not been economically viable to serve low-budget customers. This leads farmers to reduce investment in productive assets and select low-risk, low-return crops and livestock, restricting their ability to escape poverty and earn higher incomes (World Bank 2016).

Nowadays, fortunately, more than 20,000 farmers in Kenya, Uganda and Ghana have access to affordable crop insurance via their smartphones with WorldCover, a US-based InsurTech start-up (Bird 2018). Putting policies on blockchain-based smart contracts avoids the need for paperwork. Importantly, the insurance focuses on a single index parameter – rainfall – and does not rely on manual assessments or decision-making. The scheme uses satellite imagery to detect rainfall and interpolate plant growth. Payments are made using a mobile money transfer service. As Christopher Sheehan, founder and CEO of WorldCover explains:

*'With machine learning and blockchain technology, we can process these data very cheaply to produce a really simple crop insurance product with premiums of \$20 to \$50 for a farmer who might only be earning \$3,000 a year.'*

Similar systems are emerging in the agriculture sector across the world. Blocksure, a UK InsurTech start-up, is developing parametric microinsurance connected to a mobile banking platform in Indonesia. Etherisc, a platform for decentralised insurance, has formed a joint venture with Aon and Oxfam to develop a blockchain crop insurance programme in Sri Lanka. In parallel, Hillridge Technology is developing parametric

weather-index and yield-index financial products for crop and livestock farmers in Australia. Its products are tailored for where the farm is, what is being grown and the risk tolerance of the farmer.

## 5.7 Blockchain for wider impact on humanitarian assistance

Blockchain technology can also be leveraged to improve the delivery of humanitarian assistance, which frequently incurs weeks of delays to transfer funds (World Bank 2016). To tackle widely diffused problems of fraud, corruption and fund misappropriation, in 2017, the UN World Food Programme used the Ethereum blockchain to develop ‘Building Blocks’ – a pilot to provide food and cash relief to refugees of the Sindh province of Pakistan. By using smartphone authentication, combined with blockchain technology, payments from the UN agency to food vendors were validated, the recipients received food, the merchants got paid and the agency could trace payments. As a result, blockchain technology enabled aid to reach remote or disaster-struck areas faster, where ATMs may not exist or banks are not functioning normally, and with improved cost efficiency (from 3.5% to less than 1%).

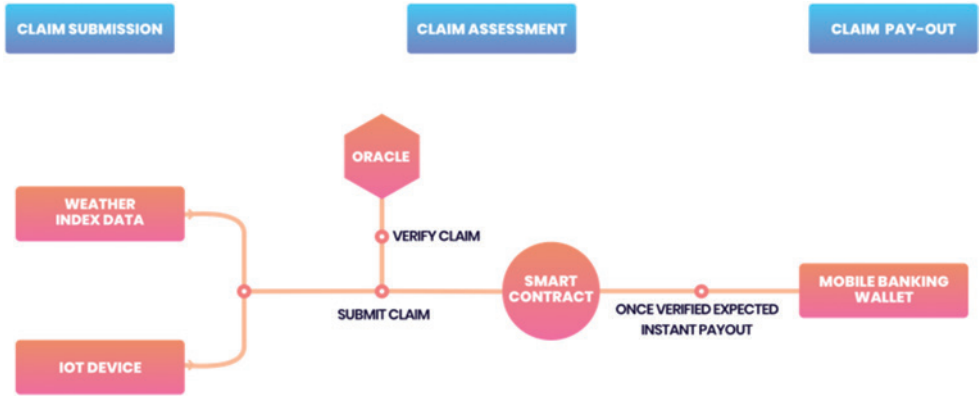
The trial in Pakistan also avoided the many security, theft and safety problems of handling cash in conflict-torn areas, demonstrating that in urgent situations, cryptocurrency can even take the place of scarce local cash, allowing aid organisations, residents and merchants to safely exchange money electronically (Observer 2017). *Smart Network’s* blockchain-based solution for international aid transfer is similar in this setting, as it can fully track the flow of funds through the chain from donor through to beneficiary.

## 5.8 Blockchain avoiding the pitfalls of traditional disaster insurance

BBPI also impacts the wider market structures, offering more diverse mechanisms for claim pay-out and insurance uptake. For example, by using the smart contract to handle claim payment, automation of claims handling can be realised in addition to improving the reliability and transparency of the pay-out mechanisms for the customer contract-specific rules enforcement. Automation by using smart contracts results in significant reduction of bureaucratic procedures and saves time for accountants, controllers and insurance companies as a whole. Building on this approach, Feed the Future has established in Kenya the world’s first quality certification for agricultural index-based insurance to ensure that PI products across East Africa can truly promote long-term resilience for smallholder farmers (UCD 2013). The aim is to create incentives for insurance companies to create higher-quality contracts. For the USAID initiative, UC Davis and NASA will partner with the Regional Centre for Mapping of Resources for Development and a technical lab to measure and refine insurance quality.

By pairing smart contracts with established mobile banking services (e.g., M-Pesa with 30 million users) and Bit-Pesa (for cryptocurrencies), policy-holders can gain

**Figure 5.1 How claims are assessed and paid using the BBPI contract for disasters (adapted from Clyde and Co. LLP 2018)**



access to claims faster and more conveniently, see Figure 5.1. Moreover, as claims can be paid directly through these streams, it also ‘*becomes cheaper to service the claims, removing the investigative problem*’. This will not only improve efficiency in terms of the compensation process – which currently can take up to four weeks after a disaster, in some cases longer e.g., African Risk Capacity (Martin 2018) – but also reduce the probability of contract failure by providing a consistent contract execution environment. As Etherisc illustrates with its blockchain-based smart contract PI policy: *HurricaneGuard*, individuals affected by 2018 Hurricane Andrew received pay-outs within 24 to 72 hours in the wake of the disaster, without having to go through the long-winded claims process (Etherisc 2018). Therefore, blockchain offers the potential for insurers to efficiently serve emerging markets and exploit new opportunities by offering more inclusive insurance.

With BBPI, disintermediation (through the use of the smart contract) and direct claim servicing offer the advantage of removing the reconciliation processing of the entire insurance cycle, significantly reducing service and administrative costs. In addition, BBPI can overcome these issues relating to contract formation. BBPI can circumnavigate the need for insurers to provide proof of cover in paper format or for the insured to physically sign the policy document, since cryptographic primitives, i.e., private and public keys, could replace the need to physically sign policy documents. As a result, this can facilitate the access and distribution of PI.

Further, by using a public blockchain for PI such as Ethereum, the transfer and aggregation of data can be streamlined, and the risk of fraud rendered obsolete by using tamper-resistant distributed ledgers. This differs from the standards of today, such as traditional database solutions and processes where data is collected and stored privately in silos. Data collected on a public blockchain offers a higher degree of transparency, as data can be atomised on a standardised platform and open to the public domain, thereby allowing the network of insurance providers, ratings agencies, regulators and investors to have access to policies, claims and claims histories registered on the blockchain.

This data infrastructure builds capacity among agencies and provides the backdrop to improving the structuring of PI policies and, at the same time, auditability by publishing open and readily accessible data. IBM's blockchain solution, Open Insurance Data Link (OpenIDL), is one such initiative to automate regulatory reporting for the insurance sector. By leveraging the blockchain, OpenIDL improves both the operational efficiency and flexibility of reporting. Moreover, the community of regulators and reporting carriers gain access to more holistic and dynamic reporting, providing a more granular level of data coverage and hence, allowing risk to be better priced.

## 5.9 Coverage in developing countries

Given the increasing frequency and impact of natural disasters in developing countries, the need for inclusive insurance is clear. BBPI has the potential to lower barriers to growth and financial inclusion. The simplicity of BBPI enables it to utilise the existing and growing network of mobile network operators, retail stores, factories and agricultural co-operatives across V20 countries, to distribute products and increase penetration (Clyde and Co LLP 2018). Customers appear to prefer these digital and remote channels to pay for insurance policies. A study by EY, an accounting firm, confirmed that 80 per cent of customers are in favour of using these streams (EY 2018). Given the rapid proliferation of smart phones in developing economies and the shift with insurance providers to service claims via mobile payment channels, this provides an opportunity for individuals to uptake insurance products and therefore increase insurance penetration.

## 5.10 Challenges of BBPI roll-out

### 5.10.1 Poor data

Access to timely and reliable data is of particular importance for the insurance and reinsurance markets. Insurers need to accurately estimate the risks and appropriately price the premiums they charge their customers, and need to have confidence in the fidelity of payment triggers (Franzke 2017). One such initiative aiming to do so is INFORM, a global risk assessment database for humanitarian crises. INFORM supports decisions about prevention, preparedness and response by aggregating data to generate local disaster-risk knowledge. This enables local actors to access and exchange risk-related information and for insurers to understand hazard risk exposure (UNISDR 2018).

However, at present, adequate data is sometimes only available nationally, and occasionally not even at this level. This restricts co-ordination, planning and insurance pricing across borders (UNISDR 2015). It is well understood that data gaps are roadblocks to achieving optimal risk assessments and may detract from focusing provisions on the local level, especially in disaster-prone areas that are unaccounted for in the current system. Literature indicates that improving the architecture of insurance products and the underwriting procedure will be the cornerstone to increasing insurance penetration and meeting the agenda of the Sendai Framework (OECD 2007).

### 5.10.2 Regulation

How BBPI is regulated across jurisdictions can also impact its ability to scale in certain countries. Since insurance licences are currently granted per country, the effort and the cost to get worldwide insurance licenses are enormous. Different jurisdictions have different approaches to the regulation of blockchain technology. For example, an individual receiving a pay-out from a PI policy via cryptocurrencies may be taxed as such currencies are viewed as a security. The solution requires awareness and a lot of work from both business and politics. Regulatory uncertainty can also stifle growth and innovation. Even when regulation has been tough, investment is spurred in such places as New York where the Bit-license has been introduced, and Singapore and the UK where regulatory sandboxes developed recently. Other regulators are more open to blockchain, such as Malta and Estonia, with large companies operating in their jurisdictions and investments following.

### 5.10.3 Barriers to adoption

As a nascent technology, yet unresolved issues are keeping many insurers from adopting blockchain in insurance. These include slow transaction speeds, a lack of standards and interoperability between different blockchain platforms, connectivity with existing enterprise systems, and legal and regulatory concerns (Deloitte 2018). Progress is being made on increasing throughput and performance via new consensus mechanisms, on enhancing standards and interoperability, and reducing the complexity, cost and energy requirements. Over time, these developments will help lower the cost and risk of deploying blockchain, while expanding the applications of the technology.

For small states, there is the additional barrier of access to trusted oracles, the robustness of technology and communications infrastructure post-disaster – such as emergency cellular networks and a functioning internet – and the small market size for private insurers. The use of pilot programmes and studies – with the support of government and multilateral institutions – can help identify and address the unique challenges in applying BBPI to small states.

Finally, as with any new insurance product, uptake of BBPI, even if offered in market, is also a challenge. It requires a well-thought-out, go-to-market and distribution strategy, investment in product design, technology development and customer acquisition – including educating the consumer – before the product breaks even. It is critical to maintain the confidence of both policy-holders and underwriters, especially in the initial years before the product becomes financially self-sustaining.

## 5.11 A call to action

As climate change-related disasters increase in frequency and intensity over the coming decades, we cannot afford to ignore the potential for BBPI to provide faster, cheaper and fairer financial recourse for people affected by climate disasters. This is particularly important in rural and regional communities, especially in developing countries, who are least likely to have the capacity to adapt to climate change and have the most to lose in the event of climate-related disasters.

To address the challenge of implementing these novel solutions, governments, civil society and insurers should ask themselves these questions:

- What current disaster aid schemes or insurance products suffer from a lack of transparency, delays in payments after climate disasters strike or fail to reach intended recipients? Could a BBPI solution work instead?
- Is the BBPI solution structured in the right way so it pays out when needed, in a timely way, to the players who most need them? Can we invest in local resources to design the BBPI solution? Who has better insight to take into account local conditions? Has the BBPI structure passed a quality certification?
- Are there trusted data sources upon which risks can be assessed and payments can be triggered? Is there more to be done to make weather- and disaster-related data publicly available, free and easy to access? What investments need to be made in collecting, storing and providing data in a trusted, transparent and consistent way? Can novel technology such as drone and satellite data help?
- What role can government play to provide regulatory certainty to InsurTech providers? Can a well-structured regulatory sandbox be applied, particularly for micro-insurance? What can regulators do to foster a collaborative environment for innovative solutions and encourage the uptake of novel products?

BBPI not only offers a cost-effective, structured and fast approach to distributing funds to governments, organisations and individuals affected by climate-related disasters after the event. By providing a safety net to those vulnerable to the impacts of climate change, it allows them to invest in the future, rather than hoarding resources in preparation for disasters to come. Ultimately, BBPI can provide financial security and climate risk related resilience to individuals and frontier communities, in turn, promoting productivity equity across countries and regions.

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