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Article

The benefits of fit-for-purpose land administration for urban community resilience in a time of climate change and Covid-19 pandemic

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Abstract: The major global pressures of rapid urbanization and urban growth are compounded by climate impacts resulting in increased vulnerability for urban dwellers, with these vulnerabilities exacerbated during COVID-19. Much of this is concentrated in urban and peri-urban areas where urban development spreads into hazard-prone areas. Often this development is dominated by poor quality homes in informal settlements or slums with poor tenure security. Lessons from a current resilience-building project shows that the fit-for-purpose (FFP) approach to land administration can provide a solution to increase the number of households with security of tenure and improve resilience outcomes as informal settlements grow. This paper discusses the influence of FFP land administration on vulnerabilities to multiple shocks related to climate change and COVID-19. This paper proposes ways the growth of human settlements can be better managed through responsible governance of land tenure rights, and effective land-use planning to improve resilience to different shocks and stresses and provide adequate access to safe land and shelter. Land administration systems can support improved resilience to the multiple stressors of climate and pandemics through improving tenure security and enhancing land use planning controls. Climate change adaptation and risk management need to be better mainstreamed into two major elements of land governance: (i) securing and safeguarding of land rights, and (ii) planning and control of land-use.

Keywords: fit-for-purpose land administration; climate; resilience; pandemic.

1. Introduction

The major global pressures of rapid urbanization and urban growth are compounded by climate impacts resulting in increased vulnerability for urban dwellers. It has been argued that climate vulnerability will be most severe when combined with other stressors [1]. Urbanisation is a key driver of both climate vulnerability and tenure insecurity in urban settlements in the Global South. Land use planning has not controlled the growth of urban communities living in informal settlements, with some settlement occurring in highly vulnerable areas (ref). Many households are living in poorly constructed houses and without formal access to water and sanitation. The households most exposed to natural hazards are among the most vulnerable. Informal occupation of land can lead to discrimination, evictions and physical insecurity - especially for the more vulnerable and marginalized.

The links between land tenure and climate vulnerability are now well-established. Insecure land tenure directly and indirectly exacerbates vulnerability to climate-related hazards ([2], [3], [4]). Disputes over land can disrupt or halt climate change adaptation (CCA) and disaster risk reduction (DRR) initiatives. Conversely, CCA and DRR initiatives can result in eviction and resettlement that increases tenure insecurity. Those with insecure land tenure are often more exposed to natural hazards, with inadequate housing and lack of formal water and sanitation making them very sensitive to climate impacts [5]. Many with insecure land tenure are disconnected from formal

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governance processes, lack knowledge to inform resilience decisions, and have restricted access to finance for actions to strengthen their adaptive capacity [6].

It is also well established that effective and "responsible" land governance is needed to secure access to land for shelter and livelihoods, and reduce climate vulnerability. Urban housing needs to be more climate-resilient to meet the Global 2030 Agenda and providing secure land tenure for all should be a fundamental aim. However, the multiple stressors of urban growth, climate impacts and the COVID-19 pandemic undermine this relationship. As the 'UN Special Rapporteur on the right to adequate housing' noted: "By ensuring access to secure housing with adequate sanitation, States will not only protect the lives of those who are homeless or living in informal settlements but will help protect the entire world's population by flattening the curve of CV19," [7]).

What is less well understood is the interlinkages between land tenure, climate vulnerability and pandemics. Recent efforts have focused on understanding how land tenure impacts responses to pandemics. However, to our knowledge, there has been very little research into land tenure and multiple stressors of climate and pandemics. This paper seeks to address that gap.

There has been much literature on how fit-for-purpose land administration (FFP LAS) is an important approach in improving tenure security at scale, and recent literature has illustrated the benefits of FFP LAS to support climate resilience efforts. This paper seeks to further develop this research in the context of multiple stressors of climate and pandemics. The focus of this paper is on the benefits of FFP LAS for community resilience to multiple shocks and stresses. Both pandemics and natural disasters involve an unexpected short-term shock, causing economic and social impacts leading to a longer-term recovery. This article focusses on both the current impacts from climate and COVID-19 as well as the longer-term resilience building. The research draws from an extensive literature review, and participatory action research based on a case study in Honiara.

Lessons from current resilience projects show that the FFP approach to LAS can provide a solution to increase the number of households with security of tenure and improve resilience outcomes as informal settlements grow. This paper discusses the influence of FFP land administration on vulnerabilities to multiple external shocks related to climate change and COVID-19. This paper proposes ways in which the growth of human settlements can be better managed through responsible governance of land tenure rights, and effective land-use planning to improve resilience, and provide adequate access to safe land and shelter.

The remainder of the paper focuses on a literature review as well as a case study that is used to support the authors' contention that FFP land administration approach, informed by participatory enumeration of the complexity of urban land tenure, can support scaling up efforts to improve tenure security and deliver more effective and equitable climate resilience actions for vulnerable urban communities in the Global South.

2. Pandemics and land tenure rights

Global changes in land use patterns and accelerating rate of land conversion have been well recognized as contributing factors to increased pandemic risk and the emergence of new infectious diseases; particularly as a consequence of diminishing natural habitats and ecological disruption ([8]; [9]). Health emergencies such as the 2003 severe acute respiratory syndrome (SARS), 2009 H1N1 influenza (or "swine flu") to the 2014 West African Ebola crisis, and more recently the 2016 Zika outbreak in the Americas [9] demonstrate not merely similarities between climate change and health risks but their intertwined trajectories (see [10]; [11]; [12]). Covid-19 underscores the need to rethink land-use change, and preparedness of health systems by closing critical knowledge gaps and fostering society-wide engagement in pandemic risk reduction in the new 'pandemic era' [13]. A case study of slum dwellers in Liberia shows how multiple vulnerabilities arise out of location, climate

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risks, past epidemics such as Ebola and socio-economic profiles given prolonged civil war and displacement [14]. Instead of a linear approach that creates a dichotomy between health responses and other vital environmental adaptation, the common socio-economic and ecological determinants that disproportionately affect certain categories by gender, age, ethnicity landlessness and other vulnerabilities need to be addressed together.

Recent research attest to how unsustainable urbanization – with its knock-on effects on human health and wellbeing – is a critical part of reducing the risk of future pandemics ([15]; [16]; [17]; [18]). In the Anthropocene epoch, human choices directly impact on the natural world, and biodiversity and natural habitats are conditioned on sustainable urbanization and responsible human consumption of animal products to prevent new communicable zoonotic diseases. While pandemics are often viewed as health crises, socio-economic implications are under-researched often overlooking urban resilience and sustainability. Enforced border shutdowns, travel restrictions and quarantines have highlighted the impact of the virus on the global economy, affecting well-being, employment opportunities and food security ([19]). Thus, responsible land administration approaches in the future will have to respond to concerns at various levels.

The nature of pandemic risk in relation to land tenure rights intersects the loss of livelihoods, threats of eviction and changes human mobility patterns. Pandemics exacerbates existing characteristics in many informal settlements – poor sanitation, high density, insecure tenure rights, and mobile populations – that contribute to complexity in addressing health risks ([20; [21]). Loss of livelihoods, eviction, and human mobility, while elements of the stressors of urbanization and climate impacts, became more critical issues during the COVID-19 pandemic. Impacts on access to drinking water and sanitation for vulnerable households, as well as overcrowding in affected households. Loss of livelihoods during the pandemic also affected the ability of households to pay mortgages or rent placing additional, sometimes forcing human mobility decisions impacting tenure security and the quality of shelter.

COVID-19 interrupts urban services such as access to drinking water and sanitation, but also the capacity of local actors to intervene to redress these risks due to social distancing, lockdowns and diminishing resources ([22]; [23]). An effective way of tackling complex land, housing, environmental and health challenges is to understand the linkages and pooling of resources, through local perspectives and community action.

As with earlier epidemics such as Ebola and HIV, COVID-19 exposes how the urban poor, including migrants and slum communities struggle with household size, housing costs, livelihoods and tenure security while encountering unfavourable structural, economic and political conditions ([3]). Top-down strategies such as hand washing, self-isolation or self-quarantine after exposure to the virus, physical distancing, and 'work from home' advice are based on elitist assumptions. Those living in urban informal settlements need additional support, as well as local knowledge in creating equitable systems for the most vulnerable populations ([24]). The 'new normal' for future cities and communities requires a shift towards a 'new social contract' that fosters rights-based, well-planned, inclusive and climate resilient cities [25]. Building back better in the face of climate change and the COVID-19 pandemic will need be centered upon future innovative land-use decisions and sustainable practices.

3. Climate change, COVID-19 and land administration in Pacific Islands Countries

3.1. The Socioeconomic impact of urbanization, climate and COVID-19 on urban systems in the Pacific Island Countries?

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Pacific Island Countries (PICs) are highly exposed to natural hazards such as earthquakes, cyclones and tsunamis. They are affected by the El Niño-Southern Oscillation (ENSO) which creates climate variability and impacts each PIC differently. These 'natural' regional climate cycles influence extreme events such as drought, flooding, and tropical cyclones [26]. During April 2020, the PICs faced the widespread destruction caused by Tropic Cyclone Harold in the Solomon Islands, Vanuatu, Fiji, and Tonga which compounded the impacts of COVID-19 and presented additional challenges through damages to crops, homes, buildings and roads [27].

Rapid border closures and swiftly imposed lockdowns curtailed the impact of COVID-19 in the region and at the end of 2020, only four of the 14 PICs have confirmed cases. Nonetheless, the experience of Papua New Guinea this year underscores the fragility of this stability, and how quickly PICs can be overwhelmed due to existing and entrenched development challenges. Indeed, the use of widespread lockdowns and States of Emergency, while undoubtedly saving lives, have resulted in extensive externalities in terms of macroeconomic pressures for governments as well as myriad socioeconomic impacts for PIC communities particularly urban ones.

Most people in PICs live in cities and towns. Urban growth rates continue to exceed annual population growth rates in nearly all Pacific economies (UN-Habitat, 2020). This growth is especially significant in Melanesia, where the urban growth rate of some countries such as the Solomon Islands exceeds 5% and its capital, Honiara, has a population density of nearly 6000 persons per square kilometers [28]. The total population of Pacific countries is forecast to grow by more than 60% by 2050 (to almost 20 million), propelled by growth in just four countries: Vanuatu, Kiribati, Solomon Islands, and Papua New Guinea [29]. This presents challenges for every development sector.

Pacific urbanization is characterised by social, cultural, linguistic, political, economic, and environmental diversity across Melanesia, Micronesia, and Polynesia. Climate change impacts, informal settlement, urban poverty and infrastructure deficiencies undermine urban resilience. Within informal settlements the challenges include evictions, discrimination with the more vulnerable and marginalised most affected. The degree of resilience of households is a major factor in how they transition from informal settlement to formally recorded settlement [26].

Currently, around one in four PIC residents live below national poverty lines; for seven out of 11 PICs, this is more likely to be the experience for urban populations rather than rural ones (Jones, 2016). In PICs, livelihoods are heavily reliant on informal and subsistence economies: limited labor statistics for PICs show that informal employment rates can range between around 30% (e.g. Cook Islands) to 80% (e.g. Tonga)[1]. Across the Pacific, a range of statistics demonstrate the gender bias against women in both participation in formal economies as well as pay gaps[2]. Hence, the informal economy is significant for PICs and although accounting of the impact is difficult, a case study in Fiji shows the informal economy contributes around 15% towards GDP [30]. During COVID-19, restricted movements and lockdowns meant that these economies ground to a halt and many were forced to turn to subsistence economies. Although subsistence economies are already dominant in PICs like Solomon Islands and Papua New Guinea, especially in rural areas [31], for urban communities, this undoubtedly placed more pressure on already scarce (and often contested) land resources. However, during COVID-19, many PIC governments mandated a return to rural islands under State of Emergency powers which reversed longstanding patterns of rural-urban and inter-island migration.

Demographic trends in the region mean that half of the PIC population are below 24 years of age, especially in the Melanesian countries of Solomon Islands, Vanuatu and Papua New Guinea. The youth bulge tends to be concentrated in urban areas and youth in these areas are more likely to face increased poverty, chronic health issues, poor educational outcomes, unemployment, and higher risks of distrust in government [32]. Additionally, geography is a significant factor impacting development in PICs, especially in countries like the Federated States of Micronesia, which comprise

[1] https://ilostat.ilo.org/topics/informality/

[2] Https://pacificwomen.org/wpcontent/uploads/2020/01/EconomicEmpowerment_PacificWomen_January2020.pdf

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607 islands spread across a large area, which imposes unique challenges for coordination and distribution of services. A recent study demonstrates that 50% of Pacific people live within one km of the coast and 90% live within five km of the coast (excluding Papua New Guinea as its exponentially greater population numbers skews analysis) [33]. In recent years, a growing trend in rural-to-urban migration and inter-island migration has led to an increase in "urban villages" and informal settlements as a dominant urban form throughout PICs [34]. These coastal urban areas are exposed to an array of climate impacts including sea level rises, storm surges and cyclones, commonly experienced by island states.

These environmental risks are exacerbated by limited coping and adaptation capacities. Some of these are consequences of physical isolation and physical size of countries themselves; but PICs also experience chronic structural issues that produce weak governance systems, poor infrastructure, lack of diversity in internal and external trade markets – all of which convey poor socioeconomic development outcomes for PIC urban residents [35]. Consequently, the 2020 World Risk Index identifies three PICs in the top five most at-risk countries in the world: Vanuatu (first), Tonga (second) and Solomon Islands (fifth).

The introduction of COVID-19 into such contexts therefore severely test the limits and capacities of urban systems. Institutional ambiguity over the governance of urban informal settlements often creates conflict over who is responsible land governance and basic service provision, resulting in many settlements living without access to basic sanitation and water facilities. Urban informal settlements are therefore particularly vulnerable to health and socioeconomic impacts of COVID-19: crowded housing, the existing prevalence of vector-borne diseases, coupled with limited access to clean water and sanitation and higher rates of chronic health conditions, all serve to create the ideal conditions for the spread of the virus.

3.2. FFP Land administration to enhance resilience to multiple shocks and stresses in Honiara (Darryn and David to write) (1000 words)

Honiara, the capital city of the Solomon Islands, is situated on a narrow coastal strip, spreading out into a series of rugged hills and valleys to the south (see Figure 1).

Figure 1 Honiara map of informal settlements (Source: UN-Habitat 2020)

Several of the authors have a long-standing engagement through a UN-Habitat-supported city-wide adaptation planning process, resulting in the Honiara Urban Resilience and Climate Action Plan (HURCAP) [36]. Honiara faces a wide range of severe climate hazards exacerbated by shortcomings in urban development and infrastructure. Flood events, extreme heat, drought, sea level rise, and landslides – are projected to increase in intensity and frequency due to climate change [37]. Informal settlements are often located in exposed coastal areas, river floodplains, or steep hilly terrain they are very exposed to climate related hazards, adding to existing underlying vulnerabilities ([6], [38]). High levels of exposure and sensitivity to extreme events, and limited adaptive capacity, mean the current day vulnerabilities of informal settlements are priorities over future events. Local actions are needed to increase urban resilience to urbanisation and climate-related drivers ([6]).

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Within the municipal boundary, formal land tenure is granted through 50-year period Fixed-Term Estate leases (FTEs) of government-held land, or 3-year Temporary Occupation Licenses (TOLs). TOLs were originally introduced in the 1970s to manage unplanned urban migration, however most TOLs have now lapsed. Government efforts to convert TOL areas to FTE through surveying, subdivision and valuation are underway, but the conversion does not keep up with the scale and pace of informal urban growth ([6]). Also, dispute remains over the boundaries of the city established in 1978 with some customary land-owners challenging location of the land boundary [39].

Informal settlements cover about 15% of the city's total land area, house approximately 35-40 percent of the population, with population densities of 5,270 people per square kilometre much higher than the rest of the city (2,680 people per square kilometre), and Ontong Java settlement with density of 21,800 residents per square kilometre. Households have inadequate access to water and sanitation infrastructure, and limited access to essential services [38].

A UN-Habitat survey in 2020 found that the average household income dropped due to the pandemic across all the surveyed settlements (See Figure 2). More than half the respondents were concerned about food running out at home, and 65% who received financial support used the money to buy food [38].

Figure 2 Average income before and after COVID-19 restrictions by settlement (UN-Habitat, 2020)

One response has been to seek alternative livelihood options such as farming and fishing for food (See Figure 3). This expansion of land use for fishing or agriculture or home gardens increases the risk of land disputes.

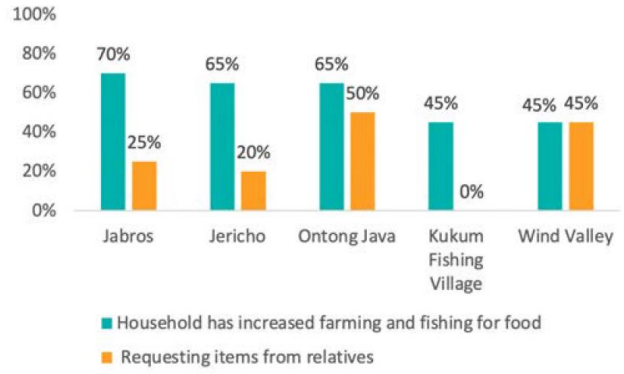

Figure 3 Traditional forms of social protection by settlement (UN-Habitat, 2020)

These factors make responses to climate and pandemic impacts difficult to implement. The pandemic highlighted the underlying socio-economic problems, exposing the fragility of informal

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settlements and slums. Indeed, the outbreak has the potential to push many into poverty and increase their vulnerability. Households rely on limited livelihood options for daily subsistence and are frequently unable to afford soap, food, or medical treatment during movement restrictions or lockdowns [38].

More recently, the UNFCCC Adaptation Fund supported the Climate Resilient Honiara (CRH) project to scope and implement actions identified by the HURCAP. CRH has four work packages at the community level (i) producing comprehensive community profiles, (ii), developing climate action plans in hotspot settlements, (iii) design of engineering solutions based on community need, and (iv) awareness raising and capacity development. ([6]).

The community profiling provides important socio-economic information to inform climate and land responses. The process was based on the vulnerability framework outlined in the HURCAP and the household survey included 54 main questions about the three factors that influence vulnerability (exposure, sensitivity, and adaptive capacity) and six themes: household, livelihoods, housing conditions, utilities, land tenure, and climate change and disaster experiences.

An important part of both the HURCAP and CRH projects has been regular community workshops (See Figure 4) to understand community attitudes and preferences, and to validate the vulnerability assessment and action plans developed. Understanding community perceptions of the land tenure implications is an important part of the consultations.

Figure 4 Community workshop in Ontong Java settlement (Photo by D. McEvoy)

In Honiara, The Ministry of Land Housing and Surveys (MLHS) decision to take no action against informal settlers and those with lapsed TOL was an important first step in improving tenure security. This was evident in the recent COVID-19 survey with almost all (99 percent) respondents perceiving they were safe from eviction, and 95 percent responding they had not been threatened with eviction due to COVID-19 in the 30 days prior to the survey" [38].

The HURCAP and CRH project build on ongoing initiatives such as the Participatory Slum Upgrading Programme (PSUP), supported by UN-Habitat since 2008, and Solomon Islands Government efforts to 'formalise' housing through a more intensive process of subdivision and converting crown to leased land; though with mixed success to date [40]; [6]). The process of land use planning, PSUP and design of new subdivisions has benefitted from existing LiDAR data as well as high-resolution imagery from drones creating a strong spatial framework, despite the dense tree cover in places.

4. Key interlinkages between land tenure and multiple stressors of climate and pandemic

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The key interlinkages discussed in previous sessions are summarized in Table 1 below, and discussed in the section that follows.

Issue/driver	Climate and pandemic vulnerabilities	Land issues	Land governance response, FFP LAS and related land tools
Urbanisation leading to unplanned urban growth in informal settlements. Increased density of development	Climate - more people exposed to climate impacts. Pandemic - increased vulnerability to disease. Limited ventilation between buildings exacerbates disease.	Ineffective urban planning. Increased potential for land disputes	**Effective land use planning and control**, participatory enumeration, FFP LAS, visible boundaries defined on high resolution imagery, tenure-responsive land-use planning.
Informal settlement and limited access to formal water supply and sanitation	Climate - poor water supply and sanitation impacts climate vulnerability. Pandemic - poor water supply and sanitation impacts health and spread of disease.	Impact on tenure security, potential increased threat of eviction and land disputes.	**Securing and safeguarding land tenure rights, Effective land use planning and control**, continuum of land rights, participatory enumerations, FFP LAS, visible boundaries defined on high resolution imagery, tenure-responsive land-use planning.
Informal settlement leaves some households without a formal identity	Climate - may result in disaster affected households not receiving disaster recovery and reconstruction assistance. Pandemic - may result in some households not receiving government pandemic grants and support.	Tenure insecurity can lead to exclusion from government resilience and other programs.	**Securing and safeguarding land tenure rights, Effective land use planning and control**, continuum of land rights, participatory enumeration, FFP LAS, visible boundaries defined on high resolution imagery.
Poor quality house construction and materials	Climate - increased sensitivity to disasters and climate impacts. Pandemic - densely populated small houses impact pandemic responses and spread of disease.	Ineffective urban planning and enforcement of building codes.	**Effective land use planning and control**, continuum of land rights, participatory enumeration, FFP LAS, visible boundaries defined on high resolution imagery, tenure-responsive land-use planning.
Human mobility as an adaptive response	Climate - displacement due to disasters or climate impacts. Pandemic - pandemic restrictions limit human mobility opportunities	Human mobility can lead to tenure insecurity and landlessness	**Securing and safeguarding land tenure rights**, continuum of land rights, participatory enumeration, FFP LAS, visible boundaries defined on high resolution imagery.
Livelihood options and food security	Climate - disasters lead to loss of some existing livelihood options and impacting household income and food security. Pandemic - existing livelihood options reduce affecting household income and household food security. Pandemic -PSUP may lead to decision to resettle households.	Reduced ability to pay rent or mortgage payments may lead to eviction, migration or landlessness. Potential for increased tenure security.	**Securing and safeguarding land tenure rights**, continuum of land rights, participatory enumeration, FFP LAS, visible boundaries defined on high resolution imagery.

Table 1 Key interlinkages between land tenure and multiple stressors of climate and pandemic

Urbanisation is a key driver of urban vulnerability to climate change and pandemics. A lack of affordable and safe land means informal settlements are often located in hotspots of natural hazards, and in areas prone to flooding due to poor drainage, making them more vulnerable to impacts. The ineffective management of urban development has also resulted in environmental degradation, with natural barriers against storm surges and cyclones being removed such as mangroves to make way for private sector coastal development.

Informal settlement of land makes settlers more vulnerable to eviction. Houses built from poor quality materials creates new vulnerabilities to climate change impacts and also future pandemics. Densely populated housing, lack of formal connection to water and sanitation and poverty are underlying vulnerabilities for both COVID-19 and disasters and can contribute to the spread of infectious diseases. The poor and vulnerable groups within informal settlements can be more isolated from social networks and government services. Larger household sizes create additional pressures during a pandemic lockdown as houses also become the workplace for more family members, a place for school work, and for health care. A result for households has been social, structural, economic and political impacts, with the most vulnerable becoming more vulnerable to multiple crises.

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Human mobility is a key vulnerability and tenure security factor. Human mobility can be an important adaptation response if voluntary and if tenure security is protected. However, climate impacts can lead to involuntary migration, resettlement and displacement with each potentially leading to poor tenure security or landlessness. During pandemic lockdowns, the important adaptive responses involving human mobility may not be available.

Both climate impacts and pandemics can lead to loss of livelihoods and impacts on food security. While both these are elements of the stressors of urbanization and climate impacts, they became more critical issues during the COVID-19 pandemic. Loss of livelihoods during the pandemic affected the ability of households to pay mortgages or rent, sometimes forcing human mobility decisions impacting tenure security and the quality of shelter. Reduced cash income during the pandemic reduced the purchasing capacities of the urban poor for basic food items, creating a decline in food security. Where alternative livelihood strategies include expanding agriculture or home gardens the potential for land disputes increases. Land disputes and conflict can lead to increased landlessness and undermines adaptation efforts.

5. FFP LAS for urban resilience

Urban resilience is a key objective in addressing urbanization, climate, pandemic and land issues. It promotes an integrated approach to addressing multiple shocks and stresses, such as climate and pandemics, that impact urban systems both now and into the future [26]. Urban resilience is ehanced by addressing insecure tenure and vulnerability to multiple stressors. As summarized in Table 1, the urban interrelationships between underlying vulnerabilities to pandemics and climate change are complex. These include poverty, lack of access to water and sanitation and basic services, overcrowded informal settlements and limited open space. These vulnerabilities are compounded when a disaster event and a pandemic occur at the same time. A challenge is to address both vulnerability and tenure insecurity at scale.

As informal settlement is the predominant form of new housing in the global south, any process to improve tenure security at scale must include all existing forms of land tenure. The 'continuum of land rights' (See Figure 5) reinforces that in many countries a range of informal and formal tenure systems exist, varying in tenure security, including informal settlement, customary land, freehold, leasehold, and usufruct (land use) rights. In climate-exposed areas, as it is those with least security of tenure who are often the most vulnerable to the impact of natural hazards ([41]; [42]).

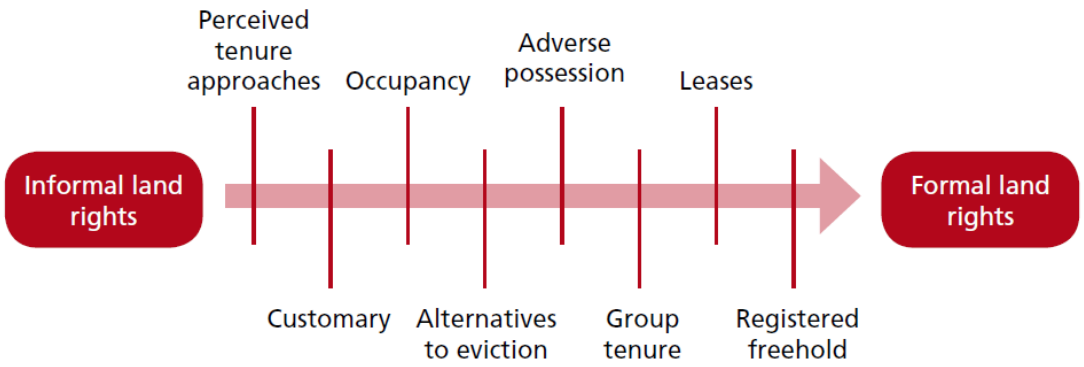

Figure 5 The continuum of land tenure rights (UN-Habitat, IIRR and GLTN, 2012)

The FFP land administration approach supports the data collection and recordation of land tenure, based on the continuum of land rights. FFP LAS focuses on locally appropriate solutions to provide security of tenure and control of land-use. Building from international experience, as well as experience in Honiara, there are some clear lessons for the role of FFP LAS in resilience building

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projects at the city level. The aim is to improve tenure security at scale to support city-wide improvement to resilience to multiple stressors. This can be broadly considered to comprise three main stages:

5.3.1 Assessing the climate, pandemic and land vulnerabilities and risk factors.
5.3.2 Resilience action planning.
5.3.3 Enhancing resilience through responsible land governance

How FFP LAS supports each of these stages is described in the following sections.

5.1. Assessing the climate, pandemic and land vulnerabilities and risk factors

The UN-Habitat Cities and Climate Change Initiative (CCCI) has supported city-wide climate change Vulnerability and Risk Assessments (VRA) identifying 'hotspots' which include informal settlements. As part of a comprehensive system's response to risk and vulnerability, the VRA supports the development of climate Action Plans with targeted actions to build the resilience of communities [38]. Based on internationally recognized methodologies the VRA analyses climate hazard characteristics, exposure, sensitivity, and adaptive capacity (See Figure 6).

The development of climate and pandemic resilient actions plans requires a deep understanding of the existing risk factors and vulnerabilities faced by households and other stakeholders. It is also important that resilience planning and implementation applies to all existing households – not just those with formal land records. This household-level and settlement-level understanding also supports decisions on housing and tenure security which need to be explicitly informed by climate impacts and a vulnerability assessment of affected communities in informal settlements.

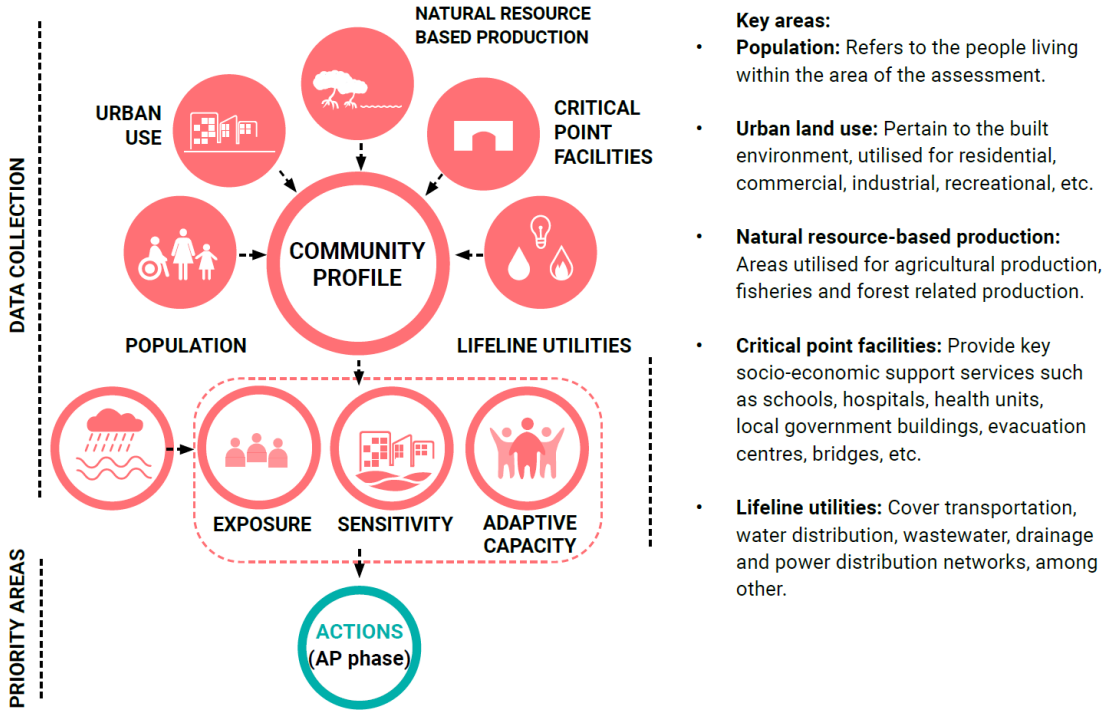

Figure 6 Vulnerability and Risk Assessment and Action Planning overview [38]

5.1.1 Community Profiling supported by participatory enumeration to record land tenure and vulnerability to multiple stressors.

Community profiling based on a multi-stressor VRA helps to design actions plans to build resilience so that both climate and pandemic responses are integrated into a broader resilience development process. Integrated climate change VRA can include tenure security assessment. These inform actions

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including climate change adaptation, resilience building, urban planning and infrastructure provision. A multi-stressor VRA supports a consultative, bottom-up, and more inclusive approach to the development of actions plans. Community profiling also provides valuable understanding of the diversity of the population and their existing vulnerabilities. Community profiling is based on participatory enumeration using household surveys at the settlement level, supported by spatial information that provides mapping of the houses, public buildings and infrastructure in the settlement.

5.1.2 A FFP LAS approach to building the spatial framework.

A key component of FFP LAS is the large-scale spatial framework comprising mapping that identifies the buildings and land parcels across the continuum of land rights to support decisions on securing land tenure rights and land use control. A low-cost approach using high-resolution imagery, and adopting the principle of visible boundaries, allows expansion of the land administration system at scale with this imagery used to support registration processes [42]. Once the spatial framework is developed the imagery data is also very useful to support the community profiling and vulnerability assessment processes, assessment of tenure security, as well as supporting community consultation discussions on action plans. Mapping of tenure security mapping based on the concept of the continuum of land rights is possible in the community profiling process. It provides the necessary baseline data to inform tenure-responsive land use planning, using approaches to land administration that are fit-for-purpose [6].

5.2. Action planning

The findings from the VRA lay the foundation for the action planning. The aim of the AP is to support communities to decide upon community-based interventions to strengthen their resilience to climate change and supporting development [38]. Community profiling and a FFP LAS approach to developing a spatial framework provide the basis for the design of action plans and community and stakeholder consultation to validate these action plans. This detailed understanding and mapping is also very useful for support resolution of disputes over land. This detailed baseline information allows harmonization between resilience action planning and actions to improve tenure security such as slum upgrading programs, or land readjustment projects. The mapping and community profiling can also support systematic and sporadic formal land recording. The resilience action planning stage is where land issues can be mainstreamed into climate action plans, and hazard-risk information can be mainstreamed into land administration and land use planning.

5.3. Enhancing resilience through responsible land governance

The need for secure land tenure is recognized in the Committee on World Food Security (CFS) endorsed 'Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security' (VGGTs) which call on States to ensure that legitimate tenure rights are respected and protected. To achieve this climate change adaptation and disaster risk management need to be better mainstreamed into two major elements of responsible land governance (i) securing and safeguarding of all formal and informal land tenure rights and (ii) effective planning and control of land-use to prevent housing in the most hazard-prone locations ([42], [4]). Taking a responsible land governance approach informed by the VGGTs provides a pathway to address tenure security in the process of climate change adaption and resilience building.

5.3.1 Securing and safeguarding land tenure rights at scale

Safeguarding all land tenure rights involves understanding, recording and recognising the complex, long-established and accepted social tenure relationships - including informal settlement. In the short-term, addressing forced evictions and tenure insecurity are key. At the policy level, acceptance of the right of informal settlers to live there and a moratorium on evictions are key measures in improving tenure security. Slum upgrading is one approach to improve security of tenure, and

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upgrade infrastructure and facilities in settlements, as well as reduce hazard risk. UN-Habitat's Participatory Slum Upgrading Programme (PSUP) seeks to address vulnerability and marginalization during informal settlements upgrading [38].

A FFP LAS approach is necessary to do this complex task at scale, based on participatory enumeration that informs community profiles including existing tenure arrangements and perceptions of tenure security. FFP LAS supports the data collection and recording of informal land rights as well as formal land rights. Land tools for recording the people-to-land relationship – including social tenures – can be used to support recognising and recording land tenure rights, especially for the poor and informal settlers. One example is the Social Tenure Domain Model which can record complex land-people relationships based on the Land Administration Domain Model, and can later be upgraded for inclusion in the formal register of land records.

5.3.4 Tenure-responsive land use planning

Effective planning and control of land-use is necessary to restrict housing being built in unsafe or hazard-prone locations, and to make decisions to support slum upgrading where informal settlement is well established. Medium- to long-term improvement in community resilience to climate and pandemic stressors requires improving housing quality, connection to formal water supply and sanitation, and tenure insecurity in informal settlements. The community profiling based on VRA and an assessment of tenure security, supported by the FFP LAS spatial framework and recording of the people-land relationships, is a strong basis for effective land use planning and control. This means that land use planning can be tenure -responsive and cognizant of vulnerability and risk.

5. Conclusions

Based on an extensive literature review, and participatory action research based in Honiara, this paper discussed the benefits of FFP LAS for community resilience to multiple shocks and stresses. Lessons from current resilience projects show that the FFP LAS, informed by vulnerability assessments and community profiling can allow scaling up of the number of households with security of tenure and improved resilience outcomes as informal settlements grow. We contend that FFP land administration approach, informed by participatory enumeration of the complexity of urban land tenure, can support scaling up efforts to improve tenure security and deliver more effective and equitable climate resilience actions for vulnerable urban communities in the Global South. The paper has proposed ways in which the growth of human settlements can be better managed through responsible governance of land tenure rights, and effective land-use planning to improve resilience, supported by FFP LAS, and provide adequate access to safe land and shelter.

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