Prof. M.S. Swaminathan

A Memoir

डॉ. मणकोम्बू साम्बशिवन स्वामीनाथन
(मरणोपरांत)

मैं, भारत की राष्ट्रपति, द्रौपदी मुर्मु, व्यक्तिगत गुणों के लिए आपके सम्मानार्थ, भारत रत्न प्रदान करती हूँ।

द्रौपदी
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Prof. M.S. Swaminathan

A Memoir

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Foreword

It is indeed an honor for me to write foreword for the volume entitled "Prof. M.S. Swaminathan: A Memoir", a tribute to one of the most eminent and transformative figures in the annals of Agricultural Sciences. Prof. M.S. Swaminathan's decades-long-journey has left an indelible mark on India and the global community. His visionary leadership and unparalleled contributions to agriculture not only averted a national famine but also established a robust foundation for sustainable agricultural practices worldwide. His pioneering role in spearheading the Green Revolution transformed India from a food-deficit to a food-surplus nation. This monumental achievement countered dire predictions of widespread famine and population decimation, earning him the well-deserved title of the "Father of the Green Revolution" in India.

This memoir encapsulates the reflections and tributes from a multitude of distinguished National and International personalities, each adding a unique perspective to Prof. Swaminathan's exemplary journey. As we navigate through the pages of this memoir, we embark on a journey through the life and achievements of a visionary whose dedication to the advancement of agricultural practices has reshaped the very fabric of our Society.

The memoir also highlights Prof. Swaminathan's multifaceted contributions beyond agriculture, including his pivotal role in establishing key Institutions and his advocacy for policy reforms to benefit small-scale farmers. These insights, coupled with personal reflections from colleagues, offer a rich tapestry of Prof. Swaminathan's life and work, illuminating the profound impact he had on generations of scientists, policymakers, and farmers alike.

This memoir not only pays tribute to the extraordinary career of Prof. M.S. Swaminathan but also serves as a valuable resource for future generations of scientists, policymakers, and agricultural enthusiasts. It encapsulates the essence of his visionary leadership, offering insights into the challenges faced and the triumphs achieved along the way.

I extend my heartfelt gratitude to the authors, NAAS team, and all the contributors who have painstakingly crafted this memoir, capturing the essence of Prof. Swaminathan's remarkable journey. May this publication serve as a Coffee Book guiding us towards a better future where agriculture thrives, and humanity flourishes.

Himanshu Pathak
(President, NAAS)

Preface

Dr. A.B. Joshi (Former Director, IARI and DDG Crop Science, ICAR) has rightly said that "*M.S. Swaminathan has been the most eminent research scientist that India has ever produced- one like him in the past and there shall be none like him in the far distant future. But for Dr. Swaminathan, the green revolution in India would never have been taken place. But for his contributions, India today would have been decimated, depopulated country, as prophesied by the American doomsayers, the Paddok Brothers. Prof. Swaminathan alone has been the savior of India*." Prof. Swaminathan has been unmatched saviour of Indian agriculture and farmers besides conservation of our environment. In fact, Prof. Swaminathan and Green Revolution in India are synonymous. Realizing ecological and social harms associated with Green Revolution, he worked for Evergreen Revolution with pro-nature, pro-poor, pro-women and pro-livelihood technologies. In his early part of professional journey he provided visionary leadership at Indian Agricultural Research Institute (IARI), Delhi, and Indian Council of Agricultural Research (ICAR), New Delhi. Thereafter he continued to provide dynamic leadership role at International Rice Research Institute (IRRI), Manila (Philippines). As he never wanted to rest, he established M.S. Swaminathan Research Foundation (MSSRF) in 1987 to improve lives and livelihoods of communities using modern science and technology. The motivation behind his journey was *to develop a hunger free India-an India which will not go with the begging bowl, an India which will not go on with a ship-to-mouth existence*.

He was responsible for establishing several Institutions in the Country such as Agricultural Scientists Recruitment Board (ASRB) to search for talented gene pool through Agricultural Research Services (ARS); National Academy of Agricultural Research Management (NAARM) to produce effective Science Managers and National Academy of Agricultural Sciences (NAAS) for creating a Think Tank. Further, to ensure that the Science is relevant for the Society, he played a crucial role in establishing Krishi Vigyan Kendras (KVKs) in the Country.

Prof. Swaminathan, the founder President of NAAS, had nurtured the Academy for nearly 30 years. This has been serving as a useful platform to voice independent and valuable opinion on agricultural policies. As he has been

closely associated with the Academy since inception, the Academy under the leadership of Dr. Himanshu Pathak (President, NAAS) decided to bring out a MEMOIR to remember and cherish his life time accomplishments. Truly speaking, this has not been an easy task. The opening chapter of the compilation is by Prof. Anupam Varma on his biographical sketch (1925-2023), followed by messages (34) from eminent scientists, policy makers, his friends, students and fellows of the Academy.

We are very much thankful to Dr. Pathak for his valuable guidance in compilation of this memoir. We convey our appreciation to all who have contributed their reflections about Prof. Swaminathan. We also thank the esteemed fellowship of the Academy and entire staff for their assistance in bringing out this volume. We are also thankful to Malhotra Publishing House for bringing out this Memoir.

V.K. Baranwal & R.K. Jain
(*Editors, NAAS*)

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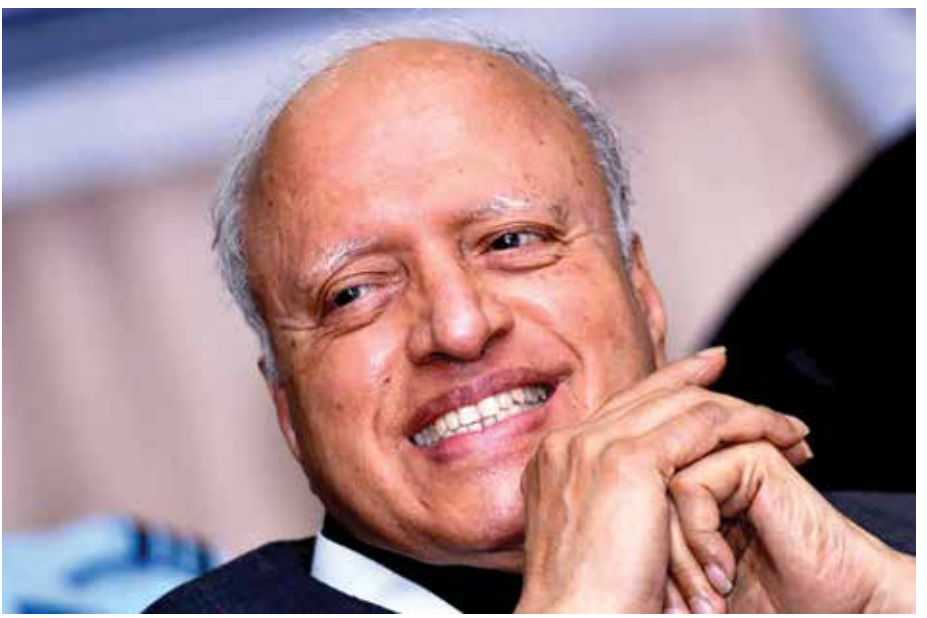
Bharat Ratna Prof. M.S. Swaminathan: One of The Greatest Gifts of God to India

Prof. Anupam Varma

Prof. Monkombu Sambasivan Swaminathan was borne on August 7, 1925 at Kumbakonam in Tamil Nadu; his first name is drawn from the name of the scenic village Monkombu in Kerala where his family is famous for pioneering paddy and coffee cultivation. His second name is drawn from his father's name - Dr. M.K. Sambasivan, a respected doctor and Civil Surgeon of Kumbakonam, where he is credited to eliminating the vector mosquito species and successful management of the dreaded filariasis disease, through interactive societal participation in the application of scientific techniques. Mother of Prof. Swaminathan – Thirumadi Thangammal, had enormous influence on his life as in the words of Prof. Swaminathan "She was the embodiment of all that is good and great in Indian womanhood – unilateral love, patience, hard work, and taking pain and pleasure with equanimity".

Prof. Swaminathan had early education at the Catholic Little Flower High School in Kumbakonam. In 1940, he joined the University College, Trivandrum



Prof. M.S. Swaminathan; ***Photo Credit:*** *Nagara Gopal (The Hindu)*

to study Zoology, and obtained B.Sc. degree in 1944. However, distressed by the low yields of paddy and poverty of the farmers and the devastating Bengal famine in 1942-43, Prof. Swaminathan made 'food security' a mission of his life and joined the Agriculture stream and obtained B.Sc. degree in Agriculture in 1947 from the famous Agriculture College and Research Institute (that later became Tamil Nadu Agricultural University), Coimbatore, and the Associateship of Indian Agricultural Research Institute (IARI) (1949) - a two-year diploma equivalent to M.Sc. degree, with specialization in Genetics and Plant Breeding, under the guidance of Dr. Harbhajan Singh – a renowned proponent of conserving and utilizing plant genetic resources, who must have motivated Prof. Swaminathan in selecting 'Non-tuber bearing Solanums' for the Associateship dissertation. Prof. Swaminathan continued the interest in potato during the UNESCO-Netherland Fellowship tenure (1949-50) at the Netherlands Agricultural University, Wageningen. In the Netherlands, golden nematode had emerged as a serious problem and he was assigned the challenge of transferring genes from wild relatives of potato to develop resistance in cultivated potato to nematode infestation and frost damage; he successfully developed techniques for transferring the desired genes from wild *Solanum* spp. to cultivated potato, *S. tuberosum*. He followed this up during his Ph.D. programme (1950-52) at the School of Agriculture of Cambridge University in Trumpington, UK, where he worked on 'Species differentiation, and the nature of polyploidy in certain species of the Genus *Solanum*, sect. *Tuberarium*', under the guidance of Dr. Harold W. Howard. Prof. Swaminathan's classic work on 'cytology and genetics of potato' and 'induced polyploidy in non-tuberous Solanums and interspecific hybridization' are still being widely quoted.

After obtaining Ph.D. degree of Cambridge University in 1952, Prof. Swaminathan briefly worked as a Research Associate at the University of Wisconsin, Madison, where he developed a frost-resistant potato hybrid by transferring the gene for frost-tolerance from tuber-bearing *S. acaule*, that grows at 4000 m in the Andean ranges in Peru using an innovative technique that was later known as 'Swaminathan artificial stigma method'; this hybrid was later used to develop a frost resistant potato variety Alaska Frostless. The University of Wisconsin offered him a regular teaching-cum-research professorship, which he did not accept and returned to India in January 1954 to follow up **his mission of improving crop productivity in the country**.

Prof. Swaminathan

He worked for a short time at the Central Rice Research Institute, Cuttack, in a temporary position as an Assistant Botanist to breed fertilizer-responsive *indica-*

japonica hybrids of rice, before joining the IARI in October 1954 as Assistant Cytogeneticist in the Botany Division, soon he was promoted to the positions of Cytogeneticist (1956) and in 1961 he became the Head of Division of Botany. In July 1966 he was appointed the Director of IARI. These twelve years were also the period of awakening of agricultural research in the country when from the gloom of ship-to-mouth existence to the hope and cheer of food self-sufficiency, and emergence of a visionary scientific leader - Prof. M.S. Swaminathan.

On the advice of the legendary plant breeder, Dr. B.P. Pal, who was the Head of the Division of Botany at the IARI in 1954, Prof. Swaminathan initiated transfer of genes of interest from wild to cultivated wheat on the lines of his path-breaking work related to the development of potato hybrids for frost tolerance and resistance to the golden nematode *Heterodera rostochiensis*. Motivated by Dr. B.P. Pal, Prof. Swaminathan's group laid the foundation of understanding of the basic chromosome numbers, monosomic analysis for identification of chromosome carrying genes of interest, polyploidy and radiosensitivity, induction of haploidy by radiation, induction of awning, effect of neutron radiation, mutations induced by physical and chemical mutagens, on the genome of bread wheats and other graminaceous species, published in prominent journals like *Nature* and *Science*. In recognition of the path-breaking scientific contributions, Prof. Swaminathan was awarded the prestigious Shanti Swarup Bhatnagar Award of the CSIR (1961), and Mendel Memorial Medal of the Czechoslovak Academy of Sciences (1965).

A major challenge for the plant breeders at that time was to develop non-lodging and fertilizer responsive varieties of wheat, as the varieties like NP 809 and NP 824 developed for resistance to stem, stripe and leaf-rusts with the efforts of Dr. B.P. Pal were tall and prone to lodging with yields of less than one tonne per hectare. Knowing that Dr. Orville Alvin Vogel has developed short strawed and high yielding winter wheat varieties at Washington State University, USA by using wheat var. Norin-10 - a dwarf wheat developed by an agronomist, Gonjiro Inazuka, in Japan, Prof. Swaminathan requested Dr. Vogel in 1960 for the seeds of Norin-10. Dr. Vogel informed Prof. Swaminathan that Dr. Norman E. Borlaug, has successfully transferred the dwarfing gene to spring wheats in CIMMYT, Mexico from var. Norin-10 and its derivatives. It was

Dr. Borlaug and Prof. Swaminathan examining the performance of Mexican wheats in 1964

good news. On the request of Prof. Swaminathan, Dr. Borlaug readily agreed to supply suitable material after examining the wheat growing conditions in India. On the invitation of Government of India, Dr. Borlaug visited India in March 1963, and travelled extensively the wheat belt of India with Prof. Swaminathan and his colleagues – S.P. Kohli, M.V. Rao and V.S. Mathur. The first consignment of seeds of Mexican dwarf wheat varieties Lerma Rojo-64A, Sonora 63, Sonora 64, Mayo 64 and other strains – the seeds that led the Green Revolution in India, were received in September 1963 and sown in a 2-hectare field at the IARI. The Mexican varieties were free from pests and diseases and produced two to three times more grains, but the colour of the grains was not preferred by the consumers in India.

The task, of improving the Mexican varieties to meet the local needs and their quick adoption for increasing production, was gigantic. A major concern of the country at that time was the dependence on imports to maintain food grain buffer stocks for various needs; in 1966, the country imported 10 million tonnes of food grains under PL 480. To accelerate production, in 1966 a bold decision taken at the instance of Shri C. Subramaniam, India imported 18,000 tonnes seeds of Mexican wheats - the largest amount of seed import in a single consignment in the history of agriculture. In the meantime, mutation breeding for changing the red grain colour and improving disease resistance and *chapati*

Prof. Swaminathan explaining the significance of dwarf wheats to Prime Minister Lal Bahadur Shastri ji during his visit to IARI, that expedited import of large quantities of wheat seed from Mexico

making quality of the grain, and development of suitable agronomic practices helped in achieving a quantum jump in wheat production of 17 million tonnes in 1968. It was made possible by Prof. Swaminathan's dynamic leadership and innovative strategies that the country quickly developed amber-colour wheat and technologies that resulted in quick increase in wheat production. The wheat evolution in India is a great success story of human endeavor and synergy between scientists, policymakers, politicians, and above all the farmers for adopting the new technologies, which led the Green Revolution, which Prof. Swaminathan liked to refer as "Forest-saving Agriculture" as much of the increase in wheat production came from increased productivity and not in increase in the area.

Prof. Swaminathan has been following the "explosive progress of the science of molecular genetics, opening up uncommon opportunities for transferring genes across sexual barriers" (in his own words) since his Ph.D. days (1950-52) at the University of Cambridge as he used to visit the Cavendish Laboratory where his contemporary James Watson and Francis Crick were working on the molecular structure of DNA in association with Maurice Wilkins and Rosalind Franklin. His interest in modern biology continued unabated, and always motivated the students to apply the emerging new tools in their research for the benefit of mankind.

Secret of Life *– dance choreographed by Mrs. Mina Swaminathan based on DNA structure and performed by the students of IARI. Photo courtesy Dr. Asha Sarbhoy*

The BBC telecast an interview of Prof. Swaminathan in early 1967. I was fortunate to watch it live at that time, I was completing my Ph.D. programme at the Rothamsted Experimental Station, UK. The interview was a brilliant exposition of Prof. Swaminathan's ideas and vision of Indian agriculture. He emphasized that agriculture in India is on the cusp of a new era and will soon emerge as a leading producer of food grain by developing and adopting eco-friendly new agronomic practices suitable for small-sized farms and conserving

the finite resources. He underlined that the agriculture production in India is predominantly based on the use of renewable resources but our productivity is low. The need is of a revolution through the adoption of high-yielding crop varieties and introduction efficient production technologies for relay cropping, soil conservation, nutrient supply, irrigation, pest and disease management, reducing post-harvest losses, effective land-use and improving productivity of the small-sized farms. He appreciated the active participation of dedicated multidisciplinary teams of scientists for their efforts in demonstrating quantum increase in wheat productivity, and was confident of the transformation in Indian agriculture. He showed the way forward. His interview was highly inspiring.

The pre-GR period was an exciting period for all sciences in India, and the country had introduced a scheme to offer the temporary position of 'CSIR-Pool Officer' to attract the scientists working or studying in other countries. I obtained Ph.D. from London University in July 1967, and joined the Division of Mycology and Plant Pathology, IARI, as a 'CSIR – Pool Officer' on August 28, 1967. The same day I had a memorable meeting with Prof. Swaminathan. These were defining moments of my life. Since then I have been fortunate to receive his benevolent blessings and closely work under his guidance.

Late 1960s was a period of excitement and happiness in the entire NARS in general and the IARI in particular due to the spectacular progress across agricultural sciences. Motivated by Prof. Swaminathan's vision and dedication to make India a food secure nation, the multidisciplinary teams of scientists played a pivotal role in launching 'wheat revolution', that was celebrated by the country with the release of a special postal stamp by the then Prime Minister Mrs. Indira Gandhi in July 1968 at the premises of the newly built Nuclear Research Laboratory, another brain child of Prof. Swaminathan. It was a moment of great anticipation and celebration in the country. Even today the memory of the event and thundering applause is fresh in my mind.

A special postal stamp being released by Prime Minister Indira Gandhi at the IARI to celebrate the Green Revolution

Prof. Swaminathan was a 'parasmani' (touchstone with miraculous powers) with the ability to instill hope and excellence in every one who came in touch with him, and his photographic memory and ability recall faster than the super-computers were transformative. He used to have regular monthly meetings, with all the scientists and the key administrative and audit personnel,

in the auditorium – now known as Dr. B.P. Pal Auditorium, to discuss scientific progress and achievements, and resolve administrative and organizational hurdles if any. His message to the administrative and audit personnel was that their role is to provide support for effective work environment and efficient scientific productivity. Prof. Swaminathan's top priority was science-led advancement, and he was ever ready to personally see the significant basic or applied scientific achievements of the scientists, and appreciated the work and naming the scientist in the monthly meetings. Prof. Swaminathan addressing every scientist by their first names and appreciation of their work and guidance for moving forward was highly motivating, it made every one bubble with optimism and work tirelessly. These meetings had enormous impact in building positive mindset and team dynamics.

Non-availability of residential accommodation in the vicinity of IARI for the majority of the scientists was a major constraint, as commuting was a drain on their time and energy. To find solution, Prof. Swaminathan not only readily agreed to my request to register a group housing society, but also signed as the first member of the society. The society was registered in 1971, with the objective to build flats close to the Institute with the approval of the Delhi Development Authority (DDA). It would have been a game changing situation, but the plot of land allotted by the DDA was too far, defeating the purpose of saving commuting time! Although it provided opportunity for many to build their dream homes.

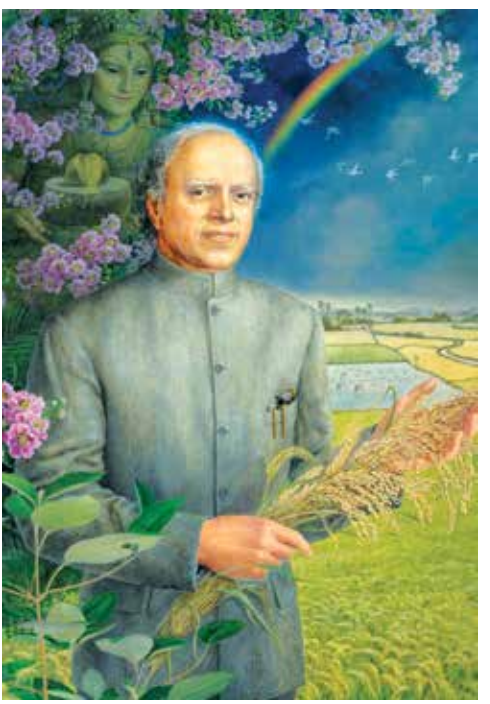
In 1972, he was appointed Director General of the Indian Council of Agricultural Research (DG, ICAR) and Secretary, Department of Agricultural Research and Education (DARE), Government of India. In the same year, he was conferred **'Padma Bhushan'** another civilian honour by the Government of India for distinguished service of higher order in the field of science. Prof. Swaminathan, brought vibrancy to the national agricultural research system by first ensuring elevation of the position of DG, ICAR to the level Secretary, Government of India, and preparing a road map for research across the disciplines of agricultural sciences to meet the emerging challenges of food security in the backdrop of dwindling natural resources and changing environment. I was blessed to have had opportunity to continue to close interaction with him and receive his guidance, as a part of the five-member committee he constituted to suggest reorganization of the ICAR.

In 1973, Prof. Swaminathan conceptualized and created the Indian Agricultural Research Service (ARS) to lay foundation for networking of agricultural scientists for accelerate development of innovative solutions to the emerging and re-emerging problems and improving agricultural productivity. For an effective implementation of the ARS, an independent Agricultural Scientists Recruitment Board (ASRB) was also established. One of the most important unique feature of the ARS was that a scientist could rise to the top level of the ladder, while continuing to work in his chosen field of scientific endeavour. He

was a scientist by heart and desired that the scientist should continuously focus on their scientific research without any distraction or need to move to managerial position. Another important feature of the ARS was to open doors for Indian diaspora doing well in other countries to join ARS to bring diverse technologies and strengthen scientific research in the country. However, both these features were lost during ubiquitous bureaucratisation.

In 1980, when he joined the Union Planning Commission on the invitation of the then Prime Minister of India Mrs Indira Gandhi, he got a National Biotechnology Board (NBB) set up to promote molecular genetics and genetic engineering, it was the precursor of Department of Biotechnology. As the Chair of a Committee in 2004 he stressed 'The bottom line of our national agricultural biotechnology policy should be the economic well-being of farm families, food security of the nation, health security of the consumer, biosecurity of agriculture, protection of the environment, and the security of national and international trade in farm commodities'. However, in the back-drop of resistance in India to the use of GMOs due the fears of their potential adverse impact on human health, biodiversity and environment, he suggested that **"India should enact a comprehensive law on biosafety"** and the need of **"a cadre of Science communicators"** to create public awareness as "Biodiversity and Biotechnology need priority attention in efforts designed to bridge the Scientist–Society perception gap."

In 1982, Prof. Swaminathan was the first Asian to be appointed as the Director General of the International Rice Research Institute (IRRI) in the Philippines. In his capacity as the DG, IRRI (1982-88), he played a significant role in strengthening the national agricultural research system for improving rice productivity in several East-, South- and South Asian countries. It was during his tenure at IRRI that he was honoured with the inaugural World Food Prize in 1987 for his breakthrough achievement in improving the quantity, quality and availability of food in India and countries around the world. "In his role as the 'Dean' of the World Food Prize Laureates Prof. Swaminathan has been a guiding light in shaping and participating in the core activities



Mural of Prof. Swaminathan in the World Food Prize Hall of Laureates

and milestone events of the World Food Prize, … including as Chair of the Laureate selection committee."

The 15th Genetics Congress on the theme "Genetics: new frontiers; genetic organization, function and regulation" in New Delhi in 1983 was another important landmark. It was the largest congregation of > 3000 world geneticists. The Congress organized was by Prof. Swaminathan in his capacity as the President of the International Genetics Federation. The congress was a grand success due to his organizational prowess. He took periodic meetings of the organizing committee to review the progress of the tasks assigned to individual members, who were given complete freedom to plan and execute their tasks. It was a wonderful learning experience as a part of the organizing committee. Prof. Swaminathan's Presidential address on Genetic conservation: microbes to man, was memorable and laid the foundation for conservation of biodiversity of all living forms.

In 1988, Prof. Swaminathan returned to India and stayed in Delhi for some time. It was an exciting time as he was looking for a suitable place to establish a research centre using the World Food Prize money; he had built a very impressive model of the proposed research centre. Finally, using the proceeds of the World Food Prize, Prof. Swaminathan established the 'M.S. Swaminathan Research Foundation' (MSSRF) in Chennai, Tamil Nadu, India, in 1988 as a not-for-profit NGO. The main driving force behind the establishment of the MSSRF was the need to accelerate research for the conservation and utilization of biodiversity; capacity building of the farm communities to empower them for blending modern and traditional technologies for enhancing food production to end malnutrition and hunger; and development of model farms for demonstration of self-reliance in the application of problem solving eco-friendly approaches; and policy advocacy. To achieve these objectives the MSSRF developed programmes on (i) coastal systems research, (ii) biodiversity, (iii) biotechnology, (iv) eco-technology, (v) climate change, (vi) agriculture, nutrition & health, (vii) gender, and (viii) grass-root institutions.

In 1981, Prof. Swaminathan, envisioning the significance of the role of mangroves in climate change mitigation and also as a source of useful genes - particularly for salt tolerance, initiated anticipatory research at the MSSRF for conservation of mangrove wetlands and utilizing the valuable genetic resource particularly for developing salt tolerant crop plant varieties by using salt-tolerant genes of mangrove plants. This initiative lead to the launch of the Coastal Systems Research Programme in 1991 for conservation of mangrove wetlands and sustainable utilization of their resources. To conserve plant biodiversity of the Western Ghats and promote economic growth, the MSSRF established the Community Agro Biodiversity Centre (CAbC) at Wayanad district in 1997; starting with 13 acres, the CAbC campus is now spread over 46 acres. Many farmers in the area have become custodian of some unique plant genotypes with the support of the Protection of Plant Varieties and Farmer's Rights (PPV&FR),

which was established in 2001 with the vision and support of Prof. Swaminathan; it is a novel system linking science with society.

The biotechnology group of the MSSRF is playing an important role for capacity building and developing skilled human resource for biotechnology research. The group has produced valuable data on genetic fingerprinting of saline tolerant mangrove and associate species, characterisation of genes of interest from mangroves and their utilization; these and the other achievements of the MSSRF were the major highlights of Prof. Swaminathan's response to the Award of the Indira Gandhi Prize for Peace, Disarmament and Development (2000). The JRD Tata Ecotechnology Centre was established at the MSSRF in 1996 to develop innovative models for sustainable eco-friendly agriculture to promote sustainable rural livelihoods and gender and social equity.

The MSSRF building in itself is a model of energy saving eco-friendly architecture; solar-energy is used to meet most of the needs, including the requirements of the data centre. The data centre has played an important role in developing trained human resource in data management; it will be of interest to know that with the help of Prof. Swaminathan ji some personnel of the Academy were also trained there in the early 1990s. I have had the privilege of also visiting the Village Knowledge Centre at Pondicherry, to see wonderful impact of the initiatives of the MSSRF in the rural areas through the empowerment of rural communities in learning new technologies and their use in holistic development of villages following eco-friendly management of the resources for meeting food and nutrition requirements of the communities. Remodelling of the villages to eco-villages with the efforts of the MSSRF in Tamil Nadu and Kerala is leading silent transformation of villages in other parts of the country.

His stay in Delhi 1988, provided me a good opportunity to get his valuable guidance in planning a symposium on 'Preparing for the agricultural challenges in the 21st Century' in my capacity as the President of Agricultural Sciences of the Indian Science Congress. The symposium was held during the 76th Session of the Indian Science Congress in January 1989 at Madurai. We were fortunate to have had the blessings of *Bharat Ratna* Shri C. Subramaniam ji who has been the guiding force of Green Revolution in India, as the Chief Guest of the symposium, and Prof. Swaminathan, who Presided over the function and also delivered the inaugural lecture. Prof. Swaminathan, highlighted climate change and agricultural sustainability as the major emerging challenges, emphasizing the need for undertaking anticipatory research to reduce the adverse impact of global warming that may result in widespread droughts and floods, emergence of pests and diseases, and decline in crop and farm-animal productivity.

During 1988, Prof. Swaminathan expressed the idea of establishing an Academy to motivate agricultural scientists by giving them recognition to promote agricultural research. This idea was discussed in a series of breakfast

Meeting of the Founder Fellows of the NAAS at the IARI, New Delhi - Nov. 1989

The Chief Guest of the First Agricultural Science Congress, Shri P.V. Narasimha Rao, (seated 5th from the left) and Prof. M.S. Swaminathan (seated 4th from the left) with other dignitaries and the NAAS EC Members

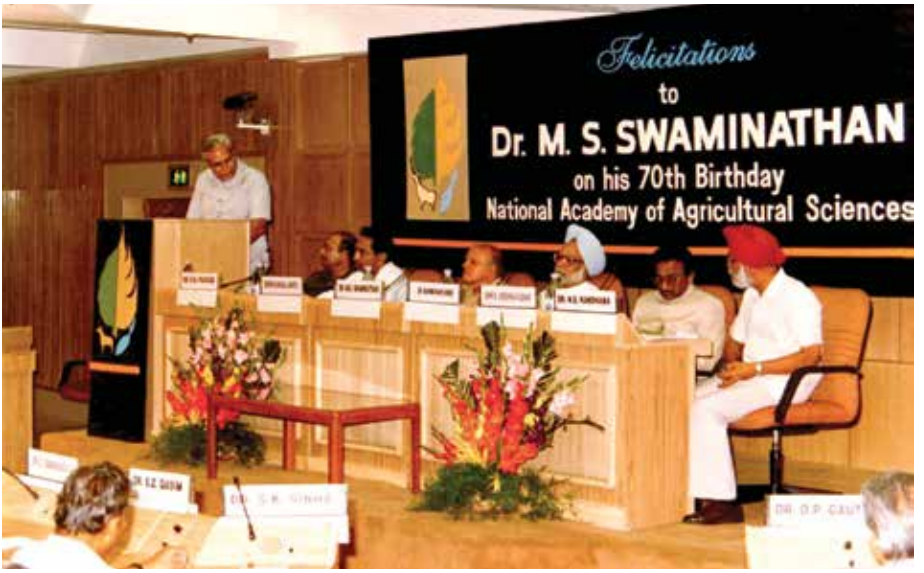
meetings at the IIC with Prof. Swaminathan and Dr. S.K. Sinha (ICAR, National Professor). As a follow up, a special meeting of the agricultural scientists was held under the Chairmanship of Prof. T.S. Sadasivan (former Head, Department of Botany, Madras University), during the 76th Session of the Indian Science Congress on January 3, 1989 at Madurai. The meeting was Co-Chaired by Prof. Swaminathan, in which he emphasized that the strength of agriculture lies in coordination and synergy of multidisciplinary approach. The country is fortunate to have established Scientific Societies, in various disciplines engaged in agricultural research, that provide good opportunity for close interactions between

the scientists of the disciplines. The need of agriculture is of a suitable platform for active multidisciplinary interaction. He also informed that to achieve this objective his mentor, Dr. B.P. Pal established a Federation of Indian Societies of Agricultural Sciences and Technology, based at the Indian Agriculture Statistics Research Institute, New Delhi. It served an important purpose of bringing the societies of various disciplines. However, for giving recognition and providing a platform to the agricultural scientists to express their concerns and opinion for the growth of agriculture the need is to establish an independent Academy. The idea was unanimously agreed, and it was decided to establish a "National Academy of Agricultural Sciences" (NAAS) at New Delhi, as a society on the pattern of other science academies.

Subsequently series of meetings of the INSA Fellows connected with agricultural sciences were held during 1989-90, under the Chairmanship of Prof. Swaminathan, to plan and draw roadmap for the proposed academy. The NAAS was finally established on June 6, 1990 with the blessings of Dr. B.P. Pal. The Academy organised the First Agricultural Science Congress at New Delhi, November 12-14, 1992, on the main theme 'Global Climate and Agriculture'; the Congress was inaugurated by the then Prime Minister of India Shri P.V. Narasimha Rao. Prof. Swaminathan was the Founder President of NAAS (1992 to 1996); it was a great learning experience for me to work with him as one of the three Secretaries of the Academy and help in the establishment of NAAS along with the other two Secretaries - Prof. S.K. Sinha and Dr. N.C. Ganguli.

In 1995, the NAAS celebrated the 70th Birthday of Prof. Swaminathan at the Vigyan Bhavan. The then Finance Minister of India Dr. Manmohan Singh was the Chief Guest. He praised Prof. Swaminathan for his genius and pioneering contributions to enhancing agricultural production through the introduction of modern technologies that has not only helped in changing the economic policy to promote competitive agricultural exports, including the food grains. The then President of India **Dr. R. Venkataraman** sent the following birthday greetings and message:

> ***"...Dr. M.S. Swaminathan is a living legend in our times, I offer him my greetings and good wishes for a long, healthy and happy life of continued service to the nation and to human kind. Pleasant, soft spoken, dignified but unassuming, Dr. Swaminathan has a demeanour which conceals his brilliant intellect, unparalleled achievements in science and research.... The Green Revolution which transformed our chronic food deficit country... has earned for him an indelible place in our national history".***



Under the Chairmanship of Prof. Swaminathan, the National Commission on Farmers (NCF), completed a mammoth task of preparing five reports between December 2004 and October 2006, containing the findings and policy recommendations on major issues of agriculture, including land reforms, irrigation, credit and insurance, food security, employment, productivity of agriculture and farmer competitiveness. The Government of India has accepted 200 of the 201 recommendations of the report, shown the report was unique and would have a long-term positive impact on Indian agriculture. As a nominated member Rajya Sabha from 2009 to 2013, Prof. Swaminathan promoted The Women Farmers' Entitlements Bill, 2011, raised the issues related to climate smart agriculture, impact of climate change on women, disposal of straw after harvest, alternative cropping strategies, reducing river pollution, problems of food grain storage, restructuring of proposed Food Security Bill as the 'Food and Social Security Bill', arsenic contamination of potable, etc. The views of Prof. Swaminathan must have had positive influence

Prof. Swaminathan and Dr. (Mrs) Mina Swaminathan arriving at the Parliament House

on the Members of the Parliament to accept nearly all the recommendations of the NCF.

Prof. Swaminathan's unique nature of being warm, gentle, always accessible and ever willing to help endeared him to everyone who got the opportunity of meeting him, and he showered his blessings on all. I was one of the privileged ones to get his blessings throughout my career. For me it was overwhelming to receive his blessings on my 70th Birthday. organized by Dr. R.K. Jain, Dr. Bikash Mandal and other friends at the Advanced Centre for Plant Virology (ACPV), IARI, New Delhi in 2010. Prof. Swaminathan was well known to always reach at the venue of any function well before time; well aware of this I reached the ACPV about 20 minutes before the function, but I was late Prof. Swaminathan was already there!!

In 2013, the Ministry of External Affairs (MEA) constituted a Task Force under Prof. Swaminathan's Chairmanship to oversee the projects related to Agriculture undertaken by the Government of India in Afghanistan and Myanmar. The project in Afghanistan was to establish the country's First Agriculture University in collaboration with the ICAR-IARI. On the recommendation of Prof. Swaminathan, the MEA appointed me a consultant to help in the establishment of Afghanistan National Agriculture Science & Technology University

Prof. Swaminathan discussing the 10-Year Plan of ANASTU; picture courtesy Dr. Vinod Prabhu.

(ANASTU). I was fortunate to get another opportunity to work under the tutelage of Prof. Swaminathan. It was a challenging job. However, with the guidance of Prof. Swaminathan a plan was prepared in December 2013, and ANASTU was inaugurated at Kandahar by the President of Afghanistan Mr. Hamid Karzai on February 14, 2014, in the august presence of Prof. Swaminathan. The First Batch students of M.Sc. Agronomy of ANASTU graduated on June 6, 2016. Prof. Swaminathan was proud of India's success in the quick start of the establishment of a first ever university in another country. The ANASTU programme continues as per the 10-Year Plan. Starting with one discipline in 2014, this year ANASTU is admitting M.Sc. students in nine different disciplines. A good progress that was made possible due to the amazing speed of guidance and approvals by Prof. Swaminathan.

The Gandhian thoughts of *caring for the needy*, *social justice*, *equity and dignity for all* had a great influence on Prof. Swaminathan from his childhood as his father, Dr. Sambasivan, was a devoted follower of Mahatma Gandhi, who also stayed in their house during visits to Kumbakonam. The thoughts of the Mahatma became life's mission for Prof. Swaminathan. In an interview in 2008, Prof. Swaminathan was asked the secret of his keeping young and he said there is no secret, **'one should have a mission in life to make a difference in the lives**

Prof. Swaminathan in his study with the photograph of the Mahatama

Prof. Swaminathan with the first Batch M.Sc. Agronomy students of ANASTU

of others'. He had many missions, but the main driving force was 'to achieve food security by providing economic, social and physical access to food and safe drinking water to all and transformation of small farms and farmers. To fulfil the dream, he introduced the lab-to-land program to ensure that the benefit of research reached those toiling in the fields. The welfare of the farmers was always his top priority.

Between 2002 and 2007, as the Chair of the United Nations Millennium Project on Hunger, and the Head of the Pugh Conference on Science and World Affairs, Prof. Swaminathan emphasized on the need to add environmental dimension to productivity improvement and advocating for a paradigm shift from a **green to an ever-green revolution** for addressing the emerging challenges associated with agricultural sustainability and achieving food security. He also promoted the concept of "trees on farms", that resulted in the founding of the International Council for Research in Agroforestry (ICRAF), and believed that "agroforestry is a pathway to food and nutrition security, livelihood security, ecological security, and climate risk mitigation and adaptation."

Prof. Swaminathan will always be remembered for rapid transformation of food system making India as one of the world's largest producers of food. However, Prof. Swaminathan was deeply concerned about the challenge of sustainability, as the rapid growth in agricultural production 'came at a heavy cost to the environment' – groundwater depletion and pollution, soil erosion, the loss of biodiversity. His major concerns were about the "ecological harm due to unsustainable exploitation of land and water … and excessive use of mineral fertilizers and chemical pesticides" and appealed to the farmers in January 1968 "not to harm the long-term potential for short-term gains". He was even more concerned about "ecologically unsound public policies, like the supply of free electricity…" leading to "deep ecological distress" of major farm lands. His message was clear that the need is to foster evergreen revolution by supporting organic farming in areas that lack organic matter and crop-livestock integrated farming will be useful in improving soil fertility, whereas in areas suitable for grain production the need is for "conservation farming movement" deploying ecologically sound practices by integrating cutting-edge technologies for "green agriculture" by integrated pest management, integrated nutrient supply, natural resource conservation, and use of varieties that resist biotic and abiotic stresses and more nutritive.

Prof. Swaminathan was the most respected and popular teacher and mentor. Nearly one hundred students – 22 M.Sc. and 77 Ph.D. were benefitted to work under his direct supervision for their thesis research. All his students have been valuable human resource for the development of agriculture in India and other countries. Prof. Swaminathan was a Fellow of many of the leading scientific academies of India and the world, including the Royal Society of London, the US National Academy of Sciences and Indian National Science Academy. He was honoured numerous national and international awards for his outstanding

contributions to agriculture. In addition to the inaugural World Food Prize, he was also the recipient of inaugural Shanti Swarup Bhatnagar Award, the Ramon Magsaysay Award, and the Albert Einstein World Science Award. He was awarded Honorary Doctorate Degrees by 85 Indian and foreign universities. Prof. Swaminathan made significant contributions as Chairman and other key positions of a large number national and international organisations on key issues related to agriculture.

Prof. Swaminathan passed away, at the age 98, on September 28, 2023 at his residence in Chennai. He is survived by three daughters — Dr. Soumya Swaminathan, a pediatrician and a globally recognised researcher on tuberculosis and HIV, is now the Chairperson of the MSSRF; Dr. Madhura Swaminathan, is Professor, at Indian Statistical Institute, Bengaluru, and Dr. Nitya Rao, is Director, NISD, University of East Anglia, UK. His wife, Dr. Mina Swaminathan, a school teacher, educator, educationist, and child care expert, and the founder of the Integrated Child Development Scheme (ICDS), was the Distinguished Chair, Gender and Development, MSSRF; she died in March 2022.

In a tribute to Prof. Swaminathan, Prime Minister Narendra Modi said:

> ***"Swaminathan loved India, and wanted our nation, our farmers in particular, lead a life of prosperity... He understood the principle described in the Tamil classic The Kural 'that farmers are the pin that holds the world together because it is the farmers who sustain every one'... He was a true farmer' scientist".***

The Farmers' Scientist, Prof. M.S. Swaminathan was happiest when he was with the farmers. Picture courtesy Shri Dinesh Lakhanpal

Prof. Swaminathan and Prime Minister Narendra Modi at the time of release of his books by the PM

Prof. Swaminathan's family, friends, and the entire fraternity were filled with immense joy when Prime Minister Narendra Modi announced on February 9, 2024 on X, that "*the Government of India is conferring the Bharat Ratna on Dr. MS Swaminathan Ji, in recognition of his monumental contributions to our nation in agriculture and farmers' welfare. ...Dr. Swaminathan's visionary leadership has not only transformed Indian agriculture but also ensured the nation's food security and prosperity...*".

Prof. Swaminathan was Conferred **'Padma Vibhushan'**, the second highest civilian honour by the Government of India in 1989, for exceptional and distinguished service in the field of science. It was a long-cherished dream of the entire agricultural science fraternity that he should also be conferred 'Bharat Ratna', the highest civilian honour of the country for his unparalleled service to humanity. The day finally came when **'Bhrat Ratna' award to Prof. M.S. Swaminathan** was received by his daughter Dr. Nitya Rao from the President of India on March 30, 2024.

The joy would have been much greater if the award was conferred during the lifetime of Prof. Swaminathan ji ….

I am sure our most respected Professor is blessing us from heaven!

Prof. Swaminathan and his wisdom will be missed and remembered for a long time to come for his scientific contributions and vision giving the hope of a better and

peaceful future for the world, which is very nicely described by microbiologist geneticist Dr. Joshua Lederberg, Nobel Laureate in Medicine - Physiology:

> *'I can think of no one who has combined the insights of the cutting edges of biological science, with attention to the most urgent of human needs, with the competence, devotion and energy that Dr. M.S. Swaminathan has given. The world is and will be a better place on account of his contributions to its welfare'*

Acknowledgements

I warmly thank Dr. Himanshu Pathak, President, NAAS, for giving me the honour to write biosketch of Prof. Swaminathan ji and my experiences/ interaction with him for the Memoir, NAAS is bringing out. I also extend warm thanks to Dr. Soumya Swaminathan for he kind support in completing the assignment. I also extend warm thanks to Dr. R.K. Jain and Dr. Virendra Baranwal for their kind help and observations, and thanks to Dr. ParasuRaman (MSSRF), Shri Hira Lal (IARI, Photlab), and Shri Jai Singh (NAAS) for their kind help in arranging access to various photographs.

The Earth belongs to all living creatures, not just humans

M.S. Swaminathan

Revered Reminiscences

Dr. S. Ayyappan

Still alive amidst us in various ways, inspiring us, speaking to us, guiding us, to write memoirs about the Legend, Doyen, Giant, Visionary, Father of Indian Green Revolution, Scientist of Eminence, Institution Builder, Policy Maker & Science Administrator unparalleled in Agriculture, Thinker, Global trend setter, Mentor, Guide, Philosopher, Great Humanist, Reformer, is a painful effort. Our very own Professor Sahab, Prof. M.S. Swaminathan, is always present wherever agriculture is, from Farmers' fields to Scientists' laboratories to Teacher-Students' Universities to Planners' corridors.

Elderly by more than three decades, Not from the same domain of agricultural research, Not his student, Never worked with him in person, but his influence on me is all round and indelible, as is the case with thousands of Scientists like me across India and the world. It is my fortune that I met Sir, 50 years ago and providence ensured his blessings all through my life.

It was in 1974, at the College of Fisheries, Mangalore, that I first saw him. I distinctly remember the day when we were in the midst of a practical session of fish processing technology, preparing fish sausages, when the Hon'ble Secretary to the new DARE in Government of India & the Director General, ICAR, New Delhi, walked in with his slightly folded sleeves of the white shirt, as the hallmark of his photographs in the fields. Time froze as he went round asking our names and the work we were engaged in. That personal touch we received as students remained as joyful memories for long times to come.

As an ARS Scientist in ICAR just for three months at the Central Inland Fisheries Research Institute, Barrackpore, in 1978, I had a dilemma of whether to go overseas for higher studies on a government scholarship or continue here. I went to seek the advice of the DG, ICAR, who was the architect of ARS, and waited in the Visitors' room in front of his Chambers in Krishi Bhawan in New Delhi. His words, so soothing and assuring for an youngster, on that December evening still ring in my ears. He came into the room, put his hands on my shoulders and said, 'you have got a wonderful opportunity of serving this country and the farmers. We will send you to America any time, continue here'. These have proven so prophetic and his blessings showered all through.

Prof. Swaminathan delivered a talk at the Indian Institute of Science, Bangalore, in 1982, titled 'Indian Agriculture at Cross Roads'. I remember his

words to Prof. Satish Dhawan, Director, IISc & Chairman, ISRO, where he said: 'It is much easier to send the APPLE to space with a planned programme, than to produce Apple on the farmers' trees, given the fragmented farm holdings, agro-climatic variations and volatilities of the markets', true to this day. It was his kindness to spot ICAR Scientists in such gatherings and enquire about professional and personal lives, also happened at NIRD, Hyderabad, in 1988, when he was a Member of the Planning Commission.

While at the Central Institute of Freshwater Aquaculture, Bhubaneswar, 1996, I had occasions to visit MSSRF, Chennai, where Professor had kindly consented to host one of the ten State Centres of the ORP on Aquaculture. He would spend so much time discussing inland aquaculture in the country, as well as in states of Tamilnadu and Odisha. It was our privilege to receive him at CIFA, Bhubaneswar, during October, 1997. While escorting him to Kausalyaganga from the town, he remembered the incident of 20 years back and told me: 'I was in the Prime Minister's convoy to the proposed site for foundation laying ceremony and the Chief Minister asked me: ''What can the Prime Minister say in her address today?''. I told him that Bhubaneswar is a city of a thousand temples and we are going to build a temple with a thousand ponds'. This is on record of the deliberations and has made that day to become a historic event. At the end of the Visit, Sir wrote in the Visitors' Book, that is reproduced, as follows: 'October 23, 97: M.S. Swaminathan, 11, Rathna Nagar, Chennai 600018: 'I am happy to see that the expectations of our then Prime Minister when she laid the foundation stone for this Institute in 1977, have been more than fulfilled by the scientists and staff. I hope in the coming years, this Institute will help our country to become the world leader in sustainable inland aquaculture. My best wishes to the dynamic Director and Staff. M.S. Swaminathan, 23.10.97'. It was heartening to the entire

CIFA Family to read his words, that have also become prophetic, that the Institute has been widely recognized for its role in sustainable aquaculture.

Prof. Swaminathan travelled to Mumbai, in July, 2000, only to visit the Central Institute of Fisheries Education, the event becoming so special to the CIFE *Parivar*. After going round the Institute, he addressed us saying 'Being the only Fisheries University in the country, you have to hand hold and guide all the Fisheries Colleges'. On learning about the launch of the National Fisheries Development Board by the DADF, Ministry of Agriculture, Government of India in 2006, he appreciated, saying that 'it is a much needed institution to link Research with Development in the Fisheries sector' and wished me good luck as the Founder Chief Executive of the Board.

The First 'Global Conference on Women in Agriculture' held in New Delhi in March, 2012, graced by delegates from all over the world, brought Professor's favourite theme of 'gender mainstreaming in agriculture' to the fore and they were moved by every word he said during the three days.

The 100th FOCARS course and the Meet at the National Academy of Agricultural Research Management (NAARM), Hyderabad on 30 September,

2014, saw the Professor immensely pleased at his brainchild travelling thus far and recollected the initial stages of the ARS, the Agricultural Staff College of India, and contributions to Indian Agriculture.

Chairing the NAAS Round Table on 'GM Crops for Nutritional Security' on 12 February, 2014, in New Delhi, in the presence of several agricultural biotechnologists, suggested constitution of two Committees at the Academy for greater communication of agri-science to the civil society, *viz*., Committee on Political Understanding of Science and Committee on Public Understanding of Science. It was our fortune that he launched the Committee on Political Understanding of Science at NAAS, New Delhi, on 3 June, 2014, in the presence of several dignitaries. The recommendations of the Committee submitted to the new Government that had just been formed and the Parliamentarians, in brief, pertained to: (i) Natural Resource Management: Soil amelioration including bioremediation, bioenergy, biofencing; Provision of soil health cards; Integrated Farming Systems; Climate resilient technologies; Conservation of local breeds of animals and varieties of plants in a mission mode; water harvesting and waste recycling; (ii) Enhanced Investments in Agriculture: Strengthen, reorient research, and adequately finance education and extension systems; Conservation of indigenous livestock; Every agri-graduate an entrepreneur; Mechanisation of small farms; Farmer friendly agricultural credit and insurance; and (iii) Regulatory: Revise and enact 'Biosafety and Biotechnology Regulatory Authority Act'; Amendment of APMC Act. Apart from eliciting responses from some Members of Parliament at that time, it is also noteworthy that several of these have received attention and action over the years.

A milestone in the journey of NAAS was the Silver Jubilee in 2015, with several events during June 3-5, 2015, including the culmination of Section-wise meets held across the country as the Panel Discussion on 25 years' Scientific Achievements, Inter Academy Meet on Science-led Developments and so on. It is a matter of pride to the Academy that the First President of NAAS led the memorable Silver Jubilee programme on all the three days.

Following was the Commemoration of Golden Jubilee of Green revolution at New Delhi on 27 November, 2015, wherein the Father of Indian Green Revolution, Prof. Swaminathan Sahab, in presence of several dignitaries, went down the memory lane, recalling the unprecedented combination of scientists, farmers and policy makers, to usher the era of Green Revolution in India. We were the blessed witnesses to the occasion graced by the Architect himself.

There have been several meetings and interactions at MSSRF, Chennai, on occasions of his Birthday, 8th August, in 2013 (Silver Jubilee), 2014 & 2015; New Delhi, Chennai, Bengaluru and so on. Ever ready to listen, motivate, advise, guide, encourage, all treasured memories for life time. Not a single letter, message, phone call went unreplied, that too within hours or days, always starting with three words: 'My dear Ayyappan…'. I am again fortunate that Sir

graced the occasion of Dinner at DG's Residence at NASC, New Delhi, on 29 June, 2016.

Excellence with Relevance, Vigour with Rigour, Science for Society, Quality with Humanity, are among the invaluable lessons Prof. Swaminathan Sahab taught us in the last five decades. He ensured Farmer at the centre of all our efforts, gave a new dimension and unprecedented opportunity to thousands of agri-researchers like me, and elevated the entire domain of agri-science in the country to a level, that generations would benefit, remember, celebrate and be grateful to this Fatherly Figure.

Recipient of illustrious global awards and all the Civilian honours of the country including *Bharat Ratna*, Prof. Swaminathan Sahab has been *Hriday Ratna* of crores of people associated with agriculture in various ways. Heartful respects and salutations to you, SIR. We know wherever you are, you will keep blessing us.

We must protect and preserve our natural resources for future generations

M.S. Swaminathan

Honoring Prof. M.S. Swaminathan: A Legacy of Science and Leadership to Inspire the Next Generation for a More Just and Food-Secure World

Dr. Jean Balié

Taking pen to paper to honor such a distinguished scientist and noble soul is indeed both a daunting and humbling task. While our paths never crossed, Prof. Mankombu Sambasivan Swaminathan's influence extended through one of his daughters, Dr. Madhura Swaminathan. We had the privilege of serving together on the IRRI Board of Trustees, where I directly witnessed the enduring legacy her father instilled in her. Assuming the role as Director General of IRRI, I felt the weight of his immense legacy. Following in his footsteps felt like a lifetime challenge, given his remarkable achievements at IRRI and the other prestigious institutions he led, both internationally and nationally. Prof. Swaminathan's model of people-centered leadership served as an invaluable compass during my tenure as Director General and continues to inspire my work even today.

Prof. Swaminathan's leadership at IRRI coincided with the end of the Green Revolution, a period of agricultural innovation he significantly influenced. This transformation in Asian rice production saved millions of people from starvation and extreme poverty. His scientific prowess extended beyond rice. His relentless efforts not only increased yields but empowered farmers and fostered sustainable practices. He was among the first to consider the rice plant holistically, promoting awareness of the socio-economic value of every part of the rice crop among rice-growing families.

Prof. Swaminathan received numerous accolades. His achievements transcended the prestigious World Food Prize (1987) or the Albert Einstein World Science Award (1986). Since Prof. Swaminathan's biography is usually well-known I decided to depart from it and rather write about how his legacy has influenced my personal thinking and actions, though I readily acknowledge the immense challenges of replicating his extraordinary achievements.

Prof. Swaminathan's personal story, shaped by witnessing the Bengal famine of 1943, illuminates his lifelong dedication to battling food shortage and hunger. This horrendous episode explains his pursuit of solutions, embracing all avenues – scientific, political, and institutional – to change the nature of things. To me, it exemplifies an unwavering focus on promoting innovations to overcome physical constraints and institutional barriers to build a better world. It took me some time

to absorb his core message translated into simple yet powerful words: Food is the key. Everyone must eat. Food and nutrition security is paramount. Producing more and better food requires technological and institutional innovations. More innovations require resources. Resources are scarce. Grow and eat those foods that use the least resources with the most nutrition.

As an economist, I was particularly inspired by Prof. Swaminathan's advocacy for agriculture policy reforms in India during the Green Revolution period, ensuring they benefited the most vulnerable families who typically depend on agriculture for their livelihoods. He showed the power of action and courage by pioneering innovative approaches to seemingly intractable challenges. His efforts to combine policy and science represent the foundation for the transdisciplinary research desperately needed today across research institutions at the international or national levels.

Prof. Swaminathan was among the first to recognize and advocate for the need to connect the various domains of science. His work exemplified a crucial concept, well-accepted now but not yet fully realized: success in science hinges on integrating various disciplines. In more than one way, he championed the early integration of social sciences with "upstream" sciences like genetics. His tenure at IRRI saw the groundbreaking "Women in Rice Farming Systems" conference, earning him the first award for "Outstanding Contributions to the Integration of Women in Development" from the US-based Association for Women in Development.

Highlights of Prof. Swaminathan's career progression includes his Presidency of the International Union for Conservation of Nature and World Wildlife Fund vice-presidency (1984) and showcased his remarkable foresight and exceptional ability to address nature conservation, a topic largely overlooked in the profession at the time. He championed a holistic approach, dismantling artificial divisions between science and nature, advocating against false dichotomies. This paved the way for a systems-thinking approach to complex and interdependent global challenges. May his legacy continue to inspire us in this regard.

Reading the works of influential thinkers and practitioners like Prof. Swaminathan, particularly their insights on agriculture's historical trajectory across societies, ignited my passion for policy and institutions. It led me to dedicate a significant portion of my career to understanding the political-economy drivers of institutional change i.e. How institutions emerge, develop, transform, and eventually vanish. Prof. Swaminathan was a remarkable institution builder. He was instrumental in creating and expanding institutions that, today, are making critical contributions across scientific domains and geographies. CGIAR owes him a lot. His legacy includes promoting the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT) in India, fostering the Board of Trustees for the International Plant Genetic Resources Institute (IPGRI) in Italy (renamed Bioversity International and now part of the Alliance

Bioversity-CIAT within CGIAR), and supporting the International Council for Research in Agro-Forestry (ICRAF) in Kenya. His motivation was clear: cooperation over competition. He built institutions that fostered collaboration as a core principle. In a world increasingly fragmented, Prof. Swaminathan's legacy offers hope, reminding us of the value of cooperation and benevolence among people, institutions, and nations. These values are more crucial than ever as we face global challenges.

Prof. Swaminathan's message resonates with even greater urgency today. Humanity faces a daunting confluence of existential threats: a rapidly changing climate, irreversible biodiversity loss, an unprecedented energy crisis, and a socio-economic development model that perpetuates poverty, inequality, and instability. These complex and intertwined challenges demand a paradigm shift and radical transformations of man-made global systems– a seemingly insurmountable task in our limited timeframe. Yet, Prof. Swaminathan's legacy reminds us : change is inevitable but transformation is intentional. His pioneering efforts to operationalize food systems transformation serve as a powerful inspiration. We must recognize the urgency of replicating this approach across all sectors, as we face the escalating threat of climate change. This is not just an environmental imperative, but one of social justice for all humanity.

Inspired by Prof. Swaminathan's legacy, our community recognizes education as the cornerstone. We must cultivate an "Ecology of the Mind," as Gregory Bateson termed it. We cannot act differently unless we think differently. Prof. Swaminathan championed the environment and embodied the First Law of Ecology: Everything is Connected. Understanding these connections is crucial for appreciating the delicate balance of nature and the power of our individual as well as collective/ societal choices. Following Prof. Swaminathan's path, we can decide to become stewards, fostering a healthy planet for all life forms. As we witness the rapid destruction of the natural world, we must remember the wisdom of our ancestors: the environment is not "out there" but within and around us. Sustainable agricultural systems must be designed in harmony with ecosystems, maximizing synergies between human food production and the natural processes that underpin it.

Prof. Swaminathan was a visionary and champion for a poverty-free, food-secure, environmentally sustainable, and just world. His legacy is a remarkable blend of scientific excellence and deep empathy for the most vulnerable and poorest people in our societies. We honor Prof. Swaminathan not only for his scientific achievements but also for his unwavering belief in the power of science to guide societal transformation through better institutions and policies. As I contemplate Prof. M.S. Swaminathan, I see a man who lived by his principles. His life is an inspiration to all who strive for a world built on fraternity, cooperation, and prosperity for the many, not just the few.

Thank you, Prof. M.S. Swaminathan.

Remembering Prof. Swaminathan

Dr. R.V. Bhavani

Prof. M.S. Swaminathan (hereafter MSS) was Chairman of the National Commission for Farmers (NCF) from 2004 to 2006, a position in the rank of a Union Cabinet Minister. A large part of this term overlapped with his second stint as President of NAAS from 2005 to 2007. I worked in the NCF as Officer on Special Duty (Technical) to the Chairperson. In this piece, I reminisce on the period of the NCF and some of its recommendations on the agricultural research system, as well as some of the initiatives by MSS to foster collaboration with the agricultural research system.

The official notification from the government regarding constitution of the NCF came in November 2004, but work had commenced a little earlier. Even as he entered his eighth decade of life, MSS's energy levels were amazing. He set a fast pace of work for the NCF and the first report was submitted in Dec 2004, to be followed by four more reports and a draft national policy for farmers in the next two years! 'Serving Farmers and Saving Farming' was the generic title of all the reports. The goal is the well-being of farmers, he would emphasize. In keeping with this, the recommendations of the NCF addressed issues around agricultural research, production, food security, marketing, trade, and policy, to equip farm men and women to face the emerging challenges of climate change and international competition and enhance their livelihood security.

Space was allocated for the NCF office in the National Agricultural Science Complex (NASC) where NAAS was already located. Until infrastructure and logistics of the NCF office were ready, MSS often operated from the office of the President, NAAS. In the process, I became familiar with NAAS and the courteous and helpful staff working there. A number of consultations of the NCF were organised at NAAS, not to speak of the many smaller meetings with eminent scientists and experts that took place in MSS's office there.

The NCF made several recommendations on agricultural research and education, which remain relevant even today. Significant among these were: i) set up **Centres of Excellence in Agriculture** (Crop and Animal Husbandry, Fishery and Forestry) on the model of IITs and the IIMs; declaring national institutions such as IARI, IVRI etc. as institutes of national importance by an Act of Parliament would provide them autonomy to become global centres of excellence in research, education, and capacity building. ii) Promote the ethos of

'Every Student an Entrepreneur' and mainstream entrepreneurship and business skills in all applied courses, rather than keep business management as a separate course; this will attract youth to agriculture as a profession; iii) develop a system for farm graduates to provide extension and other services by recognizing them as **Registered Farm Practitioners** on the lines of registration of practitioners in medical and veterinary sciences, and setting up an All India Agricultural Council on the model of the Medical and Veterinary Councils to give such accreditation; iv) engender the curriculum of agriculture universities to sensitize students on the role of women in agriculture; and v) promote participatory research, demonstration and training centres designed on the lines of the polyclinics of CSIR, to bring together in an integrated manner, the available scientific institutes in relation to research for different agriculture ecosystems such as arid, semiarid, coastal, hill and mountain. It also recommended that agricultural and rural universities should undertake **Rural Systems Research** (RSR) with concurrent attention to on-farm and non-farm livelihoods; and called for enlarging the scope of Krishi Vigyan Kendras to promote enterprise development by including capacity building in postharvest technology and food safety and renaming them as **Krishi Vigyan Aur Udyog Kendras**!

Quick to recognise the importance of information technology, MSS saw its immense potential for effective extension and outreach and emphasized on its multiple uses. He would often say that the green revolution succeeded because of the synergy of technology and public policy and effective extension, and highlight the importance of reaching need-based information to farmers at the right time. The draft national policy for farmers developed by the NCF was discussed in stakeholder consultations across the country, for feedback and suggestions. MSS himself chaired many of these. A common refrain from farmers at these meetings used to be that the usefulness of research by agricultural scientists to farmers' problems should be a criterion for their promotion, and not just publication of their research in high impact journals.

MSS was the first recipient of the World Food Prize and he established the M.S. Swaminathan Research Foundation in 1988 with the award money. Drawing on his vast experience in the agricultural research system, he set the filling of critical gaps in ongoing research (strategic, anticipatory, and participatory) in the field of agriculture following a pro-poor, pro-women, and pro-nature approach as the mission for MSSRF. MSS steered the MSSRF as chairperson for a quarter century till 2012. The drafts of two landmark national legislations relating to the rights of farmers, the Protection of Plant Varieties and Farmers' Rights Act, 2001 and the Biological Diversity Act, 2002 emerged from consultations at the MSSRF under his leadership. Joining the MSSRF as a Principal Scientist in 2000, I got an opportunity to see firsthand how he steered collaborations and fostered engagement with the agricultural university system and governments at national and subnational levels, as the institution engaged in action research and piloted models that could be upscaled. To MSS must go the credit for moving beyond food security and bringing the focus on 'food and nutrition security'. He actively

campaigned for nutrition security at national and international forums and coined the term 'Farming System for Nutrition' (FSN). In 2013, the MSSRF under his guidance undertook to demonstrate feasibility of the FSN approach under a research consortium programme on Leveraging Agriculture for Nutrition in South Asia (LANSA). A technology platform was constituted of the agricultural university and research institutes in the two regions where the study was piloted, to guide the process.

MSS was also the chair of LANSA's Consortium Advisory Group (CAG). The annual meeting of the CAG in 2014 was held at the University of Agriculture, Faislabad in Pakistan, whose Vice Chancellor was also a member of the CAG. The University used this opportunity to confer an honorary doctorate on MSS. While I have been in many meetings with MSS, this was a particularly memorable occasion, seeing the overwhelming affection, respect, and regard with which MSS was treated by the gathering in our neighbouring country.

During the last decade, MSS also chaired a task force setup by the Ministry of External Affairs of the government of India, to oversee projects in Afghanistan and Myanmar, and provided leadership for the establishment of the Afghan National Agriculture Science and Technology University (ANASTU) in Kandahar, Afghanistan, and training of their faculty at the IARI. MSSRF partnered with IARI and organised training programme for the Afghan students in information technology, especially for establishing Village Knowledge Centres. In Naypyitaw, Myanmar, MSSRF in partnership with the Department of Agricultural Research, Yenzin, established a rice biopark conceived by MSS.

Honorary Doctorate being conferred on Prof. Swaminathan by the University of Agriculture, Faisalabad, Pakistan, 2014

The rice biopark is a solution that MSS had been recommending in recent years to alleviate the recurrent problem of stubble burning and consequent air pollution in North India.

Calm and considerate in his mien, MSS remained accessible to all till a few years before his demise. He was always keen to engage with youth and would listen with attention as young scientists presented their research; he interacted with rural men and women with warmth and the same equanimity with which he interacted with national and international leaders, scientists, intellectuals, and policymakers. A man of vision, MSS strode tall on the world's stage and has left behind a lasting legacy for us to learn from, cherish, and practise.

Technology should be used in harmony with nature, not against it

M.S. Swaminathan

Tribute to Prof. M.S. Swaminathan

Dr. Peter Carberry

As homages deservedly flow for Prof. M.S. Swaminathan, internationally renowned scientist and humanitarian, I can only but add small personal experiences and reflections on the contributions of a great man. Prof. Swaminathan positively influenced humanity through his science, famously for his leading role in the 'Green Revolution', through his institution building and legacies, and via his influential voice in global, regional and Indian affairs which continued up until his passing in 2023. For those of us privileged to have met and engaged with Prof. Swaminathan, we appreciated his real warmth as well as his encouragement in our own duties aligned with a life-long cause of livelihood development through agricultural research. I am thankful for having known and benefited from his sincere advice and influence.

My tribute is grounded in a continuum from Prof. Swaminathan co-founding the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in

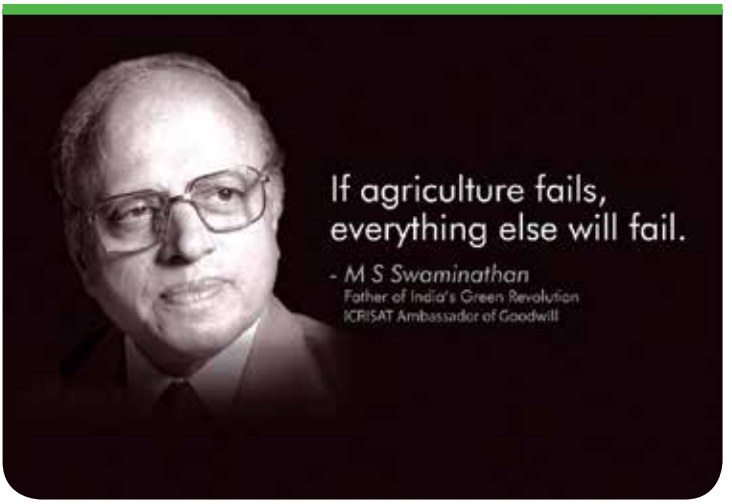
Prof. Swaminathan and Peter Carberry at the 30th anniversary of MSSRF (August 2019)

1972, my own career commencing as a Ph.D. student at ICRISAT in 1982, a return to the Institute in 2015 before departing in 2020. Prof. Swaminathan served as Vice-Chair of the initial Technical Advisory Committee (TAC) formed in 1971 to help shape the newly constituted Consultative Group on International Agricultural Research (CGIAR) under the Chair of Sir John Crawford, Australia's own eminent agricultural economist. Under Prof. Swaminathan's counsel, TAC recommended ICRISAT's addition to the CGIAR and its location at Patancheru, India. While Director General of the Indian Council of Agricultural Research (ICAR), Prof. Swaminathan served on the ICRISAT Board from 1972-80 and his influence and advice undoubtedly underpinned the successful establishment and growing reputation of ICRISAT as a leading research institute for dryland agriculture and its mandate crops of sorghum, the millets, groundnut, chickpea and pigeonpea. Subsequent ICAR Directors General have mirrored Prof. Swaminathan's Board role at ICRISAT, providing essential counsel and substantive support to the Institute. I can personally attest to this close ICAR-ICRISAT connection and wish to acknowledge here the encouragement and backing provided by Dr. T. Mohapatra, ICAR DG 2016-2022.

In 1982, as Prof. Swaminathan joined the CGIAR through appointment as the Director General of the International Rice Research Institute (IRRI), I arrived at ICRISAT as a Ph.D. student which turned out to be an incredibly positive and life-changing opportunity for which I am forever grateful. That early period of study at ICRISAT in 1982-83 was career-forming, culminating in the opportunity for me to return to ICRISAT as Deputy-Director General in 2015 and thereafter as Director General from 2018-2020.

I had the pleasure of meeting with Prof. Swaminathan on several occasions. Notably, when he returned to the Institute in early 2015 when I witnessed the revere held for him by staff, Indian researchers and international visitors attending the conference at which he gave the keynote address. In private audience along with ICRISAT DG, Dr. David Bergvinson, we engaged with Prof. Swaminathan as he related his story of the rationale for and decisions behind the establishment of ICRISAT (see ICRISAT, 2002).

In August 2019, I had the pleasure of presenting at the 30th Anniversary celebration for the MS Swaminathan Research Foundation (MSSRF). The conference coincided with his 94th birthday, yet despite such advanced years, Prof. Swaminathan gave every presenter his full attention and offering of inquiring questions. His warmth in greeting me and real interest shown in our private conversations reflected the quality of the man and I will forever cherish the attached photo.



As you walk the corridors of ICRISAT, you will pass the attached picture of Prof. Swaminathan, meant to inspire the current and next generations. His legacy is assured, and the world is a far better place for his devoted service.

Agriculture is the backbone of our society and needs to be sustainable

M.S. Swaminathan

Prof. M.S. Swaminathan: An Emblem of Noble Humanity

Dr. K.L. Chadha

A pioneer in agricultural research, Prof. Mankombu Sambasivan Swaminathan was widely hailed as the scientific force behind India's self-sufficiency in food production. In the annals of history, there are individuals, whose contributions transcend their lifetimes, leaving an indelible mark on the world. Prof. M.S. Swaminathan, popularly referred to as the "Father of the Green Revolution," is one such luminary, whose legacy continues to shape the destiny of nations. Prof. Swaminathan's life and work have been an ode to the betterment of humanity through agriculture. Prof. Swaminathan's contributions to agricultural research and global food security were reflected in his many collaborations with research and policy conglomerates including CGIAR, FAO and UNESCO.

In 1987, he was honoured with the first World Food Prize. He used the proceeds to give a gift to the nation in the form of the M.S. Swaminathan Research Foundation (MSSRF), in the year 1988. The Foundation has done pioneering work to accelerate the use of modern science and technology for sustainable agricultural and rural development with emphasis on tribal and rural communities with a pro-poor, pro-women and pro-nature approach. A plant geneticist by training, he helped set up and promote the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT) in India, the International Board for Plant Genetic Resources (now known as Bioversity International) in Italy, and the International Council for Research in Agro-Forestry in Kenya. Prof. Swaminathan was instrumental in developing high-yielding crop varieties that led to a significant increase in crop yields between 1960 and 1970, making India self-sufficient in food production. In 2004, he was appointed chair of the National Commission on Farmers, a body looking into farmer distress amid alarming number of farmer suicide cases due to failed crops. I was delighted to hear conferment of Bharat Ratna to Prof. Swaminathan which I believe was long awaited in recognition of his contribution to the world Agricultural communities. His legacy will continue to inspire researchers, policymakers, and advocates worldwide to address the pressing challenges of our time, from climate change to sustainable agriculture. He was Honorary Fellow of Indian Academy of Horticultural Science (IAHS), New Delhi.

Prof. Swaminathan started his career as Scientist at ICAR-Central Potato Research Institute, Shimla and contributed significantly in the research and development of number of horticultural crops. He elucidated the mechanisms of

speciation in the genus *Solanum*, section *tuberarium*. Understanding the genomic affinity of the cultivated tetraploid potato 2n = 4x = 48 (*Solanum tuberosum*), with wild diploid (2n = 2x = 24) enabled inter-specific hybridization and transfer of genes to confer resistance against abiotic and biotic stresses to potato. Later on, as DG, ICAR he took keen interest in development of Infrastructure for Horticultural research, finalising the technical programme and priorities for various projects under Horticulture SMD.

I met Prof. Swaminathan for the first time on April, 1992 days after he was designated as Director General, ICAR and Secretary, DARE. Subsequently, with his consent, I was posted as Project Coordinator and Head of Central Mango Research Station, a regional centre of ICAR-Indian Institute of Horticultural Research, Bengaluru. Thereafter, there was regular interaction with him while I was serving as Project Co-ordinator and later as Director, ICAR-IIHR and Deputy Director General, Horticultural Science. Prof. Swaminathan also took lot of interest in the activities of the Horticulture Society of India. He lent his advice and support in organizing number of the Horticulture Congresses. He had given a lot of emphasis on collection, maintenance, conservation and utilization of genetic resources of different horticultural crops. Prof. Swaminathan was a Gem as person, simple in habit, visionary in thoughts and was very easily approachable. He always lent his support whenever approached and for his contribution the IAHS had the privilege to confer him with Honorary fellow and most of the scientists from all over India were present to felicitate him on this occasion.

Dr. K.L. Chadha, receiving the cheque of Rs 15 lakh from Mr G.V.S.S. Anjanayalu and Prof. M.S. Swaminathan during First Indian Horticulture Congress-2004

Welcoming the chief guest Prof. M.S. Swaminathan during 5th Indian Horticulture Congress, 2012

While paying tribute, Hon'ble Prime Minister of India has made a special mention of his experience during the time he was Chief Minister of Gujarat. He said: "Among the many

Felicitating Prof. M.S. Swaminathan during Sixth Indian Horticulture Congress-2014

initiatives we launched was the soil health card, which enabled us to understand the soil better and address problems if they arose. It was in the context of this scheme that I first met Prof. Swaminathan. He appreciated the scheme and also shared his valuable inputs for the same. His endorsement was enough to convince those who were sceptical about the scheme that would eventually set the stage for Gujarat's agricultural success."

Prof. Swaminathan was a scientist of rare distinction, an institution builder, an able administrator, a motivating educator, an alert parliamentarian, and a true world leader. The M.S. Swaminathan Research Foundation has been a pioneering leader in the field of agriculture, environment and biodiversity, natural resources, and science communication pursuing what he called, "a pro-poor, pro-women and pro-nature approach." Prof. Swaminathan's legacy continues to resonate, inspiring generations to dream big and aspire to greatness, all while embracing the humble mantle of humanity. His life exemplified that one can achieve limitless heights in accomplishments and contributions, as long as they are rooted in profound humility—an emblem of noble humanity. I feel privileged and honoured to contribute in the Memoir of the Bharat Ratna Prof. M.S. Swaminathan.

Felicitating Prof. M.S. Swaminathan during 7th Indian Horticulture Congress 2016

Food security is a fundamental human right

M.S. Swaminathan

Prof. M.S. Swaminathan: Journey from Science to Policy

Prof. Ramesh Chand

Prof. M.S. Swaminathan, described as doyen of Indian agriculture, left deep imprint on several areas of agriculture and farmers welfare. I first heard Prof. Swaminathan in a function organized by PG Students Union of IARI, New Delhi, in year 1981. He inspired the students by sharing his own experiences beginning with his student day at IARI. Prof. Swaminathan instilled great pride in the students by sharing the fact that he had left much valued and glamourous civil service job offer to become an IPS officer in his 20s and rather chose to pursue research career- a decision that subsequently changed not only his own life but also destiny of Indian agriculture in several ways.

Prof. Swaminathan got first opportunity to demonstrate his capabilities in mid 1960s when India faced severe food shortage and widespread hunger. This led to a desperate search for breakthrough in agriculture to raise production and self- sufficiency in food. These years coincided with development of high yielding varieties of wheat in some universities in USA followed by similar breakthrough in wheat at CIMMYT, Mexico, by the team led by Dr. Norman Borlaug, who later got Nobel Prize. A trio of Shri C. Subramaniam as Food and Agriculture Minister, Shri C. Sivanappan as secretary Food and Agriculture, Government of India and Prof. M.S. Swaminathan as Scientist and R&D Leader rose to the occasion to steer India out of the severe food shortage and laid the foundation of Green Revolution despite lot of criticism of new technology from many quarters. The seed of HYV of wheat brought from CIMMYT produced miraculous results as wheat production in the country after mid 1960s doubled in five years and tripled in 13 years. Similar success was followed in rice. Together this success came to be known as green revolution.

Prof. Swaminathan and Delhi based Indian Agricultural Research Institute (IARI), where he served as Director played lead role in spreading Green Revolution technology in the country which made food shortage and dependence on food imports a history in a short period of one and a half decade. Rice and wheat had not only sustained food security for rapidly growing population of the country since late 1960s, they also remained strong pillar of growth in Indian agriculture. Prof. Swaminathan guided and spearheaded this development first as Director, IARI then as Director General of ICAR for a very long period. Later, Prof. Swaminathan was appointed as Member, Planning Commission where he steered policy for Science and Agriculture for the entire country.

After his strong and memorable contribution in development of wheat varieties and spread of Green Revolution technology in the country, Prof. Swaminathan turned to agriculture policy and long-term implication of Green Revolution technology. During 1980s, Prof. Swaminathan started drawing attention of the country to the second and third general problems of Green Revolution and its impact on water, ecology and environment. He emphasized the need to measure progress of the country through "Gross Nature's Product" rather than measuring it only through economic indicator of Gross National Product. Subsequently he came with a call to turn Green Revolution into Ever Green Revolution.

Prof. Swaminathan set up MS Swaminathan Foundation mainly to draw attention towards sustainability, gender dimension in agriculture, health and nutrition, especially of small and marginal farmers and agriculture labour households. Based on his contribution and vision for agriculture, Prof. Swaminathan was appointed as Chairman of National Commission on Farmers set up by Atal Bihari Vajpayee Government in 2004. The Commission under his chairmanship published comprehensive reports covering almost all aspects of agriculture, farm economy and farmers income. In order to draw focused attention of the government and society towards farmers' issues he brought out National Policy for Farmers. He was convinced that technology alone cannot transform agriculture and livelihood of farmers. So, he started pleading for favourable price policy for agriculture. Though some economists did not agree with his formula of cost plus 50% margin for deciding level of MSP Prof. Swaminathan pushed it relentlessly. His recommendation to change cost norm for fixing MSP to 50 per cent above cost has been implemented by Narendra Modi Government in crop year 2018-19. This has led to sizeable shift in the terms of trade in favour of agriculture sector and in turn increase in farmers income.

Contribution of Prof. Swaminathan in the field of agriculture R&D put him in the league of legendary like Dr. Homi Bhabha in the field of atomic Research and Dr. Vikram Sarabhai and Satish Dhawan in the field of Space Research.

Agriculture sector is once again facing formidable challenges of different type now. They relate to sustainability, climate change, resilience and food safety. Vision of Prof. Swaminathan can be very helpful in addressing these challenges and turning Green Revolution into Ever Green Revolution.

It is remarkable that Prof. Swaminathan shaped thinking on agriculture for more than half a century. He will be remembered not only as a great agriculture scientist, but also as a visionary, institution builder, crusader for sustainable development, supporter of marginalized sections of society and a staunch advocate of farmers' welfare. The roadmap suggested by Prof. Swaminathan for development focused on agriculture will serve as a useful guide for a long time.

Remembering Prof. M.S. Swaminathan: A Life Time Journey of Agriculture

Dr. Swapan Datta

Proud and happy to write a short note remembering Prof. M.S. Swaminathan (in short, we address him as Professor) for more than 50 years recently awarded "Bharat Ratna" by the Govt. of India. It started with listening a special talk arranged by ISCA (Indian Science Congress Association) by Professor at Kolkata while I was studying M.Sc. at University of Calcutta.

I would like to highlight a few of many issues I was attached with Professor during my long association with him.

- "Bt-brinjal need not to be banned" says Professor, but it needs a long standing careful experimentation and observation of regulatory package of safety evaluation of different events of genetically modified Bt brinjal (according to him). I have had the privilege talking to Professor many times at different places such as Chennai, Delhi, Bhubaneswar, Coimbatore, Pune, Hyderabad, Kolkata, Santiniketan, Manila (Philippines), Egypt, Myanmar, USA etc. on various aspects of Agriculture and particularly on GM crops, regulations and environmental release of GM crops in India and elsewhere. Professor invited me several times to talk on various issues of Biotechnology of crop plants at MSSRF, Chennai and he always took keen interest listening and interacting with me and other experts attending the meetings. I found him always supporting to the new science, innovations to boost the productivity of crop plants ensuring food and nutrition security. At MS Foundation, a group of scientists led by Dr. Ajay Parida developed a large number transgenic plants including rice using genes isolated from Mangrove for salt/drought tolerance and published several outstanding research publications.

Two interesting issues are noteworthy:

(1) The parliamentary standing committee on Agriculture (members were MPs of different political parties) didn't support the release of Bt brinjal in the environment.

(2) A scientific committee (community) consisting of 30 + eminent Indian scientists were invited by the Ministry of Environmental Science for a panel discussion and recommendation on Bt brinjal release in the environment in 2011. Except 3 scientists from Ministry of Ayush who were silent, all

other members favoured in release of Bt brinjal based on scientific molecular analysis and experimental field evaluation governed by the scientific committees of ICAR, ICMR and MOEF. However, the Ministry (MOEF) didn't support the release of Bt brinjal in the environment. People often used to ask me whether Professor could take more positive role in advancing this technology for the benefit of science and technological application in crop improvement in India. My best guess on this subject is the lack of trust on our regulatory data provided by the system placed Professor in a dilemma: Professor didn't have any hesitation in accepting the science and utilization of GM-crops, but not to immediate release the GM events until the full proof of safety evidence is produced.

Professor at IIPR, Kanpur, 2013

Professor with Swapan Datta and Trilochan Mahapatra at CRRI, Cuttack 2014

Where and how could we build up the trust? Does the same question remains valid with the conventional breeding? What about with the mutation breeding? DSR (Direct Seeded Rice) with herbicide resistance is now in the field and soon would be available for commercial breeding. I wish we could go to Professor with many such questions and can get Professor's smiling responses and asking us move on.

- I spent 12 years at IRRI (1993-2005). During that time I met Professor a number of times at Los Banos, Philippines. In one occasion, Indian community at IRRI interacted with Professor for induction of an Indian society for human welfare at Los Banos. Professor in his address gave us a valuable suggestion "Good to have many ideas and enthusiasms but start with a modest way and expand slowly for its sustainability" an advice with immense reality.

- I was with him in a delegation of GoI (Govt. of India) visiting to Myanmar for establishing the R&D on Agri-Biotech Park to be supported by the Govt. of India. Every morning we used to meet in the lobby of the Hotel and Professor was always the first man arrived in the lobby with a notebook and the agenda for the day's activities. Again, at the end of the day he used to sum up the outcome of the discussions with us over coffee/tea. I never saw him tired even after the hectic day trip with several round of discussions, field visit etc. The

president of Myanmar invited Professor and the delegation for tea in the President's crop garden. It was a memorable visit particularly to witness the appreciation of the President to Professor for his Agriculture vision which I have heard from many world leaders about Professor. One of my friends and collaborating scientist, Prof. Qifa Zhang, a distinguished molecular biologist (also advisor to President of China) once told me irrespective of how good science is done by Chinese scientists in China or elsewhere "You have Professor from India, what we don't have". One such statement speaks a lot about Prof. M.S. Swaminathan, a visionary global leader in Agriculture.

Swapan Datta, Prof., Ajay Parida and Bharat Chattoo (left to right) at MSSRF, Chennai

- Professor loves plants, biodiversity, conservation and sustainability of the ecosystem which he has shown his passion and dedication in various ways e.g. mangrove cultivation and conservation, saved lands for fodder crops (ICAR-Indian Grassland and Fodder Research Institute IGFRI) requesting Sri

Professor at Santiniketan with students and scholars of Visva-Bharati

Sharad Power in one public seminar meeting at NAAS Complex, ICAR for his intervention and Sri Sharad Power honoured Professor in accepting his request to keep most of the lands of IGFRI and the Institute is running well .

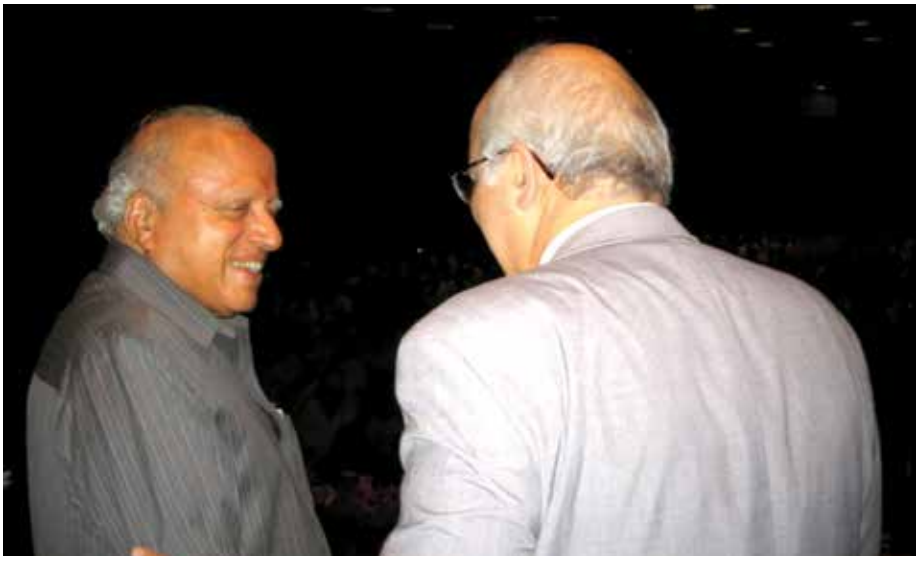
- Professor came with a large number of delegations mainly MPs (Member of Parliament) from South India for a discussion with Ministry of Agriculture at Delhi. Mr. P.K. Basu (Secretary, Ministry of Agriculture and Farmer's Welfare) was chairing the meeting along with a few other members including me. Professor proposed a project for cultivation and conservation of rice below sea level at Kuttanad, Kerala. This is one very rare natural ecosystem where rice is grown at below sea level. I was personally excited about this project and Professor's request was accepted with the entire financial support for the modernization of the set up at Kuttanad for the better conservation of this rare ecosystem where the researchers, tourists and students can learn, enjoy and be prepared for further improvement of the system and livelihood of the people attached to this ecosystem.

- I have attended several seminars organized by the Foundation celebrating Professor's birthday e.g., his 80, 85, 90th birthday and many. In addition to scientific presentations, workshops, farmers meet, presentation by the distinguished personalities with different views e.g. in

Mangrove system at Ashtamudi Lake, Kerala

Below sea level farming system, Kuttanad, Kerala

one such event where Mr N. Ram, Managing Director and the Journalist/ Editor "The Hindu", Sri Gopalkrishna Gandhi, Ex Governor of West Bengal and educationist, Dr. Sunita Narain, Editor, "Down to the Earth" and myself participated in one of the panel of discussions which is well appreciated by the audience of diversity in culture, Political and Scientific views. It was only possible for Professor who could organize such vibrant narrative scientific debate for the welfare of the society.



Professor with Ismail Serageldin

I shall conclude my write up paying heartfelt tribute to Bharat Ratna Professor with a few of his words (Prof) which is close to my heart

- "We live in an age of unparalleled opportunity for promoting sustainable nutrition security. The prospect for a world without hunger is a glorious legacy…".

"As we depart for dinner this evening, what could be a more satisfying and joyful feeling than knowing that every other member of the human family will also go to bed after nourishing meal? Until such a wholly attainable world becomes a reality, our task remains unfinished". Acceptance speech by MS Swaminathan in 1987 "Our common Agriculture Future" on the occasion of the World Food Prize presentation (From "Science, Ethics and Food" edited by Brian W.J. Le May, 1988, Smithsonian Institution Press, Washington, D.C., IRRI, Manila)

Planting the Seeds of An Enduring Legacy: Prof. M.S. Swaminathan's Remarkable Journey Beyond 1988

Prof. Sanjay Deshmukh

In the annals of agricultural history, one name stands out as a beacon of innovation, resilience, and visionary leadership- Prof. M.S. Swaminathan. This article presents an in-depth examination of Prof. Swaminathan's extraordinarily remarkable journey spanning from 1988 to 2018, characterized by the establishment of the M.S. Swaminathan Research Foundation (MSSRF) and his unmatched endeavors in addressing worldwide challenges pertaining to agricultural and rural development, crucial for the sustenance of humanity.

This article provides insights on this invincible journey of Prof. M.S. Swaminathan with a focus on 20 of his most exquisite traits as follows that made him a Legend which can be summarized as follows-

A. Conceptualizing and Founding MSSRF: At the outset, Prof. Swaminathan embarked on a visionary mission to establish MSSRF in 1988, envisioning a platform dedicated to addressing agricultural challenges sustainably. With meticulous planning and unwavering determination, he laid the foundation for an institution that would become synonymous with excellence in agricultural research and development.

B. Identifying Research Areas and Securing Funding: Driven by a passion for innovation, Prof. Swaminathan identified precise research areas, including biodiversity conservation and climate-smart agriculture, blending traditional wisdom with modern techniques. Moreover, he displayed exceptional acumen in securing funding, engaging diverse stakeholders, and raising corpus funds to ensure MSSRF's long-term sustainability.

C. Balancing Global Commitments and Organizational Responsibilities: Despite engaging in international assignments, Prof. Swaminathan maintained a delicate balance between global commitments and organizational responsibilities, ensuring that his endeavors complemented MSSRF's overarching goals. This nuanced approach underscored his strategic vision and unwavering commitment to advancing sustainable agricultural practices on a global scale.

D. Nurturing Leadership and Advocating for Change: Central to Prof. Swaminathan's legacy is his unwavering dedication to grooming future leaders and advocating for transformative change in agricultural

development. Through mentorship and professional development initiatives, he empowered employees to become catalysts for change within MSSRF and beyond, fostering a culture of innovation, collaboration, and ethical integrity.

E. Impact on Policy and Global Agricultural Development: Prof. Swaminathan's influence extended far beyond the confines of MSSRF, as his research findings translated into impactful policy recommendations, shaping government and intergovernmental decisions on agricultural development. His visionary leadership and innovative thinking propelled MSSRF to the forefront of global agricultural development, driving positive change and leaving a lasting legacy for future generations.

F. Embodying Traits of Excellence: Throughout his journey, Prof. Swaminathan exemplified traits of visionary leadership, innovative thinking, resilience, empathy, collaboration, adaptability, strategic networking, ethical integrity, inspiring communication, and legacy building. These traits not only defined his personal ethos but also laid the groundwork for MSSRF's enduring impact in agriculture and beyond.

In summary, Prof. M.S. Swaminathan's journey from 1988 to 2018 epitomizes a saga of unparalleled dedication, visionary leadership, and transformative impact in the field of sustainable agricultural development. His legacy continues to inspire generations of leaders, shaping a brighter, more sustainable future for our planet.

1. Introduction

In the vast landscape of agricultural history, one figure stands out as a titan, whose influence reverberates across time - Prof. M.S. Swaminathan. In 1988, Prof. Swaminathan initiated the establishment of the M.S. Swaminathan Research Foundation (MSSRF) with the aim of tackling sustainable agricultural and rural development challenges, foreseeing the global issues that would arise in the 21st century.

Prof. Swaminathan’s visionary aspirations were ignited, perhaps inspired by the esteemed Sir C.V. Raman, with a profound longing to cultivate lasting change in agriculture, transcending the boundaries of conventional retirement. His vision for the M.S. Swaminathan Research Foundation (MSSRF) was that of a crucible for agricultural transformation, fostering innovation, resilience, and forward-thinking leadership.

Prof. M.S. Swaminathan’s journey from 1988 to 2018 embodies a saga of unwavering dedication, visionary leadership, and transformative impact in sustainable agricultural development. As I undertake this exploration outlined in the upcoming pages, where I spotlight 20 of Prof. Swaminathan’s remarkable qualities as provided below, that distinguished him as a legend, we not only

honour the individual but also acknowledge the timeless heritage he has bestowed upon future generations.

1.1. TRAIT 1. Conceptualizing and founding his own organization

Prof. Swaminathan's journey towards founding his own organization epitomizes visionary leadership and a steadfast commitment to catalyzing positive change in agriculture. Recognizing the need for a dedicated institution to address the multifaceted challenges facing agricultural development, he embarked on the ambitious endeavour of conceptualizing and establishing the M.S. Swaminathan Research Foundation (MSSRF).

Utilizing the esteemed World Food Prize's award money and his personal savings as foundational pillars, Prof. Swaminathan laid the groundwork for an institution that would not only push the boundaries of scientific inquiry but also translate research outcomes into tangible solutions for farmers and rural communities. He meticulously crafted the vision and mission of MSSRF, envisioning it as a beacon of excellence in sustainable agriculture research and rural development.

The genesis of MSSRF in 1988 marked not only the birth of an organization but the dawn of a movement, propelled by Prof. Swaminathan's unwavering resolve and entrepreneurial zeal. MSSRF commenced its operations in August 1989, initially housed in facilities provided by the Indian Institute of Technology, Chennai, before relocating to a rented premise in the Kotturpuram area. Subsequently, on April 14, 1993, MSSRF's staff and scholars transitioned to their purpose-built facility in the Taramani Institutional Area, generously allocated by the Government of Tamil Nadu. Further bolstering its research and training infrastructure, the JRD Tata Ecotechnology Centre was inaugurated in July 1998, augmenting MSSRF's capacity for pioneering work.

Thus by founding MSSRF, Prof. Swaminathan demonstrated remarkable entrepreneurial spirit and a pioneering zeal to carve out a new paradigm in agricultural research. His visionary leadership and unwavering commitment to the cause inspired others to rally behind the mission of MSSRF, laying the foundation for a legacy that would endure for generations to come.

1.2. TRAIT 2. Developing criteria for identifying potential employees

In building the M.S. Swaminathan Research Foundation (MSSRF) into a bastion of excellence, Prof. Swaminathan placed great emphasis on identifying and nurturing exceptional talent. Recognizing that the success of any organization hinges on the caliber of its workforce, he developed meticulous criteria for selecting individuals who embodied the values and principles of MSSRF.

Drawing upon his vast experience and expertise in agricultural research, Prof. Swaminathan crafted a comprehensive framework for assessing potential

employees, prioritizing qualities such as intellectual rigor, passion for innovation, and a deep-seated commitment to sustainable development. Through rigorous screening processes and interviews, he sought out individuals who demonstrated not only technical proficiency but also a strong sense of social responsibility and empathy towards farming communities. Moreover, Prof. Swaminathan placed a premium on diversity and inclusivity, recognizing the importance of assembling a team with a wide range of expertise and perspectives. By fostering a culture of meritocracy and excellence, he ensured that MSSRF attracted the best and brightest minds in the field of agricultural research, laying the foundation for groundbreaking discoveries and impactful interventions.

In essence, Prof. Swaminathan's discerning approach to identifying potential employees played a pivotal role in shaping the culture and ethos of MSSRF, setting the stage for its transformation into a global leader in agricultural innovation and sustainable development.

1.3. TRAIT 3. Identifying precise research areas/programme areas

At the heart of Prof. Swaminathan's visionary leadership was his ability to identify precise research areas that would yield maximum impact in addressing the pressing challenges facing agriculture and rural communities. With a keen understanding of the complexities of agricultural systems and a deep-rooted commitment to improving livelihoods, he meticulously delineated research priorities that aligned with the overarching mission of the M.S. Swaminathan Research Foundation (MSSRF).

From its inception, MSSRF embarked on an interdisciplinary journey, focusing on coastal systems research, community biodiversity conservation, biotechnology for climate change adaptation, ecotechnology integration, and food security. Emphasizing the integrated use of technology and public policy, MSSRF addressed critical gaps in anticipatory and participatory research, particularly within coastal ecosystems.

Drawing upon a wealth of expertise and insights, Prof. Swaminathan identified thematic areas that held immense potential for driving transformative change, including biodiversity conservation, climate-smart agriculture, sustainable land management, and rural development. By focusing on these strategic areas, he ensured that MSSRF's research agenda remained closely aligned with the evolving needs and priorities of farming communities. Moreover, Prof. Swaminathan championed an interdisciplinary approach to research, recognizing that complex agricultural challenges demanded holistic solutions that transcended disciplinary boundaries. By fostering collaboration between scientists from diverse backgrounds, he catalyzed innovation and breakthroughs that had far-reaching implications for agricultural development.

In essence, Prof. Swaminathan's astute identification of precise research areas served as a guiding light for MSSRF, steering its scientific endeavors towards

impactful interventions that have improved the lives and livelihoods of millions of smallholder farmers across India and beyond.

1.4. TRAIT 4. Identifying potential donors for supporting research activities

Prof. Swaminathan's ability to identify potential donors for supporting research activities was rooted in his exceptional networking skills and strategic vision. Recognizing the critical importance of securing funding to advance MSSRF's scientific endeavors, he meticulously cultivated relationships with philanthropic organizations, governmental agencies, and private donors who shared the foundation's commitment to agricultural sustainability.

With a deep understanding of the funding landscape and donor motivations, Prof. Swaminathan targeted organizations and individuals whose philanthropic goals aligned with MSSRF's research priorities. Through personalized outreach efforts and compelling presentations, he effectively communicated the impact and significance of MSSRF's work, garnering support from a diverse array of donors. Moreover, Prof. Swaminathan leveraged his extensive network of contacts and affiliations to identify potential donors with a vested interest in agricultural development and environmental conservation. By forging strategic partnerships and alliances, he expanded MSSRF's funding base and secured resources to propel its research agenda forward.

In essence, Prof. Swaminathan's adeptness at identifying potential donors for supporting research activities was instrumental in securing the financial resources needed to sustain MSSRF's scientific pursuits and drive meaningful impact in agricultural development.

1.5. TRAIT 5. Identifying potential donors to raise corpus funds

Prof. Swaminathan's foresight and strategic acumen extended beyond securing project-based funding to the establishment of corpus funds aimed at ensuring the long-term sustainability of MSSRF. Recognizing the need for a robust financial foundation to support the foundation's ongoing operations and initiatives in perpetuity, he embarked on a deliberate effort to identify potential donors willing to contribute to MSSRF's corpus funds.

With a compelling vision and a track record of impactful research, Prof. Swaminathan adeptly showcased the transformative potential of MSSRF's work to potential donors, emphasizing the importance of investing in the foundation's future. Through targeted outreach and advocacy efforts, he mobilized support from individuals, organizations, and institutions committed to advancing MSSRF's mission and values. Furthermore, Prof. Swaminathan's strategic approach to fundraising encompassed the cultivation of enduring partnerships and alliances with donors interested in fostering sustainable agricultural development. By leveraging MSSRF's reputation as a hub of

scientific excellence and innovation, he fostered collaborative relationships that resulted in significant contributions to the foundation's corpus funds.

In summary, Prof. Swaminathan's ability to identify potential donors to raise corpus funds was instrumental in laying a solid financial foundation for MSSRF, ensuring its continued growth and impact in agricultural research and development.

1.6. TRAIT 6. Balancing international commitments with organizational responsibilities

Prof. Swaminathan's ability to balance international commitments with organizational responsibilities reflects his exceptional capacity for multitasking and strategic prioritization. As a global leader in agricultural research and development, he was often called upon to engage in international initiatives, conferences, and collaborations aimed at addressing global agricultural challenges.

Despite the demands of his international engagements, Prof. Swaminathan remained steadfast in his commitment to advancing the mission of MSSRF. Through meticulous planning and effective delegation, he ensured that organizational responsibilities were met while fulfilling his international obligations. Moreover, Prof. Swaminathan leveraged his international connections and affiliations to bring valuable insights and resources to MSSRF, enriching its research programs and initiatives. By strategically aligning international commitments with organizational goals, he maximized the impact of his global outreach efforts while maintaining focus on advancing agricultural sustainability at the grassroots level.

In essence, Prof. Swaminathan's ability to balance international commitments with organizational responsibilities exemplifies his exceptional leadership and dedication to driving positive change in agriculture, both at home and abroad.

1.7. TRAIT 7. Sparing time for family and social commitments

Prof. Swaminathan's dedication to family and social commitments underscored his holistic approach to life and leadership. Despite the demanding nature of his professional endeavors, he recognized the importance of maintaining a balanced and fulfilling personal life. Prof. Swaminathan prioritized quality time with his family, ensuring that he remained connected with his loved ones despite his busy schedule.

Through regular communication and periodic visits, Prof. Swaminathan nurtured strong familial bonds that provided him with a source of strength and solace amidst the rigors of his work. Moreover, he actively participated in social activities and community initiatives, demonstrating a deep-seated commitment to giving back to society and contributing to the welfare of others.

By sparing time for family and social commitments, Prof. Swaminathan exemplified the importance of maintaining a harmonious balance between personal and professional responsibilities. His unwavering dedication to family values and social causes not only enriched his own life but also served as a source of inspiration for others, reflecting the true essence of his timeless legacy.

1.8. TRAIT 8. Grooming employees to become leaders

Prof. Swaminathan's visionary leadership extended to grooming employees to become leaders within MSSRF and beyond. Recognizing the potential for talent development to drive organizational growth and impact, he invested significant resources in mentorship and professional development programs aimed at empowering employees to assume leadership roles.

Through structured mentorship initiatives, Prof. Swaminathan provided guidance, support, and constructive feedback to emerging leaders, helping them navigate the complexities of their roles and responsibilities. By sharing his wealth of experience and insights, he equipped them with the skills, knowledge, and confidence needed to tackle challenges and seize opportunities effectively. Furthermore, Prof. Swaminathan fostered a culture of continuous learning and growth within MSSRF, where employees were encouraged to expand their horizons, pursue new avenues of research, and embrace innovation. By creating an environment conducive to personal and professional development, he empowered individuals to realize their full potential and contribute meaningfully to the foundation's mission.

Under Prof. Swaminathan's mentorship, a new generation of leaders emerged within MSSRF, driven by a shared vision of sustainable agricultural development and societal transformation. These empowered leaders not only upheld the foundation's values and principles but also spearheaded initiatives to drive positive change and innovation in their respective domains.

1.9. TRAIT 9. Honing writing and speaking skills to develop a global vision

Prof. Swaminathan recognized the pivotal role of effective communication in articulating MSSRF's global vision for sustainable agriculture. He prioritized honing employees' writing and speaking skills to effectively convey the foundation's mission and impact to diverse stakeholders across the globe.

Through targeted training programs and workshops, Prof. Swaminathan equipped employees with the tools and techniques needed to communicate persuasively and compellingly across different platforms and audiences. Whether engaging with policymakers, donors, or the broader public, employees were adept at conveying complex scientific concepts in accessible and engaging ways. Moreover, Prof. Swaminathan leveraged various communication channels, including traditional media, social media, and public speaking engagements, to

amplify MSSRF's voice and reach a wider audience. By effectively leveraging these platforms, he positioned MSSRF as a thought leader in sustainable agriculture, influencing public discourse and policy agendas at both national and international levels.

Ultimately, Prof. Swaminathan's focus on honing writing and speaking skills empowered MSSRF to effectively convey its message of sustainable agricultural development to a global audience, garnering support and mobilizing action towards building a more food-secure and resilient future for all. His legacy of effective communication continues to inspire and guide the foundation's efforts in addressing the most pressing challenges facing agriculture and society.

1.10. TRAIT 10. Making the impact of research felt at government and inter-governmental levels

Prof. Swaminathan's legacy is deeply intertwined with his ability to translate research outcomes into actionable policies at both government and inter-governmental levels. Recognizing the crucial role of evidence-based decision-making in shaping agricultural policies, he strategically engaged with policymakers and government officials to ensure that MSSRF's research findings were integrated into policy formulation processes.

Through targeted advocacy efforts and knowledge-sharing platforms, Prof. Swaminathan effectively communicated the implications of MSSRF's research to policymakers, highlighting the importance of sustainable agricultural practices, biodiversity conservation, and rural development. By presenting compelling evidence and recommendations, he influenced policy agendas and catalyzed positive changes in agricultural policies and programs.

Moreover, Prof. Swaminathan actively participated in inter-governmental forums and initiatives, advocating for global cooperation and coordination on issues related to agriculture, food security, and environmental sustainability. By leveraging his expertise and credibility, he played a pivotal role in shaping international policies and frameworks aimed at addressing the world's most pressing challenges.

1.11. TRAIT 11. Visionary Leadership

Prof. Swaminathan's tenure at the helm of MSSRF was characterized by visionary leadership that propelled the organization towards sustainable agricultural solutions with a steadfast focus on future generations. As a visionary leader, he possessed an innate ability to anticipate emerging challenges and opportunities in the agricultural sector, guiding MSSRF's strategic direction with foresight and wisdom.

Central to Prof. Swaminathan's visionary leadership was his unwavering commitment to addressing the complex and interconnected challenges facing

agriculture, food security, and rural development. Recognizing the imperative of sustainable agricultural practices in safeguarding the well-being of present and future generations, he championed innovative approaches and transformative initiatives aimed at enhancing agricultural productivity, resilience, and sustainability.

Under Prof. Swaminathan's visionary leadership, MSSRF pioneered groundbreaking research and development efforts that not only addressed immediate agricultural needs but also laid the groundwork for long-term sustainable development. By embracing cutting-edge technologies, interdisciplinary collaboration, and participatory approaches, MSSRF forged new pathways towards resilient and inclusive agricultural systems that could thrive in a rapidly changing world.

1.12. QUALITY 12. Innovative Thinking

Prof. Swaminathan's innovative thinking was instrumental in revolutionizing agricultural practices and addressing food security challenges. He approached agricultural research with a creative and forward-thinking mindset, constantly seeking new solutions to age-old problems.

Prof. Swaminathan's pioneering innovations revolutionized agriculture, notably through high-yielding crop varieties like wheat and rice, driving India's Green Revolution. His research in plant breeding enhanced resilience, disease resistance, and yield, bolstering food production. Advocating sustainable practices, he championed organic farming, integrated pest management, and water-saving irrigation. Prof. Swaminathan's vision extended beyond farming, emphasizing holistic rural development. He integrated agriculture with nutrition, health, education, and livelihoods, acknowledging their interconnectedness for sustainable progress. His legacy lies not only in crop improvement but also in promoting a comprehensive approach to combatting poverty and fostering resilient communities.

Prof. Swaminathan's innovative thinking laid the foundation for transformative advancements in agriculture and rural development. His visionary approach and relentless pursuit of new ideas propelled him to the forefront of agricultural innovation, where he revolutionized farming practices and addressed pressing challenges such as food insecurity and rural poverty. This vast experience and pioneering spirit were instrumental in guiding his scientific brigade at MSSRF to develop transgenic plants by identifying candidate genes for sea water intrusion, salt tolerance, and drought tolerance. In the face of mounting challenges posed by global warming and sea level rise, Prof. Swaminathan's innovative solutions offer hope for a more resilient and sustainable agricultural future.

By leveraging cutting-edge technologies and interdisciplinary approaches, Prof. Swaminathan's legacy continues to inspire scientists and researchers to

push the boundaries of agricultural science and develop innovative solutions to the complex challenges facing our planet. As we navigate an uncertain future, Prof. Swaminathan's innovative thinking serves as a beacon of hope, guiding us towards a more food-secure, resilient, and sustainable world.

1.13. TRAIT 13. Resilience

Prof. Swaminathan epitomized resilience in the face of adversity throughout his career. Despite encountering numerous challenges and setbacks, he remained steadfast in his commitment to advancing agricultural research and development for the betterment of society. Whether it was navigating bureaucratic hurdles, overcoming funding constraints, or addressing scientific complexities, Prof. Swaminathan demonstrated remarkable resilience in pursuing his vision of sustainable agriculture and rural development.

His resilience was evident in his ability to adapt to changing circumstances and persevere in the pursuit of his goals. Prof. Swaminathan's unwavering determination and resilience inspired those around him, motivating them to overcome obstacles and strive for excellence in their own endeavours.

1.14. TRAIT 14. Empathy

Empathy was a hallmark of Prof. Swaminathan's leadership style, as he deeply understood the needs and aspirations of farmers and rural communities. He recognized the importance of listening to and empathizing with the challenges faced by agricultural workers, smallholder farmers, and marginalized communities, and he was dedicated to improving their livelihoods through scientific innovation and social empowerment.

Prof. Swaminathan's empathy drove him to prioritize inclusive and participatory approaches in agricultural research and development, ensuring that the voices of farmers and rural communities were heard and respected. By empathizing with the plight of the marginalized and vulnerable, he sought to create solutions that were both scientifically sound and socially equitable, ultimately contributing to greater social justice and human well-being.

1.15. TRAIT 15. Collaboration

Collaboration was central to Prof. Swaminathan's approach to addressing complex agricultural challenges. He recognized that no single individual or organization could tackle the multifaceted issues facing agriculture and food security alone, and he actively fostered collaboration among diverse stakeholders to drive collective action and innovation.

Prof. Swaminathan promoted collaboration across disciplinary boundaries, bringing together scientists, policymakers, farmers, NGOs, and other stakeholders to co-create solutions to pressing agricultural problems. Through collaborative

research projects, knowledge-sharing platforms, and strategic partnerships, he facilitated the exchange of ideas, expertise, and resources, harnessing the collective wisdom and capabilities of diverse actors to achieve common goals.

His collaborative ethos extended beyond national borders, as he engaged in international partnerships and initiatives aimed at addressing global agricultural challenges. By fostering collaboration at local, national, and global levels, Prof. Swaminathan catalyzed transformative change in agricultural research, policy, and practice, leaving a lasting impact on the agricultural landscape.

1.16. TRAIT 16. Adaptability

Prof. Swaminathan possessed a remarkable ability to adapt to changing circumstances and evolving challenges in the field of agriculture. Throughout his career, he demonstrated flexibility and agility in responding to new scientific discoveries, technological advancements, and socio-economic shifts that shaped the agricultural landscape.

His adaptability was evident in his willingness to embrace new ideas and approaches, incorporating emerging technologies and methodologies into his research and development efforts. Prof. Swaminathan's forward-thinking mindset allowed him to stay ahead of the curve and anticipate future trends, enabling him to effectively address emerging issues such as climate change, biodiversity loss, and food insecurity.

Moreover, Prof. Swaminathan's adaptability extended beyond scientific innovation to organizational management and leadership. He recognized the need to adapt organizational structures, policies, and strategies to meet the evolving needs of agricultural communities and stakeholders. By fostering a culture of adaptability and innovation within his organization, he ensured that it remained responsive and relevant in a rapidly changing world.

1.17. TRAIT 17. Strategic Networking

Prof. Swaminathan was a master strategist when it came to building networks and alliances to advance agricultural research and development. He understood the power of strategic networking in mobilizing resources, sharing knowledge, and influencing policy at local, national, and global levels.

His strategic networking efforts involved forging partnerships with government agencies, research institutions, NGOs, philanthropic organizations, and international bodies. By cultivating relationships with key stakeholders and decision-makers, he was able to leverage their support and expertise to drive forward his agenda for sustainable agriculture and rural development.

Prof. Swaminathan's strategic networking skills were instrumental in mobilizing financial resources for research activities, accessing cutting-edge technologies and innovations, and advocating for policy reforms. His ability to

build bridges between disparate actors and align their interests towards common goals contributed to the success of numerous initiatives aimed at addressing agricultural challenges and improving livelihoods.

1.18. TRAIT 18. Ethical Integrity

Ethical integrity was a cornerstone of Prof. Swaminathan's professional ethos, guiding his conduct and decision-making throughout his career. He held himself to the highest standards of honesty, transparency, and accountability in all his interactions and endeavors.

Prof. Swaminathan's ethical integrity was evident in his commitment to scientific rigor and intellectual honesty. He conducted research with the utmost integrity, ensuring that his findings were accurate, unbiased, and reproducible. He was also committed to upholding ethical standards in his organizational management and leadership, promoting fairness, equity, and inclusivity in all aspects of his work. Moreover, Prof. Swaminathan's ethical integrity extended to his advocacy efforts, as he consistently championed policies and practices that prioritized the well-being of farmers, rural communities, and the environment. He was unwavering in his commitment to social justice, human rights, and environmental sustainability, and he used his platform and influence to advance these values on a global scale.

Prof. Swaminathan's ethical leadership earned him respect and admiration from colleagues, collaborators, and stakeholders alike, solidifying his reputation as a trusted and principled leader in the field of agriculture and beyond.

1.19. TRAIT 19. Inspiring Communication

Prof. Swaminathan possessed exceptional communication skills that enabled him to inspire and mobilize individuals and communities towards a common vision of sustainable agricultural development. Whether addressing scientific audiences, policymakers, or the general public, he had a unique ability to convey complex ideas with clarity, passion, and conviction.

His communication style was characterized by its inclusivity, empathy, and authenticity, which allowed him to connect with people from diverse backgrounds and perspectives. Prof. Swaminathan was adept at tailoring his message to resonate with different audiences, using language that was accessible, engaging, and persuasive.

Through his speeches, writings, and public engagements, Prof. Swaminathan effectively communicated the urgency of addressing pressing agricultural challenges such as food insecurity, poverty, and environmental degradation. He inspired hope and optimism by highlighting the potential of science, innovation, and collective action to transform the agricultural sector and improve livelihoods. Moreover, Prof. Swaminathan's inspiring communication extended beyond words

to actions, as he led by example and demonstrated unwavering commitment to his ideals and principles. His passion for sustainable agriculture and social justice was contagious, motivating others to join him in his quest for a more equitable and sustainable future.

1.20. TRAIT 20. Legacy Building

Prof. Swaminathan's legacy extends far beyond his own lifetime, leaving an indelible mark on the field of agriculture and the lives of millions of people around the world. His visionary leadership, scientific innovation, and tireless advocacy have shaped agricultural policies, practices, and institutions for generations to come.

One of Prof. Swaminathan's most enduring legacies is the establishment of the M.S. Swaminathan Research Foundation (MSSRF), which continues to advance his vision of sustainable agriculture and rural development. Through its research, outreach, and capacity-building activities, MSSRF carries forward Prof. Swaminathan's commitment to improving the lives and livelihoods of smallholder farmers and marginalized communities. Furthermore, Prof. Swaminathan's legacy lives on through the countless individuals he mentored, inspired, and empowered throughout his career. Many of his former colleagues and students have gone on to become leaders in their own right, carrying forward his ideals and principles in their work to address global agricultural challenges.

Additionally, Prof. Swaminathan's legacy is reflected in the numerous awards, honors, and accolades he received during his lifetime, including the World Food Prize and the Bharat Ratna, India's highest civilian award. These accolades recognize his outstanding contributions to agriculture, science, and humanitarianism, ensuring that his legacy will be remembered and celebrated for years to come.

2. Making of A World Scientist

The remarkable contributions of Prof. M.S. Swaminathan before and after 1988 underscore his enduring impact on global science and agriculture. Following his formal superannuation, Prof. Swaminathan's focus shifted towards broader international initiatives, notably through the establishment of the M.S. Swaminathan Research Foundation (MSSRF). Under his guidance, MSSRF emerged as a beacon of innovation, spearheading efforts to address pressing challenges in sustainable agriculture and food security. Through pioneering research and grassroots initiatives, Prof. Swaminathan and MSSRF galvanized a young cadre of scientists and advocates, amplifying their collective impact on a global scale. The Foundation's work garnered widespread acclaim, earning numerous accolades and honors from around the world.

2.1. Segmentation of Prof. M.S. Swaminathan's Achievements

Pre- and Post-1988, Cementing his International Scientific Eminence and Earning him the Title of 'World Scientist':

2.1.1. Unique Distinctions

Before 1988:

- 46 National Awards
- 35 International Awards, including the World Food Prize in 1987
- 19 Honorary Doctorates from Indian and 4 from Foreign Universities
- 10 Fellowships of various Scientific Academies and Societies
- Recognition by National and International Scientific Academies (either as a Member or as Chairman) 14
- Positions (Chairman) in organizations devoted to Nature Conservation and Sustainable Development (National & International)- 3

After 1988:

- 33 Honorary Doctorates from Indian and 19 from Foreign Universities
- Recognition by National and International Scientific Academies (either as a Member or as Chairman) 18
- 22 Honorary positions as Chairman, Vice-Chairman, President of International Committees
- 22 Honorary positions in National and International Organizations, including President of IUCN, Chairman of National Commission on Farmers (2004–2014), President of Pugwash Conferences on 'Science and World Affairs' (2002–2007)
- Membership/Chairmanship in about fifty National Committees
- Positions (Chairman) in organizations devoted to Nature Conservation and Sustainable Development (National & International)- 9

2.1.2. Unique Honours

Before 1988:

- Received Shanti Swarup Bhatnagar Award in 1961 and Fellowship of the Royal Society, London (FRS) in 1973 for his outstanding basic research contributions.
- Received accolades for his unparalleled focus on achieving global food and nutrition security.

- Recognized for his significant role in India's quantum jump in cereals production.
- Held prestigious positions in various Indian agricultural research and administrative institutions, including Director-General of the Indian Council of Agricultural Research (ICAR) and Secretary, Department of Agricultural Research and Education (DARE).
- Offered the position of Director-General of the International Rice Research Institute (IRRI) in 1982.

After 1988:

- Founded the M.S. Swaminathan Research Foundation (MSSRF) in 1988, focusing on sustainable food productivity and rural livelihood development.
- Pioneered the integration of eco-friendly technologies and traditional knowledge for rural development.
- TIME magazine of the USA, Asian edition, cited MSS as one of the three most influential Indians alongside Mahatma Gandhi and Rabindranath Tagore in August 1999.

This remarkable recognition, both in terms of quantity and quality, underscores the profound influence of Prof. Swaminathan and his Foundation on the global scientific community. His unparalleled contributions and visionary leadership have rightfully earned him the title of a 'World Scientist', a distinction unmatched by any other individual in the field. Prof. Swaminathan's legacy serves as an inspiration for future generations, demonstrating the power of science and innovation in addressing the world's most pressing challenges and improving the lives of millions worldwide.

3. Epilogue

In closing, the remarkable life and legacy of Prof. M.S. Swaminathan stand as a testament to the transformative power of vision, innovation, and relentless dedication. From his pioneering research in agricultural science to the establishment of the M.S. Swaminathan Research Foundation (MSSRF), Prof. Swaminathan's journey exemplifies the pursuit of excellence in service to humanity. Through his visionary leadership, he reshaped global agriculture, championing sustainable practices and advancing food security on a monumental scale. The numerous accolades and honors bestowed upon him, both before and after 1988, underscore the profound impact of his work on the world stage. As we reflect on Prof. Swaminathan's remarkable saga, let us be inspired by his unwavering commitment to creating a better world for future generations. His legacy will continue to inspire and guide us as we strive to address the challenges of the 21st century with compassion, innovation, and unwavering determination.

A Tribute to Bharat Ratna Prof. M.S. Swaminathan - The Doyen of Indian Agriculture

Dr. P.L. Gautam

The legendry agricultural Scientist, Prof. M.S. Swaminathan, known as father of Green Revolution in India, became the first agricultural Scientist conferred with the highest civilian award, Bharat Ratna, during 2024 in recognition of his immense contributions to Indian agriculture and farmers welfare. He played critical role in helping India achieve self-reliance in agriculture during challenging times and made outstanding contributions in modernising Indian agriculture. He has done yeoman's services as a teacher, innovator, researcher, mentor, philosopher, policy planner and promoter of R&D in agriculture. He has not only transformed Indian agriculture but also championed the cause of national food security, farmers' welfare, equity and prosperity. He was one of the most decorated scientists with all the four highest civilian national awards and first world food prize. He was recipient of a large number of national and international awards/ Honorary degrees and fellowships from academies. Several scholarships/awards/buildings/programmes have been instituted on his name. In 1999, he was one of the three Indians along with Gandhi and Tagore, on Times list of 20 most influential Asians of the 20th century. His famous quotes included, "If agriculture goes wrong, nothing else will have chance to go right" and "The future belongs to nations with grains and not guns". He championed the Evergreen Revolution which described his vision of productivity in perpetuity without associated ecological harm. He has guided and taught many students and is known as "teacher of teachers".

I am grateful to the President (NAAS) for inviting a note on my reminiscences about Bharat Ratna Prof. M.S. Swaminathan. I recollect my formal acquaintance with Prof. Swaminathan to October 1968, as one of the students of his course in Cytogenetics in IARI. He was teacher par excellence whose regularity and punctuality was unparalleled. He did not miss even a single class despite his heavy engagements as Director of IARI. His teaching method was very effective and students friendly. He kept students very active and engaged with his lectures from beginning to the end. He explained even the toughest part of the course in such away which was easy to grasp even by the weakest student. He kept the students updated about the latest literature on the topics. During the entire trimester, we did not see him unhappy or angry with any student and staff. His simplicity, humour, humility, fairness and compassion were worth emulating. His course left an inexplicable motivation, inspiration and aspiration amongst

the students. We virtually became addicted to attend his countless lectures and programmes anywhere in the country. We were lucky to have very outstanding teachers in IARI. But he stood distinct in oratory skills, simple and effective language, audience centric addresses, coining of new terms, unmatched memory etc. Beyond the lecture halls, the Prof. became a mentor to aspiring scholars. Countless students fondly recall his guidance and encouragement that fueled their academic excellence. We have also seen the difficult times which the Prof. faced, including students agitations etc. He managed these odds peacefully with exemplary compassion and audacity.

I remember having coordinated the visit of Nobel Laureate Dr. Norman Borlaug and Prof. M.S. Swaminathan to GBPUAT Pantnagar, as wheat breeder, during *Rabi* crop season of 1978. He visited the research stations, University farm, UP Seeds & TDC and Tarai farmers. During the visit, he very keenly listened and encouraged the scientists, students and farmers. He acknowledged and elaborated the role of Pantnagar University, UPS&TDC and Tarai farmers in ushering green revolution in our country. He spent good time with some of his old friends among the progressive farmers of the Tarai. His address to the academia and students was full of warmth and enthused, encouraged and motivated the audience. Auditorium was packed and many persons enjoyed his address standing near doors or sitting on the stairs or the balcony. He highlighted that the advances in agriculture hold key for the growth of our country and underscored the power of agricultural scientists in making India an exporter of food from a net importer.

Glimpses of Visit of Prof. Swaminathan and Dr. Borlaug to Pantnagar University in 1978

As Vice Chancellor, GBPUA&T Pantnagar (Uttrakhand), I invited Prof. Swaminathan to deliver Bharat Ratna C. Subramaniam Memorial lecture on 'century of wheat research' on August 25, 2003. He paid rich tribute to Sri Subramanian for his role in Green Revolution. He elegantly traced the historical milestones in wheat research in India and abroad. He cautioned that while rejoicing our past achievements, there is no room for complacency and we must strive for 'Evergreen Revolution'. He highlighted the challenges of ecology, equity, GMOs,

Visit of Prof. Swaminathan to Pantnagar to deliver Bharat Ratna C. Subramanium Memorial Lecture in 2003

expansion of proprietary science, climate change and safeguarding genetic diversity, to be confronted by wheat scientists during this century. He also planted a palm plant, which is flourishing in the premises official residence of the Vice Chancellor (Tarai Bhawan).

In my capacity as Director, National Bureau of Plant Genetic Resources (NBPGR), New Delhi, I had frequent exchanges with Prof. Swaminathan regarding drafting of Biological Diversity and Protection of Plant Varieties and Farmers Rights bills. We also shared our experiences for establishment of community seed banks, identification of agricultural heritage sites and delineation of agrobiodiversity heritage sites in India. He inaugurated the silver Jubilee celebration of NBPGR on August 1; 2001. It was a big assembly of Who's Who in PGR management. He was very nostalgic to meet the family of his teacher, late Padma Shri H.B. Singh. Elaborating the growth of NBPGR, he narrated the role of Prof. Singh in PGR management and called him "Vavilov of India". While underscoring the priority for conservation of PGRs, he emphasized the urgency for evaluation and use of the PGRs by the breeders using appropriate technologies. He expressed the need for conservation of habitats and different bioresources. He also underscored the need for effective strategies to manage the Invasive Alien Species.

During my tenure as Chairman of National Biodiversity Authority (NBA), Chennai, I had frequent communications and meetings with the Prof. He along with Sri Jairam Ramesh, (the then Minister of Forests, Environment and Climate Change) blessed us by their benign presence during inauguration of the New Office premises of the NBA on August 19, 2009. He also addressed the gathering and emphasized for gearing activities of the authority. I had honour of sharing the stage with the Prof. during important events organized by MSSRF and NBA at Chennai.

Glimpses of inauguration of new office of National Biodiversity ,Chennai, on August 19, 2009

As a part of silver Jubilee celebrations of NAAS, a symposium on sustaining agricultural productivity for food and nutrition security was organized at MSSRF Chennai on Nov 22 2014. As Vice President of NAAS, I had the honour to co-chair, this event with the Professor. His address set the tone for deliberations in the event. The silver jubilee celebration function of NAAS was held in Delhi on June 5, 2015. It was very unique opportunity to share the stage with the Professor and other luminaries. In his presidential address, Prof. traced the history of NAAS and set its future agenda for addressing the future needs and challenges.

During my Chairpersonship of Protection of Plant varieties and Farmers Right Authority (PPVFRA), New Delhi, we had several joint events and programmes with the MSSRF. Being advocate of the rights of farmers, Prof. had given his guidance for promoting, rewarding and honoring the gene saviours. He presided over the Plant Genome Saviour Award and Recognition Function (2010-11) organized by the Authority on 21 May 2012. He congratulated the awardee farmers and inspired them to continue their efforts of conserving the traditional plant varieties. He called upon the Authority to support the community Seed Banks to promote availability of seeds of farmers' varieties to the farmers at their door steps.

Prof. M.S. Swaminathan presided Plant Genome Saviour Award 2010-11 Function of PPV&FR Authority.

As Vice Chancellor and Pro Chancellor of Career Point University, Hamirpur (HP), strong relations were established with the MSSRF. Prof. Swaminathan took very keen interest in the academic and research activities of the University and he

was a continuous source of guidance and inspiration. The following notable events are worth mentioning:

(i) Prof. guided the University in successful organization of the 9th Indian Youth Science Congress during April 7-9, 2018 on the theme "Role of Young Scientists in Developing New India". He addressed the young and budding scientists, through a video message, at the inaugural function of the Congress. He exhorted the participants of the Youth Congress to work on building climate resilient New India by making friendship with science as it offers solutions to challenges, shows the way as to how natural resources can be used in a sustainable way and how to ensure sustainable development in multiple facets, including environmental, social and economic dimensions. He applauded the introduction of food security bill by the government to provide food to those who need social support. He said that the duty of young scientists, while building New India is to ensure that the minimum needs of the people in terms of minimum needs of food, minimum needs of job and minimum needs of employment are met and enough number of jobs are created in that jobless growth is a joyless growth. He further said that we must ensure that no child, man and woman should go to bed hungry.

(ii) As the chief guest of the 3rd Convocation of the University on April 10, 2018, he emphasized (in virtual mode) that "education is the key ingredient in character building and socio-economic transformation and higher education can transform India's demographic advantage into significant wealth generation. The future holds great potential, if we manage the challenge of providing quality education to all. Youth must be provided with opportunities for constructive engagement in a manner that fulfills their aspirations. He highlighted the need to create and nurture a holistic learning environment, make education student centric, bring to bear ICT technologies to enhance quality and access to quality education, and prepare the youth to be effective participants in the society."

(iii) On the occasion of the National Conference on "Agripreneurs and Startups" organized by the University during August2-3, 2023, in collaboration with M.S. Swaminathan Research Foundation Chennai, the Prof. blessed the delegates with the following message: "Indian agriculture has made a phenomenal growth since the introduction of new agricultural technology in the mid-sixties ensuring that the country moved from a food deficit to food surplus and food secure. Indian agriculture is now facing second generation problems like climate change, degradation and decreasing soil fertility causing rising input cost, falling agricultural prices leading to decrease in the profitability/returns and mounting indebtedness of agricultural households. These developments have led to a massive push of youth from agriculture notwithstanding non-availability of alternative job opportunities. Attracting educated youth of the country to farming, is, therefore a big challenge and

calls for the attention of all stakeholders. A clear road map for future action and policy interventions to make agriculture a commercially profitable profession is required, which will motivate the youth of the country to adopt it as their profession ..."

(iv) My association with the Prof. since 1968 till his last breath helped establishing very strong bonds between MSSRF and the Institutions I served in India. The Career Point University, through its academic, research and community engagement pursuits is continuing its works relentlessly on the issues espoused by the Prof. to serve and promote the welfare of the rural people. As a token of gratitude to him and intention to carry forward his bequest, the University has established "**Bharat Rattan Prof. M.S. Swaminathan Centre for Skill Development"** to impart vocational skills to the unemployed youth in the vicinity of the University to enable them earning their livelihood honourably.

Agriculture should be viewed as a livelihood and not just a business

M.S. Swaminathan

Contributions of Prof. M.S. Swaminathan During his Tenure as the Director General of IRRI (1982–1988)

Dr. Gurdev S. Khush

I had the opportunity to interact with revered Prof. Swaminathan during several meetings and conferences in India and abroad. However, I had the good fortune of working with him closely during his tenure as the Director General of International Rice Research Institute (IRRI). Upon arriving at IRRI, he reviewed the research and training programs with scientists. He used to visit research farm early in the mornings before any of us scientists came to labs or offices. I invited him to look at the promising breeding materials on several occasions.

Rice Biotechnology

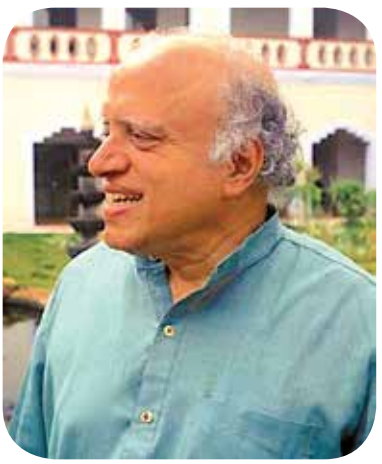
In cooperation with the Rockefeller Foundation, Prof. Swaminathan organized an International Symposium on Rice Biotechnology in 1984 at IRRI. As a follow up, he initiated a research program on rice biotechnology. Although biotechnology was a very new field at that time it became a major program at IRRI in later years

Photosynthesis

Photosynthesis is the most important process in plants. For increasing the crop yield, improvement of photosynthesis is important. Prof. Swaminathan encouraged plant physiologists to start research on photosynthesis. It became a major research project and was one of the three so-called "man-on-moon projects" at IRRI

Rice Genetics

Basic information on genetics of crop is very important for progress in breeding. The status of rice genetics was much behind that of other important crops such as wheat, Maize and tomato. Prof. Swaminathan asked me to organize an international symposium on rice genetics to promote international collaboration in rice genetics. I organized First International Rice Genetics Symposium in 1985. It was attended by 200 rice scientists from 32 countries. On the basis of discussions with the participants a formal organization for collaboration in rice genetics was established. This organization called International Rice Genetics Cooperative (IRGC) did much to enhance international collaboration in rice genetics. International Rice Genetic Symposia have been held at five year intervals at IRRI.



Problem Soils

Millions of hectares of soils in Asia and Africa have mineral toxicities or deficiencies such as salinity and phosphorus deficiency. Vast majorities of them have poor yields and some are not even cultivated. There was no breeding program to develop rice varieties for these problem soils. Prof. Swaminathan asked me to start a breeding program for these soils. A new scientist was hired and breeding program was organized. Several improved varieties were developed.

Women in Rice Farming

Most of the rice in Asia is grown by women farmers. They raise their families and do the backbreaking work of transplanting, harvesting, and threshing rice, and they are paid low wages. Prof. Swaminathan organized the first-ever "Women in Rice Farming" symposium at IRRI. Problems faced by

women farmers were reviewed. The United States-based Association for Women in Development gave Prof. Swaminathan their first award for outstanding contribution to the integration of women in development.

International Collaboration in Rice Research and Development

IRRI had collaborative rice research and development projects with most rice-growing countries. Prof. Swaminathan arranged additional resources to strengthen the projects with Vietnam, Indonesia, Myanmar, Thailand, Sri Lanka and Pakistan. Several donors, such as USAID, supported these collaborations.

There was no collaboration with Cambodia and Laos. The situation in Cambodia was desperate as most of the infrastructure in the country had been destroyed during the war years and Pol Pot regime, and famine-like situations existed. Yet no donor came forward to support research collaboration with Cambodia due to geopolitical considerations. Prof. Swaminathan asked me to lead a three-man team to study the situation in Cambodia. We visited the country in 1985 for one week and had useful discussions with scientists who had survived the Pol Pot purges. Based on our report Prof. Swaminathan prepared a collaborative project to work with Cambodia and arranged resources from the Australian Government. A five scientist IRRI team was assigned in Phnom Penh. Many improved rice varieties were developed and several young scientists were trained. From being a rice deficit country, Cambodia became rice exporting country by the turn of the country. Collaboration with Laos was also started.

We must embrace diversity and celebrate cultural heritage

M.S. Swaminathan

Prof. M.S. Swaminathan – An Exceptional Human Being

Dr. Ajay Kohli, Xenina Ibabao and Gene Hettel

Prof. Mankombu Sambasivan Swaminathan (MSS) was born into an agricultural family in Kumbakonam in the southern Indian state of Tamil Nadu. Although his father was a prominent physician whose footsteps he could have easily followed, he, not too surprisingly, decided to start his academic career by studying for a B.S. in agriculture and plant genetics at the University of Madras in Tamil Nadu. He then moved on to study at Wageningen University in the Netherlands where he was an UNESCO Fellow in Genetics, and finally to England, where he received his doctoral degree in genetics from the University of Cambridge in 1952.

Prof. M.S. Swaminathan

(Source: IRRI archive photo)

Accolades for Profound International Impact

Upon his passing, many prestigious scientific and academic publications eulogized him and his contributions. *Nature*, for example, declared that he "rescued millions of people in South Asia from famine in the 1960s and is revered in India as a major player in the agricultural movement known as the *Green Revolution*." The *Washington Post* pointed out that "as one of the masterminds of the Green Revolution initiative, he is credited with saving hundreds of millions of people from starvation," while the *New York Times* articulated that he "fused plant breeding science with keen administrative skills that steadily transformed India into one of the world's top growers of wheat and rice." And as reported in *India Today*, Indian Prime Minister Narendra Modi, said "that, at a very critical period in our nation's history, his groundbreaking work in agriculture transformed the lives of millions and ensured food security for our nation."

IRRI - A Key Stop in MSS's Career

As part of his long, unprecedented career in world agriculture, MSS spent only 6 years at the International Rice Research Institute (IRRI)—as its fourth director general (DG, 1982-88)—but he had a profound effect on practically

everyone he worked with at the institute, including two former colleagues quoted here.

In September 1982, Gene Hettel showed up at the institute's headquarters in Los Baños, Philippines, for a 1-year sabbatical on leave from Iowa State University in the USA. "As a communication specialist, I was to be a visiting editor on IRRI's 1982 annual report and some other scientific publications," he says. "My first stop upon arrival was an audience with MSS himself in his office. Seeing that I was a bit nervous and tired after the long flight from the States, he set me at ease with his friendly smile and comforting demeanor. Learning that soft red winter wheat was grown on the Ohio farm where I grew up, he—being the ultimate wheat breeder—peppered me with questions about the crop. Having established a true connection with me thanks to wheat, he gave me a warm handshake, adding that he would see me during a reception later that evening at the IRRI guest house.

Hettel with MSS and Cesar Virata at the ubiquitous IRRI guest house reception, September 1982

(Source: Urbito Ongleo photo, IRRI)

"So indeed, later that same evening, I partook in what was becoming a staple during MSS's early days as IRRI DG—the reception at the guest house, warmly referred to by staff as the "chicken-on-a-stick," Hettel recalls. "This particular event welcomed visiting Philippine Prime Minister Cesar Virata. MSS not only introduced me to the Prime Minister but also to the IRRI staff members in attendance who were curious to meet the new visiting editor from Iowa."

What Hettel witnessed that first day in MSS's office and seeing him mingle with staff during the reception with his soft-spoken and exquisite manner certainly mirrored what Ajay Kohli, IRRI interim DG (2023-24), eulogized upon hearing of his passing: "His ability to remember names of anyone he met once may be less due to a keen memory and more due to him relating to the person very quickly," he said. "That is what contributed to the staff's fondness of him during his time at IRRI.

"That geniality is evident through an explicit example, as with many who had similar experiences with MSS," recalls Kohli, "When I was introduced to

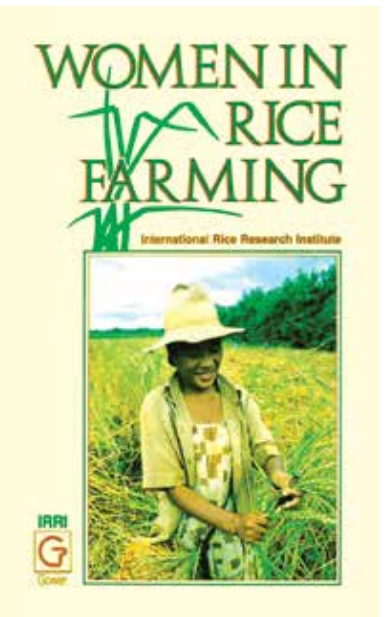
MSS by another IRRI legend, Dr. G.S. Khush, at a conference in the John Innes Centre (JIC) auditorium in Norwich, UK. Dr. Khush knew me as his student who had recently then, in 1995, moved to JIC to conduct Ph.D. research, after spending 2-1/2 years at IRRI. With his inimitable warm smile, MSS shook my hand and asked a couple of questions about my research. He then got busy with so many others who wanted to talk to him. Three years later when I met MSS again in India, ready to remind him that we had met at the JIC auditorium, he offered his hand along with the question if I had been successful, in the interim, in my breeding research project. It totally blew me away that he remembered me and what my research engagement was about.

"There was a gap of nearly 11 years (2009) until I next met a visiting MSS at IRRI," Kohli recalls. "As the leader of the Plant Molecular Biology Lab, I was at the door to welcome him. And again, it took him only a few seconds to remember our last meeting and express his congratulations and commendations on my taking the job at IRRI. While I was basking in the feeling of being recognized, he was calling different members of the staff by their names, shaking hands with some, hugging others, asking after their spouse and children, and in some cases naming them, all those 21 years after leaving IRRI in 1988. And the staff could not have enough of him. There was a sense of excited bonhomie around him, which comes only with someone who is your own. Such was his relationship with his staff."

IRRI - The Flagship for Gender Equality

"One of the most memorable events during my early 80s sabbatical at IRRI," recalls Hettel, "was helping with the organization of the International Conference on *Women in Rice Farming* Systems at the institute in September 1983. The plight of women involved in rice farming was on the mind of MSS long before it became the concern that it is today. Indeed, he pretty much made IRRI a flagship of the gender equality movement in the world, one of the first scientific institutes that really tackled the issue head-on.

"MSS asked me to get an appropriate cover photo for the conference proceedings, which I did after finding women salvaging rice panicles on a nearby farm with a severely lodged field," Hettel says. In the



Women in Rice Farming proceedings cover, 1983

Source: Gene Hettel cover photo, IRRI (note: IRRI also owns the copyright to this book)

foreword to the 531-page proceedings, MSS wrote: "Women play a major role in rice cultivation, postharvest processing, and marketing throughout the world. Rural women work long hours in domestic and agricultural production because they frequently have primary responsibility for both household subsistence and child welfare. Any technology that can increase rural women's productivity allowing them to work less and earn more will be beneficial to the welfare of rural households."

The IRRI Pioneer Interview

"In 2005, as head of IRRI's Communication and Publications Services, I hit upon the idea of conducting oral histories of prominent past and present IRRI scientists and administrators for IRRI's 50th anniversary celebration in 2010," says Hettel. "Continuing these interviews long after the golden anniversary, of the 80 or so that I've conducted over the last 19 years, perhaps the busiest person of all, MSS, granted me the most hours for the interview. Below are some highlights from the interview sessions, which took place on 10-11 October 2006 at his office in New Delhi."

MSS makes a point during his IRRI Pioneer Interview, October, 2006

(Source: Gene Hettel photo, IRRI)

Evolving challenges for IRRI

"During its first decade (1960s), IRRI's challenge was to improve rice productivity. The second decade (1970s) saw the challenge of establishing a rice farming systems background. During my decade (1980s), the challenge was to mainstream considerations of ecology and equality in technology development and dissemination and also help build national rice research institutions, including the Philippine Rice Research Institute (PhilRice). IRRI's greatest challenges today," he added, "are against the backdrop of globalization. The UN Millennium Development Goals (MDGs) presented a challenge for IRRI because, for 40% of the world's population, rice is a staple. So, the very first MDG, reducing hunger and reducing poverty, depends greatly on IRRI's work, along with its national partners. So, there is a great responsibility.

"Life becomes more interesting when some old challenges are solved and new ones come along," MSS went on to say. "We need new challenges as we enter the 21st century, and as you can see, we have them. An institute, such as IRRI, should always be ready to change course. If it is not, it will be passed by others."

Establishing PhilRice

MSS was keen on developing strong national programs. "I wanted to help all the countries with whom IRRI was working to develop strong national rice research institutes," he said. "IRRI's success is greatest when there is a strong national research system that can absorb the technology, adopt it, and use it. I was on the Philippine government committee convened to brainstorm the idea of establishing a national rice research center, which would eventually become PhilRice.

MSS escorts Philippine President Corazon Aquino around the IRRI campus in 1986

(Source: IRRI archive photo)

"Cory Aquino visited IRRI shortly after she became president in 1986. In private, we discussed whom she might appoint as the first executive director of PhilRice. I recommended Dr. Santiago Obien, who in my opinion was an outstanding scientist. So, PhilRice officially began operations in June 1987 with Dr. Obien as its first executive director. I also talked to Kenzo Hemmi, who was then the Japanese Chair of the IRRI Board of Trustees, and arranged through him to get PhilRice about $10 million of funding from the Japanese Government. And finally, I recommended to the PhilRice board not to remain in Los Baños, but to move to the science city of Muñoz in Central Luzon where it thrives today."

Initiating the India - IRRI Partnership

"Age did not slow MSS down," says Hettel. "When he was 90, he responded within 24 hours to a request that I made of him to pen an editorial column, *A Grain of Truth*, on the outstanding 50-year partnership between India and IRRI in the April-June 2015 issue of IRRI's *Rice Today* magazine." He eloquently wrote on that topic: "I visited IRRI for the first time in 1964 and was greatly impressed with the germplasm in the field, with emphasis on a new plant architecture, which could use soil nutrients and water most effectively. There was also a great emphasis on breeding varieties resistant to major pests and diseases. Therefore, I strongly recommend that the Government of India enter into a mutually beneficial partnership with IRRI, which has proven to be an outstanding exercise in promoting collaboration, which advances global rice science and development on the one hand and India's rice production on the other. Because of its symbiotic nature, this partnership has not only endured but has been enriched over the past half century and is a remarkable example of the power and value of collaboration between CGIAR institutions and national agricultural research and extension systems."

Key to Success - Never Retiring!

"MSS certainly never retired," concludes Hettel. "After the 2006 Pioneer Interview, he sometimes passed through IRRI, often busily en route to some other venue. The last time I saw him was during an institute luncheon in his honor in 2011."

The last meeting of Hettel and MSS at IRRI in 2011

(Source: Hettel archive photo)

MSS was indeed a magnificent colleague and friend to scores of people at IRRI and in the scientific community beyond, over an enduring period. His 6 years as IRRI DG were the proverbial "tip of the iceberg" of an extraordinary international career. MSS was a world scientist of rare distinction and an exceptional human being. Both Kohli and Hettel–and innumerable others–are very grateful to have known him.

President Marcos visits IRRI 16 Oct 1982

Healthy soils are the foundation of a sustainable food system

M.S. Swaminathan

Prof. M.S. Swaminathan at IRRI

Dr. J.K. Ladha and Dr. R.S. Zeigler

Both authors had the pleasure of working with Prof. Swaminathan in different capacities in our early scientific career. JKL was a young research scientist at IRRI from the 1980s. He witnessed firsthand the many transformations that Prof. Swaminathan delivered to IRRI during his tenure as Director General. These were overwhelmingly designed to make sure the benefits of research reached all people. Likewise he was conscious of the need to generate more income from the family farms and, especially, to make sure that women participated equally in the benefits. The farming systems approach that he championed still influences how rice researchers view the world.

RSZ first met Prof. Swaminathan as a young scientist in Latin America. During an international meeting at CIAT, where RSZ was working on rice for Latin America, Prof. Swaminathan had heard (or read!) some of RSZ's work and asked to learn more. He had no problem inviting a 33 year old scientist to speak to him (and 10 other DGs present) about the intricacies of certain rice pathogens. That degree of involvement by an IRRI Director General left a lasting impression.

Prof. M.S. Swaminathan, widely celebrated for his pivotal role in India's Green Revolution, also made significant contributions in his capacity as a leader and manager, particularly during his tenure at the International Rice Research Institute (IRRI). His approach to leadership was deeply influenced by his commitment to using science for the benefit of society, especially the underprivileged and marginalized communities.

People Management

Prof. Swaminathan was known for his compassionate and inclusive leadership style. He believed in nurturing talent and empowering his team, which he saw as crucial for fostering innovation and dedication among staff. By encouraging participatory decision-making, he ensured that the ideas and concerns of his colleagues were heard and valued, creating a collaborative work environment. His empathetic nature not only motivated his team but also helped in cultivating long-term relationships with stakeholders, ranging from local farmers to international partners.

Broadening IRRI's Agenda

Under Prof. Swaminathan's leadership, IRRI's agenda was notably broadened to address the more holistic needs of marginalized populations. He was instrumental in shifting the focus from merely increasing rice yields to enhancing the overall well-being of farmers. This shift acknowledged that true agricultural development must consider the economic, social, and environmental contexts in which farmers operate.

Prof. M.S. Swaminathan's advocacy for and contributions to rice biotechnology marked a significant advance in agricultural science, particularly in the realm of rice cultivation. Recognizing the potential of biotechnological innovations to address some of the pressing challenges in rice production, he supported and expanded research in this area during his leadership at various scientific institutes, including the International Rice Research Institute (IRRI).

Inclusivity in Agricultural Research

Prof. Swaminathan emphasized the importance of including smallholder and marginal farmers in the benefits of agricultural research. He advocated for the development of varieties and farming techniques that were not only high yielding but also resilient to the challenges these farmers faced, such as pest attacks, erratic weather, and poor soil fertility.

Socio-Economic Development

Recognizing that agricultural productivity alone was not enough, Prof. Swaminathan expanded IRRI's scope to include socio-economic research. This was aimed at understanding and subsequently improving the living standards of rural populations. His initiatives often focused on creating value-added opportunities, improving market access for small farmers, and ensuring women's participation in agricultural decision-making processes.

Prof. M.S. Swaminathan's initiative, often referred to as "Prosperity through Rice," was a comprehensive project aimed at transforming the lives of rice farmers, particularly in India and other rice-growing regions of Asia. The project focused on achieving both agricultural development and socio-economic upliftment through innovative and sustainable rice cultivation practices. The "Prosperity through Rice" project not only led to increased rice production and higher incomes for farmers but also contributed to rural development and environmental sustainability. By addressing the entire ecosystem of rice cultivation, from seed to market, and focusing on both technological and socio-economic aspects, the project embodied Prof. Swaminathan's vision of using science for the greater social good.

Sustainability and Ecological Considerations

A significant part of broadening the agenda under Prof. Swaminathan's guidance involved incorporating sustainable agricultural practices. He championed the cause of ecological farming techniques that could sustain not only the present but also future generations. This included efforts to reduce the dependency on chemical inputs and to increase the use of biological pest control methods.

Education and Capacity Building

Prof. Swaminathan was a strong proponent of education and capacity building as tools for empowerment. He supported numerous training programs and workshops aimed at both scientists and farmers, focusing on knowledge transfer and skill development to ensure that scientific advancements reached those who needed them most.

Through his visionary leadership and holistic approach to agricultural development, Prof. M.S. Swaminathan significantly impacted not just the field of crop breeding and agronomy but also the lives of countless individuals across the globe. His legacy as a people manager and a champion of inclusive development continues to inspire future generations of scientists and leaders in the agricultural sector.

Climate change requires urgent action and global cooperation

M.S. Swaminathan

Prof. Monkombu Sambasivan Swaminathan August 7, 1925 to 28 September, 2023

Prof. Rattan Lal

I have had the honor to know Prof. Monkombu Sambasivan Swaminathan since 1963 when he was Head of the Dept of Botany, and I was enrolled in an M.Sc. degree program in soil science at the Indian Agricultural Research Institute, New Dehli, India. Prof. Swaminathan visited the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria, in 1971 when I was a soil physicist in the Farming Systems Program, and soon after he became Director General of the Indian Council of Agricultural Research, New Delhi. At the Ohio State University, I hosted the visit of Prof. M.S. Swaminathan in 2004 when he received an honorary degree of Doctor of Science (Honorus Causa) from the Ohio State University (See Photo). Prof. Swaminathan received 73 honorary doctorate degrees from around the world. One of the greatest honor of my professional career has been receiving the Swaminathan Award from him on 12th August 2009 at an event held in New Delhi. The first M.S. Swaminathan Award in 2005 was presented to Dr. Norman Borlaug by Dr. Abdul Kalam, President of India and I had the honor to attend this historic award ceremony in New Delhi which was graced by the presence of two greatest agricultural scientists of the world: Dr. Norman Borlaug and Prof. M.S. Swaminathan.

Prof. M.S. Swaminathan was the leader of the Green Revolution in India (1960s), and he worked on three crops: potato, wheat and rice. Prof. Swaminathan worked in strong cooperation with Dr. Norman Borlaug, recipient of the 1970 Nobel Peace Prize, in promoting the Green Revolution technology in India, South Asia and throughout the world. In 1990, Prof. Swaminathan launched the slogan "evergreen revolution", with specific focus on sustainable management of soil, water, and other natural resources. The evergreen revolution, according to Prof. Swaminathan, was based on the concept of ecologically safer cultivation practices which were specifically suited to the needs of 150 million small land holder farmers of India. His vision of "evergreen revolution" promoted the concept of enhanced agronomic productivity in perpetuity but without the environmental degradation. Indeed, it was widely argued that the evergreen revolution was an environmentally-friendly solution to feeding growing and increasingly affluent population of India (and the world) while also addressing abiotic stresses on crops due to climate change and the extreme events of drought-flood syndrome which have been major challenges to India's agriculture. Because of this unique concept of the evergreen revolution, the United Nations Environment

Program (UNEP) based in Nairobi, Kenya, named Prof. Swaminathan as "The Father of Economic Ecology", and this distinction is rightfully deserved because agriculture must also be a part of the solution to addressing environmental issues of the 21st Century including the anthropogenic climate change.

Prof. Swaminathan occupied some key positions in India and abroad. His career was strongly energized during the early 1960s when he cooperated with Dr. Norman Borlaug and started testing of dwarf wheat varieties developed at CIMMYT in Mexico, and which were responsive to inputs of fertilizers under irrigated agroecoregions. By mid 1970s, India became self sufficient in wheat and rice. Thus, India's and South Asia's Green Revolutions will remain synonymous with that of Prof. M.S. Swaminathan. In 1987, Prof. Swaminathan was the first recipient of the World Food Prize, and he used the honorarium from this and numerous other awards to establish the M.S. Swaminathan Research Foundation (MSSRF). This Foundation has been the Center for research, training and extension for Indian and international scholars. I had the honor to visit the MSSRF in Chennai many times. The TATA Foundation of India provided a grant to Ohio State University to conduct research in India on sustainable management of soil and water resources, and the grant was managed through the M.S. Swaminathan Research Foundation. For me, it was a great honor and privilege to work with MSSRF on this multi-year project which also involved visit of several scholars from MSSRF to Ohio State.

Amongst numerous national and international awards, Prof. Swaminathan was the first recipient of the World Food Prize in 1987. He was also Chair of the World Food Prize Selection Committee from 2009 to 2017. Prof. Swaminathan was posthumously awarded the Bharat Ratan Award by the Government of India in 2024. Prof. Swaminathan was and will remain a role model for generations to come. He inspired researchers in agriculture and food security from around the world because of his iconic and exemplary contributions to sustainable agriculture for advancing food and nutritional security through the slogan of Ever Green Revolution. In 1999, Prof. Swaminathan was acclaimed by the Time magazine as one of the twenty most influential Asians of the 20th century, and one of the only three from India: the other two being Mahatma Gandhi and Rabindranath Tagore.

He often argued that "if farm ecology and economics go wrong, nothing else will go right in agriculture. If agriculture goes wrong, nothing else will have a chance to go right in our country." In this context, he emphasized that the role of evergreen agriculture, which implies "the enhancement of productivity in perpetuity without associated ecological harm."

Prof. Swaminathan's legacy is continued through the M.S. Swaminathan Research Foundation. His legacy will remain with both world and Indian agriculture. He worked all his life on the concept that "zero hunger is possible," and he truly believed in it.

It has been a matter of great honor and privilege for me to know Prof. Swaminathan and to follow his trail blazing path achieving a "zero hunger world" and advancing Sustainable Development Goals of the Agenda 2030 of the United Nations.

Science and research are crucial for progress and development

M.S. Swaminathan

Tribute to Prof. M.S. Swaminathan

Dr. Raghunath Mashelkar

30 March was a very special day for millions of admirers of Prof. Swaminathan, as it was the day President Droupadi Murmu conferred the coveted honour of Bharat Ratna on Prof. Swaminathan. How we all wish that he had received it when he was alive.

Let me begin by saying that as the father of the Green Revolution, Prof. Swaminathan's pioneering research, holistic vision for agriculture encompassed not only increased productivity but also equitable access to resources, nutritional security, and environmental sustainability. Prof. Swaminathan's life and work epitomize the transformative power of science, compassion, and ethical leadership in addressing the complex challenges facing humanity today.

I have many fond memories of my personal interactions with him. When I was the Director General of CSIR, he was the Chairman of the Research Council of CFTRI. He was, in fact, a great guide, friend and philosopher to CSIR. Our CSIR family will remain ever so grateful to him.

On a personal level, I remember him as a very pleasant, humble, soft spoken, dignified but a quite unassuming person. He had a demeanor, which concealed his brilliant intellect and amazing achievements with countless global accolades. He was a great listener too. He made ordinary people look extraordinary. So big was his heart.

I will just highlight two events. The first event has to do with my own realisation that Prof. Swaminathan was a social reformer, advocating for the welfare of the farming community, especially women and marginalized groups. He believed that gender equity in agriculture was not just a matter of justice but also a path to greater productivity and prosperity. His efforts to uplift rural communities through education, healthcare, and social empowerment left an indelible mark on the landscape of rural India. And I was lucky to have a personal experience of his vision of what he called as 'Village Knowledge Centres'.

I remember Prof. Bruce Alberts, who was then the President of US National Academy of science had visited India in 1998. I distinctly remember Prof. Swaminathan organising our special visit to Pondicherry, where Prof. Alberts and I were shown the 'ahead of time' experiments that he was doing to build what he referred to as 'Village Knowledge Centres'.

These were truly novel models being tested by M.S. Swaminathan Research Foundation on creating new knowledge systems in the villages around Pondicherry. The knowledge system for sustainable food security in the Pondicherry villages had its goal as the empowerment of rural women, men and children with information relating to ecological agriculture, economic access and utilisation. Such a knowledge system was being managed by local youth at the Village Knowledge Centre, from where the computer-aided information system was operated. Farmers, were becoming the knowledge workers, and they were also being trained to maintain a "Soil Health Card" to monitor the impact of farming systems on the physical, chemical and microbiological components of soil fertility.

There is another remarkable event that left a mark on my mind.

I had the privilege of giving Ranganathan Memorial Oration in Chennai. Shri C Subramaniam was the chief guest, and Prof. Swaminathan was the guest of honour. That was an incredible combination, since both of them were responsible for the phenomenal green revolution in India.

In my speech, I talked about green revolution, white revolution and then I said that there was a grey revolution in India. I was referring to the grey matter in the brain. I said that 0.06% of Indian population with an average age of 26 is generating one third of Indian exports. I was, of course, referring to IT and IT related services.

When it was the turn of Prof. Swaminathan to make the final remarks, he gently said "Dr. Mashelkar is talking about grey revolution. It has to do with a high-quality brain of our young population. Does he know about what is happening to the development of the brain today of young infants born in poor families? He should know about how due to the malnutrition of the poor pregnant women, the children that are being born to them are suffering from a lack of brain development. Therefore, nutritional revolution is the need of the hour.

But even before that he had said that we must move from Green Revolution to Evergreen revolution.

And of course, the remarks of this great visionary were so right.

The nutritional revolution is deeply intertwined with our very future. But to achieve a nutritional revolution, it is important to provide the young children with the right food, rich in nutrients at an early stage. It goes beyond mere calorie intake and emphasizes the importance of a balanced diet that includes all essential nutrients. To put it simply, it's not just about having enough food; it's about having the right kind of food. There are multiple dimensions to nutritional revolution. But I would like to bring forth a specific one. Because I feel that if Prof. Swaminathan was amidst us today, he would have been extremely happy to see how the young innovators of today are bringing his dream into reality. Here is an interesting case.

In 2021, a young innovator Senthil Murugesan, won the Anjani Mashelkar Inclusive Innovation Award set by The Anjani Mashelkar Foundation, that I started in the memory of my late mother.

This inclusive innovator Senthil is realizing had used a high technology to create an affordable innovation called SaveMom, which is a holistic hardware cum software solution for maternal and childcare that safeguards the journey of a pregnant woman and the new-born child for the first 1000 days. The price that one has to pay for this service is just Rs 1000 for 1000 days of use! That is a rupee per day!

SaveMom involves point of care devices and wearables for continuous tracking of vitals of the pregnant mother and a backend software, which is accessed by doctors in real time. The software also has AI-based decision support system for doctors which can predict pregnancy risks in the first trimester as against the third trimester in conventional processes. On the basis of the risk profiles, the software recommends the right nutrition to the mothers and children and ensures channelizing this nutrition through the existing support system.

The SaveMom solution is being an active driver in the 'nutrition revolution' across over ~7000 villages in India so far and is helping grow healthier babies and mothers across the country.

I am quite sure that Prof. Swaminathan would have been very happy to see this humble technology led contribution to his dream of nutritional revolution that he had emphasised decades ago during my Ranganathan memorial oration.

As we pay homage to Prof. M.S. Swaminathan, we must recognize that his legacy is not confined to the pages of history but continues to shape the future of agriculture and food security. His life and work is an inspiration for generations of scientists, farmers, and policymakers worldwide. In celebrating his contributions to agriculture and the nation, we honour a legend whose spirit continues to guide us towards a brighter, more sustainable future.

Small-scale farmers play a vital role in feeding the world

M.S. Swaminathan

My Memoir with Bharat Ratna Prof. M.S. Swaminathan

Prof. N. Mathivanan

In the year 1988, for the first time when I was walking in the corridor of the ground floor of the Centre for Advanced Studies in Botany (CASB), University of Madras, Guindy Campus, Chennai as a newly joined M. Phil. student, excited to see the nameplate on the door of a room as Prof. M.S. Swaminathan, Emeritus Professor. Although I knew him as the "Father of Indian Green Revolution" through teachers and books, never had an opportunity to see or meet him personally. During that time, he established the M.S. Swaminathan Research Foundation (MSSRF) in Chennai and a few of our Doctoral Scholars joined there as Scientists. On August 7th 2003, I accompanied Prof. D. Lalithakumari, former Director, CASB to MSSRF, Taramani, Chennai to meet and greet Prof. MSS on his birthday. It was my very first visit to MSSRF. Prof. Lalithakumari presented him with a shawl and a bouquet and Prof. MSS blessed us with his traditional pleasant smile. Since then, I had the opportunity to greet him on his birthday many a time.

In 2004, Prof. MSS was invited as the Chief Guest for the Graduation Day of CASB and I had an opportunity to receive him personally at the alighting point and escorted him to the venue. While walking, he enquired about our CASB and quickly shared his memories with the former Directors and faculty members of CABS. At the function, he delivered a motivating graduation day address. He advised the students to take up scientific research and to work on tough projects rather than easy topics. Further, he emphasized the future need to identify or develop tolerant or resistant crop plants for different abiotic and biotic stresses such as saline, drought, and insect pests and diseases. He also forecasted how agriculture will be impacted by climate change in the future in terms of cultivation patterns, production, and productivity of crop plants. It was an eye-opening talk to the research scholars, PG students, and faculty members.

In 2004, the National Academy of Biological Sciences (NABS) was instituted and the very first meeting was held in the Committee room of our CASB. Prof. S. Kannaiyan, Former Vice Chancellor of Tamil Nadu Agricultural University, Coimbatore was the founder President, Prof. N. Anand, former Director, CABS was the founder Vice President and Prof. S.S. Gnanamanickam was the founder Secretary and Prof. T.L. Baskaran was the founder Treasurer.

I am one of the founder members of the NABS. The Executive Committee of the NABS unanimously decided to induct Prof. MSS as the First Honorary Fellow. The award was presented to him during the special function held at the Chemical Sciences Auditorium, University of Madras, Guindy Campus, Chennai and I was involved in organizing the function along with the above office bearers of NABS.

In 2006, my wife, Dr. V.R. Prabavathy joined MSSRF as a Senior Scientist in the Microbiology Division and then onwards, my association and interactions with the Scientists of MSSRF were more frequent and continue till now. During this period, I had several visits to MSSRF and on some occasions, I got blessings from Prof. MSS. The NAAS organized the 8th Indian Agricultural Science Congress with the theme "Science for food and livelihood security and rural prosperity" in February 2007 at Tamil Nadu University, Coimbatore. I participated in the Congress along with my Research Scholars and presented four posters. We were excited to meet Prof. MSS in close proximity during the Congress and approached him for a photo. He readily consented without any reservation and it was my first photo with him along with my students.

From left: Dr. M. Jayaprakashvel, Dr. K. Srinivasan, Prof. MSS, Myself (Dr. N. Mathivanan) and Dr. E. Sagadevan during the 8th Indian Science Congress at Tamil Nadu Agricultural University, Coimbatore

In 2010, the First World Noni Congress was organized in a grand manner by the World Noni Research Foundation (WNRF) under the Chairmanship of Dr. Kirti Singh, Former Secretary, NAAS at Trade Fair Center, Nandambakkam, Chennai and the Second World Noni Congress was organized at SRM University, Kattankulathur, Tamil Nadu by the WNRF and International Society for Noni Science (ISNS) during March 2016. On both occasions, Prof. MSS participated as the Chief Guest, inaugurated the congresses, and delivered the inaugural address. In his inaugural address to the Second World Noni Congress, he rightly

emphasized that the roles of traditional folk and indigenous medical practices, which are time-tested over generations, assume significance. There is a need to go a long way in assembling the biodiversity, establishing gene banks, making inter-specific hybridization, evolving good organic farming production and protection technologies, value addition, byproduct utilization, and strengthening pharmacological and clinical studies for validation and therapeutic effects claims of medicinal plants.

In 2013, I had another occasion to meet Prof. MSS along with Prof. H. Devaraj, who assumed office as Vice Chairman, University Grants Commission, New Delhi at that time, interacted closely with him and also got his blessings. It was a thrilling experience to listen to him about his thought process on higher education of our country. He suggested that education must be holistic towards developing intellectually rich, who are willing to shoulder responsibility in nation-building.

From left: Myself (Prof. N. Mathivanan), Prof. H. Devaraj and Prof. MSS at MSSRF

I assumed office of the CASB as Director & Head in July 2015 and I met Prof. MSS and got his blessing. When I met him, Dr. G.N. Hariharan and Dr. R. Parasuraman also introduced me to him as the husband of Dr. Prabavathy. With his usual smiling face, he told me that Dr. Prabavathy is a brilliant and dedicated researcher. She is fortunate to have this exceptional complement from him.

Prof. MSS was recognized supervisor of the University of Madras to guide Ph. D. scholars. There was an issue, when his last research student, Dr. Manjula Menon tried to register herself for her Ph. D. degree with the University of Madras. One day, Prof. S. Sriman Narayanan, then Dean-Research and now

the Vice Chancellor of Vels University, Chennai called me and told me that the Research Section of the University had submitted me a file with a negative note for Ph. D. registration of Mrs. Manju Menon of MSSRF, because Prof. MSS age is not permitted to allow him to guide her. As per the University norms, a Professor up to the age of 70 years only will be given recognition to guide the Ph. D. scholars. Prof. Sriman Narayanan asked me what to do in this situation. I told him that Prof. MSS is a distinguished alumnus of our University of Madras and an eminent world-renowned scientist and having him as a recognized Ph. D. supervisor is a pride to the University. Further, I told him that this would be treated as a special case and Prof. MSS would be given recognition to guide Ph. D. scholars, irrespective of his age. I am happy to mention that to my knowledge, Prof. MSS is the only Professor at the University of Madras, who was given guideship to supervise Ph. D. scholars throughout his lifetime.

Another ever memorable occasion happened in my life is during May 2020, when I wanted to apply for the Vice Chancellor position at the University of Madras. I approached Dr. G.N. Hariharan, Executive Director of MSSRF to arrange for a meeting with Prof. MSS to request him for a recommendation letter. I was skeptical about getting his appointment as the country was under lockdown due to COVID-19 and the people movement was heavily restricted. But, Dr. Hariharan got consent from Prof. MSS and asked me to send my CV on 28th May 2020. It was my fortune to meet him on 29th May 2020 in his room at MSSRF, receive the recommendation letter, and get his blessing from his golden hands. He told us that many Vice Chancellors of different Universities across the country including the Vice Chancellors of the University of Madras have been selected in the past from the very same room at MSSRF, where he used to sit till his last breath. I witnessed that even during the Covid-19 period, he used

Prof. MSS, Prof. H. Devaraj and myself (Prof. N. Mathivanan) at MSSRF

to visit MSSRF regularly and attend to his duties. Furthermore, despite his age-related health issues, he was coming to his office till the end of his life period. I had never seen or heard of such a dedicated, disciplined and hardworking personality, but only Prof. MSS, a person of great inspiration.

I had the opportunity to see Prof. MSS from near and far several times since 1988. But I was unfortunate, regretful, and completely shattered to see him on his dead bed on 28th September 2023 in his simple and modest room at his residence, Chemiers Road, Nandanam, Chennai. The CASB organized the 4th International Conference on Bacteriophage Research and Antimicrobial Resistance from 28th to 30th September 2023 at SERC Auditorium, Taramani Chennai. The organizing committee unanimously decided to invite Dr. Sowmya Swaminathan as the Chief Guest to inaugurate the conference. When we approached her, she readily accepted, inaugurated the conference, and delivered the inaugural address on 28th September 2023. After, her inaugural address, she wanted to leave for another meeting and I was accompanying her to send her off. Around 11.20 in the morning, we were waiting for the car to arrive in the front of the venue, when she received a call, became restless and was in a hurry to go. I was just guessing that the message she received was not a good one. Immediately after her departure, I received a call from Dr. Prabavathy, Director, Biotechnology, MSSRF who with great sorrow conveyed the bad and unfortunate message that "Professor is no more". I was shattered and could not believe it. I immediately rushed to the residence of Prof. MSS and paid my homage with a broken heart.

I wish to mention that I paid my tributes to Prof. MSS by placing floral wreaths on behalf of NAAS, NABS, and ISNS as per the advice of Ms. Meenu, Chief Programme Executive, NAAS, Dr. D.J. Bagyaraj, President and Dr. T. Marimuthu, Secretary, NABS and Dr. P. Rethinam, Former ADG, Plantation Crops, ICAR and the President and Dr. T. Marimuthu, Secretary *cum* Treasurer, ISNS, respectively in the presence of Dr. Sowmya Swaminathan, Dr. Hariharan, Dr. R. Ramasubramanian, Dr. Prabavathy and Prof. Elangovan Vellaichamy.

Since 2006, I have been associating with MSSRF closely as this Foundation is affiliated with the University of Madras as a Centre for Research leading to Ph. D. degree. I have visited several times as Convener of the Inspection Committee, Examiner for conducting Ph. D. public viva voce examinations, for attending birthday celebrations of Prof. MSS, seminars and conferences and for scientific discussions. Prof. MSS developed the Foundation as State of an art research and extension centre with impressive infrastructure facilities and manpower with unique skills. He is one of my role models and every meeting with him was a great learning for me. I was fortunate to witness his dedication, perseverance, mentoring and leadership on several occasions. Anyone who had an opportunity to meet him could experience his caring nature, humility, simplicity and humanitarian touch. I was gifted to meet and interact with him and also to receive his abundant blessings.

In a condolence meeting organized at the Indian Institute of Technology Madras to pay homage to Prof. MSS, Former Vice President our country Shri M. Venkaiah Naidu and many dignitaries participated. I had an opportunity to speak about him and pay my homage and I concluded my tribute in the meeting by saying “Professor MSS’ name and fame will ever remain in the world as long as farming and farmers are there”.

The use of chemical pesticides and fertilizers should be minimized

M.S. Swaminathan

Bharat Ratna Prof. M.S. Swaminathan: Who Inspired Millions of Young Minds for Agricultural Research

Dr. C.D. Mayee

September 28 is known in the history for the death of Rao Tularam Singh who was one of the leaders of the Indian rebellion of 1857 uprising against British rule in India. September 28, 2023 now will be known for the death of one of the legendary fighters for the cause of farmers, Prof. M.S. Swaminathan. It is a black day for Indian agriculture when its most loved son died at Chennai at the age of 98. Obituaries poured across the globe as his work touched practically farmers of many countries. The most shaken by his death were many agricultural scientists like me spread across the globe whose tears were probably dried unnoticed. I was admitted in IARI, New Delhi when Prof. Swaminathan was the Director of the Institute. It was a golden period for me as like me every student was practically mesmerized to do something to save the country from begging bowl situation. This motivation came from Prof. Swaminathan who inspired the young minds to put our research energies for making the nation self-reliant on food, he being the main architect who did usher the green revolution in India. It is matter of great satisfaction that we, the students then, were part of the emerging green revolution history.

The beauty of research then was not mere lab testing but demonstration of the technology directly in Farmers' field through National Demonstration, a concept unknown till then. The credit of transferring the technology for the welfare farmers goes to Prof. Swaminathan. The very idea of bridging the gap between technology generation and its implementation in farmers field called 'Lab to Land' is what Prof. Swaminathan gave to agricultural scientists of the world. He knew that the end of research is beyond publication and the continuum of research-technology- adoption by farmers, has special significance in Agricultural Sciences. Such of his teachings made us realize that whatever we do in the name of research must have value for farmers and then it needs to be transferred in farmers' field. It is not that there was no opposition to what Prof. Swaminathan did to conduct the experiments with foreign originated wheat cultivars. However, Prof. Swaminathan's ability to convince the planners, politicians were exceptionally admirable and thus he could overcome all such hinderances to trigger the first green revolution of the country. This ability of Prof. Swaminathan came from his being a wonderful teacher at Pusa Institute. I remember many of us who could not register for his course on Genetics use to attend his class standing at windows. His teaching was simply mesmerizing and

the way he would explain the laws of genetics, genetic code, DNA replication and many nuances of science were just unparallel. Those who attended his lectures outside the class will agree on one thing that his words use to flow like honey coming from the comb. One of the great abilities of Prof. Swaminathan is instant reply to any query either by letter, mail of phone. Through out my service whenever I asked for guidance, he promptly gave it.

In 2004 when Government of India mooted the idea of creation of the first Framers' Commission, I remember as Agriculture Commissioner, the then Food and Agriculture Minister Mr. Sharad Pawar immediately chose Prof. Swaminathan as the Chairman of the Commission. The reports of the commission particularly on the recommendations of minimum support price (MSP) have been so pro-farmers that farmers all over the country have been demanding implementation of that formula for fixing MSP. His recommendation of fixing MSP at 50% higher than the cost of cultivation plus C 2 showed his love and dedication for farmers. It is because of his love for upliftment of farming community, Honorable Shri Narendra Modi calls him a true *Kisan Vaigyanik*. Certainly, we will miss his guidance but what he has instilled, *the can-do spirit*, amongst the agricultural scientific community will always grow in time of crisis.

When Prof. Swaminathan heard of the farmers' frequent suicides in Vidarbha, he was highly disturbed. Through his Foundation in Chennai, he commenced both technical and financial aid to suicide-prone farmers and established a help center in Wardha and made frequent visits to build confidence in farming. It is on one such occasion he visited the Shri Shivaji Agriculture College, Amaravati in Vidarbha. A banyan tree sapling planted by him in 1976 is now a full-grown tree. I was part of the function then and when I sent the photo of banyan tree on his 97th birthday, he was overwhelmed and happy to see me and the principal of the college below the tree. His other connection to Nagpur was being the first Adviser of Agrovision, a mega exhibition event conducted every year to educate, encourage and empower in respect of new technology adoption. In 2012 when

I retired and settled in Nagpur, he has asked the organizers to make me advisor as he was not able to frequently travel during the exhibition period. It is a long journey but the foundations laid by late Prof. Swaminathan are strong enough to make us attain the desired sustainably of Indian agriculture. In India we have several *Swamis* to preach the path of salvation but in agriculture there is only one and one Swami and that is Prof. Swaminathan to show us the path of agrarian emancipation. In the present-day world disorder, we recall his last words, **we can buy peace with grains and not by guns**. His mentor, Dr. Norman Borlaug when received Noble Prize for peace, the entire agricultural fraternity felt elated and now same feeling has come to all of us when Prof. Swaminathan is bestowed with the highest civilian award, **Bharat Ratna**.

Investing in rural development is investing in the future

M.S. Swaminathan

Bharat Ratna Prof. M.S. Swaminathan: A Role Model for All Times

Dr. S.L. Mehta

It is a rare privilege and honour to write about the illustrious son of India, world's most iconic and a radiant personality and one who has been role model for all because of his Steller qualities. Prof. Swaminathan, the Father of Green Revolution lead to food security in the country during the most difficult periods and this brought respect to all agricultural scientists in the world. Prof. Swaminathan was truly a world statesman championing for world free from hunger, poverty and malnutrition, God gifted orator, outstanding teacher and researcher, science administrator par excellence, institutional builder, champion of farmer's welfare, gender equity, sustainable agriculture and conservation. He was a noble human being, ever smiling personality, and personified in life what is the best in Indian culture.

I was fortunate to have received his guidance, mentorship, counsel and support for over five decades. I joined IARI as student in 1962 and we all used to go to his residence during Holi and were always provided with sweets by Mrs Mina ji and Prof. All students used to enjoy.

My interaction increased after joining Division of Biochemistry at IARI in August 1969. I had just returned from Canada after doing Post-doctorate. The Biochemistry lab at that time was biggest in IARI but not very well equipped. Therefore, I made a list of Chemicals and three important equipment's and requested Head Dr. N.B. Das to request Prof. M.S. Swaminathan to write to Dr. Baird, Chief, Rockefeller Foundation to provide support of US$ 5000 for chemicals and three equipments to help improve the quality of practical's in Biochemistry. We went to meet Prof. Swaminathan who was the Director IARI at that time and I said sir we at IARI admit the brightest students and biochemistry is basic to all sciences and if you kindly request Dr. Baird to get us chemicals and equipment's he would support us. He immediately called his PA and dictated letter and the letter was given to me. I went to Dr. Baird and made my submission and after a little pause he asked how much it would cost. I said sir just US$ 5000 but would make tremendous change and impact on quality of teaching in Biochemistry. He agreed and within two months everything arrived to our surprise. This led to quality enhancement in research and skills among our students. Only Prof. Swaminathan's letter helped us to achieve this.

Nuclear Research Laboratory

One of the finest and best laboratory was established in IARI with support from Swedish International Development Agency in 1969. It was the vision of Prof. Swaminathan to use nuclear tools for accelerating research involving interdisciplinary team work with innovative model of NRL. State of the art equipments were provided for the laboratory with liberal assistance. It was a unique laboratory model with provision for one scientist from each of IARI main Divisions for liaising with scientists from Institute and different institutions in the country. Equipments included NMR, Electron microscope, Amino Acid Analyser, Gas Chromatograph, Liquid Scintillation counter, Mass spectrometer, controlled environment growth chambers, Chromoscan, Spectrophotometers, Ultracentrifuge, irradiation facilities and several other facilities not available at most places.

Soon I was asked by Prof. Swaminathan to move to NRL and help establish Biochemistry Lab since many equipment's had arrived and the Biochemistry expert requested Director to provide young biochemist. At that time NRL was in Chaman shed. I went and within one week all instruments were installed and tested. This was a boon for Biochemistry Division and the Institute.

Governance

During his tenure as Director of IARI, Institute grew in strength. He decentralised powers to all officers under him and encouraged and supported them to be fearless and complete the tasks in time. That was the golden period in the history of IARI for high quality research and quality assurance in education. At that time the powers of Project Director and Head in IARI was only Rs 2000/ for each case for purchase. Dr. N.P. Datta Project Director, NRL used to sanction all purchase of local equipments costing sometimes lakhs of Rupees. He would sanction, purchase order would be placed and file sent to Director for ex-facto sanction. Every proposal was supported by Prof. Swaminathan a great visionary science administrator. Another incident I remember is he asked me to look at the estimates for construction of Biochemistry and Plant Physiology building. I took estimates to him prepared by CPWD. It was Rs 1.12 crore. He said Dr. Mehta have you gone to Bata shop price is Rs 99 or Rs 999. If estimate is below one crore finance people will see it lakhs and not crore. I got the hint and revised the estimates to Rs 99 lakhs.

Education

Dr. Swamination was an outstanding educationist and a teacher. He was the only Director in the History of IARI to take regular classes which enabled development of very competent students. His contribution in keeping higher agricultural education with DARE on the pattern of UGC shall ever be remembered.

For quality assurance in education he set up Norms and Accreditation Committee which functioned under his leadership for maintaining high standards. ICAR appointed high power Committee on higher agricultural education under the Chairmanship of Prof. M.S. Swaminathan and the report was submitted in 1997 under the title "Education for Agriculture: Bridge to a Century of Hope on the Farm Front". In the report major reforms were suggested. Chief among them included Women technology empowerment, global competitiveness, Distance education, training of rural youth in new technology and skill development, partnership involving Research institutes, public & private industry and farm families, non-Degree programmes based on market preferences and introducing agriculture in schools at 10+2 level. He further said "Agricultural education has to get out of its mold of a rigid framework and take role of continuing education where education process is adjusted to the needs of illiterate unskilled farmers and farm households" His vision for future agriculture education articulated at that time, finds space in new Education Policy.

Agricultural Reforms

It was our good fortune that Prof. Swaminathan came to our university to deliver the Golden Jubilee lecture in February 2006 on Agricultural Renewal when he was the Chairman of the Farmers Commission. During the lecture he articulated how should be, the future agriculture to give economic and technological empowerment. He suggested ways to make agriculture sustainable and ecofriendly. He said farmers are losing faith in agriculture and to reverse this young generation need to be provided training in the new technology and it should be like symphony of different players. Right price for their produce, linking farmers to markets, supporting FPO for higher income were among many suggestions made. Taking advantage of his visit we showed him work being done for tribal farmers for economic and technological empowerment through adoption of technologies.

Welcoming Prof. Swaminathan for the Golden Jubilee Lecture on Agricultural Renewal, MPUAT, Udaipur

Myanmar Farmer's Welfare

Agriculture in Myanmar occupies a place of preeminence because of major contribution to its economy and the dependence of over 65% population

for their livelihood. Fortunately, country is endowed with rich natural resources. Despite this, removal of poverty and economic empowerment of its people remains an overriding priority for the Government of Myanmar. Team of agricultural scientists led by Prof. M.S. Swaminathan visited Myanmar during July 2011 and realized immediate need for strengthening agricultural research, education and extension for improvement of agricultural production and productivity. The team proposed establishment of an Advanced Centre for Agricultural Research and Education (ACARE) and Rice Biopark in Myanmar to promote strong collaboration between leading agricultural institutions in India and Myanmar for the development of agricultural research, education and extension in the identified areas and for economic empowerment of farmers from rice cultivation.

Realising this potential in propelling agricultural growth and ushering prosperity for the farmers of Myanmar, Government of the Republic of Myanmar and the Government of India during the visit of Hon'ble Prime Minister of India to Myanmar signed a MOU on May 28, 2012. MOU was for the establishment of state of the art facility, the Indo-Myanmar Advanced Center of Agricultural Research and Education(ACARE) at Yezin Agricultural University, Yezin, NayPyiTaw and Rice Biopark in Department of Agricultural Research, as per the recommendations of the Prof. Swaminathan's Committee. Support was provided by Govt of India.

ACARE

The centre was primarily to strengthen research, education and extension through four new divisions namely Division of New Genetics, Food Technology,

Inauguration of Advanced Centre for Agricultural Research and Education in Yezin Agricultural University, Yezin Myanmar by the Hon'ble President Shri Ram Nath Kovind ji on Dec 18, 2018

Hon'ble President Shri Ram Nath Kovind ji with Dignitaries at the time of inauguration of ACARE

Participatory Knowledge Management and Capacity Building. Within a short span of one and half years the Centre became fully functional with M.Sc. and Ph.D. programme in three new areas of Molecular Biology and Biotechnology, Food Technology and Participatory Knowledge Management, state of the art equipment's and other infrastructure facilities in these areas and teaching by IARI faculty led to high quality learning and post graduate research. This helped skill development and quality enhancement in education. The ACARE was inaugurated by the then President of India Shri Ramnath Kovind ji. The Centre developed will not only meet the needs of Myanmar but South Asian region as a whole.

Rice Biopark

Rice cultivation is major contributor of agricultural economy yet the farmer's income was low. In order to improve the economic conditions of the rice growers Prof. Swaminathan suggested establishment of the Rice Biopark with the mission of utilizing every part of rice crop for income generation. It again provided state of the art facilities such as modern rice mill, nutritional lab, processing laboratory for value added products and facility for conversion of rice straw in to paper and training for farm women in processing and value addition. It was a game changer for the farming community. This facility was developed by MSSRF and inaugurated along with ACARE.

Self Help Group of Women formed under Participatory Knowledge Management Programme in Thar Yar Kone Village in NAY PYI TAW, Myanmar

Lessons from a Legend – A Snapshot

Dr. T. Mohapatra

It was 23rd April 2012. The National Rice Research Institute (known as Central Rice Research Institute then), Cuttack celebrated its Foundation Day. Prof. Swaminathan was the Chief Guest. He inaugurated the newly constructed Biotechnology Block of the institute, visited the Rice Museum and addressed the scientists, staff, research scholars, farmers and other invitees. He expressed his satisfaction on the progress the institute had made then. It was the first major programme since my joining as Director of the institute in January 2012. Without second thought, I invited him for the foundation day and he readily agreed to come despite his extremely busy schedule as a Member of Rajya Sabha at that time. With his gracious presence, the programme was a grand success. Everyone was so happy and excited. Prof. SK Datta, the then DDG (Crop Sciences), ICAR chaired the foundation day programme. When the three of us were interacting, I described my plan to develop the institute and the need for one-time financial support of about Rs.100 crores. I requested Prof. Swaminathan for his help in this regard. Immediately after returning to Delhi, he wrote a letter to the then Minister of Agriculture Shri Sharad Pawar for necessary support. Accordingly, documents were prepared by us and submitted to the council. The institute received a substantial budgetary support during that Plan period which enabled building modern labs and infrastructure as we see today. Those who have been associated with the institute would be able to appreciate the change that has taken place during past 10 years. Prof. Swaminathan's letter played a crucial role in this change.

Prof. Swaminathan had special liking for CRRI most likely because he started his research career at this institute on his return from abroad in 1954. That was reflected in his thoughts and actions. On my invitation, he visited the institute three times during three and a half years of my tenure as Director. Every visit was remarkable. He vividly remembered his involvement in the indica - japonica hybridization. He described this work at CRRI as the first step to realise Green Revolution in India. In his article titled "Genesis and Growth of the Yield Revolution in Wheat in India: Lessons for Shaping our Agricultural Destiny" published in Agric Res [2013, 2(3):183–188], he wrote: "Dr. K Ramaiah, the first Director of the Central Rice Research Institute (CRRI), Cuttack, proposed that we should transfer genes for fertilizer response from japonica to indica rice varieties. This was the beginning of the breeding of high yielding varieties which

subsequently led to the green revolution". He further states: "…the seeds of the green revolution in India were sown in the fields of the Central Rice Research Institute, Cuttack, in the early 1950s through the indica - japonica hybridization programme and later in 1963 in the fields of the Indian Agricultural Research Institute, New Delhi". When I delved deeper, I could see the reason why he was so emphatic. Most are aware of the way wheat revolution happened and the role of Prof. Swaminathan at IARI. The CRRI work on indica-japonica hybridization, with which he was associated, did yield a few prominent rice varieties such as Mahsuri that was the most widely grown rainfed area rice variety in Asia in 1970s. Mahsuri as one of the parents of the mega rice variety Swarna, continues to contribute to the higher level of rice production we realise today. Besides, the cross T(N)1 x T141, which was made at CRRI, gave rise to the variety Jaya, a popular rice variety, making a significant contribution to increase in rice production during the time of green revolution. As per record, Jaya out yielded IR8 at several locations in Punjab during 1968-70. Prof. Swaminathan's writings depicting history of Green Revolution in India and his own role in shaping India's agricultural future are full of facts and quite insightful.

During CRRI visit, he emphasized on anticipatory and participatory rice research for meeting the provisions of National Food Security Act. While expressing his satisfaction over the production of more than 100 million tonnes of rice during 2011-12, he envisioned a target of 150 million tonnes by 2030. He also emphasized on the use of modern scientific tools for enhancing yield coupled with climate resilience. He urged the scientists to focus on research for enhancing the efficiency of the rice crop that would enable lesser use of water, chemical fertilizers and labour. Inspired by his guidance, the CRRI Vision 2050 document was prepared; targets were set for achieving rice yield to the tune of 10t/ha and combining multiple stress tolerance. Today, after 10 years, when I look back, I see tremendous progress in the direction, which was defined by Prof. Swaminathan and religiously followed by me when at CRRI and at ICAR in the following years. Besides developing high yielding climate resilient varieties and new management technology, the CRRI got involved in Bringing Green Revolution to Eastern India (BGREI) program of government of India, carrying out rigorous monitoring and providing need based technology backstopping. It was assessed that this programme led to additional 8 million tonnes of rice from Eastern Indian states. We have already reached 135 million tonnes of rice in 2022-23. Given the rate at which we are growing, the country

should comfortably achieve the 2030 production target that was set by Prof. Swaminathan in 2012. Building a perspective accompanied by a proper target setting was the hallmark of superior leadership traits of Prof. Swaminathan.

He was a crusader. He tirelessly strived for eliminating hunger, malnutrition, environmental degradation and discrimination against women. Though the distribution of food grains free of cost happened under the provisions of Food Security Act, he was worried for environmental degradation and widespread malnutrition. In most of his lectures he would talk about the climate change impacts and pathways to address those. He would also highlight protein malnutrition and hidden hunger, and emphasize on preserving the culinary diversity so that consumption of diverse food items happens routinely in every household. Given his globally recognized efforts for food security and policy advocacy for hunger and malnutrition free world, Prof. Swaminathan was honoured as Living Legend by the International Union of Nutrition Sciences (IUNS) at its 20th International Congress of Nutrition held in Grenada, Spain 2013. While receiving the Outlook Poshan Living Legend honour in August 2019, he said, "We are facing many challenges in the area of nutrition security. We need a protein revolution. We need a nutrition revolution now". As DG, ICAR, I had interaction with him when we mounted our efforts on development of biofortified crop varieties, which led to release of more than 80 varieties within a span of 4-5 years after 2015. While appreciating the work, he suggested that ICAR should make special efforts to popularise them and adopt villages with high degree of malnutrition in order to transform them as nutri-smart. ICAR through the All India Coordinated Research Project on Women in Agriculture did adopt 75 villages for nutrition related interventions including promotion of

nutrition literacy in the selected villages, cultivation of diverse nutrient-dense crops including biofortified varieties, consumption of nutritionally balanced and diverse food, and monitoring the health outcomes. With continued support to this program, ICAR should be able translate the idea of "nutrition revolution" given by Prof. Swaminathan and showcase the adopted villages as models for further up-scaling to address malnutrition in the country.

Prof. Swaminathan was the President of World Wide Fund for Nature - India. There was a meeting of the WWF-India held in the Pragati Maidan in the year 1989. Prof. VL Chopra was looking after its organization. As student volunteer, I along with other students was involved in various arrangements. The programme was a grand success. Prof. Swaminathan wrote a letter of appreciation to Prof. Chopra acknowledging the contribution of everyone involved. A copy of the letter was circulated among all of us. Addressing to Prof. Chopra, he wrote, "I am glad you have built up a team which takes pride in perfection". This had an ever-lasting impact on me. For me it was not just a statement. In fact it reflected the very principle of Prof. Swaminathan's life, be it in his own research work, his class room teaching, transfer of technology to farmers' field, envisioning and planning new programs, building institutions, promoting human resources, setting new narratives nationally as well globally and influencing government policies.

As I moved up in my career, my interaction increased with him. I used to visit MSSRF, Chennai almost every year in August during celebration of his birth anniversary, which would be invariable accompanied by a conference on an important theme. The last International Conference was held during 6-8 August 2023 on "Mighty Millets for Food, Nutrition and Health Security" along with celebration of his last birth day with a big cake depicting different millets. I was fortunate to be there with him at his residence. I presented a bouquet. Holding his hand, with a emotionally charged voice, I said "You are God for all of us working in the field of agriculture". With the same typical glaze on his fore head and infectious smile in his face, he said "I am very happy". Unforgettable indeed! And those were his last words for me. With tearful eyes I bid farewell to him, being part of his last journey in September 2023.

A Golden Era of Indian Agriculture came to an end with his departure! His rich legacy, however, will continue to inspire everyone who care for agriculture and ecology, and ignite the young minds for generations. By remembering his life and work we will gain abundantly. Our youngsters should get exposed to his ideas on agriculture, environment and ecology; a vivid presentation of him as a role model will enthuse the youth to emulate what he envisioned. We must strive hard to translate his ideas of Evergreen Revolution and a Hunger Free World.

Prof. M.S. Swaminathan - The Charismatic Agricultural Legend

Dr. K.U.K. Nampoothiri

I am jotting this memoir, when the whole agricultural fraternity is exhilarated over the award of Bharat Ratna to Prof. Swaminathan, posthumously. I realise that it is not an easy task to compile the life of such a great personality who is well known as the father of Indian green revolution, who has occupied prestigious national and international positions, guided around 100 Ph.D. and P.G. students, received 90 awards both national and international including the prestigious Ramon Magsasay award, World Food Price, Padma Bhushan and Bharat Ratna apart from many honorary doctorates, one who has adorned almost 50 honorary positions in national and international organisations and has to his credit 670 well acclaimed papers apart from 50 odd books. His exemplary life has been exhaustively covered in the 15 biographies published.

I know Prof. Swaminathan personally right from 1966 when I approached him at the Indian Agricultural Research Institute with the problem of non viability of coconut seeds received from abroad for our germplasm at Kasaragod, Kerala state under the Central Plantation Crops Research Institute (erstwhile Coconut Research Station under the Central Coconut Committee). The issue was traced to the de husking of nuts followed by fumigation as per quarantine regulations which led to the non-viability. Not only was this issue sorted out, but also a policy decision was taken in due course to entrust introduction and quarantine responsibilities of various crops to the Institutes, working on the concerned crops to avoid such issues arising out of unfamiliarity about the crop. This is one of the instances where a small issue led to a significant far reaching policy decision due to the foresight of a true visionary.

How he went through the manuscripts of the thesis of so many students so meticulously using his rampant travel time, is astonishing. Prof. Swaminathan took personal interest in the work of every student (all of whom he knew by their first names), in spite of his busy schedule, having been acclaimed as an international figure by that time. His memory was phenomenal, remembering the details of even the last grade employees working in his organisation. Prof. Swaminathan had a special way of offering advice without hurting the receiver. Over these long years, I have never seen him angry. With his calm, affable, soft spoken and pleasant nature, whoever meets him returns with a satisfied positive confident mind. That is why he is considered as a perfect humanist, apart from being an eminent scientist, policy advocate, ardent environmentalist, efficient

teacher, able administrator, excellent organiser, inspiring leader and astonishing strategist.

At the tenth anniversary of M.S. Swaminathan Research Foundation, Wayanad

It was unfortunate that he was dragged into controversy for advocating the improved agricultural practices under the green revolution, forgetting the fact that he himself had clearly indicated that those were short term measures to save the country from starvation and the future course should be sustainable agriculture avoiding over exploitation of natural resources which should be preserved for the future generations.

Another garbled allegation was that he spared paddy seeds to International Rice Research Institute, Philippines, which in fact is a fundamental requirement for all the countries, to exchange seeds on the condition that it will be spared to any country genuinely requiring them for evolving new varieties.

The magnanimity and foresight of Prof. Swaminathan was evidenced by his decision to utilise the World Food Prize money to establish M.S. Swaminathan Research Foundation at Chennai in 1988, for undertaking research and development activities with a pro-poor, pro-women, pro-nature, pro-livelihood -motto. Coastal ecosystem research, agrobiodiverstiy conservation, development of environment-friendly technologies, biotechnology, food security, knowledge empowerment and climate change are the major areas of the foundation's work. The foundation has also established regional centres spreading over seven states which include the agro-biodiversity centre at Kalpetta, Wayanad, Kerala state located in his ancestral property. The altruistic work undertaken by the foundation on collection, documentation and utilisation of traditional varieties, providing livelihood opportunities to the poor tribal communities, upliftment of tribal women and

With the author and other delegates

"reaching the unreached" through village knowledge centres, are all well applauded efforts intented to uplift the down-trodden. I was immensely benefitted and socially enriched by the work culture, steadfast resolve, rectitude and tireless enthusiasm of the foundation, while working at two of its centres at Kalpetta, Kerala and Jeypore, Odisha, spanning over nine years.

Various governments in power invariably turned to Prof. Swaminathan for advice whenever far reaching policy decisions were envisaged. His magnificent ideas are well reflected in the 30 odd reports submitted not only to Government of India, but also to foreign governments all of which gave the policy makers a clear direction. The highly acclaimed Protection of Plant Varieties and Farmers' Rights Act was enacted based on Prof. Swaminathan's idea of providing proper ownership, recognition and benefits to farmers, conservationists and breeders alike.

He left an envying foot print in all the organisations which he led from time to time, especially Indian Council of Agricultural Research and International Rice Research Institute, Manila. His thought provoking impromptu speeches often echo in our thoughts.

Prof. Swaminathan was there to handhold me in all the important facets of my life. It was a turning point in my life in 1968, when he agreed to guide me for Ph.D. on a crop like coconut for which the field data had to be collected from ICAR-CPCRI, Kasaragod as coconut is not grown in Delhi. I was also permitted to join my parent Institute, after the course requirement, on a higher gazetted grade for which I was selected, facilitating data collection from the institute's fields, complimented with the laboratory work taken up at IARI and National Research Laboratory, New Delhi. When I was deputed to Nigeria for initiating coconut research in that country, he had specified two conditions. One was that I must continue to do hard work irrespective of the general slackness in those

With colleagues, former students and farmers

regions and act as a good ambassador of Indian scientists, showing by example. Secondly, I should return to India, after the five year deputation period, whatever be the lucrative monetary benefit they may offer. I abided by both those behests to the core. Later he was there to help me to develop the research infrastructure of my Institute and guide and help me throughout my service in ICAR in various positions.

The opportunity kindly offered to me to work in M.S. Swaminathan Research Foundation was an experience of my life time in understanding the pathetic state of affairs of the desolated tribal poor in some parts of Kerala and Odisha and the priority to be given to bring them to the main stream by providing livelihood and through empowerment without disturbing their identity and traditional values. Agro biodiversity conservation and utilisation of traditional knowledge were effectively used to derive rich dividends to the societies concerned. The foundation is no doubt an archetype, which others could follow.

My fond memories of Prof. Swaminathan for almost 60 years as his student and colleague will never fade till my last breath. He was my mentor, role model and guiding spirit throughout my life. He will live in the hearts of many like me, with never dying sweet memories forever.

Education is the key to empowering individuals and communities

M.S. Swaminathan

Prof. M.S. Swaminathan: A Champion for Global Food Security

Dr. Raj Paroda

A visionary agricultural scientist and geneticist Prof. Mankombu Sambasivan Swaminathan had dedicated his entire life for the welfare and food security of all globally. He will always be remembered as an architect of India's Green Revolution. I wish the announcement of ***Bharat Ratna*** to Prof. Swaminathan had come a bit earlier. It is said in common parlance that 'no one is indispensable' but I can say that 'Dr. Swaminathan was indispensable'. With his passing away, it has marked the end of an era. His legacy shall continue to inspire younger generation to make our nation '*Viksit Bharat'* by 2047. He was one of the three Indians, besides Mahatma Gandhi and Ravindra Nath Tagore, named among the 20 most influential Asians of the 20th century by the TIME Magazine in 1999.

A Global Leader

Prof. Swaminathan's influence transcended borders, leaving an indelible mark on global food security. He was actively engaged with international bodies like the Consultative Group on International Agricultural Research (CGIAR), Food and Agricultural Organization of the United Nations (FAO), and the United Nations Educational, Scientific and Cultural Organization (UNESCO), sharing his profound knowledge to tackle food challenges worldwide. His concerted efforts led to the establishment of important institutes like International Crop Research Institute for the Semi-Arid Tropics (ICRISAT), Bioversity International, and International Centre for Research in Agro-Forestry (ICRAF). His vision and guidance had shaped agricultural institutions in numerous countries,

> *"On the occasion of celebration of 50th Independence Day in 1997, the then President of India Late Dr. KR Narayanan highlighted in his speech that achieving food security had been the singular significant achievement to be proud of. Since that day, I have been dreaming that Dr. M.S. Swaminathan be awarded Bharat Ratna, which has now been conferred posthumously".*
>
> *RS Paroda*

China, Vietnam, Myanmar, Thailand, Sri Lanka, Pakistan, Iran, Cambodia and Afghanistan. As the Chair of the UN Advisory Committee for Science and Technology, he spearheaded the establishment of the International Centre for Genetic Engineering and Biotechnology (ICGEB). His multifaceted research and contributions garnered him international recognitions, including the first World Food Prize, Ramon Magsaysay Award for Community Leadership, Franklin D Roosevelt Four Freedoms Medal and the Mahatma Gandhi Prize of UNESCO and prestigious fellowships from various scientific academies worldwide including Fellowship of the Royal Society (FRS) of London.

At the national level, he was the first Director General, ICAR, who got the status of Secretary, DARE, Government of India. His vision led to the creation of All India Agricultural Research Service (ARS), giving pride to agricultural scientists, started most popular 'Lab-to-Land' program and established the National Academy of Agricultural Sciences (NAAS).

Prof. Swaminathan was the first World Food Prize winner (1987). He was also recipient of Elbert Einstein World Science Award in 1987; the Indira Gandhi Prize for Peace in 1994; UNEP Sasakawa Environment Prize in 1994; The UNESCO Gandhi Gold Medal in 1999 and many more. He also worked as Principal Secretary, Ministry of Agriculture (1979-80), acting Deputy Chairman, and later Member (Science and Agriculture), Planning Commission (1980-82). He also was decorated with *Padma Shri (1967), Padma Bhushan (1972)* and *Padma Vibhushan (1989)* by the Hon'ble President of India for his immense contribution to agriculture. He was also the President of Indian Science Congress and Chairman, FAO Council. He also served as Director General of International Rice Research Institute (IRRI) and was the Founder Chairman of MS Swaminathan Research Foundation, Chennai. Prof. Swaminathan was also the first recipient of Millenium Award given for the first time by the Indian Science Congress held at IARI, New Delhi in 2001, when I happened to be the President of Congress.

A Farmers' Scientist

Prof. Swaminathan's vision extended beyond the laboratory. He recognized that empowering farmers with the knowledge and tools to maximize their yields was as crucial as developing new varieties. Perhaps his most impactful role came in 2004 when as Chairman of the National Commission on Farmers, he

led the formulation of crucial recommendations for resolving the growing crisis of farmer distress and suicides and addressed the issues plaguing Indian agriculture through formulating appropriate policies to uplift the farming community. His tireless advocacy played a pivotal role in bringing the struggles of farmers to the forefront of national consciousness. Notably, he advocated for a minimum support price (MSP) that was 50% higher than cost of cultivation + C2, a policy advise he gave to influence policy makers. He also pleaded for a national policy for farmers welfare to be enacted by the Parliament while serving as a member of *Rajya Sabha*.

On 9th February, 2024, hon'ble Shri Narendra Modi wrote "It is a matter of immense joy that the Government of India is conferring the Bharat Ratna on Dr. M.S. Swaminathan Ji, in recognition of his monumental contributions to our nation in agriculture and farmers' welfare. He played a pivotal role in helping India achieve self-reliance in agriculture during challenging times and made outstanding efforts towards modernizing Indian agriculture. We also recognise his invaluable work as an innovator and mentor and encouraging learning and research among several students. Dr. Swaminathan's visionary leadership has not only transformed Indian agriculture but also ensured the nation's food security and prosperity. He was someone I knew closely and l always valued his insights and inputs."

My Association with Prof. Swaminathan

I had been fortunate to have had a very long association with Prof. Swaminathan: First as Post-Graduate (PG) student at IARI and later as Head, Plant Breeding, CCS Haryana Agricultural University (CCS HAU); Director, National Bureau of Plant Genetic Resources (NBPGR) then Deputy Director General (Crop Sciences) and Director General, ICAR. In fact, I was lucky to have received his blessings all through since joining Ph.D. at PG School, IARI in 1964. Being Head, Division of Genetics, he would regularly visit early morning the experimental fields and enquire as to what we were doing. My association with him and Mrs. Mina Swaminathan

got further strengthened when I was elected as General Secretary of PG School Students Union in 1967. That time, Prof. Swaminathan was Director and Mina ji, as 'First Lady' on the campus, was our advisor for social activities. It was indeed a great learning experience working under her patronage.

I had sought Prof. Swaminathan's advice while drafting the first National Agricultural Policy, which was then approved by the Parliament on July 28, 2000. I recall my days of working with him when the seeds of green revolution were being sown. Early mornings, we used to go with Prof. Swaminathan and Dr. Borlaug to dibble the Mexican wheat varieties by hand in *Jaunti* village near Delhi. Consequently, in 1967-68, the wheat production got increased by 5 mt (from 11 mt to 16 mt). This achievement was heralded as Green Revolution and a national stamp was released by the then Prime Minister Mrs. Indira Gandhi.

Under Prof. Swaminathan's overall guidance, I helped Dr. VL Chopra to organize the XVth International Congress of Genetics held in 1983. Subsequently, under his patronage, I organized the 2nd Crop Science Congress in 1996, the Indian Science Congress at IARI in 2000, the 1st International Congress on Women in Agriculture (ICWA) in 2012 and the 1st International Agrobiodiversity Congress in 2016. All these congresses were inaugurated either by honourable President or the Prime Minister of India.

The National Academy of Agricultural Sciences (NAAS) was also established under his leadership in 1996 when needed support was ensured by ICAR. As luck would have it, I followed him as second President of NAAS.

On personal front, Prof. Swaminathan had all along been my mentor, guide, philosopher and well-wisher. We had many social

events together. In fact, I was pleasantly surprised to see Prof. Swaminathan and Ms Mina Swaminathan, who came all the way from Chennai to greet me on my 70th birthday organized by my children in New Delhi in 2012. Prof. Swaminathan was again kind enough to come personally to participate in my 75th birthday celebrations in AP Shinde Hall, NASC, in August, 2017.

When I asked for his comments as to what message he has for our scientists, he mentioned: "*Raj, I wish we had appreciated each other's contributions*". On hearing this, first thing occurred to my mind that we institute an award in his name. Hence, TAAS instituted an award "Dr. MS Swaminathan Award for Leadership in Agriculture" in the year 2004. The first recipient was Dr. Norman Borlaug who received it from the then President of India Dr. APJ Abdul Kalam. Since then, 14 awards have been given to eminent people from all over the world for their outstanding contributions with specific impact on Indian agriculture. Prof. Swaminathan had personally attended all the award functions except the last two, as he was unable to travel.

To Carry His Legacy

For carrying his legacy and to remember him, may I take this opportunity to suggest both ICAR and NAAS that:

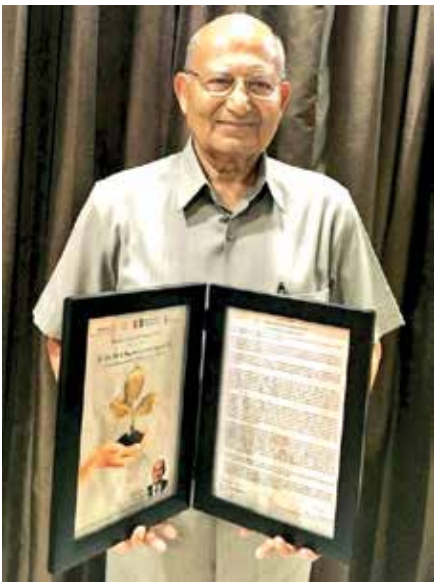
1. Prof. M.S. Swaminathan Award for Excellence in Agricultural Research be instituted by ICAR.
2. Prof. M.S. Swaminathan National Professor Chair be also named by ICAR.
3. A Swaminathan Gallery be created in the National Agricultural Science Museum at NASC, Pusa, New Delhi to inspire the students and researchers.
4. A national Policy on Farmers' Welfare, as proposed by him, be drafted and got approved by the Parliament at the earliest possible.
5. A Coffee Book on 'Reminiscences of Dr. MS Swaminathan' be brought out by NAAS at the soonest.

Humble Prayer

Prof. Swaminathan was a *Mahanayak*, a great visionary, reformer, thinker, policy maker, global trend setter, science administrator and a human being *par*

excellence. His passing away has left a void in the global agricultural scientific community. We pray the Almighty that his indomitable spirit and remarkable contributions continue to inspire us and the future generations of scientists and farmers. Let there be global food security and sustainability of agriculture. Excellence with relevance, vigour with rigour, science for society and quality with humility be our invaluable lessons all throughout life.

Let us pray for eternal peace to his noble soul!



Receiving M.S. Swaminathan Award

The power of innovation can solve many of the world's challenges

M.S. Swaminathan

Prof. M.S. Swaminathan: Father of Green Revolution in India

Dr. Himanshu Pathak

In the annals of India's agricultural history, one name stands out brilliantly – Prof. Monkombu Sambasivan Swaminathan popularly known as Prof. M.S. Swaminathan, "MSS", "MS", "Swami" or "Professor". His dedication, wisdom, and humility were unparalleled. His visionary leadership has always been an inspiration to all agricultural scientists not only in India, but globally. His legacy in championing sustainable agriculture and promoting global food security will undoubtedly live on. Prof. Swaminathan was a globally acclaimed agricultural scientist known for his elegant contributions to food security and rural, social, and gender equity in India and several developing countries. Leveraging his expertise in plant genetics, the forward-thinking scientist strategically combined scientific research, global collaboration with food and agriculture organizations, and networking with policy makers to spearhead a remarkable transformation in India's agricultural landscape, propelling the nation from a food-importing country to a food-sufficient one. While he championed the cause of the Green Revolution in the 1960s with the Nobel Laureate, Dr. Norman Borlaug, he subsequently advocated for an Evergreen Revolution for sustainable growth, incorporating all the domains of agriculture.

1. A Seed is Sown: The Foundation of a Legacy

Prof. Swaminathan was born on August 7, 1925, in Kumbakonam, Tamil Nadu, India. He was born into a Tamil Brahmin family with a strong background in agriculture and academics. His father, Dr. M.K. Sambasivan, was a surgeon, and his mother, Smt. Parvati Thangammal Sambasivan, came from a family deeply rooted in farming. Growing up, Swaminathan's family values and background greatly influenced his interest in agriculture and science. His family had a deep connection to the land, and he was exposed to the challenges faced by farmers from a young age. This upbringing instilled in him a sense of responsibility to contribute to improving the lives of farmers in India.

Prof. Swaminathan's academic journey was marked by dedication and a commitment to improving agriculture and food security. Prof. Swaminathan attended local schools in Kumbakonam and excelled in his studies. Seeing the impacts of the Bengal famine of 1943 and issues of food shortage during the Second World War, he decided to study agriculture. He completed his Bachelor

of Science in Agriculture from the Agricultural College and Research Institute in Coimbatore, Tamil Nadu, in 1944. He pursued postgraduate studies at the Indian Agricultural Research Institute (IARI) in New Delhi, where he obtained a Master's degree in Genetics and Plant Breeding in 1949, and was a UNESCO Fellow at Wageningen Agricultural University, Netherlands. His interest in genetics and breeding laid the foundation for his later work in crop improvement. Prof. Swaminathan completed his Ph.D. in Genetics from the University of Cambridge, United Kingdom in 1952 and undertook post-doctoral studies at the University of Wisconsin, USA (1952-1953). His doctoral research focused on the genetics of barley and wheat. After completing his Research Associateship, in a defining decision, he declined a faculty position in the USA, choosing to return to India in 1954 to drive impactful change in his homeland.

2. Landmark Contribution - Green Revolution

Returning to India in 1954, Prof. Swaminathan worked at the Central Rice Research Institute, Cuttack, Odisha and further the IARI, New Delhi. Prof. Swaminathan was concerned about India's food security with a 'ship to mouth' existence and India's image as a 'begging bowl'. He was interested in increasing agricultural productivity and production, especially of our staple food grains (wheat and rice). For this, he envisioned that the plant type should be tailored to be functionally responsive to the external application of fertilizers. The height of plants should be reduced without reducing the length of the grain-bearing panicle. This is what he strived to achieve by pursuing interspecific hybridization, induced radiation and chemical mutagenesis, and the use of plant growth regulators. While all these substantially added to our fundamental knowledge of biological processes/responses induced by physical and chemical agents, the goal of obtaining dwarf/semi-dwarf wheat plants with normal spikes was, however, not realized.

Fortunately, his ability to keep himself abreast of major innovations and development anywhere in the world helped him trace the 'Norin-10' dwarfing genes from Japan in wheat and 'Dee-Geo-woo-Gen' dwarfing genes from China in rice. His initial contact with Prof. Orville Vogel of the Washington State University (Pullman, USA) led him to Prof. Norman E. Borlaug, Director of International Maize and Wheat Improvement Center (CIMMYT), Mexico. As a result, Prof. Swaminathan and Prof. Borlaug collaborated, with Borlaug touring India and sending supplies for a range of Mexican dwarf varieties of wheat ('Lerma Rojo' and 'Sonora-64') from Mexico, which were to be bred with Japanese varieties. Initial testing in an experimental plot showed promising results. The crop was high-yielding, good quality, and disease-free. The hesitation by farmers to adopt the new variety with high yields, was unnerving. In 1964, following repeated requests by Prof. Swaminathan to demonstrate the new variety, he was given funding to plant small demonstration plots. A total of 150 demonstration plots on one hectare were planted. The results were promising, and the anxieties

of the farmers were reduced. More modifications were made to the grain in the laboratory to suit Indian conditions better. The new wheat varieties were sown, and in 1968, production went to 17 million tonnes, 5 million tonnes more than the last harvest. With unwavering determination, Prof. Swaminathan and his team orchestrated a dramatic transformation in wheat production. Subsequently, the Government of India declared India self-sufficient in food production in 1971.

This impressive growth marked a turning point for India's agricultural landscape. The predictions of widespread famine in Indian subcontinent by the doomsayers, the Paddock brothers, were proven wrong due to the dedicated efforts of scientists like Prof. M.S. Swaminathan and the resilience of Indian farmers. Hailed as the Father of India's Green Revolution for this monumental contribution, Prof. Swaminathan strived his entire life for ending food insecurity and ensuring a more equitable and sustainable future for all.

3. Shaping the Future through Key Positions

Among several coveted positions that Prof. Swaminathan occupied in India, each with elegance, innovation and creativity, are the Director, IARI (1961-72); Director General, ICAR and the Secretary of the newly formed DARE (1972-79); Agriculture Secretary, Govt. of India (1979); Acting Deputy Chairman and Member, Planning Commission (1980-82). Further, he was the first Indian to become Director General of the International Rice Research Institute, Philippines (1982-88), and his leadership was recognized with the first World Food Prize in 1987. One of his most pivotal roles came in 2004, when he was appointed Chair of the National Commission on Farmers. This commission was established in response to rising farmer distress and alarming rates of suicides among farmers. The Commission's report, submitted in 2006, made several recommendations. A prominent suggestion was that the Minimum Selling Price (MSP) should be at least 50% above the weighted average cost of production. He was nominated as a Member of the Rajya Sabha for his expertise and contributions to agriculture for one term (2007-13).

4. Building National Agricultural Research, Education and Extension System (NAREES)

The structure of the present NAREES system has evolved from the institutionalization processes of the Green Revolution research in the mid-1960s for rapid science and technology-driven agricultural transformation of India from begging bowl of the world to a country of food self-sufficiency. The remarkable emergence of the NAREES system within a brief 3–4 year period (1967-1971), built entirely within the public sector, stands as a testament to several factors: foresighted leadership, visionary strategy, unwavering

national policy, and the dedicated efforts of exceptional individuals like Prof. Swaminathan.

Prof. Swaminathan was instrumental in the creation of the All-India Agricultural Research Service (ARS), which facilitated collaborative research efforts among scientists from all corners of the nation. This networking of scientific minds laid the foundation for innovative solutions of problems in agriculture, fostering a sense of unity among researchers dedicated in improving national agricultural landscape. The ASRB was established on November 1, 1973 as an independent recruitment agency in pursuance of the recommendations of the Gajendragadkar Committee. The major objective of ASRB is to recruit ARS scientists and research management personnel for ICAR.

DARE was established in December 1973 in the Ministry of Agriculture and Farmers' Welfare. It has the four autonomous bodies under its administrative control. In India, DARE is the nodal Department for the International Cooperation in agricultural research and education. The Department mediates bilateral and multilateral cooperation with foreign governments, multilateral agencies and international bodies or organization through ICAR. The DARE also facilitates international student's admissions in the various Agriculture Universities/ICAR Institutes.

During his tenure as Head of the Genetics Division and later as Director of IARI, Prof. Swaminathan organized and implemented the first All India Coordinated Research Project (AICRP), in major food crops which became the epicenter of the green revolution. The AICRPs fostered an inter-institutional, inter-state, international, and interdisciplinary research culture that enabled multiple location trials across different environments to facilitate a rapid co-evolution of new science and technology generation and transfer. Despite agriculture being a State subject, the AICRPs became a powerful model of institutional governance and center-state coordination. As the DG, ICAR, Prof. Swaminathan extended the AICRP concept to all domains of agricultural research including crops, natural resources management, animal science and fisheries. His subsequent advocacy for research reforms, research priorities, and farmer- centric approaches have continued to influence the formulation of research policies for enhancing the quality and relevance of agricultural research in India and elsewhere.

5. Building Food Security for All: The International Impact of Prof. Swaminathan's Work

Prof. Swaminathan's contributions to agriculture and food security have received global recognition and acclaim. His work has had a profound impact not only in India but also in many other countries facing similar agricultural challenges. He actively collaborated with international organizations, including

Consultative Group on International Agricultural Research (CGIAR), United Nations Food and Agriculture Organization (FAO), and United Nations Educational, Scientific and Cultural Organization (UNESCO), leveraging his vast knowledge and expertise to tackle global food security challenges. Notably, he played a key role in the establishment of the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT) in Hyderabad, the International Board for Plant Genetic Resources (now known as Alliance Bioversity International - CIAT) in Italy and the International Council for Research in Agro-Forestry (ICRAF) in Kenya. As Chairman of the UN Advisory Committee for Science and Technology, Prof. Swaminathan played an important role in setting up the International Centre for Genetic Engineering and Biotechnology (ICGEB) in New Delhi. He also played a key role in promoting a Global Institute for Co-operation in Water Management in Valencia (Spain), when he served as Chairman of the International Committee on Water Management (1996-98). His guidance was instrumental in shaping numerous institutions in China, Vietnam, Myanmar, Thailand, Sri Lanka, Pakistan, Iran, and Cambodia. Prof. Swaminathan co-chaired the United Nations Millennium Project on hunger from 2002 to 2005 and was head of the Pugwash Conferences on Science and World Affairs between 2002 and 2007.

His association with various international organizations, including the FAO, provided valuable insights and expertise to the world on issues related to agriculture and food security. Prof. Swaminathan was invited to serve on numerous global committees, expert groups, and consultations on agriculture, biotechnology, and sustainable development. Universities and academic institutions around the world have conferred upon him numerous honorary degrees in recognition of his exceptional contributions to agriculture and science. His books, articles, and lectures on agriculture, food security, and sustainable development have been widely disseminated and appreciated globally. His ideas and principles, including the importance of sustainable and equitable agricultural practices, have influenced agricultural policies and practices in many countries, particularly those seeking to enhance food security and rural development.

6. Foundation of National Academy of Agricultural Sciences (NAAS)

Leveraging his deep understanding of agriculture and extensive engagement with policymakers, Prof. Swaminathan championed the creation of an independent "think tank" dedicated to providing unbiased, knowledge-based, and holistic guidance on agricultural policy. The NAAS was established in 1990 as a stand-alone organization to give agricultural scientists from various fields a forum. This forum allows for the discussion of important domestic and global topics, the presentation of group opinions, and the recommendation of action plans to decision-makers, planners, business associates, farmer associations,

Dr. Himanshu Pathak receiving NAAS Fellowship certificate from Prof. M.S. Swaminathan

and other interested parties. Consequently, since its establishment, NAAS has been actively involved in discussing significant issues and producing more than 150 Policy Papers, Policy Briefs, and Strategy Papers. Beyond policy influence, the Academy plays a vital role in recognizing and celebrating excellence in agricultural research, raising the profile of the field, and fostering its integration with other scientific disciplines.

7. Key Recognitions and Awards

Prof. Swaminathan is a Distinguished Fellow of over 30 Academies globally, including the prestigious Fellowship of the Royal Society and a Founder Fellow of the Third World Academy of Sciences. He is the recipient of 85 honorary Doctoral degrees, D.Sc. (*Honoris causa*) from across the globe. He was honoured with the Mendel Memorial Medal from the Czechoslovak Academy of Sciences (1965); Ramon Magsaysay Award (1971); Albert Einstein World Science Award (1986); the first World Food Prize (1987); Tyler Prize for Environmental Achievement (1991); Four Freedoms Award (2000); and the Planet and Humanity Medal of the International Geographical Union (2000). He was conferred with the Order of Golden Heart of the Philippines; Order of Agricultural Merit of France; Order of the Golder Ark of the Netherlands; and Order of Cambodia. The United Nations Environment Programme has called him the 'Father of Economic Ecology' and in 1999, he was on the TIME's list of most influential Asian people of the 20th century, along with Mahatma Gandhi and Rabindranath Tagore. Prof. Swaminathan's exceptional contributions to

India earned him esteemed accolades, alongside the Shanti Swarup Bhatnagar Award (1961), Padma Shri (1967), Padma Bhushan (1972), Padma Vibhushan (1987), Lal Bahadur Shastri National Award (1999), Indira Gandhi Prize (2001) and now the coveted Bharat Ratna (2024), India's highest civilian award.

8. Legacy and Continuing Works

Prof. Swaminathan left behind a substantial and enduring legacy in the subject of agriculture, as well as influence on upcoming scientific generations and ongoing efforts and projects. He is widely recognized as the key figure who transformed the country's agriculture. His pioneering work in developing high- yielding crop varieties, improved farming practices, and policy advocacy played a pivotal role in this achievement. His work in India inspired similar agricultural transformations in other countries facing food security challenges. Prof. Swaminathan's ideas and principles have had a global impact on agricultural research and development.

In recent years, Prof. Swaminathan shifted his focus towards advocating for sustainable and environmentally-friendly agricultural practices. He emphasized the importance of conserving agrobiodiversity and natural resources, and adopting climate-resilient farming techniques. Sustainable and all-encompassing farming methods are given priority in agroecological farming methods, which were strongly supported by Prof. Swaminathan. He promoted the application of indigenous wisdom and customs in agriculture. Understanding how climate change is affecting agriculture, Prof. Swaminathan underlined the significance of crop types and farming practices that are climate robust. He kept bringing attention to the difficulties facing agriculture as a result of climate change.

Prof. Swaminathan's work has inspired countless young scientists and researchers to pursue careers in agriculture and related fields. He has been an influential mentor to many, nurturing a new generation of agricultural scientists and policymakers. Prof. Swaminathan's commitment to ethical and sustainable agricultural practices has set an example for future scientists and policymakers. His emphasis on social equity and environmental sustainability continue to shape the thinking of those working in agriculture and related disciplines.

The M.S. Swaminathan Research Foundation (MSSRF) has made numerous important contributions to agriculture, rural development, and food security in India and beyond. It has played its role in advancing the principles of the Green Revolution in India, particularly in the development and dissemination of high-yielding crop varieties and modern farming practices. The foundation has been a pioneer in promoting sustainable and eco-friendly agricultural practices, focusing on conserving biodiversity, minimizing chemical inputs, and enhancing soil and water management. MSSRF's research has led to the development of biofortified crops, addressing malnutrition by improving the nutritional content of staple

foods, such as iron-fortified pearl millet. It has championed the empowerment of women in agriculture, providing them with training, resources, and opportunities for leadership roles in farming and rural development. The foundation has developed and promoted climate-resilient crop varieties and farming systems to help small-scale farmers adapt to changing climate conditions.

Despite his advanced age, Prof. Swaminathan remained active in research and advocacy. He persisted in adding to the conversation about rural development, food security, and sustainable agriculture through his writing, public speaking engagements, and attendance at several forums and conferences. Prof. Swaminathan played a key role in the establishment and upkeep of institutions and associations devoted to agricultural development, research, and policy advocacy. His vision and values are still upheld by these institutions.

Prof. Swaminathan devoted his entire life to the field of agriculture. He demonstrated that research can and should be directed toward addressing concrete difficulties, so serving as an example of how science can act as a catalyst for positive change. We were all inspired by his ceaseless efforts and steadfast dedication to the cause of agriculture. In addition to influencing the lives of millions of Indians and others worldwide, Prof. Swaminathan was a mentor to scientists, a teacher to students, a guide to farmers, and a counsellor to administrators. He also played a significant role in the establishment of agricultural institutions with international recognition. He ensured that farmers were at the center of all agri-R&D initiatives, created previously unheard-of possibilities for thousands of agri-researchers, and raised the bar for agri-science across the nation so that future generations would profit from, remember, celebrate, and be appreciative of it all. Researchers, decision-makers, and activists all across the world are still motivated by his legacy to take on today's most important issues, such as sustainable agriculture and climate change.

The future belongs to nations with grains and not guns

M.S. Swaminathan

Artificial Transmutation of Genes for Basic and Applied Research

Dr. R.P. Sharma

Historically, 1960'S witnessed an unprecedented growth of IARI, and the major credit for this transformation goes to Prof. M.S. Swaminathan. On one hand the seeds of Green Revolution were being planted in the IARI fields, on the other hand scientific infrastructure in terms of creation of new departments and addition of newer research facilities were in full swing. It is during this time, in October 1962, I got an opportunity to join the then Botany Division, now Genetics Division and to work with Prof. Swaminathan who by then had established a very strong school of cytogenetics and mutation breeding and was heading the department. For me, coming from a farming family, joining IARI was a blessing. I witnessed over the years Prof. Swaminathan's involvement in the transformation of Indian agriculture which culminated into "Green Revolution" in the country. According to Prof. Swaminathan the "yield revolution due to green revolution was only possible because the farmers were not merely conscientised but could already see the benefits of the new technology for themselves"

This was also the time when devastating impact of atomic bomb on Hiroshima and Nagasaki in 1945 had forced the world to look into the future of Nuclear energy . "Atom for Peace" an address to the United Nation General Assembly by D.D. Eisenhover, President of USA, in 1953 and subsequent establishment of International Atomic Energy Agency (IAEA), in 1957, motivated the scientific community to use atomic energy for peaceful purposes. Discovery of DNA structure by Watson and Crick in 1953 and demonstration of harmful effect of radiation on DNA by H.J. Muller was another reason to use radiation for peaceful purposes.

Prof. Swaminathan, having returned from Cambridge after his Ph.D., was fully aware of these international developments and therefore after joining IARI in 1954 he initiated the work on direct and indirect effects of radiation. For this, facilities like Gamma garden, subsequently replaced by high potency Cobalt-60 Gamma cell, and Drosophila laboratory were developed. I recollect how remarkably Prof. Swaminathan was balancing his research and teaching responsibilities and participating in the transformation of Indian Agriculture. He was always pressed for time but never short of time and was always helpful and inspiring. I adopted Prof. Swaminathan's emphasis on H.J. Muller's advocacy "If you want to understand a gene and its function, mutate it" and followed it

throughout my research career. Alongside applied research in plant breeding, Prof. Swaminathan promoted fundamental research at the genetics division- a conscious decision taken by him for the overall growth of genetics as a subject and for providing much wider exposure to the students. He always emphasised that fundamental research explores the theoretical concepts while applied research addresses to the real world issues and what is important is doing good science by asking relevant questions- relevant to the society and relevant to addressing the gaps in our knowledge.

Direct and Indirect Effects of Radiation

The effects of radiation on cells can be classified into two major groups- direct and indirect. Several studies conducted by Prof. Swaminathan's group revealed the radiomimetic potency of the indirect effect of radiation, in the form of chromosomal aberrations in the root meristem of plants, when these were cultured on irradiated substrates. In view of the obvious bearings of these data on the wholesomeness of food sterilised by radiation, these studies were extended to Drosophila.

Drosophila flies reared on gamma-ray irradiated food yielded two to four fold increase in spontaneous mutation frequency. These studies led to a detailed scientific enquiry into the consequences of using radiations for food preservations. Over these years, product-specific protocols for gamma-ray sterilisation of food and food products have been developed and are being extensively used on a commercial scale.

Mutant Garden and Mutant Resources for Functional Genomics

In the early 60's India was in a ''bicycle age''. Though Prof. Swaminathan had a personal Ambassador car, it was mostly used by his wife Mrs. Meena Swaminathan who was an honorary teacher in St. Thomas School. It was a common sight to find Prof. Swaminathan moving around the campus riding his bicycle, visiting Botany Division fields and interacting with students/scientists who eagerly awaited his visit to their experimental fields. It used to be a brief but very useful interaction. His group was deeply involved in the area of induced mutagenesis and contributed immensely to our understanding of the process of mutagenesis and the factors affecting it. In addition, several mutants of plant breeding value were isolated. A classical example is the amber grain mutant of wheat "Sharbati Sonora" derived from a red-grained Mexican wheat variety Sonora- 64.

Impressed by the wide array of induced mutations in different crop species the field, Prof. Swaminathan strongly advised establishment/development of crop-specific Mutant Gardens for teaching and research purposes. It was

such a sensible advice but much ahead of time, the importance of which is realized only in the present-day era of functional genomics. I always kept his suggestions in mind and after my superannuation, while working at the ICAR-National Institute of Plant Biotechnology (NIPB) as INSA Honorary Scientist, I started a DBT-funded project on induced mutagenesis with the help of a number of colleagues. The foremost achievements of this effort were: (1) the establishment of a rice Mutant Garden at NIPB for teaching purposes and for isolating mutants for various agronomic, physiological and biochemical traits. The data base that has been generated and regularly being upgraded serves as an information kiosk for the researchers (http://14.139.229.201/EMSgardenN22), and (2) generation of huge mutant resource (~80,000) of upland rice Nagina 22 mutagenized F2 families, separately harvested and bulked. These mutant lines are now stored at -20°C for posterity with a proviso of making this population available to any rice researcher interested in screening for mutants for traits of their interests.

It is satisfying that this population is now being shared with a number of ICAR and non-ICAR researchers. In the current research landscape, functional genomics has emerged as a key for sustaining yields and nutritional quality of crops. A number of mutants related to fertilizer (P & N) use efficiency, plant architecture, grain size and weight, high tillering, drought and heat tolerance, to name a few, have been isolated so far from the screen of this mutant resource which will be of immense use in the functional Genomic Studies.

A stupendous contribution from this work is the identification of a herbicide (Imazethapyr) tolerant mutant Robin, named after late Dr. S. Robin (TNAU, Coimbatore) who took the onus of executing my idea of developing herbicide tolerant mutant. This mutation has been transferred to several high yielding and popular rice varieties of the country. Imazethapyr tolerant Basmati 1121 and 1509 have been released by IARI for commercial cultivation. These efforts are expected to revolutionize rice cultivation and usher direct seeded rice cultivation with huge savings on the two major inputs – water and labour.

We are now in the era of Data Science and Artificial Intelligence (AI). The availability of such a huge mutant resource, almost close to near isogenic lines, is going to be quite helpful in systems biology approach for defining the phenotypes of the traits and to decipher crosstalk between genes (between interacting entities, the genetic, epigenetic and environmental components) with minimum background noise - A requisite for Future Plant Breeding Protocols and Climate Resilient Agriculture.

From *wingless* (wg) in Drosophila to *Wnt* in Human Beings

According to Prof. Swaminathan "the genetic knowledge gained from the test organisms may lend itself for extrapolation to totally different organisms". A number of mutants isolated by us in Drosophila fully support this view.

Given below is a brief description of one such mutant, wingless (wg), of far reaching significance which has not only revolutionised our understanding of development in the animal kingdom but opened up pathways for studying the functioning and modulating almost all diseases of humans including cancer.

The wingless mutant was initially discovered by us in Drosophila from the ethymethane sulphonate mutagenized F2 population in 1973. Subsequent genetic analysis revealed that it is governed by a single recessive gene located on Chromosome 2 at 29.9 cM. The characteristic phenotype of wingless is partial or complete absence of wings and halters with all combinations of two wings, one wing and no wing with and without one or both halters. In 1980, Nusslein-Volhard and Wieschaus, based on the larval cuticle pattern of lethal alleles of wg reported that it is a segment polarity gene and is necessary for proper segmental patterning of the embryos in all living beings. For this work, they were awarded the Nobel Prize in Physiology or Medicine in 1995.

It is now known that the wingless gene family is conserved in the animal kingdom - from sponges to human beings. In humans, there are 19 copies of this gene. The WINGLESS gene product is a signalling protein, a morphogenic ligand of profound importance which diffuses away from its source and interacts with target genes in a concentration-dependent manner. Subsequent studies showed that WINGLESS gene is an ortholog of mouse INT gene which causes mammary tumour. As a result, WINGLESS was renamed as Wnt, the concatenation of Wg and Int (Wg + Int = Wnt). Wnt genes are shown to be involved in processes as diverse as pattern formation, cell determination and differentiation, tissue induction, cell fate determination, axis specification, cell proliferation and cell death. Aberrant Wnt/β-catanin signalling has been observed in a variety of medical conditions including human cancers such as colorectal cancer, prostrate cancer and melanomas. Hence, the inhibitors of Wnt signaling pathway are being investigated for therapy as well as chemoprevention of these ailments.

Organising the XV International Congress of Genetics and Establishment of XV International Genetics Congress Trust

To showcase the fruits of Green Revolution where India was being elevated from “begging bowl” to food self-sufficient nation, and rich heritage of flora and fauna including a well-knit tribal population, a much sought after material for population and evolutionary genetics, Prof. Swaminath proposed to the International Genetics Federation, during the XIVth International Genetics Congress at Moscow in 1978, to hold the next congress in India. The Genetics Federation accepted the proposal and the XV International Genetic Congress was held at New Delhi during December 12 – 21, 1983. Prof. Swaminathan during those days was the Director General of International Rice Research Institute, Philippines. He identified Prof. V.L. Chopra as Secretary General for the conference. The Congress was held in

the Ashoka Hotel, New Delhi, and was inaugurated by Smt. Indra Gandhi, the then Prime minster of India. It was attended by more than 2,500 scientists including eight Nobel laureates. The conference was a grand success and was appreciated by one and all.

Prof. Swaminathan established the XV International Genetics Congress Trust in 1985 from the savings of the XV International Genetics of Congress and served as its Chairman. Prof. V.L. Chopra was identified as Vice Chair. Prof. Swaminathan firmly believed that genetic research in India should be strongly promoted if India has to consolidate gains made from advances in this field. The objectives for the Trust are:

- To create awareness about genetics as a core discipline of biology and to illustrate its impact on everyday life including agriculture, food, health and environment
- To promote the science of biology in general and Genetics in particular through lectures, trainings, and workshops
- To familiarise teachers with recent advances and developments in Genetics, Molecular Biology and Biotechnology
- To hold expert consultation meetings on specific issues arising from new developments in Genetics and biotechnology
- To attract bright youngsters to take Biology as a career option

Over these years the trust has been quite active in converting our vision into action. Following the advice of Prof. Swaminathan **"Catch Them Young"** we are concentrating on the "School Teachers" training program to reach to a large number of students. So far, we have been active in the NCR Delhi region and trying to extend our activity to other parts of the country – dreaming of being Pan-India. I would like to thank the past and present Trustees for their help and advice in fulfilling the vision of Prof. Swaminathan.

To conclude, I would like to express my indebtedness and gratitude to Prof. Swaminathan who was my teacher and mentor. I found in him a rare combination of an outstanding teacher, a great scientist, an astute administrator, and above all a great human being.

It is a very happy moment for not only agricultural scientists but also for all Indians to celebrate the Bharat Ratna award conferred on Prof. Swaminathan. Going through the life and works of Prof. Swaminathan and having spent a large part of my life under his umbrella, I am tempted to borrow the quotation of Einstein for Mahatma Gandhi "Generation to come will scarce believe that such a one as this ever in flesh and blood walked this earth", which is equally applicable to Prof. Swaminathan.

We need to rethink our industrialized food system

M.S. Swaminathan

Timeless Treasures from the Soulful Life of Prof. M.S. Swaminathan for Today's Teachers

Dr. Anupama Singh, Dr. Dinesh Kumar Sharma and Dr. Anil Dahuja

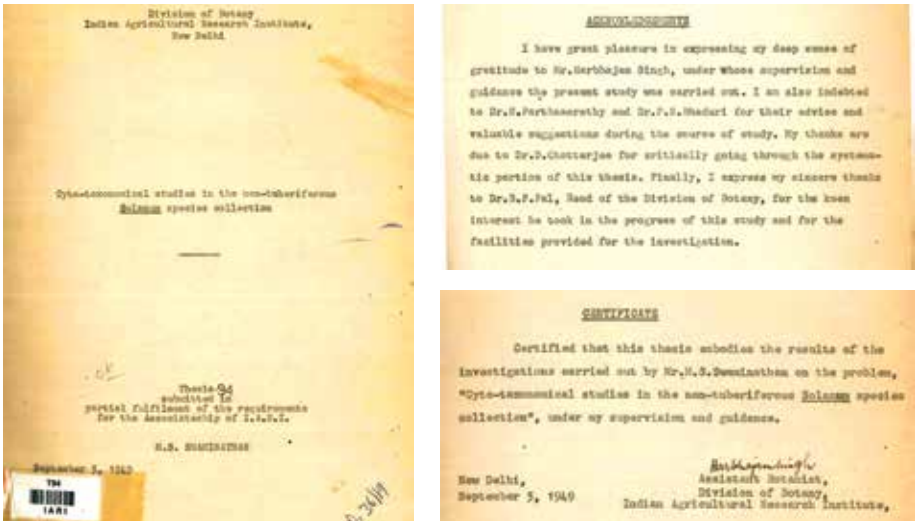
Prof. M.S. Swaminathan (7 August 1925 - 28 September 2023)- born in Kumbakonam, Tamil Nadu, India- is popularly known as "Father of Green Revolution" in India because of the legendary role he played in changing the trajectory of the Indian agriculture during challenging times of 1960s, when complex and chronic crisis of potentially catastrophic hunger were looming over India. The miraculous achievements of Prof. M.S. Swaminathan could partly be attributed to the training he received during his academic pursuits at the Indian Agricultural Research Institute, New Delhi, further traversing through Wageningen Agricultural University, Netherlands, University of Cambridge, United Kingdom and University of Wisconsin, USA, capacitating him to undertake and execute novel and ground-breaking endeavours that led to the accomplishment of country's victory over gargantuan hunger crisis of the period in context.

Prof. M.S. Swaminathan's Journey at IARI

Prof. Swaminathan began his journey at IARI, New Delhi in 1947 by joining two years diploma course, wherein he pursued "Cytotaxonomical studies in non-tuberiferous *Solanum* species" under the guidance of Dr. Harbhajan Singh and submitted his Associateship thesis 'T-94' on 5th September, 1949. The day of 'T-94' submission is coincidently also celebrated in India as Teacher's Day.

On March 21, 1949, Pandit Jawaharlal Nehru, the hon'ble Prime Minister of India visited IARI fields. During his interaction with the scientists and students of IARI, he earnestly urged them to work tirelessly towards making India self-sufficient in food production. This interaction motivated young Swaminathan to take an unspoken resolution to dedicate his life for making India a hunger free nation.

In October 1954, Prof. Swaminathan was selected as Assistant Cytogeneticist at Botany Division, IARI, New Delhi by UPSC. A decade later, he became the Head of same Division. Name of Botany Division was rechristened as "Genetics Division". The scientific accomplishments of young M.S. Swaminathan earned him the prestigious Shanti Swarup Bhatnagar Memorial Award on April 14, 1964


Division of Botany
Indian Agricultural Research Institute,
New Delhi

Cyto-taxonomical studies in the non-tuberiferous Solanum species collection

Thesis-94
submitted in
partial fulfilment of the requirements
for the Associateship of I.A.R.I.

M.S. SWAMINATHAN

September 5, 1949

ACKNOWLEDGEMENTS

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CERTIFICATE

Certified that this thesis embodies the results of the investigations carried out by Mr.M.S.Swaminathan on the problem, "Cyto-taxonomical studies in the non-tuberiferous Solanum species collection", under my supervision and guidance.

New Delhi,
September 5, 1949

Assistant Botanist,
Division of Botany,
Indian Agricultural Research Institute,

Glimpses of "T-94", the M.Sc. Research thesis of Prof. M.S. Swaminathan
(Courtesy: IARI Library archives)

and in 1966, he arose to the coveted position of Director, IARI. His predecessor Dr. B.P. Pal words of welcome "*I have watched with great interest and intense pleasure the unfolding of your genius, and I feel very happy that you are now heading the great Institute which I also was given the privilege of serving. As an older person, allow me to invoke blessings so that your mission of uplift of Indian Agriculture may be amply fulfilled*", aptly summarise the persona and stature of Prof. Swaminathan.

By 1968, Indian wheat production took a spectacular jump from twelve million to seventeen million metric tonnes while world watched in awe. Agreeing to Prof. Swaminathan's suggestion, the then Prime Minister of India, Ms. Indira Gandhi, felicitated the Institute's contribution to the wheat revolution in country by issuing commemorative postage stamp. In 1971, India was officially declared self-sufficient in food production.

The role of Prof. Swaminathan and his team in delivering the breakthrough in wheat and rice yields, was recognised by Dr. Norman Borlaug. In a letter to Prof. Swaminathan, he wrote "*To you Dr. Swaminathan, a great deal of the credit must go for first recognising the potential value of the Mexican wheat dwarf varieties. Had this not occurred, it is quite possible that there would not have been a Green Revolution in Asia".*

Prof. M.S. Swaminathan: A Role Model for Teachers

Prof. M.S. Swaminathan was a luminous teacher, who illuminated the path of countless students. He was a source of wisdom, inspiration and a ceaseless guiding light for all his mentees. His endeavour was not only to impart them the

knowledge of the subject but also to help them mine their hidden potentials to realize their dreams and achieve goals. Some of the values he lived throughout his life, which his students admired the most and tried to imbibe from him, can be considered as the key commandments from Prof. M.S. Swaminathan's life for the teachers and students of the today and future. The internalization and practicing of these commandments by teachers are much more relevant, almost inevitable, in today's context, when education ecosystem of the country is being reoriented with the implementation of the new National Education Policy-2020. The ten commandments/messages are briefly highlighted below:

1. **Thirst for knowledge and love for learning is irreplaceable**: Prof. M.S. Swaminathan was a voracious reader as he had an unquenchable intellectual curiosity to know the unknown. At the same time, he possessed a great sense of social responsibility, which always kept him inclined towards the applied aspects of the basic research to provide solutions to the problems of the society. His reading habits were spread across the disciplines, which provided him comprehensive understanding of the different subjects and an innate ability and foresightedness to devise strategies from the basic research and teaching for solving complex problems. He not only knew the need of the hour but call the future as well. Prof. P.C. Kesavan, Prof. Swaminathan's Ph.D. student at IARI recalls his student days, when he had to reluctantly take physics and basic mathematics courses following the advice of Prof. M.S. Swaminathan. The foresight of his mentor was realized by Prof. Keshvan during his career span. The physics courses stood him in good stead during the five decades of his active research in radiation biology including at BARC in 1990s.

2. **Building knowledge, skills and competencies are bare essentials**: Prof. Swaminathan had an unique ability in knowledge updating and integration. He was always the first person in the IARI campus to know and speak about the latest developments in basic sciences. After hearing him on such developments, students used to rush to the library to hunt for full details from the original literature. Every classroom lecture of his turned out to be a new learning experience. Prof. Swaminathan was famous both as a great teacher and outstanding scientist with profound knowledge, analytical ability and a source of novel ideas.

3. **Ability to deconvolute and simplify complex things is a must-learn art**: Towards the end of his lectures, Prof. M.S. Swaminathan's practice to provide sources of his lecture materials is fondly remembered by his students. Encouraged by their mentor to read the same, the students used to admire him more for his teaching ability to transform complexity of subject into easy to decipher concept without compromising on the fundamental science in context. His command on science and oration was unparallel and certainly a bar quality for present and future teachers. After reading these, students would invariably arrive at the conclusion that he had elegantly

simplified, for the benefit of students, the complex structural and functional aspects without losing the essence of the science involved.

4. **Vision is of utmost importance but it cannot be realized without values**: Prof. M.S. Swaminathan had an uncanny knack of identifying hidden talents of the students and teammates and nurturing them further. He could build excellent teams with a common vision. He was ambassador of human values who practiced what he preached and set examples through his way of living. Dr. P.S. Deshmukh (Former Head, Division of Plant Physiology, IARI) recalls how late evening of 1967, Prof. M.S. Swaminathan, the then Director of the Institute, knocked at the door of his laboratory and requested for spirit and cotton to be used by the gardner Chandan Rai, who had got injured while working in Genetics lawns. One of Prof. M.S. Swaminathan's students, Dr. N.P. Sarma, fondly remembers the day when he was walking through the Pusa gate to submit his application of ICAR fellowship at Krishi Bhawan personally, Director's car halted near him and after knowing his anxieties, Prof. Swaminathan advised him to attend to his studies and took his application form to submit in Council. No words to adequately applaud the Humane Swaminathan.

5. **Planning, punctuality and perseverance are powerful**: Prof. Swaminathan taught cytogenetics-I and radiation genetics at the Post-Graduate School of IARI during late 1950s through 1960s. His classrooms used to be full of not only students but also faculty from his own Division and other as well. As recalled by Dr. R.D. Iyer in his biography, Prof. Swaminathan's punctuality was a reference for his students to calibrate their wrist watches at 08:15 a.m. Prof. Swaminathan mantra, "Failure is the first step to success" closely defines his perseverant and optimistic character. His advice to students and co-workers "Choose a problem that is relevant to the needs of the people and put in excellent and thorough efforts to get meaningful results", reflects his concern for society and passion to translate science into social outcomes.

6. **Purpose-driven passion is paramount**: Dr. Rajeev Varshney, Adjunct Prof., ICAR-IARI and Director, Centre for Crop & Food Innovation, Murdoch University, Australia, recalls an interaction with MSS during an FAO meeting in Bangkok in 2016. Despite being on a wheelchair, he participated as invited expert. While Dr. Varshney expressed his concern over Prof. Swaminathan's mobility issue and travel strains, the later politely said that interactions with young minds like Prof. Varshney at scientific meetings, motivates and energizes him to travel at this age, adding "I can't imagine just sitting in my office when I believe I can still make a contribution to society."

   Prof. Swaminathan passion for teaching, irrespective of the positions he held, needs no introduction. According to him, "A teacher is like a candle not only spreading its own light, but also lighting many more". Before starting his

early morning lecture, it was usual for him to ask the class whether they had any doubts regarding previous day's lecture. In his words, 'Teachers must be passionate'.

Prof. Swaminathan dwelt at length on the qualities needed to be a good teacher in an article called ***'Teachers Must Be Passionate'*** written in October 1968 for the Home and School magazine of St. Thomas Girls' H.S. School, New Delhi, at the request of his eldest daughter, Soumya. The importance of attitude and passion of the teacher in the classroom; makes a great impression on the students. He wrote, "When I think of my own teachers, the only those come to my memory who were passionate in their teaching. It is not what they taught that was important, but the way they did it, the seriousness of purpose, and their identification with the students". Prof. Swaminathan's advice that if every lesson is regarded as an experiment and a new experience, then it becomes exciting for both sides, is a universal mantra for teachers across time and space.

7. **Giving respect to earn respect is the most essential virtue:** Prof. Swaminathan was an ideal research guide who took great pains to help his students at all stages of their programmes. He had a unique way of raising the standards of young researchers without ever reprimanding them. Sometimes when he happened to be with a student to examine his cytological slides and found that the microscope was dirty, he would quietly take out his own handkerchief and start cleaning it with a gentle smile. The respect for Professor grew multifolds.

8. **The superiority and supremacy of soft skills cannot be undermined:** All students used to admire Prof. Swaminathan for his classroom lectures as well as public talks, for the horizon and depth of his coverage of topics, his astounding communication skills and clarity of expression. Till he joined as director general, ICAR, in 1972, he used to teach Basic Cytogenetics-I, Radiation Genetics and Mutation Breeding Courses in the Division of Genetics. His classes used to be overflowing as nonacademic staff, apart from regular students, would also be in attendance. His public lectures always attracted huge audiences.

9. **Interpersonal skills are indispensable:** Prof. Swaminathan always emphasized that an earnest teacher establishes a two-way feedback relationship between the student and the teacher. The student soon becomes a disciple of the teacher. To reach this stage, the teacher should set a worthwhile example. Teachers should neither dissuade students from asking questions, nor try to escape answering them.

10. **Legacy becomes enduring and everlasting when it is lived during lifetime:** Prof. Swaminathan is remembered as a soft-spoken and thoughtful human being, a dedicated agricultural researcher, and a visionary statesperson who dedicated his life to addressing the paradox of persistent hunger. He always

led by the example. He believed in science but ultimately concluded that "…science can only show the way - it is only synergy between science and public policy that can help to make hunger history."

Prof. M.S. Swaminathan - An Administrator with World Class Vision for Shaping IARI as a Premier Higher Education Institution in Country

IARI got Deemed to be University recognition from UGC in 1958. The apex statutory policy body. The Academic Council of IARI, was previously called Post Graduate Council. Since the inception of PG School at IARI, Director is the Chairperson of Council. During tenure of Prof. M.S. Swaminathan as Director, IARI, (1966-1972), IARI PG School bloomed from bud to flower. Few glimpses and quotes of Prof. Swaminathan extracted from Academic Council records may serve as testimony to the statesmanship of the Great leader:

Glimpses of IARI Convocation during tenure of Prof. M.S. Swaminathan

1. Introduction of a compulsory 2 credits course of national interest for Masters Students - National Problems in Agriculture, was brainchild of Prof. Swaminathan. Farmers were invited to the institute as guest lecturers from across country (from southern states for *Kharif* crop and from rest of country during Rabi season). The very same features has been envisioned in NEP 2020 in the name of "Professors of Practice"

2. To establish NRL under UN special fund scheme, Dr. Vikram Sarabhai, Secretary and Chairman, AEC, Department of Atomic Energy, Government of India, was included in the PG Council as Co-opted Member.

3. Course 'Human Cytogenetics' was approved for teaching in Genetics Division in 1969 on the ground that IARI is the only centre that imparts high level training in Genetics in the country and hence maximum advantage should be derived from staff expertise available. The thought of Prof. Swaminathan echoes the NEP 2020 thrust on multidisciplinarity in global university.

4. "Sanctity of regulations (academic) should be honoured at all levels and that as a matter of principle, no one should recommend relaxation of these rules".

5. “Professors and Guides should not recommend any relaxation for which Dean has to take the odium of rejecting the recommendations which should not have been made at the very first instance”.

6. “Professors have crucial role to play in upgrading the efficiency and quality of teaching”.

7. “It is always easy to identify the faults of others but what is important is that everyone should try to improve at one’s own level”.

8. “The Divisional officers and central office should function in an atmosphere of efficiency speed and courtesy”.

Commitment for the Well-being of Scientists and Staff Families of IARI

The Nehru Experimental Centre (NEC) was envisioned by Late Mrs. Mina Swaminathan and established in 1966 when Prof. M.S. Swaminathan was the Director of the Indian Agricultural Research Institute (IARI), New Delhi. The primary

Nehru Experiment Centre - A brain child of Prof. M.S. Swaminathan and Mrs. Mina Swaminathan

objective of the NEC is to provide play school facilities and child care to pre-school children of working parents at IARI. The centre was later registered as a society.

Children from varied background of culture, language and states come and grow under one umbrella. Mrs. Swaminathan made efforts for their holistic development through exposure to extra-curricular activities, nature, exposure to dance, drama, music, crafts etc. Children were groomed to bring something out of nothing, recycling, etc. in each house of campus.

Mrs. Mina Swaminathan was a champion of childcare, one of the founders of the mobile creches, a former chair of the Delhi Social Welfare Board and also a founding member of the Centre for Women's Development Studies and an international consultant with UNESCO and UNICEF on early childhood care and education. Children of faculty, who spent their childhood at NEC and their parents fondly remember the days spent here. The centre has completed close to six decades since its establishment and is still serving the cause of child care and development in letter and spirit.

Education should promote sustainable development and ethical stewardship

M.S. Swaminathan

An Evergreen Legacy of Prof. M.S. Swaminathan at His Karma Bhoomi, the Indian Agricultural Research Institute, New Delhi

Dr. Ashok K. Singh and Dr. Gopala Krishnan S.

"The future belongs to the nations with grains" – Prof. M.S. Swaminathan

Prof. M.S. Swaminathan has made invaluable contributions to agricultural research and development in India as well as across the globe. His time at Indian Agricultural Research Institute is etched in golden letters and has been pivotal in laying the foundation of research, education and extension in India. We have the great privilege of recollecting some of the major milestones during his eventful stay at IARI, New Delhi.

Formative Years of a Stalwart

Prof. M.S. Swaminathan's association with IARI is marked with his landing at Delhi, when India gained its independence. Once during his visit to IARI, he recalled his arrival to IARI. In 1947, when he landed late in the night at the Delhi railway station (presently the Old Delhi Railway Station). IARI, Pusa campus which is now at Central Delhi in New Delhi was remote location and he was advised against travelling late in the night, so he stayed back at the station overnight. Next morning, he travelled in a *"Tonga*" (a horse pulled cart) to IARI. He joined for the Associateship of IARI (equivalent to Master's degree) in 1947 and completed his research in 1949 on "Cyto-taxonomical studies in the non-tuberiferous *Solanum* species collection", under the guidance of none other than the father of plant genetic resources in India, Sh. Harbhajan Singh, Assistant Botanist in the Division of Botany (now Division of Genetics). His stay at IARI for the associateship played a definitive role in laying a strong foundation for nurturing his interest in genetics and breeding, based on which he secured a UNESCO fellowship at Wageningen Agricultural University, Netherlands and then enrolled for his Ph.D. at the University of Cambridge, United Kingdom to work on "Origin of Potato". He continued his research on potato as a Post-Doctoral fellow at University of Wisconsin, USA for transferring the genes for frost tolerance from *Solanum acaule*, which led to the development of the variety, "Alaska Frostless".

Leading by Example - Excellence in Teaching and Research at the Division of Genetics

After completing his Post-Doctoral research, he declined an attractive faculty position in the USA and chose to return to India in 1954. He worked for a short period on *indica-japonica* hybridization under the leadership of Dr. K. Ramiah at Central Rice Research Institute, Cuttack. Prof. M.S. Swaminathan joined the Division of Botany as Assistant Cytogeneticist and rose to the position of Head of the Division of Botany (now the Division of Genetics), IARI, New Delhi, which he served from 1961-1966. He made valuable contributions in imparting knowledge through his involvement in teaching of cytogenetics and mutation breeding and guided students for their research programme for Master's and Ph.D. degree across the crops like wheat, linseed, chilli, tobacco, bajra, maize, and forages. In 1958, Prof. M.S. Swaminathan spearheaded the IARI Postgraduate School getting the status of Deemed to be University by the UGC for M.Sc. and Ph.D. degrees. In doing so, he became the chief architect of postgraduate education in Agriculture in India. The IARI pattern was later adopted by other agricultural universities in several states including Punjab, U.P., Kerala, Karnataka, West Bengal, Assam, Orissa, Andhra Pradesh, Madhya Pradesh and Tamil Nadu.

He made significant research contributions in cytogenetics, radiation genetics, culture of excised embryos, chemical mutagenesis, cyto-chemistry, biometrical genetics and evolutionary sequence and monosomic analysis of *Triticum*. All these research works were documented in a number of outstanding publications in reputed journals. In 1963, Prof. M.S. Swaminathan had the distinction of being invited to serve as the Vice-President of the International Congress of Genetics held at The Hague, Netherlands, which was a rare recognition to a young scientist. He thereby gave opportunities to his colleagues and students in Division to visit leading institutions in India and abroad to present their research papers at international symposia. Later, he was instrumental in bringing the XV International Genetics Congress to New Delhi in 1983. From the monetary savings of the congress, he constituted the XV International Genetics Congress Trust, New Delhi which is playing a pivotal role in spreading the genetics education at school and college level by imparting teachers' training.

Spearheading the Green Revolution

His milestone research envisioned at tailoring the plant type to be functionally responsive to the application of fertilizers through dwarf plant architecture, using interspecific hybridization, induced mutagenesis and the use of plant growth regulators.

His keen interest in staying abreast with scientific developments across the world enabled him to trace and source the dwarfing genes, 'Norin-10' in

wheat and 'Dee-gee-woo-gen' in rice. Eventually, he collaborated with Prof. Norman E. Borlaug, Director of International Maize and Wheat Improvement Center (CIMMYT), Mexico to source the Mexican dwarf varieties of wheat ('*Lerma Rojo*' and '*Sonora-64*'), and their utilization in Indian wheat breeding programme, which ushered the era of green revolution in India. The wheat production in the country, which was barely 12 million tonnes in 1968 has now reached 112 million tonnes. Thanks to his visionary leadership initiative in orchestrating the symphony of science, political will, support of bureaucracy and farmers' participation.

Seed Village Concept

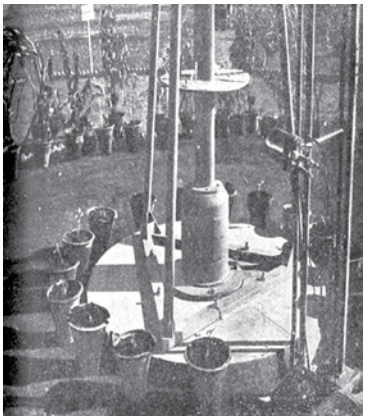
With the release of improved high yielding semi-dwarf wheat varieties, there was a need to scale up the seed production. Looking into the land limited resources available at IARI, New Delhi, Prof. Swaminathan established a seed hub at *Jounti* village in Delhi state by motivating farmers to take up cultivation with the technical support of scientist. Over 6 tonnes of wheat was produced in one season leading to development of "Jawahar *Jounti* Seed Co-operative Society" in the village, whose members were specialised in good quality seed production.

Seeding the Basmati Revolution in India

During his speech at the celebration of the success of green revolution at Dr. BP Pal Auditorium, he made the famous statement that in order to make rice cultivation more profitable, the farmers of Punjab and adjoining states should shift towards Basmati rice. With this vision, he initiated the Basmati rice breeding programme at ICAR-IARI. The genetic improvement of Basmati rice at IARI has led to the development and release of high yielding improved Basmati rice varieties, leading to a purely indigenous Basmati revolution. Our annual Forex earning through the export of Basmati rice stands at Rs. 45,000 crores in 2023-2024.

Transforming the Research Paradigm

Prof. M.S. Swaminathan served as the Director, IARI, New Delhi for a period of five years starting 1967. His tenure as Director of the institute marked a transformational phase in IARI with the establishment of several new Divisions namely Biochemistry, Plant Introduction, Plant Physiology, and Seed Technology, enabling the basic and advanced research in these areas with sufficient provisions for infrastructure and man power. He also started a separate Division of Agricultural Chemicals to undertake research on botanical pesticides (neem, mahua, tobacco) and to address the issue of pesticide residues in farm produce. The Water Technology Centre, the Algal Laboratory, the Pulses Laboratory came up during this period. Tissue culture research also received a much-needed boost with the setting up of an INSA-funded Anther Culture Laboratory for the exploitation of haploids in heterosis breeding in rice and other crops. He also initiated the concept of inter-disciplinary research schools and the most significant such school was the setting up of Nuclear Research Laboratory in the IARI campus. Another landmark contribution of Prof. M.S. Swaminathan was the initiative of establishment of Project Directorates for different crops including maize, wheat and oilseeds.



A Close-up of the Gamma Source

Gamma garden at IARI

Creation of Advanced Research Facilities

Prof. M.S. Swaminathan created the field-irradiation facility called 'Gamma Garden' for creating desirable mutations through mutagenesis. Cereal Laboratory building was established to intensity research in nutritional quality breeding of cereals.

Through his role in transforming IARI, Prof. M.S. Swaminathan created an indelible mark in the history of IARI, and later took over as Director General of the Indian Council of Agricultural Research, New Delhi in 1972. In recognition of his enormous contribution agricultural education, research

IARI named its library as Prof. M.S. Swaminathan Library in 2015

and transfer of technology, IARI named its library as Prof. M.S. Swaminathan library in 2015.

A Great Humanist

Prof. Swaminathan was a great human being, who never missed to acknowledge any letters/ mails send to him by students, scientists and his contemporaries. He was instrumental in establishing the Afghanistan National Agricultural Science and Technology University in Kandahar, and Advanced Centre for Agricultural Research and Education (ACARE) in Yezin, Myanmar with a view to make these countries food and nutrition secure through indigenous research and development. The senior author had an opportunity to travel with Prof. Swaminathan in Myanmar for a week to oversee the development of Rice

Biopark and ACARE. While departing on completion of the visit, they were seated in the car and suddenly, he noticed Professor walking back to kitchen. Curiously, he followed him to find that Prof. Swaminathan was personally shaking hands with the cook and the waiters, and thanking each one of them for the service that they provided. Then, he said "Dr. Singh, the people who serve you food are very important people and we must not forget to acknowledge and thank them". That was the humanist in Prof. Swaminathan.

How Should We Remember Prof. Swaminathan

Professor used to quote Mahatma Gandhi, "To a hungry person God can appear only in the form of bread". That god is none other than Prof. Swaminathan. Our and future generations should remember him, while taking square meal. That will be the biggest tribute to esteemed Professor.

We must strive for a world where no one is left behind

M.S. Swaminathan

My Impression About Prof. M.S. Swaminathan

Dr. Panjab Singh

My contact with Prof. M.S. Swaminathan began about half a century back when I joined ICAR as an Agronomist in 1972 at CAZRI, Jodhpur. In fact, I had the privilege of having my first appointment letter of my entry in to the ICAR system signed by Prof. Swaminathan, who has also assumed the charge of the Director General, ICAR in 1972. During my service career in various capacities starting from Agronomist and up to the DG, ICAR and beyond, I had several occasions to interact and discuss personal, official or other matters with Prof. Swaminathan. Invariably, I found him very encouraging and ready to offer advice and help to the extent possible. In fact, after talking to him you always carry a feeling that half of the work is done. It's like a medical practitioner who takes away half of your worries in very first visit through his compassionate approach and proper advice. Also, I noticed that he will, as for as possible, use the opportunity to discuss with you about the problems facing agriculture and farmers and our efforts to improve crop production, promote ecological and economic sustainability and help small farmers to improve their socio-economic status. In discussing with him you always notice that he clearly understood the intricate interplay between science and society, farmers included and ways to find solutions through technological interventions. He has a profound sense of compassion and championed technology development strategies that embodied empathy and an unwavering commitment to comprehensive progress, particularly for impoverished and food-insecure people, especially women. He recognized that genuine advancement encompassed not only science and technology but also the well-being of all, marginalized communities included. He has been largely responsible for spread of Green Revolution across India in late sixties, when farmers across the nation began employing better irrigation methods, better seeds especially of rice and wheat and using higher quality of fertilizers, making India head towards attaining self-sufficient and ending its dependency on grain imports.

He handled many official roles, including that of the chairman of the National Commission on Farmers, recommendations of which are hotly debated these days by farmers and policy makers. He held several important positions including that of Director of the Indian Agricultural Research Institute (1961-72) and Director General of Indian Council of Agricultural Research and Secretary to the Government of India, Department of Agricultural Research and Education

(1972-79). Over a period of over 60 years, Prof. Swaminathan has worked in collaboration with scientists and policy makers on a wide range of problems related to agricultural research, agricultural education and technology transfer. For many of the innovations and reforms introduced in these areas plus personnel policies for ICAR employees, Prof. Swaminathan was largely responsible. Among his scientific contributions worth mentioning are; conservation of plant genetic resources, in situ and ex situ conservation of biodiversity; manipulation of genes to improve the yield, quality and stability of wheat, rice and potatoes; identification of the barriers to high yields in wheat and initiation of the dwarf wheat breeding program; organizations of the National Demonstration and Lab to Land programs.

He has received numerous honors and awards for his outstanding contributions to agriculture, including being honored as the first World Food Prize Laureate in 1987 and being conferred with the Padma Shri (1967), Padma Bhushan (1972), Padma Vibhushan (1989) and Bharat Ratna (1924), besides many others. He is one amongst us who has earned highest number of awards, and held important positions at the national and global levels and contributed in agriculture development not only in India but several countries in South and South East Asia. Lastly, I would say Prof. Swaminathan lived a very accomplished life among his family and friends. We all cherish his memories and wish to walk the path he has set for us for future agricultural growth of the country.

Agricultural biodiversity is essential for resilience and adaptation

M.S. Swaminathan

Prof. M.S. Swaminathan: Greatest Humanist Scientist

Prof. R.B. Singh

1. Words will always fall short in adequately describing the scientific eminence, profound humanistic embodiment, and global leadership of most revered Prof. M.S. Swaminathan (August 7, 1925-September 28, 2023) in science-led transformation of livelihood security of humanity at large. The Father of India's Green Revolution, Prof. Swaminathan was the transformer of the country from the Ship-to-Mouth status to the Right-to-Food situation and savior of millions of lives from starvation.

2. Prof. M.S. Swaminathan revitalized agrarian prosperity, food and nutritional security and sovereignty as the bottom line for government policies and priorities in agricultural and rural development. Prof. Swaminathan's rich legacy and endearing persona will keep inspiring and guiding coming generations to build a prosperous, inclusive, and world-leading New India.

3. Prof. M.S. Swaminathan and his team used dwarfing genes, Norin-10 (from Japan) in wheat and Dee-Geo-woo-Gen (from China) in rice to breed input-responsive high yielding semi-dwarf wheat and rice varieties in the mid-1960s, doubling the production of these crops within 5 to 7 years. Nobel Laureate Dr. Norman E. Borlaug was the main motivator and collaborator in the Wheat Revolution. The quantum jump in productivity and production of these crops was called the Green Revolution, enabling the government to declare India self-sufficient in food production in 1971.

Prof. Norman E. Borlaug with Prof. M.S. Swaminathan and other agricultural scientists at the IARI wheat field

4. The visionary Professor was one of the first one to recognize the negative impacts of the Green Revolution, often attributed to the poor transfer and adoption of recommended technologies, as elaborated in his address at the Indian Science Congress at Varanasi in January 1968, which I had also attended. The shortcomings mentioned then and later involved indifference to smallholder and rainfed farmers, loss of biodiversity, loss of soil fertility, unscientific tapping of underground water, indiscriminate use of pesticides, fertilizers and herbicides, and GHG emission. *"If conservation of natural resources goes wrong, nothing else will go right"*, emphasized Prof. Swaminathan.

5. In order to meet the above challenges, Prof. M.S. Swaminathan strongly advocated adoption of Evergreen Revolution scientifically rooted in the principles of ecology, economics, social, and gender equity, thus ensuring enhanced productivity in perpetuity without ecological damage. It is truly a revolutionary pathway for agricultural transformation.

6. Prof. M.S. Swaminathan had repeatedly cautioned that *"if agriculture goes wrong, nothing else will go right."* Evergreen Revolution embraces all the ongoing advocacies for Regenerative Agriculture, Green Agriculture, Organic Farming, and Natural Farming and adopting a system based approach. *"Swaminathan's Evergreen Revolution is the best option available to human kind to feed the burgeoning millions of new mouths annually and at the same time save the rest of life on the planet as well"* was highlighted by Prof. E.O. Wilson, a world renowned Harvard biologist, in his famous book "The Future of Life" (2002).

Prof. M.S. Swaminathan awarding Honoris Causa Doctor of Science Degree to Dr. José Graziano da Silva, Director General, FAO, Rome at a Special IARI Convocation

7. Pursuing his innovative approaches of system-based Evergreen Revolution for sustainable food and agricultural production, Prof. Swaminathan advocated congruence and synergy of Conservation, Cultivation, Consumption, and Commercialization - the "4Cs", which have become the mantra of new paradigm that blends conservation and development for sustainable green agriculture. The Evergreen Revolution approach assumes still greater importance in face of the fast changing climate and fast depleting natural resources. He energized several international organizations to accelerate Evergreen Revolution.

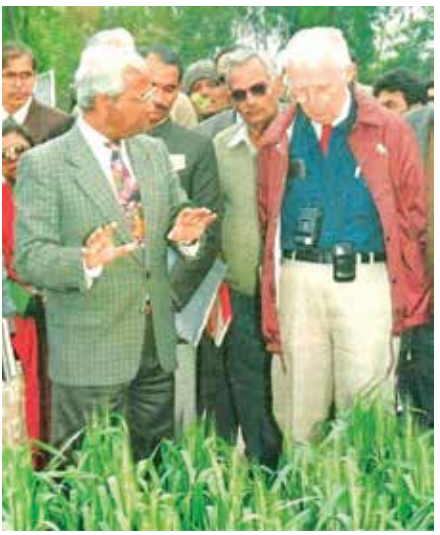
8. Prof. Swaminathan's unmatched foresight is further amplified by his Evergreen Revolution campaign which also emphasizes all the elements of the recently launched GYAN Schemes, translating to Gareeb (Poor), Youth, Annadata (Farmers), and Nari (Woman). This move is being nurtured by latest initiatives of the government such as Pradhan Mantri Jan Dhan Yojana (PMJDY), PM Garib Kalyan Anna Yojana, Pradhan Mantri Yuva Udyamita Vikas Abhiyan (PM-YUVA) etc.

9. The ICAR-IARI (Indian Agricultural Research Institute) is the "Karma Bhumi" of Prof. M.S. Swaminathan, the harbinger of Green and Evergreen Revolution. As the leading Geneticist, Prof. Swaminathan had pioneered basic research in Genetics, Cytogenetics, Radiation Biology, and Induced Mutagenesis. Further building on it, as Director of the Institute from 1966 to 1972, he took IARI to much greater heights and added several topical research and teaching laboratories and facilities, namely, Nuclear Research laboratory,

Gamma Garden, Water Technology Centre, Pulses Research laboratory, Divisions of Genetics, Plant Physiology, Agricultural Chemicals, Seed Science Technology, and Algal Laboratory. These creations helped him, the Institute, and the nation as a whole to harness science and technology for elimination of rural poverty and hunger. To cite just one of the many examples, the Basmati rice research that he initiated in 1965, is currently annually contributing over Rs. 40,000 crore through Basmati export.

10. Prof. M.S. Swaminathan has been acclaimed by the Time Magazine as one of the 20 most influential Asians of the 20th Century and one of the only three from India, the other two being Mahatma Gandhi and Rabindranath Tagore. UNEP described him as the Father of "Economic Ecology" because of his leadership of the evergreen revolution approach. UN Secretary General Javier Perez de Cuellar described him as a "Living legend who will go into the annals of history as a world scientist of rare distinction".

11. Motivated by Prof. M.S. Swaminathan's unparalleled service to humanity through science, especially as Director IARI, I resigned from a coveted continuing UN/FAO position in Rome and availed the opportunity to serve as Director and Vice-Chancellor of IARI, New Delhi from 1995 to 1999. Quickly drawing lessons from Prof. Swaminathan's *modus operandi*, I updated the scientific contents, infrastructure, policies, plans and programmes of research, education and extension to not only consolidate the past gains but also to accelerate the Evergreen Revolution to enhance social, economic, ecological and environmental synergies. Development, release, and adoption of new varieties, other technologies and innovations to realize More from Less for More (MLM) were intensified. Dr. Borlaug's interactions were sustained. World class new facilities such as Phytotron, Biotechnology Centre, Molecular Virology Centre, Protected Agriculture, Quality Seed Production, Processing, Testing, and Storage were created. Internationalization of IARI was greatly enhanced. During my tenure, IARI was adjudged as the best ICAR institute year after year on many counts. I also led the formulation of World Bank supported National Projects such as the National Agricultural Technology Project (NATP), greatly augmenting



The Green Revolution revisited: Intensifying the Evergreen Revolution - Prof. R.B. Singh (Director, ICAR-IARI, New Delhi) discussing the strategy with Nobel Laureate Dr. Norman Borlaug at IARI fields

the national capacity in research, education and extension for development and ensuring that no one is left behind.

12. I had the good fortune and privilege of working with Prof. M.S. Swaminathan on several national and international programmes and committees. My most gratifying and pervasive experience of working under Prof. Swaminathan's able Chairmanship was as a Member of the National Commission on Farmers during 2004 to 2006. Comprehensive meetings were held under his leadership in different States, from Ladakh to Kanya Kumari, including Maldives and Goa, involving all stakeholders, from Chief Ministers to farmers and local communities. The Commission also visited Vidarbha villages, hotspot of farmers' suicides, and met the affected families, a heart-breaking experience.

13. Based on ground realities, The Commission, popularly known as Swaminathan Commission, prepared six-monthly five volumes of Reports and presented to the Government on regular intervals. The Fifth Report, summarizing the past findings and taking note of farmers' distress, recommended addressing them on priority basis through a holistic national policy for farmers, and provided a widely discussed draft of the policy to the Government for approval, adoption, and implementation to ensure a faster and more inclusive growth. The Government of India approved the National Policy for Farmers in 2007.

IARI was the first Institute to receive the 'ICAR Best Institute Award' in the year 1996. Shri Chaturanand Mishra, Union Minister of Agriculture is seen presenting the award to the Director of the Institute, Prof. R.B. Singh, under the Chairmanship of Prof. M.S. Swaminathan.

14. The document contains 15 major policy goals and a holistic definition of farmer, and has advocated shift from mere production to: (i) Growth in the real income of farm families; (ii) Accelerated and inclusive agricultural growth; (iii) Accent on productivity, quality, competitiveness and safety; (iv) Rural integrated employment and agrarian economy and retention of rural youth in farming; (v) Farmer-Market-Consumer linkage and value-chain management; (vi) Quality and gene literacy, awareness, and knowledge societies and decision support systems.

15. The primary focus of the Policy is on "farmer" defined holistically and not merely on agriculture, with the main objective of improving the economic viability of farming through substantially improving net income of farmer.

Ensuring excellence with relevance, emphasis was also placed on increased productivity, profitability, institutional support, and improvement of land, water and support services apart from provisions of appropriate price policy, risk mitigation measures etc. Highlighting Serving Farmers and Saving Farming and echoing Mahatma Gandhi's words *"To those who are hungry, God is bread"*, the Swaminathan Commission had strongly suggested adoption of Minimum Support Price which should be at least 50% more than the weighted average cost of production (CII+50% of CII) for crops and other agricultural products to enhance farmers' income and agrarian livelihood security.

16. Adopting a pro-poor, pro-women, and pro-nature approach, Prof. Swaminathan strongly believed that if our farm women and men are assisted on the lines proposed in the Policy, they will ensure a glorious destiny in the field of agriculture and food and nutritional security. Based on this policy, the Ministry of Agriculture was renamed as the Ministry of Agriculture and Farmers Welfare. Prof. Swaminathan's guidelines also ensured Padma Awards to farmers.

17. The entire scientific community, especially agricultural scientists, and farmers community world over are proud on conferment of Bharat Ratna on Prof. M.S. Swaminathan. Our dreams have finally come true.

18. Hon'ble Prime Minister Shri Narendra Modi, on February 09, 2024, while announcing the conferment of the Bharat Ratna on late Prof. Swaminathan, underpinned that the Professor had played a pivotal role in helping India achieve self-reliance in agriculture during challenging times and made outstanding efforts towards modernizing Indian agriculture.

PM Sh. Narendra Modi and Prof. M.S. Swaminathan, Chair International Advisory Committee IAC 2016 during the 1st International Agro Biodiversity Congress 2016 at Vigyan Bhavan

"Dr. Swaminathan's visionary leadership has not only transformed Indian agriculture but also ensured the nation's food security and prosperity", echoed the Prime Minister.

19. I express my profound gratitude to the National Academy of Agricultural Sciences (NAAS) and President NAAS Dr. Himanshu Pathak for giving me an opportunity to submit this brief write-up to this Memoir as my tribute to the legendary Prof. M.S. Swaminathan, the founder President of the Academy.

20. I sincerely trust that Prof. Swaminathan's rich legacy will keep guiding us forever in humanizing science and reaching the unreached.

Sustainable farming practices can help mitigate climate change

M.S. Swaminathan

My Association with Prof. M.S. Swaminathan : Father of Indian Green Revolution

Dr. Riksh Pal Singh

I was most fortunate to be selected as Research Assistant at IARI in September 1964. The selection team included Prof. M.S. Swaminathan as Chairman (Head, Division of Botany) and other Members being Dr. R.D. Asana and Sri Harbhajan Singh. I joined his Wheat Team in the Cereals Laboratory. I was the first to join with M.Sc. Agronomy in "All India Coordinated Wheat Improvement Program (AICWIP)", the first interdisciplinary project headed by Dr. S.P. Kohli (Coordinator).

From day one to 15-20 days, I was asked to organize seed envelops in trays for the preparation of sowings soon after October 15, 1964. During this time, I came in contact with Dr. R. G. Anderson, a Canadian Scientist, Joint Wheat Coordinator, and was advised by Dr. S. P. Kohli to take maximum care of each seed as that material of the 631 F. Generations segregating lines from Mexico were sent by Dr. N. E. Borlaug. Along with those lines 100 kg seed of four varieties: Sonora 64, Sonora 63, Lerma Rojo 64A and Mayo 64 were also received. I was asked to conduct a soil fertility trial of those four dwarf varieties along with four Indian wheat high yielding tall varieties, under the direction of Dr. Anderson and Mr. M. D. Nandkeoler, a senior Extension Scientist with the wheat group.

I often used to take laborers at 7:00 AM every day and also on holidays to organize sowings sharp at 7:30 AM . During sowings of dwarf material, Prof. Swaminathan Sir was also coming almost every day or alternate day at 8:00 AM. After parking his cycle on the road, he would enquire what material is being sown in each line in the each sector of the large field in Block No.1, 4 and 7. Dr. Anderson also used to come to the field at 7:00 to open furrows with help of petrol run machine named Gravilly for sowing. Many a times, in the absence of Dr. Anderson, I used to open furrows for sowings. After two and half months, I used to carry out spray inoculation schedule with fungal spores (mixture of all the three rusts and smut diseases) on the due laden wheat plants early morning soon after sun rise for a week's time. During the crop season , Prof. Swaminathan Sir used to make frequent visits in the evening also at 5:00 PM after office hours in his green Ambassador car to motivate wheat workers. This was happening every year from start of preparations of seed packets from September- October till the finish of harvesting in May-June each year. After

harvest, the team led by Dr. Anderson used to gather in laboratory at 8:00 PM every day for recording grain quality and disease reactions of the each of the harvested lines etc till 12:00 mid night.

Realizing my hardworking nature, I was assigned the responsibility of taking selected wheat material from the harvest in May 1965 to Wellington for summer nursery. R. S. Paroda and N.K. Sanghi (the then Ph.D. students of Dr. A. B. Joshi, Dean P. G. School) also travelled with me carrying their Ph. D. material for advancing generation. Dr. S. P. Kohli and Prof. Swaminathan were also with us for guiding the sowing for first three days.

During 1966, Dr. Anderson encouraged me to start Ph.D. under his guidance on" A determination of uptake of nitrogen in wheat plant and its distribution in plant parts at different physiological stages of development and its effect on yield and quality of the grain". During 1966-67, Prof. Swaminathan invited Raman Magasaysay Award winner from the Philippine to visit the Institute and farmers fields to see the Green Revolution. I was then asked to join on this trip to explain the technology we used.

Dr. R.P. Singh at Prof. Swaminathan's ancestral house in his village with his brother Sri Ramdas Ji.

During 1967, when Prof. Swaminathan Sir joined as Director, IARI, I was selected as Senior Research Assistant in the Plant Introduction Division to work on "Agronomy of Medicinal Plants", but I was allowed to pursue my Ph.D. work on wheat. During 1970, while I was finalizing my thesis results and discussion with Dr. Anderson, Prof. Swaminathan called me at his residence along with my thesis results. I was fortunate that some of my findings could find place in his presentation abroad (10 slides). Those 10 slides are still preserved in the library section at MSSRF, Chennai.

After I submitted my Ph.D. Thesis to Agra University, Prof. Swaminathan Sir encouraged me to apply for higher positions. Mean while I was selected in 1971 as Assistant Agronomist in the Agronomy Division (IARI) to work on "Foliar Fertilization Scheme". By that time, Prof. Swaminathan Sir has taken over as DG (ICAR) and I continued to take advantage of his visit to IARI to show my

field experiments. After working for three years, I was assessed and promoted to Scientist S-2 in the scheme.

Prof. Swaminathan continued to watch my interest even when he was in ICAR as DG, Planning Commission, IRRI as DG and finally MSRRF, Chennai. I was also invited by Prof. Swaminathan Sir to attend a FAO sponsored International Conference on "Farming Systems" at Chennai and during that time I got the opportunity to visit his native village also.

Dr. R.P. Singh Secretory General, Indian Agricultural Universities Association (IAUA) sharing dais with Hon'ble Prof. M.S. Swaminathan Sir and others on 15 February 2005 at the inauguration of Social Sciences Conference at N.P.L. Pusa, New Delhi.

Mean while Madam Meena Swaminathan wrote a book on "**Role of Women in Agriculture**" for educating the UG and P.G. students to be adopted and implemented in State Agricultural Universities through ICAR. The book was shared with VCs attending convention at SDAU in Gujarat.

While I was working as Secretary General at the Indian Agricultural Universities Association (IAUA). I was occasional visitor at his residence for his blessings to improve IAUA working. In one of the annual VC conventions organized by IAUA, Prof. Swaminathan was the chief guest and he appraised all the V.C.s on the final recommendations of the "Farmers Commission" and their adoption through the states. During 2013, Prof. M.S. Swaminathan Sir recommended me as resource person to MEA in establishing the Afghan National Agriculture Sciences

and Technology University (ANASTU) at Kandahar in collaboration with IARI.

Finally I was fortunate to meet Prof. Swaminathan Sir and the family members at MSSR, Chennai on March 26, 2022 during celebration of Meena Swaminathan's Life and Achievements.

Dr. R.P. Singh seated next to Prof. M.S. Swaminathan Sir at MSSR, Chennai, attending celebrations on the Life and Achievements of his wife Meena Swaminathan (passed away on 14 March 2022)

Prof. Swaminathan achievements beyond limits has saved millions of lives in India and Asia in particular, and on the globe in general. I pray almighty that his Soul rest in peace in the heaven and provide enough strength to all his family members and others who were connected with him throughout his most active life to bear this un surmountable loss.

Eradicating hunger requires a holistic approach

M.S. Swaminathan

A Visionary Guru of My Lifetime

Dr. Vijai Pal Singh

As one of the students of Prof. M.S. Swaminathan, I had the great privilege to be his student, lab member, observing and interacting with him in close quarters. Prof. M.S. Swaminathan is a great visionary and an exceptional human being who inspired me and the generations of all the stakeholders including researchers, teachers, students, farmers, administrators and all those who are not only associated with agricultural research and development but also in social equity and equality for a sustainable development across the globe.

I am out of superlatives to express the delight of sharing some of my fond evergreen memories with Professor sir.

A. Atomic Energy Lab – Radiating Energy with Budding Researchers

A teacher par excellence

Prof. M.S. Swaminathan had combined excellence with creativity, intelligence, courage and brimming with energy. The annex of the IARI Auditorium (now Dr. B.P. Pal Auditorium) with four rooms was the Atomic Energy lab of Prof. M.S. Swaminathan. The core research in the lab during the time revolved around radiation genetics. One of the rooms was lecture theatre, while the other room was his office, where he had shared the space with his personal secretary, Mr. P.L. Guglani. He taught a course on "Radiation Genetics" in the second trimester, which spanned from November to January. The class would start sharp at 8.15 AM and last for an hour. He would reach the office sharply by 8.00 AM, glance through his notes and start the classes at 8:15 AM. His classes were always full in attendance with students. Sometimes, we also had the opportunity to attend his classes.

Believed in teamwork and inspired the team

I got the opportunity to join his lab on 30.03.1968 with Dr. E.A. Siddiq as a Research Assistant. Professor would make sure that all the staff who worked with him were effective as a team member with defined roles, learnt with him and also had a defined career progression path. For all the research assistants and senior research fellows, who could not secure admission to the Post

Prof. M.S. Swaminathan with the rice team during one of his visits to IARI in 2003

Graduate School, IARI, he devised a provision, wherein based on seniority, the staff were registered with other universities after completion of their probation period. This ensured equity and equal opportunity for all the members of his team to improve their career. I also had the privilege of working for my doctoral research under him by registering at the Agra University, Agra in 1972. He had the knack of inspiring each and everyone in the team. The case in point is my doctoral research work, which was recognized with the Jawaharlal Nehru Award for Outstanding Doctoral Thesis Research in Agricultural and Allied Sciences by the Indian council of Agricultural Research, New Delhi.

B. Interacting with the Legend in Close Quarters

Commitment to the Core

Prof. M.S. Swaminathan joined as an Assistant cytogeneticist in 1954 at IARI, New Delhi. Although, he wanted to continue his research on rice, Dr. B.P. Pal, the then Director, IARI assigned him to work on wheat improvement and rest is history. He went on to collaborate with researchers of International repute including, Dr. Norman E. Borlaug, from CIMMYT, Mexico to bring in a revolution in wheat production. Popularly known as the "Green revolution", Dr. Norman E. Borlaug was recognized for his contribution with the Nobel Peace prize, while Prof. M.S. Swaminathan was recognized with the first world food prize for making India a food secure nation.

Bringing home, a center for intellectuals to exchange idea – the genesis of India International Centre, New Delhi

In a meeting held in Japan, Late Shri C.D. Deshmukh was representing India at the International Centre in Japan. Taking cognizance of the need for such a

facility in India, Prof. M.S. Swaminathan advised Shri C.D. Deshmukh to make an official request for creation of such a facility in India, which got approved and the India International Centre (IIC) was established at the Max Mueller Marg, New Delhi, where statesmen, diplomats, policymakers, intellectuals, scientists, jurists, writers, artists and members of civil society meet to exchange new ideas and knowledge in the spirit of international cooperation. The trees besides the Guest House of India International Centre (IIC), Lodhi road stand as a testament for the contribution made from Professor and IARI as they were initially raised at IARI under protected condition and then planted there. He was conferred the membership of IIC, where he would exchange of ideas on agricultural research and development with the intellectuals both national as well as international.

Strengthening international cooperation at IRRI

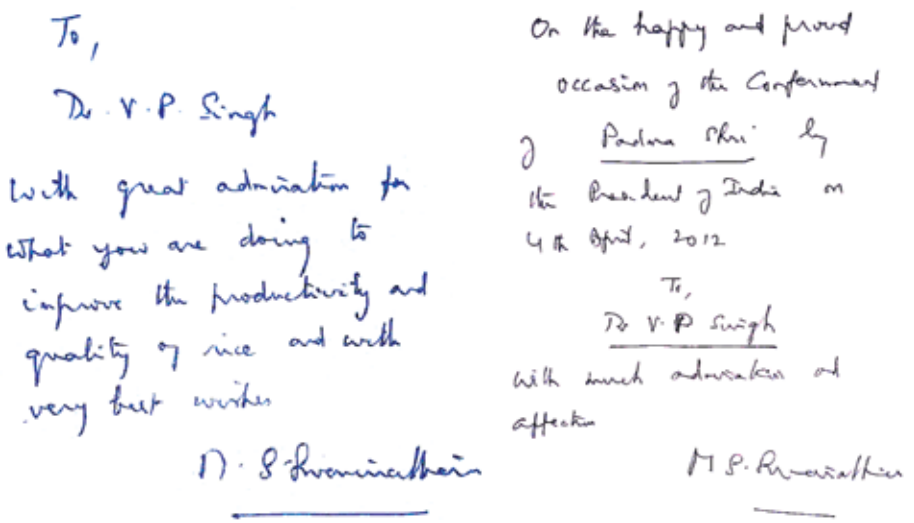
As the Director General of the International Rice Research Institute, Manila, Philippines, he invited the King of Japan and the President of the Philippines. He impressed upon them the transformative research carried out by IRRI in improving and sustaining rice production, as well as improving the life of rice farmers, as a result of which substantial donations were made by not only both these countries but also by other donors for strengthening the gene bank, laboratories, and international cooperation at IRRI. No doubt that his tenure as DG from 1982 to 1988 is recognized as the golden era of the IRRI.

C. An Eternal Source of Inspiration

Laying the foundation for Basmati rice revolution

Professor said "*You are Basmati rice farmer. You should develop high yielding high quality Basmati rice varieties*", which instilled the confidence and inspired the research on Basmati rice improvement at IARI. These words would be ringing in my thought process and work, and kept reminding me and the Basmati rice team through his regular visits to our rice fields, making us devote more time and efforts. The Basmati rice varieties, Pusa Basmati 1, Pusa Basmati 1121 and Pusa Basmati 6 developed during my active service at IARI and its impact in spurring the Basmati rice revolution is testament for his inspiration and visionary approach.

Another instance to remember in relation to this is the interaction with him at his quarters at 81, Shahjahan Marg, New Delhi and my thesis viva-voce exam was conducted at his residence. He was my research guide and Dr. S.P. Singh from Agra University, Agra was my external guide. After the viva-voce was over, he offered me Post-doctoral Fellowship at IRRI, which I politely declined by saying that "*Sir, first I have to develop a Basmati variety*", to which he remarked "*Choice is yours*".


To,

Dr. V.P. Singh

With great admiration for what you are doing to improve the productivity and quality of rice and with very best wishes

M.S. Swaminathan

On the happy and proud occasion of the Conferment of Padma Shri by the President of India on 4th April, 2012

To,

Dr V.P Singh

With much admiration and affection

M.S. Swaminathan

Handwritten appreciation note from Prof. M.S. Swaminathan is a testimony for his inspirational words

Grounded to the fields

In the outskirts of Delhi, Nangloi (now a township) there was an extension unit of IARI and the Agricultural farm of the Delhi Government. He arranged for getting fields for growing the national rice trials and visited the fields very often. In 1972, on a Sunday morning he took me to the village, Samaypur Bawana near Delhi, where IARI had grown a promising rice genotype. By the time, we reached, the crop was already harvested and was left in the field for drying. He got into the field, bent down and lifted the small bundles from various places to assess the grain straw ratio.

Connected with simplicity and spontaneity

Although, Prof. M.S. Swaminathan was occupying high administrative positions at both ICAR and Ministries in Government of India, he was always inspiring with his simplicity, connect to people through all wakes of life and the spontaneity in making timely and effective decisions. I had my own awe-inspiring moments, two of which I fondly remember.

In the early 1982, when he was Secretary (DARE) and DG (ICAR), we went to invite Prof. M.S. Swaminathan for a family dinner and my wife requested to suggest the place and time. Madam, Mrs. Swaminathan spontaneously replied that they would be happy to come to our residence. At that time, we were residing in the Type 3 accommodation, Flat No. 500 at Krishikunj. The day, 23rd March, 1982 is still etched in our memory. It was drizzling in the evening and I received them personally and during the discussion after the dinner, Madam said that Professor was invited as chief guest for the convocation at Delhi University and the students were on strike. Professor in his usual style

responded with a gentle smile and before, he reached for the convocation, the students strike was called off.

Once, I went to meet at his Vasant Vihar residence in New Delhi. As I wanted to make sure to see him before office hours, I reached early. After a short discussion, when we came out, Dr. A.M. Michael, the Director, IARI; Dr. S.N. Singh, Joint Director (Extension), IARI and Prof. V.L. Chopra, Project Director of the NRC on Biotechnology reached there to take him for a field visit to K.V.K., Shikohpur, near Gurgaon. He asked "*V.P. Singh, you also come with us*" and Prof. V.L. Chopra was kind to accommodate me in the vehicle with them.

On another occasion, he was on tour to Punjab. A progressive farmer invited Professor and some academicians and extension scientists for breakfast at his residence in Amritsar. Our family was in Beas to attend a personal programme to Dear Baba Jaimal Singh, the Head Quarter of Radha Soami Satsang, Beas. I also joined the breakfast at the behest of the farmer. After the breakfast, he was to address the staff and students of the Khalsa College, Amritsar. When he was boarding the car, he was kind enough to take me along with him to programme.

I also got the privilege of being invited to join his 80th Birthday celebrations at MSSRF, Chennai. The celebration was grand marked by an international conference for three-days, for which eminent researchers from across the world were in attendance. Additionally, the Rice Industry also came forward to celebrate his 80th Birthday at IARI, New Delhi. The one-day celebration was marked with the presentations from leading rice exporters and the address by Prof. M.S. Swaminathan. The event was a grand success.

Developing offseason facility for rice

Due to the weather in Delhi, only one crop of rice can be taken up during *Kharif* season. With a foresight to improve the breeding cycle by reducing the time taken for development of varieties, he arranged for an off-season crop at Paddy Research Station, Aduthurai in 1968 from December to April, IARI started raising the offseason nursery of rice. In those days, the farmers did not grow any rice during December to April. Even the lands of the Research Station were also left fallow. Therefore, there used to be severe problem of stray animals in the day and rats in the night in our very valuable material. In order make it operational, he got the electric fencing done for controlling the rat menace in the entire two-acre block, due to which we could succeed in taking up two crops per year, as against only one crop per year to reduce the time taken for fixation of materials and development of rice varieties. He will make it a point to visit Aduthurai along with other program scheduled in Tamil Nadu especially during the flowering time. Even after becoming Secretary (DARE) and DG (ICAR), he used to visit the rice experiments to keep up with the advances in rice research. I used to go for nursery sowing, transplanting and flowering to harvest time from December to April every year along with other colleagues. Once seeing

my dress and interacting with the staff of Paddy Research Station said "*You have become Aduthurai man*". On every visit, he will make sure that we had enough resources to take care of ourselves during the stay.

Care for all the staff

As Secretary, DARE & DG, ICAR, once he had sent a proposal for the approval of the finance. The file was returned with a remark "*Can't it wait for some time*", to which he responded in his witty style, with the remark, "*Everything can wait except death*" and sent back the file, which was approved immediately. He was the most popular Director General at the International Rice Research Institute, Philippines. The staff used to call him "*TATAY*", which meant "*father*" in their native language. Whenever there was currency depreciation due to exchange rates, the pay of native staff was also increased so that pay parity was ensured for them in Peso, the Philippines currency.

D. His Teachings

When I was a post graduate student at Raja Mahendra Pratap Degree College, Gurkul Narsan, Saharanpur (Now Haridwar) in the sixties, there used to be a very popular magazine, "CAREERS & COURSES". I read an article by him, "*WHERE THERE IS A WILL THERE AWAY*" emphasizing the importance of will power. He always attended to the farmers and made them feel at home, learnt from their experiences and helped them in all possible ways. He wanted "Pusa" name to get recognized at the global market and initiated the rice improvement programme at IARI, through basic research, on wild rice work was already being done by Dr. S.V.S. Shastry and team. He helped, supported and guided us till his last breath. When he was unable to travel by Air, Dr. A.K. Singh, the present Director, ICAR-IARI, New Delhi was regularly meeting and updating him in Chennai, which he used to appreciate. He taught us how to make a team. He knew that Basmati is a product that have to be managed differently, and advised us to involve and reach the rice industry.

E. Full of Stamina

He was very punctual with his time. He was an early riser and never took rest during the day time. During his rice field visits, which will vary from one to two hours, he will never even take water. Always without cap or umbrella. After his taking over a DG, ICAR, he was given a separate room in the third floor in Nuclear Research Lab. Generally, he preferred to go upstairs by stair and will use the lift only, when accompanied by important visitors. His speed of reading and writing was unparalleled. I requested his help in writing the introduction of my Ph.D. Thesis in 1976. He said I am going to Rome and you will get the day I come back. This was hand written without any overwriting. Still maintained in original.

On 11th February, 2014 he visited the KRBL Rice mill in Ghaziabad, on their invitation. Even at that age, he visited the entire mill going upstairs many time without any support or help.

F. Free Flow of Germplasm

During the partition, three and a half Doabas, the naturally levelled, with water round the year from the Himalayas and the Agricultural Farm, Kalashah Kaku (which was the main research centre) along with germplasm went to Pakistan. The Eastern Punjab which one and half Doabas remained in India. Prof. M.S. Swaminathan arranged for a set of world Aromatic Rice Germplasm to IARI in 1972 and 1986. This also included all the aromatic rice from all across the world. Again in 1981, the Chinese CMS with B lines were also received. The idea was to develop A, B and R lines in *indica* back ground, as they were not useful in *japonica*.

Integrated pest management can reduce reliance on harmful pesticides

M.S. Swaminathan

Prof. M.S. Swaminathan: A Daughter's Reflections

Dr. Soumya Swaminathan

My earliest memories from my childhood in the IARI (Indian Agricultural Research institute) is that our house was always full of students. There was never a time when the house was empty. My father would leave very early in the morning on his bicycle, visiting the experimental fields, on his way to the Genetics department for his morning class. In the evening after he came back home, there would usually be a few students who were waiting to discuss their research work or Ph.D. theses. Some of the earliest students I remember are Dr. A.T. Natarajan, Dr. A.T. Ganesan, Dr. P.C. Kesavan, Dr. Suman Sahai, Dr. Rohini and Dr. R.D. Iyer and many others. There were also many foreign students in IARI, and my mother was like a foster parent to them. They would come home if they had any problems and she would always help them. On festivals like Holi, my sisters and I would hide, terrified, as huge groups of students would come with colour to play Holi! Similarly, for Diwali, Christmas and all festivals, we had an open house. This is why we continue to think of IARI as our extended family.

While my father was engaged in adopting, modifying and testing the technologies that led to the green revolution, with fellow scientists and farmers in Punjab and Haryana, my mother was experimenting with innovative and affordable methods of providing early childhood education and care. She was one of the early educationists to recognize and highlight the importance of both nutrition and cognitive stimulation in the overall development of a young child. She set up the Nehru Experimental centre in IARI, which served as a creche and preschool for children of IARI staff (at all levels) and students. She later co-founded Mobile Creches which served the needs of children of migrant (mostly construction)

Prof. MSS at his residence Chennai

Prof. MSS - Family

workers. My sisters and I got an opportunity to travel with my parents to their places of work and learnt a great deal about the lives of people engaged in different occupations and from different backgrounds.

My father was completely devoted to the cause of agriculture and, more importantly to the cause of farmers welfare and the welfare of the marginalized communities, including smallholder farmers as well as artisanal fishermen and tribals. He took a holistic view of human wellbeing and highlighted the different aspects of food and nutrition security – not just availability, but access, affordability and absorption (determined by gut health, which in turn is impacted by access to clean drinking water and safe sanitation). It always saddened him that the people who grow food for us are themselves not living very healthy or prosperous lives. He was one of the first people to talk about hidden hunger - that micronutrient deficiency is as important as macronutrient deficiency was not well recognized. The fact that we still have such a high prevalence of anemia in India, especially among women and adolescent girls. implies that a lot of people are not getting a balanced, nutritious diet that provides all needed micronutrients in the required quantities. Certainly, deterioration of soil health (which affects the nutritional content of crops) and other environmental factors also play a role, and this is still a challenge we have to surmount.

My father had the ability to visualize a problem, analyze the various components and determinants and their interplay and come up with solutions in a holistic way – what is called a systems approach to problem solving. Unlike most

scientists who specialize in a particular area of work and become experts in that area, he was able to connect the micro with the broader ecosystem, including the political, social, and cultural environment. This special gift enabled him to visualize the kind of policies and laws that our country needed to be self-reliant and to think through the implementation pathways and the systems that would be needed to deliver services to the public. He was the architect of both the Krishi Vigyan Kendras and the Indian agricultural research service – both institutional mechanisms to strengthen agricultural research and enable technology transfer to farmers all over the country. Today, we probably need to re-assess the performance of the KVKs and equip them with the tools and resources they need to meet the increasingly high expectations from men and women farmers, and also consider increasing their numbers to deal with the negative impact of climate change across different agro-ecologies in the country.

Interacting with Women Farmers, Koraput, May 2008

At the global level, my father played an important role in many organizations both within the UN system like FAO, and the UN environmental program, as well as IUCN, WWF, the World Food Prize foundation, the Hunger Project and the Ford foundation. He was an integral part of global negotiations on the biodiversity convention, protection of plant varieties and the rights of breeders and farmers. He foresaw the severe impact of climate change on food systems and spoke about the need for gene and seed banks at various levels. His ideas and thinking helped shape many of the global development strategies, conventions and goals that are in place today and he constantly reminded everyone that ultimately, without ensuring farmers welfare, agriculture would not flourish, and food and nutrition security attained.

Prof. MSS at Biovillage Community, Pondicherry

My father's commitment to science meant that he was willing to be challenged. He believed that the way to progress was through debate and

discussion, being open to new ideas and to changing your mind if the evidence was clear. He also said when he chaired meetings that if we cannot agree, we must agree to disagree, and move on. I think that's one of the lessons that I learned from him that you have to see all sides of the picture because, if you look at a problem very narrowly, you may miss some of the implications of a policy change or a programmatic change. Later, at the MSSRF he promoted a consultative approach to policy making as well as participatory research with communities. Realizing that food security involves not only 'food availability' but also "access to food" (i.e. a function of livelihoods), he integrated eco-agriculture with rural livelihoods. Setting up of the MSSRF in Chennai was the fulfilment of a promise he had made to the Nobel Laureate Sir C.V. Raman, who had stayed in our bungalow in the IARI in 1967. The financial resources came from several of the national and international awards he had won, including the 'World Food Prize" in 1987. He believed that the world could meet the great sustainability challenges ahead, but only through tremendous will, scientific knowledge, ethical commitment and openness to partnerships and cooperation.

NCF-Meeting with farmers in Vidarbha

His idea of "evergreen revolution" has received enormous support and global acclamation from several top scientists, intellectuals, and policy makers globally. When he set up the foundation, he insisted that all the programs needed to be Pro Poor, Pro women and pro nature. A lot of the work, including the coastal areas research focusing on mangroves was anticipatory research, which was to anticipate the problems of the future and find solutions. He was already talking about climate change in the late 60s and early 70s when not many people were thinking about climate change and its impact on agriculture or on food systems. In his later years, he had a lot

NCF-Punjab Rampuraphul - Meeting, November 2005

of hope in the younger generation and he especially liked to meet young people and mentor and motivate them because he knew the problems were going to be solved by that generation. He was very generous with his time and ideas, and never got angry even when people exploited his goodness.

Despite all the negative news and violence in the world, he remained an optimist at heart and a very happy person. The way he lived his life has many lessons for all of us, over and above all of the scientific work that he did and the institutions he built. He got so many honors and awards from so many parts of the world, but he was driven more from seeing the results of the work on the ground and witnessing a positive change in the lives of small farmers, artisanal fishers or tribal communities. Needless to say, he would have been delighted that the country recognized him with the Bharat Ratna, but for him the next morning would have begun as usual thinking about the big global challenges still needing to be solved.

Access to clean water is a basic human right

M.S. Swaminathan

Prof. M.S. Swaminathan – A Doyen of Agriculture

My Interactions for Over Four Decades – Cherished Moments, a Valued Treasure

Dr. Renu Swarup

For every student of Agriculture and Genetics, it is a dream to meet and interact with the Father of Agriculture and Green Revolution, the greatest stalwart recognised and respected nationally and globally, Prof. M.S. Swaminathan. I recall that as a Ph.D. student, working on Forest Genetics at the Forest Research Institute, Dehradun under the guidance of Dr. M.L. Kapoor, I was selected to present my poster and Abstract at the XV International Congress of Genetics held in New Delhi in 1985. The thrill of participating in an International Conference was multiplied many fold when I was informed that Prof. M.S. Swaminathan would visit our posters. I still recall with great pleasure the first interaction of explaining my research synopsis and key findings and the appreciation and guidance received from Prof. Swaminathan. That exciting interaction made my day!!

Moving ahead I completed my Ph.D. and then went to do my Post Doctorate in Applied Genetics at John Innes Institute, Norwich, UK under a Commonwealth Fellowship. On completing my very productive and interesting term at the John Innes in Prof. Roy Davies Laboratory. I returned to India and was very fortunate to be selected as a Scientist at the Department of Biotechnology. Ministry of Science and Technology, Government of India in 1989. The decision to move from a laboratory research career to a Science Managers position was taken with the objective of serving the larger Science development Agenda, specially in the field of Biotechnology which was just emerging as the future sunrise sector. I joined my position on 30 Aug 1989, and the feel of a Ministry office in the corridors of the Central Government Office (CGO) Complex, was a total contrast from the Research Laboratories which I had been so accustomed to. As a young post doc just out of the laboratory, on the first day I was assigned the responsibility of Forestry, Biomass and Tissue culture programmes.

On the second day of my Government service ,I was called by the Adviser in charge, and informed that a meeting of the proposed Tissue culture pilot plants is being held the next day, on 1st Sep 1989 to be chaired by Prof. M.S. Swaminathan and attended by Tissue culture experts of the country. I was asked to take on full responsibility of the meeting and prepare the Record Notes. I was excited to be able to coordinate a meeting chaired by Prof. Swaminathan. It was a pleasure to be part of the discussion and there was so much of learning from Prof.

Prof. Swaminathan during the Women in Science Leadership session I had organised at the India International Science Festival held at Chennai in 2018

Swaminathan — the clarity of his vision on how tissue culture programmes in the country should be supported and how the technology can impact the forestry sector , the quick decision on which centres should be supported, and the clear focus on targets to be met for producing quality planting material. Being a great leader he heard everyone including junior officers like myself and appreciated everyone's point of view and then summarised the key decisions and actions to be taken. Before concluding a very focused and productive meeting, he had given us a road map for the future. Before leaving he asked me to make the Record notes and send him the draft for correction. I was struck by his humility and his special attention to minute details. I prepared the Record notes overnight just in case I miss out on any issue which was discussed (we did not have audio recording facilities in those days). Next morning I typed the minutes and sent them to him after my Adviser's approval. The first step of approval encouraged me since the Adviser did not make any changes, I was now waiting to see how I pass my first test -

Receiving a piece of good advice - each meeting and interaction with the Doyen was always such a learning

the document to be checked by Prof. Swaminathan for its factual correctness, accuracy and more importantly a true reflection of the key points discussed. In those days we had no email or courier and the only way to rush a letter was the Speed post of Postal Department. Despite his busy schedule Prof. Swaminathan checked the draft record notes as soon as they were received, made minor edits in his typical neat and precise handwriting, signed the document and promptly had it sent to me with a very encouraging letter, appreciating my effort for the well drafted notes. That experience of coordinating a meeting with Prof. Swaminathan as the Chair, the leadership qualities which I had the good fortune of being privy to from such close quarters and the opportunity of working so closely with a great stalwart, stayed with me through my career and was a great learning experience.

This was the start of many assignments I got the opportunity of working on under the guidance of Prof. Swaminathan .He Chaired the National Bioresource Development Board - a Cabinet approved programme which was the foundation for all Bioresource Development and sustainable utilisation initiatives across the country - from Medicinal plants, to Sericulture, to Forestry, Horticulture and Plantation crops and Minor Forest products. This was the initial step of our journey to a strong Bioeconomy. Prof. Swaminathan guided the Department in its initiatives on Biodiversity conservation and Resource management. Under his able leadership we set up two Tissue culture Pilot Plants for Forestry species, these were then scaled up to Micropropagation Technology Parks which focussed on technology development for many high value crops, forest trees, medicinal plants etc. At a time when public private partnership was still being debated and discussed, Prof. Swaminathan chartered a clear path for our Tissue culture and Bioresource programme involving all stakeholders - the academia, researchers, industry, farmers who played an important role in taking technology from the laboratory to the field . His message of "Reaching the unreached" was loud and clear and this guided us in all our programmes.

An honour receiving the Felicitation from Prof. Swaminathan, recognising my contribution as the Convenor of the Women in Science Session at the Indian Science Congress in January 1999, at the Pune session.

I also had the privilege of working very closely with him for a major UNDP-FAO programme - FARM — Farmer Centred Agriculture Resource Management which had 8 South East Asian countries participating and Government of India,

Department of Biotechnology was identified as the Nodal Agency for the Biotechnology and Biodiversity area. Prof. Swaminathan chaired the Steering group and the main implementing institute was MS Swaminathan Research Foundation. Dr. Manju Sharma, the then Secretary as the Chief Coordinator gave me the responsibility of the Associate Coordinator. Dr. RS Paroda and Dr. RB Singh were at that time leading this initiative from FAO, Bangkok and Rome. I was excited to be chosen for this very important initiative. The DBT Advisor, Dr. JR Arora, was the Head of the DBT Biotech Node. The five year programme gave me a huge opportunity to learn the nuances of international coordination and field level agriculture resource management technology development and deployment. Prof. Swaminathan as the Chair of the Steering Group and the Chairman of MSSRF guided us through out this programme. His deep involvement and personal attention to every aspect of the programme was very encouraging for a junior officer like me. He gave us a very clear message of how the technologies should address local societal challenges and develop science based solutions for different agroclimatic regions. The focus on gender and youth was a key point. The guidance I got from Prof. Swaminathan gave me so much confidence to scale up a number of our Societal initiatives and develop special programmes for Women. Through this programme we launched the major Biovillage programme which even today is the basis of our Rural Technology clusters and also the recently started Biotech Kisan Hubs.

I recall how one day when I had gone to meet Prof. Swaminathan to discuss how we need to engage more with rural communities to take up new emerging technologies for sustainable utilisation of Bioresources, his immediate advise was that we should spread this message to the youth and for that starting a special programme for Schools across regions in which the involvement of students is

Prof. Swaminathan with the Participants from eight South East Asian Countries during the Workshop organised under the FAO -UNDP FARM Project in 1996. His personal interaction with each participant was the key aspect of this workshop

important. That was the start of the "DNA Club" initiative — the Department of Biotechnology's Natural Resource Awareness Club. This was launched across the country ,at school level engaging students from Class 6-9. Special Summer Vacation Training Programmes were initiated. Over the next few years we trained and engaged with over 1,00,000 students.

I was very fortunate to have continuous guidance and support from Prof. Swaminathan through out my career. A very exciting experience was when I was working with Dr. Manju Sharma, the then Secretary DBT who was the President of the Indian Science Congress in 1998 and was responsible for coordinating the Science Congress in Chennai. We had a number of sessions which were chaired by Prof. Swaminathan and of special interest was the Women in Science session. Thereafter I was appointed as the Coordinator for the Women in Science session for next two Science Congress under the presidency of Dr. Paroda at New Delhi and Dr. Mashelkar at Pune. Prof. Swaminathan as always kindly accepted my invitation to inaugurate the sessions and deliver his motivational talk to all young women and girl students who participated. The interactions which Prof. Swaminathan had with the children in the Children's Science Congress were a treat to observe and there was a huge learning on how to engage with the budding scientists, how to motivate them. After each interaction it was important to imbibe those special qualities and internalise them. Even today the learnings and the message from each interaction with Prof. Swaminathan rings loud and clear.

A pat from Prof. Swaminathan was always the biggest award I received. He had such encouraging words to appreciate the activities and initiatives which I launched.

With the advise, guidance and support of Prof. Swaminathan, in the Department of Biotechnology, we scaled our Bioresource initiatives and developed a Bioeconomy Road map and strategy. The whole area of technology driven, women led enterprises was given a special impetus under his leadership. The First Women Biotech Park was established in the Golden jubilee year of our country's Independence and was named Golden Jubilee Biotech Park for Women.

Prof. Swaminathan was the key architect of this and because of his excellent working relations with the State Govt, the park was established as a Tripartite arrangement between Union Government (Department of Biotechnology), State Govt of Tamil Nadu and MSSRF. Today it is recognised as one of the most successful Women Entrepreneurs park and is a model for many others. Many other initiatives under his guidance like Genetic resource gardens, Bioresource hubs were set up which were not just for promoting technology deployment at field level but were also important for women empowerment and women health and nutrition.

I fondly recall his words of encouragement to me for each new initiative launched and each success I had in my career growth. When I was appointed as Secretary to Government of India, in 2018 the blessings and good wishes received from Prof. Swaminathan were special. My visit to Chennai for any official activity was not complete till I visited the Foundation and met Prof. Swaminathan. He was gracious enough to always find time and each meeting was a new learning. My last visit before COVID stopped our travel for a considerable amount of time, was to Chennai on 4th March 2020. I had visited CLRI for their Foundation Day and had expressed my desire to meet Prof. Swaminathan. As always he conveyed his pleasure and I met him in his office at the Foundation - the last detailed face to face conversation had with him. He expressed his pleasure on many successful initiatives specially the Genetic Gardens and Biotech Kisan Hubs. However he also expressed his concern on the need to accelerate policies and processes to allow new technology scale up and deployment specially gene editing.

After my superannuation, when Dr. Soumya Swaminathan after taking over as the Chair of The Foundation, invited me to join the MSSRF Board of Trustees, I accepted it immediately. It is a pleasure to be able to contribute to the vision and road map laid out by Prof. Swaminathan.

My last meeting with Prof. Swaminathan was on 5 th April 2023, when I was at Chennai for the MSSRF Board meeting. As always I expressed my desire to meet with him. Being a little unwell he was not coming to the Foundation but was happy to see me at his residence. Despite not being in his best of health,

A Picture most cherished-my last picture with Prof. Swaminathan at his Office at MSSRF Chennai on 4th March 2020. Thereafter I met him for the last time on 4 April 2023 at his residence

he spent good time with me, conveyed his pleasure that I had joined the Board and enquired about many initiatives which were launched. In his typical hospitable manner he would not allow me to leave till I was served coffee and snacks. I took his blessings before leaving and he said "you must visit me again soon". Alas this was one instruction of his which I could not comply with, I could not meet him again. The legend departed on 28th September 2023 leaving a void for all of us which is not possible to fill.

I, and many others like me who have had the good fortune of getting his teachings, guidance, support, affection and blessings over years, can only say — The legend will always live and stay with us — as cherished moments and a valued treasure.

Gender equality is essential for a just and inclusive society

M.S. Swaminathan

My Association with Bharat Ratna Prof. M.S. Swaminathan

Dr. Pramod Tandon

I am deeply honoured to have received a letter from Dr. Himanshu Pathak, President of the National Academy of Agricultural Sciences, inviting me to write about my association with Bharat Ratna Prof. Prof. M.S. Swaminathan. At the outset, I would like to pay my rich tributes to Prof. M.S. Swaminathan, one of the greatest sons of India. He was a towering personality, globally renowned for his quest to end hunger in the world.

I first met Prof. Swaminathan as a Ph.D. student at Jodhpur University in 1974. As the Director General of ICAR, he visited the Central Arid Zone Research Institute. Our University invited Prof. Swaminathan to deliver a talk. Following the lecture, the Vice-Chancellor offered him an honorarium, which he politely requested to be deposited into the University's fund for poor students. This act of selflessness deeply resonated with me, and Prof. Swaminathan became a role model for me from that day.

Many years later, in 1988, I had the opportunity to meet Prof. Swaminathan again at the Department of Biotechnology (DBT), New Delhi. At the Task Force meeting headed by Dr. T.N. Khoshoo, he shared his plans to utilize modern science for sustainable agricultural and rural development through the M.S. Swaminathan Research Foundation. DBT generously supported his efforts for this noble cause.

Prof. Swaminathan frequently travelled to the North-Eastern Region, where I was serving at the North-Eastern Hill University (NEHU), Shillong for 38 years beginning in 1977. He graciously invited me to join him for breakfast or dinner whenever he visited Shillong, and each encounter was a valuable learning experience.

I had the privilege of working with him on the Scientific Advisory Committee of DBT's Institute of Bioresource & Sustainable Development in Imphal, Manipur, which afforded me the opportunity to travel with him on many occasions. I recall one incident where our flight was delayed, and despite his age, I witnessed Prof. Swaminathan rushing to catch a connecting flight. I intervened to ensure he wasn't rushed unnecessarily.

In 2009, the North-Eastern Hill University hosted the 96th Session of the Indian Science Congress. As Vice-Chancellor of NEHU, I requested Prof.

Swaminathan to grace the occasion. Despite being due for treatment at Arya Vaidya Sala, Kottakkal, he adjusted his schedule to accommodate our request. He delivered a Public Lecture on Agriculture and Biodiversity in the North East. Prof. Swaminathan's long association with the North-East region was evident in his words of encouragement and support. He expressed his confidence in our ability to make the Science Congress a success and commended our efforts in hosting such a significant event. His dedication to the region's agricultural development and his vision for a hunger-free India inspired us all.

In 2009, upon my receiving the Padma Shri award, Prof. Swaminathan extended his heartfelt congratulations, acknowledging my contributions to the country. His words of encouragement and appreciation were deeply meaningful to me and my family.

Our association continued when I joined the National Advisory Council to the Prime Minister (NAC) in 2010. As we worked on the National Food Security Bill, Prof. Swaminathan emphasized the urgency of addressing hunger and enlarging our food basket by including nutria-millets. He articulated the components of food security and advocated for universal entitlements to ensure access to food for all.

Despite his numerous contributions and recommendations, Prof. Swaminathan at times expressed frustration at the lack of action by the government. He emphasized the importance of implementing policies rather than engaging in endless analysis.

As Chairman of the Steering Committee for the UN Committee on Food Security and the UN Committee on Millennium Development Goals (MDG 1 relating to hunger and poverty), Prof. Swaminathan highlighted the global significance of India's Food Security Bill. He remained committed to the cause of food security, emphasizing the essential role of agricultural research in achieving these goals. On the enactment of the Food Security Bill, Prof. Swaminathan said, "I hope 2011 will see the fulfilment of Mahatma Gandhi's vision of a hunger free India, which he expressed so movingly at Naokhali in 1946". He always credited the dedicated efforts of agricultural scientists, and farm women and men for India's transformation from a food-deficit nation to a food-exporting country.

My last meeting with Prof. Swaminathan took place at Vigyan Bhawan in February 2016, during the celebration of 30 years of the Department of Biotechnology, Ministry of Science & Technology. It was an honour to shake hands with him and receive his blessings on that day.

Traditional knowledge should be valued and preserved

M.S. Swaminathan

Remembering Prof. M.S. Swaminathan – A Renowned Agricultural Scientist and An Inspiring Leader

Prof. Rajeev K. Varshney

Background

Born on August 7, 1925, in Kumbakonam, Tamil Nadu, India, Prof. Monkombu Sambasivan Swaminathan has been a towering figure in the field of agricultural science, propelling India's Green Revolution. Having Prof. Swaminathan as my inspiration during my early career (comprising my Ph.D. in India and post-doc in Germany) and later as a mentor and guide since joining ICRISAT in 2005 has been both a privilege and instrumental for my research journey. His humility, warmth, and fervour for agriculture were palpable, as he maintained a deep connection to the people and the soil, recognizing that authentic agricultural progress must be rooted in the well-being of farmers and the sustainability of the environment. I learned the importance of interdisciplinary research and collaboration from him, as he consistently emphasized that addressing the challenges of agriculture required a holistic approach. This approach became a cornerstone of my 17-year tenure at ICRISAT (2005-2022) and continues to be a guiding principle at Murdoch University since 2022.

Guiding the Next Generation in Agriculture

My first encounter with Prof. Swaminathan was during my early days as a Ph.D. student at a conference organized by him and the late Prof. Lalji Singh at MSSRF in 1999 (Figure 1a). It was during this conference that I received the Best Poster Award, a moment that remains one of the most joyous in my life. Our paths crossed again in 2000 at the 2nd International Crop Science Congress in Hamburg, Germany. While I was in Germany from 2001 to 2005, I stayed connected with Prof. Swaminathan through letters and emails. However, after joining ICRISAT in 2005, I had the privilege of more frequent interactions with him (Figure 1b). We met at various locations, including ICRISAT (Figure 1c), MSSRF, and other venues in India and abroad. I invited him to deliver keynote speeches at several international conferences, and I attended many meetings organized by him at MSSRF in Chennai. Prof. Swaminathan's life was truly remarkable, characterized by dedication, innovation, and an immense love for the land. One memorable interaction occurred during an FAO meeting in Bangkok in 2016 (Figure 1d). Despite being in a wheelchair and facing mobility challenges, he participated as an invited expert. Expressing concern about his

extensive travel given his age, I suggested, "Sir, you have already contributed so much to international agriculture. Perhaps you shouldn't strain yourself by traveling so extensively". His response was swift: "Rajeev, interacting with young minds like yours at scientific meetings keeps me abreast of the latest advancements in agricultural science. That's what motivates and energizes me to travel at this age". He added, "I can't imagine just sitting in my office when I believe I can still contribute to society".

Unveiling the Genome of Prof. M.S. Swaminathan

Engaged in genome sequencing since 2007, I have always been intrigued by the secret behind Prof. Swaminathan's boundless energy, enthusiasm, and intelligence. During his visit to our Genomics Centre at ICRISAT, we asked if he would be willing to provide a blood sample. With the collaboration of CSIR-Centre for Cellular & Molecular Biology (India) and BGI-Shenzhen (China), we isolated his DNA, sequenced, and analyzed his genome. Presenting his genome sequence on a pen drive to Prof. Swaminathan on his 90th birthday at MSSRF in 2015 was a significant event witnessed by dignitaries, including the then Governor of Tamil Nadu, Hon'ble K. Rosaiah, the then Director General of ICRISAT, Dr. David Bergvinson, Prof. Bruce Alberts (author of 'Molecular Biology of the Cell'), and many others (Figure 1e). Prof. Swaminathan, after posing numerous questions about his genome, reflected, "When I was working on my Ph.D., I began

Reminiscing past cherished interactions with Prof. M.S. Swaminathan. (a) My first encounter with Prof. Swaminathan at a conference organized by him and the late Prof. Lalji Singh at MSSRF in 1999. (b) Providing insights into the workflow of next-generation sequencing to Prof. Swaminathan in the laboratory at ICRISAT in 2015. (c) Alongside Prof. Swaminathan on the stage at a conference I hosted at ICRISAT in 2015. (d) Engaging in a conversation with Prof. Swaminathan at an FAO meeting in Bangkok (Thailand) in 2016. (e) Presenting the genome sequence of Prof. Swaminathan on a USB drive during Prof. Swaminathan's 90th birthday celebration at MSSRF, Chennai (India) in 2015, in the presence of numerous dignitaries.

to understand the double helical structure of DNA. But I never imagined I would one day hold the fully decoded sequence of my own genome in my hands". Such moments and interactions have served as a beacon of inspiration for countless young minds in agricultural sciences, both in India and internationally.

A Journey through Awards, Achievements in Agricultural Science and Beyond

Prof. Swaminathan wasn't merely a towering figure in agricultural science; to me, he embodied a true hero. His distinguished career adorned with numerous awards and accolades, such as the Shanti Swarup Bhatnagar Award, the Ramon Magsaysay Award, the Albert Einstein World Science Award, Fellow of The Royal Society (FRS), UNESCO Gandhi Gold Medal, Padma Shri, Padma Bhushan, Padma Vibhushan, and the World Food Prize, left an indelible mark. It is an honour to be among the few Indian agricultural scientists, alongside Prof. BP Pal and Prof. Gurdev Khush, treading in his footsteps to receive both the Shanti Swarup Bhatnagar Award and FRS. A moment of immense pride occurred when, after sharing my election to the FRS on May 10, 2023, with Prof. Swaminathan, I received his warm congratulatory message the very next day. His words, "I am very happy to note that you have been elected as a Fellow of the Royal Society. Kindly accept my congratulations and very best wishes on your well-deserved accomplishment. A Fellow is someone who makes an 'original contribution'. I wish you good health and much happiness", remain my cherished final communication with him. During my induction as an FRS at The Royal Society in July 2023, I encountered the esteemed 363-year-old Royal Society Charter, bearing the signatures of all its Fellows. The first signature I sought was Prof. Swaminathan's, dated 1973. Discovering and beholding his signature filled me with elation, as if I was floating on cloud nine.

Prof. Swaminathan's humility and warmth, coupled with his unbridled passion for agriculture, made every interaction enriching. He was a mentor who listened intently to young scientists, nurturing their ideas, and fostering a spirit of innovation. His advocacy for interdisciplinary research and collaboration left an indelible mark on me, shaping my approach to science and research. Prof. Swaminathan's legacy is not just in his monumental contributions to India's agriculture but in the hearts and minds of those he inspired, guiding us towards a future where sustainable and innovative agricultural practices prevail. As we reflect on the life and lasting impact of Prof. Swaminathan, let us uphold the torch he lit. In a world facing ongoing struggles with food security and environmental sustainability, his lessons stand as an enduring source of inspiration. Inspired by his exemplary leadership, we aspire to walk in his path, extend his legacy, and actively contribute to the advancement and prosperity of agriculture. Prof. Swaminathan's enduring influence continues to motivate researchers and advocates to address the urgent challenges spanning from climate change to the promotion of sustainable agriculture.

Father of Green Revolution and World Food Prize Laureate

Dr. Surinder Kumar Vasal

I feel gratified writing this brief note expressing my deep appreciation and gratitude to Late Prof. M.S. Swaminathan, who was conferred Bharat Ratna recently by President of India Droupadi Murmu. I met Dr. Swaminahan for the first time in early sixties when I visited IARI as a trainee in All India Coordinated Maize Program and a few years later obtained my Ph.D. degree in genetic and plant breeding in 1966. I attended course on Cytogenetic which was delivered by him and indeed he was also on advisory committee for my thesis project. Prof. Swaminathan had a brilliant academic and professional career and held several important key positions in the division of genetic at IARI. For almost a decade he worked as cytogenetist. During this period he was involved in teaching and guiding students in their assigned research projects. He also conducted basic research in rice and wheat on various aspects relating to cytology, ionizing radiation, radiation sensitivity, mutation breeding and polyploidy. He became divisional head sometimes in mid-sixties and collaborated intensively with Dr. Norman Borlaug in testing and evaluating new accessions of wheat from Mexico that had good standabilty combining high yield potential and very responsive to chemical fertilizers. Since nation was experiencing food shortages, bulk quantities of promising ones were procured and distributed in Punjab, Haryana and U.P. with excellent results and good acceptance by the farmers. Fast spread of these HYVs was phenomenal that led to food sufficiency and Green Revolution. Prof. Swaminathan together with his team of scientists was the driving force behind this revolution. Equally important was the role of Dr. Borlaug for which he got Nobel Peace Prize in 1970. Enhanced production of rice varieties followed the same model. Enhanced production of wheat and rice thus made India from food deficit to self- reliant food nation. Following this exciting success story, Prof. Swaminathan was named as Director of IARI and subsequently Director General of Indian Council of Agricultural Research (ICAR). In 1982 he was offered

position of DG at International Rice Research Institute (IRRI), headquartered in Philippines. He completed full term and strengthened further research initiatives including emphasis on hybrid development. During his tenure at IRRI, he was the first one to be named as World Food Prize Laureate by the WFP Foundation. Soon after completing his tenure at IRRI, he decided to use award money to establish his own foundation (MSSF) to take up the next challenge of Evergreen revolution which will emphasize not only production growth but also consider sustaining ecological parameters as well. During his professional career he also served as Chair of Farmers commission and was also nominated to parliament of India between 2007 thru 2013. Prof. Swaminathan is recipient of countless prestigious awards at national and international levels. Has Published widely in reputed scientific journals and has framed pro-farmers and pro-poor policies including women empowerment. Another area which he has always highlighted and expressed his concerns is to guard and not lose biodiversity. In the end I may say that demise of Prof. Swaminathan has certainly created a void that may be difficult to fill but the path and his life long experience wherever relevant we should follow to lead and secure a better future for all. Prof. Swaminathan, You will always be remembered for your significant contributions by agricultural scientists and farmers of this nation and we are all paying our respect and tributes to the great noble soul.

Poverty should never be a barrier to education

M.S. Swaminathan

[1]Chronological Account of Prof. M.S. Swaminathan's Journey (1925-2023)

1925	Born in an agricultural family in Kumbakonam (Tamil Nadu) on August 7, 1925
1940	Received his early education at the Catholic Little Flower High school in Kumbakonam and passed matriculation (1st class)
1944	Passed B.Sc. (Zoology) from University College, Trivandrum (1st class)
1947	Passed B.Sc. (Ag) from TNAU, Coimbatore (Recipient of Gold Medal for proficiency in studies)
1949	❖ Joined IARI, New Delhi in 1947 for two years diploma course and received IARI Associateship equivalent to Master's degree, under the guidance of Dr. Harbhajan Singh (Head, Plant Introduction Division). His dissertation was on "Non-tuber bearing Solanums". ❖ Qualified all-India Competitive Civil Services Examination conducted by the UPSC and got selected for the Indian Police Service ❖ Received UNESCO Research Fellowship to study Genetics in Netherlands, which changed his career path. He joined for his doctoral research work on potato at the Deptt. of Genetics, Netherlands Agricultural University, Wageningen
1950	Moved to Plant Breeding Institute, Cambridge University, School of Agriculture, Trumpington (UK)

Contd...

1952	Earned Ph.D. (Cantab) degree under the guidance of Prof. H.W. Howard on potatoes
1954	❖ Received Post-doctoral Research Associateship to work at the Deptt. of Genetics, University of Wisconsin, Madison, USA and stayed till January 1954 ❖ Joined as Assistant Botanist at Central Rice Research Institute, Cuttack on April 1954 ❖ Joined as Assistant Cytogeneticist at Indian Agricultural Research Institute (IARI), New Delhi (Botany Division) in October 1954
1956	Succeeded to the post of Cytogeneticist, IARI, New Delhi
1961	❖ Appointed as Head, Division of Botany, IARI, New Delhi. ❖ Received Shanti Swaroop Bhatnagar Award of CSIR for 1961
1965	Received Mendel Memorial Medal of the CZechoslovak Academy of Sciences in 1965
1966-72	Succeeded his mentor (Dr. B.P. Pal) and joined as Director (IARI) in July 1966 and served with distinction for nearly six years (1966-72)
1966	Awarded Birbal Sahni Memorial Medal of the Indian Botanical Society
1967	Received Padma Shri award by the President of India
1971	Awarded Ramon Magsasay Award for Community Leadership in August 1971
1972-79	Succeeded his mentor (Dr. B.P. Pal) and joined as the Director General (ICAR) and Secretary (DARE) and continued till March 1979
1972	Received Padma Bhushan award by the President of India

Contd...

1973	Instrumental in creating all India Agricultural Research Services (ARS) through Agricultural Scientists Recruitment Board (ASRB) to attract talented gene pool
1979-80	Joined as Principal Secretary, Ministry of Agriculture and Irrigation (GOI)
1979	Instrumental in establishing National Academy of Agricultural Research and Management (NAARM) to develop effective Science Managers and also All India Co-ordinated Research Project (AICRP)
1980-82	Appointed by the then Prime Minister to the Planning Commission and served the Commission from two years initially as Acting Deputy Chairman and later Member (Science and Agriculture)
1980	Chairman of UN Science Advisory Committee set up in 1980 to take up follow up action on the Vienna Plan of Action
1981-85	Independent Chairman of the FAO Council
1982-88	First Asian to occupy the Chair as the Director General of the International Rice Research Institute (IRRI), Manila, the Philippines
1983	Received Honorary Doctorate degree from University of Wisconsin, Madison, USA
1984-90	President, International Union for the Conservation of Nature and Natural Resources
1986	Received Albert Einstein World Science Award
1987	Honored with the inaugural first World Food Prize and the prize money used to establish M.S. Swaminathan Research Foundation in Chennai (US$ 2,00,000/-)
1988	Received Honorary Doctoral Degree from The Netherlands Agricultural University

Contd...

1988	Established M.S. Swaminathan Research Foundation (MSSRF), Chennai to foster contact between 'Science and Society'
1989	Received Padma Vibhushan by the President of India
1989-96	President, World Wide Fund for Nature (India)
1991-96; 2005-07	Founder President, National Academy of Agricultural Sciences (NAAS)
1999	Listed among 20 most influential Asians of 20th Century identified by Time magazine
2000	❖ Valvo, Tyler and UNEP Sasakawa Prize for Environment ❖ The Indira Gandhi Prize for Peace, Disarmament and Development ❖ The Franklin D. Roosevelt Freedom Medal ❖ The Mahatma Gandhi Prize of UNESCO
2002-07	President of the Pugwash Conferences on Science and World Affairs
2002-05	Chaired, United Nations Millennium Project on Hunger
2004-06	Chairman, National Commission on Farmers
2007-13	Nominated by the President Abdul Kalam as Member to the Rajya Sabha (Upper house of the Indian Parliament)
2007	The Lal Bahadur Shastri National Award
2010-13	Chaired the High Level Panel of Experts (HLPE) for the World Committee on Food Security (CFS)
2013	Received the Indira Gandhi Award for National Integration and Greatest Global Living Legend Award of NDTV
2013	❖ Received Life Time Achievement Award at the 9th Nutra Summit in Bangalore ❖ Elected as "Living Legend of International Union of Nutrition Sciences" at the 20th International Congress of Nutrition held at Granada, Spain

Contd...

2014-23	Served as Chair of the Task Force set up by the Ministry of External Affairs (MEA) to oversee projects undertaken in Afghanistan (ANASTU) and Myanmar (ACARE)
2023	Breathed last on September 28, 2023
2024	Awarded posthumously highest civilian award "Bharat Ratna"

[1]Iyer, R.D., Anil Kumar and Rohini Iyer. 2021. Revised and updated biography M.S. Swaminathan: Scientist, Humanist and Conservationist. Bhartiya Vidya Bhawan, Mumbai.

[1]Swaminathan, M.S. 2017. 50 years of Green Revolution: An Anthology Research Papers. World Scientific Publishing Co. Pvt. Ltd. 465 pp.

Empowering women in agriculture will lead to increased food production

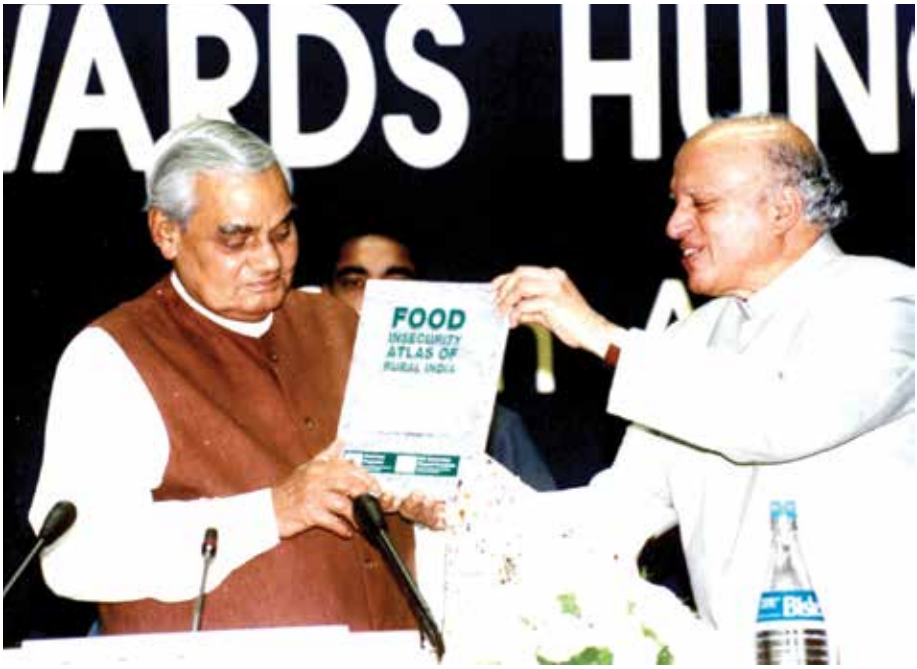
M.S. Swaminathan

Awards/Honors/Recognitions

(Source : MSSRF)

...With his holiness John Paul II, Vatican, Rome 10th November, 1985

During the First World Food Prize giving ceremony, 1987



Prof. M.S. Swaminathan with Prime Minister Atal Bihari Vajpayee Ji in 2001 on the occasion of release of the Rural Food Insecurity Atlas prepared by MSSRF & World Food Programme

Honorary Doctorate being conferred to Prof. M.S. Swaminathan by the President Pranab Mukherjee during Panjab University convocation

Honorary Doctorate being conferred on Prof. Swaminathan by the University of Agriculture, Faislabad, Pakistan, 2014

Prof. M.S. Swaminathan : His Karma Bhoomi with Dr. K.V. Prabhu and Dr. A.K. Singh

Notes

Notes

Prof. M.S. Swaminathan explaning the significance of dwarf wheats to Prime Minister Lal Bahadur Shastri ji during his visit to IARI

Inaugural First World Food Prize presented to
Prof. M.S. Swaminathan by Mr. Ferguson of General Foods,
6th October 1987 Smithsonian Institution, Washington D.C.

National Academy of Agricultural Sciences
New Delhi