

Leveraging spatial literacy to map a brighter tomorrow

SMU Libraries is the launchpad for research collaborations with world-changing impact as the University continues to gain ground on the road to achieving R1 top-tier research status.

A prime example is an innovative approach to establishing land claims in rural Africa that traces its roots, in part, to the GIS (geographic information system) and Spatial Literacy initiative centered in Fondren Library. This geospatial learning ecosystem sparks a new way of thinking about some of humanity's most complex challenges and utilizing technology and data to solve them.

Jessie Zarazaga, project director for the SMU Libraries initiative, heads the pilot that tests a low-cost device to produce highly accurate cadastral survey data that can be used to obtain land titles.

An unexpected campus collaboration developed when Zarazaga asked Office of Information Technology specialist Guillermo Vasquez for help with a software problem. In his gadget-filled lab on the third floor of Fondren Library, Vasquez and Loic Dalmeida, civil and environmental engineering graduate student, ended up spending hours brainstorming imaginative solutions to technical, social and practical aspects of the device development.

The multidisciplinary team joined forces with SMU alumna Clara Rulegura Ford '17, '19 and her Kijiji Innovative Sustainable Solutions on the project.

Zarazaga, a clinical associate

professor of civil and environmental engineering in SMU's Lyle School of Engineering, also directs the school's sustainability and development master's program, which is how she first met Ford, a 2019 graduate of the program. Zarazaga and the program won the 2022 Tech Titans of the Future – University award for outstanding encouragement and support of students in technology-related disciplines.

Ford, a senior associate examiner with the Federal Reserve Bank of Dallas, who also earned an M.A. in economics from SMU, was born in Tanzania. She is founder, president and CEO of the nonprofit focused on reducing rural poverty by promoting sustainable development through "education, community activism, sustainable initiatives and youth and women empowerment."

The land title project aims to develop an affordable, replicable solution to one of the biggest obstacles to wealth creation and economic prosperity in rural Africa. It's estimated that as much as 90% of rural land in Africa is not formally documented. Paying a surveyor and securing ownership documents are very expensive and beyond the means of most farmers and rural residents. And without a legal title, they cannot leverage their land as a financial asset.

"Many people don't have documents

"The collaboration among students and faculty, the SMU Libraries' GIS team and OIT is a good example of a new pathway for technology research support at SMU."

– Jessie Zarazaga



to prove they own their land, and without proof, they can't get small business loans," Zarazaga explains.

High-impact technology on a bare-bones budget

The team partnered with William Perry Evans of the University of Virginia and Iddy Chazua from OpenMap Development Tanzania, a nongovernmental organization promoting and developing community mapping projects. Together they tested a device to produce highly accurate, low-cost cadastral survey data for informal settlements in Dar es Salaam, the east African country's largest city and financial hub.

"Our collaborative project is to adapt their early-stage technology to the rural setting and rural political context," Zarazaga says.

The "brain" of the team's surveying device is a Real-Time Kinetic (RTK) board. RTK is basically "GPS at a very high level of precision. RTK can give you centimeter accuracy," Vasquez explains.

The RTK board operates in concert with a base and a rover. The static base is placed

at a point with predetermined coordinates, and the rover moves around and collects data. While a commercial RTK device can cost thousands of dollars, Vasquez devised a thrifty alternative from components that can be purchased on the internet.

"What's novel about our device is that we used open-source hardware and software so that it is less expensive and easily accessible," Vasquez explains.

Turning a setback into a leap forward

The team tested the device on campus in the spring before Zarazaga and Dalmeida headed to Tanzania over the summer for its field trial in the village of Kasisa, Ford's hometown and the headquarters of Kijiji Innovative Sustainable Solutions.

Their experience illustrates why site testing is crucial.

"We failed spectacularly on the first day. The data was not consistent, and the connection between the base and the rover was lost. All of the data was useless," Zarazaga says.

But that disaster inspired Dalmeida and Chazua to work late into the night to smooth out some of the kinks, setting the stage for a more successful run the next day.

Back on the Hilltop, the researchers are trying to resolve issues related to

communication hiccups between the base and rover, faulty GPS readings and unreliable internet connectivity in the rural setting.



Zarazaga shared the research and her insights in a poster presentation at the prestigious Geo for Good Summit hosted by Google at its corporate campus in Mountain View, California, in October.

Long-term goals require continued communication with the Kasisa community to ensure the technology is useful to them and developing DIY instructions in Swahili so that they can reproduce and effectively use the device to survey their land.

"Getting the technology to work is just a small piece of the solution," Zarazaga says. "Understanding community needs and gaining government recognition are much harder."