

A woman with a bindi and a nose ring, wearing a pink headscarf and a purple top, is smiling and holding a large metal pot filled with a cooked dish. The dish appears to be a vegetable-based preparation with orange-colored pieces and green peas. The background is a pink fabric with a pattern of small gold squares.

IT TAKES A VILLAGE

BETTER FUTURES: The institute's work has included (clockwise from bottom right) studying vegetable supply chains; improving availability of clean water; and promoting the cultivation of nutritious foods like orange-flesh sweet potatoes (seen in a dish on this page and being tasted in a cooking contest at top right).



Students and faculty at the Tata-Cornell Institute are working to fight malnutrition, poor sanitation, stunted growth, and more—and improve the lives of millions in India

BY BETH SAULNIER





When most people first see the tattoo on grad student Anthony Wenndt's right biceps, they take it to be a long, slender arrow. But upon closer inspection, it proves to be a stalk of wheat, positioned so its head faces toward the ground. "It's upside down," he explains, "to serve as a constant reminder of the imbalance of the global food system."

The ink embodies the fundamental challenge that Wenndt and his colleagues are working to overcome. A PhD candidate in plant pathology, Wenndt is a scholar at the Tata-Cornell Institute for Agriculture and Nutrition (TCI), an ambitious research and outreach effort that aims to improve the lives and health of millions of people in India. Part of the Dyson School of Applied Economics and Management, the institute—which has offices in Ithaca and in the Indian cities of New Delhi and Mumbai—draws in dozens of Cornell faculty, postdocs, grad students, and undergrads working in a wide variety of fields. It was founded in 2013 with a \$25 million endowment from Tata Education and Development Trust, an arm of the Tata Trusts, whose chairman is alumnus Ratan Tata '59, BArch '62, a legendary figure in India and one of the nation's most prominent industrialists. "It was an exciting opportunity to make a difference," says Prabhu Pingali, who was recruited from the Bill & Melinda Gates Foundation to be the institute's founding director. "It's been a wonderful way to do work on the ground in India, but also bring Cornell knowledge and expertise to address some fundamental problems about

hunger, nutrition, and rural poverty in my country of birth." Born in a small, rice-growing village in the southern state of Andhra Pradesh, where his father was a country doctor, a young Pingali observed how advances in agricultural research could have huge real-world effects. "It was a time when the Green Revolution was just starting in India," recalls Pingali, a professor in the Dyson School with an appointment in the Division of Nutritional Sciences. "In the late Sixties and early Seventies, we saw firsthand how these new rice varieties transformed people's lives. There was a dramatic reduction in hunger and improvement in incomes for very poor people in these villages."

Half a century later, major strides have been made in addressing hunger and poverty in India; at more than 1.3 billion people, it's the world's second most populous country after China. The nation now has a fast-growing economy, an expanding middle class, a vibrant tech sector, and the world's third-largest system of higher education. But, as Pingali and his colleagues explain, many challenges remain—not the least of them being the stark inequality in how the past decades' advances have been distributed nationwide. "India's growth is very uneven," says Mathew Abraham, the institute's assistant director, who notes that the development patterns of some regions mirror those of poverty-stricken nations in sub-Saharan Africa. "There is a huge difference in terms of economic development between the southern states, which are better off, and the poorer ones in the north

and northeast.” Says TCI postdoc Anaka Aiyar, who co-authored a book on the nation’s food systems with Pingali, Abraham, and another colleague: “India is not a story of one country, it’s a story of its states. If you want to see India grow as a whole, you need to think about the states and their specific challenges.”

As Abraham and other TCI researchers stress, while the Green Revolution greatly reduced hunger in India, it didn’t fully address—and in some ways, may have exacerbated—what remains a pressing issue: malnutrition. National policies that prioritized growing crops like rice, wheat, and maize led to under-cultivation of such foods as millet, vegetables, and legumes. “We have less hunger, but malnutrition levels are still very high because of lack of access to micronutrients, vitamins, protein, et cetera; you can especially see that in terms of high levels of stunting in children and in underweight women,” Pingali says. “There is increased recognition of the need for diversifying the food basket, that we need to invest in crops that were forgotten during the Green Revolution—bring them back through better research, improved market systems, and promoting consumption. We have to focus much more on diversity of food, more healthy food, improving access to more nutrient-rich food. These are areas where the policy community in India has not been as active.” Bhaskar Mittra, TCI’s Mumbai-based associate director, cites a term of art to describe the dominance of crops like rice: “staple-grain fundamentalism.” “The government agrees that there is this fundamentalism,” he says, “but how do we move away from it?”

At TCI, faculty and students—many of whom are Indian citizens who have witnessed some of these challenges firsthand—don’t just conduct research for its own sake. They design and test specific interventions to address malnutrition and related issues—initiatives that could potentially be rolled out to under-resourced areas around the country. “As a leading university in agriculture, Cornell through TCI has the ability to inject different perspectives and new ideas,” says Harold van Es, a professor of soil science and a faculty fellow at TCI, where he and some of his grad students have been involved in analyzing and improving soil health in India. “In addition to the research and knowledge that’s being generated, TCI is training a new generation of scientists, some of whom will go back to India and become engaged in science and policy.”

Many at TCI cite its multidisciplinary nature as one of its greatest strengths. The institute includes students and faculty from a variety of fields including food science, nutrition, engineering, crop and soil science, development sociology, and more. “It’s a holistic approach to target the problems of malnutrition and rural development,” says TCI scholar Rohil Bhatnagar, MPS ’12. “It’s not just looking at it from one angle, because this is not a problem that one discipline can solve.” Dyson School professor Mark Constas, PhD ’87, another faculty fellow, is an expert in measuring and evaluating the impacts of development programs, particularly in the areas of poverty and food security. He >



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RESEARCH AND OUTREACH: PhD candidate Anthony Wenndt (opposite page) in the field and (top right) back in the lab in Ithaca, where he studies mycotoxins. Right and above: Prabhu Pingali, TCI’s director, on a return visit to his native India.



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MOTIVATED LEARNERS

(from top): Rohil Bhatnagar, MPS '12, is developing a supplement for iron deficiency; Kathryn Merckel, MPS '15, did extensive field work on orange-flesh sweet potatoes; Jocelyn Boiteau '12 studied tomato supply chains. Opposite page: TCI staff meet with members of a women's self-help group.



regularly attends TCI's weekly seminar, where institute members present their work in Warren Hall on Friday afternoons. "It's one of the most rigorous research seminars I've ever attended in my thirty-some years as an academic," says Constat, who travels to India once a year as part of his work. "The array of topics that are discussed with a diverse group of constructive critics in that room is remarkable. It's one thing to speak to people who are in your community, but to have people who are outside it critique your work really stretches you in a positive way."

Kathryn Merckel, MPS '15, a PhD candidate in nutritional sciences, spent two summers abroad doing preliminary research followed by a full year in rural Uttar Pradesh, in an area close to the Nepali border that primarily grows cereal grains. Her goal: to develop ways to encourage cultivation and consumption of orange-flesh sweet potatoes, a form of the vegetable—familiar in America on Thanksgiving tables and beyond—that's rich in vitamin A but is not widely served in India. "We tested what types of interventions, messaging, and activities would be needed to get farmers and families interested in growing it and excited about eating it," says Merckel, who's now back in Ithaca analyzing the data and writing her thesis, "and what would make them incorporate it into their diet on a regular basis, and whether that would have any impact on their vitamin A status." She and her project team interviewed local families about their diets, trained farmers

in how to grow the crop, and even held contests where women competed to make the tastiest dishes using gentle cooking techniques that preserve the potato's nutritional value. "One of the major boons is that it's really tasty," says Merckel, who still enjoys cooking

sweet potatoes with Indian spices, "and people really did like it."

Fellow grad student Jocelyn Boiteau '12, who majored in nutritional sciences in CALS as an undergrad, has been studying a different link in the food chain: the waste and nutrient loss that can occur between field and marketplace. For a year that ended this October, she conducted an intense study of tomato supply chains while living in a part of Andhra Pradesh where the crop is heavily cultivated. "It's one of the most important vegetables in India's culture and economy," she explains. "And it's really perishable; there's no cold storage used for tomatoes in India." Boiteau's research—which was aided by an undergrad who spent the summer working with her through TCI's partnership with CALS' Global Fellows Program—involved carefully tracing the crop's journey from plant to retail sales and evaluating losses not only in the produce itself but in its perceived quality and nutritional value. Among the industry's challenges: transporting the tomatoes on poor roads that can be all but impassable during monsoon season, and ensuring that farmers get a fair price for their crops. "A lot of the prior research on food loss and waste has been on more durable crops like wheat, rice, and maize, whose shelf life is quite long," says Boiteau, whose findings could inform improvements to the distribution system for tomatoes as well as other perishable vegetables. "For tomatoes, from the time they're harvested on the farm until they get to the consumer is maybe three to four days. We want to understand losses both from the quantity and quality perspectives."

Merckel's and Boiteau's extensive research in India is typical



for TCI scholars; the institute not only requires most of its PhD candidates to spend significant time in the country, but—thanks to its Tata endowment—has the funding to support those long-term projects, which often involve the hiring of numerous local staff. Boiteau notes that it was initially hard to get busy farmers and distributors to participate in her surveys; forging a relationship with one particular wholesaler helped her break in. “I think people see that I’m not just some student coming in, putting a survey together, and leaving,” she says, speaking with CAM via Skype from India late last summer. “It’s really helpful to have that presence.” To enhance her ability to communicate, Merckel took two years of Hindi on the Hill; Wenndt, who double-majored in Russian and biology as an undergrad at Grinnell College, picked up conversational Hindi during his field work in India—which, he says, was invaluable to his research. “It enabled me to connect with communities in ways I wouldn’t otherwise be able to,” says Wenndt, who still practices the language daily. “You can only get so far with a translator. It really makes a difference when the person you’re communicating with gets to look you in the eyes and have a conversation with you.”

An Iowa native who grew up on a small farm, Wenndt is doing his doctoral work on mycotoxins—compounds, produced by fungi, that can be damaging to human health. He spent two years in Uttar Pradesh studying the prevalence of the toxins both in the field and in storage; he’s focused on crops like ground nuts and maize, where they tend to proliferate. As he explains, regulatory systems in the U.S. generally protect consumers from mycotoxin exposure. But India lacks that infrastructure, particularly

for its domestic market—putting consumers at risk for the long-term damage that mycotoxins can cause, which includes liver cancer and cirrhosis, immune deficiencies, and impaired growth. “It’s not like we’re going to see massive outbreaks erupt into a media frenzy with multiple casualties,” he says. “We’re seeing communities that are daily consuming low or moderate amounts of toxins that can build up and result in chronic outcomes in adulthood over years of unchecked exposure.” Now back in the lab at Cornell, Wenndt is studying the thousands of samples he collected in India, with the ultimate aim of informing better procedures for testing and crop storage in the context of constrained resources. “My goal, my mission,” he says, “is to do science that helps farmers secure a better life for themselves and their families.”

Bhatnagar, a New Delhi native who previously earned a master’s in food biochemistry on the Hill, is also focused on the lab. After stints as a food science researcher at UMass, Amherst, and an internship at a gluten-free bakery—where he developed a blueberry muffin that’s currently on the market—Bhatnagar enrolled in a PhD program at Penn State. But after two years he wasn’t excited about his research topic; he was so eager to do work that he felt passionate about, he opted to restart his doctoral program from scratch by returning to the Hill and joining TCI. Now he’s developing a supplement to aid the 600 million people in India who suffer from iron deficiency, using defatted microalgae, a byproduct of the biofuel industry. He hopes it can fortify wheat flour used to make the traditional Indian bread known as chapati or roti—but there’s a major hurdle. “The algae is >



BETTER SANITATION: Grad student Payal Seth (at left in above photo) studied ways to promote toilet use, a project that included the building of new facilities (top). Opposite page: PhD candidate Shiuli Vanaja (wearing glasses in top photo) examined the benefits of providing piped water to households using filtration systems (bottom) developed by a Cornell organization called AguaClara.

terribly green in color and it has a very strong, offensive fishy aroma," he says. "I can't put that directly into flour." His solution: to encapsulate the algae in food-grade materials that will mask both its color and odor. He's planning to conduct taste tests at Stocking Hall's Sensory Evaluation Center, with Indian-born students and faculty recruited as subjects. The supplement would ultimately be sold as a sachet to be mixed into flour—but as Bhatnagar stresses, whatever product he develops can't cost more than ten cents. "I'm using really cheap ingredients," he says, "because this is meant for people who do not have much financial access."

That reality underscores the fact that, as Aiyar puts it, "India is a story of contradictions." It's one of the globe's leading economies in terms of GDP, but it also has the world's highest number of people living on less than \$1.50 per day. Beyond initiatives focused on food and nutrition, TCI scholars have addressed basic resources such as sanitation and clean water. Payal Seth, a New Delhi native working on a doctorate in applied economics and management, spent a total of two years tackling a persistent problem in rural India: open defecation, which hundreds of millions of people—including 60 percent of village residents—practice daily, despite the fact the government has been promoting toilet use and underwriting the cost of construction. "We came to know that the problem is not that there's a lack of access to toilets," says Seth, who was based in Uttar Pradesh. "The problem is that people actually prefer to go outside to defecate, because it's a part of who they've been for a long time. They go with their friends for their morning walk to the fields; they felt that using a toilet was very restraining, and they didn't want that."

After spending months surveying villagers, she developed

behavioral interventions and educational programs to encourage toilet use, which is essential to improving sanitation and lowering rates of diarrheal diseases. They included a graphic demonstration—meant to illustrate how flies can transfer human feces to food—in which educators would dip a hair into human waste and then into a glass of water, which would be offered to the participants. “We need to change people’s mind-sets,” says Seth, whose work also involved tracking child health and doing predawn spot checks in areas where people traditionally relieve themselves, “to show them how bad open defecation is for them.” She ultimately found that in households that received both toilets and education, a whopping 98.6 percent of residents used them; in those that only got the facilities, the rate was 46 percent for women and just 20 percent for men. “Her results are striking,” says Pingali. “They show very clearly that toilets are necessary but not sufficient for people to use them, and that you need to have a construction program coupled with a behavior change program, or else it doesn’t work. That is a message we’re ready to carry back to the government.”

Meanwhile, grad student Shiuli Vanaja has been studying the benefits—in terms of time savings, health costs, and more—of increasing access to potable water. As she explains, most households in rural India don’t have water piped into their homes; residents often have to fetch it from far-flung communal sources like wells, hand pumps, rivers, and ponds, which may be contaminated with pathogens like *E. coli*. “I found that once households have access to piped water at home, they save a significant amount of time every day—on average, almost an hour of labor,” says Vanaja, who worked in the eastern state of Jharkhand in partnership with AguaClara, the Cornell-based group that develops sustainable filtration systems in under-resourced areas. “This time is used for other purposes, like taking care of children or working in agriculture. It’s especially important for women, because they’re the ones who are mostly involved in water collection.” The daughter of social activists, Vanaja grew up in a tribal village in the central state of Madhya Pradesh. “In my community, only two households had piped water, and one was our house,” she says. “I saw that it’s really difficult for women to travel long distances to collect water, especially when it’s raining so heavily during monsoon season, and then they will fall sick.”

Postdoc Sunaina Dhingra has focused her research on issues affecting women and children, including regional differences in rates of stunted growth and factors affecting prenatal nutrition. She marvels that joining the institute—headquartered on the other side of the globe—has immeasurably informed her understanding of her native country. “I had to leave India, travel this distance, and come to Ithaca to really know about India,” she says. “I was always an urban girl—born and brought up in Delhi—and now I’m surrounded by people from all around India. Most of my colleagues here are Indian, and we have such different experiences. This diversity and teamwork is so motivating and productive. Sitting in isolation, doing your own work, doesn’t give you that. TCI is working on real situations, real data, and real-life problems.” ■



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