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nsuring access to safe water supplies and creating good management strategies are fundamental to improving global health and sustainability. Yet the barriers to doing so are multifaceted and complex; to address these barriers and improve global health equity, the University of Michigan (U-M) Graham Sustainability Institute partnered with the U-M Center for Global Health to co-sponsor two Integrated Assessment (IA) research projects in Ghana and Peru. Research teams investigated the health and social impacts of water-related challenges in each country through interdisciplinary, collaborative research aimed at 1) filling knowledge gaps and raising awareness, 2) identifying sustainable solutions, and 3) building lasting relationships with partners in these two countries.

PYLORI IN PERU

Hericobacter Pylori (HP) is bacteria that grows in human stomachs. According to the Center of Disease Control and Prevention, around two-thirds of the world's population is infected, with much higher rates found in developing countries. HP is also a class 1 carcinogen and is linked to gastric cancer, the third most lethal cancer globally.

In Lima, Peru, gastric cancer is a serious problem, and according to Dr. Alejandro Bussalleu, it is the leading cause of death for men and women in the city. Bussalleu was a key collaborator on the IA project "Gastric Cancer and HP Infection in Lima, Peru: The Role of Water Contamination." Building on previous research findings suggesting that Lima's drinking water may be contaminated with HP, the project, investigated HP drinking water contamination in Lima to establish strong scientific evidence linking HP water contamination to human gastric infections.

The project was a collaboration between clinicians, researchers, and public health officials from U-M, the Peruvian Department of Environmental Health (DIGESA) and the Universidad Peruana Cayetano Heredia. To address the risks posed by HP contamination, the team conducted three linked projects to 1) establish scientific evidence connecting HP contamination with human gastric infection, 2) evaluate ways to provide safe, clean drinking water to prevent infection, and 3) evaluate ways to combat infection.

KEY PROJECT OUTCOMES

- Established HP contamination in Lima's drinking water.
- Showed HP antibiotic resistance, supporting the importance of primary prevention strategies.
- Strengthened scientific evidence linking waterborne HP and human gastric infection through laboratory results testing mice.
- Built technical capacity in DIGESA through personnel training and providing essential supplies, and helped create a monitoring program with DIGESA to test regularly for water contamination.
- Provided hands-on educational opportunities to medical and public health students.
- Found two low-cost water treatment strategies—boiling water and bleach exposure—that may be effective as household water treatments to protect agains HP.

PARTICIPATING U-M FACULTY

Peru Project Team

- Chuanwu Xi, Department of Environmental Health Sciences, School of Public Health
- Manuel Valdivieso, Internal Medicine, School of Medicine





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GOLD MINING IN GHANA

Artisanal and small-scale gold mining (ASGM) supports 100 million people globally and produces 12-15% of the world's gold. In Ghana, where gold has been mined for centuries, it plays a significant economic role, particularly in impoverished areas. However, it also degrades environments, contaminates water resources, and exposes miners and people living nearby to mercury, which is used in amalgamating the gold. While the full environmental and health effects of ASGM are unknown, the effects of mercury on humans is well documented. A potent neurotoxin, mercury harms bodily systems and organs with potentially fatal results.

"The practice of mining is going to pollute the only water available to these communities," says Edith Clarke, Ghana Health Services Director of Occupational and Environmental Health. "But people mine illegally because they need to make a living," she adds. It's underlying social inequities like these that make the problem challenging.

Clarke was a Ghanaian partner on the "Water Sustainability, Infrastructural Inequity, and Health in Small Scale Gold Mining Communities in Ghana" project, a partnership between U-M researchers, Ghanaian researchers, and ASGM experts. The team addressed the water quality and health impacts of ASGM. Three working groups tackled the issue from different perspectives, including natural sciences, social and economic sciences, and human health in order to answer the question:

What alternatives are available in resource-limited settings in Ghana that allow for gold-mining to occur in a manner that maintains ecological health and human health without hindering near- and long-term economic prosperity?

KEY PROJECT OUTCOMES

- Produced resources and recommendations with professionals, academics, and government officials that can be used as Ghana seeks to implement national changes surrounding ASGM.
- Contributed to the body of knowledge available to Ghana and other countries seeking to become parties to the United Nations Environment Program's recent global treaty on mercury pollution, the Minamata Convention, with entire articles devoted to the ASGM sector.
- Implemented neem seed oil production operations in Ghana that offer women new economic
 opportunities and better health for their families by avoiding mercury exposure associated with ASGM.
- 21 journal articles, including a special edition of the International Journal of Environmental Research and Public Health, "Integrated Assessment of Artisanal and Small-Scale Gold Mining (ASGM) in Ghana," and 10 international presentations.

PARTICIPATING U-M FACULTY

Ghana Project Team

- Elisha Renne, Department of Anthropology and Department of Afroamerican and African Studies, School of Life Sciences and the Arts
- Niladri Basu, Department of Natural Resource Sciences, School of Dietetics and Human Nutrition, McGill University (previously at U-M School of Public Health)
- Richard Neitzel, Department of Environmental Health Sciences, School of Public Health

The U-M Emerging Opportunities Program supports collaborative sustainability research and assessment activities spanning multiple disciplines and sectors and connects science to real-world decisions and actions. Emerging Opportunities is part of the Graham Sustainability Institute, which engages, empowers, and supports faculty, staff, and students from all U-M units and integrates this talent with external stakeholders to foster sustainability solutions at all scales. We believe that diversity, equity, and inclusion are key to individual empowerment, and the advancement of sustainability knowledge, learning and leadership. See: http://graham.umich.edu/emopps