

CHARTING CHANGE

TRANSFORMING THE DEVELOPING **WORLD**

11 INNOVATIVE
PROJECTS

**MAKING A
DIFFERENCE**

including...

EMPOWERING WOMEN
in India

PREVENTING CONFLICT
in Kenya

COMBATING MALARIA
in Peru

+ MUCH MORE

CONTENTS

- | | | | |
|----|--|----|--|
| 6 | MAKING THE CASE FOR SAFE DELIVERY | 18 | GREENING SOUTH AMERICA, ONE BUSINESS AT A TIME |
| 8 | FIGHTING MALARIA IN NORTHERN PERU | 20 | MOROCCO ADAPTS TO A NEW CLIMATE REALITY |
| 10 | GETTING CONNECTED IN MYANMAR | 22 | DIGITALLY DEFUSING THE RUMOUR MILL |
| 12 | BUILDING BETTER BORDERS IN LATIN AMERICA | 24 | DETERMINING WOMEN'S DESTINY |
| 14 | WATER PROBLEMS, SOLAR SOLUTIONS | 26 | LOOKING TO FISH FOR FOOD |
| 16 | THE RIGHT EQUATION FOR AFRICA | | |

Watch for the latest Charting Change stories every month at idrc.canadiangeographic.ca.



IDRC | CRDI

Canada



CANADIAN
Geographic

EDUCATION

Each of the stories in this digest is complemented by a lesson plan that is available online and can be downloaded as a PDF. The lessons can be used in classrooms from Grade 7 to Grade 12 and were written by one of Canadian Geographic Education's more than 18,000 members. To see all 11 lesson plans, visit idrc.canadiangeographic.ca/education.

Whether it's helping pigeon-pea farmers in Kenya (this image) reduce their vulnerability to climate change or assisting ananias plant collectors in Nigeria (cover image) improve their agricultural practices, Canada's International Development Research Centre is making a difference in the lives of people throughout the developing world.

CHANGING THE WORLD ONE SOLUTION AT A TIME

A message from Jean Lebel, president of the
International Development Research Centre



IDRC / MYALBERG

training they need to implement and share their solutions with those who need them most.

In this digest, you will meet leaders such as Tendai Mugwawa (page 16), who is a graduate of the IDRC-supported African Institute for Mathematical Sciences. Tendai now develops mathematical models that are used to control tuberculosis outbreaks and is an inspiring example of how local knowledge results in sustainable solutions. You will also meet people such as Rohan Samarajiva (page 10), chair of an information and communications technology think tank in Sri Lanka. Rohan is working with the government in Myanmar to help citizens access and benefit from mobile technology.

I am thrilled that the IDRC is collaborating with *Canadian Geographic* to bring to Canadians the latest research undertaken by top researchers from the developing world, in collaboration with Canadian-based researchers. This annual digest is a collection of stories that have been appearing monthly on the *Charting Change* website, which you can visit at idrc.canadiangeographic.ca, providing an overview of the work of the IDRC and our partners. These stories also demonstrate the many ways Canadians are contributing globally to lasting impacts.

Canadian Geographic plays a unique role by offering a Canadian lens on the world. Through these stories, the IDRC and *Canadian Geographic* are celebrating Canada's global contribution to transformative research.

If these stories interest you, I encourage you to follow the series as more stories appear each month on the website. Learn more about the researchers, their work and the pressing challenges they are addressing. I am continually inspired by their achievements, and I hope you will be too.

The stories you are about to read shine a light on inspiring people who are creating global change through their innovation, courage and actions.

These are stories of how researchers, scientists, policymakers, academics, professionals, civil society and private-sector actors are contributing to long-term development in low- and middle-income countries. They are doing this by tackling climate change, empowering women, supporting farmers, promoting science, improving health and more.

These people are the cornerstone of our work. Since 1970, the International Development Research Centre (IDRC) has invested in knowledge, innovations and solutions to improve lives and livelihoods in the developing world. We support leading thinkers who advance knowledge and solve practical development problems. We provide the resources, advice and

PAGE 6



PAGE 8



PAGE 10



PAGE 12



PAGE 14



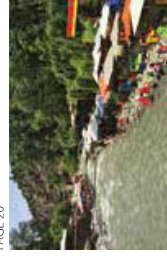
PAGE 16



PAGE 18



PAGE 20



PAGE 22



PAGE 24



PAGE 26



EDITOR'S NOTE

Perhaps you're like I once was when it comes to possessing some knowledge about the role Canada plays in the developing world.

Yes, I knew that money was being spent on helping people, but I didn't know precisely where or how these people were being helped, or indeed what Canadian institution was helping them. What vague impressions I did have were gleaned from snippets I'd catch on TV news, radio broadcasts I'd overhear, headlines I'd scan.

The concept was concrete, but the people and the reality of their day-to-day existence was amorphous.

That changed shortly after I started to work on *Charting Change*, a project that highlights the many ways Canada's International Development Research Centre (IDRC) is helping the people of Kenya, Peru, Myanmar, Morocco, India and so many more nations that face often daunting challenges day after day,

whether it's coping with the very serious effects of climate change or building a safe community through digital technology.

It helps, of course, to have great writers such as Alanna Mitchell, Brian Owens and Niki Wilson telling compelling stories. What's even better (at least from an editor's perspective) is when it's clear that their interest has been piqued *before* they start writing. That can only bode well for you, the reader.

The stories herein fall under one of three colour-coded categories, each representing an IDRC program: Agriculture and the Environment (green); Inclusive Economies (orange); and Technology and Innovation (brown). Regardless of category, I hope these stories enrich your knowledge of the developing world, and Canada's role in it, as much as they did mine.

—Harry Wilson



MAKING THE CASE FOR SAFE DELIVERY

How one organization is using the law to improve maternal and child health in Uganda

By Niki Wilson

Having successfully delivered her baby at a public health facility in Mityana, a city just west of Uganda's capital, Kampala, in 2009, Sylvia Nalubowa was surprised to learn that her labour wasn't over — she was having twins. But there was a problem. Try as Nalubowa might, her second child was stubbornly resisting entry into the world.

She was referred to a district hospital in another part of the city, where more experienced staff could help her. Her mother-in-law paid a Good Samaritan fuel costs to drive Nalubowa there, as Nalubowa had no access to an ambulance. But when she arrived she was refused care. The reason? She wasn't able to provide a "Mama Kit," which contains items such as rubber gloves, plastic sheets, cotton wool, soap, cord ties, antibiotic drops for the baby's eyes and surgical blades.

All women in Uganda who are about to give birth in a government health facility like the hospital in Mityana are required to produce a Mama Kit to ensure sterile conditions, but Nalubowa had already used hers at the birth of her first child earlier that day. The kits are distributed by the National Medical Stores, a government corporation, and are meant to be free of charge, but hospital attendants demanded Nalubowa pay for a second kit, a cost she could not afford. Despite eventually negotiating to pay for the kit after the delivery by selling some of her domestic

Uganda



animals, Nalubowa and her unborn child died hours later from blood loss.

Nalubowa's story is tragically all-too familiar in a country that has had systemic problems when it comes to maternal health, says Moses Mulumba, a lawyer and the executive director of the Centre for Health, Human Rights and Development, a Kampala-based organization that works to ensure law and public policy are used to promote and protect health and human rights in East Africa.

"Every day you would read in the newspaper that a woman has died," he says. Often the death is as a result of a doctor or other health-care provider not being available. The World Health Organization and UNICEF report that 360 women die per 100,000 live births in



Protestors in Kampala march to court in 2012 to complain about a delay in delivering judgment on a case involving two women who died in childbirth.

“The case has spurred multiple changes **not just within the government**, but also within our own thinking on how the government **can be engaged.**”

Uganda, with about 5,900 women dying from maternal health issues every year.

Mama Kits have been transformative in helping lower the risk of death and infection during birth. But there are still places where kits aren't available to, or affordable for, women living in poverty. Even if a woman in labour takes a kit to the hospital, there is no guarantee she will get help from a doctor or health-care worker, the most corrupt of whom try to turn crisis into profit. In addition, if the health-care facility has been unable to pay utility bills, there may be no running water and electricity when the expectant mother arrives.

It's better than it once was, says Dr. Olive Sentumbwe of the WHO, who works with Mulumba on maternal health issues. There is good quality health care available in many regions for a small fee, she says. "But depending on the wealth of the house, women are exposed to different conditions." With 1.4 million mothers-to-be in the country annually, she says health supplies and providers often fall short.

With the help of funding from the International Development Research Centre, Mulumba's organization is working to change this. In

2011, the organization filed a lawsuit against the government of Uganda with the family of Nalubowa and Jennifer Anguko, a woman who died from blood loss in 2010 after enduring obstructed labour for more than eight hours without the aid of a health-care professional. In 2012, a lower court refused to hear the case — a decision the country's Supreme Court overruled in October 2015, ordering the lower court to determine whether the government has taken all practical measures to ensure basic maternal health services are provided.

Regardless of the outcome, says Mulumba, the lawsuit is already making a difference. The highly publicized case has sparked an important discussion among Ugandans, brought international scrutiny to the issue and garnered the attention of the country's Parliament, which in December 2011 passed a resolution directing the government to develop laws that adequately deal with issues around maternal and newborn health. The case has spurred multiple changes, says Mulumba, "Not just within the government, but also within our own thinking on how the government can be engaged."

Photo: Courtesy of CEHURD



FIGHTING MALARIA IN NORTHERN PERU

Changing irrigation practices could help eliminate the disease

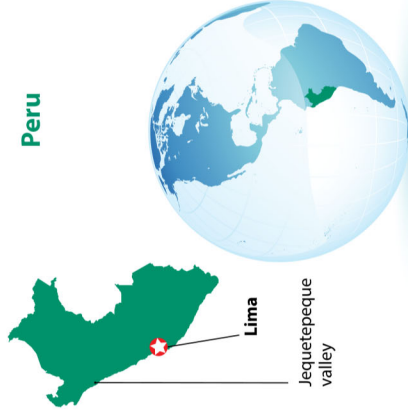
By Brian Owens

When large-scale irrigation came to Peru's north coast in the 1960s and 1970s it brought with it an explosion in agriculture, in particular rice cultivation. But it also brought a new disease to the area — malaria.

"The north coast is a semi-arid area, the only reason there is malaria there is because of irrigation," says Andrés Sánchez, a senior program specialist with the International Development Research Centre, which is supporting a project in the region that could help eliminate the deadly disease. "It's a man-made problem."

Fortunately, there's also a man-made solution. Research from the past 15 years has shown that by changing irrigation practices, farmers can prevent the breeding of malaria mosquitoes in their own fields. Instead of keeping fields flooded throughout the growing season, farmers can alternate between flooding and drying their rice paddies. This breaks the life cycle of the mosquitoes that carry the malaria parasite and drastically reduces their numbers.

"When farmers practiced intermittent irrigation, there was an 85 per cent decrease in malaria-infected mosquito larvae in rice paddies, which contributed to a reduction in disease transmission in parts of the Jequetepeque valley," says Elena Ogusuku, an entomologist at Peru's Ministry of Health who is leading the project that's investigating ways to encourage the practice.



Peru

Lima

Jequetepeque valley

Previous attempts to deal with the problem met with little success. In one jurisdiction, for example, rice paddies are not allowed within 500 metres of villages, but that still leaves farm workers exposed to infected mosquitoes. And eradication efforts using pesticides just led to increased resistance to the chemicals among the mosquitoes. Intermittent irrigation is much more effective, but needs to be taken up more widely to really make a dent in malaria transmission in northern Peru. "The mosquitoes can fly from field to field, so the trick is to do it on a mass scale," says Sánchez.

The advantages of controlling irrigation go beyond tackling malaria transmission. Intermittent irrigation can reduce water use by between 20 to 30 per cent, an important



A member of the intermittent irrigation project team helps a farmer conduct a test to measure rice yields near the town of Guadalupe.

“By changing irrigation practices, farmers can prevent the breeding of **malaria** mosquitoes in their own fields.”

consideration in the dry region, where water allocation is a constant source of tension and where 15,000 hectares of arable land lie unused because of a lack of water, says Ogusuku.

It also makes economic sense. The intermittent drying kills off common rice pests, reducing the need for expensive pesticides, and allows more oxygen to reach the plants' roots, boosting yields by as much as 25 per cent.

With so many advantages, you might think converting the entire region to intermittent irrigation would be an easy sell, but that has not proven to be the case.

Local farmers are conservative and risk-averse, and can be reluctant to try new techniques — especially since there's no support from the government to cover any extra costs, so the farmers must invest their own time and money to take part in the project. There are also no agricultural extension programs to help spread new farming methods or technologies, so Ogusuku is working with local farmers and NGOs to provide technical assistance and share local experience.

There's also bureaucracy and inertia to overcome. Getting the three government ministries interested in the project — agriculture, environment and health — to work together

has proven challenging, and there are strong vested interests involved in the allocation and distribution of water resources. "Water is power," says Sánchez.

But there are some signs of progress. The farmer-led irrigation authority in the Jequetepeque valley, representing 15,000 farmers, has financed a technology-transfer workshop to test the adoption of the technique, showing growing acceptance of the idea by farmers.

The government is also coming around. In 2014 the president of Peru declared that it was in the national interest to adopt intermittent irrigation throughout the north coast (a decree with no real legal force behind it, but symbolically powerful nonetheless). And earlier this year, the government established a commission involving representatives from the ministries of agriculture, health and environment, as well as three regional governments, to promote and track progress on implementing the technique. The National Agricultural Research Institute is now planning to run commercial demonstration fields to test large-scale intermittent irrigation in the next growing season.

"It's working," says Sánchez, "but slowly."

Photo: Esther Montalvan



GETTING CONNECTED IN MYANMAR

After years of falling behind the rest of Asia in information and communications technology, Myanmar is quickly catching up

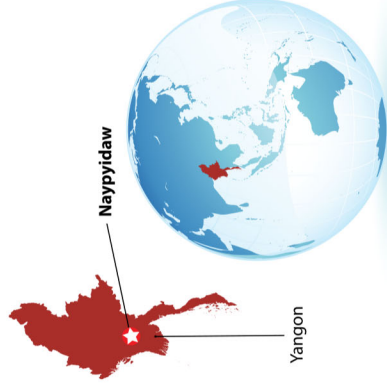
By Niki Wilson

Aung San Suu Kyi is a celebrated human rights activist that led opposition to the military junta that took power in Burma (now Myanmar) in 1962. She was one of the founders of the country's National League for Democracy and a champion for the establishment of a civilian government. In 1989, she became a political prisoner of the military and remained under house arrest for 15 of the next 21 years. She was released in 2010, as Myanmar slowly began to embrace democracy.

While the rest of the world was a Google search away from following Aung San Suu Kyi's political career, few in Myanmar had the means to access digital information about her. State restrictions on communications and a lack of reform in the telecoms sector meant Myanmar spent years in a digital blackout, its citizens without the educational and entrepreneurial opportunities afforded by the web. The ruling military failed to develop telecommunications capacity even as many of their Asian neighbours forged ahead.

As recently as 2004, while broadband networks were readily available in nearby China for US\$9.66 per month and in Sri Lanka for \$21.71, in Myanmar the cost for a low-speed connection was a whopping \$4,794 per month. In addition, "It cost \$2,500 just to get a SIM card," says Rohan Samarajiva, chair of LirneAsia, an information and communications technology policy and regulation think tank based in Colombo, Sri Lanka.

This information and communications technology hurdle, especially as it related to opportunity in the global economy, was one of the many



reasons the once prosperous country remains classified by the UN as a "least developed country," a status it first attained in 1987. But after 2010, things began to change. As part of the transition to democracy, the Myanmar government sought reforms that could begin the rebuilding of a once prosperous economy, says Samarajiva.

"Telecom was a good candidate that could yield quick results for the people," he says.

LirneAsia, along with India's Centre for Internet and Society, came on board to help Myanmar make the transition to a socially inclusive, networked economy. While working closely with the Myanmar ICT Development Organization (MIDO) and with the support of funders such as the International Development Research Centre, LirneAsia is helping support



Buddhist nuns in Myanmar take and examine pictures of each other. Myanmar has rapidly become digitally connected to the rest of Asia and the world in recent years.

“The Myanmar government sought reforms that could begin the rebuilding of a once prosperous economy.”

information and communications technology skills in Myanmar” by teaching through the process of doing,” says Samarajiva.

In some cases this means consulting with government on how to manage companies to set up and share telecommunications infrastructure and products. In other cases, LirneAsia conducts large-scale surveys and research projects (one study had 4,000 participants) to evaluate the progress of development of information and communications technology, suggest relevant policy and build government accountability. The research programs are also designed to provide mentoring opportunities so that in time organizations like MIDO will be empowered to do the same.

As a result of these collaborations, Myanmar has rapidly adopted cellular technology. In 2013, about 10 per cent of the population had phones; today, 90 per cent do. Myanmar has also blown past the voice-only cellphone stage common to many developing nations, with 63 per cent of cellphone users owning smartphones. “It is one of the fastest growing telecom sectors I have ever seen, and I have been in this field for over 30 years,” says Samarajiva.

The impacts of a digitally connected society have begun to show themselves. “One of the most significant results has been around the election,” says Samarajiva, referring to the November 2015 election in which Aung San Suu Kyi and the NLD gained a majority government. Apps were developed to allow people across the country to monitor for election fraud, says Samarajiva, making election results difficult to dispute.

Phyu Phyu Thi, MIDO's research and development manager, works with LirneAsia to collect surveys in the field and has seen the benefits connectivity has brought. For example, during floods that commonly plague the countryside, villagers requiring assistance can easily ask for help from neighbours and emergency services agencies, which has in turn improved the quality of emergency relief work. In another example, she says rural youth are trying to overcome literacy barriers and improve future opportunities by learning English on their smartphones.

Aung San Suu Kyi has been quoted as saying “If you do nothing, you get nothing.” Myanmar is doing a lot to move toward a networked society. Early results suggest it's paying off.

Photo Courtesy of LirneAsia



BUILDING BETTER BORDERS IN LATIN AMERICA

Illegal trading and accompanying violence plague Latin America's borders, but researchers in Ecuador are combating the problem

By Brian Owens

Throughout much of Latin America, borders can be dangerous places. Smuggling, drug running and human trafficking are lucrative businesses — the United Nations estimates that the illegal drug trade in the region is worth \$450 billion a year — and those that control it are not afraid to use violence to protect their investment.

It's the people who live near borders that have to deal with the consequences of this violence, says Fernando Carrión, a researcher at the Latin American Faculty of Social Sciences in Quito, Ecuador. "Border towns suffer from murder, robbery and insecurity, which hinders local development and integration between countries," he says.

Carrión is interested in what makes these illegal economies work, and how countries can work together to dismantle them. Supported by the International Development Research Centre (IDRC), he is leading a project to map and study the underlying political economy of illegal trading and violence in Latin American border regions, and come up with ways to combat and prevent it.

"We want to not only study violence and national security issues, but also to think deeper and learn what the underlying causes are," says Markus Gottsbacher, the IDRC staffer handling the project, adding that what reporting is done on the topic is "rather superficial."

Carrión and his colleagues felt it would be too dangerous and expensive to do their

research directly in the border regions, so they study newspaper and magazine reports, journal articles and national crime statistics from the past 10 years, looking for patterns that they can develop into a comprehensive picture of the illegal economies of the border regions. But that doesn't mean their work is without risk. "When you're studying illegal markets, regardless of where one is, you face risks," says Carrión. "It involves revealing the ways the smugglers operate, which can affect their interests. So our research requires us to have security when we do travel to those areas."

Using public media sources such as newspapers helps the researchers develop a fuller picture of the situation than if they relied solely on government data, adds

Ecuador

Quito



A man peers through a hole in a wall that separates Tijuana, Mexico, from the United States. Throughout Latin America, border cities are often dangerous places where illegal activity creates havoc for residents.

“The goal is not just to unravel what is happening at the borders, but also to design projects to help improve the situation. To help fight the violence associated with illegal border economies, Carrión and his colleagues are helping to strengthen international ties and cooperation in the region. “It’s very difficult for a single country to take on all of these problems,” he says.

Carrión, because reporters will often look beyond the local level when chasing a story. “Usually the information on these issues is handled by the respective countries,” he says. “The journalistic sources allow us to discover the logic of events, through the behaviour of the various actors.”

Carrión has found that the development of the illicit economy in border regions comes from the lack of integration between countries, creating what he calls “complementary asymmetries” in economic and legal policies. “Two countries with different economic policies generate, via smuggling, illegal economies,” he says.

But the problem is rarely confined to a single border between two nations. The issue is global, as what is being smuggled — drugs, guns, people, to name but a few — is fed into international illegal economies. “The whole system is connected to global matters,” says Gottsbacher. To try and develop an understanding of the complex international dimensions of the problem, Carrión’s project involves researchers and policymakers from eight Latin American countries: Argentina, Brazil, Bolivia, Colombia, Ecuador, Guatemala, Mexico and Peru.

The goal is not just to unravel what is happening at the borders, but also to design projects to help improve the situation. To help fight the violence associated with illegal border economies, Carrión and his colleagues are helping to strengthen international ties and cooperation in the region. “It’s very difficult for a single country to take on all of these problems,” he says.

They are working with Ecuador’s attorney general to create a South American International Criminal Court, fostering the development of the Latin American Organisation of Border Cities and creating a network of institutions and researchers in the region who can share ideas and solutions. “You need good allies at the national and regional level to deal with these issues,” says Gottsbacher.

All of their projects are focused on what Carrión calls the “positive agenda” — looking for ways to improve cooperation, integration and understanding between people across borders, rather than a heavy-handed law and order approach.

“This project tries to improve border governance with less focus on national security issues,” says Gottsbacher, “and more on how to collaborate in positive terms.”

Photo: Alfonso Caraveo/Archivo Coleif



WATER PROBLEMS, SOLAR SOLUTIONS

How solar-powered water pumps are helping farmers in Pakistan adjust to climate change

By Alanna Mitchell

One answer to the knotty question of how some of Asia's poorest farmers can adapt to the hardships of climate change may come down to a simple water pump.

But this pump doesn't run on the usual electricity or diesel fuel. Instead, it gets its energy from the sun, allowing farmers to bypass electricity shortages and the high costs of diesel fuel, and, using direct-current solar energy, pump water from depths of about 30 to 60 metres, as long as the sun is shining.

"If we can replace diesel-driven pumps with clean energy, that is exciting," says Bashir Ahmad, program leader of climate change and geo-informatics at the Climate Change, Alternate Energy and Water Resources Institute of the National Agricultural Research Centre in Islamabad, Pakistan.

Ahmad's research group recently unveiled an even greater breakthrough for farmers in the Soan River basin, a mid-altitude region of the Hindu Kush range in the western Himalayas. It is a more powerful alternating-current solar pump that not only allows farmers to access groundwater as deep as 91 metres below the surface but also costs half as much as the direct-current solar pump.

The new pump is the result of a partnership with the Himalayan Adaptation, Water and Resilience project (HI-AWARE), one of a quartet of programs in the Collaborative Adaptation Research Initiative in Africa and Asia (CARIAA),

Pakistan

Islamabad
Chakwal



which is supported by the International Development Research Centre (IDRC) and Britain's Department for International Development.

Between them, the two pumps could revolutionize several aspects of farming across large areas of Pakistan and other parts of Asia that are fed by mountain glaciers and the snowpack.

That's important because the Hindu Kush Himalayan region, known as the water tower of Asia, is drying up. A global climate change hot spot, its glaciers, the biggest collection of ice on Earth outside the polar caps, are shrinking as the planet warms.

The results trickle down the mountains and into the flood plains of 10 major Asian river systems, including the Indus, Ganges and Brahmaputra, across eight countries from



An array of solar panels in Chakwal, Pakistan. The panels are part of a solar-powered water-pump system that uses a high-efficiency sprinkler to irrigate crops.

“If we can replace diesel-driven pumps with clean energy, that is exciting.”

Afghanistan in the west to Myanmar in the east. Those rivers directly support about 210 million people; their basins help support 1.3 billion people, or nearly a fifth of the world's population. Many are struggling to adapt to rivers that simply don't contain as much water as they once did — or at least not at the times of year they once did.

"The climate change impacts are very high; people are quite poor," says Kallur Subramanyam Murali, who oversees HI-AWARE for the IDRC in New Delhi, India. "Livelihoods are under immense pressure."

It will be worse in the future, as climate change continues to shrink the glaciers and destabilize the seasons even more, says Ahmad. Projections suggest that by about the middle of the century, the flow of the mighty Indus River will be reduced by 30 to 40 per cent, he said. Not only that, but rainfall is becoming unreliable.

In the Islamabad region, for example, patterns are dramatically different from two decades ago, Ahmad says. Then, rainfall was uniform; the summer monsoon arrived in the first week of July and left in the second half

of September. Now, sometimes the rain stays away for two or three months, which makes it hard to grow food.

In a bid to help, the government of Pakistan had invested heavily in water-efficient irrigation systems using drip or sprinkler methods, but farmers weren't using them because they couldn't afford the non-solar pumping costs.

The HI-AWARE program is trying to come up with solutions to keep food on the table and the solar pumps are an early success. In the next three years, 50,000 hectares of land in Punjab province will be fitted out with high-efficiency irrigation systems. The government of Pakistan has announced that it will provide as many as 30,000 farmers with interest-free loans to buy the alternating-current solar pumps over the same period, with preference given to those who have already installed or are willing to install a high-efficiency irrigation system.

Bernard Cantin, the Ottawa-based program leader of CARIAA, says this is just one of a range of pilot projects on the go, some of which he hopes will eventually give people right across Asia new tools to keep feeding their families.

Photo: HI-AWARE project team/Pakistan Agricultural Research Council



THE RIGHT EQUATION FOR AFRICA

How the African Institute for Mathematical Sciences is helping shape the continent's future

By Niki Wilson

As a young Zimbabwean biology teacher about to become a student at the African Institute for Mathematical Sciences in Cape Town, South Africa, in 2004, Tendai Mugwawa had no idea that her time there would radically change the course of her career. Ten months of intense study would fuse her passion for math and biology, and ignite a desire to eradicate the diseases that plague her country. She would go on to earn a PhD in theoretical immunology, and ultimately work for Public Health England, where she now develops mathematical models that are used to understand and control tuberculosis outbreaks.

It's important work, but also a stepping-stone. "My ambition is to be on the team that makes policy to control disease," she says. "For example, in situations like the outbreak of Ebola in West Africa." Like many graduates of the institute, Mugwawa eventually wants to put her skills to work in Africa. She's already taking leaves from Public Health England to teach as a sessional instructor at the Cameroon branch of the institute, in the capital, Yaoundé.

The institute is the brainchild of Neil Turok, an award-winning physicist and the director of the Perimeter Institute for Theoretical Physics, in Waterloo, Ont. Turok grew up in South Africa until his family was exiled for publicly opposing apartheid in 1966. As a 17-year-old in the mid-1970s, Turok returned to Africa and became a volunteer teacher in Lesotho. His experiences

South Africa

Pretoria

Cape Town



with bright young students convinced him to create a place where Africans could cultivate skills to solve African problems.

What started out as one facility in South Africa in 2003 has led to four more across the continent, in Tanzania, Cameroon, Ghana and Senegal. This expansion is part of the Next Einstein Initiative, which started in 2008 and is one of the institute's core programs. Its purpose is to open 15 more branches of the institute across Africa by 2023.

Through the program, the institute hopes "people of rare ability — Africa's own Einsteins — will emerge, capable of innovative breakthroughs to transform Africa's future."

Through its International Development Research Centre, Canada is one of many governments supporting this expansion. AIMS



Students from the African Institute for Mathematical Sciences outside the organization's building in Cape Town, South Africa, one of the institute's five locations across Africa.

“Before I used to see mathematics as a set of problems that needed solving, but now it is a set of tools that I can use to solve other life problems.”

also benefits from the support of universities such as Cambridge and Oxford, and academic patrons such as Stephen Hawking.

With increased capacity, the list of successful alumni tackling everything from disease control to economics continues to grow. So far, 960 students from 42 African countries have graduated — 31 per cent of them women. These students have had the benefit of world-class lecturers, including Jeff Orchard, a computer scientist from the University of Waterloo.

Orchard is interested in how the brain works, particularly in the mechanisms that underlie how the brain is organized and how it moves information around. He studies this at the level of neurons, and develops computer programs to simulate neural activity. In 2012 and 2014, he offered a course at the institute in South Africa that explained the math and computing science behind the programs.

Most students come to the institute with some kind of math background, and lecturers

such as Orchard are brought in to build on that in a number of disciplines, he explains. “Last time as I was arriving, a team of scientists from Austria and the United States were just leaving, having taught a course on insurance,” he says.

All topics, however broad, are connected through the application of math skills. “Math is the universal language of science,” says Orchard. “With a math degree what you get is very careful, abstract thinkers that can take a problem, put it in a broader context and solve a broader problem.”

For Orchard, though, the institute is about much more than academics. He says the sense of community that came from eating, working and living with all the other students and faculty was one of the highlights of his time there.

Mugwawa believes her experience at the institute changed the way she viewed science. “Before, I used to see mathematics as a set of problems that needed solving,” she says. “But now it is a set of tools that I can use to solve other life problems.”

Photo: AIMS/Yasmin Hankei



GREENING SOUTH AMERICA, ONE BUSINESS AT A TIME

A look at how small- and medium-sized businesses on the continent are starting to play a bigger role in environmental sustainability

By Alanna Mitchell

How does the world's industrial production go green? While much of the focus in recent years has been on whether the brand-name, billion-dollar multinationals are doing it, economists in Latin America have begun wondering about the smaller links in the production chain.

The logic is sound. Those non-multinationals may be small, but they are massive when it comes to their cumulative effect on both employment and pollution, says Ben Petrazzini, senior program specialist at the regional office for Latin America and the Caribbean of the International Development Research Centre (IDRC) in Montevideo, Uruguay. "The issues are very important when it comes to the future of the environment and climate change," he says.

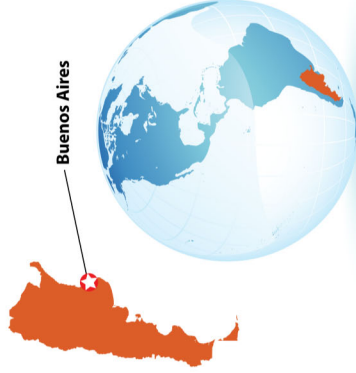
"And when it comes to small and medium-sized enterprises, there hasn't been much attention."

Recently, because Latin American economies are in the throes of a lengthy boom, there has been pressure from more developed countries for that growth to be environmentally friendly, no matter what size the business. That's driven by an idea that took hold in the wake of the global economic collapse of 2008: that green growth can create jobs, alleviate poverty and reduce social inequality.

But there's a hitch. While large companies tend to have money to put into green strategies, smaller enterprises are less likely to be able to put aside cash for that sort of investment. Not only that, but governments

Argentina

Buenos Aires



historically have focussed policy measures on the larger companies, leaving smaller ones to their own devices, without much explanation of what to do or why it matters.

It adds up to a conundrum. Worse, as Petrazzini and his colleagues at the IDRC discovered, there was a near total lack of data on the smaller business and their attempts to go green.

That led the IDRC to support two studies worth \$1.39 million to find out the basics in countries across the region, including Argentina. Both studies ended in 2015.

Daniela Ramos, an economist and principal researcher at the non-profit foundation Centro de Investigaciones para la Transformación in Buenos Aires, oversaw a two-year study that examined how efforts to go green affected the



South American businesses, such as this print shop in Peru, are seeking to reduce their environmental impact as they begin to play a key role in sustainability in the region.

“The environment is seen as a cost, but it is also an opportunity.”

competitiveness and employment at about 20 food and beverage, textiles and machinery businesses. She says her team had to agree not to name any of the companies studied to allay fears that the information could be used against them somehow, a common barrier to research in Argentina.

One of the first findings was just how little the smaller firms knew about making their operations more environmentally sustainable, whether it was reducing the amount of industrial waste put into the land and water or reducing carbon-based fuels in production. They didn't know which technologies to use or how to apply them. "We found that firms that intended to green their processes in some cases could not," says Ramos. "They were not very well informed."

And even if they knew what to do, they rarely had the money to accomplish their goals. In addition, few could see how greening production would do anything but cost them money. They didn't link it to future savings in production costs or to potentially increased markets from environmentally savvy consumers.

Nevertheless, all the firms had improved environmental standards to some extent over time, Ramos says. During the process, they were

also able to keep employment at stable levels, rather than having to cut staff because of extra costs. "It's not a dichotomy. It's a process, a continuous path," she says. "They realize this is something they can't avoid so they start incorporating some technology and they walk along a path to become greener."

Eduardo Bianchi, a professor at the Instituto Universitario Escuela Argentina de Negocios in Buenos Aires, was involved in the other IDRC-supported study, a three-year project coordinated by the Argentine branch of the Latin American Faculty of Social Sciences and carried out by the Latin American Trade Network that looked at the impact of low-carbon economies on growth and inclusion. Bianchi says that an in-depth study on the dairy industry that he co-authored for the IDRC project showed that small and medium-sized firms need policy regulation if they are to become greener. He added that governments must help them gain access to financing.

While the studies showed that the smaller firms have a long way to go to become greener, they also showed the tremendous environmental benefits Latin America could reap with a little policy help. "The environment is seen as a cost," Bianchi says, "but it is also an opportunity,"

Photo: Courtesy of CENIT



MOROCCO ADAPTS TO A NEW CLIMATE REALITY

How one project is helping a part of the North African country innovate to weather the effects of a changing climate

By Alanna Mitchell

Ten women who can barely read or write. Six remote, impoverished villages nestled in the High Atlas Mountains, near Marrakech, Morocco. An increase in flash floods that contaminate water for days. The vulnerable, especially children and the elderly, who fall ill when they drink it anyway.

How to help them cope? One idea is to give the 10 women tablet computers, internet connections and a dedicated Facebook page, and then teach them how to stay in touch.

Why the women? They are the de facto heads of their households, eking out a living running local restaurants, working in agriculture or as temporary employees while their husbands work in Marrakech. When the floods come, it's the women who must deal with the catastrophic fallout. And they do it with courage and creativity, says Diane Pruneau, a professor of environmental education at the University of Moncton, whose team developed the Facebook project.

Researchers taught the women how to use the computers, explaining how to take photographs and videos, and then post them, along with comments. The researchers chose Facebook because it's simple to use. Before the training, the women had not known each other, despite living in villages strung along the Ourika River.

During a recent flood, as the river swelled unexpectedly and put their villages in peril, the



women set up a system to warn each other. Those upstream posted pictures and video and wrote comments to let the women in villages downstream know what was happening.

After the flood, they experimented with home-made water filtration systems using sand, rocks, charcoal or fabric, taking photos of them and sharing the information with others on Facebook. Eventually, they came up with new ways of managing scarce water resources, and are exploring ways of protecting their homes during floods, meaning that they can teach other villagers, too.

Pruneau's Facebook group is part of a \$650,000, three-year program called Gestion intégrée des Ressources en Eau & Pâlement des Services Environnementaux, or GIREPSE, which



Restaurants and cafés line the banks of Morocco's Ourika River in spring and summer, but when flooding occurs, the river can damage homes, businesses and infrastructure.

“Their actions can make lives better for themselves and their families.”

is funded by the International Development Research Centre (IDRC) to help vulnerable communities in the High Atlas Mountains weather changes stemming from climate change and other types of environmental degradation.

Those problems are getting worse, says Abdellatif Khattabi, president of the Association Marocaine des Sciences Régionales who heads the project in Morocco. Climate change is already affecting Morocco, leading to droughts. Rains now arrive in odd, vast torrents that the land is less able to absorb. Not only that, but the rains are less predictable than they used to be and air temperatures are higher.

At the same time, tree-cutting in the hills that feed the watershed has decreased forest cover, and agriculture is intensifying, but land-management practices to preserve water are not keeping up with the changes. It adds up to more intense flooding, says Heidi Braun the IDRC officer in charge of the program. Mega floods that used to happen only once or twice a century now happen far more often.

And pressures are growing on what little water there is. Marrakech's population is increasing; tourists are flocking to the Ourika basin in summer and winter; industry and agriculture are consuming more water. Worse, analysts

predict that as climate change intensifies, less rain will fall on the area each year on average (although in more dramatic storms) and the temperature will continue to rise, causing greater evaporation.

The GIREPSE project is exploring a raft of innovative coping mechanisms for these problems. For example, could tourists pay a small environmental tax to support water conservation? Could increasing and maintaining agricultural practices such as terracing reduce erosion? Could villagers make money from preserving fruit crops so they could sell them at higher prices throughout the year?

Meanwhile, the Facebook group has been an early and exciting success story about the ability of villagers to adapt to the coming changes, says Khattabi. But both he and Pruneau say that the project has had intriguing side benefits that go far beyond adapting to climate change. As the women communicated with each other, they began to believe that their observations and even their opinions about the floods mattered. They liked being heard. They even began sharing views about other issues they face. Perhaps most important of all, they began to believe that their actions can make lives better for themselves and their families.

Photo: Courtesy of GIREPSE



DIGITALLY DEFUSING THE RUMOUR MILL

The text-messaging technology that's helping quash misinformation and save lives in Kenya

By Brian Owens

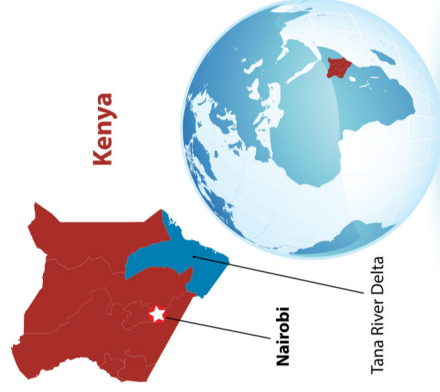
In southeastern Kenya's remote Tana River Delta, bad information can be deadly. For six months starting in the summer of 2012, violent clashes between two of the region's main ethnic groups, Pokomo farmers and Orma herders, killed about 170 people and displaced as many as 40,000.

Much of the violence was driven by rumours, as people heard about attacks or planned attacks and retaliated or launched pre-emptive attacks of their own. But most of the rumours were false or exaggerated, either growing organically from a misunderstanding, or started deliberately to stir up trouble.

So in 2013, with support from the International Development Research Centre, The Sentinel Project, a Toronto-based NGO that works to prevent genocide, began studying how the rumours spread and how to counter them.

Christopher Tuckwood, The Sentinel Project's executive director, notes the lack of any local media in the area is a major driver of rumours. "People have no reliable source of information, so they rely on word of mouth, which is often unreliable," he says.

To help fill that gap, the Sentinel Project created Una Hakika (Swahili for *Are you sure?*), a service that uses mobile phone text-messages, voice calls and Facebook to verify or debunk rumours and provide accurate information about the local situation. When subscribers hear a worrying rumour — that a neighbouring village is stockpiling weapons for an attack,



A group of Una Hakika community ambassadors in the town of Kipini.

“They started to trust us as they saw the information was good.”

violence. “That morning, some young men were planning a revenge attack,” he says.

Una Hakika is careful about how it sends out information. For example, the service won’t send out a message debunking a rumour to an area where that rumour hasn’t been spreading. “We don’t want to spread rumours inadvertently,” says Tuckwood. And if a report of violence turns out to be true, the reply will often be delayed to give people a chance to calm down.

The most important aspect of the project has been building trust between Una Hakika and the local communities, so that they see it as a reliable source of information, says Otunga. That involved meeting with the elders and chiefs of the villages, and getting members of the community involved in the project (Una Hakika has about 200 volunteer community “ambassadors” who help with investigations, pass on information and organize meetings). Gaining that trust was a challenge, and took the better part of a year. “The first reaction was that people thought

the organization had its own agenda,” says Kode Komora, one of the ambassadors. “But with time, they started to trust us as they saw the information was good.”

That trust-building has paid off. Over the past two years, phase one of the Una Hakika project in the Tana Delta has gained more than 1,500 subscribers in 17 villages, and reaches an estimated 45,000 people. There has been an “explosive improvement” in the quality of information available to people in the Tana Delta with the arrival of Una Hakika, says Komora.

The next step is to expand the project to cover more of the country in time for the August 2017 elections, when politically motivated misinformation is expected to raise tensions. The political parties tend to divide along ethnic lines and often play up the conflicts between groups to drum up support, and that can boil over into violence, as it did during the 2007 elections when more than 1,000 people were killed. The hope is that Una Hakika can defuse some of those tensions this time around.

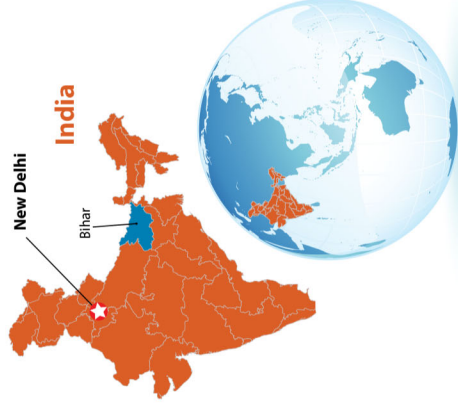
Photo: Adrian Gregorich



DETERMINING WOMEN'S DESTINY

How evaluating an educational program that helps women in India empower themselves could help ensure its future

By Niki Wilson



Just outside the city of Muzaffarpur in the Indian state of Bihar, a middle-aged woman named Vibha works as a stonemason in a production plant. Without knowing the context, there would be nothing remarkable about this situation — after all, women are paid to work physical jobs around the world every day. But not here, where women don't often have the education and training required to earn money for themselves. Vibha is known locally as “the first woman mason.” The fact that she has a job — let alone one traditionally held by men — was a social breakthrough in her community.

Vibha's journey to employment was born from a necessity for the most basic needs. She comes from one of Bihar's poorest districts, a place where there are neither bathrooms nor infrastructure for sewage. Many people simply defecate in open fields or patches of vegetation, exposing themselves to E. coli and the bites of poisonous snakes and insects. It's a difficult situation for all that live there, but women suffer additional hardships.

As public nudity is taboo for women in India, they tend to only relieve themselves before dawn or after dark, a practice that can lead to medical problems caused by attempting to suppress urination and defecation for the entire day and leave them vulnerable to sexual assault.

The Mahila Samakhyia program is working to help prevent such problems. Launched in 1988 by the Indian government, it educates and empow-

ers rural women on issues such as sanitation, domestic violence, education and child marriage. A key part of the program is that women identify specific issues important to their communities and support each other to find solutions.

Through her local Mahila Samakhyia program, in 2000 Vibha learned about the basic principles of hygiene and sanitation, and was encouraged to participate in the planning and management of water and sanitation resources. The program helped train her and other women as masons so that they could build toilet facilities themselves. The work not only made Vibha's environment more secure but also created a path to her economic empowerment.

The process by which Mahila Samakhyia economically empowers women like Vibha



A member of the Mahila Samakhyia program. Women who joined the program are helping India's Centre for Budget and Policy Studies evaluate its effectiveness.

“A key part of the program is that women identify specific issues important to their communities and support each other to find solutions.”

is the subject of a three-year study being conducted by Nivedetha Menon and her colleagues at the Bangalore-based Centre for Budget and Policy Studies. Menon hopes the study will help her and her team understand more about how women learn to negotiate and advocate for themselves. “What is the process through which women start to see themselves as persons?” she wonders of those who come from districts where women are often considered property and are married away from their families at young ages.

Funders of the centre's evaluation — the International Development Research Centre, the United Kingdom's Department for International Development and The William and Flora Hewlett Foundation — hope that it will provide opportunities to learn from the program's successes, along with opportunities to lend credibility to the outcomes.

“Evidence-based policy is becoming more and more important,” says Sharon Buteau, executive director of the Chennai-based Institute for Financial Management and Research LEAD,

an organization supporting the centre with their experience in setting up successful study designs for collecting information in rural India. Buteau says the government must show more transparency in their programs. It's not enough that they exist — programs must be evaluated and reported on.

The evaluation team is working in Bihar and the state of Karnataka, collecting data from almost 4,000 households. While in some areas Mahila Samakhyia groups have been established for decades, in others, the program is relatively new to the community. This will allow researchers to observe the effects of the program at different levels of progression.

Meanwhile, Vibha travels around Bihar teaching other women masonry skills, takes university courses and is held up by her children as a role model. Through the support of Mahila Samakhyia and the women in her community, she has overcome many gender stereotypes to become a respected community member. In doing so, she has laid the groundwork, brick by brick, for others to follow.

Photo: Courtesy of the Institute for Financial Management and Research LEAD



LOOKING TO FISH FOR FOOD

Exploring ways to get fish on the table in Bolivia

By Brian Owens

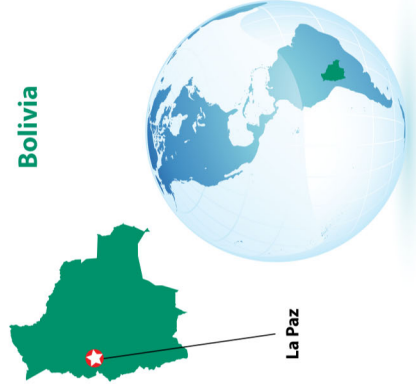
People in Bolivia don't eat much fish — among South American nations it has the lowest per-capita consumption — despite having a large number of lakes and rivers.

But local, sustainably sourced fish could be a good source of protein and help reduce food insecurity, as well as provide a new source of income for poor, rural populations. So the International Development Research Centre and Global Affairs Canada have teamed up with academics and NGOs in Canada and Bolivia on the Amazon Fish for Food project, which is trying to find ways to encourage the sustainable use of the country's fish resources through fishing and aquaculture.

"We want to build the value chain to get people to eat more fish, and to get fish into markets," says Joachim Carolsfeld, executive director of the World Fisheries Trust, and one of the project's leaders.

The project aims to increase fish consumption by developing a fishery for the invasive paiche and through small-scale aquaculture for the native pacu.

Paiche are native to the lower Amazon, but were introduced to the upper Amazon about 40 years ago when a Peruvian aquaculture project went bust and released its fish. Since then they have "gone wild" in the river's upper reaches, says Carolsfeld. The monstrous fish, which can be as long as three metres, could provide new opportunities and new markets if managed sustainably.



Bolivia

La Paz

A big advantage of paiche is that as a new fishery, there is an opportunity to rethink how the production chain works. Currently, most of the money from Bolivia's fisheries goes to middlemen, rather than the fishers themselves, so Carolsfeld and his colleagues in Bolivia are trying to negotiate more equitable arrangements for the paiche fishery. "The challenge is we're dealing with the established social status quo," says Carolsfeld. "We have to manage not only the resource, but how people think about it."

In other parts of the Bolivian Amazon, the project is encouraging people to take up fish farming of pacu, a kind of giant vegetarian piranha, in small earthen ponds. In some regions, there is a tradition of women raising fish, so the goal is to spread the practice to



A Bolivian fisherman on a tributary of the Amazon River paddles back to shore with his catch of paiche.

“The goal is to spread the practice to other areas to provide a livelihood for rural communities.”

other areas to provide a livelihood for rural communities. Mark Flaherty, a geographer at the University of Victoria who is part of the project team, is working with a Bolivian rural development bank, CIDRE, to develop loans and other financial products to help people set up small aquaculture operations in their communities. "We're trying to verify the assumption that people are interested," he says. "We want to find out what they need to get started, and if credit is an issue."

They also want to build up local technical expertise rather than rely on foreign experts who will disappear when the project ends — a problem other community-based aquaculture projects in the developing world have encountered before, says Flaherty. "The fancy for it ends when the project ends," he says. "People need skin in the game."

With that in mind, the team is working to identify and train lead farmers who can help launch new aquaculture projects.

But none of this will matter if people in other parts of Bolivia aren't interested in eating the

fish. So Luis Badani from the Bolivian marketing consultancy IMG is surveying markets around the country to find out why people eat so little fish, and what might change their minds. The main complaints, he has found, are that fish is generally expensive, smells bad and has too many bones.

Badani's team is working on ways to solve those problems — improving the supply chain so that the fish arrive to market in better condition, with more diverse choices and better prices, as well as designing a permanent media campaign to encourage people to try fish.

Paiche and pacu currently make up just a small part of the market for fish in Bolivia, so there's plenty of room for growth, he says.

There could also be major export markets for both paiche and pacu in neighbouring countries, says Badani, but it could take several years for Bolivia's nascent industry to develop to the point where it meets international quality standards. "The priority in these years is to meet domestic demand and achieve reasonable levels of consumption at the national level," he says.

Photo: Fernando M. Carvajal-Vallajos



Canada's International Development Research Centre (IDRC) has been improving lives and livelihoods in the developing world since 1970, investing in knowledge, innovations and solutions that have a lasting impact. The stories of the IDRC projects in this digest are global, but they're also Canadian, making them a natural fit for *Canadian Geographic*, the

mandate of which is to make Canada better known to Canadians and the world. The map below shows the 11 locations of the stories herein, each of which is colour-coded to represent one of IDRC's three main programs: Agriculture and the Environment (green); Inclusive Economies (orange); and Technology and Innovation (brown).

