TRIBUTE

Pioneering Perspectives on Global Warming and Agriculture

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It is well known that the issue of climate change played a central part in M. S. Swaminathan's vision of ecological sustainability. His continued and intense interest in mangroves and coastal protection in the light of sea-level rise, developed over the past 30 years at the M. S. Swaminathan Research Foundation (MSSRF), reflected this aspect of his vision. However, what is perhaps less well known is that Professor Swaminathan (henceforth MSS) was one of the pioneers in evolving a global perspective on global warming and anthropogenic warming and their impact on human society, especially with reference to agriculture. MSS also specifically contributed to the early development of the two key multilateral initiatives that shape the global response to the climate challenge today, namely the Intergovernmental Panel on Climate Change (IPCC) and the United Nations Framework Convention on Climate Change (UNFCCC).

In this brief note, we trace some of his key interventions in the period 1977–1992, a period that began when he was Director-General of the Indian Council of Agricultural Research (ICAR), until the time that MSSRF began to occupy a major part of his time and energy.[1] These interventions were often, in collaboration with S. K. Sinha, his colleague at the Indian Agricultural Research Institute (IARI), who himself had a distinguished career at that institution, eventually serving as its director.

MSS was a participant and the sole delegate from India at the First World Climate Conference, organized by the World Meteorological Organization (WMO) and held in Geneva from February 12 to 23, 1979. His presentation to this conference arguably gave the first indication of MSS's viewpoint on climate change and agriculture. The conference, a landmark in the history of global climate governance, ended with a declaration signed by more than 150 scientists, including MSS. It was

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[1] For a brief timeline of his career, see the webpage https://www.mssrf.org/founder/ and the links provided therein.

titled "Appeal to Nations," the first global call from scientists for urgent action on climate change.[2] The Appeal opened with these words:

> Having regard to the all-pervading influence of climate on human society and on many fields of human activity and endeavor, the Conference finds that it is now urgently necessary for the nations of the world: (a) to take full advantage of man's present knowledge of climate; (b) to take steps to significantly improve that knowledge; and (c) to foresee and prevent potential man-made changes in climate that might be adverse to the well-being of humanity.

The declaration, called on nations to support the WMO in developing a World Climate Programme, and to "utilize existing knowledge of climate and climatic variations in the planning for social and economic development."

At this conference, MSS presented an assessment of the global status of food security and the fight against hunger and malnutrition across the world. The entry point for considerations of global warming is brief but pointed (Swaminathan 1979). He notes, first, that

> While the need for introducing an era of accelerated agricultural advance is becoming increasingly urgent, the process of man-made damage to agricultural assets is proceeding unabated.

Subsequently, after a brief reference to the significance of land degradation and desertification and the first UN Conference on Desertification in 1977, he turns to climate:

> The impact of man-made activities on the climate, such as the effects of increasing carbon dioxide and the release of nitrous oxide, freons, and other trace chemicals on the ozonosphere, is also a matter of serious concern. Above all, the pathway of agricultural advance so far adopted places a heavy reliance on non-renewable forms of energy, and if the same pathway is followed in the future, a blind alley could be reached in the matter of improving food production.

The rest of the lecture is devoted to the assessment of food security and the fight against hunger. MSS focuses on the call from the World Food Conference of 1974, setting the year 1984 as the

> deadline for achieving the objective of ensuring that no child, woman, or man goes to bed hungry and that no human being's physical and mental potential is stunted by malnutrition.

This was to be the distinctive mark of MSS's interventions on climate change and agriculture, in which working for a hunger-free world was the context for considering climate change.

[2] The text of the Declaration is available on the web at https://www.documentcloud.org/documents/3467449-First-World-Climate-Conference-Declaration. (WMO 1979).

A striking aspect of this intervention is the reference to fossil fuels, or non-renewable sources of energy. The emphasis was on ensuring that agriculture had a sustainable source of energy for the future rather than on the threat to agriculture from the emissions of fossil-fuel sources. This was a line of thought that MSS developed in some detail in his 1977 address to the Indian Association of Agricultural Economists, titled "Indian Agriculture at the Crossroads" (Swaminathan 1977). The address had extensive references to energy use in Indian agriculture and its dependence on fossil fuel sources, based particularly on calculations undertaken by Sinha. It was also heavily influenced by the book *Rays of Hope: The Transition to a Post-Petroleum World* by Denis Hayes (Hayes 1977), on the basis of which the address refers to the threat of increasing global temperatures from carbon dioxide emissions because of fossil fuel use. However, the reference to the threat of global warming in the 1977 address is not yet at the level of "serious concern," the term he was to use in the report to the World Climate Conference two years later.

The next major intervention by MSS was in the area of sustainability and agriculture, not directly referring to climate change but clearly reflecting his overall vision of sustainability. MSS chaired the Advisory Panel on Food Security, Agriculture, Forestry, and Environment of the World Commission on Environment and Development, popularly known as the Brundtland Commission. The Panel produced a report in 1986 that was subsequently published (Swaminathan 1987). By this time, MSS had become the Director-General of the International Rice Research Institute and was also the President of the International Union for the Conservation of Nature and Natural Resources (IUCN).

While the terms of reference of the Panel were to advise the Commission on the subjects listed in the Panel's title, the Report itself deemed its "ultimate aim" to be

> to propose some means through which food security can be achieved worldwide to the year 2000 and beyond, while sustaining and enhancing the life-support systems of land, water, flora, and fauna by following and practicing ecologically sound farming systems.

The document is notable for its articulation and development of the idea of "sustainable livelihood security," an idea that was undoubtedly helped along by Robert Chambers' participation in the Advisory Panel (Scoones 2009). But there are distinctive touches, such as the reference to Mahatma Gandhi and his concept of Antyodaya, that speak to MSS's influence on the final output. The panel report is also noteworthy for its emphasis on both equity and ecology. Analyzing the "root causes of and nature and extent of the threat to sustainable food security" (Part 2: II. III), it notes that

> "ecologically blind" policies pursued by national governments, particularly the over-rich incentives in some countries or lack of them in others; inequitable distribution patterns of,

> inter alia, land, educational, economic, and technological resources; marginalization of segments of the population, in particular the majority of small-scale producers and the landless; unsound management or imprudent resource-use practices followed by farmers that cause erosion, deforestation, and contamination of soils and waters, as examples; inadequate and/or poor irrigation systems.

Again, in the report, while posing the question of the reason for the existence of both environmental degradation and continued "exponential growth in the number of children, women, and men going to bed hungry," it locates one of the key causes in the nature of politics and power both at the national and international levels.[3]

As the issue of global warming rapidly became one of the chief concerns of global environmental governance, a number of meetings world-wide began to discuss issues that would subsequently become part of the mandates of the Intergovernmental Panel on Climate Change (IPCC) and the United Nations Framework Convention on Climate Change (UNFCCC). As a fact-sheet of the UNFCCC (UNFCCC, 2000) notes, these included the Villach Conference (October 1985), the Toronto Conference (June 1988), the Ottawa Conference (February 1989), the Tata Conference (February 1989), the Hague Conference and Declaration (March 1989), the Noordwijk Ministerial Conference (November 1989), the Cairo Compact (December 1989), and the Bergen Conference (May 1990). The Center for International Environmental Law (Center for International Environment Law 1990) has published a compilation of the closing statements and declarations of this series of meetings.

MSS had at least two major contributions to this series of conferences. The first was a paper jointly authored with S. K. Sinha and N. H. Rao for the Conference on "The Changing Atmosphere: Implications for Global Security" held in Toronto on June 27–30, 1988, and organized by the World Meteorological Organization and the Government of Canada (WMO 1988).[4] Sinha, who was also co-chair of the Working Group on Food Security at this conference, delivered the paper; MSS did not attend the meeting in person.

[3] In language that continues to be relevant more than 35 years later, the Report notes: "The real difficulty at the national level is the narrowness of objectives in sectorally fragmented organisations, the disproportionate influence of the rich and the powerful within and outside the nations and the distortion of objectives and policies because of greed and corruption. The urban orientation to agricultural policies in most developing countries is another impediment to rural livelihood security. The international economic system reinforces these difficulties and adds to them the pressure of price and economic fluctuations which force national governments to take a very short-term view of agricultural development. Ecological considerations can play a more central role in agricultural development only if there is a political will to tackle these weaknesses in decision-making structures at national and international levels."

[4] The proceedings of the Conference themselves are of much interest in the context of even contemporary debates in global climate governance and many of the issues and themes that would be taken up by the climate convention in 1992 can be noted in their initial form in the declaration of the conference (WMO 1988).

The paper, titled "Food Security in the Changing Global Climate," is perhaps the first by MSS in which the focus is on the specific challenge of global warming for agriculture. The paper which draws on the literature to present an overview of the subject, is strikingly relevant to this day. It deals with two scenarios, the first being that of food security under the current climate regime and the second that of climate change and food security. With the words "climate change" and "greenhouse gases" occasionally appearing within quotation marks in the paper, we are reminded that this was before these terms acquired internationally accepted definitions and meanings. However, the overview of climate change and food security provided on that occasion, in the view of this author, stands the test of time in highlighting the key issues. Further research over the past three decades and a half has deepened our understanding of these issues, but it has in no way diminished the significance that MSS originally assigned to them.

The "Tata Conference," as it came to be called, was held in 1989. It was officially titled "Global Warming and Climate Change: Perspectives from Developing Countries: The Indian Sub-Continent," and was jointly organized by the Tata Energy Research Institute, Delhi and the Woods Hole Research Centre, Woods Hole, Massachusetts (of which MSS was an Honorary Trustee), with support from the United Nations Environmental Programme (UNEP), and the World Resources Institute (WRI).[5] MSS delivered the opening address to this conference, which he co-chaired with R. K. Pachauri. This was the first international meeting of the time to focus on the perspective of developing countries on climate change, and its declaration was cited subsequently by other conferences. The declaration of the conference is also noteworthy as the first instance in which developing countries insisted on the leading role that developed countries had to play in combating climate change and the commitment that they had to make to support the low-carbon development of developing countries. A brief summary report of the conference is available on the UNFCCC website (UNFCCC 1993), and the final statement available in the compilation of statements and declarations referred to earlier (Center for International Environmental Law 1990).

In 1990, MSS was a participant in the Second World Climate Conference, at which R. K. Pachauri, A. Khosla, A. K. N. Reddy, and MSS's collaborator S. K. Sinha, among others, were fellow Indian delegates (Jager and Ferguson 1991). His paper at the conference again focused mostly on the contemporary situation in food security along with the energy needs of agriculture, while the future under climate change was still a secondary consideration, with two sections devoted to it at the end. Even in these two sections, the emphasis was again mostly on the impact of climate change, while the mitigation of greenhouse gas emissions in agriculture merited only a brief mention.

[5] The author is grateful to Dr K. Ramakrishna for drawing his attention to the significance of this meeting.

Two subsequent papers dealt further with the relationship between climate change and agriculture. In these, the focus was on the study of climate impact on food production, in the present and in the future, with increasingly specific quantitative findings. The first of these papers (Sinha and Swaminathan 1991), again co-authored with Sinha, is well known for stating a quantitative relationship between wheat production and higher than optimal temperatures in the growing season. In contrast to the earlier papers on global warming, the geography under consideration in this paper was restricted to India. Sinha and Swaminathan estimated that a 0.5°C rise in mean temperature would lead to a decline in yield of about 0.45 tonnes per hectare, resulting from a reduction of about 7 days in crop duration, amounting to about a 10 per cent decrease in productivity. Similarly, they estimated that rice would suffer a loss of 0.75 tonnes per hectare in productivity for a 2°C rise in temperature, but this loss was for high-yielding regions and would be significantly lower in low-yield regions, especially in coastal areas. Incongruously, the paper appears in a special issue devoted to deforestation and its impact of the journal *Climatic Change*, and the word deforestation even appears in the title. In reality, there is no more than a token reference to deforestation, noting its contribution to rising temperatures, and the bulk of the paper is on the impact of rising temperatures on agricultural production.

Together with Martin Parry, MSS wrote a second, more comprehensive paper (Parry and Swaminathan 1992), which the Stockholm Environmental Institute published in an edited volume. This 11-page paper was again a comprehensive global review of climate change and agriculture, focusing on the impact of climate change on food and livestock production. Although the conclusions of the paper refer to the need to study greenhouse gas emissions caused by agriculture, the bulk of the paper is on the impact of warming on agriculture, hence its emphasis on adaptation rather than mitigation.

A special mention must also be made of MSS's address in Tokyo in 1988. As noted in a later review by MSS (Kesavan and Swaminathan 2012), the emphasis in the address was on sea-level rise, the potential salinization of rice fields in coastal regions and means of adapting to such phenomena. These means included the development of salt-tolerant varieties of rice using mangrove genes through the application of biotechnology methods. This was to become a project carried forward at the MSSRF; despite its successes, however, the effort could not yield the anticipated payoffs because of the crippling regulatory barriers that subsequently emerged.

Climate change continued to be a central theme in MSS' work and vision in the 1990s and later. In all his initiatives in the exploration of sustainability in agriculture, he referred to the importance of agriculture adapting to climate change. It does appear, though, that he did not enter the world of climate science and policy *per se*. He continued to remain devoted to the cause of agriculture and food security within the overarching context of the effort to create a hunger-free world, with climate change being part of the context, but not solely or overwhelmingly so. MSS's presence is

not registered in any significant manner with either the work of the IPCC or the UNFCCC, both organizations whose establishment he directly witnessed and to whose formation he contributed.

MSS led two other large-scale multi-country assessments in the sphere of climate change, the report on Food Security and Climate Change (HLPE 2012) and Biofuels and Food Security (HLPE 2013), by the High-Level Panel of Experts on Food Security and Nutrition (HLPE) of the World Committee on Food Security (CFS) of the United Nations. Both of these were produced under his leadership and guidance when he was Chair of HLPE after the reform of the CFS in 2010. The first of these two publications marked a return, after a gap of almost two decades, to a global scientific assessment of climate change and agriculture and food security. Indeed, in the preface to the report, MSS recalls his plenary lecture on agriculture and food security at the First World Climate Conference of 1979. As is evident from the titles of the reports, climate change and agriculture and the closely related subject of biofuel production for climate mitigation were studied with a very strong focus on food security.

It would be difficult to undertake any overview of MSS' engagement with the issue of climate change and agriculture without a closer reading of some of the key writings and the reports whose writing he led or guided. But even a cursory examination of the material suggests to this author that there is much that is useful to contemporary policymaking in these reports.

In the context of the current enthusiasm for a mitigation-centric approach to climate change and agriculture, in which considerations of food security are increasingly ignored or downplayed, MSS's vision and approach to the science of agriculture, which were rooted in his overarching desire to see a hunger-free world, remain strikingly relevant and inspiring.

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