

M. S. Swaminathan – scientist, hunger fighter, World Food Prize Laureate

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M. S. Swaminathan is a central figure in the history of the Green Revolution and of the World Food Prize. This article recounts his association with Norman E. Borlaug, his recognition as the first World Food Prize Laureate in 1987 for his breakthrough achievement in improving the quantity, quality and availability of food in India and countries around the world, and his role as ‘Dean’ of the World Food Prize Laureates. Swaminathan has been a guiding light in shaping and participating in the core activities and milestone events of the World Food Prize, including its annual Borlaug Dialogue international symposium on cutting edge themes in agriculture and food production/food security; Global Youth Institute and Borlaug-Ruan International Internship programme for high school students; and as Chair of the Laureate selection committee.

Keywords: Borlaug, Green Revolution, Swaminathan, World Food Prize.

Introduction

ONE of the largest artistic depictions of any citizen of India anywhere in the United States is found not in New York or Washington DC, but, rather improbably, in the Midwestern city of Des Moines, Iowa.

Standing over 10-feet in height, this work of art is a colorful mural comprised of more than 250,000 individual pieces of glass that depict a man with a kind face holding a strand of rice while standing in a field of plenty (Figure 1). The man honoured with this magnificent artwork is M. S. Swaminathan. Its location in middle America is perhaps better understood when it is learned that the building in which his mural occupies such a central place of honour is the Dr Norman E. Borlaug Hall of Laureates, home of the World Food Prize.

‘M.S.’ as Swaminathan is known to contemporaries and colleagues, is honoured as the first-ever recipient of the World Food Prize, a recognition bestowed upon him in 1987, one year after Norman Borlaug himself created this new award, which he dreamed would one day come to be seen as the ‘Nobel Prize for Food and Agriculture’. As the ‘Dean’ of the Laureate Corps, a group of 40 of the

most accomplished scientists and leaders who were at the forefront of a stunning array of agricultural and nutritional breakthroughs, Swaminathan is rightfully highlighted in this exceptional manner.

Indeed, Swaminathan’s connection to Norman Borlaug reflects just how interconnected their professional lives were in initiating and shaping the Green Revolution – the single-greatest period of food production and hunger reduction that our planet has ever seen.

In my view, they are best described as brothers. Norm was 11 years older than ‘Swami,’ but their collegial relationship was always one of mutual respect and admiration. Their roles in bringing unparalleled agricultural innovation to South Asia were inextricably intertwined. It was, after all, Swaminathan who had invited Borlaug to come to India for the first time in 1963, an event seen as so linked to India’s agricultural redemption that it was the cause of the Indian ambassador in Washington to hold a

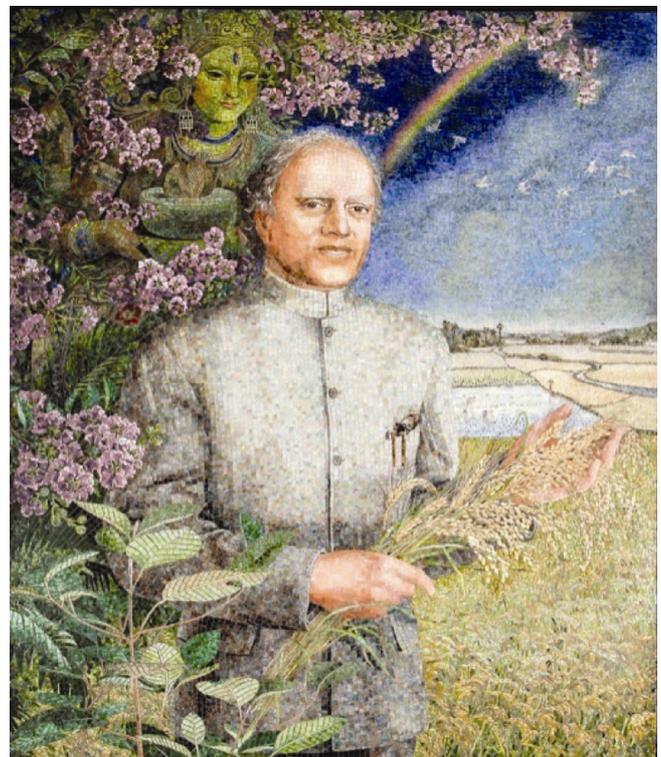


Figure 1. Large mural of Swaminathan in the World Food Prize Hall of Laureates.

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reception at her residence in 2013, just to celebrate the first time Borlaug's feet ever touched Indian soil. The impact of Swaminathan's initiative was never more apparent.

Like Borlaug's work in wheat, Swaminathan's leadership in rice was central to his being chosen as the first World Food Prize Laureate in 1987, when he was serving as Director General of the International Rice Research Institute (IRRI) in the Philippines. I was serving as Deputy U.S. Ambassador in Manila at the time, and knew full well that the extraordinary impact of the new 'miracle rice' that had been developed at IRRI by Hank Beachell and Gurdev Khush (who later received the World Food Prize in 1996) was truly transforming agriculture in Southeast Asia and lifting an entire generation out of poverty. I had seen its impact while serving as a rural development adviser in the Mekong Delta in the 1960s.

At the time of his selection as the first World Food Prize Laureate, Corazon Aquino, then president of the Republic of the Philippines (and later a member of our Council of Advisors) lavished praise on Swaminathan, as did U.S. President Ronald Reagan.

No other person was as directly involved in bringing both the Green Revolution to India and then spreading it throughout Southeast Asia as Swaminathan. It is therefore most appropriate that when I speak of him in public in 2015, I say without hesitation that he is the most revered agricultural scientist on our planet.

In the struggle for a hunger-free world – 'we were like brothers'

In the 1960s, as Southeast Asia faced the threat of widespread famine and the potential loss of hundreds of millions of lives, Swaminathan worked closely with Borlaug to bring about the great agricultural transformation that came to be known as the Green Revolution. Together they spread high-yielding wheat and rice varieties and improved agricultural practices among the poorest farmers of India, demonstrating particular courage and risk-taking in challenging the political establishment of the time (Figure 2).

Swaminathan's reflections on his longtime friendship and professional association with Borlaug include the following, in 2007: 'I have been associated with Dr Borlaug in the struggle for a hunger-free world for nearly fifty years, and I have the greatest admiration and affection for him...'¹.

These two world-renowned agricultural scientists met for the first time in 1953 at a conference organized by the American Society of Biological Sciences hosted by the University of Wisconsin-Madison. Swaminathan, then a post-doctoral researcher at the university, was most intrigued with Borlaug's presentation about a new method of controlling rust disease in wheat – innovative research

that catalysed a global effort to bring modern science to the forefront in addressing the problem of how to feed the growing world population.

They walked to a nearby drugstore to have coffee together, and, from that point on, their friendship blossomed into inspired collaboration that continued until Borlaug's death in 2009. Swaminathan recalled that Borlaug 'was a very warm, friendly, humorous and loving person. Once he knew that my motivation was the same as his, we became not just friends...we were like brothers'².

He expressed that he had the greatest admiration for Borlaug not only as a scientist but as an original thinker who anticipated problems – 'what we call anticipated research'³.

They quickly discovered a mutual interest in the importance of applying laboratory research to farmers' fields, particularly resource-poor smallholder farmers, directly providing them with new scientific tools to increase agricultural production in food-deficit regions of the world. A hallmark of both men's approach to solving food insecurity problems was to work in rural villages to understand needs at the local level. Like Borlaug, Swaminathan '...always felt my responsibility to be toward the farmers'⁴.

Borlaug, who founded the World Food Prize in 1986, and Swaminathan, the first recipient of this distinguished



Figure 2. Swaminathan (center) in wheat field with Borlaug (right).

international Prize, achieved remarkable innovations in genetic research and plant breeding that changed the course of history. Their collaborative efforts staved off imminent famine conditions in India and Pakistan in the 1960s with the development and dissemination of high-yielding hybrid miracle wheat, thus providing the world with one of the most successful large-scale programs to help alleviate poverty and improve food security in the history of international development.

The Green Revolution in India – inspired collaboration

Recognizing the effectiveness of Borlaug's new dwarf wheat varieties – and the potential for adaptation to different climatic conditions – Swaminathan asked for help from his friend in countering India's looming famine. In March 1963, Borlaug responded affirmatively by traveling for three weeks with Swaminathan in the wheat belt of North India – observing the crops and growing conditions, and spending time talking with the farmers (Figures 3 and 4). He became convinced by what he learned from Swaminathan, what he saw in the countryside, and what he heard from the local people that his high-yielding dwarf wheat, which he had developed in Mexico, could significantly boost grain production in India.

When Borlaug's miracle seeds were introduced through initial national demonstration trials set up by Swaminathan across the country – the crucial 'lab to land' step – the new wheat varieties proved to grow successfully in the varied soils and climatic conditions of India. It was crucial that these demonstration plots were in poor farmers' fields, Swaminathan explained, because 'when a poor farmer produces more, it has a tremendous impact'. To the contrary, success in a rich farmer's field 'will be attributed to affluence and not to technology'⁵.

A challenge that still needed to be met was palatability. Indian consumers did not care for the red colour of the

Mexican wheat varieties like 'Lerma rojo' for making unleavened chapati bread, and so Borlaug provided seeds from his work in Pakistan that were more amber in colour. Swaminathan conducted additional research on these varieties to develop 'Sonalika' and 'Kalyan Sona', which had the desired chapati-making quality⁵.

In 1964–1965, the Indian government was persuaded by Borlaug and Swaminathan to act quickly in approving widespread planting of the new wheat varieties. Through the application of science, education of farmers, and the political leadership of Minister of Agriculture C. Subramaniam and Prime Minister Lal Bahadur Shastri, followed by Prime Minister Indira Gandhi, famine was averted, and, by the late 1960s, Indian agriculture was on course to self-sufficiency in cereal grains.

Prime Minister Gandhi paid tribute to Borlaug for providing the original seed material to Indian researchers and farmers, for working with government officials, and thus helping make possible a quantum leap in production, which greatly strengthened national security. Her government commemorated this achievement by issuing a special postage stamp, 'Wheat Revolution', in 1968 to commemorate the significant impact of the new wheat varieties in increasing yields.

The Green Revolution in Asia was a period of astounding food production and hunger abatement brought about by scientific discovery and application combined with policy intervention. India's grain harvest greatly increased, until by 1999, the miracle seeds enabled farmers to grow 70 million tons of wheat a year, compared to 12 million in the early 1960s. In 2014, the production levels had reached 95 million tons of wheat – on roughly 30 million hectares.



Figure 3. Swaminathan (second from right) and Borlaug (fourth from right) in Indian wheat field.



Figure 4. Swaminathan inspecting wheat.

‘You cannot have a revolution without a mass movement, and this was a movement started with the farmers, with the help of scientists,’ Swaminathan said in a 2014 interview with our World Food Prize Communications Director Megan Forgrave. ‘That is what happened in Indian agricultural history.’

Swaminathan has called the Green Revolution a ‘symphony of ingredients’. ‘One is science, which is the prime mover of change; another, the gamut of public policies; third, services such as seed production, electricity, and fertilizer; and, finally, farmers’ enthusiasm and toil’⁶ (Figure 5).

Borlaug wrote to Swaminathan in 1970 after receiving the Nobel Peace Prize: ‘The Green Revolution has been a team effort and much of the credit for its spectacular development must go to Indian officials, organizations, scientists and farmers. However, to you, a great deal of the credit must go for first recognizing the potential value of the Mexican dwarfs. Had this not occurred it is quite possible that there would not have been a Green Revolution in Asia’.⁷

Many years later, speaking at the award presentation ceremony of the U.S. Congressional Gold Medal (America’s highest civilian honour) to Borlaug in July 2007, Swaminathan expressed that: ‘The impact of the Borlaug-led Green Revolution is clear from the fact that during 1964–1968 Indian farmers increased wheat production by an order greater than that achieved during the preceding 4000 years. At a critical time in human history, he proved the prophets of doom wrong, and enabled developing countries to buy time in achieving a balance between population growth and food production (Figure 6).’

The First World Food Prize Laureate

Swaminathan was selected the first Laureate to receive the World Food Prize, created in 1986 by Borlaug to be seen as the ‘Nobel Prize for food and agriculture’, for



Figure 5. Swaminathan (right) in a rice field at the International Rice Research Institute in the Philippines.

extending the Green Revolution among India’s farmers, thereby ensuring greater food security and improved livelihoods for millions of rural poor (Figure 7).

When World Food Prize Chairman Al Clausi informed Swaminathan that he was the first recipient of the newly created World Food Prize, Clausi recalled that Swaminathan ‘was very pleased and humble in accepting the honour’. At the award presentation ceremony, which took place in Washington D.C. at the Smithsonian Institution in the fall of 1987, Clausi said that the Laureate ‘held an audience of about one thousand spellbound – and ended with the announcement that he was going to use the



Figure 6. Swaminathan in the Rotunda of the U.S. Capitol with statue of Abraham Lincoln behind him. Also pictured (left to right) Senate Majority Leader Harry Reid and Iowa Senators Charles Grassley and Tom Harkin.



Figure 7. Swaminathan accepting the World Food Prize sculpture from James Ferguson, CEO of General Foods, at the 1987 Laureate Award Ceremony at the Smithsonian Institution in Washington DC.

award funds of US\$ 200,000 to start his own institute in India dedicated to helping his countrymen, particularly women, reach food security’.

Clausi, retired Senior Vice President of General Foods Corporation – the original sponsor – at the time expressed that he and everyone involved with the creation of the World Food Prize knew that, with Swaminathan as the first recipient, ‘they had started a great and noble thing, which over time would spotlight more great and dedicated people like him’⁸.

Javier Perez de Cuellar, then Secretary General of the United Nations, wrote the following about Swaminathan on the occasion of his receiving the World Food Prize: ‘[He] is a living legend. His contributions to agricultural science have made an indelible mark on food production in India and elsewhere in the developing world. By any standards, he will go into the annals of history as a world scientist of rare distinction.’

At the inaugural presentation ceremony, Borlaug praised Swaminathan: ‘He is a craftsman of the highest order and architect of the Green Revolution in India. He has performed with consistent, energetic deftness the roles of innovator, statesman, scientist, and administrator – focusing always on the goal of improving the quantity, quality, and availability of food to national, regional, and worldwide communities.’

In his acceptance speech, Swaminathan expressed an urgent warning that both he and Borlaug shared. ‘We have no time to relax on the food production front. If statesmen who determine national policies and priorities would all become conversant with food production and equitable distribution, hunger could be made a problem of the past sooner than otherwise would be possible (Figure 8).’

‘The prospect for a world without hunger is a glorious legacy given to our contemporary world by scientists and technologists; communicators and social scientists;

administrators and industrialists; and workers in the factories, fields, forests, pastures, rivers, and oceans’, he added. He then went on to say: ‘How satisfying and joyful it would be if every member of the human family could go to bed every night after a nourishing meal. Until such a wholly attainable world becomes a reality, our task remains unfinished.’

Swaminathan also spoke on that occasion about the need for sustainability and the importance of nutrition: ‘We live in an age of unparalleled opportunity for promoting sustainable nutrition security.’ His advocacy of sustainable agriculture through an Evergreen Revolution has made him an acknowledged world leader in the field of sustainable food security.

Officials of the sponsor, General Foods Corporation, cited Swaminathan as ‘one of the great men of this century, a man who has made – and continues to make – an imprint upon history. His accomplishments have greatly improved the quality of life for tens of millions. As a pre-eminent scientist, educator, scholar, administrator and policymaker, he is held in the highest regard by the world’s scientific and academic communities and by government leaders around the world.’

Upon returning to IRRI in the Philippines where he was serving as Director General (1982–1988), Swaminathan was honoured by then President Corazon Aquino, who presented him with the Golden Heart Presidential Award at Malacanang Palace, expressing high praise: ‘Dr Swaminathan fully deserves the distinction of being the first recipient of the World Food Prize, which is awarded to those who have made significant improvements in the world’s food situation. He has expanded considerably the International Rice Research Institute’s capacity for upstream research to bring the fruits of recent advances in science and technology to Asian rice farmers.’

Swaminathan paid tribute to President Aquino in his World Food Prize acceptance speech, complimenting her for leading the Philippine government to champion ‘the aim of agricultural progress through increasing in real terms the income of Filipino farmers’. The president had taken a lead role in reorienting the general thinking of her government to raise the livelihood security of the poor in rural areas, which Swaminathan applauded as an important step in realizing the untapped potential of that nation.

I had the opportunity to know President Aquino from my diplomatic service in Manila at the same time. In my view, she was truly a heroine of democracy. Together with Borlaug and Swaminathan, she was one of the most inspiring leaders I have ever known. For that reason, I invited her to become a member of the World Food Prize Council of Advisors, a position from which she brought great prestige and attention to the Prize and its honourees.

One of Swaminathan’s most enduring achievements was his creation of the M.S. Swaminathan Research Foundation (MSSRF) in Chennai, using the Prize funds



Figure 8. Swaminathan speaking at the National Press Club in Washington DC when he received the 1987 World Food Prize.

he was awarded. Under his guidance, that center has for decades worked to confront hunger, poverty, social disenfranchisement, and environmental degradation by uniting experts and pioneering projects in disciplines as disparate as aquaculture, gender issues, crop genetics, economics, tropical ecosystems, and information technology.

I saw firsthand this amazing epicenter of science and humanitarian concern in South India during a visit to Chennai in 2010 to speak at the Conference on the UN Year of Biodiversity that Swaminathan organized (Figure 9). It was held to honour Borlaug shortly after his death in September 2009. In my remarks, I noted that in my conversations with him, Borlaug had been a strong proponent of biodiversity, especially noting the importance of preserving as wide a variety as possible of all crops, since the traits developed over hundreds and thousands of years can be critical to producing new, stronger varieties. This was the case with Borlaug's own miracle wheat from Mexico, the Quality Protein Maize developed at CIMMYT and New Rice for Africa, all developed by World Food Prize Laureates.

I was also able to see firsthand the range of scientific research and applied social science occurring at his center. I was so impressed that members of Swaminathan's team were working to see how biotechnology might be able to be used to ameliorate the impact of salt water intrusion on rice lands, as the seas rise due to climate volatility.

His staff was also at the forefront of studying the social science aspects of bringing change to villages by working with women, and also translating extension materials into local dialects. This aspect of MSSRF has been a great benefit to our Borlaug-Ruan International Internship program – as we have been so grateful to partner with Swaminathan in placing our high school student interns at MSSRF for eight-week assignments every summer since 1999, and have them integrated into the village-level research efforts (Figure 10).



Figure 9. World Food Prize President Kenneth Quinn delivering keynote address at 2010 Biodiversity Conference at MSSRF in Chennai.

Dean of the Laureates

Unofficially the 'Dean' of the World Food Prize Laureates, Swaminathan has provided valued guidance and wise counsel to the World Food Prize Foundation leadership as the organization has grown steadily in global outreach, stature, and prestige (Figure 11).

He was most supportive of the rescue of the Prize in 1990 by Iowa businessman and philanthropist John Ruan Sr, after the original sponsor was lost as part of a corporate restructuring. Ruan and his family fully embraced the



Figure 10. 2009 Borlaug-Ruan Intern Danika Schaaf gathering information and data as part of her Watershed Project research at MSSRF.



Figure 11. Swaminathan entering the Laureate Award Ceremony at the Iowa State Capitol.

mission of the Prize, set up an endowment to fund the annual award (increasing the amount to US\$ 250,000), and provided it with a new home in a modern downtown Des Moines building that he had built.

Since becoming the inaugural Laureate, Swaminathan has been actively involved with our World Food Prize's expanding programmes and activities, including: the distinguished Selection Committee of global experts, which he has chaired since 2008; the three-day international symposium, known as the Borlaug Dialogue, which now attracts more than 1300 attendees from 65 countries and to which he has offered guidance and made multiple presentations; the Laureate Award Ceremony held in a magnificent setting at the Iowa Capitol, at which he annually leads the procession of Laureates, and has on several occasions presented the Prize to new recipients; and the Global Youth Institute, which began with a handful of Iowa high school students and their teachers in 1994 and has evolved into a premier, 3-day educational experience for over 200 students (plus their teachers) from Iowa and 26 other states, and several countries around the world. He has personally hosted and mentored our Borlaug-Ruan high school interns at MSSRF.

When Borlaug was no longer able to carry out his duties as Chairman of the World Food Prize Selection Committee (whose members, except for the Chairman, serve anonymously), the one person in the world he chose to succeed him was Swaminathan. The Laureates who have received the Prize during his tenure as Chair include: Gebisa Ejeta of Ethiopia (2009); David Beckmann and Jo Luck of the United States (2010); H. E. Luiz Inácio Lula da Silva of Brazil and H. E. John Kufuor of Ghana (2011) (Figure 12); Daniel Hillel of Israel (2012); Mary-Dell Chilton and Robert Fraley of the United States and Marc Van Montagu of Belgium (2013); and Sanjaya Rajaram of Mexico and India (2014).

Many of his fellow Laureates have been inspired by Swaminathan, and have participated with him in World



Figure 12. The 2011 Laureate Award Ceremony at the Iowa State Capitol (left to right: Swaminathan, World Food Prize recipients H. E. Luiz Inácio Lula da Silva of Brazil and H. E. John A. Kufuor of Ghana, and John Ruan III, World Food Prize Foundation Chairman).

Food Prize events as well as important international initiatives and forums.

Philip Nelson (2007 World Food Prize Laureate) recently recalled the momentous influence on his own food science research career of meeting Swaminathan in the early 1970s as part of a U.S. National Academy of Sciences team invited to study the extent of food losses in India. 'My interactions with and observations of Swaminathan at that time of my young career so impacted my life that I was prompted to start exploring for a technology that could be used in developing countries to aid in reducing food losses.'⁹

He was so impressed that he continued to follow Swaminathan's work and was not surprised when he was recognized as the first World Food Prize Laureate. 'His career has altered the fate of mankind,' Nelson declared.

Gurdev Khush, who was awarded the Prize together with Henry Beachell in 1996 for their research in rice breeding at IRRI, recalled Swaminathan's passion for working with farmers and his comment that: 'Farmers have given me guidance and encouragement which has proved extremely important in my work. I was fortunate to learn from Indian farmers rather early in my life that they are the backbone of food production systems.'

Reflecting the global respect in which they are held, Secretary General Kofi Annan invited Swaminathan and Pedro Sanchez (2002 Laureate) to co-chair the UN Millennium Project's Hunger Task Force. Comprised of 30 leading experts in science, economics, nutrition, business and development policy from 17 countries around the world, this august assembly was charged with determining 'how to meet the Millennium Development Goal #1 – to reduce the proportion of hungry people in half from 1990 to 2015' (ref. 10).

Both Laureates participated in the Borlaug Dialogue international symposium in 2003 in the session 'The Fight Against Hunger: Report from the Millennium Project Task Force on Hunger'. They highlighted the hunger hot spots around the globe, and also what they called food security bright spots. Swaminathan expressed that 'We should not only talk about the hot spots, we should talk about bright spots.'

The Hunger Task Force's final report, with Swaminathan and Sanchez the lead authors, was published in 2005, entitled *Halving Hunger: It Can Be Done*. Recommendations emphasized increasing agricultural production among smallholder farmers and improving nutritional support programmes for vulnerable groups, particularly children, pregnant women and the elderly, through locally based efforts to be supported by national-level policy reforms¹¹.

A powerful reflection of his leadership and the effective strategies Swaminathan promoted and institutionalized as co-chair of the Hunger Task Force include the following positive outcomes: the number of hungry people in the world has declined by over 200 million since

1990, and more than 70 countries have met or on track to meet MDG Goal #1 (ref. 12).

Swaminathan was a leading figure at the 2001 UN Food and Agriculture Conference in Rome, where he presented a Declaration by the World Food Prize Laureates on the urgency of fulfilling the international commitment to cut hunger in half.

In 2009, he became the founding chair of the UN High Level Panel of Experts on Food Security and Nutrition (HLPE), a position that is now held by another World Food Prize Laureate, Per Pinstrup-Andersen (2001). Pinstrup-Andersen wrote of Swaminathan's role in the HLPE: 'He was instrumental in developing a very effective and influential organization that has had major impact on policy-making in food security and nutrition by making relevant and timely evidence available to members of the UN Committee on World Food Security.'

World Food Prize Director of Secretariat Operations since 2000, Judith Pim, commented on Swaminathan's generous gift of his time and attention to her and members of the Foundation staff over the past 15 years. 'It has been a joy, and so very gratifying, to be able to consult with him personally and to receive his always insightful recommendations concerning the work of the Secretariat and the planning of our annual international symposiums.'

Contributions to the World Food Prize Borlaug Dialogue

Swaminathan has been a consistent presence and powerful intellectual force at our World Food Prize annual symposiums – known as the Borlaug Dialogue – providing incisive inquiry into the struggle to ensure adequate food and nutrition in the 21st century (Figure 13).



Figure 13. Swaminathan speaking at the World Food Prize Borlaug Dialogue International Symposium.

In 2004, which was the UN Food and Agricultural Organization's International Year of Rice, the Prize was awarded to two rice breeders who had worked independently on different continents developing new rice varieties that fed millions of people. Monty Jones of Sierra Leone was honoured for creating a rice variety specifically bred for the ecological and agricultural conditions in Africa. Yuan Longping was honoured for developing the genetic materials and technologies essential for breeding high yielding hybrid rice varieties in China.

Fittingly, Swaminathan gave a presentation at the 2004 Borlaug Dialogue highlighting the important role of rice in feeding the world. 'Rice is going to be even more important in future years because of its ample availability as a staple food for billions,' he told the symposium audience. 'That is why the International Rice Research Institute gene bank has over one hundred thousand strains of rice, varieties grown in a wide array of weather and soil conditions. From uplands to highlands to lowlands, there is enormous opportunity but also great challenge to scientists as they research how to improve the farming systems under diverse ecosystems.' He said that the world needed improved grain quality and nutrition, and he hoped this would be achieved through science and public policy.

He also touched upon what he saw as the need for a paradigm shift from a Green to an Evergreen Revolution: 'All of us must have one basic aim – the prosperity and well-being of farmers, the health and safety of consumers, and the safety of the environment. Working toward these interconnected goals will bring us into a new era of bio-happiness.'

In 2006, he delivered a major address at the Borlaug Dialogue, entitled 'Looking back at the Green Revolution: how can we replicate the greatest achievement of food production in history.' His short reply was: 'We have to be positive on this challenge. We have to replicate the greatest achievement. It cannot be one single achievement, it has to go on.'

Swaminathan emphasized the importance of information technology in ramping up production to feed the growing global population. 'We can produce more because there is an untapped reservoir in the agricultural production bank, and today we can leapfrog in terms of communication, by mobilizing all the tools, whether the Internet, cable TV, or FM radio, the community radio, or the cell phone – this information technology is opening up enormous opportunities.'

He again echoed the urgency to push forward, a call to action frequently and forcefully expressed by Borlaug. 'The 21st century challenges of producing more food without expanding agricultural land,' Swaminathan said, 'can be met only by harnessing the best in frontier technologies and blending them with the rich heritage of ecological prudence; eco-technologies for an Evergreen Revolution should be the bottom line of our strategy, to shape agriculture in the future.'

He concluded this address with a poignant reference to the correspondence and friendship between George Washington Carver (an Iowa agricultural hero) and Mahatma Gandhi (who had visited Swaminathan's childhood home and went on to become a hero of India's independence movement), and the latter's soliciting advice on nutrition from the former. The great American food scientist – Carver – and the great leader of non-violent civil disobedience – Gandhi – were men for whom universal food security was the key to health, productivity and freedom.

Swaminathan noted that Carver believed that his scientific work could only be considered successful if it reached the last person – 'unto the last'. Gandhi called it 'unto the end'. The lesson, as Swaminathan framed it, is: Scientists and politicians are measured by others and by themselves according to whether their work is going to benefit the poorest person in society. 'That's the way to end all the inequity and the various divides in the world,' he said.

In 2010, Swaminathan chaired a panel conversation at the Borlaug Dialogue on biodiversity, with emphasis on the smallholder farmer. He began by pointing out that Borlaug early on recognized the importance of genetic diversity. 'He wanted to have genetic heterogeneity, not homogeneity, in his varieties, so he brought about the pyramiding of genes from diverse sources, whether it was winter wheat or spring wheat, all of them together. And that is one of the reasons why most of the varieties he bred were not only capable of using soil energy, nutrients and water more efficiently, but also were resistant in the broad spectrum of diseases and pests' (Figure 14).

'It is now recognized that climate-resilient agriculture has to be built on the foundation of biodiversity.... Now, in the case of small farmers, it is largely, mostly women who have been the great conservers. From the time over 12,000 years ago when the transformation took place from purely food gathering to food growing, a very great contribution – the selection of varieties, the selection of species were all done by women.'



Figure 14. Swaminathan conferring with Quinn.

He pointed to the importance of local efforts among the tribal areas of India where 'enormous work is being done by the smallholder farmers to conserve biodiversity. For example, one group of farmers, mainly women, developed a system of community conservation of biodiversity through their own gene banks. They have always considered biodiversity to be their ally in sustainable agriculture. Whenever there is drought, whenever there are floods, the large number of varieties helps them in order to save something, at least, that they have obtained.' Swaminathan concluded this panel conversation with a hope that 'the farmers of the world will continue to practice conserving agrobiodiversity through their local, on-farm traditions'.

At the 2012 Borlaug Dialogue, Swaminathan chaired a panel conversation with Marc Van Montagu and Robert Fraley on 'Innovations shaping the future of green technology'. In his introduction, he discussed the role of biotechnology in 'opening up some unusual opportunities in terms of crop, animal, and microbial improvement'.

The following year, Van Montagu, Fraley and Mary-Dell Chilton received the World Food Prize for their independent, pioneering work in biotechnology. Van Montagu wrote me recently that he had been a frequent participant in scientific meetings organized by Swaminathan at his research foundation in Chennai during the 1990s, and, in that regard, he was particularly touched that it was Swaminathan who presented him with the World Food Prize during the award ceremony at the Iowa Capitol in 2013 (Figure 15).

As Chairman of the Selection Committee that chose these three individuals, Swaminathan issued the following statement putting into perspective the decision which had generated considerable controversy.

The year 2013 marks the 60th anniversary of the discovery of the double helix structure of the DNA molecule by James Watson, Francis Crick and Maurice



Figure 15. The 2013 Laureate Award Ceremony at the Iowa State Capitol (left to right: Swaminathan, World Food Prize recipient Marc Van Montagu, President Ólafur Ragnar Grimsson of Iceland, recipient Mary-Dell Chilton, recipient Robert Fraley, and John Ruan III, World Food Prize Foundation Chairman).

Wilkins. During the last 60 years, the science of molecular genetics, also referred to as New Genetics, has opened up uncommon opportunities for shaping the future of agriculture, industry, medicine and environment protection. It is therefore appropriate that the World Food Prize is being awarded this year to some of the pioneers of the New Genetics who have opened up opportunities for achieving a balance between human numbers and the human capacity to produce adequate food.

Sustainability is a theme that runs through Swaminathan's work and his many addresses and speeches at World Food Prize events and other forums. In that regard, he has often stated that new gains in productivity, profitability and sustainability of major farming systems can be made through 'concurrent attention to the principles of ecology, economics, gender equity, employment and energy.' Furthermore, 'attending to these tasks will help to foster harmony both within humankind and between humankind and nature'¹³.

In a major address at the 2014 Borlaug Dialogue, Swaminathan said he had coined the term 'Evergreen Revolution' to mean increasing agricultural productivity in perpetuity without associated ecological harm. It became clear to him after the successes of the Green Revolution that vertical growth in productivity – producing more from less land – is the only way to ensure a sustainable and nutritious food supply in the decades to come.

In that speech, he especially urged the Global Youth Institute students in the audience – and the next generation of aspiring Borlaugs everywhere – to work hard toward achieving a world where nutrition security becomes the common denominator. He emphasized that an important element in achieving the UN Zero Hunger Challenge, a global call to action by Secretary General Ban Ki-moon to eliminate hunger by 2025, is to focus scientific and policy efforts on nutrition security for all.

'Anticipate future problems, anticipate climate change,' he has said, 'and do not forget the fact that the human population is growing. Producing more food with less land and less water can only be done with new technology. That is our human challenge, and it is a challenge that can be met, provided that everyone comes together, like a symphony'¹⁴.

In a *Science* magazine editorial published in August 2014, he wrote: 'the drive to reduce hunger in the world has largely relied on crops such as wheat and rice that provide calories. But an increase in calories alone is not good enough. Improved diets and good health require bolstering nutrition.... Without mainstreaming nutritional criteria in large-scale agricultural cropping and farming systems, the prospect for meeting the UN's Zero Hunger Challenge will be dim.'¹⁵

Inspiring the next generations through life-changing World Food Prize youth programmes

Swaminathan has been an instrumental champion and participant in two of the World Food Prize's annual youth programmes – the Global Youth Institute and Borlaug-Ruan International Internship – which educate and develop tomorrow's scientific and humanitarian leaders in the fight against hunger. He shares Borlaug's passion in inspiring the next generation, animated by his long-term, unflinching commitment to mentoring and working directly with students in the World Food Prize youth programmes.

Following the example of these two great men and the other World Food Prize Laureates to think big and innovate, the World Food Prize Foundation has built several unique programmes that encourage high school students to pursue education and research in agriculture and STEM (Science, Technology, Engineering, Math) subjects, launching their careers in food security and global agriculture.

As part of Borlaug's strong commitment to encourage young, talented researchers and trainees across the globe, he dreamed of a World Food Prize youth initiative where in every state in America, and every country in the world, high school students would have an annual opportunity to come together to learn about global food security issues, explore solutions, and, above all, become inspired to commit their lives to combating hunger and meeting the challenges of the 21st century.

Each year, exceptional high school students from across the United States and other countries are selected to participate in the three-day World Food Prize Global Youth Institute (GYI) in Des Moines, Iowa. Since the programme's inception in 1994, thousands of top high school students and their teachers from Iowa, the US, and around the world have participated in the Global Youth Institute, which takes place every October in conjunction with the annual World Food Prize Borlaug Dialogue international symposium and Laureate Award Ceremony.

Participating students and teachers have the unique opportunity to engage with their peers from around the world, tour cutting-edge industrial and research facilities, perform service-learning activities, and take part in symposium discussions with World Food Prize Laureates and other distinguished global leaders in science, industry and policy. Swaminathan is always one of the first to arrive on the culminating day of the Institute at which students present summaries of their own papers. He carefully listens to students' recommendations on solutions to alleviate hunger and poverty, and personally discusses their research with them (Figures 16–18).

As an extension of the Global Youth Institute, the World Food Prize Foundation's prestigious Borlaug-Ruan International Internship provides high school students an all-expenses-paid, eight-week hands-on experience working with world-renowned scientists and policymakers at leading research centers in Africa, Asia, Latin America

and the Middle East. The Borlaug-Ruan International Internship is unique from other study abroad internship programmes in that students conduct original research



Figure 16. Swaminathan surrounded by students attending the 2014 World Food Prize Global Youth Institute.

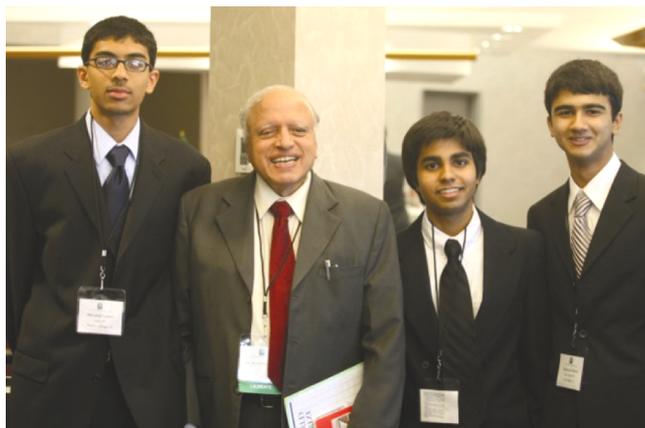


Figure 17. Swaminathan with Global Youth Institute students.



Figure 18. 2014 Global Youth Institute group photo: front row from right – Mina Swaminathan, Swaminathan, Lisa Fleming (Director of Global Education Programs), Kenneth Quinn (President of the World Food Prize), Sanjaya Rajaram (2014 World Food Prize recipient), Claudia Schickler (Iowa Youth Institute sponsor), Libby Crimmings (Co-Director, World Food Prize National Youth Program), Keegan Kautzky (Co-Director, World Food Prize National Youth Program).

projects directed by our Laureates as well as other acclaimed international scientists while getting a personal view of pressing food security issues and nutritional problems in poverty-stricken areas of the developing world. In the process, they immerse themselves in new cultures and learn firsthand about local populations and the real-life challenges of global food security.

Swaminathan's research facility, MSSRF, has hosted 16 Borlaug-Ruan interns in Chennai, India since 1999. Interns have been immersed in a diversity of projects addressing issues such as (but not limited to): how the Information and Communication Technology (ICT)-enabled Village Knowledge Centers (VKC) facilitate local women in accessing services and improving their socioeconomic status; and how community-managed small-scale irrigation systems have affected the lives of rural women. Interns have also had the opportunity to work on projects and research focused on: microfinance and microenterprise in rural villages; trichogramma wasp production; bio manure and hybrid seed development; and banana waste paper production (Figure 19).

The journey of so many young World Food Prize trainees to become real-world practitioners has been initiated and sustained through Swaminathan's personal mentorship. These Borlaug-Ruan interns – who spent a summer under the mentorship of Swaminathan and his MSSRF team – are now actively confronting hunger and global issues through a rich diversity of educational and professional fields, including agronomy, plant pathology, and global food production; foreign policy and law; international agricultural education; medicine, maternal health and global health; international tourism and filmmaking; global resource systems and environmental studies; civic and social organization; and agricultural and biological engineering.

Agronomist Katherine Seiser Taylor was a 2007 Borlaug-Ruan Intern at the MSSRF. 'Dr Swaminathan champions the concept of "paying it forward",' she said. 'Not only has his life's work been devoted to improving food



Figure 19. Swaminathan talking with 2007 Borlaug-Ruan Intern Katherine Seiser Taylor at the Global Youth Institute.

security, but he has used acknowledgements of his accomplishments to further his mission. And with each success, he made room for others to succeed as well. Dr Swaminathan's work expands so vastly beyond plant breeding. It reminds me that there is always room in the crusade against hunger for a myriad of disciplines.'

Lisa Fleming, World Food Prize Director of Global Education Programs for the past 15 years, stated: 'Dr Swaminathan has created a legacy of positive change and profoundly impacted the lives of many young people around the world'. She continued: 'He has inspired our Borlaug-Ruan interns to look deep within themselves to ensure they are doing their best to achieve their full potential. Just like the "symphony of ingredients" Dr Swaminathan explained was necessary to achieve the Green Revolution, or the combination of agronomics required to achieve the greatest yield potential from a crop, Dr. Swaminathan and his MSSRF team have carefully assembled all of the essential components that make experiential learning for our Borlaug-Ruan interns so successful.'

The timeliness in the lives of the young interns of the international internship experience at the MSSRF and other host sites abroad is significant. The internship creates life-defining moments at a critical period in the interns' lives (when they are considering their future academic and career paths) that shape who they are and how they see the world. It opens doors for students professionally and academically, provides interns the nurturing and confidence necessary to believe in themselves, to earn advanced degrees if desired, and to follow career paths leading toward long-term and engaged research. As one intern expressed, the experience 'reaffirms that "normal folks" from modest backgrounds with a passion to improve livelihoods can pursue excellent, independent research'.

When polled, all MSSRF intern alumni unanimously expressed that they were grateful for the opportunity to work in India, but most importantly, to learn from Swaminathan – such a humble, intelligent leader and kind man. He works with the students personally, getting to know them and encouraging each individual in his or her educational pursuits. He and his wife Mina have graciously invited students into their home for dinners and conversation (Figure 20).

Alumni have conveyed that they found Swaminathan's unwavering commitment to improving the livelihoods of smallholder farmers and his foundation's emphasis on sustainable agriculture solutions extremely reassuring as the global community works to end hunger and food insecurity. While the MSSRF interns witnessed dire poverty and human suffering in India, they also gained awareness of the resilience of the hungry and vulnerable and how hope, perseverance, and the true beauty of the human spirit can overcome incredible odds with grace and dignity.

According to intern testimonials, Swaminathan's ethic toward life captivated and transformed them. Swaminathan has always set an admirable example of the values, attitudes, and behaviors associated with being a scientist with a social conscience. This is a perspective and leadership style that the interns strive to emulate every day. Among the many positive qualities and lessons that Swaminathan has modeled for the interns are how he:

- Shows compassion for all humanity, especially those invisible to society at large – mainly the rural poor, women and children;
- Understands that the pursuit of scientific discovery without humanism is empty;
- Understands the importance of cooperation in working on solutions to food insecurity;
- Demonstrates a holistic and respectful relationship with the land; and
- Shows that all sincere effort, dedication and resolve can generate impact.

In addition, the MSSRF experience has considerably improved interns' cultural sensitivity and instilled in them a sense of moral responsibility for alleviating world hunger. The young trainees have learned from Swaminathan that the health of our families and communities is everyone's concern and responsibility, and that our problems can have sustainable solutions if each of us makes a daily habit of lending our time, attention, and talents to the common need, be it in our own communities or half a world away.

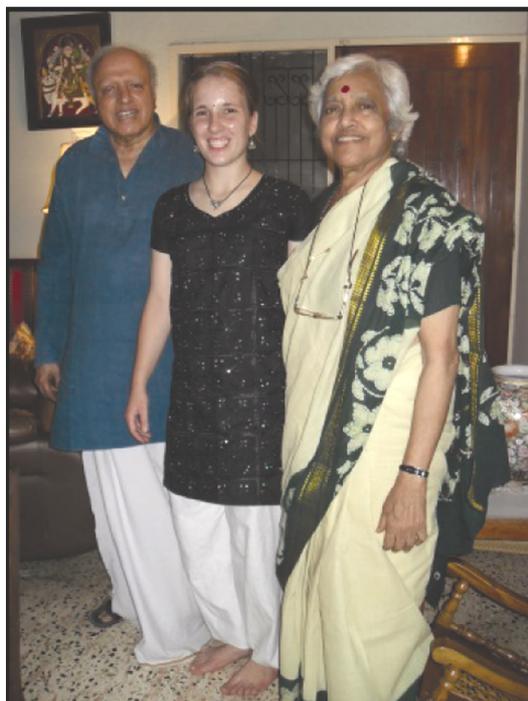


Figure 20. 2010 Borlaug-Ruan Intern Jenna Moser at the home of Swaminathan and his wife Mina.



Figure 21. M. S. Swaminathan, one of the most influential Asian leaders.

Swaminathan continues to offer inspiring words of encouragement to our students, as he inscribed in a copy of his biography that he gave to an MSSRF intern alumnus, ‘Please keep up the traditions of the World Food Prize Interns and become an affirming flame in the quest for a hunger-free world.’

When asked to reflect on the MSSRF internship and the indelible mark that Swaminathan and his work have had on young World Food Prize interns and countless other trainees from around the world, Blake McGhghy (2012 Borlaug-Ruan MSSRF Intern alumnus), now a Harvard University student studying social science with a focus on civic and social organization, stated: ‘I learned to more fully understand how hunger does not exist in a vacuum, but rather is a symptom of the broader problems of environmental degradation, poverty, and powerlessness. Thanks to the inspiration that Dr Swaminathan provided, many have become committed to helping address these challenges to promote a more food secure world.’

One of the 20 most influential Asian leaders of the 20th century

Inspired by Mahatma Gandhi, a colleague of Borlaug, and a citizen of the world, Swaminathan, a son of India, belongs to the rarefied pantheon of the world’s most outstanding agricultural leaders and humanitarian heroes. It is a privilege to call him my mentor, my colleague and my friend (Figure 21).

He is a bold visionary and a tireless pragmatist who, through the application of science and the formulation of policy, has worked for the eco-friendly, sustainable production and distribution of food that can, in his words, ‘deal with the growing damage to our life-support systems, ... [and also] confer tangible ecological and economic benefits’ in countries with pervasive poverty and expanding populations.

Just as the large mural of Swaminathan in the World Food Prize Hall of Laureates honours him as our first laureate, there is another artwork, while smaller in size, that is even more impactful. In the entry hall of the World Food Prize Hall of Laureates, there is a white marble plaque on which is engraved a poem by Ranier Maria Rilke (quoted below). Swaminathan referenced these words during the awarding of the Congressional Gold Medal to Borlaug.

Yet, as I am certain Borlaug would wholeheartedly agree – there is no man alive today to whom these words could be more fittingly addressed than to Swaminathan, his great friend and brother, partner in the fight against hunger, shepherd to the World Food Prize, mentor to the next generation of hunger heroes, and inspiration to us all.

*Again and again in history
Some special people wake up
They have no ground in the crowd
They move to broader laws
They carry strange customs with them
And demand room for bold and
Audacious actions
The future speaks ruthlessly through them
They change the world.*

1. Memorandum from Kenneth Quinn to Hon. Jimmy Carter regarding the appointment of Dr Swaminathan to the World Food Prize Selection Committee, 11 January 2007.
2. First person reminiscence told to Shobha Warriar, rediff.com, 6 October 2010.
3. Interview with World Food Prize Communications Director, 2014.
4. Rao, N., *M. S. Swaminathan in Conversation with Nitya Rao: The Ethics and Politics of Science*, M.S. Swaminathan Research Foundation, Chennai, 2014, p. 27.
5. Swaminathan, Plenary Breakfast Address, World Food Prize Borlaug Dialogue International Symposium, 17 October 2014
6. Rao, N., *M. S. Swaminathan in Conversation with Nitya Rao: The Ethics and Politics of Science*, M.S. Swaminathan Research Foundation, Chennai, 2014, p. 26.
7. Rao, N., *M. S. Swaminathan in Conversation with Nitya Rao: The Ethics and Politics of Science*, M.S. Swaminathan Research Foundation, Chennai, 2014, p. 51.
8. E-mail communication from Al Clausi to Kenneth Quinn, 10 January 2015.
9. E-mail communication from Dr Philip Nelson to Kenneth Quinn, 15 January 2015.
10. Sanchez, P. and Swaminathan, M. S., ‘Cutting world hunger in half’. *Science*, 2005, **307**, 357–359.
11. Sanchez, P. and Swaminathan, M. S., *Halving Hunger: It Can Be Done*, Earthscan Publishers, London, 2005, p. xvi.
12. Statistics cited in *The State of Food Insecurity in the World 2014: Strengthening and Enabling Environment*, FAO, IFAD, and WFP; Rome, 2014.
13. Swaminathan, M. S., U.S. Congressional Gold Medal Award Ceremony to Dr Norman E. Borlaug, U.S. Capitol, Washington D.C., 2007.
14. Swaminathan, M. S., Interview with World Food Prize Communications Director, Des Moines, Iowa, 2014.
15. Swaminathan, M. S., Zero Hunger. *Science*, **2014**, **345**(6196), p. 491.