

TATA-CORNELL INITIATIVE 2013-2014 ANNUAL REPORT



TATA-CORNELL AGRICULTURE
AND NUTRITION INITIATIVE (TCi)

College of Agriculture and Life Sciences
Cornell University



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FROM THE DIRECTOR



I am honored to be the Founding Director of the Tata-Cornell Agriculture and Nutrition Initiative (TCi). I began my work at Cornell University in early June 2013 and have had a very productive and exciting year and half while setting up the program, establishing a vision and strategy, and overseeing the start of several promising field-based initiatives for addressing malnutrition in India.

Currently, agriculture and nutrition are at the top of the policy debate and political agenda in India. The global crisis in food prices of 2008 focused the world's attention squarely on agriculture and the need to ensure stable food supplies. Global food markets have remained tight since then, and upward pressure on food prices is shifting the policy focus away from short-term measures such as the rice export ban implemented in 2008 towards long-term productivity improvement strategies. At the same time there is growing realization that, despite strong economic growth, rates of poverty, hunger, and malnutrition continue to be stubbornly high, requiring deliberate actions that

address the agriculture–nutrition nexus for lagging regions and the people left behind.

Setting up a multi-disciplinary cross-campus program is possible only with strong support from all levels of University administration. I have been fortunate to have enjoyed enthusiastic and steadfast support from the President and the Provost of Cornell University as well as the Dean and the Senior Associate Dean of the College of Agriculture and Life Sciences. The TCi is based at the Charles H. Dyson School of Applied Economics and Management, where the Director and the staff could not have been more welcoming and generous with their support. The same is true for the Director of the Division of Nutrition Sciences, where I hold a joint appointment.

Setting up a field-based action research program in India can be enormously challenging. Fortunately, our partners in India have helped make that task easier with their strong support for the program and for the students and faculty visiting from Cornell University. Tata Trusts have been extremely generous with financial support as well as with helpful advice on setting priorities and managing operational realities in rural India. The Tata Institute of Social Sciences (TISS) and the International Center for Research in the Semi-Arid Tropics (ICRISAT) have provided us with strong bases from which to work in India, and NGOs such as Professional Assistance for Development Action (PRADAN), BAIF and Digital Green have welcomed us as valued collaborators. Finally, the TCi is very fortunate to have a world-class Advisory Board that has helped us shape our vision and strategy and continues to guide us as we move towards implementation.

I look forward to a future in which the TCi and its partners make a difference in ameliorating the state of malnutrition in India.

Prabhu Pingali, Director

FROM THE CHAIR OF THE BOARD



It is always a pleasure to be associated with a successful program. Since its inception the TCi has taken off in the direction visualized by the Advisory Board. As stated in its report last year, “The Board is very impressed by the progress made during the short period of time since Prabhu Pingali has taken over the leadership and management of TCi.” Since then, and as shown in this report, the TCi has initiated a series of important research and training activities guided by the five priority areas identified in the TCi’s vision and strategy.

Sparked primarily by the food price increases of 2007 and subsequent food price volatility, more action to improve nutrition through changes in the food and agricultural system is being pursued by national and international organizations. However, although much is being written on the subject and many conferences are being held, the debate and policy recommendations suffer from a lack of the solid empirical policy-relevant evidence that policy-makers need. Conceptual relationships must be understood

in order to generate the appropriate empirical evidence needed to guide action, but the evidence must be generated through field-level analyses. The TCi offers an excellent opportunity for generating such evidence and it is on its way to doing just that. As shown in this report, the research is closely linked to another important TCi goal, namely post-graduate training.

In view of the strong interest among national governments, international organizations and donor institutions to make food and agricultural systems more nutrition-sensitive as well as the great demand for solid, field-based, policy-relevant evidence, I believe the TCi will help to fill the current void in international leadership by expanding its funding base and gradually extending its field-based research and training beyond India over the next couple of years. I fully appreciate that one usually crawls before walking but I believe the TCi will soon be ready to run.

Per Pinstrup-Andersen, Chair of the Board



OVERVIEW

OVERVIEW

The past 50 years have seen extraordinary food crop productivity growth—in spite of rising populations and shrinking availability of arable land—largely due to the Green Revolution. Yet malnutrition has persisted for close to a billion people in the developing world.

Nowhere is this truer than in India, a nation that is both economically emerging and developmentally lagging. A Green Revolution pioneer, the country has been able



to achieve self-sufficiency and record remarkable gains in per-hectare productivity for staple grains, resulting in a high rate of economic growth. But heightened focus on a few commercially successful crops has led to low agricultural yields and reduced investment in other offerings, such as micronutrient- and protein-dense crops whose cultivation and consumption could pull rural populations out of poverty and enhance the health of the entire nation.

India is a global epicenter of anemia, with close to 40 percent of young women in their childbearing years suffering from the debilitating condition. High rates of stunting for children under five years of age have also persisted. This condition of chronic malnutrition can condemn one to a lifetime of physical and cognitive disability, with implications for generations to come. The TCi is positioning itself to become a leader in understanding the complex conditions that lead to hunger, poverty, and malnutrition in India, and in developing collaborative, system-wide solutions to these challenges.

A long-term research initiative launched in 2013 with a generous gift from the Tata Trust, TCi brings together students, visiting scholars and research professionals from fields spanning several disciplines—nutrition, economics, engineering, human ecology, horticulture and resource management—to develop innovative technological and policy solutions capable of improving human health and nutrition in India.

Working on issues ranging from access to clean water and smallholder farmer cropping patterns to soil health, dietary diversity and rural access to iron-rich foods, a team of nearly 50 faculty, staff and students spent their inaugural year as TCi Scholars, Fellows and Interns working on projects and research efforts that have yielded diverse insights into how agriculture and rural realities contribute to nutritional outcomes.

On the following pages we highlight the TCi's 2013-2014 activities as well as its plans for 2015, including projects that apply the latest technological advances and social science insights in conjunction with on-the-ground observations and assessments to deliver practical solutions to persistent problems.

THE PUZZLE OF MALNUTRITION IN INDIA

Stunting, wasting and intrauterine growth restriction is a cause of 3.1 million child deaths annually, and more than 45 percent of all child deaths in 2011. The prevalence of stunting in children younger than five years of age in sub-Saharan Africa and south Asia affects an estimated 200 million children.

The first 1,000 days of a child's life—from conception through age two—is now considered a critical window within which to avert stunting. Moreover, success in combatting childhood stunting has been inextricably linked to the health, nutritional status, and empowerment of mothers. A society of healthy women of childbearing age (between 15–45 years old) will experience significant long-term reductions in the prevalence of child stunting. This is especially true for rural women, who depend overwhelmingly on agriculture for employment, income and food.

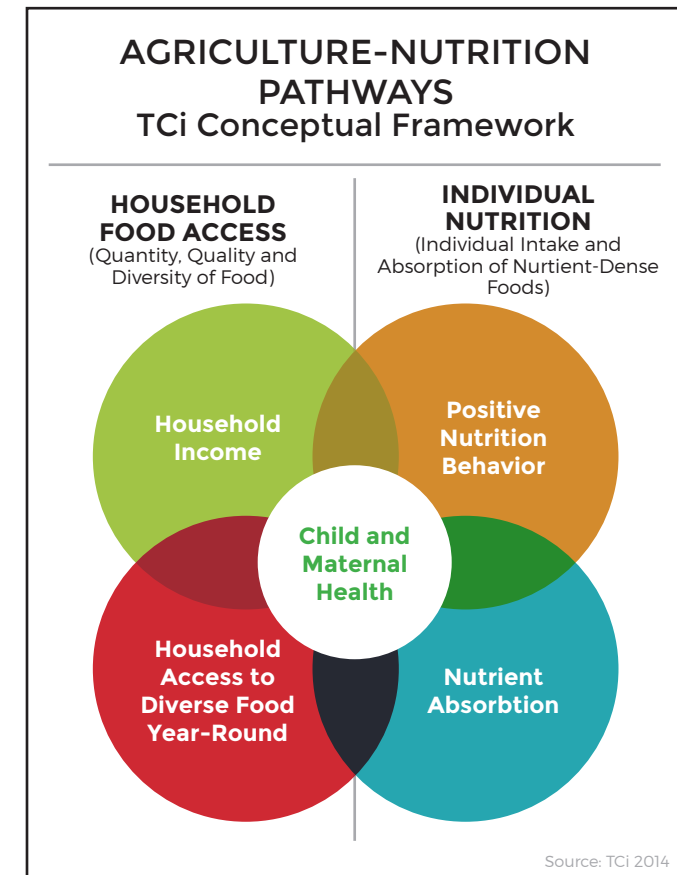
Pathways Linking Agriculture to Nutrition

We believe the road to better health lies at the intersection of several pathways linking agriculture and nutrition. We have identified and oriented our applied research along four such pathways:

1. The **income pathway**, where gains in household income can translate to better food affordability and other impacts
2. The **food supply pathway**, including a household's access to sufficient, diverse and quality food year-round
3. The **positive nutrition behavior pathway**, where interventions attempt to equalize food allocation among individuals within a common household, and optimize early childhood care practices

4. Nutrient absorption through improvements in the **health environment pathway**, which links access to clean water and improved sanitation/hygiene practices to better nutritional health

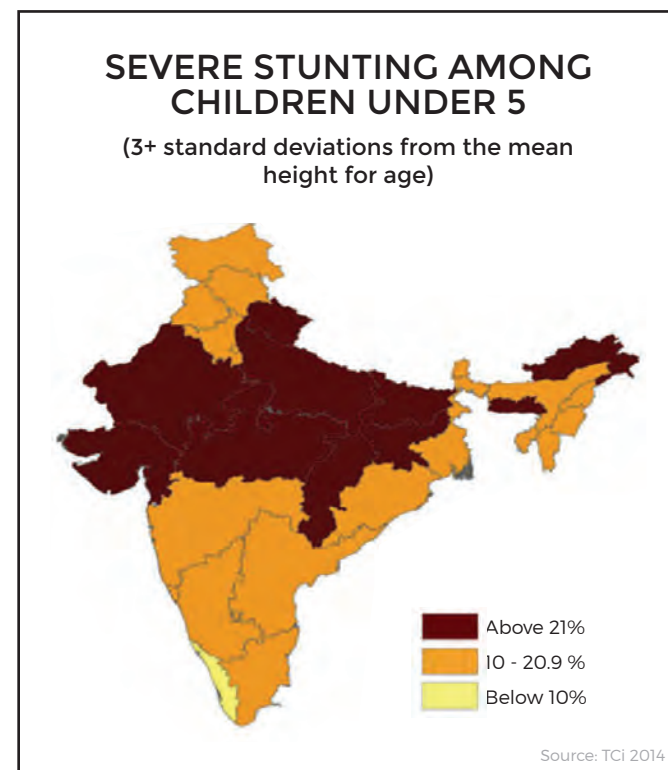
TCi research in India considers the factors that influence both a household's ability to afford and obtain food—such as relative income and employment activities—as well as the challenges posed to individuals



within the household who may not receive the same quality or quantity of food as others, may require alternative foods and care at various life stages (such as pregnancy or infancy), or face conditions that make

absorbing and metabolically utilizing nutrients more difficult.

The income pathway and the food supply pathway have the most obvious connections to agriculture, given the dependency of the poor on these activities for income as well as their ability to influence the quality,



quantity, and diversity of the overall food supply. However, improvements along some pathways can create ripple effects along others. Enhanced income-earning opportunities for women through investment in agricultural technologies, for example, could promote women as decision-makers within the household and lead to more equal access to household resources—including better quality or quantities of food. Similarly, public investments in clean water access can encourage

or enable rural communities to comply with food quality and safety regulations that otherwise act as barriers to entering higher-value markets.

Nutrition is multidimensional and capable of promoting and affecting multiple facets of life, and development across these areas must occur simultaneously. Focusing on agriculture is only one critical dimension of the policy puzzle for improving nutrition. Other mediating factors influence household income, micronutrient availability, nutrient absorption and utilization, and household food allocation.



SCHOLAR SPOTLIGHT

Soumya Gupta, TCI Scholar and Applied Economics and Management Ph.D Candidate

Women in smallholder farming households divide their time between agricultural labor, child-care and other household chores. These same women tend to have high rates of micronutrient deficiencies; in particular, iron-deficiency, which is responsible for 50 percent of the global burden of anemia. In India, devastatingly high incidences of anemia have marked it as a global epicenter.

My research revolves around exploring linkages between agriculture and nutrition as I try to understand how different types of farming systems influence women's empowerment, dietary diversity and iron-deficiency anemia status. My field sites are within Chandrapur, a district of Vidarbha in Maharashtra, India. I spent 2013-2014 collecting data from 960 households (1,920 individuals), on household economics, agricultural production, access to food, and women's health, empowerment and dietary intake.

Designing, implementing and monitoring a survey from scratch was a challenge. Initially, it was overwhelming to work with collaborating institutions in India and to manage a large survey team of Indian men and women. I faced numerous logistical challenges while moving staff, materials and tools around rural India. But learning how to manage and monitor quality data was invaluable for me as a researcher. I'm grateful for the knowledge I gleaned and I'm looking forward to sharing the results of this study in 2015.

RIGHT: Soumya Gupta, TCI Scholar and Ph.D candidate takes a break while doing her fieldwork in Maharashtra, India.



2013-2014 TCI RESEARCH HIGHLIGHTS

INNOVATIONS IN CLEAN DRINKING WATER SYSTEMS: AGUACLARA

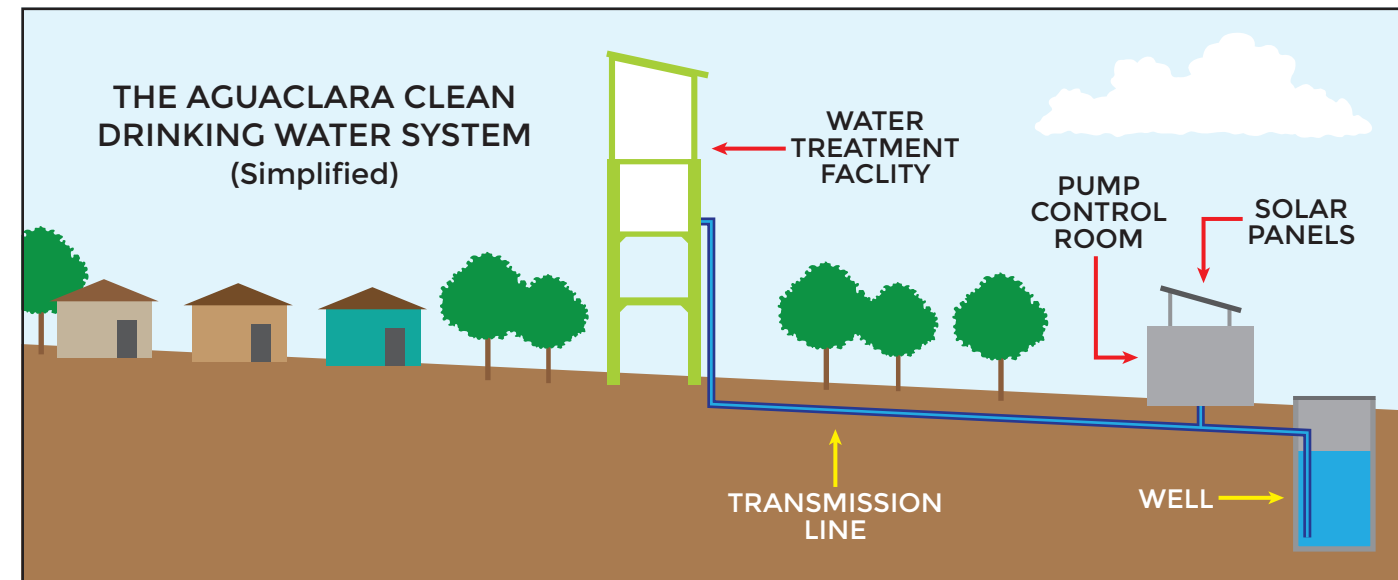
Inadequate supply of clean water and sanitation in India continues, despite longstanding efforts at various levels of government to improve the access and affordability of safe drinking water. Clean water is directly associated with adequate nutrition; intestinal inflammation and infection due to drinking water contaminated with worms, parasites, viruses and bacteria can lead to partial or complete malabsorption of essential nutrients and calories, in addition to life-threatening dehydration.

AguaClara, a clean drinking water technology system developed at Cornell University and supported by the TCI, is currently being piloted in the Jharkand villages of Gufu and Ronhe. The technology comprises a filtration unit for removing suspended matter and a

chemical dosing unit for removing fecal contamination that releases a precision dose of chlorine in the water, making it safe for drinking and cooking. The use of solar-powered pumps allows water to move from lowland wells to elevated tanks and then into village homes without electricity or consumption of fossil fuels.

Ensuring Successful and Local Operation

Working with the local Indian non-governmental development organization PRADAN, AguaClara hopes to demonstrate that these technologies can be owned, operated and maintained independently in Indian villages. Operators are trained to reliably run the treatment system so that tap water is always safe to drink in their villages. In 2015, we hope to show that the system can be maintained through an affordable tariff paid by every household.



RIGHT: A newly completed AguaClara water tower stands in a rural village in Jharkand, India.



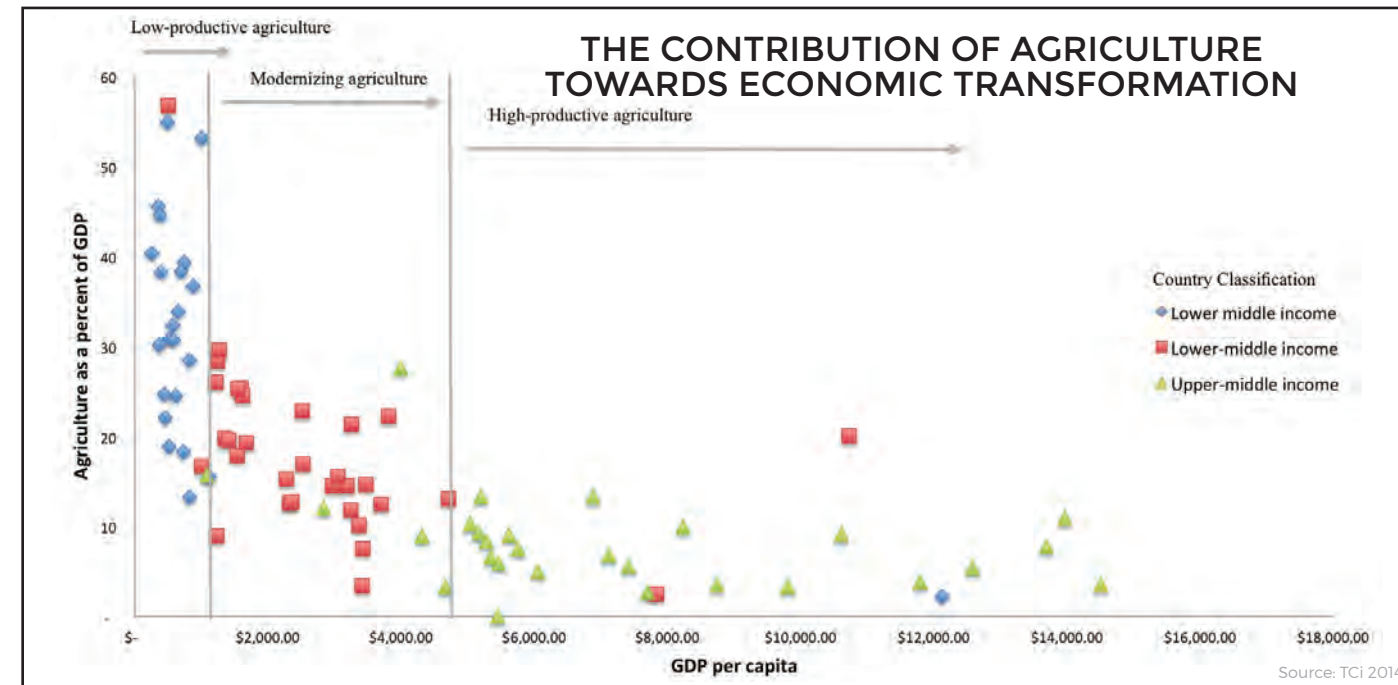
AGRICULTURAL POLICIES FOR IMPROVED NUTRITION

Despite growing demand from a burgeoning middle class, crop production trends in rural India are not reflecting changes in urban India's consumer preferences. Demand for meat, milk, and processed and packaged foods would seemingly point to new and growing opportunities for agriculture producers in rural areas. However, significant barriers and market failures keep rural farmers from diversifying beyond staple grain production and meeting new market demand for micronutrient and protein-dense fruits, vegetables and animal products. In addition to the lost rural income that could otherwise be realized by leveraging these new market opportunities, the relative prices of fruits, vegetables and animal products remains disproportionately high for rural families in comparison

with staple grain prices. Obtaining dietary diversity has thus remained a challenge over much of India.

Agricultural policies can play a significant role in facilitating change and enabling access to diverse and nutritious food. Price supports, input subsidies, and research investments have biased producers towards cultivating staple crops rather than encouraging movement into emerging markets for micronutrient-dense foods. Targeted investments in market infrastructure, access to credit, and reductions in transaction costs can ultimately encourage market entry and sustain participation on the part of many farmers who could benefit from the opportunity to expand the supply of micronutrient- and protein-dense foods and reach hungry urban and rural communities.

Despite these synergies in health and wealth, agricultural interventions have rarely been defined



PUBLICATION ALERT

Pingali, P.L., Ricketts, K.D., and Sahn, D.E. (in press). Agriculture for Nutrition: Getting Policies Right (Chapter 7). In D. Sahn (Ed), *The Fight Against Hunger and Malnutrition: The Role of Food, Agriculture, and Targeted Policies*. Oxford, UK: Oxford University Press.

or driven by nutritional goals, even though a strong connection exists between stages of economic transition and population-level nutrition patterns. Investments capable of “getting agriculture moving” or incentivizing farmer diversification can have a direct impact on the quantity, quality, and affordability of available food, all while mobilizing greater economic development. Public investment in agriculture, if targeted correctly, can be instrumental in ensuring positive nutrition outcomes as well as economic growth.

TCi researchers have been working to understand these connections between a country’s stage of economic transition and the resulting population-level nutrition patterns. By developing a typology of agricultural systems that reflect a particular stage of economic transformation, TCi research highlights initiatives that can be undertaken in India for reducing undernutrition and micronutrient malnutrition.

Beyond publishing this research for policymakers and practitioners, the TCi has participated as a technical expert in preparatory meetings of the Second International Conference on Nutrition (ICN2), which was convened by the World Health Organization (WHO) and the Food and Agriculture Organization (FAO) of the United Nations.

FILLING THE AGRICULTURE-NUTRITION DATA VOID: ESTABLISHING A MINIMUM SET OF NUTRITION INDICATORS

For decades, agricultural surveys have focused on tracking household income and employment patterns, food supply and prices, and farm management and agronomy practices. This has provided valuable insight into the availability and affordability of certain types of

foods in rural communities. However, understanding how agricultural changes or interventions affect nutrition status has largely remained a mystery. Nutritional data are rarely collected alongside large-scale, long-term agriculture datasets such as those compiled by the World Bank in Africa or the International Center for Research in the Semi Arid Tropics (ICRISAT) in India. A better understanding of the links between agriculture and nutrition will require new thinking about how agriculture and nutrition surveys can collect the same critical data needed for meaningful comparison and analysis of nutritional trends.

Enter the Minimum Nutrition Dataset for Agriculture (MNDA), a TCi project seeking to achieve consensus on the most essential nutrition metrics and ultimately develop a short (1-2 page) module for current and future longitudinal agriculture surveys. In consultation with other experts, the TCi has identified five distinct categories, or modules, for obtaining information on an individual’s nutrition status:

1. Dietary diversity
2. Anthropometric and clinical indicators
3. Biochemical markers
4. Metrics around intra-household allocation
5. Metrics around early childhood care

The modular nature of this framework will allow survey administrators to choose indicator categories that are useful for addressing the types of nutritional questions about which they want to gather information.

Beginning with Dietary Diversity

The process of building the MNDA began with a workshop at Cornell University in December 2013, during which experts from nutrition, economics, sociology and natural resource management came together to outline the basic components and indicator categories.



RIGHT: Katy Merkel, one of five 2014 TCi Interns, interviews and collects dietary information from woman in Telangana.

PUBLICATION ALERT

Pingali, P.L., Ricketts, K.D. (in press). Mainstreaming nutrition metrics in household surveys—towards a multidisciplinary convergence of data systems, *Annals of the New York Academy of Sciences*.

A practitioner meeting was convened in early 2014 to understand the operational challenges posed by the MNDA modules, and the dietary diversity module was selected as the first module for development and testing.

Dietary diversity information can be difficult to gather, expensive to undertake, and time-consuming to consolidate. As a result, such information is often not included in surveys that are not focused solely on nutrition. Lack of dietary diversity is a particularly severe problem among poor populations in the developing world, as starchy staples and grains dominate diets, with little or no animal products and few fresh fruits and vegetables. There is strong evidence linking



low dietary diversity to a number of micronutrient inadequacies. By targeting women between 18–45 years of age (women in their childbearing years) and asking them to recall three days of food intake, the MNDA dietary diversity module was designed to yield a dietary score results similar to those a more intensive version would yield, but in less than 30 minutes.

SPOTLIGHT

TCi Student Internship Program

In June 2014, TCi began its first Summer Intern program, linking students with work/study opportunities available with TCi projects and partner institutions. This year, five interns worked at the International Center for Research in the Semi-Arid Tropics (ICRISAT) in Hyderabad, developing and testing the dietary diversity module of the Minimum Nutrition Dataset for Agriculture, a core TCi project.

The group spent several weeks living among villagers in Maharashtra and Telangana, interviewing the residents and learning about the communities they were sampling from.

“After we returned from data collection in the field, all of a sudden it clicked—data points suddenly became people,” said Katy Merckel, an intern currently pursuing a master’s degree in International Agriculture and Rural Development.

“We made lasting friendships with our colleagues and the villagers we spent time with,” said Christian DiRado-Owens, a TCi intern and Development Sociology major. Reflecting on the experience, Applied Economics and Management student Andrew Pike, ‘15, noted, “Numbers make sense! I now see how interesting and useful statistics can be in explaining the world.”

Read more about TCi intern experiences and the MNDA project at www.tatacornell.tumblr.com



Pilot Testing the First MNDA Module: Preliminary Results

Pilot testing for the dietary diversity module began in the summer of 2014 with a team comprised of TCi staff, interns, and ICRISAT researchers. Four villages in Telangana and Maharashtra were surveyed and more than 140 households participated. Our participants, women between 18–45 years of age, were randomly drawn from a larger group that had previously taken part in an ICRISAT-administered intensive nutrition survey.

The women were asked to recall what they had eaten over the past three days. We collapsed the foods into nine food groups for individuals (yielding an individual intake score) and 12 food groups for households (yielding a household access score) as outlined in the Food and Agriculture/FANTA Dietary Diversity Guidelines—the same categories used in the ICRISAT intensive nutrition survey.

Findings from this MNDA pilot survey showed that the mean and distribution of dietary diversity scores were not significantly different from those found in the intensive ICRISAT survey, but the results were achieved in less time—an average of 27 minutes—and with fewer questions. The MNDA also captured additional information that is useful for contextualizing diets and better understanding how access might be shaped by the overall food system. These include: atypical eating patterns, such as days when women fasted or went to special events; eating that occurred outside the home; and the origin of the food items that were procured. In the case of atypical eating patterns, we discovered that fasting was dramatically shifting our results; once we controlled for this variable, we saw strong connections between BMI and dietary diversity scores.

We will be publishing more detailed results of the summer 2014 pilot on our blog and through academic

and practitioner publications throughout 2015. Planning and eventual piloting for other components of the MNDA, including the use of dried blood spots for measuring biochemical indicators, will continue in early-to-mid 2015.

CONVENING AN INDIAN WORKING GROUP ON SMALLHOLDER AGGREGATION MODELS FOR IMPROVING NUTRITION

Increased production of staple crops and improved varieties offer the chance to deliver necessary calories as well as iron and other essential vitamins to undernourished people throughout India. A meeting convened by the TCi in February, 2014 focused on discussing opportunities and challenges pertaining to aggregation models that could accomplish one of the following:

1. Expand the supply of iron-biofortified pearl millet
2. Increase per-capita consumption of protein-dense pulses around the country through increased supply

Participants in this spirited discussion included a select number of academics and NGO participants in addition to representatives from an eager private sector.

Biofortified Pearl Millet: Expanding Production and Enabling Access

Pearl millet is a staple consumed in much of Rajasthan, Gujarat, and western Maharashtra. Biofortification of the crop requires increases in seed production and widespread adoption of hybrid varieties in order to decrease relative prices and increase local demand. Yet millets are grown on marginal lands, with farmers who

are unable to access inputs, credit, or other technologies, including the iron-biofortified varieties. Access to services that can help improve productivity will be crucial in generating farmer interest in cultivating the crop, as will certification programs for differentiating the product and generating price premiums. In order to justify a slightly elevated price, consumers also need assurance that they are buying an improved



product. The development of certified supply chains and marketing efforts to explain price premiums, boost consumer confidence, and highlight the benefits of biofortified pearl millet for both urban and rural consumers will help build demand for the food. Coordinated communication efforts with public health officials and integration with school feeding programs, the public distribution program (PDS), and other institutional buyers such as ICDS could generate further consumption.

Increasing Protein Intake Through Pulses: Focusing on Raising Per Capita Consumption

Many Indians are consuming less than 50 percent of their required daily protein. Close to half of Indian women are anemic, and many in this group are anemic due to diet-related iron-deficiency. Greater

consumption of protein-dense pulses, which are already key ingredients in many traditional dishes, can ensure inexpensive access to this key macronutrient. Despite increased demand for pulses in urban and rural areas (and the clear nutritional benefits increased consumption could provide) domestic pulse production has struggled to keep up. The meeting convened by the TCI discussed how, in recent years, expanding and inexpensive pulse imports have left many Indian farmers unable to compete on price. Farmers now find greater farm profitability in cultivating alternative crops, especially as irrigation expands and marginalized, rain-fed lands that were once good only for pulses transition to higher-value crop cultivation.

To meet this growing demand and improve local supplies in rural communities and beyond, investments in research (genetic and productivity improvements) farm management strategies, and market access are needed to make pulse production more profitable. Such investments could provide income opportunities that could benefit poor, marginalized farmers who depend on rain-fed lands where little else, other than pulses, can grow.

Moving Ahead

The TCI will focus future efforts in this area on developing key partnerships, supporting product development and expanding research. By alleviating some of the farmer constraints and exploiting opportunities for new markets, the TCI will attempt to expand pulse and iron-biofortified millet production and consumption.

ENGAGING WITH STUDENTS IN INDIA: JOINT COURSES HELD BETWEEN THE TCI AND THE TATA INSTITUTE OF SOCIAL SCIENCES

The TCI held its first joint course with the TISS in Mumbai, India, in January 2014. Targeted towards interested first-year students from any academic program and Ph.D. scholars from the TISS, "Sustainable Global Food Systems: Food Policy for Developing Countries," was attended by nearly 100 participants. Led by TCI director Prabhu Pingali, lecturers included



TISS director Sulabha Parasuraman and TISS professors Madhushree Sekher and R. Ramakumar. Academics from other institutions also participated, including Dr. Mahendra Dev, current director of the Indira Gandhi Institute of Development Research (IGIDR) and ex-chair of the Commission for Agricultural Costs and Prices (CACP) of the Government of India; Dr. J. Mohan Rao, University of Massachusetts Amherst; Dr. J. V. Meenakshi, Delhi School of Economics; Dr. Sukhpal



FROM THE TCI BLOG

Will India's New Food Bill Have an Impact on Under-nourished Women and Children?
Guest author: Alina Paul-Bossuet

With the new Food Security Bill, an estimated 800 million people are entitled to wheat, rice and millet at subsidized prices. This scheme hopes to tackle alarming rates of child under-nutrition in India where 60 million (almost half of the child population) are underweight.

When we look at food as part of the holistic system, we also need to look at promoting diversification in diets through production and consumption traditional nutritious crops. Innovative partnerships and new technologies will be key. For example, consumption of millet alongside high protein pulses like chickpea and pigeon pea (up to 25 percent protein) can provide important micro and macronutrients.

ICRISAT, part of the CGIAR consortium for agricultural research for development and a central TCI partner, is working with smallholder farmers in Africa and Asia to grow more nutritious, diverse and resilient food.

ICRISAT has been improving soil fertility and increasing the quality and quantity of harvests through a land rejuvenation initiative in Southwestern India. Through this research, farmers can diversify production and increase crop yields. Some have seen a 66 percent gain in calcium-rich finger millet yields through improved varieties and better soil health...[read more at www.tatacornell.tumblr.com](http://www.tatacornell.tumblr.com)

Singh, Indian Institute of Management in Ahmedabad and Dr. Sulabha Parasuraman, International Institute of Population Sciences. Dr. Ashok Gulati, ex-chairman of CACP and ex-director of the International Food Policy Research Institute (IFPRI) in Asia, and Biraj Patnaik, who is currently the principal adviser to the Supreme Court commissioners on the Right to Food Act, also added insights from the policy world.

The course outlined the evolution and current transformations of the greater global food system, with a particular focus on implications for health, trade, and agricultural development across India. The course outlined the key drivers that are contributing to the persistence of malnutrition in rural India despite growth in Indian agriculture and advancements made over the last 50 years.

VISUALIZING SHIFTS IN AGRICULTURE AND NUTRITION IN INDIA: THE TCI'S SPATIAL ANALYSIS WORK

This year TCI researchers charted new territory and launched a research effort focused on mapping agricultural production trends across space (i.e., regions) and time. Thanks to district-level time-series data from a TCI partner organization, the ICRISAT, 50 years of Indian agricultural data were analyzed. By mapping out agricultural production trends across these five decades, new insights into India's population and state-level nutrition patterns have come to life.

TCi scholars involved in this work, including Hilary Byerly, a masters student in Applied Economics and Management, began by identifying a baseline in the late 1960s. More than 50 years later, agricultural production patterns—indicating what crops were grown and

where—illustrate some dramatic trends. Beginning in the 1960s, much of India's rural population practiced subsistence agriculture, cultivating coarse cereals, rice, and pulses.

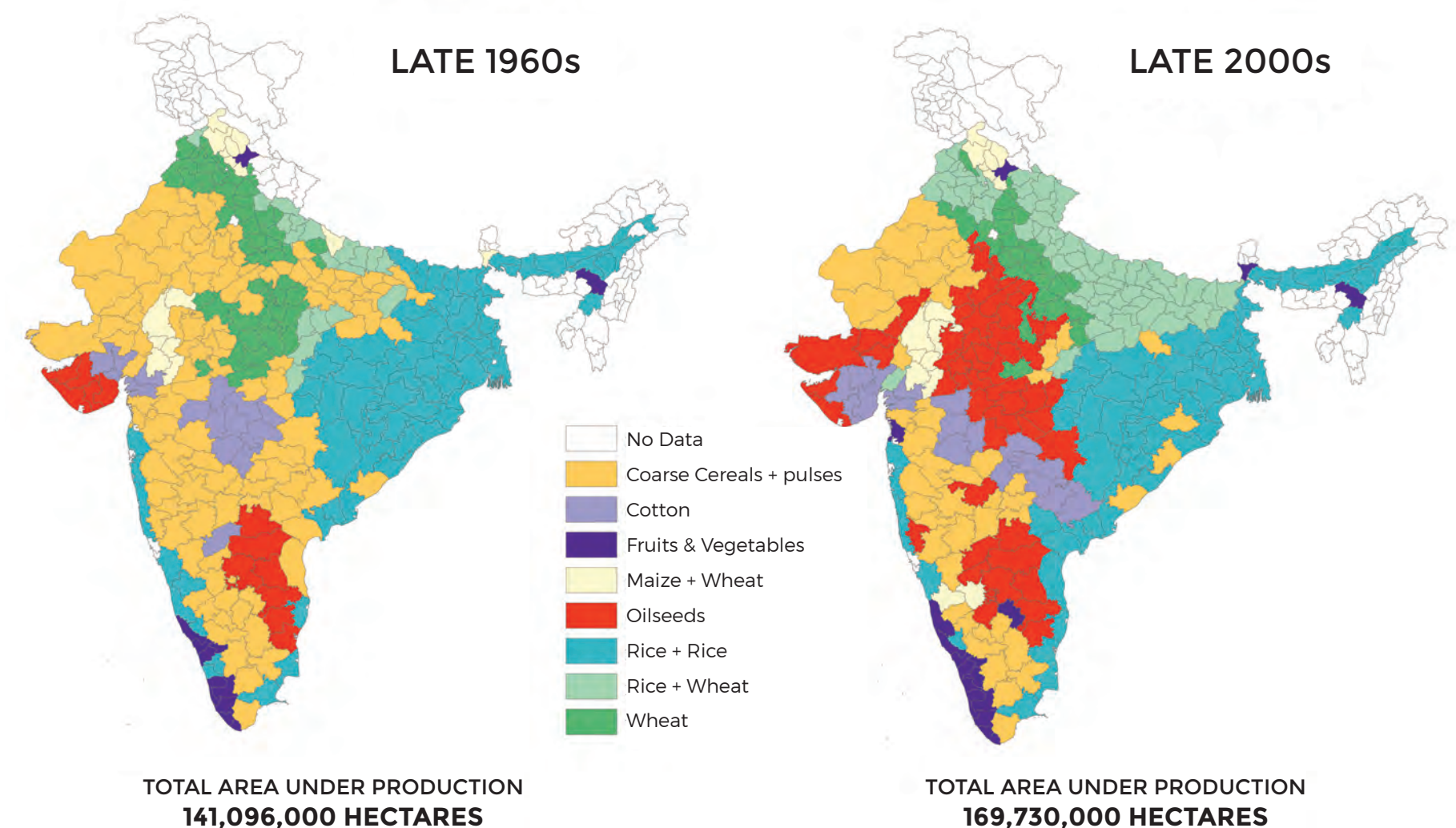
In the 1970s, however, crop production patterns began to shift dramatically towards intensive rice and wheat cultivation as the technological advancements of the Green Revolution took hold. During this time, high-yield varieties of rice and wheat and improved access to essential inputs such as fertilizer expanded production across the country. Following this era, the late 1980s ushered in a period of declining staple grain prices due to increased supply. Many farmers responded by moving into cash crops such as cotton and oilseeds. The TCI's spatial maps from the late 1980s indicate a surge in oilseed production—a trend that has continued into the present day.

By late 2000, pulse production had shrunk and India remains one of the world's largest producers of vegetable oils. Increasingly, cropping trends in the country are beginning to show diversification into fruits and vegetables. Fueled by a growing urban middle class that's demanding greater dietary diversity, new market opportunities seem to be changing agricultural production patterns yet again.

The adjoining two maps are the first in a series of maps that can help to connect the dots between agricultural production patterns, current nutritional realities, and potential health challenges ahead. The TCI will continue to use this and other seasonal, climate, and socioeconomic data to illustrate the current and changing rural landscapes of India.

CHANGING AGRICULTURAL LANDSCAPES IN INDIA

Dominant cropping systems over the last 40 years



Data source: Govt of India - Agricultural Statistics; 1970 district boundaries



**BEYOND 2014:
PLANNED
RESEARCH
AND
ACTIVITIES**

DEVELOPING NEW TOOLS FOR OPTIMIZING SOIL HEALTH IN INDIA

As the population of one of the largest countries in the world continues to rise, India will need to produce more food with fewer resources. A prerequisite to enhancing crop production is optimum soil health.

A first step in protecting soil resources is to quantitatively establish baseline values for the characteristics and current health status of the soil. In India and elsewhere, farmers and other professionals have generally directed their attention to the chemical analysis (macro- and micronutrients) of soils, neglecting the physical structure and soil biota that can offer important clues for understanding soil health and informing its proper management.



The Government of India has also placed a priority on soil health. Together with researchers in the Section of Crop and Soil Sciences at Cornell's School of Integrative Plant Science, TCI researchers will work in 2015 to develop a "soil assessment framework" for

Indian agricultural land. This framework will use basic physical, chemical and biological indicators to assess soil functioning; identify constraints; and develop new management practices based on actual conditions to improve soil functioning.

They will use the mobile Cornell Soil Health Test and SoilDoc, developed at Cornell and the University of Maryland, respectively—tools that will enable them to develop a "soil lab in a box" for direct testing in remote, infrastructure-poor regions throughout India.

Soil and land use surveys will also be combined with GIS and GPS mapping to construct digital soil maps, providing new opportunities for communicating and reporting on soil health throughout India.

Farmers will also be trained in soil testing and advised on management strategies to address soil constraints and serve as depositories for soil characterization data. The work will be executed in collaboration with Indian entities such as PRADAN, whose members will function as farmer trainers and consultants to increase prospects for project success.

IDENTIFYING IRON-FORTIFICATION OPPORTUNITIES IN INDIA: PURSUING IRON-FORTIFIED WHEAT FLOUR

High levels of anemia are rampant across India. Women in their childbearing years (especially pregnant women) can disproportionately suffer from iron-deficiency anemia. Enabling greater access to iron-fortified foods, for women as well as young children, can help ensure that proper iron intake is available for local and

regional consumption. In early 2014, a team comprising representatives from the TCI and the Micronutrient Initiative (MI) made an exploratory trip to the Melghat region of Maharashtra to evaluate possibilities and innovations for fortifying flour with iron and folic acid. The TCI and the MI are exploring new possibilities for designing fortification methods that could be realized at both the national and village levels. Based on discussions during these trips, the following two options have emerged as opportunities for research and investment:

1. Centralized wheat flour fortification and supply through the Public Distribution System (PDS)
2. Decentralized wheat-flour fortification using a *chakki* (small-scale wheat-flour mill) at the local village level

To develop and eventually implement village-level and national plans for flour fortification with iron, the TCI has been working with numerous Indian and global partners, including the BAIF Development Research Foundation. DSM, a fortificants manufacturing company based in the Netherlands, has shown interest in participating as the iron-fortificant supplier. Together, a pilot for next year in the state of Gujarat is being planned. The Health Systems Studies unit at the TISS will support the project in analyzing and evaluating changes in participant nutritional status (levels of anemia through hemoglobin testing).

The pilot will be carried out on a cluster of 30 villages in the Tapi district of Gujarat. BAIF has been working in this region for several years and retains strong connections within the community. By generating awareness of the benefits of fortified wheat flour and nutrition education training, the project aims to eventually cede fortification management to the local women's self-help group.

EXPLORING WOMEN'S SELF-HELP GROUPS AS CONDUITS OF CHANGE

With around three million registered groups across the country, women's self-help groups (SHGs) are becoming ubiquitous across rural India, and integral to the lasting resilience of its food systems and communities. They can also provide some useful lessons for the rest of the developing world.

Initially set up for facilitating microfinance activity, SHGs are now playing an important role as conduits of overall empowerment of rural women in India, giving



them the strength to create change they would not have been able to achieve individually, in terms of access to finance, environmental stewardship, and politics. However, not all groups are able to take on broader development and local governance challenges. So what makes an SHG flounder or flourish?

The TCI will continue to conduct research with the aim of evaluating and understanding the opportunities and

challenges surrounding the use of SHGs as a method for facilitating female-led development. In an attempt to track the activities and effectiveness of SHGs as they reach higher levels of economic achievement, TCI team members reviewed a volume of reports and concluded that much remains to be discovered about how best to harness the change that these groups promise.

Throughout 2014, TCI team members also traveled across India to acquaint themselves with SHGs firsthand. What they saw in the field mirrored much of what they gleaned from the literature: that SHGs were diverse in every sense. Some seemed cohesive,



effective, and united behind a common mission, moving beyond microfinance and small-scale entrepreneurial activities into governance, such as managing a village's natural resources or participating in local decision-making committees. Others lacked leadership and were factitious.

Future work will attempt to bridge a critical knowledge gap regarding what characterizes successful SHGs. All too often, in their eagerness to see change, external organizations have elected to channel projects through SHGs without fully understanding how they function, what kinds of group dynamics are at play, and whether they are already responding to other demands. As a result, the splintering of limited time and resources available to women's SHGs might undermine their capacity to manage their own affairs—a fundamental dimension for change.



FROM THE TCI BLOG

Women's Groups as Conduits for Resilient Communities
 Author: Prabhu Pingali, TCI Director

Women's self-help groups (SHGs) are becoming ubiquitous across rural India. There are currently around 3 million registered women's SHGs in the country. Institutions, donors and organizations looking to leverage the power and potential of SHGs should be optimistic about the potential for using these groups to leverage positive change.

Earlier this year a leader of an SHG in Jharkand told me proudly: "We now have a bank account and I go to the bank to manage the account. I never went into a bank before I started with this group. I always thought banks were for people with money. We have money now." This new sense of confidence has women increasing their participation in village-level meetings and even encouraged them to participate in local government offices and natural resource management. Yet not all groups are able to mature and take on broader development and local governance challenges: so what makes a SHG flourish or flounder?

As development agencies, researchers, or practitioners, we need to proceed with caution so as not to undermine the potential of SHGs. Equipping SHGs with the financial and managerial resources they need to meet goals determined by the group and forgoing projects that could highlight the differences amongst women (educated versus non-educated, young versus old) will remain critical principles of practice...[read more at www.tatacornell.tumblr.com/](http://www.tatacornell.tumblr.com/)



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