2015 UNESCO Sultan Qaboos Prize for Environmental Preservation

The 2015 UNESCO Sultan Qaboos Prize for Environment Preservation has been awarded to Fabio A. Kalesnik, Horacio Sirolli and Luciano Iribarren of the Wetlands Ecology Research Group, University of Buenos Aires, Argentina. The Prize is awarded every two years, and consists of a diploma, a medal and a cash endowment of US$ 70,000. It is funded by a generous donation by His Majesty Sultan Qaboos Bin Said Al Said of Oman[1]. The award ceremony took place on the first day of the World Science Forum held in Budapest, Hungary, from 4–7 November 2015, under the auspices of UNESCO[2]. This year marks the 150th anniversary of the Hungarian Academy of Sciences, the 70th anniversary of the foundation of UNESCO and coincides with the silver jubilee of the Prize.

The research and advocacy of Kalesnik, Sirolli and Iribarren has contributed to the establishment and management of the Delta del Paraná Biosphere Reserve of UNESCO's Man and the Biosphere Programme. Established in the year 2000, this Biosphere Reserve is a coastal freshwater delta of the Paraná River located just north of Buenos Aires. It is an area rich in biodiversity, including species that find their southernmost limit of distribution, which makes the area interesting for the conservation of genetic diversity. The flooded riverbeds are dominated by Totora (*Schoenoplectus Californicus*). The Biosphere Reserve also contains low forests, forest ecosystems and secondary forests with plants such as black cottonwood (*Populus trichocarpa*; also known as western balsam poplar or California poplar). The main human activity in the delta is the exploitation of the willow forest for commercial purposes. Some areas are however difficult to access and human impact is low. The region has suffered from a loss of human population and there were only 3600 inhabitants, when the project was established. The establishment of the Biosphere Reserve aims at revitalizing the economy of the region and at the same time conserving the natural and cultural values of the area[3,4].

In order to support international efforts in the field of environment conservation, Sultan Qaboos Bin Said of Oman declared the establishment of the prize during his visit to the UNESCO Headquarters in Paris, France in 1989. The awarding of the prize commenced in 1991. The purpose of the prize is to recognize the outstanding contributions by individuals, groups of individuals, institutes or organizations in the management or preservation of the environment. Contributions have to be consistent with the policies, aims and objectives of UNESCO, and in relation to its programmes in this field, i.e. environmental and natural resources research, environmental education and training, creation of environmental awareness through the preparation of environmental information materials and activities aimed at establishing and managing protected areas such as biosphere reserves and natural world heritage sites. Nominations for the prize can only be made by UNESCO Members States and by International Organizations or by Non-Governmental Organizations which have consultative status with UNESCO, each of which may make only one nomination. Others can propose their candidates to their country's National Commission for UNESCO. The deadline for submitting nominations for the 2017 Prize is around June 2017 (ref. 1). It is the first Arab environmental protection prize to be awarded at the international level. The other major science prize instituted by the Arabs is the King Faisal International Prize by Saudi Arabia[5].

1. UNESCO Sultan Qaboos Prize for Environmental Preservation, http://www.un-qaboos-prize.net/ and http://www.unesco.org/new/en/natural-sciences/environment/ecological-sciences/man-and-biosphere-programme/awards-and-prizes/sultan-qaboos/.
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A sci-fi film about a Mars survivor calls our attention to the importance of microbiome in agriculture

NASA then announces that the explosion caused the temperature to drop, thereby wiping out the bacteria that was essential for the vegetables to grow... — 'The Martian' – a sci-fi film (2015).

'The Martian', in a typical celluloid fashion of a sci-fi film focusing on the rescue of a stranded astronaut from the red planet and showcasing human survival instincts in extremely adverse conditions, couches an important message for us earthlings about the significance of soil microbes for our food security. The film released in October 2015, came at the opportune time when 2015 was designated as the International Year of Soils by the UN.

In the film, the astronaut, a botanist by profession left stranded by mistake on the red planet, cultivates potato in the harsh uninhabitable environment for his survival. To enrich the barren Martian soil, he adds his own faecal waste along with spuds of remaining potatoes and develops an ingenious method to water them in the poly-house like bio-habitat. He succeeds in raising a good crop of potatoes. Though composted waste would have been more safe and appropriate, the gut microbes present in the faecal matter of the healthy astronaut successfully drive the biogeochemical reactions to supply essential nutrients for the growth of potatoes. Later, unfortunately, an explosion occurs near the poly-house which ushers in icy Martian winds that freeze-dry the soil and kill the potato plants. It also kills the bacteria in the soil without which another crop of potato cannot be raised. The film thus reaches out and educates public at large on the importance of microbes for the cultivation of crops. It is possible that this message could be lost in the tense climax of the film that focuses on the successful rescue of the astronaut.

However, the message about the importance of soil microorganisms in agriculture well established since the findings of Selman Waksman and Martinus Beijerinck has not been lost on the scientific community, and is now being given a fresh impetus with emphasis on the 'microbiome' approach. Coinciding with the release of 'The Martian', two publications in October 2015 in *Nature*[1] and *Science*[2] bring to spotlight the necessity to harness the power of Earth's diverse and abundant microorganisms and their genomes, termed 'microbiome', for betterment of agriculture, environment, energy, human life and sustainability of our planet. The authors call for an International Microbiome Initiative[1] (IMI; Germany, China and US effort), and Unified Microbiome Initiative[2] (UMI; an US initiative) at the global level for developing microbial solutions to address the challenges we are facing and anticipate to face. For this, the IMI[1] proposes four key functions: (i) developing guidelines for cutting edge methods, data analysis, data sharing and IPR issues for the study of microbiomes; (ii) chart out the priorities for developing common research agenda for comparative analysis at local to global scales; (iii) identify cross-disciplinary tools for microbiome studies, and (iv) create fora where the exchange of research information within and between nations can be discussed. The UMI[2] too emphasizes on evidence-based, model-informed microbiome management. To achieve this it proposes (i) unravelling the microbial genes and their chemistries; (ii) understanding cellular genomics and genome dynamics; (iii) using high-throughput, high-sensitivity multi-omics and visualization technologies; (iv) modelling and information technologies, and (v) developing precision approaches for stimulating, inhibiting, adding, removing or altering microbes and their genes *in situ*. The forerunner to these programmes is the Earth Microbiome Project (EMP)[3] initiated in 2010, with an objective to analyse at least 200,000 biomes from different parts of the globe for their microbial taxonomic and functional diversity using next generation sequencing technologies coupled with bioinformatics. It has successfully completed 30,000 soil, air, water, tissue, etc. samples thus far and the data are available for the public.

Relevance of microbiome for improving agriculture to feed the ever-growing billions as well as counter the climate challenge is one of the main focus of these initiatives as it offers immense scope to reduce inputs such as pesticides, fertilizer and water use besides helping in enriching marginal land and to rehabilitate contaminated and degraded soils[1]. Plants are closely associated with a complex microbiome called plant microbiome[4], which plays a critical role in the host nutrition and health, and protection from biotic and abiotic stresses[5]. The plant microbiome is compartmentalized into its rhizosphere microbiota, endosphere microbiota, endophytic and phyllosphere microbiota with soil being largely the source of microbiome diversity of the plant[6,7]. Therefore, understanding the soil microbiome–plant nexus is key to developing fit plants[5], and in relation to climate change this holds much importance to agriculture in terms of carbon management and greenhouse gas emissions[8]. New approaches which are based on ecological microbiome transfer are emerging as the futuristic technique for plant disease[9] and drought management[10]. Such techniques could possibly go on to become the precursors for developing next-generation crops that are more resilient to biotic and abiotic stresses. In India, numerous public and private institutions spread across the country are working to unravel and use the microbial diversity for plant growth and soil health, desert environment, rumen ecology, pathogenic microbes, application in biotechnology, etc.[11,12]. These researches can be updated to the goals matching those of IMI/UMI by partnering with them or even initiating our own like the Brazilian Microbiome Project[13] that began in 2014. Concerted efforts in soil microbiome research using advanced technologies could help in overcoming several challenges faced in Indian agriculture. Microbiome study could also aid in the National Mission on Clean Ganga that can improve the agriculture along the Gangetic Plains of India.

Soil is the living epidermis of the Earth, and existence of life on Earth depends upon the diverse microbes present in the soil and the vital ecosystem functions they perform. Therefore, the success and security of species on Earth is tightly interwoven with the way we manage or will manage our soils, directly or indirectly[14]. It is clear that soil microbes will play a pivotal role in feeding the world[15], not forgetting that they too need to be fed[16] as they are the smallest farm hands working for sustaining the food security of Earth[17]. Therefore, the next green revolution will depend much upon the microbiome for becoming an ever-green revolution.

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