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# ARTICLE

## Describing the Small Vessels Maritime Tourism

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### Abstract

Tourism trends indicate the growth of maritime tourism and the increase of diversified operations to fit a variety of tourist preferences. Operators have delivered in producing new tourism experiences on small maritime vessels that stand in contrast to the image of mass tourism and large ship cruising. Interviews with maritime tourism stakeholders reveal how small vessel operations fit into a competitive industry. These operators will make the valuable distinction ignored by many that smaller expedition ships and like vessels do not fit the cruise tourism model and that their tourist product is separated from cruises based on two main elements; authentic experience and sustainability.

Whereas traditional cruise tourism conjures images of luxury and excess, a rapidly developing tourist profile has prompted the diversification of maritime tourism. Where maritime tourism has expanded both quantitatively and qualitatively there are now ships of every size and shape in almost every port around the world, ready to deliver a unique tourism product (Diakomihalis, 2007). While the scope of maritime tourism remains ambiguous, researchers have begun to look beyond the iconic image of mass tourism cruise ships to study the diversity of tourist experiences that occur at sea (Kizielewicz, 2012; Jones,

et. al., 2016). Rapid expansion and transformation of the industry have generated opportunities to create diversified and competitive tourism products aboard a variety of vessels (Georgsdottir & Oskarsson, 2017). Some researchers have often likened all maritime tourism to cruising (Bowen et. al., 2014; Marti, 1986), others consider a variety of on-shore and off-shore experiences maritime tourism (Diakomihalis, 2007; Kizielewicz, 2012; Hall, 2001; Miller, 1993). While there is no doubt that maritime tourism includes the cruise industry, how far beyond this mass tourism market does our understanding of maritime tourism go? In many maritime destinations around the

world sailing, yachting, and daily maritime tours make up a large part of the industry, “the perception of maritime tourism solely as a mass phenomenon is obviously wrong because traveling in smaller groups: 12 passenger cargo-passenger ships or yachts and sailing ships also represent a significant segment” (Kizielewicz, 2012). Researchers have struggled to differentiate the on-shore and off-shore experiences; some combine ‘coastal’ and ‘marine tourism’ (Miller, 1993), while others (Hall, 2001) use the terms ‘ocean tourism,’ ‘coastal tourism,’ ‘cruise tourism,’ and ‘marine tourism,’ all interchangeably going so far as to include water sports into the definition, including scuba diving and windsurfing along with cruises and yachting. In response, Kizielewicz analyzed the maritime industry and produced a working definition that differentiates maritime tourism from a maritime excursion, “maritime tourism can be defined as staying at sea or ocean for the purposes of tourism or business, using maritime means of transport in the period not longer than 12 months. And in turn, a maritime excursion is a tourist activity with using the means of water transport for tourism or business that lasts no longer than 24 hours” (2012). Using Kizielewicz’s definition of maritime tourism, sport-related water activities such as scuba diving, surfing, and

jet skiing are all examples of maritime excursions, not maritime tourism. Removing these from the equation, there remains a large amount of cruising and sailing vessels available to tourists.

### **The “small vessels” community**

Many coastal economies have capitalized on the ability to charter vessels to tourists for an experience that enables them a directness to the sea unavailable to cruise passengers (Diakomihalis, 2007). From this emerges three main subsections of the maritime industry in addition to cruising: yachting, sailing, and leisure maritime shipping. These activities may take place on master sailing ships, sailing vessels, sailing yachts, bareboat, small caiques, luxury caiques, motor yachts, mega yachts, big caiques, maritime cruises, blue water cruises, maritime yachting with or without a crew, ferry travel, high-speed ship travel, submarine expedition, fishing vessels, passenger-cargo ships, and cargo ships (Diakomihalis, 2007; Kizielewicz, 2012). It is popular to categorize maritime vessels by size but is done with little consistency. Where Kizielewicz categorizes individual vessels (1-9 passengers), group vessels (10-500 passengers), mass cruises (501-2000 passengers), and resort cruising (2001-4000 passengers), there are various other ways to make the ‘small’ vs ‘large’ distinction:

- *Marti (1986): Small Vessels (1-100 passengers) and Large Vessels (more than 100 passengers)*
- *Go Over Seas.com (2019): Small ship cruises (1-300 passengers) and Traditional cruises (more than 300 passengers)*
- *Honey et. al. (2010): Pocket-Cruises (1-250 passengers) and Traditional cruises (more than 250 passengers)*
- *Sariisik et. al. (2011): Yachts (36 passengers or less)*
- *Cruise Critic.com (2020): Small ships (1-799 passengers), Small-Mid ships (800-1499 passengers), Midsized ships (1500-2499 passengers), Large ships (2500-3499 passengers), and Mega ships (3500 or more passengers)*

With a combination of vessel sizes and itineraries to explore, tourists have more options than ever to engage in diversified maritime experiences. Where tourists seek out new experiences, the small vessel maritime community has responded with unique operations that challenge traditional cruising. They are met with a wide range of on-shore and off-shore offerings that span hours to months. With a loose understanding of what tourism products and experiences make up this growing industry, this study looks to explore how maritime tourism has expanded beyond cruising to offer diverse tourism products. In doing so, operators and other maritime tourism stakeholders are given an opportunity to share valuable insight into the development of the community. We explored how the operators and other stakeholders of the small vessel maritime tourism industry prefer to define themselves and the valuable distinctions they make between their operations and other players in the maritime tourism industry.

### **Exploring the small vessels maritime tourism community**

A mix of semi-structured interviews from a variety of industry professionals and empirical research, involving both academic literature and media reports, are used to triangulate the reliability of source information. Exploratory research hinges on our understanding that knowledge is “situated” and that by looking at the same material from multiple angles we can uncover “previously hidden facets of reality” (Reiter, 2017).

Interviewees were selected using snowball sampling which is a valuable tool in gaining access to finite or marginal

groups “[leading] to dynamic moments where unique social knowledge of an interactional quality can be fruitfully generated,” (Noy, 2008). This technique was used to gain access to operators and people who have experience with the operations of the small vessel maritime tourism industry by utilizing existing relationships. Initial exploratory conversations with three of the participants revealed emerging themes and shaped the direction of the semi-structured interviews. The semi-structured interview was created with three objectives in mind: Explore operations related to maritime tourism, discuss emerging themes of diversification and sustainability and, gather participants for expanding the study.

Interviews were conducted in person and over the phone. Emails were used to follow up with interviews and clarify information when needed. The resulting research is a narrative of industry professionals and empirical material that provides an increased understanding of the maritime tourism industry. In the end, six participants were contacted and interviewed about their involvement in the maritime tourism industry. The participants varied in age, gender, and race. Three of the participants are owners or managers of maritime tourism operations (but not cruises). Two participants are managers of popular North American ports of call. One participant is a director of a national cruising association. All participants and their enterprises are in North and Central America. The interviews took place during the months of January and February 2020.

**Our findings: describing the small vessel maritime tourism industry**

Not a cruise!

An overwhelming sentiment with the three operators interviewed was that they did not associate their maritime tourism operations with cruising. In fact, two of the operators disassociated their enterprise with 'tourism' as well and called the passengers guest-crew as opposed to tourists or customers. In some cases, the distinction was a technical one (e.g., having less than 12 passengers means we are not a registered passenger vessel), but more often the avoidance of certain vocabulary was based on of perception of cruising as being negative:

*'Cruise' to me personally has a negative connotation...I would not want to associate myself with the 'cruise industry' we are much more about ecotourism...everything I try to do is more real. We avoid the word tourism... we want everybody who comes on board to be integrated in a larger way... [they] are expected to participate in one way or another. We wouldn't want to send the wrong message... [it is not] a hotel... With adventure tourism...those people are not catered to in the same way as traditional tourists...we wouldn't want to attract people who want to be catered to because that is not what we offer.*

Yes, a maritime travel experience!

Interviewed operators all feel strongly that what they provide is a service that is inherently different than a cruise. Two of the operators are sailing cargo vessels that combine a twelve-person (overnight capacity) guest-crew into their business model with variable distribution of tourism integration. There is very little information regarding this niche form of maritime tourism in the literature,

therefore, exploring the extent of the tourism operation became both exciting and challenging. These operators fell into the ambiguous peripheral of maritime tourism that was noted by many of the industry researchers. A study by Szarycz explains the draw for tourists to seek out these types of vessels for an "atypical" experience, thus further differentiating themselves from the majority of maritime tourism operations; "among these niche-oriented product offerings are 'freighter cruises' inviting participants to travel by cargo ship solely for the purpose of a unique and atypical travel experience" (2007). Testimony of freighter travelers can be found from adventure magazines to popular newspapers (outsidemagazine.com, 2020; nytimes.com, 2020) indicating an increase in interest in this form of travel. Two of the operators interviewed claim that their service offerings go way beyond freighter travel by offering a reciprocal and integrated experience that combines sustainable cargo with guest passengers.

The idea of a cruise is more akin to a luxury hotel than an oceanic adventure is not new. The comparison has been made by many researchers before; "floating cities," "floating hotels," "well-organized hotels," "mobile tourism enclaves," "cathedrals of entertainment," and "cathedrals of consumption," have all been attributed to the traditional cruising industry (Diakomihalis, 2007; Georgsdottir & Oskarsson, 2017; Szarycz, 2008; Quatermaine & Peter, 2003; Ritzer, 1998). Each operator speaks to what differentiates them from this floating-hotel-like image that is cruising:

*We are trying to fill a niche we believe is underserved with what we are doing*

*[combining sailing and cargo and passenger crew]... we use [the term] experiential adventures and charter opportunities.*

*[About the terminology 'small cruiser' or 'pocket cruise'] I would never associate that with what we are doing... We use tourism out of necessity, and there is a real interest and demand there... people will pay to come sailing and that will support the sail cargo service we provide.*

And to explain what a traditional cruise looks like, a participant shared that:

*cruising is putting as many people as you can on a ship... the sheer numbers of how that operates... you can't have a real experience [in nature or with culture].*

The inherent 'realness' of their operations was used regularly to form a contrast with the perceived 'fakeness' of cruising. The third operator is a self-defined 'adventure company' and has a fleet of small ships that range from 22 to 86 guest capacity. This operator with the largest fleet and most extensive itineraries appeared on the surface to have more in common with traditional cruising but made a similar distinction between the 'realness' that they are able to provide:

*We like the intimacy, we don't have WiFi on the boats, we don't have gambling on the boats... if you are used to a regular cruise ship it is not like that. We are an adventure company... We don't go port to port [like traditional cruises] we get you out into the wilderness... [the experience] is concentrated on the adventure part of it and getting to be with nature.*

The operator further highlights that their itineraries are flexible in order to take advantage of better weather situations, wildlife sightings, or guest's preferences of activities; ***We are the wild west out here!*** 'Adventure' and 'real' are more than just

buzzwords used to sell a product when the operators all expressed that there was no place for 'contrived' experiences in their operations. The two-port managers who participated in the study agreed:

*"We are really interested in this market [small tourism ships], they tend to be more environmentally conscious... they get to see more of what [a place] has to offer."*

Even the director of a national cruise association admitted that these experiences were hard to achieve on traditional large cruises, saying that the cruises were only in port for 12 hours or less in this location. However, he argued that traditional cruises could be a gateway to further, more intimate, experiences; Cruise ships are a window into the country. Even if they are here for 12 hours, they will fall in love and want to come back.

All of the participants saw value in the type of intimate experiences a smaller vessel could provide tourists and the operators themselves were eager to distance themselves from the cruise industry. In making this distinction, the operators have shown that the maritime industry is far more than just cruising. Authenticity as the main ingredient

All participants noted an inherent difference between traditional cruises and the service offerings of smaller vessels with guest crews. The operators attributed part of this difference to their ability to provide authenticity to the guest. Traditionally, tourism has been a contrived and superficial pursuit, but as the discipline expanded, it was determined that there are different types of tourists seeking different experiences (Cohen, 1979). MacCannell (1976) presents an understanding of the tourist experience as a pursuit for authentic experiences. The type of tourist that

MacCannell saw has more in common with the guests that are drawn towards experiential adventures such as those provided by small ship operators. They reject commodified experiences and seek realness. In contrast with their contrived lives, they can find real meaning through travel. While it would be dangerous to assume that tourists fall into categories so easily, it is worth noting the popularity of tourism services that claim to stand in opposition to the masses. The postmodern tourist has emerged as a person who is interested in a variety of experiences and as a result niche tourism markets are gaining worldwide awareness (UNTWO, 2017). With articles like 'Eight International Cruises that don't Suck' (outsidemagazine.com, 2018), one can observe that there is a desire for some tourists to seek unique and niche experiences during their vacations and travels. As described by Szarycz (2008), freighter travelers consider themselves 'travelers' able to "construct their own meanings about their experiences, the places they visit and the people they meet" giving credibility to their travel and journey authenticity.

Georgsdottir & Oskarsson found that for those who worked in the cruising industry, they much preferred to work with passengers who travel on small cruisers, "they tended to speak more positively about smaller exploration ships. They described the passengers from such ships as 'well educated', 'active' and closer to nature, 'people who want to see and learn'" (2017). The adventure operator agreed with this sentiment:

*They [big ships] can tell you about it, but we get to show you it. You get to be with nature, we want you to experience that... to smell it, taste it, see it, and respect it... Being on a*

*small ship educates you more about the environment, it is more intimate. We want people to see the real Hawaii, the wild Hawaii... the real Alaska.*

This was echoed by another operator: [You go on cruises] to see things but not to understand them.

*There are people who want to get out and pretend they are doing something... we are the furthest thing from that... my goal is to offer real experiences with an old boat that really does sail, that really does require participation, and we are doing real things, we are really trying to build a business of shipping goods from local communities.*

In this way, achieving authenticity is tied to contact with nature as well as participation in onboard ship operations. MacCannell would describe this as "backstage areas" where the operation of the vessel is not altered for the presentation to a tourist, but integrated into the experience to convey authenticity. The operators will argue that contact with the sea and the forces of nature should be inherent in any form of ocean travel (1976). Where yachting is presented as a form of maritime tourism that offers "directness to the sea" by allowing the tourist autonomy over the navigation of the vessel (Diakomihalis, 2007), that same directness can be achieved with these experiential voyages;

*[on a cruise ship] you're not experiencing the sea, you never really come in contact with it.*

*[A cruise] is like watching a movie.*

Here the participant indicates that their own operation is in opposition to the way cruise passengers are removed from the oceanic experience.

### Intimate experience with a positive impact

The way each operator creates an authentic experience for their passengers is motivated by their mission to achieve realness as discussed above. However, two of the operators credit their ships' small size with the ability to create those intimate experiences:

*We are a small ship company and we want to stay that way, while still having a big impact.*

This operator foresees expanding their operations in quality more than quantity and highlights the attentiveness they are able to give each guest by having at least one guide for every eleven guests:

*We want everyone to feel taken care of... and that there are options for everyone.*

This attentiveness, they argue, would not be possible on a larger ship. It all aligns with their vision that stands contrary to the idea of mass tourism:

*[The founder] had a vision of taking people to remote and untouched places... we want to keep people out in nature... to get away from massive amounts of waste, massive amounts of consumption.*

In agreement, an operator explained:

*With a small group, you can go somewhere and have a real experience... When you have a small crew on a small ship you can bring people into a town without overwhelming that community, and they get a real experience.*

In a popular North American port, maritime tourism ships of all sizes go in and out of the port daily, "marinas are considered very significant facilities for the development of maritime tourism," (Diakomihalis, 2007). The port managers interviewed explained that they anticipate more of the 20-100 passenger small cruisers to frequent their port in the future and have

conducted a study on how they can meet the needs of these types of ships and what facilities are required to accommodate them. In the literature, these smaller "expedition" ships are gaining popularity (Georgsdottir & Oskarsson, 2017).

*[The community] probably enjoys having passengers from small ships more, they have more time [at port] and want to interact more.*

The literature agrees that having passengers arrive in ports in smaller numbers is more beneficial for the host community, "keeping the size of tour groups to a minimum is an opportunity to reduce negative social impact and least disturb host communities' way of life, as well as reducing stress on the natural environment," (Weeden, 2001). This consideration for tourism's impacts is shared by all of the operators and is considered a distinguishing characteristic of their small ships. With traditional cruising being characterized by excess and mass tourism, the maritime industry appears to be being pulled in two different directions, "until recently the tendency in the cruise industry was towards larger and more luxurious ships, but now it seems to be changing direction" (Georgsdottir & Oskarsson, 2017).

### Sustainability

Tourism operations are feeling the pressure of incorporating sustainability to satisfy social demand and remain competitive (Hritz & Cecil, 2010). The maritime industry is feeling the same pressure, so much so, that Environmental Sustainability and Destination Stewardship were the #1 and #2 trends in the CLIA 2020 State of the Cruise Industry Outlook. However, many would consider these steps reactive and not proactive, as several

reports have raised concerns about the sustainability of cruise operations (Gibson & Papathanassis, 2010; Papathanassis, 2019;

of sustainable initiatives creates an impressive resume as an example of what the industry is capable of achieving:

- *Regenerative ship building; a combination of using local native hardwoods as lumber and tree planting*
- *Offer formal and informal training in specialized ship building and sailing skills to create opportunities for local people*
- *Equal opportunity for women*
- *Goal to have 50% local workers*
- *Conduct surveys and participate in studies to understand social & environmental needs within community*
- *Partnerships with local institutions to create learning opportunities*
- *A sustainable investor reinvestment program for shareholders*
- *Carbon neutrality*
- *Technological innovators for environmental sustainability*

Hritz & Cecil, 2010; Brida & Aguirre, 2008; Johnson, 2002; Polat, 2015; Ponton & Asero, 2018; O'Brien, 2014; Klein, 2010; Jones et al., 2019; Klein, 2011; Han et al., 2018; Jones et al., 2016). The UNWTO warned that cruising, by nature of bringing large numbers of people to concentrated areas for brief periods, has the potential to magnify tourism's negative impacts (2016). It would seem that smaller ships than are better positioned to create smaller impacts and better control the narrative of sustainability and maritime tourism.

By putting sustainability at the core of all operations, one operator hopes that the guest crew will feel fulfilled in contributing to such an enterprise; a genuine business that has meaningful outcomes:

*Guests [are] contributing to this reality of making a change.*

As one of the sailing cargo operations, sustainability is integral to the business beyond the applications of tourism. A list

*The community supports us and other people come here and see how we support the community... everything we do we look at the social and environmental impacts.*

Starting from the ground up, incorporating sustainability has defined their operation and is an important differentiation factor within the maritime industry. Such initiatives go beyond 'best practices' to incorporate multiple levels of sustainability into the business model. Another operator has a similar outlook and includes their guests in their mission.

The operators recognize the acceptance that their sustainability efforts are having with their guests:

*More people than not were amazed and proud of getting behind a company that stood for something... 95% of guests [felt similarly to us] about [the environmental stance] so it strengthened our community. It is peace of mind, to work for the planet and come to work every day knowing that.*

- *Educating their guests about water usage*
- *Use locally sourced and organic foods whenever possible on the tours*
- *Require all guides to have a Leave No Trace certification*
- *Bring National Park staff on the boats when entering marine sensitive areas*
- *Use only environmentally friendly chemicals including giving guests 'true' sunscreen that protects coral reefs*
- *High employee retention*
- *Bamboo bedding*
- *Buys materials in bulk*
- *No single use plastics*
- *Provides stainless steel water bottles for guests*
- *Collects rainwater on the vessels*
- *[The owner] uses resources and influences to campaign for environmental policies and make socially responsible choices*

These small vessel operations stand in stark contrast to the common critiques of the maritime and cruise industries as being large polluters. Johnson(2002) provides a comprehensive look at where the cruise industry should be paying more attention to their sustainability efforts by examining the waste impacts, infrastructure impacts, operations impacts, distribution impacts, and use impacts that add up while operating one of these floating cities. Evidence submitted by the Network to the US EPA in 2000 stated that a typical cruise ship can generate an estimated 1,000,000 gallons of greywater on a 1-week voyage, as well as significant amounts of hazardous chemical from onboard printing, photo processing, and dry-cleaning operations” (Johnson, 2002).

From the point of view of the director of one national cruising association who participated in the study, large cruisers are focusing on technical innovations that alleviate negative environmental pressures. He was impressed by some of the larger cruise lines. He explained that the cruisers were switching to more efficient oils and fuels, installing advanced wastewater management, and reusing gray water

where possible. Their economies of scale allowed them to phase out older boats and install newer technologies with sustainability in mind. The CLIA highlights in their State of the Cruise Industry Outlook that their cruise lines were focusing on using Liquefied Natural Gas, Exhaust Gas Cleaning Systems, Advanced Wastewater Treatment Systems, and Shore-side Power in order to be more sustainable in 2020.

However, vessels of all sizes should be considerate of more than just their environmental impacts. Cruises create considerable socio-cultural impacts on host communities at port cities. Researchers have called out major cruise lines for adopting strategies that create underlying tension between sustainability and economic growth (Jones et. al., 2016). With maritime tourism expected to grow in the coming years, tourism operations must evaluate their social and environmental impacts and avoid negatively impacting the quality of life of local peoples (Klein, 2011). At the ports, the managers interviewed see an opportunity with these small vessels;

*We have an interest in these [smaller] boats because they add more to the town... they spend more money in the community.*

At the same time, both participants recognized that ships of all sizes are interested in the needs of port communities, especially in so far as it affects their bottom line. With such far-reaching impacts, it can be difficult for tour operators to manage sustainability, yet all three of the operators' site sustainability as an integral part of their operation:

*[Sustainability] is imperative, I couldn't do something if I thought it would have a detrimental effect on the environment... at every level of our business, we want to evaluate how we can have the lowest possible impact on the environment.*

*Everything is easier [by incorporating sustainability from the inception of the business], you attract the right people from the beginning... it helps to enrich and support our goals.*

*We try to be proactive... in every little thing we can.*

## Conclusion

By analyzing the attitudes, opinions, and operations of those involved with the small vessel maritime tourism, this paper has presented new information that expands the current understanding of what constitutes maritime tourism. Operators feel strongly that they provide unique experiences that are authentic forms of oceanic adventure and are rooted in sustainable practices. This new, still unspecified community of small vessels maritime tourism operators contrasts traditional views of cruise tourism. Port managers too are excited about the potential of new types of maritime vessels

minimizing the negative impacts and maximizing the positive impacts of tourism in and around port communities. While traditional cruising will likely remain the major feature of the maritime tourism industry, a new wave of postmodern tourists creates the opportunity for small operators to make large waves in maritime tourism.

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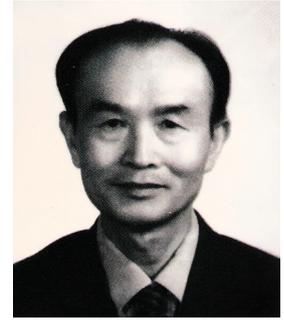
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# ARTICLE

## Special Humankind's Role in the Universe: Smart Blue Planet of Coordinated Development Between Humankind and Nature



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### Abstract

Cosmology refers to the research on the whole universe and extends the study of humankind's position in the universe. This puts research on humankind beyond the research on the whole universe for carrying out separate exploration and is of special significance. Today, the scientific community finds that humankind, as intelligent living beings, is the "only", "only possible" or "very low-chance" smart life. Therefore, the word "wisdom" becomes the particularity of humankind in the universe. This article explores the important role of human wisdom from three aspects. (1) By combining wisdom with the basic principles of dialectical logic, the first type of logic, the essence of coordinated development of man and nature can be discovered, and the laws governing their inherent indispensable relationship can be found. Moreover, the earth can be given a new name: "smart blue planet with coordinated development between humankind and nature (hereinafter as SBP)". (2) By combining wisdom with the six categories of formal logic, the second type of logic, the inference, deduction and argumentation at the logical level can be carried out and the change of practical problems can be guided. (3) By combining wisdom with the applied mathematics of mathematical logic, the third type of logic, revelations from the laws governing the three eras of civilization can be absorbed, which will put forward a new series of sustainable development mechanisms, explore the laws governing time and space evolution in the whole universe in-depth and develop new forms of civilization.

### I. Special Role of Human Wisdom

Cosmology calls for "study of the whole universe and extension to an exploration of man's role in the universe".

1. European and American experts proposed that humankind is the only intelligent life in the universe, so intelligent life is the particularity of the position of humankind in the universe. The definition

of wisdom in classics is the ability to discriminate, judge, and invent. It is combined with concepts, judgments, inferences, and proofs in logic and scientific methods to constitute a source of wisdom for the development and growth of human civilization. The history of human development witnessed a tremendous development of productive forces and

rapid progress in liberation of people's thoughts, great development of science and technology, industrialization, urbanization, and modernization in the Middle Ages and modern times, especially the Renaissance. Their positive energy was the satisfaction of the need for population growth and the need for economic and political competition. Their negative energy was great destruction of the ecological environment and great plunder of resources. Nowadays, the global climate became warmer, as Nature Communications reported: from next year (2020), it will become hotter and hotter for four consecutive years, and the emissions reduction plan in Paris Agreement cannot be realized. Scientists predict that after 100 years, the melting glaciers in the Arctic and the Antarctic will raise sea levels, waves will dash to the skies, and people will lose their shelters. This is deepening and intensifying the conflict between humankind and nature, and there are more severe crises. While examining the positive and negative energy, merits, faults, and responsibilities of human wisdom in it, it cannot be denied that wisdom has certain limitations in the development of human civilization, and this has to do with the "maidservant" restraint of the society's eagerness for quick success and instant benefit especially.

2. In particular, the outbreak of the novel coronavirus pneumonia pandemic and its ferocious and rapid spread caused a lot of deaths and make everyone nervous. This invisible ghost is wandering in the world day and night. In the past half-year, more than 15 million cases were confirmed positive for COVID-19. Compared with the destruction of the ecological environment

and climate warming since the above-mentioned industrialization, this disaster has several characteristics. First, it directly combats people in close quarters. Second, it is the most obvious proof of the intensified conflict between man and nature. Professor Walter Ian Lipkin, an American virus hunting expert, said that it came from wild animals. Then they passed the mutated virus to human "receptors" just like Monkey King went into Princess Iron Fan's stomach after mutation, so person-to-person infection occurred quickly (TV Program *Yang Lan One On One*. Episode "Virus Hunter": There Is No Evidence that COVID-19 Is Artificial). Third, wild animals spontaneously grow, live, and die without provoking human beings, but people hunt them to enjoy delicacies. In light of law and reason, people should examine their bad behavior; otherwise, it will bring greater consequences. Human being should wake up and must not fall into nightmares and die without knowing how. This is nature's cruel revenge on humans. Legislation should be stepped up today to strictly prohibit hunting of all wild animals by severely punishing offenders.

3. The "laurel (wisdom)" bestowed on mankind by the universe should be liberated, and efforts should be made for its sublimation. First, people should use wisdom to carefully discriminate and distinguish true and false concepts, prudently judge right and wrong, and boldly invent new technologies and create new things in particular.

People should especially use the ingenuity of wisdom to carefully distinguish right or wrong relationships between human and nature as mentioned above, and prudently judge whether human and nature are in an internal

relationship or an external hostile relationship. In particular, people should try their best to invent intelligent and clever techniques for correctly handling the relationship between humans and nature. To sum up, while exploring the objective laws of the universe, people should follow the path of necessity and freedom.

One of the important theoretical supports can be found in Jiang Pizhi's work *Interpretation on Hegel's Shorter Logic*, in which the author suggested that "Hegel's logic is composed of three parts: the study of being (also translated into ontology), the doctrine of essence and conceptualism." In particular, Hegel puts forward the concept that the essence is established between contradiction and unification. (Jiang Pizhi, 1980, pp2-5,) We now propose a new concept of wisdom—human is only a part and a very small part of the vast universe, all human activities must obey the unified laws of nature and then nature can appropriately meet certain human needs, and when the two sides are in a state of coordination and balance, man can merge into nature and develop smoothly. The earth with human inhabitants now should be entitled a new beautiful name: smart blue planet of coordinated development between humankind and nature.

4. Hegel, the founder of dialectical logic, proposed: "The nature of dialectical thinking... fully lies in grasping them in the unification of contradicting links" (Lenin, p115), and this is another important theoretical support. The nature of dialectical thinking lies in solving the contradiction between two opposing sides in "unification" to reach coordination and balance. Then in what ways can people reach the goal of such coordination and balance? Hegel proposed two ways: one is

to intensify and maximize contradiction first and then negate it; the other is that both sides in contradiction grasp themselves and the contradiction to promote their transformation in directions favorable to both of them. "Wisdom" proposed in SBP and "unification" proposed by Hegel play an equivalent and same position and role. However, in specifically solving contradiction or promoting the transformation of its position, wisdom can provide wittier and clever methods and ways.

5. This shows that the establishment of the SBP program fully complies with the basic principles of dialectical logic. In an investigation of environmental protection, I found two practical proofs. The first one is that during my visit to Switzerland, a professor said Switzerland could become a beautiful world park because its constitution stated that "whoever destroys a tree must plant another one". The second one is that when China's Beijing Taiji Computer Company began to build the factory on the site of the Asian Games venue, the government gave a strict order: the license of land occupiers would be immediately revoked if land occupiers fail to fulfill their duty of protecting the environment. Therefore, in the 20 years after the establishment of this factory, the Taiji Company stuck to carry out production while curbing the pollution; not only production increased, but it adhered to environmental protection standards.

The new theory of "smart blue planet of coordinated development between humankind and nature" has been reasoned with basic theories and proved by objective facts, and will be published soon. It will meet the needs of full victory in the current battle with novel coronavirus pneumonia

and elimination of its rebounds, make a good start in addressing the root cause, and lay a solid foundation for change in logical deduction, long-term sustainable development, and exploration of a new civilization.

## II. Logical Hierarchy of Reasoning and Reform Measures

Aristotle's formal logic is mainly about *Wu Gong* (Five Concepts) and *Shi Lun* (Ten Categories). The five concepts that translated from Latin to Chinese by Li Zhizao are *Zong* (category), *Lei* (genus), *Shu* (differentia), *Du* (unique attribute), and *Yi* (accidental attribute). These five concepts are indeed very important to Aristotle's deductive logic. The ten categories also translated by Li Zhizao are *Ziliti* (substance), *Jihe* (quantity), *Hesi* (quality), *Hushi* (relation), *Heju* (place), *Tishi* (position), *Zanjiu* (time), *Deyou* (state), *Shizuo* (action), and *Chengshou* (passion). The above expertise is necessary to grasp reasoning methods of logic at different levels (Zhao, 1999, pp7-8).

In addition to the above concept of SBP, which is proposed as the means to resolve the basic contradiction in the relationship between humankind and nature, six reasoning and reform measures at the logical level are put forth to comprehensively analyze and solve the contradiction of imbalance between humankind and nature as a scientific approach.

### 1. Substance

Since the Industrial Revolution began two centuries ago, humankind has tried to conquer nature and waste its resources in response to the increasing human population and consumption of natural

resources. and that is the primary cause of environmental degradation. It violates the objective law of the development of the universe and nature. The main purpose of this paper is to restore the overturned human-nature relationship to reconfigure the human-nature relationship. From conquering nature to complying with nature, from grabbing to cherishing the resources, it will be an epoch-making historic change and an effective intervention program to fundamentally solve the ecological and environmental problems.

### 2. Quality

Replacing the outdated "treatment after pollution" environmental protection policy with the new policy of "treatment before pollution." For years, pollution has been allowed while treatment was neglected in the context of growth-, industrial wave-dominant economic development. As a result, pollution has risen, and the rate of environmental degradation has increased. Therefore, a worldwide environmental protection law should be established to carry out the policy of "treatment before pollution." Worldwide enterprises would adopt "two front lines and one point." The "two front lines" refers to the production and pollution treatment front lines, and the "one point" is a critical point for the human-nature coordinated development. It is the essence of achieving the overall goal of SBP. Then, coupled with the effect of conformity behavior, 80-90% of enterprises would gradually meet environmental protection criteria. The remaining 10-20% will be punished severely to reflect the seriousness of the violation. If this was carried out by millions of enterprises, it

would be a critical and major program to protect the global environment.

### **3. Relation**

The long-term governmental ecological and environmental authority's unitary management system should be urgently reformed to a new environmental protection system incorporating worldwide masses, enterprises, and governments. This method can solve the contradictions among the people and promote the disclosure of ecological and environmental information through a coordinated and national approach. Ecological and environmental information should be fully and openly shared all around the world to improve environmental information disclosure. All stakeholders need to collaborate to solve the global environmental problems. It will build a natural and powerful ecological and environmental protection wall.

### **4. Quantity**

Replacing the partial, discreet and unordered environmental protection network system with an entire, centralized, ordered, enormous Internet system, like building abscissa and ordinate on the earth surface. The ordinate indicates the parent system for the fusion of humankind to nature, and the sub-systems of economy, sci-tech, administration, culture, and education for the human relationship. The abscissa comprises the macroscopic system (UN), moderate-scope system (countries), and microscopic system (subsystems within a country). It will become an engine that will enable the whole world to actively promote the development of information civilization. The monitoring modes, modules, system intelligent platform, new partial differential equation, big data, cloud computing, and other operating systems

and mechanisms of the "Macro Environmental Protection Information System" will be applied for operations. By utilizing the super network system's real-time identification and obedience of nature's objective laws, humankind will have a reliable guarantee for the sustainable development of human society and the earth (Macro Environmental Protection Information System is another project of this research team, which includes Professor Song Shuwei, the general designer who proposes new theory; Professor Dai Jianzhong proposes new partial differential equations and scientific computing solutions; Zhu Tao, the computer expert who proposes the overall software system framework of this project; Ms. Guo Yue, the user experience designer who proposes a smart platform in software system; Dr. Li Zhangang who is engaged in research of legal issues of the project).

### **5. Action**

Setting up a Global Ecological Environment Protection Supreme Management Committee. The famous modern cosmologist Stephen Hawking specifically presented that because there is a law like gravity, the universe can and will create itself from nothing in the manner described in Chapter 6. Spontaneous creation is the reason there is something rather than nothing, why the universe exists, why we exist. It is not necessary to invoke God to light the blue touch paper and set the universe going (da Rosa & Staffen, 2011, p227). That is to say, as the universe created itself, it can promote itself, manage itself, save itself and develop itself, etc. It may be induced that the universe can display resilience. After solving the fundamental concepts on ecological

environmental protection, selecting leadership is imperative to achieve sustainable development. So, Global Ecological Environment Protection Supreme Management Committee (short for SMC) should be established. It is critical for strengthening environmental protection.

The SMC, as the supreme organization that contributed to the ecological environmental protection and managed by humankind, would have a significant role in combining openness and integration in the field of new histology. The SMC's power and obligation are consistent and the Committee enjoys no more rights other than some proper rewards. The SMC would consist of representatives from all countries and all walks of life across the globe (with branches established in the countries). The members and workers need to possess the right qualifications, such as communication, delegating, motivation, etc. It is important to regularly evaluate each SMC employee. The SMC will have three major tasks. The first is supervising all global organizations to carry forward the "treatment before pollution" policy; the second one is amending previous major pollution problems; the third one is exploring potential ecological and environmental risks to have a risk management plan in place.

SMC would also have the task to establish the Global Nature Special Court with the grand justice directly elected by humankind for independent trials and severely punishing criminals for crimes against humanity.

## **6. Passion**

Reform of UN's function and power. United Nations (UN), an organization

established after World War II, aims to carry out international cooperation, safeguard world peace, and promote economic development and cultural progress. Due to the divergence in ideologies and the competition for hegemony, the world has experienced the cold war, hot war, and continuous campaigns and collisions (though no world war) within the past 70 and more years. To its strengthen strengths, many countries have joined the arms race, grabbed resources, energetically developed economies at the price of increasing environmental pollution, resulting in continuous degradation of the ecological environment.

To sum up, to save humankind and the earth, the management power for environmental protection should be shifted to SMC. The practice of "being the judge and the athletes at the same time" should be given up. Since the establishment of the UN, this will be the first time that the UN has reformed itself, and it will also be the fundamental plan for its strong development.

In the future, the UN should fulfill its responsibilities as stipulated in its charter, strengthening international cooperation, safeguarding world peace, fighting hegemony, preventing armed conflicts, and energetically promoting social and economic development in the context of environmental protection. As a result, the UN can fulfill its assigned responsibilities, and humankind can live in a clean, safe, peaceful, and beautiful environment.

### III. Inspiration of Regularity in Three Major Eras and New Series Mechanism for Sustainable Development

“A Contribution to the Critique of Political Economy” is a book by Karl Marx, published in 1859. In this book, Marx set forth three social forms in history (Marx, Dobb, & Ryazanskaya, 1971). The first is ancient agricultural civilization or the first era when human beings were unenlightened, afraid of “humankind’s dependence”, and worshiped God and spirits. The second is the modern industrial civilization. It is an era of “humankind’s independence based on the dependence on objects”. In the industrial society with developing technologies and a prosperous machine manufacture industry, humankind had its independence. It is the second era that arrogant people contradicted and struggled with nature intensely. The third social form is “the emergence of human being’s liberty based on individual’s all-round development and their common social productive forces and wealth which have seen a great increase.” Liberty is the understanding of humankind to the inevitable law of nature. The unity of consciousness and liberty complies with the dialectical law of the negation of negation from the slavish agricultural civilization to the struggling industrial civilization and then the smart, coordinated information civilization, and will surely broaden a new vision for the new third era (Marx, 1972, p104). (1) There are quite a few heritage sites of outdated agricultural civilization in the world. Slavish obedience and blindness must be given up through learning and following the unified law of nature. (2) Most regions in the world have access to industrial civilization. The main

task is to break the contradicting relationship between humankind and nature, respect nature, obey nature’s objective laws and enter the Information Civilization Era from the post-Industrial Civilization Era. (3)The world’s access in the Information Civilization Era means. (4) Comprehensively realizing the human-nature coordinated development, and completely solving environmental pollution, overconsumption of resources, and various calamities. (5) In the upcoming years, energetically reduce air pollution, water pollution, and soil pollution. (6) Starting from children, a lifelong universal education system about respecting nature will be pursued. Implement ecological and environmental protection cause to be controlled by the humans. All enterprises and units shall promote the “two-line and one point” normative system about coordinated development. Establish a special court of countries, international law, and nature, open the trial process and punish all criminals with iron law. Through the high-tech information technology of high intelligent internet ecological environment protection, big data, cloud computing, and so on, the developmental capabilities of our current and future generations will rapidly improve. It will continue to be passed down from generation to generation to achieve long-term and sustainable development. At that time, the world will be alive and green, and this planet will become a beautiful star with blue and rich treasures and sublimation of human wisdom.

(1) Large numbers of scientists will be mobilized and organized to work together in the study of scientific methods; to explore the unified laws of the universe within and outside the atmosphere, and to

explore special laws at their greatest, most essential depths.

(2) Organizing sophisticated scientists and brave innovators to team up and travel around the universe; if new “smart life” is discovered, then cooperating with them to develop new galaxies, build new civilizations as well as promotes the advancement of advanced civilizations in the overall space-time evolvement of the universe.

#### **About the Author**

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# ARTICLE

## Toward a New Community Resilience Understanding: The Findhorn Ecovillage Case

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### Abstract

Community resilience is a recognized, important dimension of ecological communities. However, although the resilience term at an ecosystem level is well developed, it usually does not happen the same at the local and community level. In a world of constant change, a lack of clarity of what resilience is could affect the community development and its strategies to flourish and remain in time. This seems to be even more relevant to ecological communities, which tend to face lots of difficulties to emerge, generally not surviving more than two years after their creation (Forster & Wilhelmus, 2005). Using Findhorn Ecovillage as a case study (Lombardozzi, 2019), this paper reflects on the importance of community resilience, proposing a new definition. It is concluded that at least four dimensions are needed to define a broad and robust community resilience concept: economic, social, ontological, and institutional.

### Introduction

We live in a highly globalized world. Although this has created lots of opportunities and benefits, like facilitating communication over long distances, it has also increased vulnerability due to global crises. These phenomena can be seen in climate change, where no country seems to be safe from the negative effects of industrialization. Globalization also increases the probability of making local communities more vulnerable, especially when their economies depend highly on international tourism, as it happens with some ecovillages, such as Findhorn, which hosts around 4,000 guests each year (Meltzer, 2018). But ecovillages are not

necessarily condemned to the waves of global uncertainty. One way to overcome - or at least decrease- the vulnerability of communities is to enhance their resilience.

The importance of community resilience has been appreciated by the members of ecovillages. These ecological communities have been framed as examples of how a 'degrowth world' (one which ends with the pursue of eternal economic growth) would look like (Cattaneo, 2015). Therefore, they are more focused on making a community resilient environment rather than a profit-making structure, as Findhorn Ecovillage explicitly claims (Lombardozzi, 2019). This cultural and axiological difference makes ecological

communities a different field within community studies. It is important then to identify the specific characteristics of community resilience in ecovillages, to avoid the category fallacy, which tends to impose a category developed in a very different culture onto another, as Kirmayer et al. (2009) explain:

“Resilience depends on complex interactions within systems, including physiological and psychological processes within an individual and social, economic and political interaction between individuals and their environment, or between a community and the surrounding ecosystem and the larger society. As a result, resilience can only be understood by considering systems in their ecological and social context” (p. 102).

But before going deeper into the characteristics of resilience in ecological communities, it is important to highlight that meanwhile, the resilience term at an ecosystem level is well developed, it usually does not happen the same at the local and community level (Berkes & Ross, 2013). This lack of development can be understood when the history of the resilience term is exposed. Therefore, it may be important first to discern the different disciplines where this concept is used, and then approach it at its community level.

### **Resilience: General overview**

Resilience is an interdisciplinary concept used in natural and social sciences. Although nowadays is mostly known by the general public in its psychological perspective, which mainly signifies the individual’s ability to thrive under stress and adversity (Kirmayer et al., 2009), Sherrieb et al. (2010) claim that the concept

was originally coined in physics and mathematics. In these fields, resilience refers to the ability of a material or a system to return to its equilibrium after a stressor ‘move from it’. Sometimes resilience also means the time required to return to that state (Bodi & Wiman, 2004 in Norris et al., 2008). This conception was differentiated from resistance, which alludes to the force necessary to move the system from its equilibrium (Norris et al., 2008).

One rupture with the previous concept occurred in ecology when its scholars realized that the ecosystems could express different forms of homeostasis or equilibriums, and therefore, resilience should not mean just coming back to an original ‘pure’ and unique equilibrium, but also to adapt and modify the system to create new equilibriums in response to the external shocks (Kirmayer et al., 2009; Norris et al., 2008).

This conception of resilience is closer to the one that it can be found in social sciences. When psychologically one refers to a resilient individual, we do not tend to understand it as an individual who is necessarily stubborn in a way that nothing extern affects him, but most of the individuals that can thrive, adapting to difficult circumstances. It is important to highlight, as Longstaff (2005 in Norris et al., 2008) points out, that those resilient systems are the ones that are very adaptable. According to this author, the adaptability of a system is enriched when it has diverse resources, resources that, as it will be seen later on, are not only economical.

### **Sustainable communities and resilience**

The Brundtland report in 1987 called the world attention to the urgency of

sustainability. In this report, sustainable development was understood as a “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (World Commission on Environment and Development, 1987). Although different political trends emerged from the previous report (such as ‘strong’ v/s ‘weak’ sustainability), practically all of them accept that sustainability involves environmental, social, and economic dimensions.

Ecovillages, which are one of the most representative types of sustainable communities, try to be an example of sustainable life (Andreas & Wagner, 2012). They generally mention the previous sustainability dimensions on their purpose, although sometimes the social dimension is mixed with the economic one – or this last one is underestimated, and not explicitly considered (Lombardozi, 2020). However, ecovillages’ structures manifest efforts to strengthen resilience on its economic dimension. In the opinion of Jackson & Svensson (2002), the economic global disintegrates local communities. That is why ecovillages try to develop strategies of ‘localization’, that is to say, to empower local communities rather than foreign multinational commercial players.

The way to enhance localization is diverse and it depends on the community itself, but some common strategies are the seek of energy and food autonomy (directly produce on-site), thus, with lower external energy inputs. One example of this strategy can be seen on Findhorn, where all the electric energy is produced by their wind turbines (Lombardozi, 2019).

As Ludwig (2017) describes in her book *Together Resilient, Building Community*

*in the Age of Climate Disruption*, ecovillages are aligned with the efforts of reducing the ecological impact (necessary to reduce the dynamics that increase the climate crisis that threatens the resilience of societies). Again, one example of this is Findhorn Ecovillage, which has the lowest registered ecological footprint of the industrial world (Nissen, 2014).

Lastly, one of the main characteristics of ecological communities is their strong social ties, which is a form of social capital, that creates -among other benefits- a strong feeling of ‘belonging’. Furthermore, as Lombardozi (2020) explains, ecovillages are a ‘new type’ of community: an organic community. This means that, differently from ancient communities, sustainable communities tend to organize themselves with ‘organic solidarity’ (a cohesion based on diversity more than in a forced similarity). This kind of solidarity, differently from its opposite (mechanic solidarity), is characterized by flexibility, a very important characteristic of resilience.

### **Dimensions of resilience: Economic dimension**

The concept of resilience is popularly associated with its psychological-individual level. However, societies and communities can also be resilient (Sonn & Fisher, 1998 in Kirmayer et al., 2009). It is important to analyze then, the different dimensions associated with resilient communities, of which the economy is one of the most important. Briguglio et al. (2008) frame economic vulnerability as the exposure that an economy has to external shocks due to its openness to external markets. This economic openness is operationalized as

“the ratio of international trade to GDP” (p. 4). The more open the economy, the more susceptible it to be affected by external shocks. According to the authors, the way to counteract this vulnerability is through economic resilience, which is understood as the policy-induced ability of an economy to withstand or recover from the effects of those exogenous shocks. The way to increase the economic resilience would be enhancing its four main dimensions: good governance (which is based on respect to law and property rights), social cohesion, market efficiency, and macro-economic equilibrium (for example, with low levels of unemployment).

As it can be seen, the previous conceptualization implies the economic terms of vulnerability and resilience in a macroeconomic way. This macro framework could be limiting when analyzing communities, which, as in the case of an ecovillage, express microeconomic dynamics. But when communities are analyzed from a systemic perspective (Lombardozi, 2020), the previous economic resilience dimensions could be extrapolated from a country level to a community one. For example, in the case of ecovillages, the economic openness could be operationalized as the percentage of the community incomes that comes from external buyers (people or companies that buy products or services that are produced or offered within the community). The separation in the analysis of the offer of products, on the one hand, and services on the other could be useful to make clearer the economic openness of a community. For instance, considering the actual context of the COVID-19 virus, when external people can hardly visit communities, it

could be understood that the services offered within the community might make it more vulnerable than the products, due to these last ones are easier to deliver to long distances beyond the community. This framework can be especially important to ecovillages, which economies tend to depend highly on *in situ* tourism, due to the different kinds of spiritual, ecological, or educational workshops they offer (Miller, 2018; Lombardozi, 2019).

According to Briguglio et al. (n.d.), within the economic literature, resilience has been used in three different ways: shock-counteraction (how quickly the economy recovers from a shock), shock-absorption (to withstand or resist the effect of shocks) and to avoid the shocks (which expresses the opposite of economic vulnerability). All these dimensions exemplify a very important idea of resilience: that economies (and communities) are exposed to (external) shocks and that resilience is the capacity of that economy (or community) to cope -in a functional way- with those shocks, in other words, to avoid them, to resist to them (to not be destabilized) or to adapt to them.

The previous responses can be glimpsed -generally in a partial way- throughout all the resilience literature, independent of the discipline implied. It is important to analyze resilience from a systems perspective. This paradigm allows extrapolating concepts from one discipline to another. For example, the economic term shock can be equalized to the stressor concept. Both represent an external input to the system that might disturb or alter it.

One of the weakest dimensions of the resilience of sustainable communities can be their financial dimension. Because, although these communities try to be

relatively self-reliant, at least in their energy and food production, it is also true - as Briguglio et al. (2008) show- that higher GDP per capita is associated with the highest level of resilience. This vulnerability was seen in Findhorn, especially with foreign members which do not belong to the EU and therefore did not receive its financial support (Lombardozi, 2019). However, as it will be seen in the next section, this was counterbalanced by the social dimension of resilience.

Having considered the importance of the economic dimension, it is important to understand that resources are not strictly limited to economic resources. As Norris et al. (2008) define it, resources are “objects, conditions, characteristics, and energies that people value” (p. 131). According to these authors, vulnerability happens when resources are not enough to respond in a resilient way, which means when resources are not robust, redundant, or rapidly mobilized as a response to external shocks, which might produce dysfunctions. This resilient response can depend on other dimensions beyond the economic, which will be explained in the next section.

### **Social dimension**

In the previous section, the importance of the economic dimension of resilience was exposed. However, economic resources are not the only quality that makes a community resilient (Magis, 2010). The responses to shocks depend also on an integrated social network that can face changes. If the economy is well organized but the social structure is not able to mobilize the resources efficiently, the community will lack a robust resilience,

because, as Adger (2000) claims, social resilience is “the ability of communities to withstand external shocks to their social infrastructure” (p. 361).

Hence, social capital is a complement to economic resilience. Especially when it is about communities that, as the ecovillages, try to be self-sufficient (Pickerill, 2016). While economic resilience gives the resources needed to face stressors, social resilience -manifested in social capital- could be understood as the lubricant needed to oil the economic structure. For example, one community could be rich, in terms of having lots of economic resources. But if those resources are not well distributed (for example, if all the communal property is owned just by one member) the economic shocks can destabilize more intensively the social structure, producing conflicts and making members abandon the community. That is why economic resilience considers social cohesion as one of its four dimensions. And it is also the reason why the equitable distribution of income is a crucial factor of social resilience (Norris et al., 2008).

One example of the previous can be seen in Findhorn Ecovillage. This community is considered as one of the most resilient ecovillages in the world, it has remained in time for several decades, and with a considerable number of members (Lombardozi, 2019). The members that work for the community (i.e., not as independent worker or having a business) are paid directly from the resources that the community make with the different activities that they develop within the community. And although the range of jobs done is diverse, from cultivating, cooking, and organizing workshops, their income ratio is 1 to 1.3

(FF, 2018). Therefore, the long life and success of Findhorn can be an example that although ecovillages might not express so high GDP per capita levels, their social structures can enhance its resilience, counterbalancing the financial capital by social capital.

At this point, it is important to highlight that although the concept of resilience has been traditionally understood and framed from the individual perspective, this has been problematic, because sometimes it ignores the social and cultural context and also that “a collection of resilient individuals does not guarantee a resilient community” (Norris et al., 2008, p. 128). Therefore, the community should not be understood as an abstract subproduct of the social interactions of individuals (individualist methodology), which could fall under an ‘atomistic fallacy’ (Kirmayer et al., 2009), but as an entity with the agency (systems perspective), i.e., with Norris et al. (2008) and Keck & Sakdapolrak (2015), framing resilience as a set of capacities from the community; recognizing the fact that community resilience was born from systems theory (Magis, 2010).

However, this perspective does not ignore the agency of the individual, but as an element of the system that the community represents. In the words of Kirmayer et al. (2009): “Resilience of the community itself involves the dynamics of the social response to challenges that threaten to damage or destroy the community. These dynamics may involve adaptations and adjustments of individuals, groups, and organizations with the community (seen as components of the community as a system) as well as interactions of the whole community with its surrounding

environment, including especially other social, economic, and political entities.” (Kirmayer et al., 2009, p. 66).

From this perspective, the social dimension of community resilience is a capacity of the system. It is the ability of the community to create an environment, or social structure that facilitates the robustness of social capital. This resource involves an organic network of relationships, based mainly (but not exclusively) on primary (affective) relationships, that can help community members in moments of adversity. Examples of these dynamics are the social cohesion produced for seeing the rest of the community members as a family (Lombardozi, 2020), or the formal groups within the community that helps each other without money involved, for example, taking care of children when their parents are busy (Lombardozi, 2019).

### **Ontological dimension**

As it was seen in the previous section, according to Norris et al. (2008) the decrease of inequality is a key factor of social resilience. These authors also established that the stability of livelihoods is another key parameter of social resilience — and it is a factor of individual resilience as well (Ungar et al., 2013). Although the stability of livelihoods is related to inequality, this last one is not the only factor of the former. That is why this stability should be considered as a dimension itself.

For example, the stability of livelihoods could be affected by climate disasters. However, as it can be seen in the study of Kirmayer et al. (2009), not all the adversities of communities are produced by sudden impersonal events such as

climatological catastrophes, but also by long social and political factors that are not so discrete and explosive.

The previous reflection is very important to understand the particular characteristics of community resilience. Otherwise, this concept could be confused with other kinds of resilience. For example, psychological resilience implies a response to a disturbance. In other words, the individual must face a problem to express resilience. If the individual avoids that stressor, that may weaken him, and this could be considered as a lack of resilience. On other hand, resilient communities try to limit risks and reduce threats (Magis, 2010). For example, if one economic crisis emerges, an economic resilient response can be to avoid those shocks (Briguglio et al., n.d.). Hence, differently to individual resilience, within community resilience to avoid shocks should not be considered as a lack of resilience. On the contrary, avoiding such shocks can be fairly considered as an adaptation of the system, because as Keck & Sakdapolrak (2015) state, the adaptive capacities of social resilience means the “ability to learn from past experiences and adjust themselves to future challenges” (p. 5); i.e., these adaptive resilient capacities are ‘pro-active’ (ex-ante) (Obrist 2010a, 289) or ‘preventive’ measures (Béné et al. 2012, 31)” (p. 10). As Norris et al. (2008) claim, the reduction of risks increases collective resilience. Risk can be understood as the probability that stressors or shocks impact negatively on the ontological (or economic) security of the community, that is to say, the impacts that may affect the “trust that most of part of the human being have in the continuity of our identity and the continuity of our social and natural

environments of action” (Giddens in Beriain, 1996, p. 26).

### **Institutional dimension**

In the previous section, it was seen how resilience involves the reduction of risk and therefore the enhancement of security. The community can do this not only by adapting or resisting stressors, but also avoiding them, considering they are “aversive circumstances that threaten the well-being or functioning of the individual, organization, neighborhood, community, or society” (Norris et al., 2008, p. 132); and that to keep the same structural function of the system even when reorganizing is a characteristic of social resilience (Folke, 2006).

In the economy section, it was mentioned that social cohesion is a dimension of economic resilience. In that section it was also defined that economic resilience is a *policy-induced* ability to withstand or recover from shocks, which exposes the institutional dimension of resilience. This institutional level can also be glimpsed in the literature about social resilience. For example, Adger (2000) states that “social resilience is institutionally determined, in the sense that institutions permeate all social systems” (p. 354). Similarly, Keck & Sakdapolrak (2015) claim that the transformative capacities of social resilience refer to the “ability to craft sets of institutions that foster individual welfare and sustainable societal robustness towards future crises” (p. 5).

However, at the micro-level, it could be argued that institutional is an unnecessary dimension due to the horizontal and primary kind of relationships of communities (Lombardozzi, 2020) and

therefore, that communities have only *social* capacities to respond to shocks. But this is not strictly true. For example, within Findhorn Ecovillage there is an institution called Findhorn Foundation. All members that belong to it are offered a job within the community. This increases the ontological security of members, that do not have to worry about losing their jobs (Lombardozi, 2019). Therefore, the community can also have institutional capacities to cope with stressors.

## Conclusion

The present paper has reflected on the importance of community resilience, as a specific and different type of resilience. Nonetheless, thanks to systems theory, when the community is considered as a system, some similarities with other disciplines can be found. To withstand or adapt to external shocks are common abilities of other kinds of resiliencies. However, community resilience integrates another possible response: to avoid stressors, as a peculiar characteristic which is not a proper response in other kinds of disciplines, as it happens in the case of psychological resilience.

Also, it was highlighted the importance of enhancing economic security, to cope with shocks that might affect the community's functioning. This economic dimension was closely related to institutional responses but also with social support. It is important then, to understand that a resilient community is characterized by a strong social network that can act in times of crisis. These crises involve high levels of risks and uncertainties, which not only may threaten the ecology of the community, that is to say, they are not only

related to climate catastrophes. Any other kind of stressor, like economic shocks or social disintegration, can also affect the trust in the continuity of our social environment of action, negatively affecting the ontological security of the community. Having considered all the previous dimensions, community resilience will be understood as the social and institutional capacities to adapt, resist, or avoid external shocks that threaten the economic and ontological security of community members.

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# ARTICLE

## Sustaining Long-term Care Model: Green House Experiences in COVID-19

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The COVID-19 pandemic has caused heated discussion around care models within long-term care facilities, such as skilled nursing, assisted living, memory care, and continuing care retirement communities (CCRC). Are there certain design elements that are going to prevent or accelerate the spread of the virus? Has particular workforce management been shown to be more advantageous during the pandemic? What is the relationship among residents' lifestyle, staff care, and COVID? How does the culture element impact the health results of long-term care facilities during the pandemic? There are many articles on various topics such as outcomes in not-for-profit versus for-profit nursing homes, a comparison of COVID-19 statistics against Five-Star Quality Ratings, and nursing home density among other items (Ziegler, 2020).

Due to its unique design and care model, the Green House model is becoming a potential model for preventing and managing coronavirus outbreaks. In this paper, we will introduce the Green House model and discuss its experiences in the COVID.

### What is the Green House?

Over 1.7 million individuals reside in the 15,600 nursing homes (NHs) in the United States (Centers for Disease Control and Prevention 2016). Despite the critical need for NHs, there have historically been poor care and lower quality of life, such as untreated pain and depression and lack of choice regarding basic daily needs (Institute of Medicine 1986). In 1987, the Omnibus Reconciliation Act, also known as Nursing Home Reform Act, was enacted to improve the quality of long-term care. A survey by Miller et al. (2014) found that the number of nursing homes implementing reform and culture change had risen to 85 percent in 2013 from 56 percent in 2008.

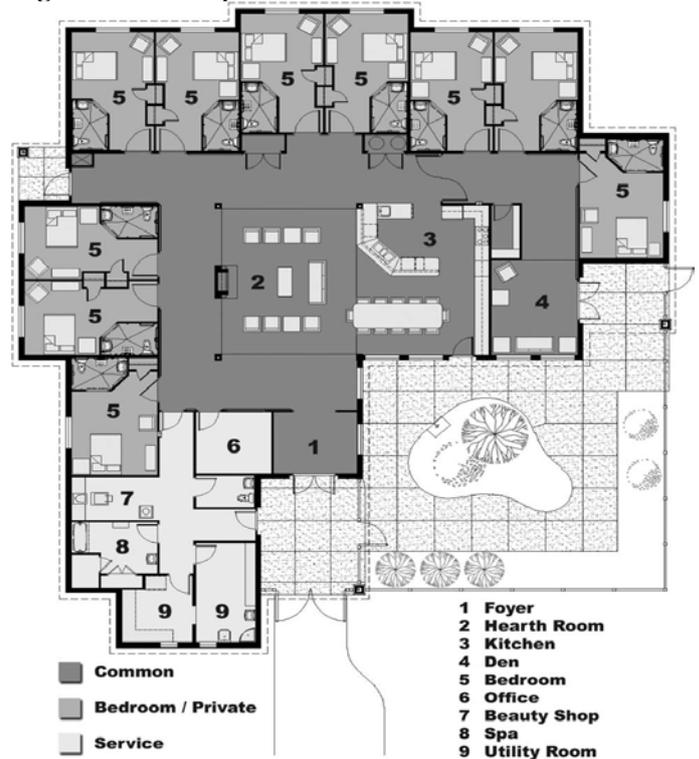
The reform of nursing homes brought the concept of the culture change movement. The culture change movement call for person-centered care service instead of an institutional model, in which, the care for older adults is following the institutional rules and schedules. The Key elements of person-centered care include resident direction, homelike atmosphere, close relationships, staff empowerment, collaborative decision making, and quality-improvement processes (Koren, 2010).

Several researchers have introduced several culture-change models in long-term

care facilities. The Eden Alternative, articulated in 1994 (Thomas, 1994), advocated that residents interact with children, pets, and plants to help older adults combat feelings of boredom, loneliness, and helplessness. The Wellspring model, also initiated in 1994, focused on clinical quality improvement and environmental culture change within a consortium of a nursing home that shared ideas and resources (Stone, 2002). The Green House project was generated by William Thomas several years before the first Green House was opened. The model emphasizes a good quality of life for residents rather than hospital circumstances (Rabinson, Thomas, Kane, Cutler, & McAlilly, 2006).

The Green House model is based on three values—real home, meaningful life, and empowered staff (The Green House Project 2012), which aims to provide the non-traditional living experience of long-term care facilities for older adults and to deinstitutionalize care services. These values are established through the creation of small, residential-style houses located in community neighborhoods. To minimize the medical atmosphere in those facilities, the Green House model intends to avoid medical signs in visible areas. The residents in Green House facilities must have private rooms with full bathrooms and share a central living space with an open kitchen, dining, and living area; and have access to outdoor space. Meals are to be prepared in the open kitchen by caregivers and are shared at a common dining table (See Figure 1).

Figure 1. Floor plan of first Green House.



Resource: Radical redesign of nursing homes: applying the green house concept in Tupelo, Mississippi The care in a Green House be provided by Shahbazim, who are responsible for the range of personal, clinical, and home care activities. The Green House model prescribes that Shahbazim attends not only to elders' care needs but also to cooking, cleaning, laundry, ordering, scheduling, and other tasks. In a typical Green House, each unit has three Shahbazim, two of them take the first and second shifts and the last one for the third shift (Bowers & Nolet, 2014). Shahbazim do not report to a director of nursing or clinical supervisor but are supported by a Guide who coaches and supervises them. The clinical staff is to visit frequently, and a nurse is to be available 24 hours a day. To reinforce the implementation of these components, Green House receives ongoing support from the national office, which includes national meetings, webinars, a peer

network, and other forms of communication (Zimmerman & Cohen, 2010; The Green House Project, 2012). The Green House intended to be person-centered, meaning that elders decided their daily schedules, activities, and meals by themselves.

Five key words of Person-centered care in Green House:

**1. *Autonomy:*** The elderly have their private bathrooms and rooms, and they are not subject to schedule. They can enter the sharing and social areas of the house at any time to make it feel like home.

**2. *Green life:*** In this case, "green" means living in nature. The green house project residence allows plenty of sunlight, including garden areas, plants, and outdoor activities.

**3. *Intimacy:*** The Green House project is not a traditional collective housing, but is composed of 6-10 elderly residents.

**4. *Smart technology:*** The green house community uses smart technology, such as adaptive equipment, computers, and ceiling lifts.

**5. *Warmth:*** This is one of the core values of the Green House project. The cozy living environment encourages social activities, as well as decorations and furniture that provide a sense of comfort.

The evaluation for the Green House model has mixed results. Family satisfaction, lower resident depression rates, and lower levels of social isolation or helplessness have been reported to improve through many studies (Bergman-Evans, 2004; Kane, Lum, Culter, Degenholtz, & Yu, 2007; Lum, Kane, Cutler, & Yu, 2008). However, issues have also been reported including the risk of falls, and higher staff turnover (Bergman-Evans, 2004). An evaluation of Green House

Project care found it provided higher direct care (23–31 minutes more per resident per day) than traditional nursing homes and more than four times as much staff engagement with elders outside direct care activities (Sharkey, Hudak, & Horn S, 2014). In November 2008, Senate Finance Committee Chair Max Baucus (D-MT) said The Green House Project model has shown improving the quality of life and care in these settings (Senate Finance Committee, 2011). At present, 68 organizations in 32 states are in various phases of developing 347 Green Houses (The Green House Project). This successful model of early collaboration with the state health departments has been repeated in many states where Green Houses are now being developed, including New York, Ohio, Arizona, Georgia, Nebraska, North Carolina, Florida, Michigan, Kansas, Hawaii, and so on.

### Green House experiences in COVID19

The Green House Project partnered with the University of North Carolina to conduct official data collection on the coronavirus after positive reports within nursing homes. The study tracks the number of COVID-19 cases and deaths among both staff and elders in Green House homes and compares those statistics with national nursing home data. Green House homes are reporting fewer cases of coronavirus and fewer deaths than other nursing home models.

Ninety-five percent of Green House homes reported zero cases of COVID-19 among residents or staff, according to a study of coronavirus data gathered from February 1, 2020, through May 31, 2020 (see Figure 2).

This information reflects 306 Green House Homes and 3,295 seniors residing in those homes (The Green House Project COVID Study Report, 2020). The data below

provides additional perspective on these findings.

Figure 2.

**Green House Homes and Small Homes with Confirmed COVID-19 Cases & Deaths and Homes without Cases, Across All License Types**

**Reporting Period 2/1/20—5/31/20**

License Type	No. of Orgs	No. of Homes	No. of Elders served on 5/31/20	No. of Homes with Positive cases	No. of confirmed COVID-19 Positive Cases for Elders	No. of COVID-19 related deaths	Percent of COVID Free Homes
GH SN	45	229	2,384	11	32	1	95%
Small House SN	10	47	404	7	15	3	85%
Green House and Small House Combined (SN)	55	276	2,788	18	47	4	93%
Assisted Living	13	24	218	2	15	3	92%
Family Care	2	3	24	0	0	0	100%

Resource: The Green House Project COVID Study Report

[https://www.thegreenhouseproject.org/application/files/2415/9526/8890/GHP\\_COVID19\\_Study\\_Report\\_Two\\_Pager\\_Jul\\_1.pdf](https://www.thegreenhouseproject.org/application/files/2415/9526/8890/GHP_COVID19_Study_Report_Two_Pager_Jul_1.pdf)

Not only were cases among residents lower but among staff as well. A similar pattern was found with deaths among residents living in Green House homes. In all, its data from January through July 26 show 2.84 deaths per thousand

residents, compared with 38 deaths per thousand residents in all certified skilled nursing homes (see Figure 3). The organization will continue to collect data from Green House homes each month until December 2020.

**Confirmed Elder Cases and Deaths Green House/Small House Skilled Nursing to National Nursing Home Data (1/1/20—7/26/20)**

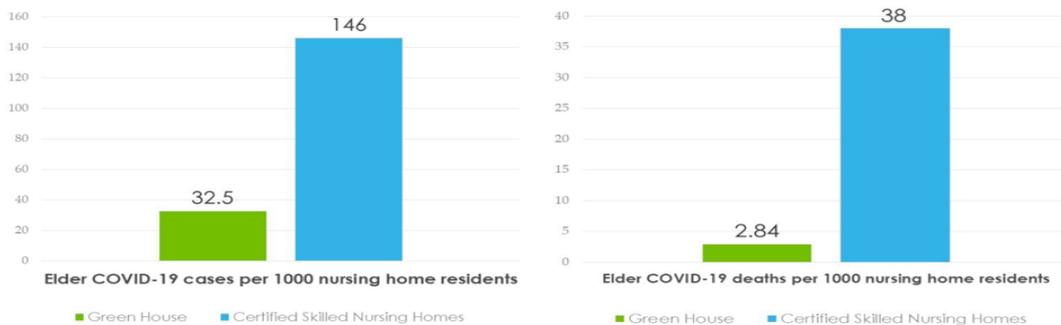


Figure 3. Resource: The Green House Project COVID Study Report

([https://www.thegreenhouseproject.org/application/files/2415/9526/8890/GHP\\_COVID-19\\_Study\\_Report\\_Two\\_Pager\\_Jul\\_1.pdf](https://www.thegreenhouseproject.org/application/files/2415/9526/8890/GHP_COVID-19_Study_Report_Two_Pager_Jul_1.pdf))

It is important to affirm that the Green House model is designed for single rooms with full bathrooms. It has been generally understood that this design element helps reduce the spread of the virus. And also, it is not a privilege for high-income older adults to reside in the Green House with private payment, some low-income older adults are eligible to take care of the Green House with subsidies. For example, in the original Green House Home in Tupelo, MS, there are roughly 65% Medicaid residents. Nationally, roughly 4 out of 10 Green House residents are covered by Medicaid.

For years, experts have called for rethinking the U.S. nursing home model, replacing large facilities containing hundreds of beds with smaller facilities and fewer residents. And now with COVID-19 death in nursing homes nationwide, another look is being given to these alternative housing options.

### **Implications: Smaller is Better?**

On the one hand, the smaller, self-contained, autonomously functioning residence of Green House is better than long hallways, semi-private rooms, or even three- and four-person rooms in traditional nursing homes. On the other hand, the universal worker concept means the communities have fewer workers coming and going, and caregivers can develop much closer relationships with residents, it is easier to detect resident's behavior. Hence, from the physical environment to the staff workplace, small-house models can provide more person-centered care for residents to deal with COVID.

Green House is one of the small-house models. There are also numerous other senior house providers that are

creating their own household models. Though varying in size and scope, most house no more than one or two dozen residents, and many provide higher-acuity care, such as assisted living or memory care. Some of these small-house senior living models have reported minimal levels of Covid-19. Assured Assisted Living in the Colorado State reported just three positive cases of Covid-19 among residents across its 10 small-home communities. All three residents didn't show symptoms when they had the disease and have since recovered. Francis LeGasse Jr, president of Assured Assisted Living, thinks this is an example of what the small packages are, and what is the advantage of the small model through Covid-19. According to CEO Brandon Schwab, Shepherd Premier, an Illinois-based senior housing provider with five small homes, there is no case of Covid-19 among its residents or workers. He believes the small-house model which is 10-15 beds is much more responsive to infection control compared to 150-200 beds (Regan, 2020). Bee-Hive Homes has 216 small-home seniors living across the U.S. The company has only seen a small number of positive Covid-19 cases among staff and one case among residents, with no deaths reported. The model's flexibility, coupled with its more person-centered care, helps with infection control measures (Regan, 2020).

However, there are some obstacles to making the model work. One is the affordability of small-house communities, which often high cost than their traditional nursing home counterparts, especially if they focus on a service like memory care and assisted living. And planning for small-house construction projects can be more complicated, given that resident

rooms are spread farther apart than traditional facilities, requiring more creative land uses and design considerations. Another challenge is that small-house communities can be harder to license for senior living services, as regulators don't always understand the small-house as a long-term care facility. We hope that the talented designers are willing to participate in senior living small-house and plan a more diverse senior community. We recommend that Medicaid and Medicare could cover the cost in small-model for those who cannot afford the service of small-house, at the meantime, the federal and local government should help these small-house get their long-term care license to better serve the senior residents

We believe that senior living providers will navigate the post-COVID world in a manner that helps long-term care maintain sustainable development. Green House and other small models are the trends, and traditional nursing homes may welcome the trend sooner or later.

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# ARTICLE

## Residential and community rooftop rainwater harvesting in urban areas of Harare, Zimbabwe

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### Introduction and country context

Zimbabwe is a landlocked country that lies in Southern Africa and is bordered by Mozambique, South Africa, Botswana, and Zambia. The climate can be described as tropical and temperate, with the rainy season starting around late November till March (CIA, n.d.). Winters are dry with cooler temperatures. Agriculture is the mainstay of the economy, followed closely by mining activities (CIA, n.d.).

The country has experienced the global effects of climate change, manifested locally through erratic rainfall patterns resulting in several crippling droughts over the past 30 years (Chaminuka & Nyatsanza, 2013). Closely linked to the phenomenon of drought is the associated shortage of treated water, coupled with rationing and non-supply in some areas (CIA, n.d.). This shortage of treated and piped water sources has resulted in citizens accessing water from rivers, streams, and other unprotected water sources. Mapepa and Adekoye (2019) and Chimbari (2012) list data that suggests that most households do not have alternative water sources as incomes remain extremely constrained

following more than 20 years of social and economic hardship in Zimbabwe since the downturn of the economy in 1997.

Unemployment is recorded at over 90% with most households living on less than a dollar a day (Mapepa & Adekoye, 2019; CIA, n.d.).

### Waterborne diseases

These unsafe water sources have resulted in documented occurrences of disease, water-borne schistosomiasis and epidemics in Zimbabwe, affecting urban and rural communities alike (Chaminuka & Nyatsanza, 2013; Chimbari, 2012; Youde, 2010). These researchers reported that the most significant epidemic was the countrywide year-long cholera outbreak of 2008 which infected more than 100,000 Zimbabweans, killing over 4,000 people. A similar major outbreak of Typhoid was also recorded in 2012, concentrated in suburban areas where there have been erratic water supplies for years (Chaminuka & Nyatsanza, 2013; Chimbari, 2012). These two outbreaks are indicative of poor-quality water sources and the risk of untreated water.

Having lived in Harare, families and organizations that have additional financial resources can purchase what is arguably “treated” water for primary use that is delivered by trucks, for upwards of US\$50 per 5000 liters, enough for about two weeks of careful use for a family of four. This has been compounded by the significant lowering of the water-table due to pressure on dwindling surface and subterranean water sources (Atwood, 2013). Many households and schools that previously enjoyed uninterrupted underground water sources have now found that prolific boreholes sometimes run dry, especially during the dry winter months. Unfortunately, boreholes remain a very expensive option, averaging US\$5,000 upwards and requiring regular maintenance, electricity, and replacement of pumps, which are all costly and beyond the reach of the typical Zimbabwean family or community locations such as schools (Atwood, 2013).

### **Paper objectives**

To this end, this paper seeks to highlight a viable option of urban rooftop rainwater harvesting for households, institutions, or schools in Harare, through: (i) collection and storage of available rainwater for general use and other uses like gardening; (ii) reduction of the incidence of disease by preserving limited treated water for hygienic use and using rainwater for secondary uses, and (iii) minimization of the incidence of illness and unnecessary loss of life due to schistosomiasis-related conditions by planning better water access.

This paper proposes an alternate approach to alleviate current water supply and quality issues experienced in most

urban locations in Harare (Chimbari, 2012). The target population are houses, businesses, and schools that have standard domed roofed features which range from tin/steel, polycarbonate, or concrete tiled roofs that can channel rainwater to the ground through gutters. Harare receives, on average, about 32 inches of rainfall each year in the wet summer months (CIA, n.d.). With very few and low-cost modifications, rainwater can be harvested and used as-is for various secondary uses such as flushing toilets, cleaning, and watering gardens. This would ease pressure on the Harare City Council to prioritize the provision of scarce treated water for primary use such as drinking, cooking, and hygienic use (Youde, 2010).

### **Improving nutrition and livelihoods**

This in turn may positively influence nutrition aspects for families as the food sources may significantly reduce susceptibility to diseases through the growing and consumption of home-grown fresh vegetables (Chaminuka & Nyatsanza, 2013). Securing diversified food options lessens the risk of purchasing contaminated vegetables from unsafe sources, reducing the incidence of diarrheal conditions (Chaminuka & Nyatsanza, 2013). Enhanced food security can also have a knock-on effect of preserving the environment as small spaces are well managed for maximum profits, sustainable outputs, and an expansion to viable livelihoods despite limited water sources (Mutekwa, Kusangaya & Chikanda, 2005).

### **Implementing urban roof rainwater harvesting**

Rainwater harvesting has long been a viable option for many countries as an

additional source of potable water (Elder & Gerlak, 2019). Typically, rainwater can be collected using ground-water collection drains that typically lead to a central water storage facility or lake (Gumbo, 1998). For example, Harare utilizes stormwater drains to channel rainfall ground-runoff to Harare's main water source, Lake Chivero, where it is treated and is supposed to be piped back to households (Gumbo, 1998). Due to the infrastructural challenges of an aging water reticulation system, many areas endure years without receiving piped water, while most receive erratic supplies, at best (Gumbo, 1998). This approach for rainwater collection was piloted by the United States Agency for International Development (USAID) in a few Harare households, to alleviate water supply issues (Jimenez, 2011). Vulnerable groups to accessing safe and accessible water supplies include children under the age of five, the elderly, and those with disabilities (NASCOH, 2013).

### **Benefits of rainwater harvesting**

The author asserts that rainwater harvesting has a practical application immediately, in the short-term as well as in the long-term as most gutters and downpipes have a lifespan of between 15 to 20 years (Gumbo, 1998). This means that an initial investment in year one may have a potential return on investment that far outweighs the initial outlay, even after just five years. According to (Chaminuka & Nyatsanza, 2013), the benefits of urban roof rainwater harvesting can be qualitatively and quantitatively measured in terms of the following outcomes:

(1) Reduced dependence on erratic piped city water, increasing water supply predictability. (2) Lower costs of

purchasing water or money that can be directed towards other financial priorities. (3) Improved awareness of alternative water options and building resilience in favor of water conservation.

(4) Reduced time spent by households trying to access safe water elsewhere.

(5) Increased environmental sustainability and the possibility of urban livelihoods projects in the creation of vegetable gardens for improved nutrition.

This paper focuses on the five outcomes indicated above, which are directly attributable to the implementation of rainwater harvesting in the short- to medium- term.

### **Community participation**

By stimulating community involvement, beneficiaries can be empowered to take charge of the provision of sustainable and regular water sources. There is a unique opportunity for Public-Private Partnerships (PPP's) or Corporate Social Responsibility (CSR) programs to partner with schools and communities to counter the ongoing challenges of providing regular water. This can include grants and subsidies in support of roof gutters for collection and water tank storage for later use. This can be a viable positive initiative for establishing a culture of community projects that positively support regular and clean water supplies for more urban communities. These are the two primary costs, in addition to piping and optional water pumps (Gumbo, 1998; Jimenez, 2011). A water collection system can take advantage of high rainfall yield days to store the water for later use on dry days.

### Support and stimulation of small local businesses

The aim of such a project could stimulate the local business community. It can as well promote the decent work agenda at the local level for plumbing artisans, and manufacturing companies to produce associated collection and storage equipment. The use of endogenous components needed for the successful conversion from regular gutters to water collection gutters can be subsidized where possible (Gumbo, 1998). Additionally, significant discounts and subsidies could be offered to households purchasing their water tanks from authorized sources as well as fitment and configuration by approved companies or contractors. This will also go a long way in ensuring consistency in how the collection systems are erected for maximum effect and disease minimization due to cross-contamination or loss of water through leakages or evaporation (Elder & Gerlak, 2019). A sense of community partnership of shared water sources is encouraged to ensure security from diseases not just for individual

households but for the greater community good (Gumbo, 1998).

### Achieving the United Nations Sustainable Development Goals (SDG's)

This paper has the potential to impact several of the U.N. Sustainable Development Goals that were adopted globally in 2015 three months before the Paris Climate Change Agreement (SDGs, n.d.) The SDGs are a call to action, and by ensuring water security directly and indirectly impact can be realized in the long term as indicated in the graphic below.

### SWOT Analysis

The specific problem to solve is that of access to alternative water sources that can be used for secondary purposes that do not require treated water, such as toilet flushing, watering gardens, washing vehicles, and so on. In summary, such a project could influence the following strengths, weaknesses, threats and opportunities in the long run.



Figure 1. Sustainable Development Goals (SDGs, n.d.).

**Strengths identified**

- (i) Simple and low-cost retrofitting of existing gutters can turn wasted rainwater into collected water for households to use for secondary purposes.
- (ii) Most urban houses in the city have sloped roofs as well as existing gutters already, lowering costs even further.
- (iii) Low implementation cost with the potential for high benefit in the short to medium term.

**Weaknesses observed**

- (i) Since existing roofs and gutters are being used, the water quality cannot be assured, so the water is suitable for secondary purposes.
- (ii) Simple collection of rainwater does not allow for filtering or treatment of the rainwater, as a potential to expand the rainwater’s use.

**Opportunities presented**

- (i) Community members can take charge of the way they manage their available water more effectively and in an involved way without wastage.

- (ii) PPPs can provide grants or subsidize costs by partnering with the community as part of CSR programs.
- (iii) The project can be further used as an opportunity to educate households on sustainable water use habits.
- (iv) Households can utilize the secondary water in nutrition gardens for own consumption or create livelihoods by selling any excess vegetables

**Threats to implementation**

- Funding for such a project may not be available at the individual or community level, despite the merits of water harvesting due to the depressed socio-economic environment in Zimbabwe.

**The Logical Risk Framework**

The Logframe is included below and is based on the SWOT analysis for the project after installation and the review of literature in the preceding pages (Aquatabs, 2020; Gumbo, 1998; Jimenez, 2011; Leafguard, 2020). It identifies the risk indicators based on the strategic objectives as a basis for the assumptions.

#	RISK	MITIGATION	LIKELIHOOD
1	Use of rainwater for primary purposes such as drinking, thereby exposing themselves to the risk of disease	Introduce water treatment tablets in storage sources to sanitize all stored water	HIGH
2	Lack of individual ownership for community installations may result in collection systems ending up in disrepair	Create maintenance clubs for communal installations or schools, encouraging the use of the shared additional water resource	MEDIUM
3	Contamination of water due to rust and plant matter buildup	Encourage the use of UV treated gutters that are sealed to collect rainwater and eliminate foreign matter	HIGH

Figure 2. Risk Matrix

## Conclusion

An urban roof rainwater harvesting project is a potentially viable option in alleviating the pressure of the municipality in providing treated water to a growing city population due to rural-urban migration and water reticulation systems that have not been expanded since the 1960s (Chaminuka & Nyatsanza, 2013). This approach can improve water access and reduce the risk of

communicable diseases and epidemics by creating empowered community members with a greater awareness of the importance of safe water sources. Household vegetable gardens would also be encouraged, as a means of positively influencing community nutrition aspects, preserving the environment, and creating small sources of income within the community.

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# ARTICLE

## Nursing Home Sustainability: Controlling Covid-19 Infections

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### Abstract

**Background:** Until May 2020, the coronavirus pandemic has caused 25,000 nursing home resident deaths in the United States. Nursing home facilities are facing severe challenges in maintaining quality care and minimizing Covid-19 infections and fatalities. As Texas re-opened its economy at the end of April, nursing homes should prepare sufficiently to respond to the strike's second wave. We aimed to investigate factors related to Covid-19 nursing home infections on Texas's residents and staff aspects, respectively, and propose appropriate steps to control Covid-19 infections.

**Method:** A secondary dataset from CMS was employed, and a total of 958 nursing home facilities were qualified for the study. Each dependent variable (total resident infectious numbers and total staff infectious numbers) was determined by two simultaneous regressions from characteristics of nursing homes and shortage of staff as well as PPE variables. After that, the statistically significant predictors from simultaneous regressions were selected into each dependent variable's final regression model, respectively. **Results:** For residents perspective, regression analysis indicated that the size of a nursing home ( $\beta = 0.200, p < 0.001$ ), passed a quality assurance check ( $\beta = -0.097, p = 0.003$ ), a shortage of other staff ( $\beta = 0.084, p = 0.008$ ), and the total number of occupied beds ( $\beta = -0.123, p = 0.014$ ) were statistically significant with resident infections. For staff perspective, the regression revealed that passed a quality assurance check ( $\beta = -0.263, p < 0.001$ ) and private nursing homes ( $\beta = -0.074, p = 0.018$ ) were related to the staff infections. **Conclusion:** Nursing homes are suggested to focus on those factors to prevent and manage Covid-19 infections as well as to minimize outbreaks and fatalities.

**Keywords:** Covid-19, nursing homes, infections, factors, sustainability, Texas

According to the Kaiser Family Foundation (KFF; 2020), almost 2.5 million cases and appropriate 120,000 deaths have been reported due to the coronavirus pandemic in the United States since December 31<sup>st</sup>, 2019. A well-known fact is that the United States experiences the most significant diagnosed cases and deaths worldwide (Solis et al., 2020). Of those enormous death numbers, at least 25,000 deaths happened on nursing home residents were recorded until May 2020 (Behrens and Naylor, 2020; Stall et al., 2020). Because of the smooth transmission and the high fatality rate among the aging population, the coronavirus perils care quality in nursing home facilities. Those affected facilities become hard-hit areas. In some countries, such as Canada and the U.S., nursing home facilities are related to the first documented coronavirus outbreaks and deaths with up to a 33.7% fatality rate (Stall et al., 2020).

Many kinds of research have been focusing on Covid-19 related fatalities in nursing homes. For example, residents' age is considered as a risk factor contributing to nursing homes' high fatalities, and the fatality rate among the aging population may be ten folded than young people (Dosa et al., 2020). Gardner, States, and Begley (2020) proved a similar statement. Residents' health condition is acknowledged as another risk factor (Dosa et al., 2020). Residents with more comorbidities or medical conditions have the highest fatality rate (Solis et al., 2020; Ouslander, 2020; Yancy, 2020). Besides those, the percentage of African American residents is one of those risk factors. A nursing home with a high percentage of African American residents has more

fatalities during the pandemic. The CMS dataset we applied for the research doesn't furnish whether all residents with severe infections have been staying in nursing homes over time or were just transferred from hospitals. Therefore, the nursing home infectious numbers are more accurate than fatalities in this scenario. From the nursing home level, factors contributing to infections include location and facility size. Abrams et al. (2020) demonstrated Covid-19 outbreaks and fatalities in nursing homes are linked with urban location and bigger facility size. In addition to following the CDC guidelines, nursing homes are also suggested to delve into resident and staff infections at the nursing home level to minimize infections and fatalities.

As the State of Texas re-opened its economy at the end of April this year, there's a severe consideration that the second wave of coronavirus will strike the state again. To control nursing home infections and maintain their sustainability, risk factors leading to infections should be evaluated appropriately. Even many published articles provide guidelines or protocols for nursing home facilities to prevent and manage infections, factors associated with the Covid-19 infections in Texas are understudied when considering the state as a risk factor. This article sought to deliver the information on factors related to Covid-19 infections on both residents and staff aspects, then investigated applicable methods to control infections and maintain nursing homes sustainability in the Texas region.

## **Method**

### **Design and Participants Selection**

This study was quantitative descriptive research. We utilized the

secondary dataset named the Covid-19 nursing home dataset. It is a national-wide public file reported by nursing home facilities in each state and entered by the Centers for Medicare & Medicaid Services

(CMS). We chose all nursing home facilities in Texas reported until May 24<sup>th</sup>, 2020. There were 1219 nursing home facilities selected for the study. Despite 274 nursing

Table 1.  
*Characteristics of Nursing Homes, Staff Shortage and PPE (N = 958)*

	n (%)	M (SD)
<b>Characteristics</b>		
Passed Quality Assurance Check		
Yes	944 (98.5)	
No	14 (1.5)	
Number of All Beds		112.05 (38.97)
Total Number of Occupied Beds		71.08 (28.88)
Laboratory Type is State Health Department		
Laboratory Type is Private		
Yes	848 (88.5)	
No	110 (11.5)	
Laboratory Type is Others		
Yes	123 (12.8)	
No	835 (87.2)	
<b>Staff Shortage and PPE</b>		
Nursing Staff		
Yes	137 (14.3)	
No	811 (85.7)	
Clinical Staff		
Yes	31 (3.2)	
No	927 (96.8)	
Aides		
Yes	189 (19.7)	
No	769 (80.3)	
Other Staff		
Yes	82 (8.6)	
No	876 (91.4)	
Any Current Supply of PPE		5.46 (1.46)
0	55 (5.7)	
1	0 (0.0)	
2	1 (0.1)	
3	1 (0.1)	
4	73 (7.6)	
5	42 (4.4)	
6	786 (82.0)	
Residents Confirmed Covid-19 Cases		1.66 (7.43)
Staff Confirmed Covid-19 Cases		1.53 (15.00)

homes missing reports, a total of 965 cases were eligible for the study.

**Assessments and Measures**

**Characteristics of nursing homes.**

Those characteristic variables included passed quality assurance check (*yes or no*), numbers of all beds, total number of occupied beds, state laboratory (*yes or no*), private laboratory (*yes or no*), other type laboratory (*yes or no*).

**Shortage of staff variables.** Nursing homes self-reported if with a shortage of staff (*yes or no*), including nursing staff, clinical staff, aides, and other staff.

**Current supply of PPE variable.** The PPE variable was computed from six items measured yes or no, which were N95 masks, surgical masks, eye protection, gowns, gloves, and hand sanitizer. It was scaled from 0 to 6.

**Confirmed Covid-19 variables.** The variables include residents total confirmed Covid-19 cases and staff total confirmed Covid-19 cases.

### Data Screening and Analysis

By running frequencies in the Statistical Package for the Social Sciences (SPSS, ver. 25), there were some missing data on staff shortage variables and each current supply of PPE variable, with none of the aforementioned variables having above 10% missing cases. According to Cohen et al. (2013), those missing data were handled by the mean. Besides that, outliers were diagnosed by comparing resident confirmed Covid-19 cases and a total number of occupied beds, as well as the number of all beds and the total number of occupied beds. In this scenario, the resident confirmed Covid-19 cases should be less than the total number of occupied beds, and the number of all beds was considered equal or over the total number of occupied beds. Seven cases were not qualified for the study due to the inaccurate numbers on all beds variable without other significant outliers. As a result, a total of 958 cases were qualified for this study. Before running regressions, we tested collinearity diagnostics to ensure that the variance inflation factors (VIF) were under ten or the tolerance values were near 1 (Cohen et al., 2013).

As the dependent variables, the residents total confirmed Covid-19 cases and staff total confirmed Covid-19 cases shared the same independent variables and measurements in the study. Therefore, we conducted two simultaneous regressions to determine risk factors associated with each dependent variable from characteristics of

nursing homes and shortage of staff and PPE variables. Both simultaneous regressions of two dependent variables applied predictor variables from characteristics of nursing homes: (a) passed quality assurance check; (b) numbers of all beds; (c) a total number of occupied beds; (d) state laboratory; (e) private laboratory; and (f) other types of laboratory. The shortage of staff and PPE simultaneous regressions were operated with predictor variables: (a) shortage of nursing staff; (b) shortage of clinical staff; (c) shortage of aids; (d) shortage of other staff, and (e) any current supply of PPE. The statistically significant predictors from simultaneous regressions were selected into each dependent variable's final regression model, respectively.

### Results

#### Descriptive Statistics

As shown in Table 1, almost all nursing home facilities passed quality assurance checks ( $n=944$ , 98.5%). The estimated numbers of state health department laboratory, private laboratory, and other type were 402 (42.0%), 848 (88.5%), and 123 (12.8%). The means of the number of all beds and the total number of occupied beds were 112.05 ( $SD=38.97$ ) and 71.08 ( $SD=28.88$ ), respectively. One hundred and thirty-seven cases (14.3%) reported shortage of nursing staff, 31 (3.1%) described as a shortage of clinical staff, 189 (19.7%) presented shortage of aides, and 82 (8.6%) declared a shortage of other staff. The mean of the PPE variable was 5.46 with a 1.46 standardized deviation. As the dependent variables, the means of residents confirmed Covid-19 cases and staff confirmed Covid-19 cases were 1.66 and 1.53 with 7.43 and 15.00 standardized deviations, respectively.

**Characteristics of Nursing Home**

The model was statistically significant ( $R = 0.169$ ,  $R^2 = 0.028$ ,  $F = 9.305$ ,  $p < 0.001$ ) when predicting residents confirmed Covid-19 cases from characteristics of nursing homes. Among the predicted variables, number of all beds

( $\beta = 0.206$ ,  $t = 4.136$ ,  $p < 0.01$ ), passed quality assurance check ( $\beta = -0.101$ ,  $t = -3.164$ ,  $p = 0.002$ ), and total number of occupied beds ( $\beta = -0.124$ ,  $t = -2.481$ ,  $p = 0.013$ ) were statistically significant to the residents confirmed Covid-19 cases.

**Table 2. Outcomes of Two Simultaneous Regressions for Residents Confirmed Covid-19 Cases (N=958)**

	R <sup>2</sup>	B	SE B	β
<b>Characteristics of nursing homes</b>	0.028			
Number of all beds		0.039	0.009	0.206
Passed quality assurance check		-6.269	1.981	-0.101
Total number of occupied beds		-0.032	0.013	-0.124**
<b>Staff shortage and PPE</b>	0.009			
Other staff shortage		2.543	0.860	0.096

Note. Model for staff shortage and PPE:  $R = 0.096$ ,  $R^2 = 0.009$ ,  $F = 8.751$ ,  $p = 0.003$ ; Model for characteristics of nursing homes:  $R = 0.169$ ,  $R^2 = 0.028$ ,  $F = 7.337$ ,  $p < 0.001$ . \*  $p < 0.05$ , \*\*  $p < 0.01$ .

**Table 3. Outcomes of Two Simultaneous Regressions for Staff Confirmed Covid-19 Cases (N=958)**

	R <sup>2</sup>	B	SE B	β
<b>Characteristics of nursing homes</b>	0.077			
Passed quality assurance check		-32.858	3.892	-0.263
Private type of laboratory		-3.462	1.465	-0.074**

Note. Model for characteristics of nursing homes:  $R = 0.278$ ,  $R^2 = 0.077$ ,  $F = 39.902$ ,  $p < 0.001$ . \*  $p < 0.05$ , \*\*  $p < 0.01$ .

**Table 4. The Predictor Outcome for the Final Model of Residents Confirmed Covid-19 Cases (N=958)**

	R <sup>2</sup>	B (95% CI)	SE B	β
	0.036			
<b>Characteristics of nursing homes</b>				
Number of all beds		0.038 (0.020, 0.057)	0.009	0.200
Passed quality assurance check		-5.984 (-9.866, -2.102)	1.978	-0.097
Total number of occupied beds		-0.032 (-0.057, -0.006)	0.013	-0.123**
<b>Staff shortage and PPE</b>				
Other staff shortage		2.242 (0.578, 3.905)	0.848	0.084

Note. The final model:  $R = 0.188$ ,  $R^2 = 0.036$ ,  $F = 8.772$ ,  $p < 0.001$ . \*  $p < 0.05$ , \*\*  $p < 0.01$ .

**Table 5. The Predictor Outcome for the Final Model of Staff Confirmed Covid-19 Cases (N=958)**

	R <sup>2</sup>	B (95% CI)	SE B	β
	0.077			
<b>Characteristics of nursing homes</b>				
Passed quality assurance check		-32.858 (-40.496, -25.221)	3.892	-0.263
Private type of laboratory		-3.462 (-6.337, -0.587)	1.465	-0.074**

Note. The final model:  $R = 0.278$ ,  $R^2 = 0.077$ ,  $F = 8.772$ ,  $p < 0.001$ . \*  $p < 0.05$ , \*\*  $p < 0.01$ .

The model to predict staff confirmed Covid-19 cases from characteristics of nursing homes was statistically significant ( $R = 0.278$ ,  $R^2 = 0.077$ ,  $F = 39.902$ ,  $p < 0.001$ ). Among those variables, passed quality assurance check ( $\beta = -0.263$ ,  $t = -8.443$ ,  $p < 0.001$ ) and private type of laboratory ( $\beta = -0.074$ ,  $t = -2.363$ ,  $p = 0.018$ ) were statistically significant to the staff confirmed Covid-19 numbers.

### **Shortage of Staff and PPE**

The model was statistically significant ( $R = 0.096$ ,  $R^2 = 0.009$ ,  $F = 8.751$ ,  $p = 0.003$ ) when predicting residents confirmed Covid-19 cases from shortage of staff and any current supply of PPE. Among the predicted variables, shortage of other staff ( $\beta = 0.096$ ,  $t = 2.958$ ,  $p = 0.003$ ) was statistically significantly to the residents confirmed Covid-19 numbers. However, the model to predict staff confirmed Covid-19 cases from a shortage of staff and PPE was not statistically significant. Tables 2 and 3 present the outcomes of both simultaneous regressions for each dependent variable.

### **Final Models**

The final model to predict residents confirmed Covid-19 cases from four statistically significant variables based on those simultaneous regressions was statistically significant ( $R = 0.188$ ,  $R^2 = 0.036$ ,  $F = 8.772$ ,  $p < 0.001$ ). Among all predictors, number of all beds ( $\beta = 0.200$ ,  $t = 4.042$ ,  $p < 0.001$ ), passed quality assurance check ( $\beta = -0.097$ ,  $t = -3.025$ ,  $p = 0.003$ ), shortage of other staff ( $\beta = 0.084$ ,  $t = 2.645$ ,  $p = 0.008$ ), and total number of occupied beds ( $\beta = -0.123$ ,  $t = -2.469$ ,  $p = 0.014$ ) were still statistically significant.

The final model to predict staff confirmed Covid-19 cases based on simultaneous regression was also

statistically significant ( $R = 0.278$ ,  $R^2 = 0.077$ ,  $F = 39.902$ ,  $p < 0.001$ ). Both passed quality assurance check ( $\beta = -0.263$ ,  $t = -8.443$ ,  $p < 0.001$ ) and private type of laboratory ( $\beta = -0.074$ ,  $t = -2.363$ ,  $p = 0.018$ ) were statistically significant.

## **Discussion**

Our findings suggest that Covid-19 Texas nursing home infections among residents are more related to the number of all beds, passed quality assurance check, shortage of other staff, and the total number of occupied beds rather than nursing staff, clinical, staff, and aides shortage, as well as any current supply of PPE. From the staff perspective, nursing home infections were associated with passed quality assurance checks and private laboratory type instead of others.

The analysis mentioned above shows that the number of all beds explained the most variance of infectious cases among residents. This is an imperative finding in Covid-19 infections at the nursing home level. The bigger size of a nursing home leads to higher infections. The result is similar to an article that described the relationship between the spread of the disease and family size (Liotta et al., 2020). Both analyses demonstrated that people in a larger setting would have higher risks of infection and fatality rates. The results are associated with the long incubation period of coronavirus and the high frequencies between residents and personnel flow. However, minimizing resident infections can be adjusted via reducing occupied beds since its negative beta weight. Reducing occupied beds in such sizable facilities has a positive effect on dwindling infection cases. A similar example is that any

restaurant's maximum capacity in Texas was set up to 25% in early May.

While a nursing home is short of other staff, the resident infectious numbers presumably increase. The infections have no relationship with the shortage of clinical staff, aides, and nursing staff. The result implies that maintaining adequate other staff under the pandemic is challenging for nursing homes (Dosa et al., 2020). Many conditions may cause this shortage, such as fear of Covid-19 infection, lack of PPE, and sick leave. To keep staff adequately, it's essential for nursing homes to hold training sessions related to Covid-19 prevention and to obtain enough supply of PPE to protect residents and employees.

Both resident and staff infections have connections with whether a nursing home passed a quality assurance check. Compared to those that failed to pass the examination, the one passed has fewer infectious resident and staff cases. Quality assurance in nursing homes implies a high quality of health care. A nursing home with passed the check is more likely to be capable of providing and maintaining a high quality of health care to residents. Many reasons contribute to those failed to pass the check, such as inefficient management and unmet needs for residents. The result suggests that those who were unable to pass should pay more attention to prevention and protection for their residents and staff to minimize infectious cases.

Staff infections are related to private nursing homes. Our analysis demonstrates that when a nursing home in Texas is private, the infectious staff numbers will be reduced, which differentiates from one study in New Jersey. That study reported that private nursing homes are confronted

with more problems than non-private nursing homes under the coronavirus pandemic. Consequently, their Covid-19 infection rate for residents is much higher than public facilities in New Jersey. Abrams et al. (2020) mentioned that the state is considered a risk factor, and diverse states have specific results regarding nursing home Covid-19 infections. In Texas, the means of the resident and staff confirmed cases in private nursing homes are much lower than those in public nursing homes. Texas's private nursing homes are presumably preventing and managing the Covid-19 effectively since resident infections have no statistically significant relationship with private nursing homes. Such private facilities decrease infectious staff cases exclusively.

Surprisingly, both resident and staff infections are not related to the current supply of PPE. A well-known fact is that adequate PPE, including masks, gowns, and gloves, etc., can protect employees or healthcare professionals in nursing homes against Covid-19 infection and fatality (American Geriatrics Society, 2020). For instance, those PPEs are capable of preventing the spread of the disease among staff to residents and residents to residents. A possible reason that PPE failed to be statistically significant with the infectious resident and staff numbers in the study is that when they live or work in the same enclosed building with long-term exposure, the possibilities of spreading the virus and infecting people nearby go high. In this case, the effectiveness of PPE gets reduced. However, with appropriate training and strict implementations, staff and residents can prevent and manage Covid-19 infections. In addition, other necessary guidelines and protocols, such as banned

visitors, canceled all group activities, and heightened infection control should be rigorously implemented.

In summary, the study's findings have two major implications: (1) risk factors associated with Covid-19 infectious cases on both residents and staff perspectives in Texas nursing homes, and (2) the prevention and management of infections and fatalities according to each risk factor. As the second wave of Covid-19 starts to strike Texas, nursing homes face severe challenges in minimizing Covid-19 outbreaks and deaths again. The study could benefit nursing home residents and staff.

The study has some limitations. Firstly, the CMS dataset was with some errors. For instance, the Saugus Rehab and Nursing Center administrator in Saugus found 794 infectious cases falsely reported in her facility in the dataset (Clark, 2020). Given the matter, two prudent methods in our study were applied to detect those errors in the data screening and selecting section. Additionally, we backtracked unqualified cases based on those mentioned above methods to minimize possible inaccurate outcomes caused by those errors. Secondly, the results in the study may vary based on time. The cases and variable information were chosen until May 24<sup>th</sup>, 2020. Since the CMS dataset was updated every week, the status of staff shortage and the number of occupied beds in each nursing home may vary with time. However, the inevitable risk factor, such as nursing homes' characteristics, will not be affected along with time. Thirdly, when the state variable becomes a risk factor, a

different state will have distinctive results regarding its risk factors associated with nursing home Covid-19 infections and fatalities (Abrams et al., 2020). For instance, different types of nursing homes between Texas and New Jersey hold diverse outcomes.

## **Conclusion**

Resident infections in nursing homes are significantly related to the size of a nursing home (total number of all beds), the total number of occupied beds, whether a nursing home passed a quality assurance check, and a shortage of other staff. Infectious staff numbers decrease based on private nursing homes or passed quality assurance check nursing homes. Our study recognizes no factors contributing to the increase of staff infections based on CMS's current variables provided. By acknowledging those factors and following guidelines or protocols, nursing homes can prevent and manage Covid-19 infections and minimizing their outbreaks and fatalities to maintain sustainability ultimately. Additionally, strong infection control causing social isolation of elders in nursing homes during the Covid-19 pandemic should be vigilant. Therefore, nursing homes should consider two perspectives, which are controlling infections and reducing social isolation. The leadership in nursing home facilities needs to adopt new technology (e.g. digital smart TVs) and other social activities (e.g. fresh production of vegetables) for their residents.



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# ARTICLE

## Pillars of sustainable health and wellbeing among rural indigenous Swazi community women

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### Abstract

The study sought to explore sustainable health and wellbeing resourcing of women in an indigenous Swazi rural community with Swazi young mother informants (n=25; age range = 18-21, all subsistence farmers). Participants were a convenience sample of married, subsistence farmer women. The participants completed focus group and individual interviews on their supports for sustainable health and wellbeing. Thematic analysis of the data yielded a resilient health and wellbeing theme defined by their being happily married, good weather, ability to profit from the land from farming/gardening, and hope for a better future. The participants also perceived their indigenous culture religion and social support systems to sustain their long-term health and wellbeing. Our findings suggest resilient living important for the sustainable health and wellbeing of subsistence economy communities.

**Keywords:** Eswatini, indigenous community, sustainable health, psychosocial wellbeing, & subjective wellbeing.

### Introduction

Sustainable health and wellbeing are associated with quality of life in the lived environment (Di Fabio & Rosen, 2020; Di Fabio & Rosen, 2018; Di Fabio, 2017; United Nations, 2018). It is premised on a prevention framework in which communities engage in health promotion-oriented practices, leveraging the natural environment and socio-economic systems for prosperity, reduction of poverty and

health inequality, peace, and justice. Indigenous communities live closest to and with their natural environment. They place a high value on allowing members “good health, to work and move around as well as emotional, psychological, economic, mental and spiritual aspects of health” (World Health Organization [WHO] 2012, p.12). Their implementation of sustainable health and wellbeing support systems is less well studied (Nell, de Crom, Coetzee & van

Eedeh, 2015; Ogilvie, 2012; Oppong et al., 2021).

### **Sustainable health systems**

Health systems refer to "all the activities whose primary purpose is to promote, restore, and maintain health" (WHO, 2020, p. 5). Sustainable community health systems comprise all the elements for enhancing population and individual health, including family, cultural, inter-agency, and inter-sectoral relationships, natural environmental safety, financing, and technologies for health (Mpofu, 2021; Schroeder, Thompson, Frith, & Pencheon). They are "designed for people to attain their highest possible health and to provide timely care for the specific needs of the members and with affordability, fairness and equity for members and providers" (Fineberg, 2012, p.1020), providing "a framework within which health gains and reductions in health disparities are possible and greatly facilitated" (Guidotti, 2018, p. 357). Sustainable health and wellbeing go beyond the disease management approach to include wellness actions for, and by community members, in so far as all human activities have health consequences (Ingman & Mpofu, 2021). The types of community activities members engage in may deliver various health benefits to the members, including recovery from stress and fatigue, increased self-esteem, improved life satisfaction, and improved health (Cummins, Mpofu & Machina, 2015; Hawkins, Mercer, Thirlaway, & 2013; Siu, Kam, & Mok, 2020; Van den Berg, van Winsum-Westra, De Vries, & Van Dillen, 2010). We sought to explore the drivers of sustainable health and wellbeing for indigenous community women from Eswatini, a Southern African country.

### **Indigenizing health and wellbeing in the Kingdom of Eswatini**

Indigenous communities draw on their wisdom and practices to sustain their health in the modern and Fourth Industrial Revolution age [4IR] (Oppong, et al., 2021). Until now, the cultural health and wellbeing heritage of indigenous communities have been marginalized from being viewed by mainstream medicine as only complementary or alternative, even though indigenous health systems provide health care to billions of people around the globe (Oppong et al., 2021). Yet, indigenous communities survived for centuries, adapting in many different ways to difficult health and environmental conditions and managing to create sustainable livelihood systems.

Research has shown that the types of community activities members engage in may deliver various health benefits to the members, including recovery from stress and fatigue, increased self-esteem, improved life satisfaction, and improved health (Hawkins, Mercer, Thirlaway, & 2013; Siu, Kam, & Mok, 2020; Van den Berg, van Winsum-Westra, De Vries, & Van Dillen, 2010; Wood, Pretty & Griffin, 2016).

### **Context for the study: The kingdom of Eswatini**

The Kingdom of Swaziland (now Eswatini) is located in southern Africa, bordered by South Africa to the north, west, and south and Mozambique to the east. Eswatini's population of about 1.2 million (females = 51%). About 22.1% are between the ages 15 to 24 years old. Eswatini is divided into four regions: Hhohho, Lubombo, Manzini, and Shiselweni. Each region is further divided into *tinkhundla* which translates to constituencies. While

Eswatini is of lower-middle-income status (Swaziland Demographic Profile, 2018), 58.9% of Swazis lived below the poverty datum line in 2017 (World Bank Eswatini, 2019). Unemployment is high at 49.0% (World Bank Eswatini, 2019), and a majority of the population are subsistence farmers. Women are the backbone of the economy and mostly in agriculture and informal open market trading.

We sought to explore how Swazi women in a rural setting perceived their health and wellbeing and the enabling personal and environmental resources support. The following specific question guided the study: How do rural Swazi women perceive resources for their sustainable health and wellbeing?

**Method**

**Research Design**

We followed an exploratory qualitative design (Charmaz, 2014) for this study. An exploratory qualitative design allows for an in-depth understanding of lived health from the informant perspective. Applying an exploratory qualitative design enabled an in-depth understanding of the women’s perspectives on their sustainable health and wellbeing in the rural community of Eswatini.

**Participants and setting**

We recruited 25 women for this study, all mothers (see in Table 1 for study sample characteristics). These participants all resided in the Ekhaya community in the Hhohho region of Eswatini. The Ekhaya indigenous rural community of the northern Hhohho of Eswatini is a subsistence farming area. All the participants had lived in the area for at least 10 years. Nineteen of the participants (76%) were mothers. Sixty percent (60%) of the participants self-

identified as moderately religious or engaged in informal employment.

Table 1. Demographic Characteristics of Participants (n= 25)

Item	Frequency	%
<i>Age range</i>		
18- 19	09	36
20-21	16	64
<i>Length of marriage</i>		
6 – 12 months	19	76
13 – 18 months	06	24
<i>Number of children</i>		
None	06	24
1-2	19	76
<i>Educational attainment</i>		
From 1 to 3	07	28
<i>Employment status</i>		
Employed	10	40
The indigenous African belief system	10	40

**Data collection**

The woman participants reported their demographical characteristics including (age range, marital status, number of children, employment status, duration of residence in the Ekhaya indigenous community, and self-reported religiosity). They also participated in (focus group and individual) interviews on sources of their sustainable health and wellbeing. Ten (10) participants took part in individual interviews while all the participants completed the focus group discussion interviews. Data collection was sequential with individual interviews conducted first

followed by focus group discussion interviews.

### ***Individual interviews***

For the individual interviews, we started with the broad open-ended question about resources for sustainable health and wellbeing. "Could you share with me personal and environmental resources you consider important for sustainable health and wellbeing in your community"? Relevant follow-up probing questions were then asked.

### ***Focus group discussion interviews***

We focused on the probe stem: What participants perceived to be important personal and environmental sources for their sustainable health and wellbeing. Two focus group discussion interviews, comprising of 12 and 13 women participants each respectively were conducted. All the participants took part in focus group discussion interviews based on their willingness.

For data credibility and trustworthiness checks, we did member checks with 12 of the participants. We also maintained field notes (Gunawan, 2015) for the dependability of the data observations.

### ***Procedure***

The Eswatini Ministry of Health and Social Welfare granted permission to the study. The women participants individually consented to the study. We informed the participants of the aim and procedures of the study and their voluntary participation and with the right to withdraw if they wished to do so, without penalty. We de-identified the data to ensure anonymity. The second listed author and a research assistant moderated individual and focus group discussion interviews in *SiSwati*, the first language of the participants. All interviews were digitally recorded with the permission

of the participants. Digital recordings were transcribed and translated into English using the forward translation procedure (Africa Scholarship Development Enterprise [ASDE], 2009).

### **Data analysis**

We thematically analyzed the data following the guidelines suggested by Corbin and Strauss (2008) as follows. For the initial coding phase, we segmented data into units of meaning, assigning code labels. Next, we performed axial coding, codes examining the data for similarities and differences in order to group the data into meaning units. Finally, we integrated the meaning units into overarching themes.

### **Findings and Discussion**

Two (2) main themes resulted from the analysis: resilient living and finding safety in religion and cultural systems adherence. We elaborate on these themes below and with the verbatim evidence for them.

#### **Theme 1. Resilient living in marriage, ability to profit from the land, good weather, and hope for the future**

Many of the participants (80%) reported their community was under-resourced and overwhelmed by high rates of unemployment, resulting in widespread poverty levels in the community. They also reported poor access to medical services. The following are example statements from participants:

*I am not working so sometimes I don't have money to buy things that I need and can't always ask my husband for money (Participant # 13, 20 years, unemployed);*

*We are really struggling sometimes even if we are working, we don't get a lot to buy*

*basics such as food and clothes (Participant # 11, 21 years, employed).*

*We can't get all medical checkups we need here sometimes as women so one has to go to town (Participant # 2, 19 years, unemployed).*

*The clinic is too far and sometimes you have to wait in line for long to be seen by a nurse (Participant # 3, 21 years, employed).*

### ***Happy marriages***

Participants reported being very happily married to spouses who provided for their basic needs such as food, clothing, and shelter. They also reported that being married gave them an opportunity to raise their children together with their spouses and earned them respect from the community members. The following are illustrative statements from participants:

*I am happy now that I get support from my husband and in-laws. I don't have to worry about what to cook, who will buy me clothes and where to sleep because all these are provided by my husband since I don't work (Participant # 4, 19 years, unemployed).*

*I am happy that the father of my child finally married me. This makes it easy for our child to*

*be raised by both parents unlike my friends who struggle to bring up children alone. People here also respect me as am now a married woman. (Participant # 6, 20 years, employed).*

### ***Farming/ gardening***

Participants reported their planting crops, cooperatively, and working as a village in farms or gardens to enhance their social and economic health wellbeing (See pictures 1 to 3). Farming/ gardening brought participants closer as women in the indigenous community than they perceived to have been before. Several participants who were self-employed farmers and gardeners found the planting and nurturing of the crops to give them a sense of purpose and fulfillment. The following are some of the verbatim quotations from participants:

*I really like to farm and this brings me closer to other women in my community and we can share our problems as we work (Participant # 5, 20 years, employed).*

*Working in this garden makes me feel important as I am actually responsible for taking care of the crops since I have no child as yet to occupy my time (Participant # 10, 20 years, employed).*



Picture 1: Illustration of farm/ garden of some of the vegetables the participants grew

***Hoping for a better future***

Participants stated that they certainly believed and hoped that poverty that was in the community would ultimately be eradicated and their living conditions would improve. Moreover, the participants reported that they were also grateful for the life they were living, as other people were homeless that they knew. Below are some of the illustrative statements from the participants:

*We won't give up we have hope and believe one day we will also have better services here* (Participant # 2, 19 years, unemployed).

*This is my home I am happy with what we have and hope that things will change for the better to improve our lives here* (Participant # 5, 20 years, employed).

***Profiting from the land***

As previously noted, participants also said to be happy from profiting from the land through growing crops such as maize, pineapples, sweet potatoes, and vegetables. Participants also indicated that they harvested and sold some of the crops they grew such as vegetables and maize (See pictures 1, 2, and 3 for illustration). They also indicated that the land provided good grazing for their goats and cattle owned by their spouses. The following are example statements from participants:

*I am happy here as the land is very good to grow anything I want and I grow maize vegetables and sweet potatoes...* (Participant # 9, 19 years, employed).

*we are happy here the soil is rich for ploughing and animals have good shrubs to graze since we have lots of animals* (Participant # 1, 20 years, unemployed).



Picture 2: Vegetables that participants grew and harvested for eating and selling from their farms/gardens.



Picture 3: Illustration of the maize participants sell to vendors from their farms/gardens who then roast the maize for reselling.

Most of the participants (88%) reported that their community had good weather, they indicated that the warm temperatures were the reason for being happy in their community. The following are verbatim quotations from participants:

*I enjoy the warm weather here so much*  
(Participant # 12, 19 years, unemployed).

*We like it here it is always very warm even in winter at times*  
(Participant # 13, 20 years, unemployed).

The finding that resilient living was enhanced through being happily married enabled participants to experience happiness, social and economic capital in their community. It appears that the participants' status of being married increased the psychological, social, emotional, and economic resources thereby enhancing their health and wellbeing. This finding mirrors those of previous studies that a happy marriage increases the psychological, social, and economic

wellbeing of individuals (Khumalo, Temane, & Wissing, 2012; Liu, Elliott, & Umberson, 2010; Uecker, 2012) and help individuals avoid the stress of relationship dissolution (Simon & Barrett, 2010). Cooperative subsistence farming plays an important role in reducing the vulnerability of indigenous communities, providing food securities, improving livelihoods, and helping to mitigate high food inflation improving livelihoods (Baiphethi & Jacobs, 2009; Oppong et al., 2021; Savo et al., 2016). Moreover, subsistence community activities such as farming and gardening promote resilient health and wellbeing among populations (Baiphethi & Jacobs, 2009; Machida, 2019; Siu, Kam, & Mok, 2020; Soga, Gaston, & Yamaura, 2017; Von Rueden, & Jaeggi, 2016). This is certainly the case among rural indigenous communities of Sub-Saharan Africa (De Luna, 2016; Nell et al., 2015) which draw considerable livelihood and food profiting off the land growing crops and rearing domestic animals.

**Theme 2: Finding safety in religion and cultural authority of the indigenous community**

Several participants (76%) reported experiencing a sense of cultural authority security and felt very safe when working or walking alone in isolated areas, even during the night. Below are example statements from participants:

*I don't feel afraid when working in the field; it is very safe here everybody knows everybody no one can do anything bad* (Participant # 7, 21 years, employed).

*We feel safe here and don't mind walking alone even at night.* (Participant # 2, 19 years, unemployed).

Most participants (80%) reported that they completely trusted other people within their indigenous community and had no fear that others would steal their possessions. For instance, many participants indicated that they left personal possessions such as buckets and containers for fetching water and baskets in public places in the community without worry that these would be stolen.

*No one takes what does not belong to them containers for fetching water, baskets or firewood they know they belong to someone who will come and get them.* (Participant # 14, 20 years, unemployed).

*People do not take other people's things like spades, hoes and axes because they know you can just borrow them* (Participant # 3, 21 years, employed).

Participants further indicated that crime levels were very low because they had traditional chiefs (*Indunas*) who are responsible for overseeing safety and are respected by community members. Below

are illustrative statements from participants.

*"We have the Indunas who are there to see that there is no crime in the community* (Participant # 1, 20 years, unemployed).

*Let us say you have taken someone's possession they will report you to the traditional chiefs who will help sort you out* (Participant # 6, 20 years, employed)

**Religion**

Participants reported that religion (both in terms of Christianity and indigenous religious belief systems) provided them a sense of safety as a source of daily support, providing for community members in times of need. The following are example statements from participants:

*The church is very important because people support each other when in good and bad times for example when one is getting married church members help each other in cooking and skinning the animal* (Participant # 13, 20 years, unemployed).

*As church members we are always there for one another to support especially when one dies, we support each other through prayers and taking food* (Participant # 6, 20 years, employed).

Apparently, the strong cultural identity and Christian religion positioning help to join community members around a key set of beliefs and cultural systems (such as the *induna* system). This in turn controls the behavior of community members in practical ways (as lowering the rates of crimes), which ultimately supports participants' safety and wellbeing in this indigenous community. Participants also reported practicing indigenous African belief systems (traditional healers) to address their health-related problems (Mpofu, Peltzer, & Bojuwoye, 2011; Nell, et

al., 2015; Peltzer, Mngqundaniso, & Petros, 2006). Previous studies confirm that the *Induna* system is a respected traditional system that is associated with administrations of social justice and the discipline the people exhibit with reference to traditional customs (Nell, et al., 2015). Religion beliefs are a health-protective factor (Hill & Pargament, 2003; Mpofu et al., 2011), providing a sense of meaning, purpose, and hope (Copeland et al., 2004; Mpofu & Mpofu, 2011; Murphy et al., 2000; Schafer, Ferraro, & Mustillo, 2011). For instance, religion (faith in God, prayer, church) comforts and brings relief from anxiety and depression (Koenig, George, & Titus, 2004). For participants of this study faith in God and church provide the security and contentment concerning challenges experienced in the community as the temporal.

#### **Study limitations and suggestions for further research**

There are some limitations inherent to this study. First, data were obtained from women from an indigenous Swazi rural setting and findings may only apply to this setting. Second, study participants may have under-reported challenges to

health and wellbeing to women in their communities out of social desirability. Finally, future studies should utilize mixed methods and with a larger sample of participants for more representative findings.

#### **Conclusion**

The findings revealed that young women in an indigenous Swazi community seemed to be more thriving in their health and wellbeing rather than languishing in poverty and unemployment. These findings affirm that self-employment in indigenous community sustenance economy makes for resilient health and wellbeing. These current study findings also further suggest that communal partnerships living on the land sustain the health of indigenous communities. The findings of this present study also highlight the fact that sustainable health and wellbeing of indigenous communities are improved by approaches that promote communal safety, effective utilization of natural environment leveraging their existing naturalistic social supports.

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# ARTICLE

## Community Mapping for Community Health: GIS, ICT, and Citizen Engagement

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Community health refers to promoting healthy living and health outcomes at the community level (CDC, 2017). Community in this chapter refers to not only a particular geographic area but also to a specified group of people, such as tribal or homeless communities. Individual health condition is mainly determined by the individual genetic makeup. Nevertheless, environmental and external factors determined by where a person lives and works also significantly influence an individual's health. Therefore, it is important to understand a person's community health factors, such as socioeconomic factors, physical environment, health behaviors, and clinical care ability.

When it comes to community health the main focus often lies in providing preventive care. Its first step is to assess the community's health needs and create a plan to address those needs. Engaging and empowering community members to participate in this process is imperative to have a better understanding of the community and to make a sustainable community health initiative that fits the community's cultural background.

Promoting community health requires collaboration between multiple stakeholders from the community such as healthcare providers, public health officials, businesses, community developers, faith-based organizations, local and regional governments, social service providers, schools, and most importantly community members. Individuals from the community know more about their community than anyone else and can identify issues and provide innovative ways to improve their communities.

Community mapping is an innovative method to make community members involved in community health initiatives. It is a citizen engagement activity using geographic information systems (GIS) and information and communication technology (ICT). This chapter will present 1) the concept of community mapping with current geospatial technology and 2) case studies of community mapping.

### What is Community Mapping?

It is difficult to present a clear, standard definition of community mapping because of its novelty. Community mapping is often seen as being

synonymous with the concept of community asset mapping. Community asset mapping was defined as a capacity-focused way of redeveloping devastated communities where an inventorying of the assets of individuals and organizations is taken. Physical mapping was not required in the early stages of community asset mapping, the concept of community asset mapping has also broadened to include physical assets of the community, not limited to just individuals and organizations.

Crowd-sourcing has become a frequently mentioned mapping solution for resource-limited organizations needing better information or data about their community or region. While community mapping can be viewed as crowd-sourcing or as citizen science, which focuses on the collective power of amassing community asset data, the unique characteristics of community mapping come from the process of mapping.

Drs. Im and Tullock (2013) defined “Community Mapping” as a process for generating geospatial data through collaborative group work, using mapping technology to identify, understand, analyze, resolve, and disseminate community issues. Community projects are identified by three clear intentions:

- education, with participants learning about an issue(s) important to their community;
- engagement, with participants becoming more actively engaged in at least one public or community process; and
- empowerment, with participants being newly equipped with information or data to apply to a community problem or issue.

To understand community mapping fully, public participatory geographic

information systems (PPGIS) need to be addressed. PPGIS illustrates how Geographic Information Systems (GIS) can be used to help marginalized communities with location-based technology. The concept and definition of community mapping in this chapter were developed by Dr. Im while practicing in PPGIS with various communities.

### **Public Participatory Geographic Information Systems (PPGIS)**

In the 1990s, the initial concept of PPGIS referred to making GIS accessible to citizens in order to effectively share information and to facilitate public participation in the planning process. In the past, utilizing GIS required significant hardware, software resources, and data access, as well as organizational staff support, which was often considered a barrier to utilizing PPGIS. In recent years, internet and mobile communication technology have evolved, and individuals now have access to these technologies at an affordable price (from the unpublished paper Im & Mercer, 2008).

PPGIS was first coined at a meeting of the National Center for Geographic Information and Analysis (NCGIS) at Orono, Maine, the USA in 1996 (Sieber, 2006). Since then, the term has been used to describe the various government and private actions to garner input and commentary on planned development projects by those who would be affected by the development. The spatial visualization aspect of PPGIS has made it an important tool for professional planners to gain information from under-represented groups that are otherwise unable to participate in the planning process (Craig et al. 2002; Seiber et al. 2002; IAPAD 2007).

The visual effect of maps gives community groups tremendous power in communicating their message. Maps are attractive, can provide clarification to community problems, and are more likely to draw the attention of important government officials to issues. Early PPGIS initiatives focused on projects with indigenous and/or impoverished communities. In most cases, PPGIS consisted of printed maps presented to local residents, who then had the opportunity to provide comments.

PPGIS grew to be used in mainstream planning and decision-making processes to assist with quality of life and social justice issues. Those initiated by the government related to development tended to be reactive, allowing community members and grassroots alliances to pick from a number of design alternatives (Seiber et al 2002). On the other hand, preservation-minded individuals, community groups, non-government organizations, and universities have used GIS to find solutions related to their missions and to communicate that information to authorities (Ghose 2000; Laituri and Ramasubramanian 2006).

The number of PPGIS applications is growing. It is commonly accepted that PPGIS is an interdisciplinary approach that can and should be used as a tool to help communities analyze and find solutions to their problems (Craig et al. 2002; Laituri and Ramasubramanian 2006; Seiber 2006). Owing to its origins in GIS, PPGIS provides a medium to coordinate, view and share knowledge and information.

### **Benefits of Community Mapping (Im & Tulloch, 2013)**

**Record and archive community information:** When community information is recorded by community members, the information is archived from the community member's perspective. The information reflects the community's needs and the data quality is improved from the community's perspective.

**Encourage community engagement & collaboration:** By using community mapping, community members are more engaged and collaborate with mapping.

**To raise awareness on community issues:** By participating in community mapping events, communities become more aware of the issues that they may have not deemed significant. While collecting data, they can begin to see a pattern of the item they are interested in, and they can even add community asset data overlaid on the map to dig deeper into community needs.

**Promoting a sense of connection to the community, and give a sense of identity:** While doing community mapping, participants feel a sense of attachment to the community and feel bond with other members.

**Empower communities to advocate for change:** Community members are empowered to be involved in planning and actions taken. The data can be used to present information to state officials that may need evidence in order to change laws or allocate more resources to specific communities.

**Innovative solution (collective intelligence):** By mapping community assets, you also can look at the information using other data layers which can help solve community issues that you may have missed. You can use the input from community members' dialogue and discussion to then find innovative ways of solving community problems.

**Help local governments be more effective and equitable:** Citizens participate more, the local government's work can be more effective and equitable.

### **The Process of the Community Mapping**

When community mapping is considered, what do you need to think about?

- What is the purpose of the community mapping project?
- What issues do we need to solve?
- What kind of outcomes are expected?
- What kind of data is going to be collected?
- How do we solve the issues using community mapping?
- Who are the community members/entities who will be engaging in the process?
- What community will get benefits?
- What kind of methods/technology will be used?
- What kind of data do we need to collect?
- What are the available/existing data and limitations of such data?
- What types of data need to be updated?
- Once data is collected, how can it be visualized and how can it be analyzed?

- How to get feedback from the community people?
- How can we evaluate the project?
- How can the process be improved?

### **Common Questions**

Dr. Im has put together hundreds of community mapping workshops in both South Korea and the United States. During these events, there are common questions that he is often asked which include the following topics, the reliability of the data collected, how to motivate and engage community members, and digital divides for a population that can not afford mobile technology

### **Reliability of the Data Collected**

The reliability of the data collected by community members is a valid concern, which is why there are many checkpoints implemented that safeguard the reliability of the information. To control the data quality, rigorous pre-training is needed before community members can participate in collecting data. During the process of collecting data, teams include at least two members which serve as a way to increase the reliability of the data collected. Oftentimes, community mapping projects have a website gatekeeper that approves and controls data sets. Since the site is only open to community members with the secured password, the community asset data can only be entered by participants assuring that false data is not added by others in the community. If the community mapping site is open to the public, a more cautious approach is needed. This approach is possible if the public is only viewing data or the project is for emergency needs such as natural disaster management.

### **How to Engage Community Members**

It is often difficult to get community members to participate in the community mapping processes. Working with existing community groups is the most effective way to get the rest of the community involved. Community members are more engaged if the project directly addresses their concerns in the community, so working collaboratively with the community is essential to be successful since they will be more motivated by the process. Sometimes, due to the nature of the project, the community mapping project may be open to the public which requires the public's input and participation. An example would be during disaster management, which has many benefits to the community being affected and therefore garners increased participation.

### **Digital Divide**

A digital divide is an uneven distribution in the access to, use of, or impact of ICT for certain groups of the populations. Seniors, disabled people, and the homeless population often do not have similar access to smartphones which are needed for the community mapping process and if they do have smartphones they may not have knowledge or familiarity with using the device. To combat the digital divide, teams are often used during community mapping events. Teams are divided such that each team has at least one person that has access to a smartphone and can input data, for example, a team may consist of a senior and younger individual.

### **Geographic Information Systems**

Geographic Information Systems is defined as "a computer system for

capturing, storing, querying, analyzing, and displaying location-based data". In other words, it is an information system that can handle location-related data. An information system makes it easy to do the following: Add/update location-based data

- Display data on various visualizing methods on the map based on the author's intention with the user's perspective
- Store and copy/transfer data in digital format (the storage capacity has become much larger, the size is smaller, and the cost becomes affordable)
- Automate analysis (especially for repetitive tasks)

When identifying GIS history, the story of Dr. John Snow is a well-known historical case showing how mapping diseases played a crucial role in solving public health issues. He traced the source of a cholera outbreak in Soho, London in 1854. To do so he observed and collected information from residents, and used a dot map to identify public water pumps on streets, and illustrated the clusters of cholera cases. Based on the findings, he contributed to understanding the circumstantial features for the cholera outbreak and made London and other cities change the water system.

GIS can also help identify at-risk or minority populations within a community because the visualization by GIS can differentiate data in multiple ways such as color, and space differences, and lighten understanding of data intuitively.

Despite the potential of GIS in community health, GIS has not been widely used at the community level due to its

resource requirement. These resources include the cost of the hardware and software, data availability and accessibility, and the lack of knowledgeable GIS professionals since it wasn't until 2000 when GIS professionals started emerging. Prior to 2000, only large corporations, governments, and universities, and colleges were able to use geospatial technologies. In 2005, internet maps became available, especially Google Maps and Google Earths, so there was a huge increase in GIS usages.

### **Components of GIS**

The following will describe the five components of GIS. However, with the evolution of technology including the internet and cloud service technology, there are now combinations of data and hardware, or software and process combined as services for consumers or users of GIS. Often this combination is customized based on the needs of the user.

#### **Technology (Hardware and Software)**

Initially, community mapping applications produced paper maps to support community engagement. The high cost and technological specialization associated early on with GIS can be traced to its initial users—the private sector, researchers, and governmental agencies (Sheppard 1995). At the same time, most non-profit organizations and individuals lacked the financial and personnel resources to utilize GIS.

There have been significant changes in computer hardware, GIS data accessibility, and the process of creating and accessing GIS. The speed of computing power has increased, while the price has decreased the basic required hardware costs are now low. Moreover, most internet portals allow people to access free and

secure data storage spaces. We also now have mobile phones, which are more powerful, accessible, and affordable and can be used for GIS.

GIS software was expensive and not user-friendly until the 1990s. Some of the GIS software, such as ESRI's ArcGIS or QGIS (open source) require knowledge of the software. Now, there are tools that can be used relatively easily for data visualization and some of those applications provide the basic mapping services for free. An example of an application that is user-friendly is Google My Maps, this application can be used by beginners as it is easy to navigate.

#### **Access to Data**

In earlier years, obtaining GIS-related base data for community mapping was a major obstacle. Some agencies and websites provided data for free, but the available information may not have been relevant to a specific group's cause. Moreover, many community organizations did not have the necessary hardware and software to analyze the available GIS data. When groups were able to acquire data, hardware, and software, they still had the barriers of technical expertise and personnel development needed to use GIS (Craig et al. 2002). With the significant advances in internet technology that we now have, most federal, state, and local government data is now available via web portals.

These advances in data accessibility enable PPGIS communities the following benefits:

- Access to the latest roadmaps and aerial photos (where available)
- Ability to geocode and add other geographic features

- Ability to associate text, photos, and movies to geographic locations
- A greater awareness in the general public regarding geospatial technology, thus more comfort with this technology
- Many applications are developed by user communities, and these applications trigger other ideas as to how PPGIS communities can use the mapping

### **Open Data**

“Data.gov is the federal government’s open data site and aims to make the government more open and accountable. Opening government data increases citizen participation in government, creates opportunities for economic development, and informs decision making in both the private and public sectors” - [from data.gov site](#).

The US federal government made an open data website called Open Government based on citizen participation in government. The site provides various mapping data about the economy, public safety, finance, etc. The initiatives of open data by the government are significant to increase the potential benefits and data innovation. Agencies' dependence on external innovators influences their actions to share data (Zhenbin et al., 2020).

### **People/Users**

Another innovation in recent years is the Google Maps application programming interface (API) which allows user communities to customize Google Maps for their own needs. Many other web portals followed suit providing their own API. In addition, 3D visualization tools like Google Earth and Microsoft Virtual Earth have

captured the public’s attention. These mapping tools have raised awareness of GIS technology, and shed light on the endless potential for using GIS. There are now many public and commercial tools available that allow community users to customize internet mapping applications for their own needs at low or no cost (Miller 2006).

Prior to 2000, using GIS software required training and taking GIS classes, and the fields using GIS were somewhat limited (in the fields of environment and city and regional planning). Now, GIS has become more widely used, especially in public health, and more people are aware of its benefits to society. Some of the consumers/users of GIS include:

- GIS Professionals- those who use GIS modeling and analysis and create sophisticated GIS
- Application Developers- those who use location-based data
- Professionals (in other domains who use mapping as a tool)- those people who use Google Maps API, ArcGIS Online, Carto.com, Mappler
- Users or Participants of GIS- volunteers who leave their smartphone to be used as an information collector or provide information via their smartphone and people who use GIS outcomes.

### **Process**

To be able to use GIS, users need to know how to use different processes of GIS. Most of the widely used processes become a module (as an object), the user does not need to know a detailed process other than using the functions.

## **Other Key Technologies**

### **Interoperability**

Another recent phenomenon important to GIS is “Interoperability”, or the “Open GIS” concept. Interoperability refers to the capability to communicate, execute programs, or transfer data among various applications and operating platforms. In addition, users do not need to have extensive knowledge to use or share the data. Open GIS provides users the ability to exchange data freely over a range of GIS software systems and networks. Interoperability enables GIS users to integrate various GIS data via the internet, without having in-depth knowledge of how to manipulate the data. The development of Open GIS can be summarized as an “effort to enhance user-friendly interfaces, interoperability between data repositories, web GIS services, and affordability”. Google Maps is allowing communities to have access to relevant maps without significant resources and technical expertise, which has tremendous implications for PPGIS. Web-based mapping expands the possibilities beyond the simple printed map, allowing for the re-purposing of the location-based data for multiple communications campaigns, projects, and planning efforts.

### **Web Services/API**

Technology has made locational data available to the public through applications, and therefore people/consumers are more aware of GIS technology. In the 1990s, using locational data required existing knowledge in GIS to locate addresses on the map using latitude and longitude. During the mid-2000s, several web-based internet mapping services were available, and they provided

a free service of geocoding and routing locations on the map. With smartphones becoming popular, more people have used mapping functions in navigating locations. With available data, mapping services provided by internet service providers, a few web or applications have been developed to provide services such as restaurant locators, public transit service locators, and so on. In the increase of data availability, the trend of open data has been pervasive, and governments provide public mapping data to make citizens use and observe their communities allowing more people access to public data.

While the platform of mapping data is provided publicly by the government, there are some online mapping services that affect the use of GIS. For example, Google Maps provides various map-based data such as satellite imagery, street view, public transportation, etc. Additionally, they provide an API that makes the maps visualize and analyze more graphically. One practical way of using GIS was demonstrated through the online New York restroom map, based on public participatory mapping, in 2015 made by Dr. Im. This map was created using Google Maps at reasonable prices, which is a clear example of the community mapping possibilities using low-cost user-friendly platforms.

It is apparent that the development of the internet and the concept of PPGIS initiated a change in GIS. There has been a significant transition in GIS since Google Maps was launched in February 2005. Google Maps offered an API that allows maps to be embedded on third-party websites and offers a locator for businesses and other organizations. API is a computing interface which defines

interactions between multiple software intermediaries. This implies a huge change in how GIS application is created and delivered. For example, GIS application developers can develop location-based applications without having their own GIS database and GIS software on the web servers. By using Google Maps API, Dr. Im was able to create an interactive mapping application for the New York Restroom site, where people can add and update publicly accessible restrooms.

New applications like Uber and Lyft, the common ride-sharing applications, have been popular in terms of using geospatial technology. The data is used to show where consumers and drivers are and helps find the fastest routes to travel or even how to avoid expensive tolls.

### **Use (Functions) of GIS**

#### **Data Visualization (Location or Thematic)**

Data visualization is one of the main utilization of GIS. One way this can be used is for community resources mapping to see the distribution compared with population distribution by race and ethnicity. Non-physical boundaries can be mapped such as health service areas, watershed boundaries, or political boundaries. By looking at the map, certain visual patterns can be found, and a new hypothesis can be developed.

#### **Proximity**

Proximity is about measuring distance on the map. For example, users can view or query accessibility to health care providers.

#### **Overlay**

Overlay enables researchers to make a relationship with multiple different layers. For example, a homeless shelter location map and bus stop map layer can be

overlaid to assess the transit accessibility for homeless shelters.

#### **Connectivity**

Connectivity is often used for line data, such as road networks or water/sewer pipes. The function enables you to see how different line segments are connected. In community health, the connectivity of bike lanes or pedestrian roads can be assessed.

#### **Mapping and Monitoring Change Detection**

Detecting a change is important to evaluate what is happening in the community. Land use or vegetation change, air pollution change, or any pattern can be viewed with different time intervals.

#### **Modeling**

Complicated spatial modeling can be done with various data like disease spread which can be modeled and predicted. This can also be used for air pollution or water pollution impact modeling.



Fig: Images of nyrestroom.com application created by Dr. Wansoo Im using Google Maps API

## **Effective Data/Information Dissemination via Web/App**

Effective map visualization can make citizens understand better. Interactive maps and mobile applications are more user-friendly and informative.

## **Case Studies**

### **IMSOCIO Community Mapping Event**

#### **Background**

IMSOCIO is an organization that was borne out of the partnership between Scholars Organizing Culturally Innovative Opportunities (SOCIO) and Dr. Wansoo Im. SOCIO began as a branch of the Franklin Township Spanish Club but has undertaken many projects that have been beneficial to both the students and the local community since the students started working with Dr. Im in 2010.

The goal of IMSOCIO is to provide high school students with the skills and resources necessary to succeed in their future endeavors. Although filled with potential, many students lack the means through which they can direct their talents. By involving these students in local initiatives, IMSOCIO demonstrates the value of cooperative focus. The local initiatives undertaken by IMSOCIO include:

- College Access for Teens: focusing on providing information about the college application process and emphasizing the benefits of having a college degree
- Recycling and Garbage Disposal: focusing on cleaning up the community and encouraging others to do so
- Oral History of Senior Citizens: recognizing the value of recording the

stories of the elderly in order to reconnect with the past

- Sidewalk Inventory: mapping sidewalks and crosswalks that are unsafe in order to persuade township officials to repair these areas

#### **Safe Routes to School**

Dr. Im in conjunction with Franklin High School students in New Jersey partook in a community mapping event through the IMSOCIO Sidewalk Inventory initiative.

Goals of the Sidewalk Audit:

- Provide an accessible and easily understood visual depiction of safety hazards
- Empower community members and demonstrate the power of collaboration
- Ensure the safety of pedestrians, cyclists, and motorists
- Cultivate community advocacy skills in high school students
- Provide another tool for residents to voice their concerns in an organized and efficient way

#### **Description of Project**

On September 10, 2011, Dr. Im and Franklin High School students surveyed the areas around Pine Grove Elementary to assess the cleanliness and walkability of the routes to school. The students documented the quality and safety of the sidewalks and crosswalks with notes and photographs. The students made sure to record the presence of litter and the locations of garbage/recycling bins using smartphones. The information that was collected was added to interactive maps generated by Vertices, LLC, a geospatial technology company.

## IMSOCIO Walkability Survey

**Pine Grove Manor Elementary School**

ZONE ID     

GROUP ID

1. Walk to a location marked with a number on your map.
2. Record the location number in an empty row on the survey form.
3. Using the keys, list all codes that describe the street side or intersection.
4. Note any special things that you would like people to know about the location, too.
5. Take photographs to show the location's good and bad features you chose to describe. Remember to fill out the photo information board and place it in each picture. Record the numbers of the photographs taken.
6. Draw different colored lines on the sidewalks corresponding with their conditions:
  - **Red** – for bad or not maintained crosswalks
  - **Blue** – for good or well maintained crosswalks
  - **Blue dotted line** – for "goat trails" or man-made trails that stray away from regular crosswalks
  - Leave blank if there is no sidewalk

<b>Sidewalks</b> S1a – Sidewalk present S2a – Wide sidewalk S3a – Sidewalk in good condition S4a – Sidewalk continues S5a – Worn path instead of paved sidewalk S1b – Sidewalk absent S2b – Narrow sidewalk S3b – Broken/cracked sidewalk S4b – Sidewalk stops S5b – Sidewalk stops	<b>Crossings</b> X1a – Crosswalk present X2a – Crosswalk is visible X3a – Pedestrian Xing sign present X4a – Stop sign present X5a – Traffic signal present X6a – Crossing signal timing good X7a – Crossing signal works X8a – Child can reach button X1b – Crosswalk absent X2b – Crosswalk is faded X3b – Pedestrian Xing sign absent X4b – Stop sign present X5b – Traffic signal absent X6b – Crossing signal too short X7b – Crossing signal not working X8b – Child cannot reach button	<b>Drivers</b> D1a – Drivers wait for pedestrians to cross D2a – Drivers don't enter crosswalk D3a – Drivers obey safe speed limits D1b – Drivers do not wait for crossing pedestrians D2b – Drivers enter crosswalk D3b – Drivers exceed safe speed limits
<b>Comfgt</b> C1a – Feels safe to walk C2a – Area is clean C3a – Clean air C4a – Shade trees present C1b – Feels unsafe to walk C2b – Area is littered C3b – Polluted air C4b – Shade tree absent	<b>Traffic</b> T1a – Traffic visible to pedestrians T2a – Light traffic T1b – Traffic blocked from view T2b – Heavy traffic	

**Safe Routes to School - IMSocio**
Scholars Organizing Culturally Innovative Opportunities

Photo: Walkability survey instructions and input codes.

## Safe Routes to School - IMSocio

Scholars Organizing Culturally Innovative Opportunities

Home
About Site
Help
Contact Us

SEARCH CRITERIA

Name

**Select Walkability**

YES  NO

Search

DESCRIPTION / LEGENDS

This website is the companion to the "walkability" assessment conducted on Saturday by IMSOCIO (www.imsocio.org), September 10 for Franklin Township Elementary School. This effort works to find and map the safe routes for children to walk to school.

Sidewalk

Intersection

LAYERS

Log In

Map Satellite Hybrid

Photo: Neighborhood map illustrating points where students recorded data for that location.



Photo: Franklin High School students taking photos and recording crosswalk data.



Photo: Dr. Im and Franklin High School students and Rutgers University student volunteers at the Safe Routes to School event.

### **Post-Event Survey**

Following the Safe Routes to School event, a survey was distributed to students that took part in the audit. There was an overwhelmingly positive response to the event. Students enjoyed the event and learned about safety in their community. Below is a sample of responses to questions in the survey.

Please explain your response to the event (student):

- *“My response to this event was definitely a positive one due to the hard work and determination shown by myself and my peers. I enjoyed helping the community and making a difference.”*
- *“It will benefit the students who walk to school.”*

What were the greatest lessons you took from this event?

- *“It takes teamwork and cooperation to produce an understanding of the concepts and how to approach the tasks at hand.”*
- *“The areas not only discourage people from walking around town but also pose a safety hazard to pedestrians and motorists.”*

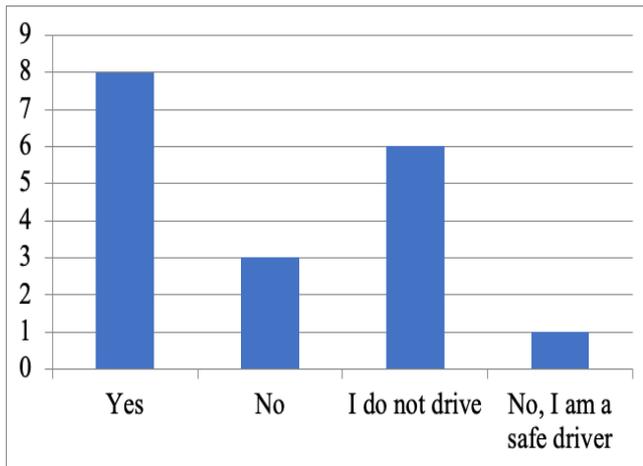
How did the event change your perception of your neighborhood?

- *“Even though the streets and sidewalks were clean, they are not all pedestrian-friendly.”*
- *“There could be better walking opportunities in neighborhoods if there were more sidewalks in residential areas.”*

What did you learn about sidewalks, crosswalks, etc?

- *“I learned that there are barely any sidewalks. Some streets have potholes and uneven sidewalks.”*
- *“Crosswalks have to be improved/repainted. Stop signs have to be a consistent distance from the curb.”*

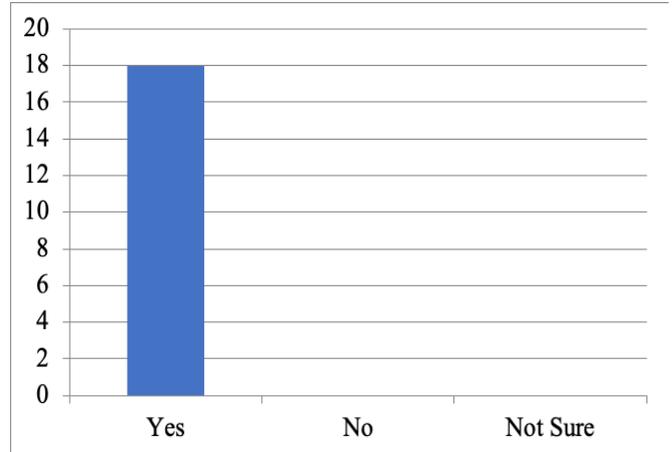
As a driver, will your attitude/behavior change towards pedestrians because of this event?



If yes, please explain:

- *“I’m going to be extra careful and I will be on the lookout for locations with crosswalks and locations where crosswalks need to be present.”*
- *“I would put myself in their position.”*

Would you participate in this type of event again?



Do you have any suggestions for improving the walkability audit?

- *“Advertise more!”*
- *“More preparation, including communication with police departments so more community members are aware of the event.”*

**Conclusion**

Through Community mapping events like Safe Routes to School, students have the opportunity to learn the importance of community advocacy while integrating Geographic Information Systems (GIS). Franklin High School students were at the forefront of identifying possibly hazardous conditions in their neighborhood. Through the post-event survey, it is clear that many of the students learned collaborative skills and some even agreed that they would change their own driving behaviors to ensure a safer community. The IMSOCIO partnership and its many initiatives that integrate GIS have exposed students to public participatory information gathering which is a skill that

can be used by these students in their everyday life.

**Project Title:** Mosquito Breeding and Zika Virus Mapping

**Name of Organization:** The Health Disparities Research Center at Meharry Medical College

**Duration:** One Year

**Dates:** September 2016 to August 2017

**Description of Project**

Dr. Paul Juarez and Dr. Wansoo Im, The Health Disparities Research Center at Meharry Medical College, along with Meharry Public Health graduate students, organized community mapping projects with both Creswell Middle School and Haynes Middle School in Nashville.

The purpose of the Community Participatory Mapping Project is to engage the community in a coordinated effort to identify and eradicate mosquito breeding sites to control the spread of the Zika Virus in North Nashville/Davidson County.

These 6<sup>th</sup>-8<sup>th</sup> grade students were trained to map possible mosquito breeding areas around their respective schools using a mobile application called Mapper. This portion of the project was intended to teach students about data gathering and data analysis, focusing on how the Zika virus is transmitted. During the technical training, the students were instructed how to use the mobile application besides taking an actual photo of the suspected mosquito breeding site, the students were taught to record information related to the site (i.e. approximate amount of water, physical attribute of container: cup, stump, flowerpot, bold, stream, etc.). Pictures of possible breeding sites were placed on the overhead projector and students were asked to identify in the picture where those mosquito breeding sites might be in the pictures. The students caught on very quickly identifying the majority of potential sites.

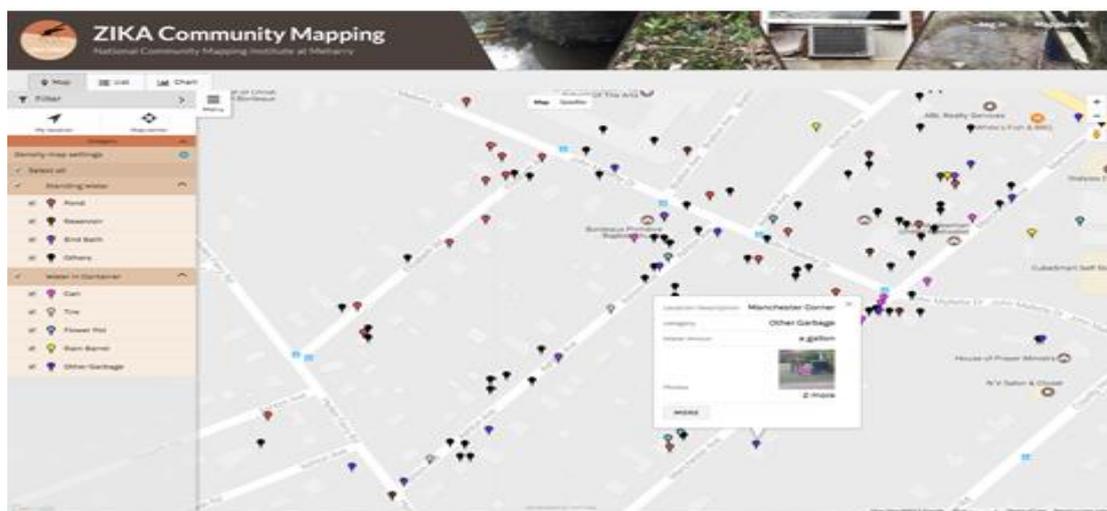


Photo: Mapping data uploaded to the Mapper website by Creswell Middle School Students

While doing community mapping, students were divided into groups that

were supervised by either a Meharry Public Health graduate student or school staff.

Students and their chaperones went into the neighborhood near their middle school to identify and map mosquito breeding sites as they participated in the Community Mapping Project. The students were given one hour to map the assigned sites and were very diligent in doing so. After the time allotted, students had identified over 150 sites where potential mosquito breeding locations existed.

To continue the learning experience, each middle school held a Zika Virus poster contest where the information used was primarily taken from the CDC website. During the time set aside in the class, the students worked together to create a unique poster for their classroom focused on the Nashville community. In each classroom, they focused on how to engage the community to respond to the information presented on the poster, and how to make sure that the poster would draw attention to the topic. To further impart the importance of community advocacy, the final element of the project was for middle school administration to schedule time for the classes to attend (a) meeting(s) of the Nashville City Metro Council, and/or Nashville School Board, and/or the Advisory Council of the Department of Public Health for Nashville

to present their class posters and describe their learning experience. Instead, a letter was created by the class to the Mayor of Nashville explaining the problems the students identified, but exams began, and the letter will be held to be sent out at the beginning of the next school year.

### **Student Survey**

Upon conclusion of the project, a student survey was conducted. From the survey question “After today’s mapping event, how much did you learn about Zika Virus?”, 84.0 percent of students who participated in the event answered “Learned a lot”, 14.0 percent answered “Learned a little”, 2.0 percent answered, “Didn’t learn anything”. From the survey question “After today’s mapping event, how much did you learn about mosquito breeding sites?”, 76.0 percent of students who participated in the event answered “Learned a lot”, 24.0 percent answered “Learned a little”, 0.0 percent answered, “Didn’t learn anything”.

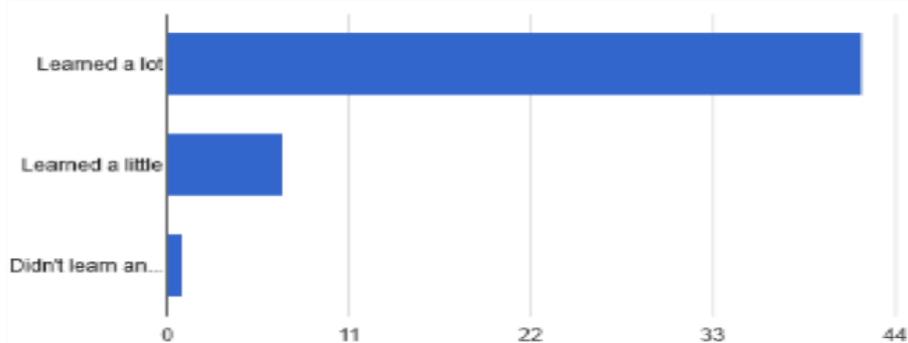


Figure 1: Survey Question: After today’s mapping event, how much did you learn about the Zika virus?

The initial results are impressive. Several of the 240 students have decided to concentrate on the STEAM curriculum (Art was added to the STEM curriculum), in their journey through the educational system. The Metro Nashville Public School System (MNPS) has decided to increase its emphasis on the STEAM curriculum, which up to now was principally in MNPS high schools. Beginning in the 2017-2018 school year the STEAM curriculum will be strengthened in the middle school curriculum. Following the Community Mapping Project:

- There are between 12 and 20 6<sup>th</sup> grade students interested in science and health/medical careers.
- More than half of the students (28) in the 7<sup>th</sup> and 8<sup>th</sup> grades are interested in science and in careers in health, medicine, and dental services.
- The most significant achievement is that 90% of the students in these three grade levels at both schools have developed a new interest in science and found that this new process of learning about science, in a hands-on way, is exciting and fun.
- Also exciting, and the second benefit that we have been able to achieve at both schools is that they will be starting an afterschool program, under the auspices of the Health Occupation Student Association (HOSA), that will work with the science teachers in the schools to develop an advanced interest in science, science projects, and science learning.

### **Conclusion**

The students were excited about the active learning segment using their mobile telephones to gather data and then seeing

that data displayed on a map, where it was much easier to analyze visually. We learned that residents, who live in communities challenged by health care and financial resources are extremely concerned about their environment, this was evident in the advocacy displayed by the students, for their communities. The students involved in this project decided to write a letter to the Mayor of Nashville asking her to become more proactive in addressing the need for education regarding personal and community management and control of mosquito breeding. The students agree it needs to be important to everyone all the time because of the health risks and the impact on the environment and on communities.

Overall, the students were excited by what they learned and what they needed to do to protect their families and their community. We have had a number of the students indicate they will focus on medical and health careers as they move through their formal education. Six students in the Middle School for the Performing Arts have committed to turning their spotlights on STEAM courses, emphasizing the Sciences. Our collaborative efforts with the teachers, school librarians, administrators, and parents have helped us to identify bright, interested students, who were not sure that science could provide a career that would be stimulating and satisfying to them. These students have now made an initial commitment within themselves that science is of growing interest to them and might unfold into a wonderful, fulfilling career for them.

As a result of the National Library of Medicine Grant “Mosquito Breeding and Zika Virus Mapping,” we have gained close ties to the Science Teachers and the STEM curriculum at both Creswell and Haynes Middle Schools.

Community Mapping for K-12 Students  
Measuring Fine Dust with Community  
Participatory Mapping

Wansoo Im, Ph.D., Community Mapping  
Center in Seoul, South Korea  
Maharry Medical College, USA

### **Background**

The Community Mapping Center in Seoul, South Korea is a non-profit organization that promotes civic engagement and empowerment using location-based technology. The Center was founded in 2013 by Dr. Wansoo Im who is currently an Associate Professor at the Division of Public Health Practice and Director of the National Community Mapping Institute at Meharry Medical College in Nashville, Tennessee. The Center has used community participatory mapping, also known as “Community Mapping” to educate, engage, and empower underprivileged community members.

In recent years, South Koreans have struggled with severe air pollution at record highs that are extremely detrimental to their health. There is no clear understanding of what sources exactly contribute to the high levels of PM<sub>2.5</sub>, which are dangerous atmospheric particulate matters, in South Korea. Despite government initiatives to mitigate the impact of PM<sub>2.5</sub> no significant reduction in PM levels has been recorded.

The Community Mapping Center is working to develop the Particulate Matter

Citizen Information Network (PM CIN) to educate the public and better understand what determines the levels of fine dust in the air. PM CIN is an open data platform that connects community collected air pollution data with existing air pollution monitoring data, leveraging existing work and systems. The portal is accessible to the public and the interactive map has relevant GIS layers such as wind, air pressure, and traffic and industry point data. The Community Mapping Center has engaged the public from the outset, involving them in the collection and use of PM data to encourage grassroots public health campaigns for air pollution mitigation in South Korea.

### **Description of Project**

The Center worked with a volunteer organization in South Korea to develop personalized PM monitors (DIY kits) and educate and organize K-12 students on collecting air pollution data. The purpose of these efforts was to help students:

- Learn the scientific method and the process of informed active civic engagement; learn the causes of fine dust and its impact; and increase students’ environmental sensitivity.

Dr. Im’s most recent community project took place in April 2019 with students from multiple grade levels. Third-grade students assembled dust sensor monitoring kits and learned how to measure the levels of fine dust at their school campus. High school students measured PM levels, temperature, and humidity in the Hongdae area and paired this data with land and building usage in the area. They also measured fine dust levels inside each station in the Seoul Metropolitan Subway Station Line 2.



Photo: Students assembling a fine dust monitor at DukGye Elementary School in YangJoo City.

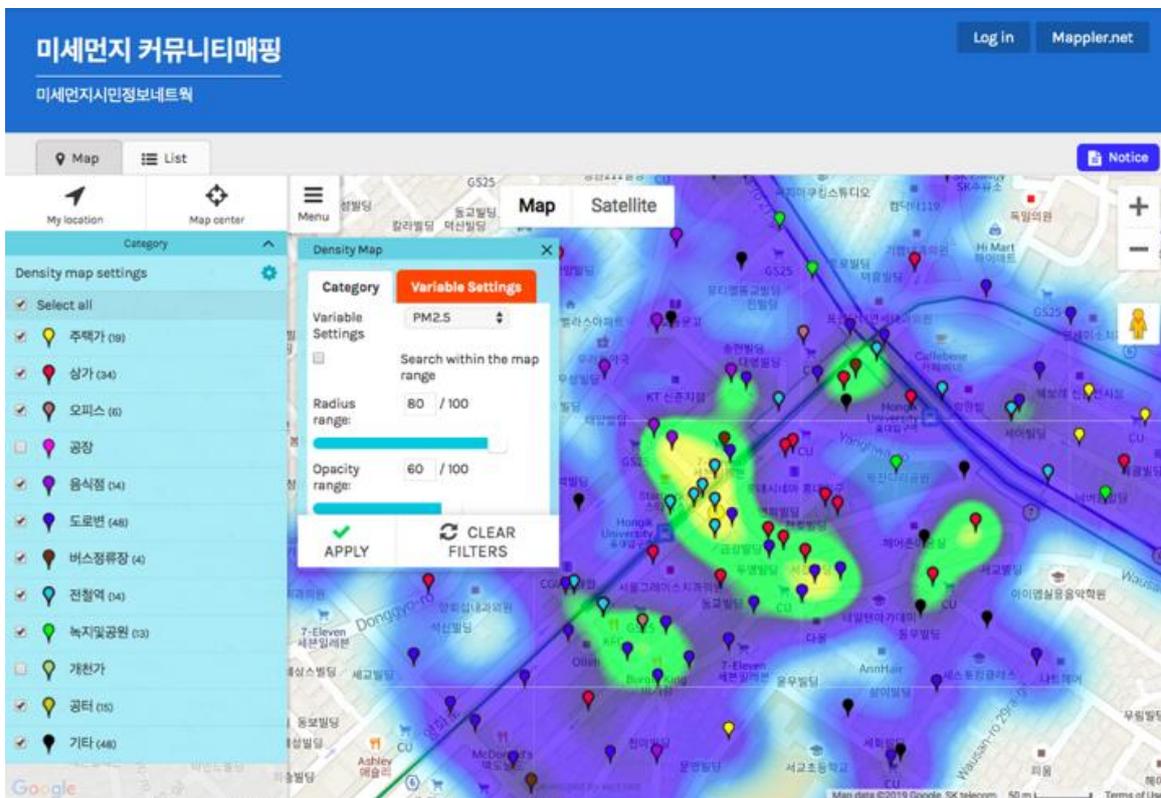


Photo: PM sensor data collected by high school students with land/building usage.



Photos: Senior Students from SongNae High School measuring PM levels in the subway stations in Seoul, S. Korea

### **Reflections**

Below are reflections from two students who participated in the event.

**JoonYoung Lee**, a 3rd-grade student at DukGye Elementary School in YangJoo City, South Korea

I was not interested in fine dust but the topic became very interesting when I made a fine dust monitor and measured the level of fine dust. I learned that fine dust is very harmful to my body and learned the difference between fine dust and ultra-fine dust. I hope our air becomes cleaner soon. The fine dust should disappear. I would like to breathe clean air without fine dust as soon as possible. Now I am thinking of my future career because of this project. I want to make a robot that predicts the level of

fine dust when I go to a college and let them know there is a robot like that.

**SiJoon Kim**, a senior at SongNae High School at Bucheon City, South Korea.

I learned the characteristics of the areas that showed a high number of PM2.5 when I did community mapping for measuring fine dust. The PM2.5 levels were much higher in smoking areas, BBQ restaurants, and parking lots than in other areas. I was able to see what activities produced fine dust. I felt that we have to do our best to reduce fine dust after I realized how bad the air quality is in our surrounding area. I am interested in our environment, and I would like to share what I learned with the people that I know so they can value the importance of environmental protection.

We measured the level of fine dust in Seoul Metropolitan subway line 2 (inside of the subway, and in the subway station). I usually go to school by train, and I often wondered about the fine dust inside the closed space. For me, it was very interesting to measure the concentration of fine dust inside the train. From the process, I was able to learn three things.

The first finding was the relationship between humidity and fine dust. I do not know if this is obvious, but I noticed that the higher the humidity the lower the concentration of fine dust. I was wondering "if the fine dust adheres to the moisture in the air?"

The second finding is that when more people were inside the subway train, the higher the concentration of fine dust. I thought about this, but I had never checked it myself. By directly measuring the concentration of fine dust inside the subway we found that the more people there are, the higher the concentration of fine dust.

Third, there is a clear difference in the fine dust levels of different subway platforms (open platform on the ground vs. underground). The open platform showed a higher level of fine dust than the underground ones. The ambient level of PM2.5 was very high on that day and I didn't see any air filtering in the open platform. I wonder what the measurements will be when the ambient level of PM2.5 is low.

I want to know where many of these fine dust particles are being generated. I want to make a hypothesis and then start a project to determine the cause of the fine dust by measuring the fine dust to test the

hypothesis. For example, the hypothesis that a coal-based power plant is a major cause of generating fine dust and that the concentration of fine dust around the thermal power plant will be high, and that the cause of fine dust is to be found by measuring the fine dust around the thermal power plant directly.

In urban areas such as the Hongdae area (one of the busiest areas in Seoul), I could examine bus stops with a lot of moving cars, a factory, a charcoal grill house, and so on. It is possible to find the cause of fine dust and it is an important step to removing the cause. I think it is more necessary to remove the cause of fine dust and develop techniques to replace them instead of finding ways to deal with the problems caused by fine dust.

After measuring fine dust as part of community mapping twice, I changed my behavior. Before even though the concentration of fine dust was very high I never wore an air filtering mask but now, I wear an air filtering fine dust mask every time the fine dust concentration is high. It is because I learned how fine dust can affect our body from this process. I hope more students will become aware of how serious a problem fine dust is in our society.

### **Conclusion**

The community mapping events in South Korea have shown that participatory mapping can be a good way to get the community engaged. Some students even showed interest in continuing to acquire more knowledge about PM in order to become advocates for change. The students enjoyed the experience and acquired more knowledge about the places they frequent,

like the subway station. They collected information on PM1.0, PM2.5, PM10, temperature, humidity, and pictures of the location where the reading was taken. Although the community mapping was a small-scale event, GIS and the information gathered can be used on a larger scale to help find ways to minimize PM in the air, and therefore help the Seoul community live in a healthier environment.

### Chapter Conclusion

- Community Mapping is very valuable tool for community health
- ICT Technology enables GIS to become more powerable, accessible, and affordable at the community level
- Community members can view various different data, and collect their own data for their own community needs
- Even though technology and data area available, community members are most important in community health.
- Community mapping can educate, engage, empower community members so they can understand what is happening to their community, and how to change it.

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