Impact of Climate Change on Food Production in the Dry Areas

Hybrid Webinar
September 3–5, 2022

Organized by

International Dryland Development Commission (IDDC)
Regional Action for Climate Change (RACC), STS, Japan
International Center for Agriculture Research in Dry Areas (ICARDA)
Arid Land Graduate Studies and Research Institute (ALARI), Ain Shams University, Egypt
Nizami Ganjavi International Center (NGIC)

Hosted by

Ain Shams University, Cairo, Egypt

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Proceedings

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by
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International Dryland Development Commission (IDDC)

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1. Introduction

The International Dryland Development Commission (IDDC), the Regional Action for Climate Change, STS Japan (RACC), the International Center for Agriculture Research in Dry Areas (ICARDA), Ain Shams University Arid Land Graduate Studies and Research Institute (ALARI), and the Nizami Ganjavi International Center (NGIC) organized this hybrid webinar at the Ain Shams University, Cairo, Egypt.

The meeting focused on dynamic assessment of the impact of climate change at local and regional level in different agro-ecological zones in the dry areas, and identifying strategies for adaptation to climate change, including development of coping and adaptive capacity through advanced science in changing genetic makeup and agro-management techniques. In addition, it aimed to identify the means of enhancing coping and adaptation capacity in communities living in the dry areas. A significant effort is required to translate into action the resolutions agreed upon by world leaders in various global conventions on Climate Change, as the lack of political will so far has increased the gap in the economic wellbeing between the people living in the industrialized and the developing nations, with serious ethical and spiritual dimensions in the face of changing climate.

This Webinar included the following topics:

1. Dynamic assessment (simulation modeling, etc.) of the impact of climate change on the eco-systems in different agro-ecological zones.
2. Dynamic identification of genetic resources for different agro-ecologies.
3. Dynamic identification of appropriate agro-management techniques for different agro- ecologies.
4. Enhancing the coping and the adaptive capacity (human and physical infrastructure):
    4.1. Review of the political obstacles to implementing a strategy that would restrict global warming at 1.5-2.0 ^{0}C by 2050.
    4.2. Identification of an approach to mobilizing the requisite funds

to assist the developing countries implement adequate adaptation measures and promote their resilience to climate change.

The formulation of the Program was guided by an International Organizing Committee, supported by a National Organizing Committee of Egyptian national program scientists (Appendix 1). The Webinar included keynote and lead presentations covering the abovementioned topics. As well, two panel discussions were held. The list of speakers is given in Appendix 2.

The Program of the Webinar is given in Appendix 3. A summary of presentations and discussions and recommendations emanating from the presentations are given in the subsequent section.

2. Summary of Presentations and Discussion

2.1. Opening Session

The session was chaired by **Prof. Dr. Mahmoud El-Metini**, President, Ain Shams University. Prof. Dr. Adel El-Beltagy welcomed Prof. Dr. El-Metini and thanked him for hosting the webinar. He welcomed the participants from different parts of the world for their personal or virtual presence in the webinar that was going to address one of the most serious and urgent challenges confronting the humanity, namely the climate change as it would impact food production and resilience of people in the dry areas of the developing world. While the mitigation strategy to cope with climate change was important, the immediate concern is to develop adaptation mechanisms and facilitate the adoption of these mechanisms by the vulnerable people. The task, being huge and immensely challenging, would require a global partnership. He hoped that the webinar would be of value in enhancing awareness of the problem and identification of coping strategies developed through application of science and technology.

Prof. Dr. El-Metini thanked the organizers to select Ain Shams University as the place for holding this important event, as the objectives of these deliberations were in line with the overall objectives of its Arid Land Agricultural studies and Research Institute (ALARI). The webinar was a very timely event because its outcomes would become a valuable feed for the upcoming COP 27, being held at Sharman Sheikh. He extended his welcome to all the participants and then introduced the special guest Dr. Mahmoud Mohieldin, UN Climate Change High-Level Champion for COP27 and former Executive Director, International Monetary Fund (IMF), and invited him to make his statement.

Dr. Mahmoud Mohieldin thanked the organizers to give him an opportunity to share his thoughts on the subject at this opportune moment. He said that reduction of agriculture production and disruption of the food chain will occur worldwide because of Climate

Change. A comprehensive approach needs to be adopted to face the challenge, with emphasis on climate adaptation. The implementation of pledges already made by the industrialized countries in the previous global forums is the immediate need and not more negotiations. There is a need to consider the support for the projects already available for Africa (19 project), Asia (20 projects) and Latin America (some 25 projects). He further said that the Egyptian Council of Ministers, in cooperation with the United Nations, held 3 sessions with the aim of coordinating the required implementation of climate commitments at the regional level, and clarifying the requirements of the real economy sectors in the fields of industry, agriculture, basic services and the available funding. This confirms that developing countries have diverse projects such as reducing harmful emissions, adaptation, agriculture, food, water management and infrastructure for the agricultural sector. The projects should be chosen in line with the Paris Agreement and digital transformation priorities, whether small-sized or large-sized, linked to the Dignified Life Program, Women's projects, and Emerging projects with a developmental impact, and the results be presented in COP-27. The goal of these projects would be to raise awareness and inform people of the necessity of the close connection between sustainable development and digital transformation issues. Local and regional dimensions in Sustainable Development need to be emphasized more as we usually care about global dimensions and miss the local emphasis.

Speaking next was **Prof. Mahmoud Sakr**, President of Academy of Scientific Research and Technology (ASRT), Cairo, Egypt. He provided details of MHESR's "Climate Change Action Plan: COP27 and Beyond". He provided an overview of what had so far been done by Egypt to combat the negative effects of climate change. In the last 5 years, several projects have been launched to reduce greenhouse gas emissions and to shift to clean energy voluntarily. It has been proposed that most of the transportation in the country would be electrified. The action plan of MHESR includes: 1. Strategic Studies and Development of Policy Papers; 2. National RDI Green Fund; 3. National and International Networking; 4. Social and Institutional Adaptation; 5. Higher Education (Development of New Curriculum); and 6. Green and Social Initiative. The Government has committed resources for Green Research and Development. Project "Redirect" ensures that parts of resources for

scientific research are directed toward research on climate change.

Co-sponsoring organizations of the Webinar were briefly introduced by their respective representatives as follows:

- **Regional Action on Climate Change (RACC)** of the Science & Technology for Society (STS), Kyoto, Japan – *Dr. Ismail Serageldin*
- **Nizami Ganjavi International Center (NGIC)** – *Dr. Ismail Serageldin*. Nizami Ganjavi International Center (NGIC) is an international institution based in Azerbaijan, that celebrates the legacy of the great Azerbaijani poet and sage, Nizami Ganjavi, and promotes the participation of high-level eminent figures in the study of possible solutions for the pressing problems of our times, with a view to promoting knowledge, tolerance, dialogue, understanding and shared societies between peoples, cultures and nations.
- **Food & Agriculture Organization (FAO), Rome, I**taly – *Dr. AbdulHakim Elwaer, Assistant Director General, NENA Region, FAO, Cairo, Egypt*
- **Arid Land Agricultural studies and Research Institute (ALARI), Ain Shams University** - *Prof. Usama El-Behairy*
- **International Center for Agricultural Research in the Dry areas (ICARDA)** – *Mr. Aly Abousaba*
- **International Dryland Development Commission (IDDC)** – *Prof. Adel El-Beltagy*
- **African Platform: Young Master's Program** - *Dr. Salah Soliman*

Introductory Address

Prof. Dr. Adel El-Beltagy, Chair of the International Dryland Development Commission; Professor, Arid Land Agricultural Graduate Studies & Research Institute, Ain Shams University, Cairo, Egypt gave the introductory address under the title "**Navigating Through Uncertainties: Agro-Ecosystems Affected by Dynamic Impact of Climate Change",** setting the tone for the subsequent deliberations. The summary of his presentation is given below:

The current world population is already 7.94 billion and it is expected to reach over 10 billion by 2050. Food production in the developing countries will have to be almost doubled to meet the needs of rising population, and this has to be done in the face of the changing climate that has been negatively impacting production. The Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) has examined the scenarios of rise in global temperature by 1.5ºC and 3ºC by 2050; the danger of reaching 4°C by the end of the century still loaming. It is anticipated that 4°C increase in temperature will reduce production of food (crops, fish and animals) by 50%, by the end of the century. Measures are highly required to avoid such temperature rise. In spite of this grave reality, the political action remains elusive in implementing the Climate Change (CC) related global agreements such as the Paris Agreement, Sendai Framework for Disaster Risk Reduction, and Sustainable Development Goals (SDGs).

CC will have a major impact on agro-ecosystems and hence on the geographical distribution of species of terrestrial and marine organisms. This will impact bioclimatic drivers that regulate the geospatial distribution of dryland agro-ecological classes (AECs) and will lead to greater shifts in cropping-system uncertainty. These projections by IPCC are counter to cropping system goals of increasing intensification, diversification and productivity. The implementation of land-based mitigation options would require overcoming socio-economic, institutional, technological, financing and environmental barriers that differ across regions. This will call for continuous assessment of impacts on the local level, where the major action of adaptation would have to occur. This will also require international cooperation and national capacity building in different ecological zones. Monitoring climate variation will require the establishment of advanced national meteorological networks in different local ecological zones. The developing countries would need financial and technical support in this regard.

Adaptation options that reduce vulnerability of human and natural systems, if well managed, have many synergies with sustainable development, such as ensuring food and water security, reducing disaster risks, improving health conditions, maintaining ecosystem services, and reducing poverty and inequality. Increasing investment in

physical and social infrastructure is a key enabling condition to enhance resilience and the adaptive capacities of societies. These benefits can occur in most regions with adaptation targeting 1.5ºC of global warming. Collective efforts at all levels, in ways that reflect different circumstances and capabilities, in the pursuit of limiting global warming to 1.5ºC, taking into account equity as well as effectiveness, can facilitate strengthening the global response to climate change, achieving sustainable development and eradicating poverty.

There is an urgent need for establishing an action-oriented knowledge network to accelerate and enhance the effort to develop local assessment of the impact of climate change and facilitate more precise prediction of agro-ecosystem sustainability and future change. A group of concerned scientists and experts started a Regional Action in Climate Change (RACC) in 2009. RACC is based on Knowledge Action Networks to connect the global science, technology, and policy communities to realize locally applicable solutions. Climate change could unite the international community, recognizing climate change as a threat to humankind. We, in dry areas, are concerned about the future of 2.5 billion people living here, when temperature rise exceeding 2°C will cause high risk for their livelihood. We need to work together, as time is running out, for all humanity to retain and aspire for a better future.

Keynote Address

Dr. Ismahane Elouafi, Chief Scientist of the Food and Agriculture Organization (FAO) of the United Nation, delivered the keynote address in the opening session under the title "**FAO Efforts in Building Resilience and Improving Livelihoods of Local Communities in Drylands.** The summary of her presentation is given below:

The drylands are home to an estimated 2 billion people, about 90 percent of them being in developing countries. Drylands are also a great home to biodiversity including a wide range of indigenous livestock breeds and plant species that are essential for food security and livelihoods. Based on the FAO Global Agro-Ecological Zones, drylands represented about 43.2 percent of total global area in 2020, and are predicted to be about 44.2 percent by 2050. However, the challenges

associated with agrifood systems in drylands are increasing over the time and are leading to significant decline in the productivity and sustainability of the ecosystem. These problems include soil erosion, degradation and salinization, groundwater depletion and deterioration, water conflicts over various uses and displacement of indigenous farmers. Recently, some of these problems have become more serious by the climate change and variability such as desertification and salinization, where the drylands contain about 30% of the total global salt-affected soils estimated at 831 million hectares.

Irrigation is crucial for food production in drylands, however it mainly depends on reduced surface water and unrenewable and depleting groundwater sources. Thus, water scarcity at critical times during agricultural seasons makes populations in drylands particularly vulnerable in the absence of appropriate technologies and risk management strategies. This calls for critical action and means to sustainably manage the available water resources in the dry areas to enhance water productivity and efficiently use the water for irrigation. Therefore, FAO, together with its partners, is moving towards implementing its Global Programme on Sustainable Dryland Agriculture, which will implement adoptable and science-based approaches such as protected agriculture and precision farming to sustainably enhance the agricultural systems' productivity and improve the livelihoods of local communities and build their resilience.

In line with the FAO led 'Hand-in-Hand' Initiative, this Global Programme will apply new ways and means of working through data management and utilization to build cross-cutting approaches to identify the proper opportunities for innovations, and investments that create sizable impact at various scales. The FAO, first-ever, Science and Innovation Strategy will enable and support the implementation of the Global Programme. The strategy has been built on three interlinked pillars: i) Strengthening science and evidence-based decision-making; ii) Supporting innovation and technology at regional and country level; iii) Serving members better by reinforcing FAO's capacities. These pillars will help to increase the availability, awareness and the uptake of open-source solutions by the vulnerable communities and strengthen their livelihoods.

2.2. Topic 1: Dynamic Assessment of the Impact of Climate Change on the Eco-systems in Different Agro-ecological Zones

This session was chaired by **Prof. Dr. Raj S. Paroda**, Chairman, The Trust for Advancement of Agricultural Sciences (TAAS), India.

2.2.1. Keynote Address

Dr. Hemanshu Pathak, Director General, Indian Council of Agriculture Research (ICAR) and Secretary Department of Agriculture Research and Education (DARE), Government of India, presented keynote address under the title **"Simulating the Impacts of Climate Change on the Crop and Soil Processes"**. The summary of his presentation is given below:

The Inter-Governmental Panel on Climate Change (IPCC), in its 6th Assessment Report (2021, 2022), reiterated that the warming of the climate system is widespread, unequivocal and intensifying. Rainfall variability and intensity are increasing, sea level is rising, and cyclones are becoming fiercer and more frequent. These extreme events will significantly alter the crop and soil processes affecting agricultural productivity, profitability and sustainability. The variations in the meteorological parameters, in combination with soil characteristics, cultivar, pest and diseases, and agronomic practices, have paramount influence on the agricultural systems to determine the production levels. It is, therefore, important to assess the consequences of climate change on crops and soil to develop adaptation and mitigation strategies.

Simulation modeling is potentially a valuable tool to assess the impacts of climate change on agriculture, develop adaptation and mitigation technologies, and help in formulating policy for achieving climate-smart agriculture. Crop models can simulate the inter-annual variation of yields for specific crop management options from the available historical meteorological data and, in the next step, facilitate identification of adaptation strategies to reduce adverse effects of climatic variability.

Different crop models (APSIM, DSSAT, InfoCrop, Oryza) have been employed for statistical analyses of historical climatic and crop data, simulation of crop yields and the effect of crop management options. InfoCrop, for example, simulates crop growth processes; calculates the transformations and uptake of nitrogen; evaluates the emission of greenhouse gases and predicts the crop yield. It also provides an opportunity to evaluate performance of various adaption and mitigation options and the trade-offs. With decreasing cost of computing, simulation models are becoming accessible to a wide range of users with differing degrees of modeling expertise. Knowledge of crop growth and development being incomplete, even the most rigorous model includes some approximations and therefore, possesses some limitations. Nevertheless, crop models can contribute to identify gaps in our knowledge, thus enabling more efficient and targeted research planning.

Models are capable of supporting extrapolation to alternative cropping cycles and locations, thus permitting the quantification of temporal and spatial variability of climate change and its impacts on crop and soil processes. Over a relatively short time span and at comparatively low costs, the modeler can investigate a large number of management strategies that would otherwise be difficult using the traditional methods. Models can also predict the consequence of adaptation vs. maladaptation in the current and future climates, helping in designing policies for enhancing the resilience of farmers to climate change.

More than 104 countries in the world have some form of crop insurance program. Crop loss assessment is essential for implementing crop insurance policy and providing farmers adequate compensation in case of any calamity. Crop-loss Assessment Monitor (CAM) is a web based multi model tool for harnessing technologies and big data for improved crop insurance.

Dr. Pathak gave several examples from India, where the simulation modeling has been put to good use in predicting adaptation gains in yield for different crops from 2020 baseline to 2030 in different climate change scenarios and relative advantage of different adaptation strategies for different crops in diverse agro-ecological conditions. The

modeling has also helped in developing contingency plans and issuing crop advisory to farmers in case of climate aberrations, which are becoming increasing frequent in the dry, rainfed areas.

While there are so many advantages of modeling in promoting climate-smart agriculture, there are also limitations of simulation models. It is difficult to mathematize all the biological process. There is incomplete understanding of plants, environment and management interactions. Developing a crop or animal model is difficult and thus only limited number of models is currently available. There is need for calibration and validation in different agro-ecological conditions. Knowledge is the main limiting factor and there is need of team efforts of various disciplines. Despite these limitations, the simulation modeling is one of the best means of assessing the effects of climate change, helping in development and up scaling of the technologies, and formulating policies for adaptation and mitigation.

Concluding his presentation, Dr. Pathak said that models were holistic, universal, knowledge-based tools for global and local applications. They are potential tools for assessing the impact of climate change and adaptation gains. They, however, need quality data for calibration and validation, building evidences, learning and scaling adaptation. It is to be realized that it is difficult to capture all the complexities of biological systems and knowledge is a limitation. Therefore, they should be used with caution and their results interpreted judiciously. To enable all developing countries to harness this potential tool, there will be a need for technical, financial and capacity-building support from the industrialized and other advanced countries.

2.2.2. Lead Presentations and Discussion

Nine presentations were made in the session related to the topic '**Impact of Climate Change on the Eco-systems in Different Agro-ecological Zone**s'. Summary of these presentations is given below:

2.2.2.1. Prof. Dr. Farouk El-Baz, Retired Director for Remote Sensing, Boston University, USA, Member of Advisory Council of President El-Sisi of Egypt, made the presentation titled '**Use of Satellite Image Data in Monitoring and Assisting Food Production in Arid Regions'**. He said

that arid and semi-arid regions of the Earth are particularly susceptible to climate changes, which drastically affect the amount of irrigation water. At least a third of the world's population depends on products from such lands. Thus, it is incumbent on the international scientific community to provide mechanisms to ameliorate the impact of the predicted changes. A most useful mechanism has been provided by the great variety of imaging satellites in Earth orbit. It has been proven that multi-spectral imaging satellites are most useful in assessing the health of crops, which is indicative of the potential yield. India's visionary program now allows farmers to request images of their plots at critical times to assure a good crop. Furthermore, radar imaging from space allows revealing channels in arid lands that were dug during past rainy periods as well as the current occasional rainfall. Such data should be made available for free, or at nominal cost, to farmers and cooperatives focusing on food production in the world's arid regions. This would alleviate the potential of hunger or disease in much of the developing world.

2.2.2.2. Prof. Dr. A. S. Sheta, Former Chair, Soils Department, Faculty of Agriculture, Ain Shams University, Egypt, made a presentation in co-authorship of Dr. M. Elsharkawy, and Dr. M. S. Abd El Wahed, on '**Monitoring the Spatiotemporal Urbanization and its Ecosystem Responses in Some Central Nile Delta Areas Using Remote Sensing'.**

He said, climate change was causing considerable impacts on lands in the Nile Delta. Agricultural productivity has declined as a result of climate change, especially rising temperature over the previous two decades, and there has been loss of vast agriculture areas. Thus, monitoring the changes of vegetation cover in response to climate change is of great significance. Investigation was made of the effects of urbanization on land surface temperature using Geographic Information Systems (GIS) and Remote Sensing techniques. This study employed agro-metrological data, Landsat time series imagery acquired from 2000 to 2021, soil maps, and monthly precipitation data to monitor and predict the variability of land cover distribution. Evapotranspiration was estimated using Surface Energy Balance System (SEBS) and the land cover change maps of Quesna and Shubin Elkom districts, were obtained. The threshold values were used for monitoring the land cover

changes through the discrimination with an existing assessed classification dataset of the same output land cover classes. The results showed that the threshold of normalized variance difference had significantly stabled pixel values within the sample datasets. Moreover, there was a huge fluctuation in land cover, total cultivated area, urban area, land surface temperature and amount of evapotranspiration during the study period. Results also showed that the vegetation in Quesna's surrounding area has a decreasing trend in most of the habitats except the new cropland reclamation areas. The most important directions of change are from irrigated agricultural land into urban areas and bare areas.

2.2.2.3. Dr. Mulatu Liyew Berihun, Faculty of Civil and Water Resource Engineering, Bahir Dar Institute of Technology, Ethiopia, presented the results of a study under the title **'Modeling Hydrological Responses to Changes in Land Use, Climate, and Land Management in Contrasting Agroecological Environments Toward Climate-Smart Sustainable Land Management in Ethiopia'** on behalf of the senior author **Prof. Dr. Atsushi Tsunekawa**, Arid Land Research Center (ALRC), Tottori University, Japan.

Modeling the long-term hydrological responses using spatially distributed model is a challenge in Ethiopia due to data scarcity, particularly in the Upper Blue Nile (UBN) basin, which is the source region of the Nile River. It is necessary to develop theoretical and practical methodology of climate-smart sustainable land management (SLM). This study, therefore, examined the hydrological responses to changes in land use, climate, and land management in different agro-ecological watersheds of the UBN basin. The watersheds included Guder, Aba Gerima and Debatie, which represent highland, midland, and lowland agro-ecologies of the basin, respectively. Hydro-meteorological data such as discharge, sediment sample and rainfall were monitored in the watersheds since 2015. Land use changes were analyzed by integrating field observations, and aerial photograph [1: 50,000 scale] and very high-resolution [0.5–3.2 m] satellite images. The hydrological responses were analyzed after calibrating the empirical model (runoff coefficient and evapotranspiration models) based on experimental data from fifteen runoff plots, which were established in different land uses and slope ranges in the three watersheds. Thereafter, the SWAT model

was used to evaluate the impact of soil water conservation (SWC) practices on flow and sediment in Aba Gerima watershed. Results showed that from 1982 to 2016/17, natural vegetation remarkably decreased as the cultivated land expanded. In contrast, between 2006 and 2017, plantation coverage increased due to *Acacia decurrens* expansion by 262% in the Guder watershed. The observed land use changes caused an increase in runoff in the range between 4% in Aba Gerima to 29% in Guder. Climate variability in terms of change in annual rainfall had no significant effect on runoff, whereas both land use change and climate variability had significant effect on estimated ET. Though climate variability increased evapotranspiration (ET) from 34% in Aba Gerima to 42% in Guder, the land use change related to the reduction in natural vegetation had an offsetting effect, which led to overall decreases in ET ranging from 16% in Guder to 33% in Aba Gerima watershed. Implementation of SWC practices reduced the surface runoff and sediment yield by ~14–40%, and ~51–78%, respectively, in Aba Gerima watershed. SWC practices had twice higher impact on surface runoff, flow, and sediment yield than the combined effects of changes in land use and climate. As changes in land use and climate are expected to intensify in the future, it is important to further understand their hydrological impact to devise appropriate sustainable land and water management strategies.

2.2.2.4. Dr. Toshichika Iizumi, National Agriculture and Food Research Organization, Tsukuba, Japan, and Visiting Professor, ALRC, Tottori, Japan made the presentation under the title **'Rising Temperatures and Increasing Demand Challenge Wheat Supply in Sudan,'** jointly with other scientists from Agricultural Research Corporation, Sudan (**Drs. Imad-Eldin A. Ali-Babiker, Izzat S. A. Tahir, Yasir S. A. Gorafi, Amani A. M. Idris**) and Japan (**Drs. Mitsuru Tsubo, Yasunori Kurosaki, Wonsik Kim, and Hisashi Tsujimoto**).

He said, the demand for wheat in Sudan has been increasing in the last decades. Sudan imported 2.5 million tonnes of wheat in 2018 that accounted for 83% of the national wheat consumption. Given that the population in Sudan would increase from 33 millions at present to 80 millions by 2050, this requires farmers, breeders, agronomists and national food agencies to strengthen the capacity of domestic wheat

production to meet the challenge. However, wheat production in Sudan has suffered from cyclic fluctuation associated with economic factors, exchange rate reforms, etc., for instance. Climate change poses an additional burden for supply goals. Assessing the wheat production capacity under projected warming is therefore crucial. This paper projects how the national wheat production from the current harvested area would respond to projected warming by 2050. For this, the global gridded crop model, CYGMA (the crop yield growth model with assumptions on climate and socioeconomics; Jägermeyr *et al.,* 2021), was calibrated so that it can reproduce the response of two cultivars of wheat ("Debeira" and "Imam", differing in the level of their heat tolerance) to season temperatures observed in the field experiments, and then model simulations were performed using climate and socioeconomic scenarios as the inputs. Two warming levels, the +1.5 °C and +4.2 °C (relative to preindustrial levels), were used in the future run to account for the uncertainty in the climate projections by 2050.

The simulation revealed that the domestic production share would probably decline from the current 16.0% level to 8.0–12.2% of the anticipated demand depending on the warming. Adopting more heat-tolerant varieties than are currently used in hot regions, and relocating or expanding production areas to relatively cool regions, are two main emerging strategies to address the supply goal under climate change. The benefit of adopting the more heat-tolerant cultivar ("Debeira") in the hot regions with adjusted sowing dates is evident but insufficient to maintain the level of domestic production. In contrast, sowing date shifts with the less heat-tolerant but higher yielding cultivar ("Imam") will help producers in the relatively cool region adapt to climate change and retain their capacity to increase production.

These findings have two implications for wheat breeding. First, producers in the relatively cool regions can focus on high-yielding varieties rather than heat-tolerant varieties, even under projected warming, at least until the middle of this century. This scenario is probably feasible because low heat tolerance often accompanies high yields. Second, improvement in heat tolerance should be a priority in hot regions, and heat-tolerant cultivars need to be bred at rates necessary to keep pace with the projected temperature increase of 1.5 °C and +4.2 °C by 2050, respectively.

Dr. Izumi said that the key message from the findings of this study was that current wheat varieties are insufficient to offset the adverse effect of projected warming by 2050. Varieties more tolerant to heat need to be bred and disseminated. If the temperature rise was assumed to be 4.2^0C, the required rate of improvement in the yield of new varieties over current heat tolerant varieties will have to be 2.7% per year. The required rate could be decreased to a more feasible level of 0.3% per year if warming was limited to 1.5^0C. Also, climate mitigation was necessary in parallel with adaptation to ensure that the requirement for the development of adaptation measures (e.g., wheat breeding) does not exceed our capacity.

2.2.2.5. Dr. Adel Aboul Naga, Emeritus Professor, Animal Production Research Institute, Agriculture Research Center, Egypt presented the paper titled **'National Strategy and Action Plans for Combating Climate Change Impact on Livestock',** in co-authorship with **Dr. Mohsen Shoukry,** Chair, Livestock, Poultry & Fisheries Research Council, Academy for Scientific Research & Technology, Egypt and **Ms. Sophy Allam**.

He said, Egyptian national strategy for combating impact of Climate Change (CC) on livestock includes:1) sustainable economic growth by setting plans for low gas-emission and directing larger investments to the field of renewable and alternative energy; 2) build resilience through the sustainability of local natural resources and ecosystems and preservation from CC impacts; 3) improving governance and management of combating CC by different stakeholders, and establishment of early warning systems; and 4) developing infrastructure for combating CC activities and promoting scientific research, technology transfer, and public awareness of CC impact. The strategy includes number of action plans as follows: 1) implementation of integrated practices to reduce greenhouse gas emissions, through coordination between different agricultural sectors; 2) improving animal feeding systems (precise and disciplined feeding) by encouraging the use of new sources of feed and reducing competition between food and feed; 3) expanding cultivation of salinity-resistant fodders in marginal lands; 4) intelligent management of animal waste in production of green energy; 5) managing animal genetic resources,

especially utilization of heat tolerant local breeds such as Egyptian buffalo and Barki sheep; 6) control of trans-boundary diseases; 7) reducing red meat consumption and expanding fish farming; 8)technical assistance to improve value chain and good husbandry to reduce greenhouse gas emission and improve animal welfare; 9) activating positive role of livestock in the agro-ecosystems; 10) addressing the impacts of CC on livestock and reduce environmental footprint of livestock supply chain; and 11) expanding use of smart housing systems and care practices.

2.2.2.6. Prof. Dr. Mohamed F. Osman, Emeritus Professor, Animal Production Department, Faculty of Agriculture, Ain Shams University, Cairo, Egypt presented the paper titled **'Effect of Climate Changes on Fisheries and Aquaculture'.**

He said, the drivers of climate change in fisheries and aquaculture production systems can be broadly categorized as: changes in indoor air and water temperatures, changes in solar radiation, changes in sea surface temperature, changes in other ocean geographic factors (currents, wind speed, waves, etc.), sea level rise, increased frequency or intensity of extreme events, and water stress. It is expected that these effects will increase in the future. One of the most important changes that accompany the rise in temperatures is the increase in the amount of rain, which greatly impacts fisheries, especially close to coastal sites. A change in the direction of the water currents, caused by different water densities, reflects on the biological diversity of fisheries. Increased acidity, due to the increase in CO_2, also has a severe impact on fish. In addition, the seasonal changes also affect various vital processes such as growth and migration of fish for reproduction. Climatic change also affects the shape and relationships of food web in the aquatic environment.

It is expected that with rising water temperatures, more fish will migrate towards the poles, while the preferred locations of warm water fish will expand. Fish being cold-blooded creatures, their surrounding environment has great influence on their life. Rising pond temperature in fish farms (aquaculture) will lead to: an increase in the activity of pathogenic and thermophilic microbes, causing fish disease; an increase

in algae growth resulting in fast consumption of large amounts of oxygen during the night would expose fish to suffocation and death; an acceleration of the mechanical digestion processes, increasing food consumption and decreasing food use efficiency, will negatively impact economics of fish production.

Protecting fisheries from climate change will require: acclimatizing saltwater fish to low or medium salinity; finding alternatives to freshwater fish for farming in brackish water; finding alternatives to fish meal in the diet as a source of protein; establishment of marine hatcheries for spawning marine fish; implementing marine fish farming projects to compensate for the shortage that may occur in freshwater fish production; providing a distance of 200 meters from the sanctuary of the sea beaches, as stipulated in Article 73 of the Environmental Law No. 4 of 1994 AD, and strict execution of this law in terms of procedures and conditions to be followed.

2.2.2.7. Mr. Ehab Hendawy, GIS and Remote Sensing Analyst at National Authority for Remote Sensing and Space sciences (NARSS), Egypt presented the paper titled **'Assessment of Soil Contamination Using Geospatial Data and Contamination Indices: A Case Study Kitchener Drain, North Nile Delta, Egypt'** in co-authorship with **Drs. Ayman F Abou-Hadid, Abdel-Aziz Belal, Abdel Aziz S. Sheta**.

Mr. Hendawy said, water recycled from agricultural drains is a major resource to adapt for lack of water and increased water consumption due to climate change. Kitchener drain (Gharbia Main drain) is one of the largest drainage systems in Egypt, which is located in North Nile Delta. The soils there are having high levels of heavy metals affecting crop production adversely. The work aimed to produce spatial distribution maps of heavy metals concentration in the soil, based on evaluation of contamination indices for assessing the environmental risk in the studied area. A total of 30 surface soil samples were collected and analyzed by ICP-MS. Eight metals were selected (Ni, Mn, Co, Cu, Cd, Pb, Fe and Zn). Assessment of contamination in the soil was done based on contaminant factor (CF), contamination degree (CD), geo-accumulation index (I-geo), and pollution load index (PLI). The results, based on contamination factor, showed three metals (Ni, Cd and Fe) caused very high

contamination and four (Pb, Mn, Co, and Zn) moderate contamination. The contamination degree ranged from very high to moderate. Based on I-geo values, results showed the pollution was extremely high for Fe and Mn, heavy for Ni and Zn and moderate to heavy for As, Pb and Co; and Cd showed no pollution. PLI was less than 1 for heavy metals in the study area. The results indicate that concentration of toxic metals in the soil has increased, and it will have long-term adverse consequences for both human health and the environment.

2.2.2.8. Ms. Rania Gamal, Research Fellow, Irrigation & Water Management- ICARDA, Cairo, Egypt presented her work on **'Identification and Quantification of Actual Evapotranspiration Using Integrated Satellite Data for Sustainable Water Management in Dry Areas'.** The study was conducted in the research partnership with **Drs. Mohamed El-Shirbeny, Abdel-Ghany El-Gindy, Atef Swelam, Yasser Arafa** and **Vinay Nangia.**

She said, evapotranspiration (ET) is a significant consumer of irrigation water and precipitation on cropland. Global and regional interest in the sustainable management of limited freshwater supplies to meet rapidly increasing population and food demand has resulted in advanced scientific research on ET measurement, rapid water accounting, and irrigation scheduling in the NENA region. The primary aim of this study was to compare actual daily evapotranspiration (ET) with that collected by a remote sensing model and validated by Energy Balance (EB) flux tower field measurements. The flux tower was installed in a wheat field in Sids Agricultural Research Station in Beni Suef Governorate. Through the integration of Moderate Resolution Imaging Spectroradiometer (MODIS) Terra and Sentinel-2 data, a new remote sensing-based ET model is built on two parties: thermal condition factor and vegetation condition factor The remote sensing-based ET estimation model was evaluated using ET field measurements from the Energy Balance flux tower. The land use and land cover maps were created to assist the interpretation of remote sensed ET data. Field data for five categories were collected to test the accuracy of the land use and cover maps: water bodies (93 points), urban areas (252 points), trees (104 points), other field crops (227 points), and wheat (249 points), for a total of 925 ground points. The Google Earth Engine (GEE) imported sentinel-2

datasets and filtered for necessary dates and regions. From 1 October 2020 to 30 May 2021, sentinel-2 data was processed and transformed into Normalized Difference Vegetation Index (NDVI), Normalized Difference Water Index (NDWI), and Normalized Difference Built-up Index (NDBI), which were then combined. The composite layer data were classified using the Random Forest method on the GEE platform, and the results showed an overall accuracy of 91 percent.

The validation factors revealed good indices when RS-based ET results were compared to ground-measured ETs. The Root Mean Square Error (RMSE) was 0.84 mm/day. The 'r' and 'd' values indicated satisfactory results, where 'r' yielded a value of 0.785 indicating that the correlation between predicted and reference results is robust. The analysis of d values revealed a high degree of correlation between predicted (RS-based ET) and reference results (measured ET). The d value was found to be 0.872. Between November 21, 2020, and April 30, 2021, RS-based ET was 418 mm/season, while ground measured ET was 376 mm/season. The new RS-based ET model produced acceptable daily and seasonal results. The results will help develop the best water management to adapt for lack of water and increased temperature as a result of climate change.

2.2.2.9. Dr. Usama A. El-Behary, Dean, Arid Land Agriculture Graduate Studies and Research Institute (ALARI), Ain Shams University, presented the paper titled '**Simple Roof Garden Techniques for Combating Global Warming in Egypt'** in co-authorship with **Dr. Ayman Abou Hadid.**

Dr. El-Behary said, global warming is leading to changes in rainfall patterns, a rise in sea level, and a wide range of impacts on plants, wildlife, and humans. Increasing emissions of Green House Gases (carbon dioxide, ozone, methane and nitrous oxide) are causing rise in temperature. With the current rates of emissions continuing, the CO_2 levels in the atmosphere will double or even triple from their pre-industrial levels before the end of the 21st century, increasing the earth's average temperature by 1.4^{o}C to 5.8^{o}C by the year 2100. With rising population and urbanization, the cultivable area near the cities has been

decreasing and urban buildings are increasing. However, the area of roof has increased; hence, the idea of roof farming in towns has evolved.

Green roofs can help reduce global warming in several ways. The first of these is the purification of city's air by production of oxygen by the photosynthesizing plants and preventing smog formation. This will provide health benefits, such as reduction in mental stress and respiratory and heart problems, to the urban population. Reducing the Urban Heat Island Effect in the city would also contribute to improving the health and quality of living. Also, the increased sound insulation achieved through the layers of growing material and plants would reduce sound pollution. The second aspect is that green roofs can result in the reduction of GHG emissions by decreasing the temperature load of the dwellings and thus reducing their air-conditioning demand and reducing the carbon footprint of urban living. The third advantage is that the life of the roofs themselves, and buildings in general, could increase, and need for repairs decreased, because of protection provided against ultraviolet radiation and extreme temperature fluctuations. No wonder, therefore, the number of roof gardens in megacities is increasing, as is evident from Cairo and other cities in Egypt.

General Discussion

Dr. Paroda, the Chairman, opened the above presentations for discussion. Dr. Mohsen Shoukry wanted to supplement the presentation made by Dr. Aboulnaga regarding the adverse impact of climate change on livestock and adaptation strategy to combat it. He said it was very important to have improvement of local breeds in Egypt, particularly of water buffaloes and small ruminants. Water buffalo is the native livestock for dairy production and we should emphasize their improvement for this trait. Secondly, meat production system is responsible for more methane production than milk production system; therefore, the latter should be given more emphasis. Dr. El-Beltagy requested Dr. Paroda to comment on this issue as a lot of work on improvement of buffaloes has been done in India and there might be scope for collaboration between Egypt and India. Dr. Paroda reiterated the importance of buffaloes in dry areas of India and said they were the lifeline of farmers in these ecologies as they could tolerate temperatures as high as 45 to 48^{0}C. In past, buffalo trade was there from India up to

countries like Azerbaijan, Egypt and Italy. India has been open for collaboration. Recently, India gifted buffalo breeds to Vietnam. Dr. Aboulnaga said there was need for laying emphasis on exploiting the local germplasm of both small ruminants and buffalo. Dr. Rattan Lal said, on a farm in Brazil he saw large number of 'Haryana' cows and 'Murra' buffaloes imported from India and used for meat production. The latter were also imported in Florida, USA, where they were highly adapted and were considered a good source of meat; particularly, if harvested a year younger there was no difference in their meat and beef. Dr. Paroda said buffalo was very good for meat and India was exporting buffalo meat to several countries and is becoming a major exporter in the world.

Dr. Abou Hadid said that the world was currently facing a greater problem of food shortage. He asked Dr. Paroda whether he thought that miracle like "Green Revolution" could happen again. Dr. Paroda hoped so and said there was a need to reorient our research agenda to make those areas that were bypassed by the green revolution more productive, especially the dryland areas. Several presentations have already referred to the potential of Conservation Agriculture (CA) in this regard. CA was currently being practiced on more than 200 million ha globally but has yet to be adopted in the dry areas, although some start has been made in Central Asia and India. This innovation will require very careful approach to take it to farmers, in a mission mode, and with full commitment from the policy makers and with a robust extension system, because the benefits of this innovation would not be visible as quickly as was the case when dwarf wheat and rice cultivars were introduced to usher green revolution. A longer lead time would be needed as also farmers will need support for mechanization through the joint intervention of public and private sectors. On the crop improvement front, good progress has been occurring, but efforts will be needed to improve the efficiency of input use and harnessing modern tools for genetic improvement in developing cultivars for future climates.

Dr. Suleiman raised the concern about the depletion of underground water and water table going down because of unrestricted withdrawals by the private farm owners, particularly in Saudi Arabia, and increasing salinization of land. Dr. Farouk Al Baz emphasized the need for

government intervention to prevent this overexploitation of underground water and ensure sustainable use of water and land resources.

The Chair then summarized the salient points that emerged from the presentations made in the session. The scope of use of simulation modeling was very clearly highlighted, not only for future adaptation needs and impact predictions but also fur current benefits such as helping in crop insurance. A twin pillar approach was needed based on genetic enhancement and natural resource management to cope with the adverse impact of climate change in the dry areas. National commitments have to be achieved. Regenerative agriculture is important and has to be promoted. While adaptation is important but hard approach to mitigation should not be ignored. Agroforestry, afforestation, and cash for more carbon sequestration are important initiatives in this regard. A mission mode approach was needed to tackle the problem. It has to be recognized that agriculture is not only a cause but also a solution of the climate change problems. Therefore, investment should increase on research and development in the field of agriculture, particularly dryland agriculture. Inter-institutional and inter-ministerial collaboration at national level was essential.

Prof. El-Beltagy thanked Dr. Paroda for conducting the session and for bringing out succinctly the take-home messages from it. As there was still time before the start of the next session, he suggested to have a brief panel discussion and invited Prof. Jim Falk, Prof. Dr. Mahmud Ayed Duwayri and Prof. Mohan Saxena to participate in it.

Prof. Falk raised the issue of water management from different river systems and ground water and hoped that the webinar will highlight these issues as they impact the resilience of farmers in the dry areas in the face of changing climate. He stressed that the CC was disturbing food chains, especially in Africa, and there was need to model and predict these impacts. Prof. Duwayri said he would talk about the problem of water and its management in Jordan in another session. He reiterated that the problem was becoming increasingly serious because of climate change. Even the drinking water was becoming scarce. Desalination was being planned to meet municipal needs. There was need for crop diversification and the use of gray and black water for irrigation. Prof.

Saxena emphasized the importance of cutting-edge science in developing adaptation options for different agro-ecologies. Government policies have often restricted the realization by farmers of the benefits from innovative science-based technologies. These restrictions will have to be eased/removed and greater support for R&D ensured. There should be greater coordination of efforts by different agencies, at national and regional levels, and increased cooperation between various stakeholders to enhance the efficacy of various climate-related actions and ensure increased resilience of dryland farmers in the face of climate change.

2.3. Topic 2. Adaptation of Genetic Resources for Different Agro-ecologies

The keynote part of the session on this topic was chaired by **Mr. Aly Abousabaa,** CGIAR Regional Director CWANA and Director General, International Center for Agricultural Research in the Dry Areas (ICARDA), and Former Vice President of the African Development Bank. The lead presentations and discussion part was chaired by **Prof. Dr. Ayman Abou Hadid** of Ain Shams University ALARI Program.

2.3.1. Keynote 1:

The first keynote address under the title **'Genetic Resources for Adaptation to Climate Change in Drylands'** was delivered by **Prof. Dr. Raj Paroda**, Chairman, The Trust for Advancement of Agricultural Sciences (TAAS), and former Secretary, Department of Agricultural Research and Education (DARE) and Director General, Indian Council of Agricultural Research (ICAR), India.

Dr. Paroda said, climate change poses significant risks to our future food, nutrition and environmental security. Agricultural production and productivity are likely to be affected adversely in the drylands, ranging between 5-20 per cent or more, due to rise in temperature, variable rainfall pattern and increase in the incidence of heat, drought, pests and diseases. Therefore, adaptation, through improved varieties and breeds, with better tolerance to biotic (pests and diseases) and abiotic (salt, cold, heat, drought, flood, etc.) stresses, shall help the farmers reduce adverse impact of climate change. Obviously, farmers of drylands have no other option but to embrace climate smart agriculture, centered around 'genotype x environment x management' practices.

Managing genetic resources to adapt well to climate related variations would need concerted efforts to evaluate and identify useful genes present in the landraces, farmer varieties, crop wild relatives and wild and weedy species. For that matter, considerable genetic diversity exists in nature, which must be researched, evaluated and conserved for the benefit of present and future generations. Therefore, availability, through timely access and benefit sharing (ABS), to genetic resources,

possessing valuable traits for climate change adaptation, is most critical in the present context.

It is indeed gratifying that highly tolerant germplasm, be it to cold, heat, drought, flood, pests and diseases, is available with many national agricultural research systems (NARS) and the genebanks of international centers like ICARDA, CIMMYT, ICRISAT, ICRAF, ILRI, etc. Moreover, Central West Asia and North Africa (CWANA), Central Asia and the Caucasus (CAC), and South Asia are known to be the important centers of genetic diversity, possessing hardy crop plants, trees and animal species. Hence, greater research efforts and higher investments are needed now to search for useful genes that can withstand better adverse impacts of climate change. Fortunately, a disruptive innovation like CRISPER/Cas9 offers much better options for genome editing as well as gene pyramiding both in crops and animals. As emphasized, it is encouraging that CWANA, CAC and South Asia region is rich in genetic resources, be those of grasses, trees, crops including horticultural crops, animals, fish, or micro-organisms, especially suited to withstand extreme weather conditions.

Currently, there is a wide range of adaptation options to climate change. These include shift to short duration early maturing stress tolerant varieties (e.g. extra early pearl millet HHB 67; short duration and early maturing chickpea cultivars; salt tolerant wheat cultivar Karchia, etc.) diversification through change of crops, shifting crops to newer areas such as apple to higher elevation, maize to winter season, soybeans to drylands, etc., and mixed or relay farming practices. In fact, major gains have been obtained through genetic enhancement (such as nobilization in sugarcane to spread its planting from tropical south to sub-temperate regions in north India). Similarly, breeding suitable single cross hybrids of maize for winter season in eastern India, short duration chickpea to spread its cultivation from north to south India and short duration mungbean to fit well in rice-wheat cropping system in the northern region, has led to more sustainable intensification and increase in both production and productivity. However, these options are not mutually exclusive. In fact, these are most often used in combinations (e.g., changing farming practices also includes changes in crops and varieties). He emphasized the importance of drought tolerant crops such as moth bean *(Vigna aconitifolia*) and multipurpose tree crop *khejari* (*Prosopis cineraria*) for providing resilience to farmers in the

arid areas. Genetic improvement of the latter, in terms of plant structure and bearing habit, has enabled it to become a very profitable tree species for mixed farming in arid areas of India.

Another major form of adaptation is gradual transition to more resilient production systems such as conservation agriculture (CA), integrated nutrient and soil management (INSM), regenerative agriculture, etc. All these practices, helpful in carbon sequestration, would demand use of wider genetic resources, besides greater investment in AR4D, strengthening of institutions and human resource, coupled with enabling policy environment, to address Paris Agreement.

In the recent past, COVID-19 pandemic has also taught us important lessons. In fact, the farmers and nations shall have to make adjustments and take actions to enhance resilience through climate smart agriculture centered around local food systems that not only enhance their income but also help in reducing adverse impact of climate change. Recently held UN Food Systems Summit has also laid greater emphasis on renewed thrust on R&D around local nutri-food systems that are good for nutrition, health and immunity.

In fact, the Climate Smart Agriculture (CSA) addresses the interlinked challenges of food security and climate change. It aims to tackle three objectives: i) sustainably increasing agricultural productivity and incomes; ii) adapting and building resilience to climate change; and iii) reducing emissions for each calorie or kilo of food produced, avoid deforestation from agriculture, and identify ways to absorb carbon out of atmosphere. The genetic resources could also play a key role in carbon sequestration especially in the soils of drylands. Globally, 'no till' practice is being adopted covering around 225 m ha of drylands, mainly in Argentina, Australia, Brazil, Canada and the USA. Accordingly, CSA is expected to help farmers in drylands of CWANA, Central and South Asia to combat climate change while aiming to achieve both the SDGs and Paris Agreement.

In summary, the way forward is to explore, collect, exchange, evaluate, document, use, and conserve diverse genetic resources to meet climate change related stresses. Concerted efforts are urgently needed to use valuable genetic resources - both indigenous and exotic. For this, the biotechnologists and plant breeders need to intensify efforts to develop improved varieties and breeds that may adapt well to increased biotic and abiotic stresses due to climate change. The strategy to move

forward will be to ensure that there are: 1) a national policy and commitment on climate smart agriculture; 2) scientific, eco-region wise, land-use planning; 3) strategic research networks for scaling innovations; 4) collaboration involving all stakeholders at the national/regional/international level; and 5) institutions and capacity development.

In the discussion that followed, Dr. Soloman commented that application of new technologies in crop improvement is constrained by excessive overhead charges made by the multinational private sector companies on these technologies or their products. This issue has to be resolved so that small-holder farmers could also get their benefit. Dr. Paroda agreed and said that public and private sector partnership is important in this regard and the policy makers have to make bold decisions. He gave example of the Bt cotton in India, where a local private sector company (Mahyco) in India was encouraged to enter in collaboration with the multinational company and produce the seeds for making them available at affordable price to the farmers. The result was that India is now the largest producer of cotton and use of pesticides on cotton is considerably curtailed.

2.3.2. Keynote 2:

The second keynote address under the title **'CGIAR's Agri-food Systems Climate Adaptation –Responding to the Global Food Crisis'** was delivered by **Mr. Aly Abousabaa**, Regional Director CWANA and Director General, International Center for Agricultural Research in the Dry Areas (ICARDA); Former Vice President of the African Development

Mr. Abousabaa said that the global food prices have surged 65% since the start of the Covid-19 pandemic, while the war in Ukraine has crippled grain supply chains and caused a spike in energy prices, driving up fertilizer and shipping costs. The rural poor in developing countries dependent on imports, especially in the Middle East and North Africa, have been badly hit. Yet the crisis presents us with an opportunity for a critical change in the global mindset about climate adaptation of our agri-food systems.

Already, CGIAR's innovations offer the potential to ease the global food crisis – but only if we can optimize them through north-south research collaboration, funded by significant investment in agricultural R&D. With a worldwide partner network spanning five decades, and 9,000

staff in 100 countries, CGIAR is in a solid position to play a key role in the global response to the food crisis.

While CGIAR is engaged in reducing wheat dependence through its climate-resilient varieties that can still perform well in harsher environments, at this critical moment, we should also look beyond wheat. We must consider the highly nutritious, hardy, yet 'neglected' crops that ICARDA, under CGIAR's mandate, quietly develops in the background to significant effect. Take our high-yield, high-protein, early maturing lentils in India that, planted between rice harvests, offer farmers a 'bonus' crop for extra income; the improved barley varieties boosting Morocco's pasta and brewing industries; and barley/wheat flour mixes gaining traction in the NENA region for bread production, reducing the amount of import of wheat. Accompanied by climate-smart water and soil management approaches, and scaled via improved policies for market access and capacity development programs, these innovations can significantly reduce pressure on import dependence.

CGIAR's Regional Integrated Initiative for CWANA, coordinated by ICARDA, has five work packages: WP1. Innovations in partnership, policies and platform; WP2. Biodiversity preservation; WP3. Sustainable and equitable intensification of farming systems; WP4. Water and landscape management and energy systems; and WP5. Digitization-assisted climate resilience.

Beyond crops, there is also a need to work on the weaknesses in our agri-food systems, such as price volatility and export restrictions. CGIAR, through its partner networks, provides early warning systems through engagement with global information frameworks, supported by our innovations such as the 'Excessive Food Price Volatility Early Warning System' and 'Food and Fertilizer Exports Restrictions Tracker'.

Alongside our partners, we have also developed a new portfolio of global initiatives that strengthen agri-food, land, and water systems foundations by addressing fragility in climate-vulnerable regions, rehabilitating post-conflict seed systems, halting land and soil degradation, and protecting precious biodiversity for tomorrow's generation of agricultural experts. Capacity building and policy research are central to making technology and markets more accessible to

farmers, especially women and youth. We have also committed to joining forces with NARIS to bolster the Global South's in-country capacity for research and scaling. We also advocate for accelerated deployment of tools and analytics to deliver fertilizer recommendations at scale, and we collaborate with the 'Nature+ Initiative' on rapid identification of locally available sources of organic fertilizer inputs to bridge the fertilizer gap.

Climate-smart agri-food systems innovations should be holistically and systematically designed and targeted, delivered within integrated technology, capacity building, and policy research packages that ensure innovations are inclusive of all stakeholders and thereby adopted, effective, and scaled out. Furthermore, the Global North is a new agricultural frontier for CGIAR. The climate-impacted south can offer essential knowledge, innovation, and expertise. At this critical moment, world's leaders, research institutions, farmers, and private sector have to work together to build sustainable and resilient agri-food systems that can take further shocks in their stride.

In the discussion that followed the detailed presentation by Mr. Abousabaa, Dr. El-Beltagy, while congratulating him for the work being done by ICARDA, reminded that the CWANA region needed more expertise in the field of genetic enhancement of field crops. ICARDA had taken the initiative for capacity building in crop improvement in the region by establishing the Norman Borlaug Center at the Headquarters in Syria. He enquired about the current status in this regard. Mr. Abousabaa agreed that this was an area of great priority for the Center. Two specific developments were worth sharing in this regard: 1. Breeding structures and methodologies are being improved through research. For example, procedures for accelerated breeding of ICARDA mandate crops are permitting incorporation of climate smart characters in the cultivars in a very short time; 2. Funding for Arab Center for training of young scientists in crop breeding has been procured, and, in collaboration with Japan, a Post-Doctoral training program has been started.

Dr. El Shaer enquired about ICARDA's research work on small ruminants. Mr. Abousabaa, acknowledging that his presentation did not cover this important work, said that the Center was working with NARS

partners in breeding, health and nutritional aspects of small ruminants for improving their productivity and reducing their GHG emission through the use of innovative feeds. Pasture and rangeland management was another important area of collaborative research with NARS partners.

2.3.3. Lead presentations and discussion:

2.3.3.1. 'Climate Change, its Impact and Mitigation Technologies for Agriculture and Environment' was the title of the presentation of **Prof. Dr. Kauser Abdulla Malik**, HEC Distinguished National Professor and Head of Biotechnology Program at Forman Christian College (FCC), Lahore, Pakistan. He reminded the audience that the climate change is a reality and no more a topic for debate. This, at present, is the most important environmental factor affecting agricultural production, thus impacting food security. Global agriculture is estimated to account for about 20% of the total anthropogenic emissions of greenhouse gases. Pakistan is 7th in the list of countries affected by climate change. With the increasing population, it is imperative to find ways and means to adapt and mitigate effects of climate change on our agriculture. The main Climate Change culprit is CO_2, which accounts for 77% of GHG emissions; other gases namely CH_4, N_2O, SF_6, CFC, etc. contribute to remaining 23% of emissions. Due to the increase in GHG emissions, there are predictions that temperatures will go beyond 1.8^{0}C by 2050. This will affect evaporative demand of crops and create water scarcity in many areas, whereas at other places there might be increase in rainfall intensity and storms leading to floods, as has been occurring in recent months in different countries, including the worst flood in recent history in Pakistan. This will all affect crop productivity and accentuate food shortage. Adaptation to these changes and mitigation of their adverse impact would require a multi-pronged approach.

For mitigation, afforestation to sequester CO_2 will be most important as also other measures that reduce the emissions of GHGs from agricultural lands and production systems. Adoption of all conservation agriculture technologies such as laser leveling of fields and use of high efficiency irrigation systems, minimum tillage, avoiding straw burning,

reducing/recycling methane gas emission from paddy fields, and reducing the use of agro-chemicals (pesticides, nitrogenous fertilizers, etc.) will all contribute to mitigation besides permitting adaptation to the unfolding impacts of climate change. Among other measures for adaptation, introducing drought and heat tolerance in all commercial crop cultivars and crop diversification are key strategies that need to be promoted as these are essential elements of climate-smart agriculture.

Biotechnology is providing opportunity to make rapid progress in the use of novel plant genetic resources to rapidly breed climate-resilient cultivars and environment safe production inputs. FCC has been undertaking collaborative research, using cutting edge biotechnological tools, with national and international advanced research institutions, to improve the genetic base and develop new cultivars and production inputs which will enable farmers to enhance their resilience in the face adverse impacts of climate change. Genome editing has permitted developing transgenic wheat with salt and herbicide tolerance, improved N and P use efficiency, enriched vitamin B6 content and improved bioavailability of Zn and Fe. Use of advance molecular biology techniques has permitted isolation and identification of microbial populations capable of recycling methane that gets generated in paddy rice fields. Also, plant growth-promoting rhizobateria have been identified for wheat, maize and cowpeas and commercially used. Increased support for R&D is needed to further promote the use of biotechnology and molecular biology tools in developing climate-smart crop cultivars and essential production inputs, that could be accessible to resource poor farmers to enhance their resilience to climate change. Farmers.

2.3.3.2. The next paper, **'Gene Editing for Adaptation of Dryland Crops to Changing Climate'** by **Prof. Dr. Magdy Madkour**, Emeritus Professor, Biotechnology at the Arid Lands Agricultural Research Institute (ALARI), Ain Shams University, and **Prof. Dr. Sameh E. Hassanein**, Head of Bioinformatics and Functional Genomics Department., College of Biotechnology, Misr University for Science and Technology (MUST), Egypt was presented by **Prof. Hassanein**. He said, climate change imposes a severe threat to agricultural systems, food security, and human nutrition. The development of high throughput technologies has given rise to a wealth of information at system level

including genome, epigenome, transcriptome, proteome and metabolome that can help in speedily developing climate-smart crop varieties. However, it remains a major challenge to digest the massive amounts of information and use it in an intelligent and comprehensive manner.

During the past several years, significant progress has been made regarding the DNA sequencing technologies. Meanwhile, efforts in crop and livestock gene editing have been undertaken to improve performance across a range of traits. Plant-genome editing, using a host of new tools, including Zinc-Finger Nucleases (ZFNs), Transcription Activator-Like Effector Nucleases (TALENs) and Clustered Regularly Interspaced Short Palindromic Repeats (CRISPRs), is poised to have the greatest effect on precisely changing DNA sequences in crops in novel ways. CRISPR can be used to introduce new genetic material. CRISPR can make precise mutations by substituting existing DNA sequences with desired ones. Developing computational tools and resources to analyze and integrate large scale 'omics' datasets and tools, will help researchers to understand how genes work together to compose functioning systems and organisms that could be beneficial for climate change adaptation.

While only a few applications of gene editing have been translated to agricultural production thus far, numerous studies in research settings have demonstrated the potential for potent applications to address climate change in the near future. Traditional plant breeding can take years – or even decades to develop new crop varieties. Advancing genomic technologies are making the direct editing of the DNA of crops possible for many plant breeders. The science of genomics studies the entire DNA sequence of an organism, which covers all the chromosomes. Knowing the DNA sequence guides decisions about how to solve problems faced by that organism. In crop plants, genomics is used to determine the best genes to be selected for improved crop varieties. This allows plant breeders to choose, from a wide selection, the plants with the best DNA sequence at many genes and for many traits at the same time. Studying genomics allows scientists to look at how plants respond to biotic and abiotic stresses. They also study traits that make plants more (or less) resilient to various environmental conditions like heat, drought, salinity, new emerging pests and pathogens. The final goal is to predict which plants will perform best, and under which conditions. It

can even help produce plants that adapt to high global rise of temperature up to 4C°. However, policy makers in the government will have to create enabling environment to let the outcome of this innovation-based research technology to benefit and enhance resilience of farmers and enable them to meet the growing needs of food in spite of the changing climate.

2.3.3.3. Prof. Dr. Hassan M. El Shaer, Animal Production and Rangelands Utilization, Egyptian Center of Excellence for Saline Agriculture (ECESA), Desert Research Center, Ministry of Agriculture, Egypt, presented the paper titled '**Improving the Livelihood of Smallholder Farmers impacted by Climate Changes in Sinai, Egypt through Optimal Utilization of Integrated Saline Agriculture Systems: A Case Study.'** He said that one of the major challenges for Egypt Government is to meet the food needs of fast-growing population in the face of severe climate change impacts on agricultural development. Northern Sinai region is of strategic, economic, and social importance for the security and economic development of Egypt. It is particularly vulnerable to environmental and climatic changes. Rural small-holder farmers are most vulnerable in the region. Farming community is largely composed of traditional small-scale farmers whose soil and crop productivity, and animal and human health are adversely affected by severe climate changes.

The region is facing many challenges such as sand dune movement, increasing drought, a long hot summer with low and erratic winter rainfall and animal feed shortage. Experiences and skills of local farmers in improving agriculture and animal productivity practices under these marginal conditions are humble. A five-year project was implemented in the region, in collaboration with ICBA, other relevant IARCs and FAO. It identified the barriers to diversification of the farming system and scaling out. The objective was to improve the livelihood of small-holder farmers in salinity-affected environment of North Sinai region, through increased crop-livestock productivity. It was achieved through the following activities: 1) Developing and disseminating new high-yielding, salinity-tolerant forages (sorghum, pearl millet, barley, fodder beets, triticale), and other high value crops (oats, safflower, quinoa etc.) and crop management technologies (e.g., use of gated pipes and drip irrigation systems instead of flood irrigation, use of effluents from fish

farming for fertigation, dairy production, etc.) for economic and sustainable crop-livestock production; 2) Conducting large-scale field evaluation and transfer of integrated management packages (IMP) of crops and animal production and feeding technologies (e.g., use of feed blocks) to local farmers; 3) Socio-economic empowerment of farmers; and 4) Building capacity of participating farmers in crop and livestock production and value addition to their farm produce.

The project demonstrated that enhancing plant production through transferring new integrated management technological approaches, for using all marginal resources, would ultimately contribute to the improvement of the livelihood and income of farmers in such regions. It was successful in developing more resilient agricultural production systems through better management of farm resources along the value chain and in attaining high production and income. It is recommended that utilizing fragile ecosystem resources, impacted by climate changes in North Sinai region, in a more sustainable integrated model is an opportunity to contribute to the local socioeconomic development of small farmers' livelihood. This model should be replicated in similar marginal regions in Egypt, and other Arab and African countries.

2.3.3.4. Prof. Yasser M. Shabana, Plant Pathology Department, Faculty of Agriculture, Mansoura University, Egypt presented his paper titled '**Impact of Climate Change on Wheat Yellow Rust Epidemics in Egypt'.** Prof. Shabana said climate change directly influences the disease infection on the crops, and their productivity, and thus causes food insecurity. Yellow or stripe rust is a major disease of wheat in Egypt and other wheat producing countries. This study was conducted to develop weather-dependent disease-incidence models to predict disease incidence in the future (years 2030, 2050, 2070, and 2090), based on weather conditions predicted in Global Climate Model GIS-SE2, with two pathways (RCB 4.5 and RCB 8.5). This would help providing all stakeholders with information on short and long-term measures to minimize crop losses and threat to food security.

Disease score of wheat yellow rust were recorded in late February to early March, in 8 growing seasons (from 2012/13 to 2019/20), on 6 winter wheat varieties ('Sakha 94', 'Sids 12', 'Giza 168', 'Gemmeiza 11', 'Giza 171' and 'Misr 1' which differ in their susceptibility to the disease),

in 7 governorates of Egypt (Al-Beera, Al-Sharkia, Al-Fayoum, Kafr El – Sheikh, Al- Menofia, Bani Suef and Al-Nobaria). Regression model was used to relate % disease severity with monthly total rainfall and maximum, average and minimum temperatures from December to February.

There was good fit between the observed and predicted values from the fitted model. Disease incidence was low till 2016, but increased to nearly 100% thereafter till 2020 in Gemmeiza 11, a susceptible cultivar, because of changing weather conditions and perhaps the appearance of a new race of the pathogen. In case of Misr 1, the disease incidence change had same pattern but the incidence was lesser. Incidence in Gemmeiza 11, predicted for future climate change was, 100% in both pathways (RCB 4.5 and RCB 8.5). In case of Misr 1, the predicted incidence increased in both the scenarios till 2070, but decreased thereafter under RCB 8.5 scenario, where the rise in predicted temperature is higher than RCB 4.5. The study led to the conclusion that cultivation of susceptible cultivar Gemmeiza 11 should be stopped altogether because the disease incidence was 100% after 2030 in both the pathways of climate change prediction. Even the moderately susceptible Misr 1 should be replaced by more resistant cultivar such as Giza 171. The work highlights the need to develop adaptation strategies to mitigate the impact of predicted climate change on yellow rust incidence and wheat production. The strategy should include: disease resistant cultivars, new technologies for surveillance of disease outbreaks, shifting the date of sowing, and developing new effective fungicides with multiple modes of action.

2.3.3.5. Dr. Vinay Nangia, Research Program Leader – Soil, Water, and Agronomy at ICARDA presented the paper titled '**Water for Food, Water for Life: The Drylands Challenge'.** He said water scarcity is increasing, especially in dry environments with climate change and degradation of natural resources. About 41% of the Earth's land area is classified as dryland; wherein the farming system is characterized by low annual rainfall with much of it falling in the winter and spring. Agriculture, especially in Central and West Asia and North Africa (CWANA), is required to produce more food and welfare for rapidly increasing populations but with less freshwater resources. Conventional

responses to this situation are focused on increasing yields, improving irrigation efficiency and managing demand. However, it seems those strategies are either not working under current conditions or not anymore sufficient to cope with the daunting demand for more food in water scarce dryland regions.

A paradigm shift in how we manage water is needed as we go into the future. The debate on how better to handle agricultural water allocation and use with increasing scarcity is being intensified over the last decade and is producing new transformative solutions. Climate-smart agricultural practices that would require less water, can sustain climatic stresses, produce food with high nutritive value but require less water and energy to produce are urgently needed. This seems possible because of the two bright spots. First is the digital readiness of the farming community. Nearly 72% of the area has some sort of network coverage (2G, 3G or 4G) and 26% hazard-exposed areas are suitable for climate information services. The second is the possibility of practicing climate smart agriculture by harnessing digital technologies, machine learning, artificial intelligence, and early warning and decision support models to help, plan, control, optimize input and risks to improve, sustain and profit from agriculture.

Climate smart precision farming is a key component of the third wave of modern agriculture revolution in which each farmer can produce enough food for 265 people as against the first revolution (mechanization of agriculture in 1900-1930), when each farmer could produce enough food for 86 people and the second revolution of 1960s (prompted by green revolution based on new methods of genetic modification of cultivars) when each farmer was able to meet food needs of 156 people, on the same area of agricultural land.

Precision farming is a technology-enabled approach to farming management that observes, measures, and analyzes the needs of individual fields and crops. It involves ‘smart irrigation’ (based on automatic monitoring of soil conditions, weather changes, evaporative losses, and plant water use to determine and adjust watering schedule; ‘smart detection’ (computer vision enabled high resolution cameras to recognize insect pests for detection and planning pest management); ‘smart fertilization’ (demand-based application of right inputs at right

place and right time for balanced nutrition); 'smart sensing' (using weather pattern analysis, automatically generate alerts for disease outbreaks; and 'smart advising' (cloud computing-based analytics to generate vernacular advisory for farmers on precision farm management to optimize inputs and enhance income) on smart phones.

That this is possible has been demonstrated by some of the recent work done by ICARDA in the CWANA region, in partnership with national programs and advanced research institutions elsewhere. For example, climate-smart agriculture water management practices were introduced in some ICARDA projects in NENA region: 1) Solar-powered ultra-low energy (ULE) drip irrigation system, developed in collaboration with MIT, that has an activation pressure of 0.15 bars requiring 50% less overall system pumping power than the existing products and 42% less capital cost. 2) Sensor-based irrigation scheduling (evapotranspiration based) advisory system, developed with the University of Minnesota, being promoted in Uzbekistan, providing 32% irrigation water saving in contrast to flood irrigation common in the Central Asia region. The 'NENA Regional Evapotranspiration Network', jointly established with FAO, in which the ET measurement instrumentation provides for informed decision making on agricultural water management, is another innovation spearheaded by ICARDA. Profitable diversification of cropping system, by introducing high value crops such as quinoa or introducing inter- and relay cropping, is yet another approach being promoted to increase farm income and availability of more nutritious food per unit of water used.

With young aspirational population, advent of new material and business models, significant ownership of smart phones and reduction in the cost of 'Internet of Things', sensors, drones, remote sensing imageries etc., there is hope that digital technologies can bring transformative changes in the livelihoods and food security in the face of changing climate.

2.4. Topic 3. Identification of Appropriate Agro-management Techniques for Different Agro-ecologies

Prof. Dr. Rattan Lal, Professor of Soil Science and Director of the CFAES, Rattan Lal Center for Carbon Management and Sequestration at the Ohio State University, Ohio, USA, chaired the session.

2.4.1. Keynote: Farming Carbon in Global Drylands

Prof. Dr. Rattan Lal, delivering the keynote address, said drylands are the planet's largest terrestrial biomes and provide large feedback to climate change. Global drylands constitute 41-47% of the world's land surface and host 38-39% of the world's population. However, the aerial coverage of global drylands has increased since the 1950s (41% to 47 % at present), with notable changes in precipitation patterns prior to and after 1980. Further, the aerial coverage of global drylands could increase by an additional 7% by 2100 under high-end climate change. At the same level of warming, the number of people projected to live in drylands may range from 3.3 to 5.2 billion depending on socio-economic developments. At 4°C warmer world compared to the pre-industrial level, 11.2% of global land area is projected to shift towards drier types and 4.24% to wetter regimes. The increasing aridity, enhanced warming, and growing population can exacerbate risks of desertification, and the attendant global warming. By limiting global warming to 1.5°C, as many as 1.9 B people could avoid living in drylands compared to a 4°C warmer world. Thus, sequestering atmospheric CO_2 in land-based sinks in drylands is one of the win-win options of adaptation and mitigation of climate change.

With judicious land use and management, dryland agro-ecosystems could be an important sink for atmospheric C because of their spatial extent and the severity of degradation. Furthermore, rainfed agriculture accounts for ~3/4 of global croplands. Sequestration of soil organic carbon (SOC) and soil inorganic carbon (SIC), through judicious land use and management, may help reduce risks of drought. Drought preparedness and drought mitigation are important to developing world's drylands. Increase in dryland surface Albedo may represent

feedback to future climate change. With rate of SOC sequestration in arid/ semi-arid grasslands at 50.6 g $C/m^2.yr$ in the top 50 cm depth, drylands are an important sink of atmospheric CO_2.

Agricultural practices leading to SOC sequestration include conservation agriculture, and complex rotations including integration of crops with trees and livestock. Strip inter-cropping of maize-pulse crops has a productivity advantage over monoculture on some drylands of South Asia. Adoption of no-till in field crops and growing cover crops in tree crops can increase SOC stocks. Clump or bunch planting improves water use efficiency and sustains productivity. Drylands, covering 5.2 B ha of land area (43% of Earth's surface), have a potential to sequester more than 1.0 Pg C/ yr. The soil C pool in drylands is stabilized for 100 to thousands of years. Potential of SIC sequestration in dryland soils is large and is receiving increasing attention. In addition to adaptation and mitigation of climate change, increase in both SIC and SOC stocks can create another income stream for farmers.

The carbon farming, growing of soil C stock for the purpose of using it as a farm commodity that can be bought and sold, in vast drylands of the terrestrial biome, can advance several key Sustainable Development Goals of the Agenda 2030 of the United Nations. It involves management of carbon pools, flows, and GHG fluxes at farm level with the purpose of mitigating climate change. It includes management of both materials and vegetation, plus fluxes of CO_2, CH_4, and N_2O, the last one related to fertilizer use. The expected deliverables of carbon farming are: a) carbon removal and subsequent storage in biomass above/below ground and in agricultural soil; b) avoidance of future CO_2 and other GHG emissions; and c) the reduction of existing CO_2 and other GHG emissions.

Farmers should be paid for this. In addition to public funding, C farming mechanism are being setup that enable private sector to pay farmers for delivering climate mitigation. Transfer of fund can occur via the supply chain for agricultural products (e.g., as a markup of product prices) or via C market. The latter can be setup as a public or private initiative. The C markets are not well setup as yet. The demand for C offset is developed with companies, which have taken C-neutrality pledges (e.g., Amazon, Uber, Microsoft, IBM etc.). These pledges are voluntary and the

companies have wide latitude in how to meet these pledges. The buyers are uncertain about these pledges. The current price is about $ 10 to 20 per Mg of CO_2 equivalent. The role of private sector is very crucial in promoting this, in translating science into action by promoting nature positive agriculture and increasing access to inputs and improving investment in agricultural research and development. Fertilizers and other management factors affect grain yield in arid regions, depending on whether the farming is rainfed or irrigated. Carbon based fertilization (CNPK) is important rather than just use of only NPK. The societal value of organic carbon is $130 per ton of C. It is important that farmers are paid properly, fairly and adequately for their efforts in sequestering C through their agricultural practices.

Dr. Lal reminded that, just like there are human rights and rights of nature, the soils must also have rights, as they harbor enormous biodiversity. Being essence of all life, soils must also have rights to be protected, restored, thrive and managed judiciously. There is no life without soil. Soil C has primary impact on Sustainable Development Goals (SDGs) 2 (End Hunger), 13 (Climate Action) and 15 (Life on Land) and secondary impact on SDGs 1(End Poverty), 3 (Good Health), 6 (clean Water) and 7 (Clean Energy).

Importance of soil and soil carbon, as an important part of natural endowments to the people has to be inculcated in the coming generation through education. They should be prepared to appropriately address global issues. Hence, their curriculum should make them aware not only of 3 Rs (Rights, Respect and Responsibility) but also of Food & Nutrition, Environment (Soil, Water, Air, Global Warming), Personal Responsibility, Ethics, Integrity and Respect for Nature. The children should know where the food comes from.

Dr. Lal strongly recommended that COP27 consider that creating science is not good enough. It should get converted into action. Translating science of dryland farming into action by linking with SDGs and scaling up regional and global levels by networking, cooperation and building bridges across disciplines and political/social boundaries is very important. Soil and Agriculture should be considered as a solution to global issues. Being the source of critical ecosystem services for human wellbeing and nature, it is essential to make judicious

management of soil integral to addressing global issues "Beyond Food and Fuel". It is critical to objectively consider how we produce, store, process, transport and conserve our food and manage byproducts of agro-ecosystems in ways that spare land for nature, maximize the use efficiency of inputs and minimize the environmental footprint. The importance of other uses of soils beyond food and fuel can never be over emphasized. COP27 must clearly state the importance of making sustainable soil health and agriculture management as a win-win solution to climate change and other environmental issues and also being critical to advancing the SDGs and the Agenda 2030 of the United Nations.

In the discussion that followed the presentation, Dr. Sheta said that the carbon status of the arid land soils is low and it seems difficult to raise the carbon stock. He wanted to know if there were any new techniques to raise carbon status of these soils. Dr. Lal agreed that raising organic carbon content in drylands posed limitation, but inorganic carbon could be conserved in the form of secondary carbonates and bicarbonates. Also, other practices that increase crop productivity would lead to carbon enrichment of soil through increased root and other biomass addition. Mulching with crop residues was also important. Use of gravel mulch was a very potent practice and is being extensively used on the drylands in China.

2.4.2. Lead Presentations and Discussion:

2.4.2.1. **Dr. Rolando A. Flores Galarza**, Dean and Chief Administrative Officer in the College of Agricultural, Consumer and Environmental Sciences at New Mexico State University (NMSU), Las Cruces, NM, USA, presented his paper titled **'Improving and Enhancing Adaptive Capacity to Cope with Climate Change Worldwide'**. The College of Agricultural, Consumer and Environmental Sciences (ACES) at New Mexico State University (NMSU) is a land-grant College in a Hispanic-Serving Institution with the mission of being an engine for economic and community development through teaching, research and extension activities in the Southwest of the USA, serving arid and semi-arid lands, particularly the eco-region of northern and central New Mexico and the Chihuahuan desert. To increase the worldwide impact of ACES activities and tackle the grand challenges of our time, while strengthening the

relationship with Latin American and the Caribbean (LAC) region, a partnership has been established with the Inter-American Institute for Cooperation on Agriculture (IICA). This collaboration strengthens global engagement through international scientific–technological cooperation. The activities are driven by the four pillars of ACES: food and fiber production and marketing, water use and conservation, family development and health, and environmental stewardship, within the framework of the ACES Strategic Plan 2020–2025. Research priorities for the College of ACES are related to human nutrition, food technology, food safety and security, agricultural technology, global food security, water scarcity, drought, and climate resiliency.

The current forest wildfires and ongoing drought and extreme events in northern and central New Mexico demonstrate the importance of an integrated strategy to reduce the impact of climate change. ACES research and outreach efforts are focused on: (i) dynamic assessment of the impact of climate change on eco-systems by modeling vegetation, carbon cycle, dryland water and energy exchange; (ii) the role of economic, policy and hydrologic characteristics and their contribution to explaining access to safe drinking water, as well as testing and developing new water management technologies in agriculture; (iii) carbon management and soil health and their role in natural climate solutions, as well as identifying, verifying, and disseminating cost-effective practices that will provide additional revenue to farmers in arid and semiarid environments; (iv) development and incorporation of digital technologies in agricultural and food systems such as machine learning, robotics, and artificial intelligence; (v) genetic resources for these agro-ecologies through a comprehensive seed bank, nursery, and planting operations in forests; (vi) bio-economy in agriculture and rural areas through innovative, trans-disciplinary research that develops strong food and value-added agricultural businesses, in partnership with industry; and (vii) sustainable development in arid and semi-arid areas through the use of renewable energy (wind, solar and bioenergy) in agriculture.

2.4.2.2. Dr. M.L. Jat, Global Research Program Director, Resilient Farms and Food Systems Program, ICRISAT, Hyderabad, India presented his paper titled **'Sustainable Intensification and Enhanced Resilience of**

Drylands: Constraints and Strategies' in co-authorship of **Dr. Mahesh K Gathala** of CYMMIT, Dhaka.

He said, the world's drylands form an extensive biome, covering some 45% of the terrestrial surface area supporting 2.5-3 billion people and 1.4 billion (48%) of the Worlds' livestock. Drylands are home to majority of the World's poor, with around 16% living in chronic poverty -- mostly smallholder farmers. The dry areas are the global 'hotspots' for contemporary and future climate vulnerability with most stressed natural resources as compared to other regions. They are also the most food and water deficit regions of the world. The anthropogenic climate change has already slowed down the global agricultural productivity growth by 21% with highest impact in dryland regions. There is a strong relationship of dominance of smallholders, drylands, climate change and malnutrition. The agri-food systems in drylands require systemic solutions of climate-smart, regenerative and profitable innovations.

For sustainable food, nutrition and livelihoods, immediate actions are required to produce more nutritious food from less inputs, degraded natural resources and with increased climatic variability. Conservation Agriculture (CA) based sustainable intensification practices (currently covering over 200 million hectares globally), coupled with precision water- and nutrient management and adapted climate resilient crop varieties, can potentially help in sustainable farming in drylands.

The sustainable intensification in drylands would essentially need to integrate genetic, ecological, and socio-economic innovations and information, considering whole farm and household issues to increase productivity per unit land, labor, and capital through ensuring efficient and prudent use of inputs, conserve or enhances natural resources and increase resilience and equity and reduce risks. Therefore, developing and targeting portfolio of component technologies through bundling on a system basis and defining their recommendation domains are critical for the needed investment decisions for impact at scale.

A meta-analysis of CA based practices in irrigated drylands of South Asia shows a mean yield advantage of 5.8% with 12.6% higher water use efficiency, 25.9% increase in net economic return and 12–33%

reduction in global warming potential. Further, there has been a significant advancement in various conservation agriculture based technological interventions for a food- and water-secure world. The recent research innovations on portfolios of innovative agronomic practices on bundling CA with other component technologies such as laser leveling, soil moisture tension-based irrigation scheduling, sub-surface drip fertigation, automated irrigation etc. have shown promise in this respect. Fully validated science-based evidence has demonstrated that system targeted CA-based management practices have a potential to produce more (10-15%) food from less water (20-75%) and energy (20-45%), while increasing farmers income (25-50%) in an environmentally responsible manner through lowering carbon footprints by 25-30%. System-based research showed complementing effects of layering laser land leveling and CA on crop and water productivity and economic returns.

Sustainable intensification and resilience of drylands would require holistic approaches combining genetic innovations, climate-informed planning of cropping systems, efficient use of production input, adaptive measures to climate shocks, market inclusivity and ecosystem services. Therefore, R&D efforts in drylands must focus on innovations, integrating agronomy, genetics, and socio-economics combined with knowledge intensification to build climate safety nets for improved wellbeing of smallholder farmers and poor rural communities.

In subsequent discussion, Dr. Ratan Lal saught Dr. Jat's suggestions for the optimization of Conservation Agriculture. Dr. Jat said there was a need for identifying approprite crops and cultivars for different agroecologies to enhance the efficacy of Conservatiuon Agriculture. Also, specific machinery will be needed for different situations, as one make may not be ideal for all.

2.4.2.3. Dr. Ch. Srinivasa Rao, Director of ICAR-NAARM, Hyderabad, India presented the paper titled '**Identification of Appropriate Agro-management Techniques Towards Climate Change Adaptation in Tropical Ecosystems'.**

Dr. Rao said, changing climate and its catastrophic impacts on agriculture sector are being witnessed globally. Reduction in

agricultural production creates food shortage, reduction in farm income, and increase in poverty and hunger in the vulnerable communities, particularly in the rainfed dryland ecosystems of the world. There are nearly 195 million undernourished people in India, mostly in dryland regions, and there is a challenge of doubling food production in India by 2050 to meet the requirement of the ever-growing population. Thus, it is important that management of different agro-ecosystems, through appropriate techniques, is implemented in the face of increasing climate change impacts such as droughts, heat waves, cyclones, floods, cold waves, etc., threating food and nutrient security at regional and sub-regional levels. Adaptation to climate change would also help in achieving sustainable development goals (SDGs).

Some 54% of India faces high to extremely water stress. At the same time, large proportion of agricultural land (>55%) is rainfed. Hence rainwater management is very important. Water-smart technologies involving in-situ rainwater management as well as farm ponds are critical for managing droughts that can occur at any stage of crop growth. Efficient utilization of conserved water with micro-irrigation (drip and fertigation) techniques, furrow-irrigated raised bed, laser land leveling, recycling wastewater, mulching, watershed management, appropriate drainage systems etc., would enable soil moisture availability throughout the period of crop growth. At the same time, there is a need to prioritize the use of harvested water in the face of extreme water scarcity. The first priority should be livestock, second horticulture and third annual crop production. Multiple uses of harvested water at farm level need to be promoted: for example vegetable growing, duck farming, cage aquaculture and home nursery production.

Crop management techniques *viz.,* replacement of mono-cropping with pulse-based cropping, which reduces the need for N fertilizer input because of the atmospheric nitrogen fixation by legumes, mixed cropping and inter cropping practices, which minimize the pest infestation and losses from crop failure, and cultivating drought, flood and salt tolerant cultivars that overcome the climate impacts, will have to be the major adaptation strategy in the face of changing climate. Multiple stress tolerant genotypes of important food crops have been developed and are being provided to farmers. Stress tolerant livestock breed (e.g. *Tharparkar* cattle) and high temperature tolerant riverine

fish (e.g. *Apocryptes bato*, *Channa punctata*) have been identified for use in the affected areas.

Soil management options *viz.,* conservation agriculture coupled with crop residue addition and crop rotation, avoiding crop residue burning and incorporating it into the soil, integrated nutrient management (INM), fallow management, addition of organic amendments such as FYM and vermicompost, and novel materials such as bio char and tank silt, green manuring, cultivation of cover crops, etc., would aid in soil organic carbon sequestration in deeper soil profile, and improving soil structure, water conservation, nutrient use efficiency and overall soil health.

Biodiversity conservation practices such as agroforestry and integrated farming systems (incorporating crop-livestock-poultry-fishery with conjunctive use of water and farm-level nutrient recycling through use of farm residues) would create favorable microclimate, help in ecosystem maintenance, and increase farm income. Provision of reliable weather information, early warning systems, weather risk insurance and land-use planning would help farmers in climate adaptation.

Many of the above-mentioned technologies and programs are being implemented in different parts of India. Long-run investment on identification and implementation of appropriate agro-management techniques for different agro-ecologies would help in achieving climate resilient agriculture. The framework for climate preparedness and climate smart agriculture would thus include R&D, education, capacity building, community sensitization, policy changes and up scaling of implementation at village level.

In the discussion that followed, Dr. Rattan Lal referred to the exposure of the land in arid/semiarid areas of India to erosion and asked about some practical solutions of the problem. Dr. Rao said that this problem was common during the break period between the two crops and planting a legume cover crop in between and leaving the crop residues on the surface were the measures being promoted. He agreed with Dr. Lal that these practices, which are a part of conservation agriculture, would be an effective solution.

2.4.2.4. Dr. Donald C. Slack, Professor Emeritus of Biosystems Engineering, Watershed Management and Eco-Hydrology, Arid Lands Resources Sciences and Civil Engineering and Architectural Engineering and Mechanics at the University of Arizona, USA, spoke on '**Water for Agriculture in the Face of Megadrought in the Southwestern USA'**.

Prof. Slack said, southwestern US is a major producer of food crops for the United States of America. In fact, California is the number one state in the US in terms of agricultural production and nearly 100% of the winter fresh green vegetable crop in the US is produced in Southwestern Arizona. However, a major drought (meteorological, hydrological and social), now termed a "Megadrought" by many climatologists, for the past 20 years, puts the agricultural production of the region in jeopardy since virtually all of these crops are produced under irrigation.

Irrigated agriculture in Southern California and Arizona relies primarily on the Colorado River for water and two major reservoirs on this river serve as storage for this region as well as for a portion of Mexico. There has been a steady decline in the flows in this river since 2000 and in July 2021, Lake Powell, which sits just above the Grand Canyon and releases water to Lake Mead, just below the canyon, was at only 26% of normal. The US Bureau of Reclamation, which manages the river, recently announced that the seven Colorado River Basin States must reduce their take from the river by up to 4 million acre-feet ($4.9X10^9$ cubic meters) in 2023. This is out of a total annual withdrawal of 14 million acre-feet ($17.3X10^9$ cubic meters) or a reduction of over 28.5%.

There is growing competition between metropolitan and agricultural use of water. California farmers have significant reduction (25 to 75%) in irrigation water, which has forced some of them to remove their nut orchards, and some have moved to SE Arizona, where they use ground water to grow nut crops.

The farmers in SW USA, in the face of current situation created by the megadrought, have following alternatives: a. Give up farming; b. Leave increasing proportion of their farmland as fallow; c. Changing to new crops that use less water; and d. Installing water-saving irrigation systems. In fact, all this is happening.

The California almond orchards in the Central Valley have been abandoned for lack of water and some farmers have moved out. There are significant instances of crop substitution to save water use. Guayule, a cash crop alternative to cotton, is being promoted. It is an arid land shrub needing half as much water as cotton, and is a source of rubber. Bridgestone Tire has a research facility and a plant in Goodyear, Arizona and they are having contract farming of this crop. Another example of alternative crop is triticale as a source of green chopped fodder for dairy cows as an alternative to maize, with half of its water use.

Use of water-saving irrigation technology is a very promising way to cope with water shortage. Underground drip irrigation system has permitted considerable saving of irrigation water. In Central Arizona, where it is being subsidized by the State, farmers have installed the system for cotton production on substantial scale in last 6 to 7 years.

In the discussion that followed, Dr. Rattan Lal asked whether there was a possibility of using desalination as a technique to overcome the problem caused by the megadraought. Dr. Slack agreed and informed that in Santiago there was already a major desalinization plant, but its use was mainly for municipal purposes. The Governor of Arizona was studying the possibility of such step in Arizona, but again it will be for municipal purposes. However, there is possibility of using the grey and blue water for irrigation purposes.

2.4.2.5. Prof. Dr. Abdel-Ghany M. El-Gindy, Professor of Agriculture Engineering and Dean, Faculty of Desert Agriculture, King Salman International University, Ras Sudr, South Sinai, Egypt presented the paper titled **'Use of Smart Agriculture to Improve Water Use Efficiency and Energy Saving under Climate Change Challenge in Egypt'** in co-authorship with **Prof. Dr. Ayman Abou Hadid**, Emeritus Professor at the Arid Lands Agricultural Studies and Research Institute, Ain Shams University.

Prof. El-Gindy said, Egypt is located in one of the most arid regions of the world, where small amounts of rain are confined to a narrow strip of the northern coast. Egyptian agriculture, therefore, relies, mostly on

irrigation water from trans-boundary sources. The agriculture here has evolved for thousands of years based on a fluctuating but rather steady share of Nile water despite a continuous increase in the population. The natural cycle of climate change, which has accelerated in the second half of the twentieth century, has put considerable pressure on the possibility of the continuation of the old agricultural pattern in this region. Other problems are the increasing urban encroachment on the agricultural area, higher prices for imported production inputs, reliance on hybrid seeds produced abroad, and decreased per capita water share leading to a state of water poverty. The water resources availability for the whole economic and services activities is extremely dependent on the River Nile. The per capita share of water has gone below the 'water poverty' line. This year (2022) it decreased to almost 535 cubic meters per year and it is expected to fall to less than 500 cubic meters before the year 2030.

These conditions have necessitated to work on the development of new agricultural systems that would allow sustainability of agriculture in the Nile Valley. The focus is on changing the old surface irrigation system to a more efficient one that can save water and allow more land to be brought under agriculture to fill the food gap. One of the main keys to increasing the quantity and quality of production is to adopt precision agriculture. All production inputs such as water, energy, chemicals, seeds, etc., and the processes of agricultural mechanization and post-harvest services will have to be very precisely managed to enhance efficiency and economics. The smart irrigation system is one of the main components of precision agriculture. The concept is based on the digital and technical application of a package of databases and information that allows easy management of the irrigation water. The use of electronic system accurately controls the irrigation process, with the aim of maximizing the crop production with limited quantities of water, raising the efficiency of water and energy use.

The concepts of precision agriculture, digital agriculture and smart irrigation are being put to use in Egypt under the 'Sustainable Use of Agricultural Resources Program'. It includes four national projects: (1) Developing and modernizing the on-farm irrigation system on an area of 5.0 million acres in the 'old land' and 1.0 million acres in newly reclaimed land (OFIDO); (2) Reclamation of desert and development of

irrigation systems on 0.540 million acres in Toshka region, 0.5 million acres in Mostakable Watan area and 2.3 million acres in New Delta area; (3) Establishing protected agricultural, Green Houses, on an area of 0.1 million acres; and (4) Establishing plantation forests and development of sustainable forestry in desert lands using treated sewage water.

The first project (OFIDO project) aims at raising the efficiency of on-farm irrigation system from current 50% to the level of >80% by 2030, thus saving water, increasing productivity, prevent land degradation, improving investment in local manufacturing of machinery and other agricultural items and providing employment opportunity, and protect public health through improved conveyance of irrigation water. The techniques include converting old '*Maskas*' and '*Marwas*' to pipes and using control valves and water entrance in field; laser leveling, and use of gated pipes for surface irrigation; localized irrigation (drip, bubbler, underground drip, and mini-sprinklers) for fruits and vegetable crop production; cultivation on mechanized raised and broad beds; and using climate data in calculating crop water requirement and scheduling irrigation.

The second project uses central pivot system, linear moving sprinkler system and localized irrigation system for fruits and vegetables. It also includes recycling of water and farm waste by integrating intensive and semi-intensive fish production in ponds with crop and livestock production. It also involves use of solar energy for using pumps for lifting water from underground wells or from canals.

The third project involves establishment of protected agriculture using multi-span green houses with rainwater harvesting facilities, semi-closed greenhouses to save water and having shading facility, etc. Use of hydroponics and soil less culture permits achieving very high water and land use efficiency in producing high value crops. For example, production of 1 kg of fresh produce of tomato, cucumber and pepper required, respectively, 40, 36 and 99 liters of water in soilless culture in contrast to 63, 72, and 148 liters of water in drip irrigation and 162, 247, and 337 liters water in surface irrigation system.

The fourth project involves establishing plantation forests and development of sustainable forestry in desert lands using treated

sewage water and such tree species as *Gmelina arborea*. Use of more efficient mechanization, smart irrigation and solar power are integral to the project.

For providing full benefit from climate smart, sustainable, precision agricultural to the farmers, extension service will have to be expanded and modernized to serve the 'new lands' as they are located at distance from current agricultural areas and have different weather conditions. Solar energy development, innovation, and technology transfer are important for successful precision agriculture, as it will be employing remote sensing and specialized sensors for farm management. Finally, adding value to produce by integrating agricultural production and agricultural industries and linkage to markets would be necessary to increase economic returns to the new precision farming.

2.4.2.6. Dr. Magdi T. Abdelhamid, Research Professor and Head of the Botany Department of the National Research Centre (NRC), Cairo, Egypt presented the paper titled '**Biosaline Agriculture as an Opportunity for the Sustainable Development of Rural Areas and Coastal Regions'**. He said**,** Egypt's main supply of irrigation water is the Nile River. Due to shortage of irrigation water, poor quality groundwater or low-quality mixed water (agricultural drainage water mixed with freshwater) is used for irrigation in the newly reclaimed lands, that promotes soil salinization over time. Groundwater is the primary supply of water for new land reclamation projects in the Egyptian deserts. Groundwater salinity varies between 1000 and 12000 parts per million. Sodium is the most abundant cation, followed by calcium and magnesium, with the percentage of sodium ions increasing due to seawater interference. Soil salinization is one of the causes of soil degradation, affecting land use, water supply, soil fertility, and plant (and animal) community composition. Therefore, new innovative strategies to boost food production through greater yields in degraded areas, while minimizing environmental pressure, must be studied. Saline agriculture is one of these possibilities, which includes interventions through irrigation systems, soil and water management, and crop species and varieties.

This is being attempted in the project 'Good Agricultural Practices for Sustainable Improvement of Productivity and Quality of Plants in the Newly Reclaimed Area in Moghra Oasis'. The focus on saline agriculture aiming at increasing the resource efficiency by (re)purposing degraded agriculture and lowering freshwater usage. The goal is to identify salt-tolerant crops and assess their economic potential and identify socioeconomic hurdles to saline agriculture. It involves a variety of technical interventions, seed selection, and training for farmers across Egypt. The main objective is to develop efficient strategies for smallholder farmers with advanced technology aimed at optimizing natural resource use while increasing yield, crop quality, and income of smallholder farmers. The model being developed incorporates how to best use the saline water. The experience from the project will be up scaled elsewhere in the ecosystem prevailing in the 1.5 million acres of new land.

In the discussion that followed, Dr. Rattan Lal emphasized the possibility of use of raised beds to manage local salinity in the root zone.

2.5. African Platform – The Voices of the Youth of Africa

The deliberations in this special session were held under the chairmanship of **Prof. Dr. Adel El-Beltagy. Dr. Salah Soliman**, Emeritus Professor of Pesticide Chemistry and Toxicology, Alexandria University, Egypt, moderated the discussion.

Dr. Soliman introduced the program '**African League of Young Masters" (ALYM**)**.** It was created in 2011 in Alexandria, Egypt and it has representation from every part of the African Continent. It was developed with the philosophy that for a nation to develop and stay strong, its natural resources should be wisely managed. On the top of these resources come the people and especially the youth, as they are an integral part of sustainable development and change. The African League of Young Masters aims at: a) having an open channel of communication between African students studying in different universities and centers of higher learning in Egypt; b) bringing African students together for knowledge sharing and capacity building to foster further cooperation; c) promote knowledge and interest about health, environment and sustainable actions; and d) strengthen country-country and multi-country relations and collaboration. The students meet weekly to have discussions or special workshops on different topics of contemporary concerns. There are lots of off-class activities, outside the curricular activities, that contribute to achieving the aims listed above.

At this time, when COP27 is going to be held in Egypt, ALYM decided to focus on the issue of climate change as it impacts the African continent and develop strategies for mitigation and adaptation to enhance the resilience of the people of this continent. A group of students, each from North Africa, West Africa, East Africa, Southern Africa and Central Africa, has undertaken research to quantify the Green House Gas emissions by their respective region and compared it with that from some of the heavy emitters from other continent, and identify the impact of global warming on the natural resources, food production and food security, health, poverty and livelihood of their respective people in Africa. They have also identified the efforts voluntarily being made for mitigation and adaptation by these countries and kind of support

they would need to have better action to combat the negative impact of climate change. Dr. Soliman then invited the leading members of the team from different regions of Africa to present their findings.

Sherouk Ahmed, Reem Abdallah, Lina Hanno, and Yousuf Mohammed presented the report on **North Africa** (Egypt, Algeria, Morocco, Libya, Tunisia, and Sudan). The CO_2 emissions of this region in 2020 were 530.71 million tonnes, which amount to 17.56 tonnes per capita. In contrast, the world total CO_2 emission was 34.81 billion tonnes, of which China contributed 10.67, USA 4.71 and India 2.44 billion tonnes.

Mohammad Sani Ibrahim and Ajak Arou Mayon presented the **report** on **West Africa** (Nigeria, Ghana, Senegal, ColteD'voire, Benin and Burkina Faso). This region emitted 172.65 million tonnes of CO_2 in 2020, which comes to 1.90 tonnes of CO2 per capita. This is very little in contrasts to that by the big emitters in Asia and Americas.

Yunus Amour Haji and Zainab Said Mkunde presented the report from **East Africa** (Tanzania, Kenya, Uganda, Burundi, Rwanda, South Sudan, Ethiopia, Somalia, Djibouti, Eritrea). Total emissions from this region in 2020 were 52.68 million tonnes CO_2 (per capita being 0.144 tonnes).

Kuch U. Madut and Rejoice A. Ojwok presented the **Southern Africa** (South Africa, Angola, Zimbabe, Zambia, Mozambique, Nambia, Botswana, Malawi) report. The region emitted a total of 509.62 million tonnes CO_2 (per capita being 2.86 tonnes).

Maab Amged Al basiri and Rowaida Muhammad presented the **Central Africa** (Angola, Cameron, Chad, Central African Republic, Democratic Republic of Cango, Burundi, Zambia) report. The region emitted 51.78 million tonnes CO_2 (per capita being 4.85 tonnes).

The presenters emphasized that their respective regions were contributing so little to the greenhouse gas emissions, but they were suffering most from the impact of climate change largely caused by other countries. The impacts included shortage of water, frequency of disastrous climatic events such as drought, floods, heat waves loss of biodiversity, desertification, reduction in the productivity of agriculture, loss of costal habitats, sea water rise, new diseases and pests on the

crops, human diseases, increased poverty, reduced resilience to natural disasters, and population displacement as climate refugees.

Each region highlighted the voluntary action being taken by their people and the government to mitigate climate change by developing renewable energy projects and taking other action that would cause reduction in greenhouse gas emissions. They were also taking action to adapt to climate change. But their efficacy was constrained because of lack of adequate resources, technical know-how, early warning systems, etc.

Dr. Soloman thanked the presenters for doing the research to bring the information regarding the climate change in their countries and presenting them in a succinct manner. In his concluding statement, Dr. Soloman said that the region is suffering from energy crisis, food crisis, pandemics and health crisis, getting limited benefits from globalization and proportionately higher impact of global financial crises, facing human trafficking and piracy, having low level of utilization of information technology services and knowledge revolution and having practically no disaster response mechanisms. Despite the very low share in the global GHG emissions, the African continent is hardest hit by climate change due to its low adaptive capacity.

Climate change is transforming Africa's development trajectory. For the continent to be successful, both Global Environment Facility and Global Green Fund projects will need to enhance adaptive capacity, improved decision-making, access to markets, policy mainstreaming and evidence-based decision-making. Africa is asking for what the continent deserves. We need that young people in Africa take up farming and innovative knowledge-based pursuits instead of weapons, as a key objective for both adaptations to changing climate and peace building. Africa depends for growth and development, to a large extent, on its natural resources, but these were, and still are, drained without added value. There is an urgent need to promote, facilitate, and finance appropriate access to development, adaptation and diffusion of environmentally sound technologies. Also, there is need for use of information and communication technologies, where appropriate, as tools to increase the frequency of communication to share experiences and disseminate knowledge.

Dr. El-Beltagy thanked Dr. Solomon and congratulated the members of ALYM for their teamwork and all efforts in so clearly presenting the case of the African continent for finding a way forward to adapt to and mitigate climate change, enhance the resilience of people to climate change impacts and achieve sustainable development goals.

2.6. Topic 4. Enhancing the Coping and the Adaptive Capacity (Human and Physical Infra-structure).

2.6.1. Lead Presentations and Discussion:

Chair: Prof. Dr. Rattan Lal, Professor of Soil Science and Director of the CFAES, Rattan Lal Center for Carbon Management and Sequestration at The Ohio State University, USA.

In his opening remarks, Prof. Lal thanked Prof. Adel El-Beltagy for emphasizing human factor in his introductory statement and saying that human-based resource management was the need of the hour. There are already 8 billion people on this planet as of now, and the number would increase to 10 billion by the year 2050 and 11.2 billion by 2100. Therefore, the wisdom of Asian culture, and building upon that with modern science, is the way to address the issues that humanity is facing. He said, he would like to focus on three 'C's that humanity is at present facing – Conflict, Climate Change and COVID Pandemic. This would require all the wisdom that we could muster in managing the natural resources sustainably so that we could address these issues. This, he said, was for the human dimension part of this session.

Before giving floor to the speakers of the session, Prof. Lal wanted to share what he learnt himself in this regard, when in 2013, he was writing an article, "Soil and *Sanskriti*". *Sanskriti* is a Hindi word for civilization. He looked into texts of various religions practiced in Asia and was surprised to see how all of them (Hinduism, Budhism, Jainism, Sikhism, Judaism, Christianity, Islam) to see what was the common thread that linked them with respect to management of natural resources. They all had very similar language - protection, sustainable management, restoration of natural resources. Therefore, it would be better for us to look for commonality in all cultures, rather than differences, for the larger good of humanity. He expected that an affirmation would emerge out through the deliberations in this session. He then introduced the first speaker, Prof. Dr. Mahmud Ayed Duwayri, and invited him to make his presentation.

2.6.1.1. Prof. Dr. Mahmud Ayed Duwayri, Former Minister of Agriculture, Jordan; President, Ajloun National University, Ajloun, Jordan; Former Director, Plant Production and Protection Division, FAO, Rome, Italy presented his paper titled '**Climate Change Effects on West Asia and North Africa Drylands'.**

Prof. Duwayri reminded that climate change (CC) was becoming an international crisis and is affecting agriculture and the poor farmers in the dry areas more than farmers in the industrialized countries. The climate change will increase human starvation, malnutrition, and incidence of such diseases as malaria, diarrhea and heat stress. Although the richest, most industrialized countries are mainly causing the global climate change through their greenhouse gas emission, the world population at large is suffering from it.

As the earth temperature continues to rise, precipitation continues to decrease, becoming less frequent, with long dry season, the water scarcity is increasing, particularly in the dry areas. Frequent events of severe droughts, floods and heat wave are putting more pressure on the ecosystem, adversely affecting the productivity of plants and animals, even their survival. The biodiversity, particularly of plant genetic resources, is being negatively affected. Therefore, special attention is needed to strengthen biodiversity and plant genetic resources work at national, regional, and international level.

West Asia and North Africa region is facing difficult climate situation, being particularly affected by the water scarcity, higher temperature, and more frequent occurrence of extreme events. A recent review of Jordan agriculture in relation to climate change indicated that Jordan is facing harsh climatic changes that are adversely affecting agricultural production, and the situation is expected to worsen in the coming years. In cooperation with the World Bank, a smart action plan was prepared to enhance agricultural productivity in an environmentally and socially sustainable way. The plan includes: 1) Expansion of date palm and protected vegetable production in the irrigated parts of the Jordan valley and the highlands; 2) Olive production and processing, and barley production in rain fed regions; and 3) Improving small ruminant value chains and *Badia* restoration in the agro-pastoral areas.

Coping with low rainfall and the high temperatures, caused by the climate change, would necessitate search for resistance/ tolerance genes in the germplasm and using them in the breeding process, using modern scientific tools. Conservation and sustainable use of plant biodiversity should be enhanced in this region. Some 25 years back, a biodiversity project had operated in the region, supervised by ICARDA. Its results should be revisited, evaluated and applied for enhancing food production, particularly by utilizing the species identified in the project.

With increasing water scarcity, water withdrawals from underground sources are becoming environmentally and economically unsustainable and have high carbon footprint. Efficient use of limited water for high value and more water-efficient crops and tree species would be necessary using modern technological innovations of digital and protected agriculture. Desalination of sea water for municipal use and use of grey and black water for agriculture would be necessary to manage the problem of increasing water deficit.

The problem of water scarcity has become particularly accentuated in Jordan because of the influx of refugees from neighboring countries (Palestine, Iraq, Kuwait, Syria) because of their internal conflicts. Some of these refugees are settled on lands that have sizable aquifers, adding further to inaccessibility of this scarce resource. The current availability is less than $100m^3$ per capita per year. Drinking water availability is strained and that if first priority for this valuable commodity, second is tourism industry and the third is agriculture. For agriculture, fortunately we have good system for treating wastewater and use for irrigation. Climate smart agricultural practices are being increasingly used and Jordan has one of the largest infrastructures for protected agriculture for growing vegetables and fruit crops, particularly for urban markets.

In the ensuing discussion, Prof. El-Beltagy raised the issue of refugees. In last several international conferences this issue was subject of discussion but no concrete solution to deal with the issue emerged that could help the developing countries. Dr. Lal said, there were 35 million refugees globally before the current war in Ukraine, which has also created 10 million refugees internally. The crisis has to be managed

locally, where the people should be enabled to help themselves and protect these resources from misuse and abuse. Otherwise, there will be water refugees, soil refugees, food and nutrition refugees, in addition to political refugees and if the problem is not resolved at the local level it would have disastrous consequences for humanity at large. He hoped that COP 27 will take notice of this and ensure that the affected people are enabled to manage their resources sustainably and achieve better resilience. Dr. El-Beltagy said that even with 1.5^0C temperature rise climate change scenario, there is a projection that there will be another 200 million (and the number could increase to even I billion) climate refugees. The solution lies in the implementation of decisions taken by the international community before the Paris meeting, in Copenhagen, Cancun, etc., where it was agreed to create a fund to assist the developing countries with science and technology for adapting to the changing climate. There is need for translation of pledges made into implementation and this needs to be emphasized again in COP27 by the representatives of the developing countries and others.

2.6.1.2. Dr. Sameh K. Abd-Elmabod, Associate professor, Soils & Water Use Department, National Research Centre (NRC), Egypt presented the paper titled '**Past and Future Impacts of Urbanization on Land Surface Temperature in Greater Cairo Over a 45-year Period'**. He said, a rapid and unplanned urbanization can lead to altered local climate by increasing land surface temperature (LST), particularly in summer months. The Urban Heat Island (UHI), i.e. urban air and land temperatures higher than the surrounding rural areas, may induce a modification in the local climate that can negatively affect agricultural land and human thermal comfort and may lead to a less sustainable environment.

UHI phenomenon was investigated in Greater Cairo area of Egypt, using remote sensing techniques, to estimate LST of summer months over 45 years (actual in the years 1986, 2000, 2017, and predicted for year 2030). The methodology involved mapping land use/ land cover (LULC), spatiotemporal analysis of LST during summer months, predicting future LST for 2030, and examining this temporal change for a hot-spot area (Greater Cairo ring road) and a cool-spot area (the River Nile). The results showed that mean land surface temperature was more in urban

hot-spot areas than in cooler cultivated areas. In the Greater Cairo Ring Road, where the urban land use had increased from very little in 1986, to nearly a quarter of the whole area in 2000, nearly half in 2017, and nearly three-fourth of whole area predicted for 2030, with corresponding increase in surface temperature from 31.1^{0}C in 1986 to 33.4^{0}C in 2000, 37.0^{0}C in 2017, and 38.9^{0}C predicted for 2030. Similarly, the land surface temperature of rural areas in greater Cairo region was predicted to increase in summer months by nearly 4 ^{0}C from 1986 to 2030. This would have adverse consequences for agricultural production. The UHI effect can be mitigated by wind, but the threshold of wind speed required for fully mitigating the effect would increase as the population of the urban area would increase.

The study clearly shows that UHI effect is projected to increase in future because of climate change. This can adversely affect peri-urban agriculture, which is becoming increasingly important as the urban population in the megacities is increasing. In this context, roof gardening will become also very important for not only reducing UHI effect but also for augmenting local food production, as an adaptation to climate change.

Concluding his presentation, Dr. Abd-Elmabod said that, as there are only limited number of meteorological stations available to monitor temperature changes, the remote-sensing based investigation of UHI effect can be of great benefit for urban planners, who can thus understand the beneficial effects of water bodies and green areas around the cities. Urban green infrastructure has the potential of reducing the summer temperature by 6 ^{0}C. Urban sprawl in desert spaces and an associated desire to increase green and blue spaces represents a major challenge for Egypt particularly in view of the increasing scarcity of available water, which currently stands at 550 m^3 per person per year.

The Chair thanked Dr. Abd-Elmabod for his informative presentation and recalled some of the facts highlighted by him - rise in population from 36 million in 1972 to nearly 100 million currently, reduction in cultivated area because of urbanization, reduction of carbon stocks from 250,000 Mg to 140,000 Mg and rise in temperature. It all highlighted the need for protecting the prime agricultural land. He then opened the

presentation for discussion. Ms. Rania Gamal asked whether this work on heat islands could be related to the impact of climate change on the future productivity of major crops in Egypt. Dr. Abd-Elmabod said, this has been done and results published. For example, through that work, it was predicted that wheat yields in Egypt could get reduced to 50% of the current level.

2.6.1.3. Dr. Sharon G. Mijares, NM Psychologist and Professor, California Institute for Human Science and National University, USA presented her talk on **'The Decision for Environmental Restoration is a Human One'**.

Dr. Mijares said, IPCC warned us that extreme actions need to be taken to prevent fossil fuel consumption by 2030, abandon agribusinesses that are destroying rainforests, protect oceans and change the ways our industrial activities are performed. Urgent changes in our action are necessary to cut risks of extreme heat, drought, floods, and poverty. People need to know that every ones attention is needed to protect our planet and it is every body's responsibility. We have to participate in restoration of planet earth, our home.

Many species have changed the planet to the benefit or detriment of the others, but there has never been a geological force aware of its own influence. We are nearly 8 billion people on the earth, but little of these are paying attention to care taking of our planet. Being cognizant of human history is important, as we must know our past as well to change our future. Human beings appeared on the planet some 5 to 7 million years back. The hunter/gatherer society lived in harmony with nature. They eventually learned how to manipulate the environment. For example, some 11 thousand years back agricultural activities began. The idea that human could control nature was developing. Congregating and growing in cities, they no longer lived in harmony with seasons.

All these evolutionary developments were beneficial as well as destructive. Abstract thinking was developing within a couple of thousand years and human beings started formulating ideologies. Abrahamic religions build stewardship of land in our thinking. Other religions of the world also told humans to take care of the environment

and not to harm it. Concept of considering earth as mother, its flora and fauna as relatives of human being and the importance of coexisting with nature was perpetuated by some of these religions. The indigenous tribes the world over have still not lost their contact with nature and they know how to protect the natural resources. The current economic structure, motivated and designed by greed, has promoted over consumption of resources and abuse of nature, and climate change, caused partly by these changes in human behavior, is adding to the problem. The indigenous people of different parts of world continue to be the voices of earth and are struggling to protect their sacred land and environment from oil and natural gas companies and deforestation. Some 800 years back Saint Francis of Assisi recognized that all manifestations of life, as creation of God, were interconnected. He talked of "Brother Sun, Sister Moon, Brother Wind, Water, Fire, and Earth". He had great love for animals and environment and is said to have ability to communicate with birds and animals. He preached that, "World was created good and beautiful by God, but suffers need for redemption because of human sin". If, in our modern civilized world, we could see this and realize that all the nature is interconnected, our choices will have greater wisdom and be more compassionate.

In summary, despite all the many efforts to restore the health of land, air and sea, it will not be successful unless humanity alliances itself to the natural world and also listen to the indigenous people, who know how to live in harmony with nature. We will be unable to enable significant environmental restoration without a significant change in our behavior. Our values and our behaviors need to align themselves with the natural world. The need is to transform our institutions, our politics, and our ways of life. Our ideologies have been out of balance. Both Nature and Women were demeaned simultaneously as patriarchal ideologies confirmed the dominance of man over all life for profit and control. This imbalance initiated much of what we are now experiencing as Nature rages and grieves all caused by thousands of years of using Nature without recognition of its sacredness. The time has come to unite our voices and our hearts and walk our spiritual path with spiritual feet to restore the balance on the earth that is missing. We cannot wait. Through our healing circles we should create experiences that empower us to live more compassionately, transforming our world life, one by one, melting the ice in the heart of humanity.

In the discussion that followed a member of ALYM said leaders were making lots of promises but not taking action. What advise should go to these decision makers who are overseeing the catastrophe. Dr. Mijares said she was asking the people to take action and go ahead with their own efforts. Dr. Lal said each of the 8 billion people on this planet was a culprit as well as a victim. What sacrifice would she herself be willing to make to make the planet a better place to live? Dr. Mijares said, she would do her bit and gave some examples (viz. reduce the things to diminish the water use, reduce the amount of laundry and have more judicious use of cloths, recycle plastic waste, not to replace appliances that are old yet still working). The heavy consumption of goods and their waste in the USA is resulting in the highest per capita C footprint. Every one should be encouraged to moderate the consumption and help save environment.

2.6.1.4. Honorable Ms. Dena Merriam, Global Peace Initiative of Women (GPIW), New York, USA, delivered her talk on **'Changing our Relationship with Nature'.**

Ms. Merriam said, as one looks to prevent the worst outcomes of climate instability, great focus is being placed on limiting carbon output, which is causing the destruction of ecosystems and the ability of earth to support life. But, that alone will not solve the problem. In addition to whatever actions are taken, a fundamental shift in our relationship with the natural world is essential; a shift from a mindset of domination to one of collaboration, partnership and respect.

It is incumbent on the human beings to recognize all the life forms that are there on planet earth. Last year, there was a spell of heat wave that resulted in the death of some 100 people in Northwest USA, creating large concern, but according to experts nearly a billion sea animals died because of slight warming of seawater without anybody being stirred by that. During the process of evolution, individualism has developed so much that interconnectedness with other species has been lost. We have to fend all the life forms around us.

Industrial farming is destroying our natural resources of soil, water and biodiversity and quality of food that is produced. Lack of respect for soil

has led to its degradation and loss of fertility. Ancient cultures had knowledge of how to get balanced diet from what was available around them in nature without causing any damage to it. Soil is still a part of spiritual life in some societies and many religious texts ask for reverence for this natural resource. Japan is one example. Traditional cultural practices based on recycling of organic wastes and keeping the soil biota effective is common in several parts of Japan, and they have demonstrated that organically produced crop plants had stronger root system than those raised with inorganic fertilizers. Use of pesticides and chemicals was leading to crisis with soil.

We must come again into a caring and loving relationship with the natural world. We have come to see ourselves apart, separate from nature but this is a fallacy, and it is what has led us to the state in which we find ourselves today. The key question is how do we change our worldview and come into a true partnership with nature? The climate crisis is an environmental, political and economic crisis but it is also a spiritual one and to address the spiritual dimensions of this crisis, a fundamental change in thinking is required. The young generation, which is concerned about its future, should learn to fall in love with earth again. They should love plants, trees, birds and other animals and experience personal connection with natural world. The developments that have occurred have made it harder and harder to connect. Connecting with nature is healing and it helps in coming out of extreme individualism. There is need for leadership in this regard.

In the discussion that followed, Dr. Rattan Lal expressed his appreciation for the message that this talk, along with that from the previous speaker, brought out. Both have made tremendous contribution to make us realize our duty towards and connection with nature and how to bring it back. He added that he just published an article in 'Journal of Soil and Water Conservation', with the title "*Sustaining Soil for Advancing Peace: World is One Family*". The Sanskrit phrase for 'The World Is One Family' is *Vasudhaiv Kutumbhkam* (Sanskrit, from *Vasudha*, the earth; *iva*, is, and *kutumbakam*, family), which is found in an ancient Hindu text *Maha Upanishad*. This phrase is more relevant now than ever before because humanity is at both political and environmental crossroads. But the presentation just made by Ms. Merriam, and the one just before it, have said much more than

his own article. He noted from this presentation that if every one of the 8 billion people thought that they were one family and treated every body as relatives, they would feed and bring respect to every body. Ms. Merriam also brought out the issue of soil, its degradation and the need to treat it as a living entity, to be able to 'hear and speak to it'. He suggested to make the children's alphabet books environment related so that they, from the very beginning, learn to respect the nature.

Before opening Ms. Merriam's presentation for general discussion, Dr. Lal, refereeing to her book "*Untold Story of Seeta*," asked her if this was the Seeta of Hindu scripture *Ramanyana*, and if she could give one message from it. Ms. Merriam, said her Seeta was indeed of Ramayana, in the era many thousand year BCE (well before the society became patriarchal and individualism emerged), when women played dominant role in society and held in high respect – some were even *Rishis* (sages). Seeta herself was very enlightened person, and noticing that as societies were developing, agriculture was starting, people were gradually losing contact with nature, she tried to spread the message of love for mother earth. Seeta considered all animals as her children and communicated with plants and animals and cared for them, as they were a part of community of life. This part of her life got shaded out with subsequent development of individualism, and thus there was a need for her story to be told. In fact, there is a need of telling all other down-to-earth stories, e.g. that of Adam and Eve, to get connectedness to earth and nature at large. Dr. Lal reminded that Seeta was born out of earth, as King Janak ploughed the land to break the spell of drought that was crippling his kingdom. She was named Seeta, or *Sia* in Sanskrit, because that is also the Sanskrit word for a soil furrow. Ms. Merriam said here was the connection with earth, and with agriculture, which is essential for all of us.

No other questions coming from the floor, Dr. Lal, inspired by the two previous presentations, interjected a few of his own thoughts regarding the connection of humanity with nature. One was what Nobel laureate Khalil Gibran said – "*Earth rides upon the sky, we fell it down and turn it in paper to write our emptiness*". In Isalam, *Sura El Rahman* Verse 14 says, "*He created the man out of clay, like a potter*"; in Quran 2554 it is mentioned that "*We made from water every thing living*"; Prophet Muhammad himself said, "*Never overuse water even when you are*

walking on a running river". In Greek and Roman philosophy and tradition, there are gods related soil fertility and agriculture. In Christianity, the word Adam is derived from Hebrew word Adama, meaning earth, i.e. human is made of earth. In Sikhism, *Guruwani* says, "*Pavan Guru, Paani Pita, Dhrit Mata Mahaan*" (meaning air is teacher, water is father, and soil is mother the great). In Hinduism, the Upanishads say: the human body is made of five 'elements', soil, water, air, space and energy; do not degrade them! There is a saying, if diet is good, there is no need for medicine, if diet is bad no medicine is of any use. The word '*Homo*' is a Latin word for Humus. It is the soil organic matter that is the essence of all life. Problem is, humanity has forgotten its roots. There is need to connect humanity with nature. The presentations of Dr. Mijares and Ms. Merriam have brought out this message very clearly and we thank them.

2.6.1.5. Prof. Dr. Aliaa R. Rafea, Sociology and Anthropology Professor, Women's College, Ain Shams University; Chair & Founder of The Human Foundation, Egypt presented her paper titled **'A Need for a Shift of Consciousness in Dealing with Climate Change'.**

Dr. Aliaa, showing appreciation for the two previous presentations made by Dr. Mijares and Ms. Merriam, said they have very effectively dealt with the issue of consciousness that is needed in the world to deal with the catastrophe posed by climate change. Her own presentation, complementing those two, would try to show why we should reach to that conclusion.

She said, the world is passing through a time of utter chaos; we are in a state of blindness, not knowing the direction in which we are headed. We need to realize that we have to come together to protect the World for future generation as it belongs to them and whole human family. We know about the risks posed by climate change. Past decades have witnessed a growing destructiveness of climate change (CC). Loss of biodiversity, deforestation, desertification and increasing poverty are threatening livelihood sustainability. Ecosystem degradation is affecting some 3 billion people and the growing pollution and waste accumulation have cost some 9 million lives.

Science suggests many solutions. It enlightens us, but is often not enough to meet the needs. Scientists, for example, suggested the approach of integrating sustainable resource management and use of biodiversity customized to various agroecologies and different ecosystems to meet the needs of local communities. This approach requires developing intense knowledge and proper understanding of mechanism to deal with drought, drought-resilience, manage and restore ecological functions, sustainably harvesting biodiversity and diversifying production systems. This technological understanding must be shared globally, regionally and nationally. But, at present it is not reaching the vulnerable people. To reach the vulnerable communities, the scientific solutions should be in line with national policy. National policies respond to common social values, which may not be in harmony with international policies. When the standard valuation system focuses on immediate short-term gains and overlooks the impact of climate change on long term, vulnerable communities remain at risk and neglect. In several developed countries, the top leaders have not been recognizing the impact of climate change, as caused by anthropogenic practices. They, for their own national gains, therefore, continue to support or even encourage businesses and enterprises, which we know will affect the environment adversely. So, the question arises as to where we are heading?

Since more than 5 decades we are having international deliberations to crack the challenge of climate change, yet, the World is still scrambling to find path to face the challenge. At COP27, this year, the countries involved will review and renew their governments' commitments concerning Paris Agreement and what has been achieved since COP26. Can we be optimistic? The IPCC 2020-2022 says that the Paris Agreement and SDGs have come to provide the direction for coordinating, financing and reviewing the progress in climate change adaption action. It would focus on transition and transformation in energy, land, ocean, freshwater ecosystems, urban and rural infrastructure, industry and society. In COP 26, 195 countries agreed to restrict the rise in global temperature to 2^0C. It was announced that the progress being made was putting us on path of a rise of 2.4^0C, and there will be a need for correction by the end of 2022 to put us back on path for a scenario of 1.5^0C rise, by maintain the upper end of emissions as agreed in Paris.

What do we expect? No change; why would it be? There is no interconnectedness between the national and global economy as affected by climate change. The large economies have not kept their promises regarding environment. Globalization has created a universal culture of consumerism, greed, selfishness and individualism. The dominant global economies have their short-term interests and they do not pay attention to sharing seriously in realizing the SDGs intertwined with climate change. Their values and worldview are blind to climate change. The people in the developing countries are victims of inherited value systems that came from cutting off from interconnectedness to nature. So, what we should do? We should come back to nature! We have to learn from nature to cut across the gap between the plan and action. How can that be done?

Organisms are open systems. They cannot survive with out interaction and exchange with external environment. The mutual interaction of the component systems binds the components together and keeps the system as a whole. We might not be aware of this but, in consciousness, we are a part of whole system - physically and spiritually. Being conscious of our interconnectedness brings another value system in force. Human consciousness is an extension of universal consciousness. Psychology relates our psyche to physical realm. Nature can inspire us to get knowledge. It will shift attention from individualistic perception to empathic attitude. Innovations are an inspiration coming from the Universe. There should be plans for paradigm shift in our consciousness. We have to cultivate our heart with love and empathy to open the interconnectedness. All the religions in the world emphasize interconnectedness of humans with nature, as the indigenous people do in different parts of our planet earth.

Talking of the Human Foundation (HF), which Dr. Aliaa heads, she said it is a non-governmental organization that cares most about raising awareness of our human interconnections and the oneness of life. HF has the message that every person should have equal opportunity to contribute to development and protection of natural environment, and achieve prosperity and happiness, mutual respect, respect for diversity, gender balance and access to science and technology, and sustainable development. Its projects turn this approach into action. HF encourages

people to take an inner journey to know who we are and what is the meaning of life. Its activities enable the people to interconnect with innate life, interconnect with world. HF is committed to contribute to finding solutions to problems created by climate change, in collaboration with IDDC. Understanding the sense of oneness is highly needed to translate decisions taken by the world leaders to act for the wellbeing of our earth and the most vulnerable population.

Dr. Aliaa's message to COP27 was that the World should put the clashes aside to face climate change as a significant threat to life. Let us raise global awareness that we have to work as one family for the betterment of the poor, and let the nature inspire us to do that. The mainstream scientific methodology is often poorly equipped to deal with the challenges facing us. We need a shift of consciousness worldwide to make the outcomes of scientific achievements viable. Continuing the same paradigm of dealing with the CC will take the world to a fateful destiny. Honoring nature as a living sacred entity and experiencing our interconnection with her and each other can take us to another holistic approach to using science to serve life. The world needs policy action backed up by reliable scientific research, a new worldview, and political will.

Dr. Lal thanked Dr. Aliaa for her presentation and said this and the two earlier presentations send strong message on the need for interconnectedness and action that COP27 should be taking in this regard. He then opened the presentation for discussion. Dr. Serageldin, appreciating Dr. Aliaa's presentation, said that the fundamental measure of economic activities, the Gross Domestic Product (GDP), is disconnected not only from nature, e.g. cutting down the forest and considering proceeds from it in computing GDP, but also from people in that we count the unremunerated work of mothers in taking care of children and doing other household tasks. The governments sell off their assets and count them as revenue – something illegal in the corporate world. We need to have a capital accounting system that not only takes into account physical capital assets but also human capital – education, health, nutrition and social capital, that holds all this together, and the natural capital, which has environmental services embedded in. Work had started on this some 20 years back but it is still being developed. There is new beginning of efforts in bringing these

dimensions, as emphasized by Dr. Aliaa in her presentation. Dr. Aliaa, agreeing with Dr. Serageldin, said human capital is what a person carries with him. He cannot be separate from social and natural world. We have to connect with ourselves and then interconnect to the whole, to become active in taking care of society and nature.

Dr. Abou Hadid said the action of developed economies was guided by their own economic interests, and asked Dr. Aliaa if she thought there could be a change of heart. Dr. Aliaa said she had a vision: If there were a nuclear group that believed in interconnectedness and spread it, the change would happen, slowly but surely. It will happen by the power that is beyond us. Dr. El Shaer emphasized the need for spreading the message about the dangers of climate change, at all levels, as the public at large was generally ill informed.

A member of ALYM emphasized the need for education at all levels to inculcate right habits that respect environment and wanted to know if there was a message for younger generation in this regard. Dr. Lal said he believed that future of humanity lies on the shoulders of younger generation. They have to take responsibility of protecting the nature, restoring it and making it realized by all that nature is respected. In this regard, each one of us has responsibility. The consumption of natural resources should be in a sustainable manner. We are already using 1.8 equivalent of our planet earth because of over consumption. We have to learn to minimize our demands so that mother nature could restore whatever we consume.

In concluding the session, Dr. Lal thanked all the speakers. They have raised very important issues of interconnectedness, change of conscience, need for education at all levels regarding the use of natural resources as it impacts climate change, and the problem of climate refugees. As a take home message, Dr. Lal highlighted the following points:

1. Use of fossil fuel: We are already having a CO_2 level in our atmosphere of 420ppm. In order to keep the rise in global temperature below 2^0C, the maximum tolerable limit of CO_2 concentration is 560ppm. A use of 2.1 G tonnes of fossil fuel C gives rise of 1 ppm in CO_2 level. Therefore, total permissible use of fossil fuel is no more than 300 G tonnes C. The question that

should be raised at COP27 is how the use of this quantity was inter-connectedly distributed across nations, equitably and fairly. This is a very important issue of consciousness. It will also have to be linked with how we could implement noncarbon resources immediately so that mother nature help us in dealing with climate change.

2. Importance of interconnectivity in dealing with climate change impacts was discussed in detail in this session. In this regard, he was reminded of the book by Barry Commoner titled "*Closing Circle: Nature, Man and Technology*" in which the author claims that production for profit creates dangerous ecological ramifications and offers a concise analysis of the nature, causes, and possible solutions to impending ecological disaster. It has four chapters: The first is, "*Every thing is connected to every thing else*". The second is, "*Mother Nature knows it best*" (if you make a mistake, mother nature will not forget you). The third is, "*There is no way to throw away*" (there is no place to throw; so we must be very careful in our use). And the fourth chapter is, "*There is no such thing as a free lunch*" (every thing has a price, an ecological price is even much more than economic price and we must be careful in choices of our lifestyle).
3. We at the moment are using 200 million tonnes of fertilizers. This should be brought down to 100 million tonnes by 2050 and to 50 million tonnes by 2100, by raising the use efficiency. That is where the adaptation of agriculture becomes important. The current 350 million ha of irrigated area is using 3150 cubic km of water. The water use should be reduced to 2000 cubic km by 2050 and to 1100 cubic km by 2100, and yet increase irrigated area to 750 million ha through more innovative irrigation systems (drip fertigation, vapor type irrigation, etc.). The cropped area currently is 1500 million ha, with nearly 40% of food produced being wasted. This must be brought down to750 million ha and yet have sufficient food of right quality to meet human needs. Conservation agriculture, that protects soil and permits sustainable use of water and nutrients and reduces energy use, is currently practiced globally on 200 million ha. This should be extended to all proposed cropped area (750 million ha). The grazing land now covers 4 billion ha. There is no need for more than 1million ha and should be reduced to 500 million ha by 2100.

The land and water so saved, by changing our lifestyle and food habits, should return to mother nature. This is the only way of living in harmony with nature. We have been too greedy. There are some 8.4 million forms of life on planet earth of which human is only one, but consumes 40% of global productivity.

4. These messages should come out very clearly in COP27, where it should be emphasized that agriculture, soil, dry farming, the diet, food systems, etc. must be very integral to solutions of adverse impacts of climate change.

Dr. Lal thanked Dr. El-Beltagy for giving him the opportunity to be a part of this important session. Dr. El-Beltagy thanked Dr. Lal, on behalf of the Organizing Committee, for his time and wisdom in conducting this session and his understanding for the way forward. He also thanked all participants attending the session personally or virtually and contributing to discussion.

2.6.2. Topic 4 (continued): Enhancing the coping and the adaptive capacity (human and physical infrastructure): Keynote Address and Panel Discussions

Chair: Dr. Ismail Serageldin, Founding Director of the Bibliotheca Alexandrina, former Vice-President of the World Bank, and Co-Chair of NGIC Board of Trustees.

2.6.2.1. **Opening Remarks** – Dr. Ismail Serageldin

The negative impacts of climate change are already wreaking massive damage all across the planet. While the rich countries have the means to repair the damage, the poor do not. More negative impacts of climate change can be expected even if drastic reductions in emissions are achieved rapidly. It is essential that the poor and the vulnerable be immediately given the support needed to take significant measures to adapt to the likely negative impacts of climate change. But even more important is to promote Resilience, a concept articulated in the Sendai Framework for Disaster Risk Reduction (DRR). The Sendai Framework calls for an all-of-society approach, different from the focused interventions of particular specialized ministries. Furthermore, the

promotion of resilience is not a one shot affair, it requires sustained effort over many years, as the system becomes more and more resilient. Long-term perspective planning for actions on the underlying environmental layer, as well as the needed infrastructure must be coupled with responsive adaptation of the socio-economic activities of people using that infrastructure in particular at-risk locations. It will also require the dovetailing of many different policies and programs to indeed reduce future disasters, and to enable society to respond promptly and resiliently to such disasters when they do happen.

Dr. Serageldin, starting the session for the keynote presentation and subsequent panel discussions, said this session would discuss something more than scientific issues. There are some major issues that have become clear from the discussions in last two days. First is that while countries such as those in African continent have contributed least to carbon emissions are inordinately suffering from the adverse impact of climate change. Secondly, climate change is already here; for example, enormous heat waves have struck parts of Asia and Europe; floods in Pakistan have already taken the life of some 1300 people and caused displacement of millions others; severe drought affecting several parts of European Union and crippling some major hydroelectric projects in China. Developing countries need financial support to implement adaptive and resilience measures. Thus, the keynote that follows would cover this important issue. He introduced the keynote speaker, Dr. Jeffrey Sachs, and invited him to make his presentation.

2.6.2.2. Keynote address by Dr. Jeffrey Sachs, Former Director, the Earth Institute, Columbia University; UN Senior Advisor for Sustainable Development.

Dr. Sachs said, never before have we gathered when so many simultaneous crises are confronting us and we are not doing well at all. We have wars, financial distress, COVID 19 pandemic, and the threat of climate change. Climate crisis is immediate, extraordinary harmful and beyond the control of any government. Droughts, floods, forest fires are affecting large areas in different parts of the World. Dryland areas are facing extreme stress. And we are in a political environment where hardly anybody speaks to one another. We have so many geopolitical

crises and great domestic political instability. It is in this backdrop that we have to strategize.

It is clear that we have created very useful frameworks, e.g. Paris Agreement, Sustainable Development Goals, IPCC process, etc., that are remarkable and vital for us. But, it is also clear that we are not able to implement them (climate mitigation, adaptation, access to drugs and vaccines, many other challenges). There is no progress on SDGs, on the contrary, in past three years we are in regression. Public education is in crisis, because of pandemic, even in high income countries children are not schooling. The list of crisis we face goes on and on, but the question is what should be done.

It is gratifying that Egypt will be hosting COP27 and Indonesia G20, because at least the perspective of developing countries will be in forefront, which is extremely important. It is important for developing countries to say to the rest: t it is now enough, we need a different approach, that is free from their geopolitical games and economical struggles; we are interested in surviving on this planet and need a global architecture that addresses the challenge that the whole world is facing.

Looking analytically as to what needs to be done, the key points are as follows. The agenda that the World has to follow is already discernable. The processes that have been established need investments in all parts of the world, but specially in lower and middle income group countries to address glaring threats and deficiencies in the way that world economy functions. There are six major areas of investment: education, health care, energy systems, sustainable land use and climate adaptation, urban infrastructure, and digital connectivity. They require substantial financing, which is well within the economic limits of the planet. The need for sustainable development is of the order of 2-3% of the World economic output or about 10% of World's savings. But we do not have a system to allocate these in an effective, resilient and equitable manner. Global politics, overwhelmingly devoted to great powers confrontation, is not directing us in this regard. We see proxy wars, rising geopolitical tensions in Europe, East Asia, and other regions rather than peace and tranquility to reach global solutions. A huge responsibility for the failure in last 20 years could be put on the USA by

not participating in global arena in financing and addressing global solutions but remaining interested in maintaining global hegemony.

It is not too difficult to identify solutions. We created a global financial system, but it is not being properly used. There are multilateral development banks in all the regions, but they are greatly underfunded and are thus under performing – the IMF and World Bank at global level, the regional development banks such African Development Bank, Asian Development Bank, the new development banks such as BRICS Bank in Shanghai or Asia Infrastructure Investment Bank. These are crucial institutions for addressing climate and energy challenges, but the scale of financing resources available to them is perhaps $1/10^{th}$ of what it ought to be. The total financing that goes through these multilateral financial institutions is currently about 100 billion Dollars annually. It should be aiming at nearly a trillion Dollars per year. This is not an extraordinary value given that the global savings are about 25 trillion Dollars per year and global output is about 112 trillion Dollars per year. The current financing of 100 billion Dollars is only 1/1000 of the global output. Thus, the institutions created for addressing the challenges are not being properly used. His recommendation to the UN system was for a massive scale increase in financing of multinational financial institutions. These institutions should then lend the developing countries funds for long term (30 to 40 years) at low interest rates of 2 to 3 or 4% , so that they would not be required to go to capital markets themselves and end up paying an interest rate of 10% for a loan for 5-7 years, facing repeated crisis of debt financing. The loan has to be for a long time horizon because changes to be accomplished are achievable on a long time horizon only. There should be a financial system in which China and India are playing a larger role. This is essential for sustainable transformation for a fair world.

Making long-term, small interest rate loans to developing countries is absolutely achievable but is blocked by geopolitics rather than financial reasons. It is shocking to see how the developed countries have failed to meet the commitment of 100 million Dollars for climate finance, given that this would be for lending. There is no magic band to unblock the problem of climate change, but the technical and institutional way forward is there, i.e., a vastly increased scale of financing made available to developing countries, as long-term loans at low interest rates, that

these countries could invest in sustainable land and water management which are central to climate change adaptation.

The developed countries not only have means but also historical responsibility for compensating the developing countries for the damages that they have caused to them by their past actions. The developed countries, however, are not willing to accept responsibility. A small levy should be imposed on the developed countries based on their historical Carbon emission levels, in past 50 years, and the funds so generated should be used for climate adaptation and mitigation and energy transformation through an international body.

The developing countries face two additional challenges. One is that the investments they make have a time horizon of 20 to 25 years because the changes to be accomplished require such a time horizon. Public investment planning and frameworks have to be long term, and this is a challenge to the governments of the developing countries. The second challenge is that the effective solutions are often regional scale solutions. There are shared watersheds, river systems and water resources. There are power grids that are shared by more than one country, particularly the smaller countries in Africa. Hence, there is a need to find ways for greater political cooperation, within a region and across the regions. That will require setting aside the alliance politics, and firm realization that we have reached a stage of environmental crisis and that the climate change is actually impacting our lives. It goes beyond the responsibility of a single country to respond to the threat of climate change and there is a need for collective efforts of those who can and those who need in order to benefit humanity.

Some 50 years back in Stockholm we first talked about it, 30 years back in Rio we developed a course of action, and 7 years back we developed an agreed plan of action and commitments in Paris. But, we are now in the middle of a warlike crisis and still far away from the implementation of these plans and commitments. Military alliances etc. are going to be useless if the climate problem, currently being faced, is not addressed.

Concluding his talk, Dr. Sachs said he was in close contact with the Secretary General of United Nations on financial issues related to adaptation and resilience to climate change and sustainable

development. He would be delighted to exchange views on any issues that will help in pressing hard in getting response from developed countries regarding financing through multilateral development funds by the time COP 27 is launched.

Dr. Serageldin thanked Dr. Sachs for his very insightful presentation and opened it for short discussion. Dr. El-Beltagy, referring the blockages that are in the way of achieving the climate action, asked if putting pressure on the public opinion in the developed countries would be of help in changing the attitude of the politicians. Dr. Sachs felt public opinion was not an obstacle in either USA or EU, and public was being manipulated by the political class. Most people do not want war; instead they want climate action. The biggest need is to mobilize the leadership in the developing countries, to put pressure on the leadership in the developed countries and tell them that there was a need for preventing wars, reversing geopolitical tensions, and addressing climate action. The developed countries' leadership will have to listen to them.

H.E. Mr. Petre Roman, former Prime Minister of Romania, agreeing to the suggestion that, in the face of the cold war with China and war in Ukraine, cooperation between the countries was essential. He asked what kind of political compromise should be there to get the solution. Dr. Sachs suggested that the USA should not repeat the mistake made in 1988/89, after the unilateral end of cold war by the Soviet Union, by interpreting it as a surrender and presuming themselves as the sole world leader, and trying to wean out Russia's allies from its influence. Expansion of NATO to Georgia and Ukraine was viewed by Russia as crossing the red line. The Russian-Ukrainian war has to be unbounded by ending the second Crimean War. Maintaining Ukraine's neutrality and Russia's withdrawal are some of the pragmatic answers; not by defeating Russia, which is unachievable and dangerous but is what EU members have been speaking of. Leaders from ASEAN, MENA region, African Union and Latin America have to make it clear to the USA that they do not support cold war with China, and instead of seeing China as a threat, USA should appreciate its economic progress and role it can play in making world peace and global climate action possible.

Dr. Serageldin, referring to the suggestions made by Dr. Sachs regarding mobilization of funds from corporate sector for de-carbonization, asked

him if he saw any prospects for that. Dr. Sachs said there were two huge challenges that the developing countries face. One is to have coherent long-term transformative national plans, because it is not possible to mobilize international resources on *ad hoc* basis. Long-term plans, with numbers attached, can become bankable. Secondly, they need institutional mechanisms to ensure that the projects are bankable, e.g. if a solar system is created, people pay for its use and those funds are used to service the debt incurred to build the system. Investors need clear long-term plans, with institutional arrangements and pathway-analysis for projects, as has been done for example for energy sector in Egypt. Some thing that looks un-bankable right now is a 5-year bond with 10% interest rate in contrast to completely bankable 40-year bonds with 3 % interest rate, if latter was backed up by a detailed plan and an institutional arrangement pathway analysis. Within that framework, one can add tax, subsidies coming from developed economies or emission trading, carbon pricing, carbon tax etc., as a support for enabling finance to flow. A big bull work for this would be a multilateral system that would help the institutional framework and design development. And, the private money can co-finance along side the public system.

Dr. Serageldin said there were some more questions from the audience but they could be taken up in the panel discussion that would now follow and in which Dr. Sachs will also be participating. He thanked Dr. Sachs for his presentation and moved on to the panel discussions as listed below.

2.6.2.3. Panel Discussion Topic 4.1: Rethinking National Strategies for Confronting Climate Change in the Light of the Changing Political Realities

- **Moderator**: **Dr. Ismail Serageldin**, Founding Director of the Bibliotheca Alexandrina, former Vice-President of the World Bank, and Co-Chair of NGIC Board of Trustees
- **Panelists**:
    - **H.E. Mr. Amre Moussa**, Former Secretary General of the Arab League, Former Minister of Foreign Affairs of Egypt
    - **H.E. Ms. Eka Tkeshelashvili**, Former Deputy Prime Minister (2010-2012), and Former Minister of Foreign Affairs of Georgia (2008)

- **H.E. Ms. Ameenah-Gurib Fakim**, Former President of Mauritius (2015-2018)

Dr. Serageldin, starting the proceedings of this panel, said Dr. Jeffrey Sachs's presentation had already set the scene and thus there was little needed by way of the opening remarks. There is a general agreement on the need to mobilize resources for adaptation and resilience in the developing countries and for mitigation efforts in the developed countries. China would fall between the developing and developed economies, and would thus have bigger role as also other countries like India. Africa, which has contributed little to the problem of climate change is one of largest victims of its impact. The national strategies have been based on voluntary declarations by the countries in the Paris Accord 2015, and commitments for SDGs 2015 and Sendai Principles 2015. But these have been thrown awry, partly by the COVID 19 pandemic and partly by acceleration of climate change. Hence, there is a need for moving forward in a multilateral framework and cooperating to get the kind of changes to achieve de-carbonization on one hand and help the developing countries in adaptation and resilience, as the devastating effects of climate change are already being witnessed in different parts of the world. Dr. Serageldin introduced the panel and outlined the procedure for interventions by the members.

Mr. Amre Mousa, as the first panelist, emphasized the need for cooperation between the civil societies at national, regional and global level for planning future steps. The UN Secretary General should mobilize the member states to come to an agreement to approve actions that would benefit humanity at large, rising above the political considerations and avoiding the use of veto. There were some suggestions about establishing a tribunal to deal with climate change "offenders", as their action is hurting the "non-offenders". Those pursuing wrong policies could then be referred to such a tribunal for climate violation and asked to change their course of action. There was a need for enhancing awareness about the problem of climate change and empowering women to deal with the problem, including educating the children about new challenges and how to cope with them.

H.E. Ms. Eka Tkeshelashvili, as the second panelist, referring to the keynote address by Dr. Sachs, which in her view down played the

impact of Russian war in Ukraine, said her own country, like Ukraine, had been a victim of such an aggression, and these countries were fighting for their sovereignty and freedom. Coming to the theme of the panel discussion, she emphasized the need for urgent action as the time was already running out and the devastating effects of climate change were being witness in the form of heat waves, drought, flooding, etc., causing unprecedented misery and suffering. Climate change, with its impact on food supply, social infrastructure, livelihood etc. would cause massive out migration, particularly of younger generation, from the affected areas, adding to conflicts. Geopolitics and systems related to it cannot be taken out of consideration while considering climate change. Needs of all the countries for coping with climate change should be considered in a fair and equitable manner. Referring to the energy crisis in Europe, she thought Europe was so un-pragmatic to think that energy could not be used for political games. It is an awakening moment for the world to realize that this is happening and could happen even more unless appropriate measures are taken to get energy independence.

Dr. Serageldin thanked Ms. Tkeshelashvili, and asked her to think and come forward, in the second round, with specific suggestions as to how the global opinion could be mobilized to find solution to the problem of adaptation and resilience of developing countries by bringing rich nations to meet the commitments they have been making.

H.E. Ms. Ameenah-Gurib Fakim, as the third panelist, said the commitments made by participating countries in COP 21 in Paris in 2015 for the actions to be taken by them to tackle the problem of climate change were impressive. Unfortunately, the promised funds never materialized. The accelerated climate crisis being witnessed is just a beginning, and it would become more serious unless immediate actions are taken. Problems being faced by the developing countries are not seen as global problems and there is erosion of the authority of multilateral system, e.g. at the Security Council. Institutions like IMF should be empowered to provide help the developing countries cope with the problem. G7 countries should respect the decisions reached in the UN General Assembly. Equality for all countries is necessary and they should call for greater collaboration and cooperation.

Dr. Serageldin reminded that simply having a large number of

developing countries raising this, with few other countries, might not be enough to generate the needed support. He referred to the past efforts in the UN General Assembly for a new economic order that could not be implemented because the G7 over ruled it. There is a need of finding a way to bring the whole world coming together and move forward. Paris Agreement provided some hope, but the progress has not been there and we are way out from the target of keeping the global temperature rise to below 2^0C. A willing coalition and alliance is needed. He asked Ms. Tkeshelashvili to present her thoughts on this.

Ms. Tkeshelashvili said there was a need to broaden the horizon beyond the sovereign governments and bring in intergovernmental organizations and other players intimately connected with societies and not depending on the traditional leaders.

Mr. Mousa, referring to the problems raised by Ms. Tkeshelashvili in her region, said the MENA region also had suffered similar problem. Civil society has to be mobilized through regional organizations, such as African League, Arab League, European Union for their respective regions. The issues should raised in the COP27 and G20.

Dr. Serageldin said, public opinion had undergone considerable change over the years. Great public appreciation had been generated with "green movement", activists for the protection of forests, oceans, etc., but the leadership from private sector was lacking. We should weave a collation. He invited the comments from Ms. Fakim on this issue.

Ms. Fakim said that in spite of a general fear amongst the public that the climate change is real and dangerous, there is a disconnect between that and what has been happening at the level of the political world, where decisions are taken. The climate change is occurring because of emissions and the countries have been setting the target to become carbon neutral in their activities by 2060 t0 2070; but nature is not going to wait for that time. Important structural decisions have to be taken, including reducing the emissions. The biggest contributor to emissions is the fossil fuel industry. The way we consume and address the issue of subsidies, so that all the sectors emerging, which can help in reducing emissions, are brought on board. The leadership of the world has to decide whether they would like to continue subsidizing the

industry that is contributing to the problem and destroying our own livelihood. We have to decide what mechanism would be available to different actors who can help reduce the emissions. Coming back to the coalition of caring and coalition of willing, we have to see the way the institutions are, or listen to the messages more seriously. There was a mention of the setting of a tribunal; but its possibility is rather remote. There is need to start naming and shaming the countries that are not doing their job related to climate change impacts. Globally, we have to create awakening that green funds are generated, not just 100 billion $ but even more, and redistributed to empower people who can make the change. The hardest part is to instill the political will to empower strong multilateral system. This can happen when there is a strong and functioning UN system.

Opening the discussion to the audience, Dr. Serageldin gave floor to Dr. El-Beltagy, who asked the panel whether it was possible to bring about change in the political governance of the UN system, particularly the composition of and manner of decision making in Security Council, because currently the aspirations of many are held back by a few.

Ms. Fakim agreed that the UN governance system was outdated and was not relevant to current challenges, including poverty, inequality and the climate change. The current system excludes so many people of the global system. The Security Council has 40% of its membership occupied by past colonial powers, does not have representation of Africa (having currently nearly 1.4 billion people, may reach 2 billion by 2050), and excludes India, the 5th largest economy of the World. The system has to be fit and relevant for the purpose, but this has not been happening because big players are not willing to coopt other members who could have a say in the World affairs. We need a system that holds people to account. We have the climate emergency and big powers have to wakeup to the reality that there is no planet B and action has to be taken now by existing institutions.

Mr. Mousa said the regional organizations should play role in tackling the problem of climate change in their respective regions. Regional organizations (from Latin America to Asia, to Europe, to Africa) must take the issue seriously and cooperate and create alliances and express the views of developing countries vis-à-vis the rich countries.

Ms. Tkeshelashvili, referring to need for adaptation and resilience of developing countries to climate change, said that the world was already facing the problem of inflation, food crisis, forest fires, heat waves, drought, floods, etc. There is a need for technological innovations and cooperation of private business. Technological innovations in water use, fire fighting, preventing wastes, developing early warning systems, improving urban environment, forestry, etc. are essential. We have to be innovative in engaging businesses and private sector in public-private partnership to get adaptation going forward. Private businesses and civil society should be inevitable part of raising awareness and then bankrolling to help developing countries.

Summarizing the discussion Dr. Serageldin said there was, firstly, a need for involvement of all the stakeholders, governments, civil society, private sector, etc. Secondly, there is a need for a framework for such cooperation to take place and provide a mechanism of funding for 100 billion $, earlier promised but not realized so far. That might be possible by expanding the role of multinational development financial institutions. One of the possibilities would be to create additional funding at the IMF to help or diminish the indebtedness and provide finance for developing countries, multilateral development banks and World Bank as well as other institutions like BRICKS bank, the Asian Infrastructure Development Bank in which China plays a big role, Islamic Development Bank, etc. All of these institutions can provide foundational collateral that would help in mobilizing private sector funds with sufficient incentives so that developing countries would be able to access adequate funds, with low interest rates and long time horizon, for their investments in adaptation and resilience, rather than borrowing in the international markets on short term and high interest rates. Thirdly, there is a perennial dissatisfaction with the continuing structure of the Security Council of the UN, dating back from since 2nd World War, with veto power for some countries. Many questions have arisen regarding this, and other mechanism have been setup like G7 and G20. The G20 is an interesting grouping, as it includes some 85% of the world population and 85 to 90% of World economic output represented by 20 votes, including one for EU. There is an argument for inclusion of African Union in such a grouping because of the voice of 1.3 billion people in Africa should be on the table. It would be easier to reach a

negotiated agreement between 20 or so partners than between 193 or 200+ partners that the General Assembly of the UN would require. Whether this would work is uncertain, but as the panel emphasized, we need a multipronged strategy. Public opinion should mobilize government-to-government negotiations and with some skillful diplomacy the desired goal of mobilizing the required funding could be achieved. It was not impossible. It happened when unanimous agreements were reached, first on the MDGs and 15 years later on the SDGs. Since then, problems of pandemic, lockdowns, accelerated climate change, etc. have arisen and ways have to be found to cope with these additional challenges. Meeting the target of first two SDGs ('zero hunger' and 'no poverty') is becoming more challenging with the accelerated climate change. Climate change appears in many ways in the SDGs – from goal 13 which is climate specific to the biodiversity on land and in sea, deforestation, etc. It is up to us to be able to rekindle the spirit and idealism that brought us the MDGs and SDGs, and gave us a chance to say that the whole world should confront these challenges together. With those concluding remarks, Dr. Serageldin thanked the members of the panel and all the participants for their contribution, and invited H.E. Zlatko Lagumdzija to start the deliberations of the second panel.

2.6.2.4. Panel Discussion Topic 4.2: Beyond Mitigation: Mobilizing the Requisite Resources for Effective Programs of Adaptation and Resilience

- **Moderator: H.E. Zlatko Lagumdzija,** Former Prime Minister of Bosnia and Herzegovina (2001-2002), Former Deputy Prime Minister (1993-1996, 2012-2015)
- **Panelists:**
    - **H.E. Maria Fernanda Espinosa**, 73rd President of the United Nations General Assembly (UNGA), Former Minister of Foreign Affairs (2017-2018), Minister of National Defense of Ecuador (2012-2014)
    - **H.E. Chiril Gaburici,** Former Prime Minister of Moldova (2015)
    - **H.E. Mr. Petre Romano**, Former Prime Minister of Romania (1989-91)

H.E. Zlatko Lagumdzija, in his introductory remarks, observed that the previous discussion has highlighted the fact that there are plans, people

and organizations but no funds to embark on running effective programs of adaptation and resilience to climate change in the developing countries. Climate change is having global effect, but the developing countries would have to invest much larger proportion of their wealth to become resilient and responsive to climate change issues than the developed countries. The program and projections to increase resilience are clearly formulated in the Sendai framework agreement 2015.The agreement not only covers natural hazards but also technological hazards (threats from chemical industry, use of radioactivity, biological weapons, etc.). This expansion of the framework, however did not get the required expansion of financial commitments. The assistant pledged has yet to materialize, leaving the problem as it was. The developed countries are in still bigger needs than what they used to be when the agreement was reached and 100 billion $ were pledged. So, the questions is what could be done with the situation and the absence of assistance for adaptation and resilience is likely going to lead to new waves of refugees, the environmental refugees joining an already strong wave of other refugees. With these remarks, Mr. Lagumdzija invited H.E. Maria Fernanda Espinosa to present her ideas on the subject.

H.E. Maria Fernanda Espinosa said, given the existential threat to humanity posed by accelerated climate change, this conversation is much needed. The global emissions of GHGs are at the highest level because of our reliance on fossil fuel and therefore the climate threats are increasing right now. The funds needed for helping the developing countries to adapt and become resilient are still inaccessible to them. The climate financing seems to have increased substantially. Some reports suggest it has reached 632 billion $ annually. But, some 571 billion $ have been directed to mitigation, e.g. for transition to green energy and only 46 billion $, merely 7% of the total, for adaptation which is critical for the developing countries. Therefore, one of the first tasks would be to balance the investment: 50% each on mitigation and adaptation. We have seen that the big emitters are not taking the needed steps to adequately curtail emissions and shoulder the responsibility of harm that is being created. She recalled that ten years back when she initiated the climate negotiations in the UN, the complaints about the climate threat mainly came from small island developing states from global south. Now, it is impact the whole planet

and hence it is global responsibility to address it.

Ms. Espinosa raised three important issues for discussion. First, the governments have met 27 times by now to address and solve climate crisis and inter-government process, multi-lateral solutions, common but differentiated responsibilities continue to be central. We should ensure that these processes are inclusive and transparent and enjoy social ownership. Accountability and compliance are essential. When member states take decisions, make commitments and pledge their contribution on mitigation, they should ensure that these are complied with. Secondly, multilateralism is undergoing profound transformation. Core multilateral agreements, such as Paris Agreement, are allowing for a profuse array of partnerships of public-private sector initiatives, private sector alliances, and a vibrant mobilization of young activists, change mentors, women, indigenous people, religious people, etc. The inter-government process is thus opening up to the voices of society in climate discussion. C40, for example, is a network of 100 world leading cities, led by their mayors, collaborating to deliver the urgent action needed right now to confront climate crisis, deploying a science based approach and setting standard for C40 cities to ensure that they are on zero carbon future. The initiative, started with only 18 cities in 2005. During COP 26, they announced two collaborative groups, "Global Mayor Taskforce on Climate and Migration" to address impact of climate crisis on migration in cities, and "Global Youth & Mayors Forum" that worked on vision for "Global Green New Deal". Thirdly, is the issue of accountability and liability of action. Because human life is compromised, we need strong legal mechanism for liability and climate litigation alternatives. There is already a success story related to latter from Germany where the high court recently asked the government to perform better in its climate commitments. In Ecuador, the constitution establishes rights for nature and creating jurisprudence related to precautions to be taken in mining projects.

Unfortunately, under the current geopolitical scenario and the war in Ukraine are changing the enabling environment to reach strong commitments and agreements in COP27. Therefore, we have to be very careful in what we need to achieve. The important issues are: how the industrialized countries, facing the current energy crisis, would finance adaptation in global south, meet the pledge of 100 billion $ per year that

was to start in 2020, do capacity building, implement their own transition to low carbon technology and deal with migration and climate refugee problems. Hope, all these issues would be raised in COP 27 and public opinion mobilized for achieving the objectives.

Mr. Paul Revay, Former European Director for Trilateral (Asia-Pacific, Europe and North America) Commission, Paris, France and Member of the Board of Friends of Europe, Brussels, Belgium, followed up on the issue of climate refugees, raised by Ms. Espinosa. Estimates are the number of environmental refugees would cross 1.2 billion by 2050. Climate migration is considered a major geopolitical risk in EU, as just outside its southern border is the region most vulnerable to climate migration. To face this challenge, EU has already started its homework, with good progress. The European Green Deal and EU climate law are being implemented. Yet, more needs to be done, especially to support the adaptation and resilience to climate change by vulnerable southern neighbors in MENA and Sahel region. Investment assistance and transfer of technology has to improve. Europe has developed strong policy on preparedness, which can be shared with other states. Europe is also strong in environmental research with excellent research and training facilities, which could be shared with the neighbors. The legal framework for climate refugees is still not there and it is important to develop a safe legal pathway for climate migrants. This is important because present approach is reactive rather than proactive. The UN Convention 1951 on refuges does not recognize climate stress as ground to seek asylum/refugee status. Therefore, there is a need to broaden the concept of refugees in the convention.

Mr. Lagumdzija, the Chair, said Europe was much bigger than EU and projects like EU Green Deal (EGD), the long-term policy initiative that defines EU's climate strategy to reach net zero emission by 2050, should be expanded to other parts of Europe. There are some suggestions that EU should be investing some 10 trillion $ per year for transformation towards green energy. This would come to 1.5 to 2.2% of the GDP of EU and is 100 times more than the assistance of 100million $ per year being asked for adaptation by developing countries. Therefore, making these funds available should not be difficult. Mr. Lagumdzija then invited Mr. Chiril Gaburici to take the floor.

Mr. Gaburici said climate change was a global problem and hence there is need to convince the world to come together to an agreement on the course of action. The way the energy is being used in the world has a flow. It is used for economic growth, which of course is important for the wellbeing of the World, but it adversely affects the climate of our planet. The GHG emissions from burning fossil fuel, for generating energy, in addition to those from agricultural activities, waste dumps, and industrial processes, are causing global warming. We have already reached the limit of the safe levels that the atmosphere could take. Although the scientific community has come to a consensus on this, there are still skeptics. But, the time is running out. If we permit the global temperature rise to continue the course to 2^0C, it would be extremely disruptive, throwing the planet to catastrophic consequences, some of which are still not known. Several things need to be done that can move us from fossil fuel-based world economy to low carbon economy. Three appear to be most important. The first relates to energy efficiency; enhance the use efficiency through technological innovations already available. The second is energy production; we need to move to solar, wind or other methods to generate renewable energy. The third is electrification of all transportation systems. These three are the pillars of any economy and we should strategize on them for de-carbonization. A global agreement is necessary, and the governments have to be convinced to make plans to move forward and find necessary resources, soonest possible. Mr. Lagumdzija, the Chair, thanked Mr. Gaburici for his statement and gave floor to H.E. Mr. Petre Romano, former Prime Minister of Romania.

Mr. Romano reminded the participants about the current situation of climate change impacts in different parts of the world, e.g. unimaginable heat waves in Europe causing extreme misery and loss of life; unprecedented droughts in China, crippling the hydro-electric power generation, in a region where the Three Gorges dam was constructed a few years back, following devastating floods. This should awaken every politician, the world over, about the devastating effects of climate change in real time and we have to reach an accommodation with uncertainty and unpredictability by supporting adaptation measures. We have also to bring shift in our activity, which has already done so much damage to our environment. Policies meant to mitigate climate change impacts should be the tools to make possible changes in the

society that is the foundation of global decisions. The conditions for sustainable development are already going out of reach. Marriage between growth and the use of resources was the basis, but it is not possible any more. There are still climate optimists who feel that the nature's resilience is unbreakable and the damage inflicted on natural environment by human activities is limited. As a scientist, he felt several natural phenomena were approaching critical threshold. That is why there is need to embrace common sense approach, which means, circular economy and wise use of resources without any waste. Investments in mitigation, adaptation and resilience have to be made keeping in mind that critical point with respect to climate change impacts is reaching. The Chair thanked Mr. Roman and opened the presentations for discussion.

Dr. El-Beltagy wanted to know from Ms. Fernandez whether reforms in the Security Council were at all possible. And, he asked Mr. Paul Revay about existence of any laws about the outmigration due to climate change, which is already happening and the numbers are predicted to reach above one billion by 2070. There is a need for the international community to provide a safety net for climate refugees.

Dr. Serageldin said that the EU has been pursuing the European Green Deal, which also includes the idea of carbon tariffs and wanted to hear panel's comments on the issue, and on the need to have some incentives to direct people to reduce utilization of carbon. Second question he had was about the possibility of Europe reactivating use of coal and fossil fuel, procured from elsewhere, following the switching off of the gas supply from Russia because of Ukraine-war related sanctions. Lastly, he said the EU parliament had voted to include gas and nuclear energy as green investment. Although, gas is better than coal, it still adds to net increment in emissions. The fear of what is happening currently with nuclear power installations in war affected Ukraine, and of the past happening in Fukoshima, had led Germany to close its nuclear facilities. He invited comments of the panel on these issues.

Mr. Ahmad El-Awadi, Director of Center for the Center of Excellence for sustainability at the Ain Shams University, commented on the mitigation effort in China by constructing the Three Gorges Dam, and said it was an effort to mitigate the effect of flooding rather than the cause of flooding.

When the dam was constructed, it used the amount of steel equivalent to 60 Eifel towers, and when the reservoir is full of water, it lowers down earths rotation by 0.06 microseconds per day, affecting biodiversity and the ecosystem. So, there is a need to look more for the cause of mitigation rather than the effect.

Ms. Espinosa, responding to the question of Dr. El Beltagy, said reform in the UN system and its rejuvenation were overdue after 77 years of its existence as the world has undergone dramatic change. We are witnessing a crisis, but also an opportunity. In her more than 20 years of experience in the multilateral scene, she had never heard such a vibrant discussion and debate as happening now. The new reform agenda for UN has not yet been released, but is being discussed by governments of member states. There is an opportunity now for global community and academia to discuss about the reforms in UN system. Preparation is under way, and it is likely that it may happen in 2024, when the original purpose and future role and function of UN would be discussed. Responding to other questions, Ms. Espinosa said there was no magical solution for stabilizing the planet. Carbon market is suggest as a solution, but it is only a tool. There are many challenges and failure in C-markets, and there is a need to improve the ways in which they are being used as we are looking for reduction in emissions. Carbon removal technologies are emerging, but are still not scalable. Green hydrogen technology is promising, as many others, and we have to combine them all. But the decisions are political. Looking at the root cause of climate emergency, it has to be realized that the problem arises from the dysfunctional relationship between economy, production, and consumption patterns, political models and government designs. It is systemic challenge and hence solutions will also have to be systemic. Reference has been made of circular problem of the way we consume and produce. Climate emergency is human made, hence needs human solution. It is also a litmus test for our multilateral system. We have tools, technologies and mechanisms to address it. Decisions, and strong leadership to get them, are needed.

Mr. Paul Revay referred to the issue of lack of legal framework to deal with climate refugees. Civil society has been working on this and there has been some good follow up by the International Committee of Red Cross (ICRC) in Geneva, but across the International Humanitarian Law.

So, the issue is very active. Refugee Convention in UN is another issue. The High Commissioner for Refugees (UNHCR) was also trying to amend or complement the refugee Convention, but there are people who do not want this to happen because they fear that it will dilute the protection of refugees. Regarding the use of nuclear energy in Europe, we know the history and political background, and we have to be modest in the way we go about addressing it. The Review Conference of the Parties to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), which ended a few days back without any consensus because of Russia, linked with war in Ukraine and the nuclear power plant there. National interests supersede international considerations, impeding advances in legal aspects or encountering other areas for global good. We have to be open to new ideas and address them differently otherwise no change would occur. Mr. Lagumdzija thanked Mr. Paul Revay and hoped that the things will change in the future. He then invited Mr. Gaburici to comment on the issues raised by the audience.

Mr. Gaburici stressed that there was a need to remain focused, working as a team, on decarbonization. Nations can unite around this issue. Being proactive is very important. Referring to the question as to whether we have enough incentives, he reminded that the stakeholders in climate change action are society, governments and big private companies. In order to convince the big private enterprises to participate in the fight against climate change and become drivers of decarbonization process, it is essential that governments provide them some sort of incentives. We need this investment, this motivation and this incentive to convince these big corporations.

Speaking from the floor, Dr. Aliaa Refea said she did not want to be pessimistic and thought it was very important to mobilize human society and bring about a cultural revolution to change in human consciousness. The revolution will depend on education and changing values at the grass root level. This would put pressure on politicians and political system and encourage a social movement around the world. A change in perspective is need with respect to our relations with each other and with nature, and fight the forces that divide us and find common ground.

Mr. Lagumdzija thanked Dr. Rafea and then invited the comments of Mr. Romano on any issue coming up from the floor. Mr. Romano, commenting on legal framework for climate migrants, said that there was still some hope for progress as the NIJC (National Immigration Justice Center) is proposing to have debate and discussion on climate change, although confronted with terrible political disruptions. Referring to the point raised by Dr. Srageldin regarding the interplay between economy and politics, he said such interplay in several cases in the past has ended up very badly, e.g. the case of Aral Sea that has disappeared because of the political decision of Soviet Union times to divert water flowing in to it for irrigating cotton to boost national economy. Now, cotton crop as well as Aral Sea have disappeared. The economy and the political systems are under the influence of climate change but they do not master enough the stabilizing forces. It is clear that market forces cannot temper the negative effects in the dynamics of life. On the contrary, they amplify them. The question obviously is, who is taking care of the property right of the humanity? We do not have global coordination yet, we have to embrace it culturally. Unfortunately, politics and politicians are still not in the main stream of cultural evolution.

Mr. Lagumdzija, concluding the discussion of this panel, said that in COP27, pressure has to come from all the stakeholders. As Dr. Rafea said, a cultural movement has to be created of like-minded people and entities, who understand that we are together in this spaceship earth, and nobody is passenger and every body is member of crew. Carbon tariffs have to be much more global than local, and should extend to whole value chain in order to make them efficient and effective. We have to make climate accounting work and a common sense methodology is needed. We have to bring pressure on the decision makers in COP27 to move faster than hitherto fore, by indicating to them the consequences of not making progress in mobilizing resources for adaptation and resilience in the developing world and creating mechanism for their disbursement to those who are in dire need. For example, lack of timely action now would result in serious problem of environmental refugees, the price tag of which might be in billions of dollars. Mr. Lagumdzija thanked the panel and the participants for their efforts. He then handed over the floor to Dr. Serageldin for his concluding remarks.

2.6.2.5. Concluding Remarks (Topics 4.1 & 4.2) - Dr. Ismail Serageldin:

Dr. Ismail Serageldin highlighted the major points that emerged out of the whole deliberation of the day. The session started with **keynote address** by Dr. Sachs who emphasized the need for investments in education, health, energy, sustainable land use, urban infrastructure and digital transformation in the world. This would roughly require 2-3% of global economic output, closer to 10% of world's saving. Ways should be found out to increase the role of international financial institutions (IFIs), which can then anchor and provide the way for mobilizing private sector resources. These IFIs (IMF, WB, Regional Development Banks, Asian Infrastructure Bank, etc.) are a part of government responsibility, and new funds can be created - as happened in IMF for SDGs, to be distributed in ways that reflected needs rather than the power of membership. Dr. Sachs made a case for compensation to small developing countries, whose share in global GHG emissions was little but were prime victims of climate change. A small levy at national or international level on the emissions can provide monies that could be used for the purpose of insurance, a mechanism that could help poorest countries to deal with the catastrophic problems they are facing. Regarding investment funds for developing countries, who already have serious debt problem, the terms for the loans should be soft, not 10 years at 10% interest but 30 years at 3% interest rate. There is need for a new acceptance of these mechanisms, to be implemented through already existing multilateral financial institutions, but with the recognition that the international role of China is changing, having become the second largest world economy.

In the **first panel discussion**, Mr. Amre Mousa endorsed the idea of compensation to the small developing countries, but went a step further and suggested setting up a tribunal that could establish the responsibility for causing problem and awarding compensation to the victims. Ms. Tkeshelashvili and Ms. Fakim emphasized the need for bringing all the stakeholders on board but suggested that instead of having negotiations between the stakeholders and governments nationally, they should be occurring between the regional blocks. In terms of incentives for decarbonization, the issues of carbon market and

carbon taxes were raised and a global carbon market was suggested. However, it is to be recognized that markets have problems of failure, monopolization and distortion. Therefore, governments will have to provide regulatory framework.

Opening the **second panel discussion**, Mr. Lagumdzija said that the European Green Deal should be expanded beyond EU. The European energy transformation was going to be a very costly, necessitating a trillion of dollars, over several years, which would lead to reduction in the aggregate amounts available for global economy. The global economy is, however, quite large, over 100 trillion dollars, with a 4% annual growth. Therefore, taking out 1% of the global economy for climate action should not pose any major problem, but in practice that just does not happen. Ms. Espinosa also talked about these issues and emphasized the importance of multilateralism. The UN, after 75 years of its founding, needs certain reforms in its decision making processes, that recognize the current demographic and economic situation of the member states. There is also a need to think how global production economy, which has so much adversely affected the environment, can be turned into a circular economy, and countries helped in moving in that direction. Mr. Paul Revay addressed the issue of environmental refugees, and stressed the need to be proactive in managing this problem as the costs otherwise will be huge, particularly for Europe. Funding and capacity building support for adaptation and resilience to countries south of Europe was important. Europe should also be providing funding for research on climate related issues. Mr. Gaburici outlined small steps to enhance energy efficiency, and stressed to move to renewable energy and electrified transport. Mr. Romano **e**mphasized the need for providing tools for decision making to the states based on which they could exercise their vote. Dr. Aliaa Refea reminded the need for change in consciousness while dealing with climate change issues, as every thing is connected to every thing else.

Finally, Dr. Serageldin said that he was now serving on the Global Commission on Water, where imbalance in the hydrological cycle was being very seriously considered there. There is a need for research on this issue as the hydrological cycle affects climate change. There is also research needed to develop better understanding of phenomena such melting of ice, sea level rise, changes in deep water currents in oceans,

etc., that are accelerating more than what was earlier anticipated. Europe can play an important role in spearheading this research, as a part of their climate action commitment.

Concluding his summation, Dr. Serageldin raised two additional points. The first is the need to look at the methodology of measurements and improve it as many mistakes were currently occurring. For example, the measurement of economic output does not take into consideration the negative impact of economic activity on the environment, and the reduction of national capital is not factored in the economic growth models. The second is how the regional projects could be promoted, that require agreement of multiple countries. There are 282 rivers in the world that are shared by more than one country, and so is the case with several power grids. By far the most successful regional project in the world has been the European Union. But that is just one, and there are many needs for regional projects in Africa that will require multiple countries to assume responsibilities for them and supporting them.

2.7. Closing Session Remarks

Chair: Prof. Dr. Adel El-Beltagy
Co-chair: Dr. Ismail Serageldin

Prof. Adel El-Beltagy welcomed the participants to the closing session and thanked them for their efforts in last three days and for contributing to the outcomes of the webinar. These will be communicated to COP27 and put on the website of the International Dryland Development Commission (IDDC). He said, in this session, Dr. Ismail Serageldin and he himself would highlight major elements that emerged out of the deliberations. He then gave floor to Dr. Serageldin to highlight the major points from the deliberations in the panel discussion and also from Dr. Jeffery Sachs' keynote address.

Dr. Serageldin said, the issues that need to be addressed relate to the problems being created by the climate change around the world, and particularly in the developing countries. It is known that the small developing countries have contributed least to climate change but are suffering the most from its consequences. So, we invited Dr. Jeffery Sachs, who has been a major force in globally promoting sustainability issues for last 16 years as the advisor to the United Nations Secretary Generals, to seek his views in resolving some of these problems.

Dr. Sachs made several points. The first was about the resilience-creating adaptation to climate change in the developing countries. This should be a part of a broad program of investment in six areas, viz., education, health, energy, sustainable land use, urban infrastructure, and digital transformation of society. There is a need for lot more investment than the sum of 100 billion dollars that had been earlier pledged, may be about a trillion dollars, which over a period of time should reach to 2-3 trillion dollars, a sum that is about 2-3% of the world economic output, and around 10% of word's savings. This kind of money can be mobilized by setting up financing mechanisms whereby the multilateral development banks and international financial institutions such as IMF, WB, BRICS, the Asian Infrastructure Bank provide a core capital and use this to mobilize private sector capital,

rather than to get all funding by the Governments. These funds have to be given as soft loans to the developing countries, say for a period of 30 years at 2% interest rate rather than for 10 years at 10% interest rate, because the problems - building infrastructure, transforming energy systems, etc. - are long term ones. The second point raised was that this transformation through the international financial institutions was particularly important because many developing countries already have an excessive debt problem. The blocking for this process comes from USA and the Western countries that are resisting the recognition of the fact that China is now the second economic power in the World, and therefore should play a bigger role in refinancing and restructuring of these institutions. It is also important to remember that most of the solutions to the problem are regional rather than national. For example, some 282 rivers that are shared by more than one country, the power grids similarly shared by more than one small country in Africa. This emphasizes importance of political cooperation that goes beyond the responsibility of a country to its own people, and collaborative effort to provide support by those who can to those who need. This could be done by providing compensation to affected countries through funds raised by a small levy on historical carbon emissions by the countries and handled by an international body.

Dr. Amre, picking up the issue of compensation, said that ones who are suffering from the consequences of climate change are least responsible for it. He suggested to consider the possibility of setting up a tribunal to deal with the countries/entities causing the problem and not willing to help with the solutions. Number of other speakers pointed out the need to bring all the stakeholders on board and emphasized that it would be more effective to move to global issues through negotiations between the blocks (e.g. EU, African Union, etc.), rather than individual countries, to arrive at a collective decision for climate action.

Issue of incentives as a tool to mobilize private sector funds, through global carbon market, or carbon tax/ tariffs that would encourage the sector to invest in renewable energy, circular economies and decarbonization, was also discussed. Markets are, of course, known to have their own problems, but the idea deserves serious consideration.

Mr. Lagumdzija said that Europe was now going through a major energy transformation that has been partially forced upon it by the problems of Russian war in Ukraine, which has led to sanctions against Russia by the Western countries and Russia cutting off the gas supply to Europe. Russian gas provided nearly 40% of the European consumption; therefore, there was need for huge energy transformation, costing as much as 10 trillion dollars. The European Green Deal, must go beyond EU *per se,* towards a broader concept of Europe and its neighboring countries, so that the energy transformation would benefit all the countries and significantly reduce emissions. There is, however, a situation right now that emissions would be increasing for some time as more coal and fossil fuel would have to be used because of the shortage of gas. While talking of energy transformation, it is not only limited to using the existing technologies but also developing new ones.

Ms. Espinosa, emphasizing on the need for economic production to move towards circular economy, said that it would not be possible to achieve this through the efforts of the private sector alone. Also, regulations and framework for activities to take care of market failures would be needed, and UN could play an important role here. The UN, however, after its 75 years of existence, needs reforms, which are essential.

Mr. Rebay of Trilateral Commission emphasized the need to pay great attention to the migration issue. There would be a surge of environmental refugees, in addition to the economic and political refugees. This would put enormous pressure in Europe and proactive action would be needed to avoid this. Investments in providing disaster risk reduction and facilitating adaptation and resilience actions would reduce the number of refugees seeking asylum in Europe. Greater involvement of Europe in research on clean energy technologies would be very beneficial for the entire region.

Mr. Gaburici emphasized the importance of even small steps in enhancing energy efficiency and reducing waste. Moving towards renewable energy and electrified transport would be needed. But, there would be a need to involve every body – governments, the private sector, and the civil society, to create a system of resilience. The Sendai framework would help in organizing this kind of work.

Mr. Romano, referring to the global decision-making to promote required climate action, said that it would require tools based on adequate understanding of how interactions occur between different actions. He cited the example of Aral Sea, following the action of politicians to divert river flow for irrigating cotton in Uzbekistan and neighboring areas during the Soviet era. Now there is neither cotton, nor Aral Sea any more.

The need for interconnectedness, as was discussed by several speakers including Dr. Aliaa Rafea, in the earlier session chaired by Dr. Rattan Lal, was again emphasized. There was need for a new consciousness and how understanding of the inter-linkages of things was essential, not just the scientific understanding. The issue of the hydrological cycle and its interaction with climate cycle, land use cycle, etc., was also discussed and it was noted that the discrepancies were leading towards a tipping point. There was a need to give more attention to these issues. An issue that was raised only in passing, but of enormous importance, was the rise in sea level. Expectations were that the rise would be about 50 cm, or at the most 1 meter, and slow. But, now it is clear that it would be much higher and much faster. The rate at which the ice is melting in Greenland and Antarctica is troublesome, and rate at which it is re-forming in the glaciers or on the mountains, whether in the Himalayas, Andes or Alps, is also very troublesome. If all the ice in Greenland were to melt, the seawater rise would be about 6 meters, endangering all the costal cities. The catastrophic events being witnessed now, as a result of climate change, were predicted some 30 years back by IPCC. Hence, the current predictions for the future cannot be ignored and action is needed now.

Dr. El-Beltagy thanked Dr. Serageldin for a very lucid summation of the outcome of the discussions on Topic 4. Referring to the sea level rise, he said Dr. Serageldin was not painting a doomsday scenario. It is a true scenario. In Egypt, the sea level rise is predicted to be 1 meter, which would result in the displacement of some 6 million people from the Delta region, having to move at least 35 km away from the Delta. In addition, there would be seawater intrusion for another 25 to 30 km in the Delta, leaving very little of the most fertile land of Egypt. Similarly, studies have shown that some 250 ports in Africa would be drowned

because of sea level rise, leading to catastrophic effects on the national economy and human life.

Dr. El-Beltagy then highlighted the major points that emerged from the discussions on other topics. From the deliberations in the session on dynamic assessment of climate change impacts, using simulation modeling and all tools of information technology and knowledge management including IOT, it was clear that all the agroecological zones would be shifting. There would be shift in the cropping patterns, and the crops that used to be planted for years might not remain viable anymore. There was, therefore, call from the session for a need to strengthen the team of modelers in the developing countries, working internationally with WMO, as well as, with the scholars from different centers of advanced learning the world over. In Africa, there was a need to assess the damage that might occur at different local and regional level. The IPCC scenarios 1-6 make assessment at the global level; very few studies have been made at regional level, and little at the local level. The local people have the right to know as to what catastrophe might hit them if the temperature rise were to occur as predicted, so that they might prepare and cope with the crisis and adapt. Therefore, dynamic assessment for different agroecoregions in Africa should be done, through collaborative efforts of scientists there, with international and regional organizations. They woulkd need funding from African Development Bank, as each country might be able to commit only limited funds for this ongoing exercise.

Moving on to the discussion on the second topic, dealing with use of genetic resources of plants, animal, fish etc., to dynamically change their genetic makeup to adapt to changing climates, employing not only classical breeding but also through application of such cutting-edge scientific tools as genomics, gene editing, etc. Parallel to this was the need for new agro-management techniques that would permit harnessing complete genetic potential of the newly developed varieties and breeds. Precision agriculture, including more efficient irrigation systems, with low carbon footprint, would have to be used. For this, training of young farmers would be necessary as also funding for procuring the required tools and systems. Some kind of Carbon Tax might provide the funding resource.

Moving then to the third topic, dealing with the coping and adaptive capability, Dr. El-Beltagy said that, as shown in the IPCC maps, there was a clear lack of such capability in the dry areas of the developing world. There would, therefore, be need for human resource development, for which technical and funding support from the industrialized countries would be urgently needed. Enhancing the awareness about the cause and effect of climate change amongst the public at large is important. There would be a need for designing curricula in the schools that enhance the awareness of children, right from the kindergarten stage up, on how to live harmoniously with nature and protect it. Also, the point of interconnectedness and need for change in the consciousness of humanity at large was emphasized so that the global peace and harmony could be achieved.

In concluding his statement, Dr. El-Beltagy said that there was a need to recognize that the price of doing nothing to change the *status co* would be very high. The voice of the developing countries has to be heard, and COP27 in Sharman Sheikh, Egypt, and G-20 in Indonesia, provide excellent opportunity for raising this issue. The recommendations emanating from the webinar would be presented in a side event in COP27, and the details would be put on the website of the International Dryland Development Commission (IDDC).

Concluding the session, Dr. El-Beltagy thanked all the participants, participating physically and virtually, for their contributions in the webinar He thanked the members of the International Organizing Committee and the Local Organizing Committee and all other colleagues for their efforts in making the webinar possible. He thanked Dr. Fatima Osman and Dr. Ashraf Badawi, and their respective teams, for the effective handling of the logistics and organizational work of the webinar. He proposed a special vote of thanks to the President of the Ain Shams University, Prof. Dr. Mahmoud El-Metini, who supported the idea of organizing this webinar from the very beginning and provided excellent venue and support for the webinar. Ain Shams University is a renowned institution of learning that has contributed a great deal in disseminating knowledge related to the issues that have been discussed in the webinar in the last three days. He thanked the participants once again and, declared the meeting closed.

3. Recommendations

3.1. Dynamic Assessment (Simulation Modeling, etc.) of the Impact of Climate Change on the Eco-systems in Different Agro-ecological Zones

3.1.1. Different crop models as well as tools for remote-sensing, Artificial Inelegance, GIS and Surface Energy Balance Systems (SEBS), simulation modeling of yield of different crop varieties and management options under different scenarios of climate change are available. The scope of use of simulation modeling is not only for future adaptation needs and impact predictions but also fur current benefits such as helping in crop insurance. Despite the fact that models are holistic, universal, knowledge-based tools and are being used for global assessment of the impact of climate change, their application at regional and local levels is highly needed. Quality data are needed for validation and calibration at local levels in different agro-ecologies.

3.1.2. Dynamic assessment of climate change impacts at the regional and local levels is highly needed to inform the communities about the damage they could be exposed to, so that they could take risk-avoidance and adaptive measures. It is their right to know what risk they are going to face and how risk adaptation elements can be implemented.

3.1.3. Intensive funding and technological assistance for human resources development in the developing countries in relation to the dynamic assessment of the impact of climate change is highly needed.

3.2. Adaptation of Genetic Resources for Different Agro-ecologies

3.2.1. Considerable genetic diversity exists in nature, which must be researched, evaluated and conserved for the benefit of present and future generations. Germplasm, highly tolerant to cold, heat, drought, flooding, pests and diseases, is available with many national agricultural research systems (NARS) and the Genebanks of international centers like ICARDA, CIMMYT, ICRISAT, ICRAF, ILRI, etc.

3.2.3. There are three mega centers in the world, with rich agro-biodiversity: Indus River Valley; The Nile River Valley and the Yellow River Valley. The agrobiodiversity existing in their drylands is a real asset, which needs to be explored, researched, used judiciously and conserved safely. Some speces are facing extinction due to harsh climate and newly emerging biotic and abiotic pressures. There is urgent need to make full use of this biodiversity by strengthening research, institutions and human resources. This would need enhanced public awareness to mobilize political openion and achieve policy support.

3.2.4. Development of high throughput genomic technologies has given rise to a wealth of information at system level including genome, epigenome, transcriptome, proteome and metabolome. This allows breeders to choose, from a wide selection, the individuals with the best DNA sequence at many genes and for many traits at the same time. A disruptive innovation like CRISPER/Cas9 offers options for genome editing as well as gene pyramiding both in crops and animals. This technology can be applied to develop climate-smart crop varieties for use by farmers, but governmental restrictions come in the way. Collective efforts are needed to convince governments to change their policy and permit adoption of a holistic approach for incorporation of the new crop varieties, so developed, into the cropping systems.

3.2.5. Steps are also needed towards mining the genetic potential of adapted indigenous livestock, poultry and fisheries and using them to develop more productive and climate resilient breeds for different ecologies. Better utilization of tolerant local breeds, e.g. Egyptian Buffalo, Barki sheep and new varieties of rural poultry in Egypt, and developing new varieties of freshwater fish with disease resistance and tolerance to cold and saline water is needed.

3.2.6. The genetic resources are the building blocks for human survival. These must be accessible for use through benefit sharing and without hurdles for current use and for posterity.

3.2.7. There is need to make more financial support available to international platforms, such as the CGIAR and the Global Crop Diversity

Trust (Crop Trust), to coordinate and work in partnership with the National Research Systems (NARS's) to enhance the introduction of new germplasm suitable for climate change dynamics.

3.3. Identification of Appropriate Agro-management Techniques for Different Agro- ecologies

3.3.1. Agriculture should not be considered only as a cause but also the solution to climate change problems. Sustainable agriculture, soil management and dryland farming systems are integral to adaptation to climate change and for advancing Sustainable Development Goals of the Agenda 2030 of the U.N.

3.3.2. Restoration of soil health of degraded and depleted soils of the world through carbon sequestration is a high priority for enhancing land-based carbon sinks, and promoting nutrition-sensitive agriculture. Farmers, foresters and ranchers must be incentivized ,through payments of ecosystem services, for carbon sequestration in soil and vegetation.

3.3.3. Up scaling of system-based conservation agriculture (no-till farming in combination with crop residue retention, agroforestry, complex rotations and integrated nutrient and pest management) must be planned to increase land area under this practice in dryland agriculture and elsewhere in developing countries and globally. Sustainable intensification and resilience of drylands would require holistic approaches combining genetic innovations, climate-informed planning of cropping systems, efficient use of production input, adaptive measures to climate shocks, market inclusivity and ecosystem services.

3.3.5. Precision agriculture, using digital tools and technologies and artificial intelligence that would permit optimization of use efficiency of various production inputs, particularly water (using innovative types of irrigation systems, e.g. drip irrigation, subsurface irrigation and vapor irrigation) and nutrients should be promoted. Climate-smart agricultural practices that can sustain climatic stresses, produce food

with high nutritive value but require less water and energy and reduce carbon footprint are needed.

3.3.6. For providing full benefit from climate-smart, sustainable, precision agricultural to the farmers, extension service will have to be expanded and modernized. Farmers should be trained and financially assisted to promote adoption of these production technologies and tools. Climate-smart agriculture should be a national priority, and national policy and commitment for it should be ensured.

3.3.7. Prime agricultural land must be mapped out and protected against urbanization, brick making, and industrial and other non-agricultural uses. Urban planning must include provision of food production within the city limits through roof gardening, sky farming and soil-less production systems (aquaculture, aeroponics, hydroponics). Home gardening must be promoted to strengthen local food systems against disruptions (e.g., COVID pandemic, conflicts) by promoting the slogan "One Home One Garden".

3.4. Enhancing the Coping and the Adaptive Capacity (Human and Physical Infra- structure)

3.4.1 Nature (including soil, rivers, wetlands, mountains and all life forms) has rights to be protected, restored and managed judiciously so that it can survive and flourish. In this regard, each human being has a responsibility to consume nature's resource in a way that Is sustainable. Connecting humanity with nature is important to stewardship of natural resources and cooperation between science and spiritual organizations is important to strengthen and promote t inter-connectivity.

3.4.2. Curricula at all levels (from primary school to postgraduate education) must be revised to include restoration, protection and sustainable management of environment (soil, water, climate and biodiversity), and children alphabet books in different languages must be environmental centric.

3.4.3. Strategic research networks for scaling innovations should be developed and sustained. Increased R&D funding for scaling innovations

around adaptation and mitigation is essential. Cooperation between private and public sector and farmers organization is critical for translating science into action. Strong inter-ministerial and inter-institutional collaboration and convergence is needed**.** Election platforms at national and local level must include environmental issues. A Mission oriented action by all nations is called for.

3.4.4. Risk-modeling platforms should be developed in cooperation with international and regional centers for remote sensing (e.g. NASA, European and Indian centers, etc.) in different parts of the developing world.

3.4.5. Institutions and capacity development for adaptation and resilience to climate change impacts in the developing countries should be given high priority and resources from industrialized nations, which have major share of responsibility for climate change, should be made available**.** Governments must be encouraged to fulfill the commitment they make at COPs and other political plateforms. In the Paris Agreement, 100 billion dollars were committed for adaptation and resilience to climate change impacts in the developing countries. Mechanisms should be put in place to mobilize these funds and disburse them in an equitable manner. International and regional financial institutions can play a key role in this. Looking at the disastrous impact that climate change is already having in the developing countries, the funds should be raised to at least a trillion dollars.

3.4.6. COP-27 debt-relief program (IMF and World Bank) for the countries most vulnerable to the impact of Climate Change should be endorsed and measures and conditions of the debt-relief structured to speedup the process of implementation be developed.

Appendix 1: Organizing Committees

International Organizing Committee:

1. Dr. Adel El-Beltagy, Chair, International Dryland Development Commission (IDDC); Emeritus Professor, Arid Land Agricultural Studies and Research Institute (ALARI), Ain Shams University. – *Chair*
2. Dr. Jim Falk, Chair, International Advisory Committee, Regional Action on Climate Change (RACC).
3. Mr. Aly Abousabaa, Director General, International Center for Agricultural Research in the Dry Areas (ICARDA).
4. Dr. Mohan Saxena, Executive Secretary, IDDC.
5. Dr. Raj Paroda, Chair, Trust for Advancement of Agricultural Sciences (TAAS).
6. Dr.Fatima Osman, Associate Project Scientist, Department of Plant Pathology, University of California, Davis.

National Organizing Committee:

1. Prof. Dr. Ayman Abou Hadid, Emeritus Professor, Arid Land Agricultural studies and Research Institute (ALARI), Ain Shams University. – *Chair*
2. Prof. Usama El-Behairy, Dean, Arid Land Agricultural studies and Research Institute (ALARI), Ain Shams University.
3. Dr. Salah Soliman, Emeritus Professor of Pesticide Chemistry and Toxicology, Alexandria University, Egypt.
4. Dr. Abdulaziz Sheta, Former Chair, Soils Department, Faculty of Agriculture, Ain Shams University, Egypt.
5. Dr. Ashraf Badawi, Advisor to the President of Ain Shams University, Egypt.

Appendix 2: Speakers and Participants

Speakers:

1. Dr. Adel El-Beltagy, Chair, International Dryland Development Commission (IDDC)
2. H.E. Dr. Mahmoud Mohieldin, Executive Director, International Monetary Fund (IMF)
3. Dr. Mahmoud Sakr, President, Academy of Scientific Research and Technology (ASRT), Egypt
4. Dr. AbdulHakim Elwaer, Assistant Director General, NENA Region, FAO, Cairo, Egypt
5. Dr. Ismahane Elouafi, Chief Scientist, FAO, Rome, Italy
6. Prof. Jeffrey Sachs, Former Director, the Earth Institute, Columbia University; UN Senior Advisor for Sustainable Development
7. Prof. Ratan Lal, 2020 Laureate of the World Food Prize, Distinguished University Professor of Soil Science, Adjunct Professor, University of Iceland, and Goodwill Ambassador for Sustainable Development Issues, The Ohio State University, Columbus, USA
8. Prof. Rolando A. Flores Galarza, Dean, College of Agricultural, Consumer and Environmental Sciences, New Mexico State University, USA
9. Dr. M. L. Jat, Global Research Program Director, Resilient Farms and Food Systems Program, ICRISAT, Hyderabad, India
10. Dr. Ch. Srinivasa Rao, Director, ICAR-National Academy of Agricultural Research Management, Rajendranagar, Hyderabad, 500030, India
11. Dr. Vinay Nangia, Research Leader – Soil, Water, and Agronomy International Center for Agricultural Research in the Dry Areas (ICARDA), Rabat, Morocco
12. Prof. Dr. Donald C. Slack, Professor Emeritus of Biosystems Engineering, Watershed Management and Eco-Hydrology and Civil and Architectural Engineering and Mechanics, University of Arizona, Tucson, AZ, USA
13. Prof. Dr. Ayman Abou Hadid, Emeritus Professor, Arid Land Agricultural Studies and Research Institute (ALARI), Ain Shams University, Egypt
14. Prof. Dr. Abdel-Ghany M. El-Gindy, Faculty of Desert Agriculture, King SalmanUniversity, Ras Sedr, Egypt
15. Prof. Dr. Magdi T. Abdelhamid, Botany Department, National Research Centre,Cairo, Egypt
16. Prof. Dr. Salah A. Soliman, Emeritus Professor of Pesticide Chemistry and Toxicology, Alexandria University, Egypt.
17. Mr. Aly Abou Sabaa, Director General, International Center for Agricultural Research in the Dry Areas (ICARDA)
18. Dr. R. Paroda, Chairman, The Trust for Advancement of Agricultural Sciences (TAAS), India

40. Dr. Ismail Serageldin, Founder Director, Bibliotheca Alexandrina
41. H.E. Ambassador Amre Moussa, Former Secretary-General, Arab League (2001-2011), Former Minister of Foreign Affairs (1991-2001)
42. H.E. Eka Tkeshelashvili, Former Prime Minister of Georgia (2010-2012)
43. H.E. Zlatko Lagumdžija, Former Prime Minister of Bosnia and Herzegovina (2001-2002), Former Deputy Prime Minister of Bosnia and Herzegovina (2012-2015)
44. Ms. Maria Fernanda Espinosa, 73rd President of the UN General Assembly
45. H.E. Chiril Gaburici, Former Prime Minister of Moldova (2015)
46. Mr. Paul Revay, Former European Director for Trilatera (Asia-Pacific, Europe and North America) Commission, Paris, France and Member of the Board of Friends of Europe, Brussels, Belgium
47. H.E. Mr. Petre Romano, Former Prime Minister of Romania (1989-91)

Other Participants:

Seventy-five graduate students from Africa (Nigeria, Tanzania, South Sudan, Rwanda, Kenya, Burundi, Congo, Malawi, and Egypt) attended the meeting and six of them representing different African regions made short presentations to reflect the impact of Climate Change in their respective regions.

Appendix 3: Program

<u>Day 1: Saturday, Sept. 3, 2022</u>

Time: 10:30 to 17:30

10:30 to 11:30 Registration

11:30 to 13:00 Opening Session
Chair: Prof. Dr. Mahmoud El-Metini, President, Ain Shams University

- **Welcome** – Prof. Dr. Adel El-Beltagy
- **Opening Statement** - Prof. Dr. Mahmoud El-Metini
- **Special Guest Statement** – Dr. Mahmoud Mohieldin
- **Statements by Cosponsors:**
    - **Academy of Scientific Research and Technology (ASRT), Cairo, Egypt** -Prof. Mahmoud Sakr
    - **Regional Action on Climate Change (RACC) of the Science & Technology for Society (STS), Kyoto, Japan** – Dr. Ismail Serageldin
    - **Nizami Ganjavi International Center (NGIC)** – Dr. Ismail Serageldin
    - **Food & Agriculture Organization (FAO), Rome, Italy** - Dr. AbdulHakim Elwaer, Assistant Director General, NENA Region, FAO, Cairo, Egypt
    - **Arid Land Agricultural studies and Research Institute (ALARI), Ain Shams University** - Prof. Usama El-Behairy
    - **International Center for Agricultural Research in the Dry areas (ICARDA)** – Mr. Aly Abousaba
    - **International Dryland Development Commission (IDDC)** – Prof. Dr. Adel El-Beltagy
    - **African Platform: Young Master's Program** - Dr. Salah Soliman

- **Introductory Address - Navigating Through Uncertainties: Agro-Ecosystems Affected by Dynamic Impact of Climate Change** – Prof. Dr. Adel El-Beltagy, Chair of the International Dryland Development Commission; Professor, Arid Land Agricultural Graduate Studies & Research Institute, Ain Shams University

13:30 to 14:00 Keynote: FAO Efforts in Building Resilience and Improving Livelihoods of Local Communities in Drylands– Dr. Ismahane Elouafi, Chief Scientist of the Food and Agriculture Organization (FAO) of the United Nations

14:45 to 15:00 Break

15:00 to 17:30 Topic 3. Identification of Appropriate Agro-management Techniques for Different Agro- ecologies

Chair: Prof. Dr. Rattan Lal, Professor of Soil Science and Director of the CFAES, Rattan Lal Center for Carbon Management and Sequestration at The Ohio State University

15:00 to 15:30 Keynote: Farming Carbon in Global Drylands – Prof. Dr. Rattan Lal

15:30 to 17: 00 Lead presentations and discussion:

1. **Improving and Enhancing Adaptive Capacity to Cope with Climate Change Worldwide**– Dr. Rolando A. Flores Galarza, Dean and Chief Administrative Officer in the College of Agricultural, Consumer and Environmental Sciences at New Mexico State University (NMSU), Las Cruces, NM, USA

2. Sustainable Intensification and Enhanced Resilience of Drylands: Constraints and Strategies – Dr. M.L. Jat, Global Research Program Director, Resilient Farms and Food Systems Program, ICRISAT, Hyderabad, India

3. Identification of Appropriate Agro-management Techniques Towards Climate Change Adaptation in Tropical Ecosystems – Dr. Ch. Srinivasa Rao, Director of ICAR-NAARM, Hyderabad, India

4. Water for Agriculture in the Face of Megadrought in the Southwestern USA – Dr. Donald C. Slack, Professor Emeritus of Biosystems Engineering, Watershed Management and Eco-Hydrology, Arid Lands Resources Sciences and Civil Engineering & Architectural Engineering and Mechanics at the University of Arizona, USA

5. Use of Smart Agriculture to Improve Water Use Efficiency and Energy Saving under Climate Change Challenge in Egypt – Prof. Dr. Ayman Abou Hadid, Emeritus Professor at the Arid Lands Agricultural Studies and Research Institute, Ain Shams University and Prof. Dr. Abdel-Ghany M. El-Gindy, Professor of Agriculture Engineering and Dean, Faculty of Desert Agriculture, Rector of the University Branch, Ras Sudr, King Salman International University, Egypt

6. Biosaline Agriculture as an Opportunity for the Sustainable Development of Rural Areas and Coastal Regions – Dr. Magdi T. Abdelhamid, Research Professor and Head of the Botany Department of the National Research Centre (NRC), Cairo, Egypt.

17:00 to 18:30 African Platform – The Voices of the Youth of Africa -Dr. Salah Soliman, Emeritus Professor of Pesticide Chemistry and Toxicology, Alexandria University, Egypt.

Day 2: Sunday Sept. 4, 2022

09:00 to 11: 00

Topic 2. Adaptation of Genetic Resources for Different Agro-ecologies

Chair: Mr. Aly Abousabaa

09:00 to 09:30 Keynote 1:

Genetic Resources for Adaptation to Climate Change in Drylands – Prof. Dr. Raj Paroda, Chairman, The Trust for Advancement of Agricultural Sciences (TAAS), India

09:30 to 10:00 Keynote 2:

CGIAR's Agri-food Systems Climate Adaptation – Responding to the Global Food Crisis – Mr. Aly Abousabaa, Director General, International Center for Agricultural Research in the Dry Areas (ICARDA), Former Vice President ofthe African Development Bank

10:00 to 11:00 Lead presentations and discussion:

1. **Climate Change, its Impact and Mitigation Technologies for Agriculture and Environment** – Prof. Dr. Kauser Abdulla Malik, HEC Distinguished National Professor of Biotechnology, Leading Biotechnology Program at Forman Christian College, Lahore, Pakistan

2. Gene Editing for Adaptation of Dryland Crops to Changing Climate – Prof. Dr. Magdy Madkour, Emeritus Professor, Biotechnology at the Arid Lands Agricultural Research Institute (ALARI), Ain Shams University, and Prof. Dr. Sameh E. Hassanein, Head of Bioinformatics and Functional Genomics Dept., College of Biotechnology, Misr University for Science and Technology (MUST), Egypt.

3. Improving the Livelihood of Smallholder Farmers impacted by Climate Changes in Sinai, Egypt through Optimal Utilization of Integrated Saline Agriculture Systems: A Case Study – Prof. Dr. Hassan M. ElShaer, Animal Production and Rangelands Utilization, Egyptian Center of Excellence for Saline Agriculture (ECESA)

4. Impact of Climate Change on Wheat Yellow Rust Epidemics in Egypt – Prof. Yasser M. Shabana, Plant Pathology Dept., Faculty of Agriculture, Mansoura University, Egypt

5. Water for Food, Water for Life: The Drylands Challenge– Dr. Vinay Nangia, Research Program Leader – Soil, Water, and Agronomy at ICARDA

11:00 to 13: 00

Topic 1. Dynamic Assessment (Simulation Modeling, etc.) of the Impact of Climate Change on the Eco-systems in Different Agro-ecological Zones

Chair: Prof. Dr. Raj Paroda, Chairman, The Trust for Advancement of Agricultural Sciences (TAAS), India

13:00 to 13:25

Keynote:
Simulating the Impacts of Climate Change on the Crop and Soil Processes – Dr. Hemanshu Pathak, Director General, Indian Council of Agriculture Research (ICAR) and Secretary Department of Agriculture Research and Education (DARE), Government of India

13:25 to 15:30 Lead presentations and discussion:

1. Use of Satellite Image Data in Monitoring and Assisting Food Production in Arid Regions – Prof. Dr. Farouk El-Baz, Retired Director for Remote Sensing, Boston University, USA, Member of Advisory Council of President El-Sisi of Egypt

2. Monitoring the Spatiotemporal Urbanization and its Ecosystem Responses in Some Central Nile Delta Areas Using Remote Sensing – Prof. Dr. A. S. Sheta, Former Chair, Soils Department, Faculty of Agriculture, Ain Shams University, Egypt

3. Modeling Hydrological Responses to Changes in Land Use, Climate, and Land Management in Contrasting Agroecological Environments Toward Climate-Smart Sustainable Land Management in Ethiopia – Dr. Atsushi Tsunekawa, Arid Land Research Center (ALRC), Tottori University, Japan and Mulatu Liyew Berihun, Faculty of Civil and Water Resource Engineering, Bahir Dar Institute of Technology, Ethiopia

4. Rising Temperatures and Increasing Demand Challenge Wheat Supply in Sudan – Dr. Toshichika Iizumi, National Agriculture and Food Research Organization, Tsukuba, Japan, Visiting Professor, ALRC, Tottori, Japan.

5. National Strategy and Action Plans for Combating Climate Change Impact on Livestock – Dr. Adel Aboul Naga, Emeritus Professor, Animal Production Research Institute, Agriculture Research Center, Egypt Scientific Research & Technology, Egypt

6. Effect of Climate Changes on Fisheries and Aquaculture – Prof. Dr.

Mohamed F. Osman, Emeritus Professor, Animal Production Department, Faculty of Agriculture, Ain Shams University, Cairo, Egypt

7. Assessment of Soil Contamination Using Geospatial Data and Contamination Indices: A Case Study Kitchener Drain, North Nile Delta, Egypt – Mr. Ehab Hendawy, GIS and Remote Sensing Analyst at National Authority for Remote Sensing and Spacesciences (NARSS), Egypt

8. Identification and Quantification of Actual Evapotranspiration Using Integrated Satellite Data for Sustainable Water Management in Dry Areas – Dr. Rania Gamal, Research Fellow, Irrigation & Water Management-ICARDA, Cairo, Egypt

9. Simple Roof Garden Techniques for Combating Global Warming in Egypt – Prof. Dr. Usama A. El-Behary, Dean, Arid Land Agriculture Graduate Studies and Research Institute (ALARI), Ain Shams University, Egypt and Prof. Dr. Ayman Abou Hadid, Emeritus Professor, Arid Land Agricultural Studies and Research Institute (ALARI), Former Minister of Agriculture.

15:30 to 16:00 Break

16:00 to 17:30
Topic 4. Enhancing the Coping and the Adaptive Capacity (Human and Physical Infra- structure).

Chair: Rattan Lal, Professor of Soil Science and Director of the CFAES, Rattan Lal Center for Carbon Management and Sequestration at The Ohio State University, USA

Lead presentations and discussion:

1. Climate Change Effects on West Asia and North Africa Drylands – Prof. Dr. Mahmud Ayed Duwayri, Former Minister of Agriculture, Jordan, President, Ajloun National University, Ajloun, Jordan; Former Director, Plant Production and Protection Division, FAO, Rome

2. Past and Future Impacts of Urbanisation on Land Surface Temperature in Greater Cairo Over a 45-year Period – Dr. Sameh K. Abd-Elmabod, Associate professor, Soils & Water UseDepartment, National Research Centre (NRC)

3. Changing our Relationship with Nature– Honorable Dena Merriam, Global Peace Initiative of Women (GPIW), New York, USA

4. The Decision for Environmental Restoration is a Human one–Dr.

Sharon G. Mijares, NM Psychologist and Professor, California Institute for Human Science and National University, USA

5. A Need for a Shift of Consciousness in Dealing with Climate Change – Prof. Dr. Aliaa R. Rafea, Women's College, Ain Shams University; Chair & Founder of The Human Foundation, Egypt

Day 3: Monday, Sept. 5, 2022

Topic 4 (continued): Enhancing the coping and the adaptive capacity (human and physical infrastructure)
Chair**:** Dr. Ismail Serageldin, Founder Director, Bibliotheca Alexandrina

09:30 to 10:00
Opening Remarks – Dr. Ismail Serageldin, Founding Director of the Bibliotheca Alexandrina, former Vice-President of the World Bank, and Co-Chair of NGIC Board of Trustees

10:00 to 10:30
Keynote – Dr. Jeffrey Sachs, Former Director, the Earth Institute, Columbia University; UN Senior Advisor for Sustainable Development

10:30 to 11:30
Panel Discussion Topic 4.1: Rethinking National Strategies for Confronting Climate Change in the Light of the Changing Political Realities

- **Moderator**: Dr. Ismail Serageldin, Founding Director of the Bibliotheca Alexandrina, former Vice-President of the World Bank, and Co-Chair of NGIC Board of Trustees
- **Panelists**:
  - H.E. Mr. Amre Moussa, Former Secretary General of the Arab League, Former Minister of Foreign Affairs of Egypt
  - H.E. Ms. Eka Tkeshelashvili, Former Deputy Prime Minister (2010-2012), and Former Minister of Foreign Affairs of Georgia (2008)
  - H.E. Ms. Ameenah-Gurib Fakim, Former President of Mauritius (2015-2018)

11:30 to 12:00 Break

12:00 to 13: 30
Panel Discussion Topic 4.2: Beyond Mitigation: Mobilizing the Requisite Resources for Effective Programs of Adaptation and Resilience

- **Moderator:** H.E. Zlatko Lagumdzija, Prime Minister of Bosnia and Herzegovina 2001-2002, Deputy Prime Minister 1993-1996, 2012-2015
- **Panelists:**
  - H.E. Maria Fernanda Espinosa, 73rd President of the United Nations

General Assembly (UNGA), Former Minister of Foreign Affairs (2017-2018), Minister of National Defense of Ecuador (2012-2014)
- H.E. Chiril Gaburici, Former Prime Minister of Moldova (2015)
- Dr. Ismail Serageldin, Founding Director of the Bibliotheca Alexandrina, former Vice-President of the World Bank, and Co-Chair of NGIC Board of Trustees

13:30 to 13:45 Concluding Remarks (Topics 4.1 & 4.2) – Dr. Ismail Serageldin, Founding Director of the Bibliotheca Alexandrina, former Vice-President of the World Bank, and Co-Chair of NGIC Board of Trustees

13:45 to 14:30 Break

14:30 to 17:15 Webinar Closing Session

Chair: Prof. Dr. Adel El-Beltagy
Co-chair: Dr. Ismail Serageldin

Appendix 4: Executive Board of International Dryland Development Commission (IDDC) 2022

Chairman

Adel El-Beltagy, Chair of the Food and Agriculture Council, Egyptian Academy of Science; Emeritus Professor, Arid Land Agricultural Graduate Studies and Research Institute (ALARI), Ain Shams University Cairo, Egypt; Former Director General, International Center for Agricultural Research in the Dry Areas (ICARDA)

Executive Secretary

Mohan Saxena, Former Assistant Director General (At Large) ICARDA; Senior Advisor to ICARDA Director General; Fellow National Academy of Agricultural Sciences, New Delhi, India

Board Members

Aly Abousabaa, Director General, International Center for Agricultural Research in the Dry Areas (ICARDA), Egypt

Atsushi Tsunekawa, Professor**,** Former Director, Arid Land Research Center (ALRC), Tottori University, Tottori, Japan

Ayman Abou-Hadid, Emeritus Professor, Arid Land Agricultural Graduate Studies and Research Institute (ALARI), Ain Shams University; Former President, Agriculture Research Centre, Egypt

Ch. Srinivasa Rao, Director, ICAR-National Academy of Agriculture Research Management (NAARM), Rajendranagar, Hyderabad, India

Djamin Akimaliev, General Director of Kyrgyz Agricultural Research Institute and Former President of Kyrgyz Agrarian Academy, Kyrgyzstan

Donald Slack, Professor of Agricultural and Biosystems Engineering & Professor of Watershed Management and Eco-Hydrology, Cecil H. Miller, Jr., & Cecil H. Miller, Sr., Families Dean's Chair for Excellence in Agriculture and Life Sciences, University of Arizona, Arizona, USA

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