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Compounding challenges for disaster resilience in small island developing states

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Abstract

No country will escape the ravages of climate change, but some, like small island developing states (SIDS), will be less able to withstand them. Their fundamental characteristics in essential domains pose existential threats for them. The paper borrows from Lukka and Vinnari's work on domain and method theories as a lens to conceptually explore the question, "Is it possible for SIDS to become disaster resilient?" It turns out that SIDS might be too small, too isolated, too economically and institutionally weak, and too exposed to become disaster resilient. Their developmental state, economic, institutional, and community attributes are causes of significant vulnerabilities and undermine disaster resilience efforts. The challenges from climate change alone highlight the herculean task ahead for these small and tiny developing islands without transformative actions. The advantage for SIDS is their solid social system. Their populations are resourceful, and they can pivot if they need to. However, the lingering question remains whether that will be enough to mitigate the weaknesses in other critical resilience domains?

Keywords: Disaster resilience, SIDS, resilience domains, resilience gaps

INTRODUCTION

It is challenging, if not impossible, for small island developing states (SIDS) to become disaster resilient ceteris paribus. Decades of development and disaster work in SIDS have made some but no significant inroads into the disaster resilience quest. Of all countries, SIDS face particular struggles with the effects of

natural hazards, including those that result from the changing climate. Despite variations in their geography, size, biodiversity, and their cultural diversity, SIDS as a group share fundamental challenges, including economic, institutional, social, and community[1], that amplify hazard effects and undermine disaster resilience efforts. For instance, SIDS' development is not always positive. Most are former colonies, and their developmental policies, processes, and procedures have progressed in ways that better fit their places of origin in the "developed" world[2]. Consequently, when applied in SIDS, these policies and practices often result in adverse effects and unintended consequences. Against such background, this paper explores the question: "is it possible for SIDS to become disaster resilient?

This question is especially pertinent for the smallest and most under-developed ones. The central global disaster resilience and development agreements from the Hyogo Framework for Action to the Sendai framework, sustainable development goals, the 2030 agenda for sustainable development, and climate change adaptation deploy "resilience" as their central development principle. However, in the case of SIDS, there are practical problems with this push.

Practically, as the 1992 United Nations Conference on Environment and Development in Rio de Janeiro acknowledged, SIDS are increasingly constrained by the interaction of numerous adverse factors that make them highly vulnerable. Vulnerability is a multidimensional term that implies a potential for loss due to exposure because of underlying factors[3,4]. Environmental conditions, socioeconomic vulnerability, and hazard threats together determine the spatial extent and scale of disaster impact. More specifically, SIDS' smallness, isolation, economic exposure to external shocks, social and community contexts, and institutional under-capacity are significant sources of vulnerability. Their size and geography alone make it extremely difficult for SIDS to be resilient. One hazard event could wipe out most of the smallest SIDS. The challenges associated with climate change are already visible in SIDS.

Moreover, solutions to reduce vulnerabilities and drive disaster resilience are often uncoordinated and pushed through piecemeal efforts, usually from outside actors. These efforts do not provide the systematic help necessary to support SIDS as they become resilient. When we add the economic challenges, SIDS face incredible odds in their attempts to become disaster resilient.

This paper conceptually considers the issues that might explain why disaster resilience might be impossible for SIDS. In doing so, it also contributes to the conceptual and operationalization debates. The 2021 IPCC report projects that climate change will only increase the vulnerabilities without drastic interventions by islands and regions in the coming decades[5]. Although SIDS account for less than one percent of global greenhouse gases, they bear the brunt of the effects[5]. Sea-level rise, increasing heatwaves, changing rainfall patterns, and storm surges are already having cascading effects and threaten to amplify impacts across SIDS. The cumulative effects of these threaten to reverse the progress made towards reducing vulnerabilities in SIDS when compared with other places. Moreover, increased economic hardships in SIDS touched by the Corona Virus, continued water shortages, massive flooding, intense drought, underwater volcanic eruption and tsunami around Tonga, and even famine in Madagascar justify a focus on this question.

METHODS

The paper employs a conceptual research design that utilizes already developed and tested theories and concepts to analyze, justify argumentation and arrive at conclusions about the claim.

Claim and assumption

This paper starts with the focal phenomenon "disaster resilience" and an application context "SIDS" [Figure 1]. Using pre-existing literature on both disaster resilience and SIDS, the author begins by claiming that it is challenging, if not impossible, for SIDS to become disaster resilient ceteris paribus. The author suggests that we blame this on a resilience gap. In the context of SIDS as places, critical dimensions operate in a dynamic relationship and, because they are weak, serve to undermine each other. For instance, issues related to the extent of hazard impacts and the ability to withstand and recover from them originate in the interactions among these dimensions. If these interactions do not create net positive outcomes, that place will not become disaster resilient over time. There needs to be some convergence between the domain characteristics necessary for disaster resilience of places and the fundamental characteristic of these places.

Theory selection and conceptualization

The research builds on two central bodies of literature: one on disaster resilience and the other on SIDS. The literature on disaster resilience shows a complex array of interacting and interconnected elements that impact disaster resilience - economics influence the structural-developmental trajectories of countries. Public policymaking and administration resolve imbalances in wealth distribution, power relations, discrimination, marginalization, and disempowerment. Public policy and administration should build individuals and communities' capacities, resources, and coping mechanisms at various levels and sectors[6,7]. A long and widely accepted body of literature (e.g., Refs.[8-11]) supports this thinking. This scholarship suggests at least two essential threads.

One, the preconditions necessary for systems to become disaster resilient are interdependent, historical, and ongoing at the same time. Risk is transferred into the future and compounded[10]. Therefore, scholars (see, for example, Ref.[11]) have wondered which aspects of the disaster resilience concept are appropriate in social settings. Even before places can address resilience, they must understand their vulnerabilities. Poor development choices are exacerbated over time, compounding risks and vulnerabilities of people and places. Some might have had nothing to do with generating them. Prior generations' decisions, policies, and practices or those located in seemingly unrelated locations can create hazard vulnerabilities or adaptability characteristics that affect current populations far removed from them (e.g., climate change, economic shocks).

It is detrimental and inaccurate to downplay significant social-psychological processes when assessing and formulating policies on disaster resilience. A significant difference between human and natural ecosystems is the human capacity to anticipate, learn and reset[12]. Socio-psychological theories suggest an impact of the human spirit on their survival[12]. Moreover, aspects of human social psychology impact economic and institutional systems and social functioning that then affect either vulnerability or resilience.

The literature on SIDS shows that although there is diversity among them, several systemic characteristics display similarities. They are a subgroup of developing and least-developed island states that share hazard vulnerabilities and disaster proneness because of their size, environment, and development history and trajectory. SIDS are usually underdeveloped, most are small or tiny, and they sit in geographic regions that predispose them to frequent hazard impacts. This trifecta presents SIDS with unique challenges about which developed states and even larger developing states are less concerned.

Conceptual lens

The paper borrows from Lukka and Vinnari's[13] work on domain and method theories as the lens to address the research question. A domain theory is the set of knowledge on a substantive topic area. In contrast, a method theory is a meta-level conceptual system for studying a substantive issue of the domain theory[13].

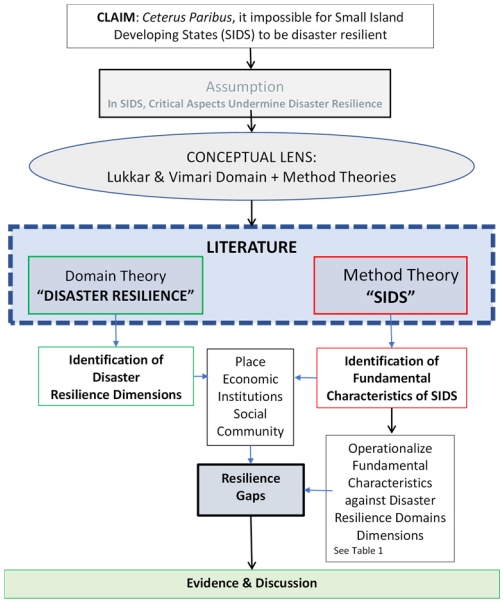

Figure 1. Research methods flow chart.

The method theory helps to provide insights into the domain theory. For example, the method theory could expand, help to organize, or offer a new or alternative explanation of concepts and relationships.

Domain theory

Disaster resilience is the domain theory. The paper uses aspects of the domain theory as critical filters to understand and then sort through essential features in the method theory context (SIDS). The paper deductively identifies multiple dimensions of disaster resilience - the physical aspects of the place itself, its economic, institutional, social, and community resilience. Disaster resilience is a system concept. The place constitutes the system. It is more or less disaster-resilient depending on the level of vulnerability that exists and how well it can resist, rebound, recover from the impacts of hazards. The bridging concept facilitates and integrates interaction among the other domains and provides feedback. "Institutions" constitute the bridging concept. They facilitate disaster resilience by connecting and facilitating the working of multiple domains, each interacting with others to produce either resilience or vulnerability. Boundaries and environment are features of a system. The boundaries denote the limit of the system and better help to focus us on the activities carried on in that system. Those things outside the system's boundary constitute its environment. Change in the environment will affect the working of the system. (e.g., supply chain; depreciation or devaluation of the US$).

Method theory

SIDS fundamental characteristics constitute the method theory. SIDS comprises nearly 38 small developing islands and 11 territories whose aggregate population stands at around 65 million, slightly less than 1% of the world's population[14]. Most SIDS sit in tropical and sub-tropical areas in the Pacific, Indian, and Atlantic Oceans off Africa's west coast and the Caribbean Sea[14]. A few small developing islands such as Malta and Cyprus lie outside these areas in the Mediterranean Sea. Listed by the United Nations as a particular group of developing countries, the enormous level of vulnerability that comes with small size prompted the 1994 UN Global Conference on the Sustainable Development of SIDS. The "SIDS" designation came in April 1994 at the first Global Conference on Sustainable Development in Barbados. The United Nations Conference on Environment and Development in Rio de Janeiro in 1992 acknowledged that the interplay of

numerous adverse factors increasingly constrain SIDS. In 2002, the World Summit on Sustainable Development highlighted that SIDS constitutes a particular case for environment and development[15].

The group is not a monolith. Eight (Comoros, Haiti, Solomon Islands, Timor Leste, Tuvalu, São Tomé and Príncipe, Kiribati, Guinea-Bissau) are designated least developed islands[14,16]. These SIDS are highly vulnerable to economic shocks and environmental degradation and have low human capacity assets, which pose problems for disaster resilience, sustained growth, and development[6]. Amongst the most vulnerable to shocks and crises, LDCs are those left farthest behind from attaining the sustainable development goals[17]. However, all SIDS share a common experience on critical characteristics of development.

JUSTIFICATION FOR THE DOMAIN THEORY AND COMPONENTS

Disaster resilience

Disaster resilience is understood as the ability of a system, community or society exposed to hazards, to resist, absorb, accommodate to, and recover from the effects of a hazard in a timely and efficient manner[18]. It includes the preservation and restoration of its essential basic structures and functions[18]. The concept of "resilience" has attracted attention and debate in a variety of literature. Still, Alexander[19] shows the durability of resilience's central meanings. The term's central meaning remains across disciplines such as mechanics, psychology, medicine, ecology, economics: to maintain integrity, absorbing, rebounding, recovering, and robustness. The concept is used in this sense here.

The proponents of sustainable development, disaster risk reduction, and climate change, especially global development organizations, have enlisted these central meanings of "resilience". Places can rebound and recover if they reorient their development philosophy and actions away from piecemeal efforts towards a more holistic approach and more systematic pursuit. Better integration of a recovery, rebounding, and innovation mindset into development and sustainability planning is vital for disaster resilience. Disaster resilience relies on our capacity to learn and systematically use the information and evidence to ameliorate the developmental crises SIDS face[20]. The paper's arguments rest on five resilience dimensions that the following sections discuss.

Resilience of place

In the context of places, resilience thinking understands them not as neutral entities but as complex systems in constant flux[21] because they are constantly evolving. Disaster resilience of place (DROP) proponents focus on the connections between social systems and their built and natural environmental systems (e.g. Refs.[20,22]). DROP explicitly recognizes that disasters happen to people in places. Consequently, when contemplating disaster resilience, both place and people matter. Pressures on any will increase vulnerability in others and lessen opportunities to build aggregate resilience of that place.

Suppose we understand places as complex and adaptive systems rather than orderly, mechanical, and reasonably predictable locations. Then, we would better understand their chaotic, complex, uncertain, and unpredictable nature and thus their inherent contradictions. Understanding this, we can perceive the seemingly stable state around us in nature or society as radically different than previously thought[6]. SIDS cannot change their small size, remoteness, or geographical vulnerabilities. These are facts of their existence. However, are these limitations insurmountable in the context of disaster resilience building?

Economic resilience

Disasters result from a lack of smart economic investments in places. We experience them through physical damage, personal and national infrastructural destruction, and social-economic losses. Investments in the

building and hardening of public infrastructure, mitigation efforts, homeownership, business environment, economic diversification, technology, innovation, educational and health outcome, income equality, and disempowerment all play significant roles in hazard exposure and disaster outcomes. Duval *et al.*[23] suggest that economic resilience comprises a couple of dimensions, including whether and how we dampen or smoothen shocks over time and hasten the speed of economic recovery following these shocks (see Ref.[23]). In line with Duval *et al.*[23], Hallegatte[24] proposes that we understand economic resilience in macro and micro-economic ways. Macroeconomic resilience points to a society's overall welfare capacity to cope with, recover from, and rebuild after a natural or human-induced event. It has two components: instantaneous resilience, which is the ability to keep aggregated short-term production and consumption losses as small as possible for a given amount of capital losses[24], and dynamic resilience, which is the ability to reconstruct and recover quickly[24]. Wise structural policies will reduce economic shocks' strength and persistence and improve welfare. For example, macroeconomic stabilization policies play an essential role in economic resilience. So too do policies to reduce the considerable reliance on a single sector, usually tourism, and on taxes and foreign aid[24]. These will reduce SIDS' revenues consumed by debt servicing and increase the portion left for investments in people and their communities. However, policy effectiveness is conditioned on the public administration's capacity to formulate, implement, and manage them. Gaillard and Jigyasu[25] warn against using reductionist and top-down approaches in assessing resilience.

At the microeconomic level, hazards affect income and livelihood, rationing in some sectors, loss of employment and tax revenues, savings losses, increased household and individual borrowing, and insurance losses. These, individually or combined, could negatively impact the social protection system and other mechanisms for sharing risks across the population (see Ref.[26]).

In the end, micro-level impacts affect the pace at which recovery ensues. Micro-economic resilience depends on the distribution of household losses and their impact on household and individual vulnerability or wellbeing considering pre-disaster income[26].

Institutional resilience

Institutions are the complex social forms that reproduce themselves in society[27]. The paper uses a country's "institutional context" as constitutive of the specific "apparatus" that formulates, enforces, and evaluates laws, regulations, and standards and delivers public services and social support - i.e., public policy and administration system. Effective public administration works as a critical component to facilitate disaster resilience[28,29]. Policy and administration enable ordered behavior, actions, and expectations by imposing form and consistency on human activities[29]. It is the mechanism that helps direct and promotes a country's disaster resilience agenda by working at the intersection of economic, social, developmental, environmental, community systems, and policy action. According to Ref.[30], institutional systems are resilient if they can withstand disturbances, provide stability, and reduce uncertainty in the sub-systems in which the disturbances occurred. The difference in storm damage in Haiti and the adjoining Dominican Republic or Dominica and Jamaica lies in their institutions' quality and ability to rebound and recover[6] and facilitate this recovery and rebounding in others.

Formal institutions are constitutive of all kinds of legally binding norms, such as constitutions, laws, and policies in the political system (e.g., the governance structure), the economic system (e.g., property rights), and the policy enforcement system (e.g., Ref.[30]). From empirical studies, Sjostedt and Povitkina[29] find that government effectiveness substantially affects the number of people killed or affected by natural disasters. So too do their voice and accountability, political stability and absence of violence, regulatory quality, and control of corruption - good governance indicators. The group, SIDS, experience disasters differently,

indicating variation in vulnerability and governance quality.

Social rules passed from one generation to the next form the basis of formal institutional arrangements and, therefore, are central to disaster resilience[31]. So too are the types of policies crafted and societal problems solved linked to a place's social rules and culture. Embedded in its social context is a culture's propensity for innovation and creative socio-cultural adaptation[31]. For example, Djalante *et al.*[32] found that to a large extent in Indonesia, their social-cultural practices influenced disaster resilience-related regulatory policies implemented by government and non-government actors.

Local and indigenous institutions, including local governments, civic associations, service organizations, interactions, and relationships, are part of the institutional context[33]. They are closer to their people and work better to integrate their traditions and lived experiences into formal practices and policies[6]. Like the term "institution", "indigenous institutions" show wide variation and, as such, are difficult to define. However, they are typically informal, pre-exist the state, and embed informal practices, customs, and norms that have evolved and say what is allowed and what is not Ref.[33].

The formal (legal, written, codifiable, or explicit) and informal institutions (norms) are inextricably linked. Formal institutions always depend upon nonlegal rules and inexplicit norms to operate[30]. Without informal support, formal institutions are not viable. Moreover, legal rules become important only by becoming embedded into customs and habits[30]. These have roots in the social and community contexts of a place.

Social resilience

The challenges confronting SIDS at the local, national, and international levels have brought with them increasing attention to the concept of social resilience. Social resilience is seen at multiple levels by the capacities of individuals and groups to foster, engage in, and sustain positive social relationships, which later help them endure and recover from stressors and social isolation[34]. For this paper, social resilience is the capacity of people and communities to systematically deal with internal and external stresses and shocks by learning and self-organizing in ways that maintain system function[35]. It is "how individuals, communities, and societies adapt, transform, and potentially become stronger when faced with environmental, social, economic or political challenges"[31,36]. Households and individuals' adaptive capacities are enmeshed in the group and other local and indigenous institutions and work to shape their decision-making and behavior patterns (see Ref.[36]). This adaptive capacity translates over time into activities that promote disaster resilience. Without it, the negative aspects of development often overtake groups and communities, resulting in increased vulnerabilities, such as deforestation of polluting water resources to build private housing developments that later hurt intended community beneficiaries.

Various aspects of a community's adaptive capacity build disaster resilience. For instance, the capacity to monitor and respond to environmental feedback[24] or developing social networks[34,37] are essential for social resilience. Moreover, sharing information and knowledge through these networks[35,36]; representation in them, accountability, empowerment, social justice[9], collaborative and social learning[36,38]. These are imperatives for resilient social systems. Human beings are unique within social-ecological systems because they can create novel approaches to transform the system's future[30]. These attributes assist people, and their social systems manage crises and making successful transformations[31].

Resilience research details that change and adaptation are always possible[39]. Consider psychological resilience. In psychology, resilience research scholars[40] generally understand that prior adversity help individuals to prepare themselves to withstand and recover from later traumas more quickly. Individuals

develop resources, relationships, and effective coping strategies based on prior understanding from lived experiences by themselves or others. In social contexts, resilience captures how people facing ongoing adversity not only survive these circumstances but thrive in the face of such adversity[40]. How well do individuals, communities, and governments leverage this adaptive capacity? Do they do so enough? Issues such as poverty, inequity, lack of access, and marginalization overlap to retard adaptive capacity and, ultimately, social resilience.

Community resilience

Communities can be understood "as the totality of social system interactions within a defined geographic space such as a neighborhood, census tract, city, or county"[1]. The concept of community resilience is contentious. Scholars have advanced multiple different aspects to understand community resilience. Some emphasize physical structures from an engineering perspective, while others focus on institutional and interpersonal dimensions, informed by the social and behavioral sciences[41]. For instance, Mileti[42] defines a resilient community as one that can both "withstand an extreme event with a tolerable level of losses" and can "take mitigation actions consistent with achieving that level of protection". The starting point is to identify the risks and potential challenges, develop measurement and benchmark tools to understand better those factors contributing to resilience, and then formulate effective interventions to sustain it[43]. Magis[41] provides a more comprehensive definition of the concept, tying community resilience to community members' dependence on and using community resources to develop and grow in environments characterized by change, uncertainty, unpredictability, and surprise. Still, others link social systems and their built and natural environmental systems as central to community resilience. While the same policies govern each community, differences among individuals and between groups predispose them to different vulnerabilities and capacities to cope with and recover from hazards. Disaster resilience of place (DROP) explicitly recognizes that disasters happen to people in places[20]. DROP reflects the connections between social systems built and natural environmental systems. Social structures are essential since those communities high in social contact usually recover faster after a disaster.

In these definitions is the realization that place matters as much as the people do when considering community resilience, and so do their adaptive capacities. Pressures to any social, natural, or built systems can increase community vulnerability. The following sections lay out SIDS' challenges to achieving their disaster resilience agenda.

Connecting domain and method theories

Operationalizations of critical elements of the domain theory in SIDS connect domain and method theories. Table 1 summarizes these connections.

As is expected in complex systems, the interdependence and interconnections of various domain elements also cause overlaps among some proxy variables. The discussion section examines these in the context of SIDS' and their quest to become disaster resilient.

Contributions to field

This paper contributes to the ongoing debate on disaster resilience by placing a specific focus on SIDS. It lays out some obstacles to achieving resilience in these developmental contexts. The paper also contributes to the conceptual and operational debates about "resilience" by highlighting and connecting dimensions of disaster resilience, proxy variables, and indicators that researchers can further finetune.

Table 1. Operationalizing the domain theory in SIDS

Domain theory (Disaster resilience)	Method theory (Proxy variables of the domain theory)
Place	Size, geography, Remoteness, distance from markets Climate vulnerability, Continued hurricane damage, Settlement Patterns Sea level rise Water vulnerability; droughts - agricultural decline
Economic	Macro Micro Dimensions: Debt distress — Distribution of HH losses External indebtedness — Patterns of marginalization High poverty rates — High under or unemployment Financial shocks driven by global trends — Low employment rates Price taking — Multidimensional poverty Undiversified economies dependence on government to drive the economy
Institution (Public policy and administration system)	Administrative capacity at all levels Favoritism v. merit Reliance on outside actors. Government effectiveness; regulatory quality; voice of accountability; political stability and the absence of violence; control of corruption Opportunities for private sector involvement Local and indigenous input in policies and administration Local capacity
Social	Psychology of survival: resourcefulness and willingness to try new things Social capital Norms -e.g., disaster recovery financing Gender inequality; exclusion; exploitation, victimization, marginalization;
Community	Public infrastructure (transportation) & asset management Brain drain Lack of available, reliable, and actionable data Rapid Urbanization High level of informal employment/underemployment High exposure of people and assets- much is historical

Limitations

This paper attempts to do what might be challenging to do practically conceptually. While disaster resilience's social, community, and economic aspects are essential, operational and measurement difficulties capture their underlying variabilities across different societal systems[19]. Where possible, the author collects comparative data across multiple SIDS. In addition, there are yet conceived issues missing from our scope. Despite our best effort, we cannot capture all that is important to conceptualizing and measuring disaster resilience.

The researcher took some latitude in what aspects of resilience to include and how these might manifest in SIDS. While the study can conclude a relationship between the variables and disaster resilience, it cannot indicate the significance or direction of this relationship since the author did no quantitative research. Other researchers and institutions collected all data used. In this regard, future research will need to revise the specific conceptualizations and perhaps include a method for data gathering. However, the paper does present data and information to build arguments in support of the claim made.

EVIDENCE AND DISCUSSION

When domain and method theories merge in SIDS, we find disaster resilience gaps. These gaps are made explicit in the operationalization of the significant domains of the domain theory. They militate against SIDS, becoming disaster resilient.

Physical attributes of place

Size

Physical attributes of SIDS pose significant hindrances to their disaster resilience. Their small size does not mean that SIDS' problems are minor. Instead, they are complex and even existential because of it (see Ref.[44]). SIDS are highly exposed places in which disaster losses have been exceptionally high. Historical data show that from 1970-to 2010, disaster losses exceeded one percent 1% of GDP and surpassed eight percent 8% in the most extreme cases (see Ref.[45]). As an example, in 2017, The damage from Hurricane Maria wiped out 226% of Dominica's GDP[46] and resulted in massive displacement and loss of livelihoods. Very little of that small island was unimpacted. Moreover, because most SIDS are small coastal states, a single storm, tsunami, volcano, or earthquake might completely inundate their territory or cause wide-scale destruction, rendering the remaining unaffected parts unable to assist recovery efforts[6]. Their size, then, by itself might pose existential challenges but is compounded by other threats that result from this physical attribute.

Climate

SIDS bear the brunt of an increasingly extreme and unpredictable global climate. Although climate change impacts are not confined to SIDS, their coastal cities are exposed to sea-level rise. Most of their human settlements, social and economic activities, and public infrastructure lie in or near their coasts. More than half the populations usually live within 1.5 km of the sea in the Caribbean islands[47]. With the average rate of sea-level rise around the Pacific region estimated at 0.77 millimeters per year and around 1.5 mm per year in the Indian Ocean, that phenomenon poses an existential challenge to those islands[47].

Sea-level rise threatens the very existence and sovereignty of many SIDS and their populations. It already leads to substantial losses of territory in many. The tiny island of Tuvalu and some of the vast islands like Papua New Guinea in the Pacific are already experiencing shrinkage of their livable space by around 20 cm annually[5]. As such, SIDS face the real threats of possibly even disappearing from the face of the earth! That is no exaggeration.

Moreover, SIDS face numerous challenges due to their geography and biodiversity because of extreme climatological, seismic events, and other adverse environmental impacts. Climate change threatens to wipe out much of their rich diversity of endemic flora and fauna, hence, increasing their resource-related challenges because of their bio-physical settings[5]. SIDS are not exempt from the toll of intense droughts because water surrounds them, far from it. They face extended periods of freshwater shortage.

Droughts' frequency, scope, and intensity pose an underestimated systemic challenge to lives, economies, and ecosystems[48] in SIDS. Periods of intense droughts have now resulted in a famine in Madagascar. Water shortages accompanied by water sovereignty woes threaten to add complexity to SIDS' water problems. Seventy-one percent of SIDS face a risk of water shortage, and 91% of SIDS in the lowest altitude are water insecure[48]. Surrounded by seas or the oceans, SIDS' groundwater is prone to saline intrusion, rendering groundwater unfit for drinking without treatment: roughly 73% of SIDS face a risk of groundwater pollution[49]. Climate change pace and intensity in the last decade indicate a bleak future for SIDS. The 2021 IPCC report shows that a mix of shifting climates, poor water management practices, and growing population densities promise a near future of catastrophic droughts[5]. Sea-level rise and a lack of potable water will intensify agricultural decline, food insecurity, and starvation, presenting severe risks that SIDS could become uninhabitable[5].

Economics

The concept of economic resilience has been garnering increasing interest from international and national policymakers. As Hallegatte[24] points out that improving overall disaster resilience means improving the

economy's micro and macro components.

Macro-components

Economic risks present additional strains on SIDS' economies and development trajectory. SIDS' small size limits their exploitation of economies of scale due mainly to limited scope for specialization[24] and a general lack of diversity in their economies. In addition, smallness also means limited ability to influence domestic prices. SIDS tend to be price-takers more than most other developing countries. Their trade volumes are relatively small compared with other markets[24], and, unfortunately, they are highly import-dependent. Furthermore, they have little control over the prices of their exports. These, combined, mean that SIDS require a large amount of foreign exchange to pay for the large import bill[50]. This situation leaves little resources to invest in the country and people.

SIDS remain vulnerable to global financial shocks. The situation is made more onerous by the UN classification of many SIDS as middle-income countries, barring them from access to official development assistance and other forms of concessionary financing[16]. Mounting debt and a lack of structural economic diversity are arguably the most important factors that impede development and perpetuate poverty, insecurity, and overall vulnerability. External indebtedness in SIDS is considerably higher than that of other developing countries. Between 2000 and 2019, for example, the external debt of SIDS rose by 24 percentage points of GDP[51]. By 2019, external debt accounted for 62% of GDP on average in SIDS [Figure 1], compared with 29% for all developing countries and economies in transition[51]. Global competitiveness for the world in 2019 was 4.37 out of 5. In Jamaica, it was 4.25, 4.19 in Barbados, 4.09 in Trinidad and Tobago, 3.76 in Cabo Verde, and 3.22 in Haiti[52].

The impact of COVID 19 has worsened many SIDS debt to unsustainable levels. The crisis has threatened the livelihoods of 1.6 billion workers in the informal economy, and the collapse of international tourism disproportionally affects SIDS[53]. While not all are going to SIDS, international tourist arrivals account for much of the islands' revenues. They fell from 1.5 billion in 2019 to 381 million in 2020 - and might take upwards of 4 years to return to 2019 levels; air passengers dropped by 60% from 4.5 billion in 2019 to 1.8 billion in 2020[54]. In addition, SIDS's high levels of public and private debt continue to weigh on investment, and poor and emerging economies are particularly exposed[51]. A diverse set of refinancing options has come with greater exposure to sudden exchange and interest rates changes[55].

Significant efforts are necessary to harden SIDS economies. Most are undiversified, relying primarily on tourism, agriculture, and fishing as their primary industries – all of which severe weather and climate change put in jeopardy. In addition, these industries are dependent on well-functioning infrastructure, which also plays a crucial role in building climate resilience. Tourism accounts for almost 30% of SIDS' GDP[53]. Wide fluctuations in that sector mean that many SIDS are quickly moving from liquidity to a solvency crisis[17], and the COVID 19 pandemic is making it worse[53]. Early in the pandemic, efforts to contain the virus, including physical distancing, resulted in a virtual shutdown of tourism[55]. The shutdown has had a significant impact on allied sectors and businesses. For instance, GDP in Pacific SIDS has already decreased around 5%, and the resultant unemployment throughout the region is rising[55]. This situation means an economic recession could loom in the Pacific[54] and other SIDS as well.

Figure 2 shows the level of debt distress in SIDS. The ratio of total public debt, debt service to government revenues, and current account deficit in SIDS will help us understand the severity of their debt distress[51]. When these indicators are all high, a country is likely to experience debt distress. In such instances, the country dedicates a large percentage of public revenues to debt repayments, leaving too little for

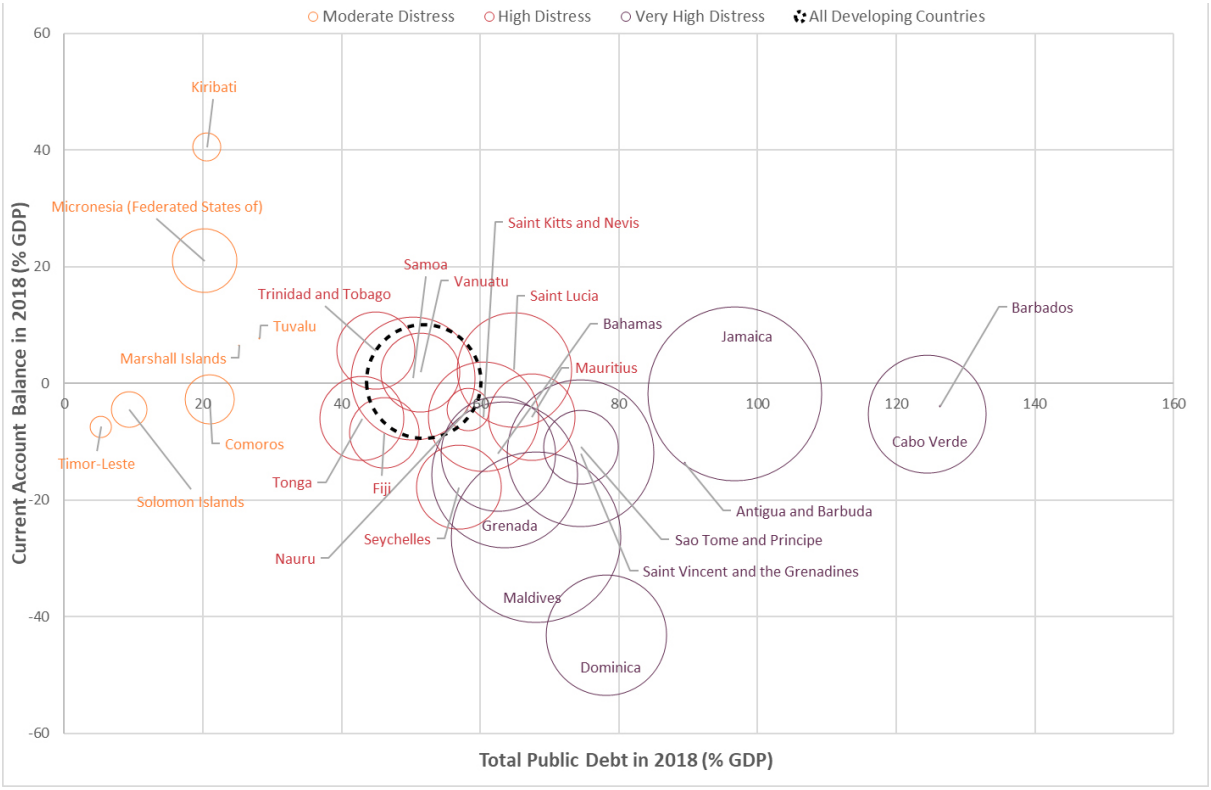

Figure 2. Used with the authors' permission.

infrastructure or public services and disaster recovery [see Figure 2]. In Dominica, for example, total public debt stands at around 78% of GDP; the current account deficit is 43% of GDP, and the debt service rate is high (10% of all government revenues).

SIDS generally have higher debt distress than other developing countries, but considerable variability among them. Barbados (restructured its public debt for the first time in 2018 and 2019), Jamaica, Antigua, and Barbuda, Dominica, Cabo Verde, Sao Tome, and Principe, Saint Vincent and the Grenadines, Maldives, and Grenada, all have exceptionally high levels of debt distress[51]. Most of the increase in debt distress occurred after the 2008 global financial crisis and accelerated in 2013 when US bond yields surged after the Federal Reserve announced a monetary policy normalization[51]. This normalization triggered capital outflows from SIDS for higher returns, currency depreciation, and a spike in external debt relative to GDP, followed by a series of external shocks. All of these put debt positions under further strain[51].

Micro-components

At the micro-level, significant portions of SIDS' population face high poverty rates. Among those living on US$1.25 per day, Haiti has 54.90%, Guinea-Bissau 48.80%, Comoros 46.10%, Timor-Leste 37.40%, and Papua New Guinea 35.80%. Only 4.20% in Trinidad and Tobago and less than 2.0% in Jamaica live on less than US1.25 per day[55]. The global average is Average 26.5%[56]. In Vanuatu, 32.2% of the population is on the brink of poverty. In comparison, in Timor-Leste, 2016 Demographic and Health Survey shows that 46% of the population is multidimensionally poor and, additionally, 26% are vulnerable to poverty[56]. In Dominica, poverty data indicate that more than half of its children and youth live in poor households[56]. The poverty problem is made worse by new patterns of marginalization associated with climate change. Rapid and unplanned urbanization, environmental degradation, and food insecurity further complicate

things[56].

Moreover, of the 36 SIDS for with data available, Samoa has the lowest employment to population ratio. Only 28.9% of those aged 15-63 are actively looking for work, and just 31.5% are seeking work or are currently employed[55]. Youth unemployment in Samoa is the second highest (18%) after Fiji (18.8%) among all SIDS[55]. Furthermore, on the Cook Islands, Samoa, and Vanuatu, the urban informal sector contributes heavily to GDP, but little contributes to the tax base used to fund government services.

These macro and micro-economic components' impacts can reduce or exacerbate pre-disaster vulnerabilities. Internal effort bolstered by political will is imperative here. SIDS efforts must be driven from the inside, with support from the outside, and not the other way around.

Institutions

Smallness and development status creates problems associated with public administration. As we have seen in developing countries more generally, and in SIDS that are a part of them, development is not always positive[2]. Colonial development patterns and early post-colonial development blueprints neglected the disadvantages to the detriment of those places. Their proponents devised mechanisms and procedures that made newly developing societies fit into pre-existing models[57], and there has been some discontent. Some have critiqued the tendency of countries in Africa, Latin America, and the Caribbean to allow more developed continental countries' development policies and practices to shape their development (see Ref.[57]). These countries are often former colonizers and have specialized public policy and administration knowledge that they transfer to SIDS through funding arrangements. The reliance on such outside actors for development assistance can and often reduces the culture's propensity for innovation and creative socio-cultural adaptation specific to their contexts. Thus, they perpetuate development policies, practices, and patterns in contexts unsuited and result in negative development consequences. Many development policies and practices continue to work counter efforts to promote disaster resilience in SIDS.

The facilitative power of institutional resilience in building disaster resilience is through national and local regulations, public policy, and administrative capacity that work to benefit as many as possible. Governments' ability to craft policies and regulations and to implement them effectively can improve access for all by going beyond simple resource availability[50]. We can use World Governance Indicators (WGIs) as proxies of resilience in public policy and administration. Kaufmann, Kraay, and Mastruzzi initially developed these indicators and have refined them over time with contributions from other researchers[52]. The WGIs comprise a research dataset summarizing the information on governance quality. This paper uses several WGI indicators (Appendix i) - Voice of Accountability; Political Stability and Absence of Violence; Government effectiveness; regulatory quality; and control of corruption in its discussion of institutional resilience.

Many Caribbean SIDS rank highly on these indicators (Appendix i). They have been relatively stable politically and have ranked higher in gender equity and other development aspects than others. Some of the smallest SIDS, including Comoros, Micronesia Federated States, Solomon Islands, and to a lesser extent, Tuvalu, and Vanuatu, score low on government effectiveness measures (see Appendix i). Dominica is the only Caribbean state that does. Neighbors Comoro Islands and Madagascar rank low on all indicators.

Moreover, this paper suggests that a country's capacity to retain talented people is a sign of its institutional strength. On this indicator, the scale ranges from 1-7, where one suggests the best and brightest leave pursue opportunities in other islands; and 7 suggests the best and brightest stay and pursue opportunities in the

country[52]. The World Average on this measure is 3.35 out of 7. The data are unavailable for many SIDS, but of the few with data, Cabo Verde had a rate of 3.34; Jamaica 3.14; Madagascar 2.82[52]. Haiti, the poorest country in the Western Hemisphere, had a rate of 1.87[52], indicating a severe brain drain there. This brain drain and resultant lack of administrative capacity negatively affect the government's ability to facilitate disaster resilience.

Social

Hazards interacting with social, community, institutional and economic vulnerabilities result in disasters[12]. Social aspects are significant disaster drivers and are increasingly recognized as such in practitioner development circles and are also the focus of academic scholarship. For example, Ref.[58] focus on Culture, Ref.[59] on the social conditions that produce disasters such as trust, inequality aversion, altruism and reciprocity, Ref.[60] focus on food security, Ref.[34] focus on social fitness. Social aspects determine the pre-existing resilience or vulnerability of a place and its people. One could even argue that strength in social aspects could counter some economic, institutional, and community deficits.

For instance, social capital is a crucial indicator of social resilience. In a quantitative study of community adaptation projects in SIDS, Hagedoorn *et al.*[61] found that communities with high social capital had more success in implementing climate change adaptation projects. Social capital is trust, reciprocity, social norms, participation, and communication within a social group (i.e., bonding social capital). Furthermore, Hagedoorn *et al.*[61] found that social capital was one of the most critical aspects enhancing adaptation intention; the other aspects were the perception of community climate change risks and resource dependency. Community members choose to prioritize adaptation measures when they perceive threats to group members. The stronger the social bonds, the more members will protect each other.

SIDS' people have long shown themselves resourceful and resilient, even if the places they live are not. From her research, Briguglio[62] credits the innate resourcefulness of their people for SIDS thriving until now. First, their smaller populations can generally foster a high degree of social cohesion, more decision-making flexibility, and governance. Second, island peoples tend to be entrepreneurial, resulting from the flexibility of their informal economies (e.g., Ref.[63]). Moreover, their small size can allow SIDS to grow faster, on average, than larger states if managed well (e.g., Ref.[63]). In some SIDS, the actions taken by policy and economic actors to manage shocks have also helped SIDS to thrive[63].

The current 'Blue' economies push, using innovation to harness the resources of the seas and oceans within which SIDS reside, exemplifies this. Of note, a blended financing instrument, the Global Fund for Coral Reefs (GFCR) launched in September 2020 and aimed to raise $500 million in public and philanthropic funding to catalyze private investments to protect and restore coral reef ecosystems[64] and communities that rely on them for their livelihood. Under the Fund, leaders from SIDS collaborate, sharing knowledge that can help each diversify its economy, thereby building resilience from future shocks[64]. It is too early to tell whether GFCR's potential outcomes will make the intended impacts when social conditions and governance capacity, not just resource availability, are considered. Another example is SIDS organizing to exploit and realize the benefits of their culture and creativity via the 'Orange economy.' The term, coined by Howkins in 2001[65], argues for policies that generate new markets, jobs, income, and growth from their people's creativity, culture, and knowledge.

That said, we know that factors such as exploitation, marginalization, exclusion, victimization, inequality based on gender, race, color, ethnicity, sexual orientation, or lack of access exacerbate vulnerability. Their intersectionality confounds efforts to build disaster resilience. Take the Gender Inequality Index (GII)

measured in 19 out of the 38 SIDS. It sits at 0.458, higher than the global average of 0.441[55]. One of the drivers of gender inequality is women's low labor force participation, which stands at 53.7%, far below the participation rate for men (73%) in SIDS. Papua New Guinea is home to the most gender unequal society (GII is 0.741), followed by Haiti, in which the GII is 0.601[55]. More telling is the lack of gender inequality data in half of all SIDS[55]. The lack of such data might indicate an absence of a political will, specific policies, and action plans to achieve gender equality and put corrective action in jeopardy[55]. Not knowing the specific ways in which gender inequality impact other aspects of social vulnerability magnify risks as they go untreated.

Telling too is the impact of the COVID 19 pandemic on society's marginalized. The pandemic's gross negative disproportionate impact on society most impoverished is alarming. For instance, we know that even before COVID 19, women, girls, and minority groups were among the most vulnerable - e.g., Dominica. In addition, the poorest people in society often intersect around certain races, ethnicities, gender, and sexual orientation who bear the brunt of the impacts., The lack of data leaves us to make educated guesses based on a priori knowledge that might not always be correct.

The SIDS Accelerated Modalities of Action (Samoa Pathway) of 2014 reaffirmed a commitment to SIDS' sustainable development. The Pathway stressed the need for sustained, inclusive, and equitable economic growth, reducing inequalities, and raising basic living standards[66]. In addition, the Pathway fosters equitable social development and inclusion and promotes the integrated and sustainable management of natural resources and ecosystems[66]. Its support for social transformations, social inclusion, and social justice while facilitating ecosystem conservation, regeneration, and restoration are critical components of disaster resilience[66]. Unfortunately, the Pathways, like other development frameworks, are driven mainly from the outside by supranational organizations.

Moreover, many SIDS display structural and cultural characteristics that favor ex-post recovery financing and high moral hazard burdens, indicating the need for pre-disaster planning and activities that support mitigation. However, disaster preparation is not often enough at the forefront of planners' minds in SIDS contexts. For example, regulations that support hazard insurance are mostly non-existent; community-level infrastructure that supports risk insurance is non-existent, and legislation is often missing. The landscape is changing, and many SIDS (e.g., Caribbean SIDS) have signed onto shared risk transfer mechanisms, including Caribbean Catastrophe Risk Insurance Facility, but this is not happening fast enough at the individual level.

Community

Due primarily to the location of people and assets, SIDS suffer substantial community losses from disasters caused by natural hazards. For instance, they tend to inherit and often replicate public infrastructure, utility systems like energy, telecommunications and water, and land-use patterns (see Ref.[67,68]). This concentration of people, assets, and infrastructure in coastal zones is a vestige of SIDS' historical development patterns and has become almost endemic and brutal to change.

For example, transportation infrastructure plays a vital role in social and economic development. Those assets facilitate the movement of people and products and connect them to services and social networks[68]. They account for a relatively large proportion of GDP. Case in point, Dominica's transportation assets value 82% of GDP, and in Fiji, it is about 1/3 of the total government budget[68]. Most SIDS are only equipped with one airport and one major port[68], although a large segment of their populations lives in rural communities with limited financial investments and restricted transportation redundancy[68].

Nevertheless, despite accounting for a large proportion of GDP and necessary to facilitate commerce, and the movement of peoples, surveys conducted in nine SIDS showed a low level of competency in transport asset management across Pacific and Caribbean SIDS[67]. Competency in transportation asset management varies across the range of SIDS. Self-assessments show relatively high capabilities in Fiji and Grenada but relatively lower levels of knowledge of transportation assets management in smaller islands such as Tuvalu and Kiribati[67], which obstruct efficiency and social and economic development.

Moreover, rapid urbanization in SIDS represents a significant challenge for national and local governments and impacts transportation assets. Dense populations, intensifying urbanization rates, changing climate patterns will exacerbate urban challenges. SIDS are likely to face continued rapid and high levels of urbanization, further increasing vulnerability in these urban centers. Around 59% of SIDS populations already live in one or a few urban settlements[47], as are the islands' primary administrative and commercial hubs. Large rural-urban migration and skewed labor supply, political systems, and administrative services concentrated to just a few larger cities[47]. In the fastest-urbanizing Pacific region, urbanization is increasing at 4.3 percent and 16 percent in peri-urban areas[47]. Growing populations in limited land space pressure already fragile human and natural systems. It further pressures governments to invest in communities and ultimately increase their vulnerability resulting in an urban population concentration trap.

Furthermore, a large proportion of the population still lives in rural communities that the national government needs to support better. These rural communities mainly depend on adaptation and resilience initiatives driven by the national government. However, many of these initiatives are underfunded or just die on the vine. In such cases, rural communities must find better ways to reflect their needs and values into disaster resilience planning and initiatives.

CONCLUSION

This paper conceptually explored the question, "Is it possible for SIDS to become disaster resilient"? So many aspects need to come together to make that happen. There is a connection between social systems, built and natural environmental systems where disasters happen. These places need to facilitate people's rebounding and recovery. Sadly, without sweeping change in SIDS' economic, institutional, social, and community aspects, the limits of their efforts are already apparent, especially in the smallest ones. In the end, SIDS might be too small, too exposed, too economically vulnerable, too weak at the community level, and too weak institutionally to be disaster resilient. Most of their fundamental characteristics tend to undermine their disaster resilience efforts. Existing empirical evidence and examples collected from operationalized disaster resilience dimensions show that SIDS' physical attributes might be one of their most significant vulnerabilities.

Evidence from the latest IPCC report highlights that these vulnerabilities by themselves might prove insurmountable for SIDS if the current climate predictions hold. The effects of intensifying climate change are intractable without concerted global effort, which is slow in materializing. SIDS' small size, underdevelopment, and narrow resource base limit their readiness for all disaster types. Their isolation and resultant long distances from export and import markets cause commodity prices to be high and debt servicing as a proportion of revenues to be exorbitant. Under-capacity in public policy and administration systems, fragile livelihoods, and unsafe locations apply dynamic pressures on social, community, and economic structures. Each, acting upon the others and compounding the situation.

These issues, taken together, show the difficulty SIDS experience in becoming disaster resilient. The arguments presented show that a resilience gap undermines the quest for disaster resilience in SIDS as the

critical relationships that support it are weak. Given the methods employed, determining the strength or direction of these relationships is outside the scope of this paper. However, the paper does identify some essential relationships among the domains presented. For instance, the bridging domain (institutions) is essential in promoting disaster resilience. We are not sure what specific aspects and in what measure. Should we rely on regulations or administrative capacity, and in what proportion? Is it government effectiveness or accountability that drives resilience the most?

Furthermore, which dimensions of these are most important? We can only say that SIDS continue to develop counter to the disaster resilience requirements. The rest requires operationalized components to be studied, relationships specified, and causation proved. Those are beyond the scope of this paper.

We can also say that development policies continue to leave assets and people in coastal areas, many of which are flood zones, vulnerable. Some continue to ignore the development and equity needs of women, girls, and youth. The tendency for favoritism in civil service employment is high in some SIDS, while at the same time, there is heavy reliance on the public service to drive island economies. These underlying issues become risk boosters that erode other resilience efforts. How and when is unclear. We know that government effectiveness substantially affects the number of people killed and affected by natural disasters. However, we might never really know the strength of this relationship.

The fact that SIDS' strength lies in their social systems is a plus. Their populations are resourceful, and they can pivot if they need to. Their smaller populations can generally foster a high degree of social cohesion, and there tends to be more flexibility in decision-making and governance at the local levels. Moreover, an innate tendency for entrepreneurship emerges from islanders' flexibility and the scope of informal economies. For SIDS, the best hope might be to exploit better and not downplay or bypass the human capacity for survival of island peoples to anticipate, learn and innovate. After all, SIDS have thrived until now despite their small size and other challenges. The lingering question is, however, will that be enough?

Source: Used with the papers' permission. See Bouhia and Wilkinson's (2021) Available from: https://unctad.org/news/small-island-developing-states-need-urgent-support-avoid-debt-defaults. Note: The size of the bubble is the size of the debt service concerning government revenues (from 0.34% for Timor-Leste to 21.55% for Jamaica). Debt service data is not available for Antigua and Barbuda, Barbados, Marshall Islands, and Tuvalu. The classification into the three groups of Debt Distress was made ex-post, in light of the islands' position in the three dimensions of the graph.

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The author contributed solely to the article.

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