# Introduction

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**Abstract**

In an era of global challenges – from climate change to economic unrest to social disruption to pandemics – the need to hear from voices of the next generation of leaders is clear. The time to listen to them is now. The purpose of this book is to assemble, organize, and amplify the knowledge and experiences of some of the world's young people who are working locally and collectively to use scientific results, geospatial technologies, and multi-national collaboration to address some of the most pressing issues facing their local communities and global society. From every region of the world, students have emerged as leaders in the YouthMappers movement, to study such problems by creating and using open data that has a spatial component. The issues they are addressing with these common tools and methods range across the entire scope of topics known as the Sustainable Development Goals, articulated globally through the United Nations. Not only do YouthMappers create new knowledge and bring unique perspectives and experiences, but they are also proposing and taking action based upon what they see and what they know from the map and from each other.

**Keywords**

Youth · Sustainable Development Goals · OpenStreetMap · Community-engaged scholarship

## 1 The Emergence of YouthMappers

More than 1 billion people in the world are missing from the maps that are foundational for basic needs and services and simply navigating our world. YouthMappers are university students who create and use open spatial data – mapping – for authentic community development and humanitarian purposes, putting their own communities and nations on the map. This group of knowledgeable students have emerged to fuel a global movement to use digital technologies –

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both geospatial platforms and communications technologies – to answer the call for leadership in this next generation of challenges.

The formal narrative of the establishment of YouthMappers as a network of young people, as a consortium of university student groups and their mentors, and as an entity that supports the capacity, activity, and engagement of members who contribute to open data and open thinking is, for the most part, already well documented in various published articles, books, and media, most of which have been co-authored between students and mentors (see especially Solís et al. 2018; Carney-Nedelman 2020; YouthMappers 2016). In particular, the literature about YouthMappers experiences includes peer-reviewed publications reflecting on how they fit into the global geospatial open data and open source movement (Brovelli et al. 2020); how they effectively use open source tools for their career pathways (Solís et al. 2020a); how YouthMappers approaches build capacity and experience in their local peer groups (Coetzee et al. 2018); how this matters for teaching and learning (Price et al. 2019; Larsen et al. 2021; Rees et al. 2020); how what they do matters for global citizenship (Solís and DeLucia 2019); and how their presence impacts what appears on the map where the needs are greatest (Herfort et al. 2021).

This book thus adds a critical yet heretofore missing component of that documented history of the trajectory of this movement. It is envisioned as a collection that conveys a sense of the pre-existing, underlying, robust knowledge and enthusiasm that have been the precondition for the emergence of YouthMappers. Sometimes this stemmed from studies or academic experiences, but often from the overflow of youth energy and ideas that our traditional higher education institutions cannot fully contain or enable (Solís et al. 2020b). While the YouthMappers blog is written by and for students and offers an enriching communications space for immediate sharing and peer learning (see especially Hite et al. 2018; Mugeha 2020; Chishala and Suleiman 2020; Arruda 2021), we are overdue to recruit lengthier, deeper, organized contributions reflecting on

YouthMappers experiences. As such, this book aims to document and share insights about this movement's emergence from the first-person voices of the very students themselves who are among those at the forefront of creating our new people's map of the world.

Using the OpenStreetMap platform as the starting point, a foundational sharing mechanism for creating data together, the authors of the chapters in this book impart the way they are learning about themselves, about each other, and about the world, developing technology skills, and simultaneously teaching the rest of the world about the potential contributions of a highly connected generation of emerging world leaders. The book is timely in that it captures a pivotal moment in the trajectory of the YouthMappers movement's ability to share evolving expertise and one that coincides with a pivotal moment in the geopolitical history of planet earth that needs to hear from them – and needs to listen to what they are saying. Certainly, this book does not portend to be comprehensive of all of voices and perspectives, but it does offer a rich glimpse into the minds and hearts of the youth behind, within, and at the front of the movement.

## 2 Where YouthMappers Connect to the SDGs

A common thread visible in the research and audible in the stories of many YouthMappers is a desire to make a better world, often in the face of struggle because of resource- and opportunity-poor environments, which they overcome with resourcefulness, spirit, and action. While their specific objectives for any particular mapping activity, whether locally or remotely, may vary depending on the context for their work, YouthMappers activities tend to relate very closely to the United Nations Sustainable Development Goals (SDGs) (Solís et al. 2018, 2020b; Chishala and Suleiman 2020). The SDGs are a comprehensive collection of 17 interlinked global goals designed to be a blueprint to achieve a better and more sustainable future for all, put in place by the United Nations General

Assembly in 2015. While the goals are aspirational, each promotes concrete sets of development objectives, written so that countries may work to accomplish them by the year 2030. This time dimension is matched by a spatial dimension – all of them literally need to "take place" somewhere. It is serendipitous – and advantageous – that the official launch of YouthMappers occurred also in 2015, in November of that same year.

While the SDGs are not legally binding, nations are expected to mobilize action to ensure leadership and solutions under all of the themes represented in the 17 goals. The YouthMappers approach to create open geospatial data is a ubiquitously relevant action that can lead to evidence to track progress across any goal, yield observations of patterns that reveal possible solutions, and involve activities that build leadership capacity, all together, openly. The stories told in this book, in their own words, provide evidence that not only is this ambition ever-present across the range of places where YouthMappers are growing, but it is also a driving motivational force for the choices of mapping projects that youth make under their own volition.

In the years since 2015, when YouthMappers began actively mapping under that name, the growth of the movement has been steady. Within the first 100 weeks, there were an astounding 100 chapters that have joined the network (YouthMappers 2018; USAID 2018). Figures 1.1 and 1.2, respectively, show the growth of activity, represented in terms of edits contributed to OpenStreetMap (by changeset hashtag) by country and accumulated over time. At the time of submission for publication, the network is celebrating its 300th chapter in more than 60 countries.

The viral growth of the network, we assess, is partly attributable to the flexible inclusive design of YouthMappers as a youth-led, faculty-mentored, university-based, student-centered, purpose-driven, no-cost, social chapter model. But we also believe that this growth is due in no small part to the idea that YouthMappers tapped into, crystalized, and catalyzed a new space to accommodate the energy and knowledge of young people, committed to make a difference using geospatial technologies for sustainable

development in tangible local ways, speaking to larger global goals. This is a purpose-driven, identity-based community.

This book seeks to guide the reader to understand what underlies this kind of movement. Most publications that cover the topic of sustainability and/or youth development and global issues are written by non-youth authors. Moreover, most are written by non-majoritarian, entrenched academic scholars. Each chapter puts forward the voices of students and recent graduates in countries where YouthMappers works, all over the world. Many of them hail from countries where expertise in geospatial technologies for the SDGs is nascent and needed. They cover topics that range from water, agriculture, and food to waste, education, and gender from their own eyes in working with data, mapping, and humanitarian and development action.

The idea for the book itself was generated from collaborative discussions with and among the organizers of network resources and the youth authors, who have decided to address these themes at various scales of perspective: from individual/local city level to provincial and national level to multi-national regional to global scopes. Often these narratives also cross borders and engage as the youth themselves are engaged, in an intricate multi-national network of ideas and activities, with co-authors spanning these borders. They reflect on some of the lessons learned, unresolved challenges, and insights they have encountered in their efforts – which may be often successful and sometimes not fully realized. They, in fact, were the voices to have elected to map their ideas to the 17 SDGs, as a concerted, purposeful way to connect the youth agenda to the global agenda and speak to leadership audiences. As editors, we have sought to facilitate this vision in the most faithful way possible.

In the end, we believe the book fills a missing niche in the literature on SDGs, science and technology (especially geospatial), and literature written by young voices who are knowledgeable and experienced yet bring a fresh leadership perspective in their own authentic voice. The resources that are available range from very broad audiences of the very young to scholarly texts that
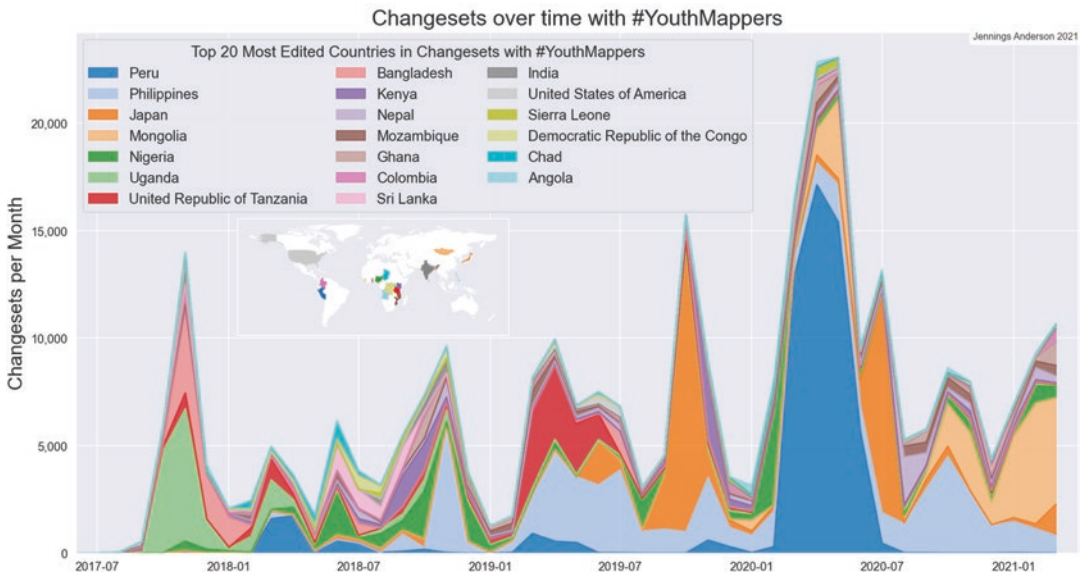
**Fig. 1.1** Number of changesets per month show activity from 2017 through 2021 with the hashtag #YouthMappers for the top 20 most edited countries in OpenStreetMap. (Credit: J. Anderson, 2022)
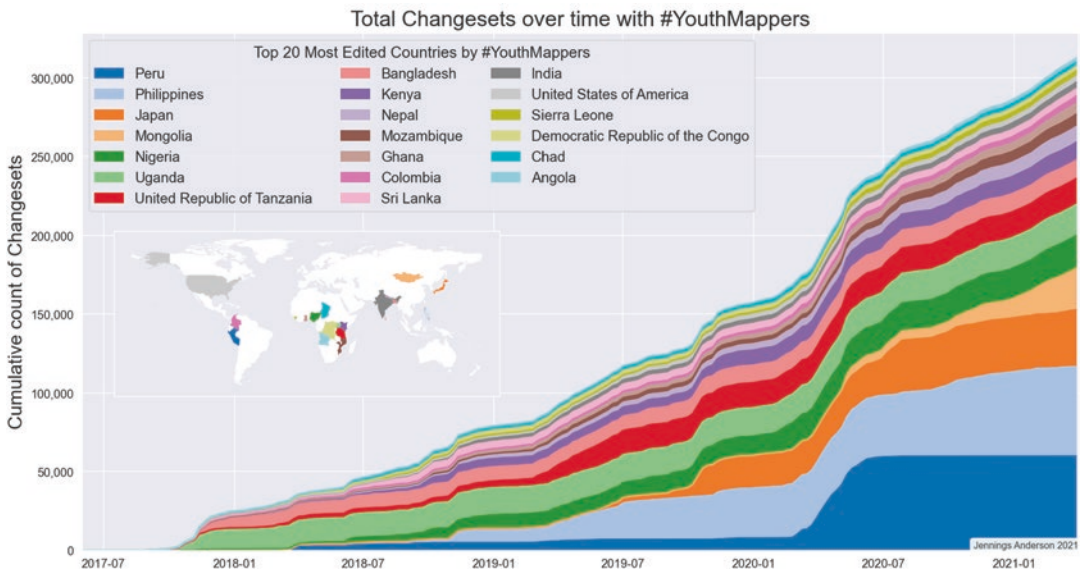


**Fig. 1.2** Accumulated changesets over time show growth from 2017 to 2021 with the hashtag #YouthMappers for the top 20 most edited countries in OpenStreetMap. (Credit: J. Anderson, 2022)

muse upon the state of youth engagement – wins, lessons, challenges, struggles, and potential, alike – but authored largely by non-youth even if written for changemaker youth audiences (Figueres and Rivett-Carnoc 2020; Reimbers 2017; Sato and Dunn 2019). A few key inspira-

tional books by individual youth activists are the exception; but a collective voice of a movement has not been adequately documented and is missing from the literature. Some works may address an individual youth activist or one specific SDG (Yousafzai and Lamb 2013; Thunberg 2019), but

a compendium of this sort that ranges across all of them, in the voice of many youth, has not been found. Moreover, this book features concrete science and technology solutions, centered on geospatial open data and knowledge skills for action, retaining a forward-looking perspective to make a tangible difference.

## 3    Who This Book Is For

We envision that this book will serve three audiences, prioritized in this order. First, we hope that this volume serves as a stellar example of youth writing for youth. The problems of the present and the futures that the SDGs seek to navigate, and open geospatial data seeks to inform, will require collective knowledge and collective action propelled by the next generation. Given our emphasis on the voices and perspectives of young leaders, we imagine that the university student peers of the thousands of YouthMappers around the world would be a key core audience to reflect on their own actions and make meaning of a movement to engage global issues. These readers are pursuing educational goals and leadership development, typically undergraduate or master's degree audiences, age 18–25, in the realm of where the United Nations defines youth.

Many of the authors are university students whose life and academic experiences draw from languages beyond English. Cognizant of the colonial legacy of this language, we hope it may be utilized nonetheless to the end of making greater more, profound connections. We preserved original phrases and analogies, rejecting typical editorial tendencies to standardize terms or overcorrect, in order to maintain the character of the stories.

We also hope to speak directly to the audience who makes up the pool of talented and dedicated faculty mentors, academic professors at universities and colleges, and even high school teachers in the 60 countries and beyond of the network who support YouthMappers specifically and youth generally in their professional and personal lives. We anticipate and hope that you find value in this book to supplement your curriculum,

engage your own students (whether they are YouthMappers or not), and use these experiences as case studies in seminars and symposia as a way to amplify their voices. This is a broad interdisciplinary audience that is interested in science for good, humanitarian and development studies, the fields represented by the UN SDGs, and globally minded social science audiences. May these chapters provide a creative resource for continuing your noble work to put youth first.

Finally, we hope that this collection also broadens and deepens the awareness of international development and environment, intergovernmental secretariats of global oriented organizations that work on various topics of the SDGs, and humanitarian professionals at UN agencies, the World Bank, NGOs, and activists who are stakeholders in engagement with youth. This tertiary audience may also include stakeholders across the OpenStreetMap community, who are involved in the fabulous idea to create a people's map but may not yet fully grasp why we seek to elevate the next generation in the broader movement. We trust you all will find the book inspiring, informative, and accessible, as we have.

## 4    The Framework

The authors of this book each chose the subjects they present and were then encouraged to identify a primary SDG and a secondary SDG to help orient the reader to the specific contributions of their efforts and as a framework to organize the set of cases. Both SDGs are indicated in the abstract, and the chapters of this book are ordered by the first goal, in succession, and then by the second goal for those with the same primary SDG. Authors were encouraged to present their experiences from the most authentic style of their work and aims and to include all co-authors who contributed, be they from one local chapter or multiple across countries and continents. Some chapters include mentors as co-authors as well. Many include illustrations such as maps and photographs that help to convey the meaning they wish to portray. Students were invited to partici-

pate in all aspects of the book, including writing the prospectus, recruited from among the alumni of YouthMappers leadership and research fellows, the regional ambassadors, at-large blog contributors, and other highly active youth across the network so that authors clearly had knowledge not only of their own work but some awareness of the movement as a whole. As editors, we aimed to balance the regional representation, thematic representation, and gender-inclusive set of contributions. Given the broad, global, diverse set of YouthMappers across the network, this did not require much effort to ensure.

Part I presents cases that primarily address the first seven SDGs (1–7), written by youth who envision a world with no poverty, zero hunger, good health and well-being, enjoying quality education, gender equality, clean water and sanitation, and affordable and clean energy for all. Taken collectively, they represent a set of voices advocating for fundamental elements necessary for each individual human being to live in dignity and to develop their livelihoods and households, able to meet basic needs. They appeal to the vital responsibility of providing essential resources across all regions of the world. By paying attention to spatial data and open mapping, they also remind us of the elementary role of place, underscored in the very first chapter about informal settlements emerging from rapid urbanization (Ruzindana, Gaspari, Ntakobangize, Ponti, Carlo Biraghi, Kilsedar, Tadi, Muindi, Agenga, and Mugeha, Chap. 2) and through considering the control of land at the nexus of water and energy (Mora-Mussio, Chap. 10), including reminding us of the need for universal access to electricity to power places (Charles, Chap. 11; Jolaiya, Akintola, and Nafiu, Chap. 12). We gain insights about the forces underlying the basic needs in both rural and urban places through the lens of food insecurity (Odame and Boateng, Chap. 3; Antwi, Lyford and Solís, Chap. 4). The ensuing consequences upon human health are narrated, especially in light of the shock of the global COVID-19 pandemic (Birkenes, Yang, Bachman, Ingraldi, and Diallo, Chap. 5; Andal, Islam, Shaheen, and Anderson, Chap. 7) and in the context of long-term stresses of endemic diseases (Montani, Cattaneo, Tourè, Diallo, Mari, and Casagrandi, Chap. 6). YouthMappers insist on inclusive solutions to these problems, ones that

rectify gender inequality (Sharma, Clark, Dhakal, and Nepal, Chap. 9) and serve as the basis for universal education (Binte Mohiuddin and Jabot, Chap. 8).

Part II shifts to evoke a greater attention to the socio-economic infrastructure that underpins development in the places where YouthMappers live and work, addressing primarily the following three SDGs (8–10). These cases center on mapping a world that offers better and more equitable opportunities for youth participation in meaningful work and economic growth, industry (especially the geospatial industry), and innovation that stems from mapping within our cities and communities. To our students, this first and foremost means putting youth leadership and skills, especially geospatial competencies, front and center in service to the SDGs, with sustained hand-off to ensure continuity (Gautam, Aman, Ojha, and Parajuli, Chap. 13; Boateng, Manyungwa, and Anderson, Chap. 15). It means getting the most innovative tools and technologies into their hands like drones and GeoAI (Mkuwu, Mtambo, and Manyungwa, Chap. 14; Charles, Chap. 11), while at the same time honoring a place for fieldwork and collaborative mapping within their communities to make critical socio-economic realities visible through the map (Naim Elias, Bortolini, Alves, Vestena, da Silva, Damas, and Philippi, Chap. 16; Walachosky, Gómez, Martínez, Amaya, Rodríguez, Centeno, and Anderson, Chap. 17).

Here we also take a moment to examine the role of YouthMappers across three major world regions, utilizing metrics on participation, presence, and statistics about the open spatial data they have created on OpenStreetMap. In particular, we assess YouthMappers contributions in Africa (Boateng, Manyungwa, and Anderson, Chap. 15); we visualize YouthMappers contributions in Latin America (Walachosky, Gómez, Martínez, Amaya, Rodríguez, Centeno, and Anderson, Chap. 17); and we generate understanding about YouthMappers contributions in Asia (Andal, Islam, Shaheen, and Anderson, Chap. 7). These data and the narratives summarizing regional action that appear with them offer a set of voices that seek not only a future with greater sustainability but also one that is characterized by resilience.

Part III looks toward building resilience through open mapping, particularly focused on

the next set of six SDGs (11–16), which attend to the dynamic systems and landscapes that form the stage for youth action. This section touches upon primary objectives to track and advance responsible systems, like that of sustainable production and consumption through the proper movement and siting of solid waste (Blevins, Karanja, Omojah, Chishala, and Oniosun, Chap. 20). It also includes advancing climate-responsible transportation, such as the movement of people for sustainability via cycling (Arruda, González, and Hermida, Chap. 19) and for resilience during disasters (Akter and Tasnim, Chap. 22; Agaton, Chap. 23). Resilience of life on land and our oceans includes open mapping to mitigate climate impacts, like flooding (Kintu and Bulley, Chap. 18; De los ríos Olarte, Peña, Arruda, and Blanco, Chap. 24), hurricanes (Agaton, Chap. 23; Akter and Tasnim, Chap. 22), and deaths from heat (Charley, Varfalameyeva, Alsanad, and Solís, Chap. 21). Mapping these systems as a stage for equitable action, YouthMappers are also attentive to justice and the need for strong institutions (SDG 16). They tell of their efforts to build this from the neighborhood scale, mapping together in participatory ways with local communities (Teixeira, Ventorini, Pôssa, Rabelo, Rocha, Figueiredo, and Silva, Chap. 25; Peña, Arruda, and Blanco, Chap. 24) and in ways that inform official cartographies (Arriaga, Birkenes, Council, Jones, Lay, McCarley, Wulf, Zhang, Wintemute, Aguirre, and Solís, Chap. 26). YouthMappers challenge us to consider how mapping can help cities of the future to be smart and just (Nakacwa and Manieson, Chap. 27).

Part IV considers the final SDG, number 17, emphasizing the importance of collective action and building partnerships for sustainability. This section features voices from the communities of support to YouthMappers, providing some additional context and insights that empower the network. This includes the importance of mentors and mentoring under best practices (Gididu, Adames, Little, Brovelli, and Coetzee, Chap. 28). We also explore the shape of the open mapping ecosystem of partners where YouthMappers are able to thrive (Carney-Nedelman and Clark, Chap. 29), especially within the dedicated sister community that is known as HOT, the Humanitarian OpenStreetMap Team (Radford, Kateregga, Machmud, Redhead, and Mwanja, Chap. 31), and the broad-based, larger community of communities that create and use OpenStreetMap (Maron and Leson, Chap. 30). This section both celebrates successes and reviews ongoing challenges of a student-centered movement.

Part V takes a look ahead and reflects on what these experiences mean for the future of youth and of the SDGs. The organizers and sponsors of YouthMappers reflect first on the general current state of engagement with youth for global leadership (McCabe and Gale, Chap. 32). Throughout the book, we have incorporated quotes from well-known youth leaders that eloquently capture some of the sentiment we witness within this movement as well (i.e., Wathut, Yousfazai, Bastida, Gómez-Colón, and Thunberg). We end with a collection of thoughts on the path ahead particularly for this YouthMappers movement offered by the committee of organizers who continuously work to provide and steer resources to sustain the movement (Anderson, Blevins, Cowan, Carney-Nedelman, Clark, Crino, Engstrom, Hinton, Mann, McCusker, Nealon, Solís, and Zeballos, Chap. 33). We advise readers and remind ourselves to be good ancestors.

## 5   In Their Own Words

As we introduce you to this book, we would like to reiterate the emphasis of listening to the voices of YouthMappers. We urge you to consider the potential impact now and in the future of their open data for advancing the SDGs in the next decade and advancing global goals that they may have a hand in determining in the following decade. We encourage you to see what they have created through their mapping actions and we invite you to learn from their experiences.

When we began planning for this collection to be created, we curated some of the most salient messages that our authors hoped to ultimately convey in the pages that follow. We finish introducing you to YouthMappers, using their own words:

> *City planning authorities should take social-spatial structures into consideration when drawing*

*plans to support proper living conditions in all corners of their jurisdiction.*

*Settlement planning must be given an important focus since it is often a key challenge that many countries face; also improving informal settlements (built environment) and improving the well-being of communities that live in them, which includes youth residents.*

*To feed the future: locate farmlands and offer dedicated services to improve agricultural output in Ghana, engaged with the next generation.*

*Even in a global pandemic, solutions for cities can be contextualized and localized as well through humanitarian mapping, geospatial and communications technologies used by youth.*

*Community projects and collaborative geospatial technologies answer the need for data and information while engaging students, researchers and citizens in the technical process, defining a learning journey that enriches both people and locations.*

*Local communities' engagement is fundamental to local action for SDGs. Youth can provide new ways to think about environmental health through participatory technologies that engage local communities.*

*The study and management of health issues as endemic diseases can be pursued through OpenStreetMap data, community engagement, capacity building and new technologies and young people already have significant expertise and inclination for team science to accomplish this.*

*Girls should be empowered to take part in geospatial technology and gender equality must be taken seriously.*

*Female leaders can serve as role models resulting in greater participation of females and decreasing the gender gap. Their involvement even in small numbers at first can provide significant contributions ensuring better results.*

*Innovation is critical for mapping projects that are for the social good. This can be achieved by regularly introducing youth and the community to open source tools and linking them with public and private partners.*

*Scientific policy advice from youth is valuable in the building of sustainable urban communities and just urban governance structures.*

*Young people are a group that are initiating their contributions in society and will do so throughout their lives. Ethics, methodologies and tools used in YouthMappers, such collaborative mapping, perfectly fits this new epoch of the Anthropocene, where it is not possible to contribute to sustain-*

*ability without recognizing the linkages between different environmental and social systems from a multidimensional social-ecological perspective.*

*Collaborative and open mapping of buildings, facilities and services put people and communities on the map, making them visible while addressing quantitatively the need for strategies for an equal and sustainable development.*

*Climate action and disaster risk reduction planning should take into account how women are affected differently during a disaster than men, and how young people can move this knowledge forward.*

*We, as organizations, institutions, communities, individuals, alike need to implement female-focused, driven, and led initiatives and programs to bridge the existing digital gender gap.*

*Continental scale organizations such as NGOs, local governments and schools should partner with YouthMappers to contribute more quality geospatial data to purpose-driven applications, given the track record of the movement.*

*For achieving education for sustainable development, students must not always keep themselves buried inside textbooks; they need experience to acquire knowledge, technical skills, values, and attitudes to enable a more sustainable society for all. The YouthMappers movement and experience overcomes many of the limitations that have been seen around education in that we typically teach about and not with the SDGs.*

**Youth seeing themselves as agents of change are pivotal to present and future development.**

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