

CAZRI FOUNDATION DAY

LECTURE

OCTOBER 1, 2011



Dr. Gurbachan Singh



Born in a village of Punjab on 16th September 1954, Dr Gurbachan Singh obtained his Masters' and Doctorate degrees in Agronomy from PAU, Ludhiana with merit scholarship and distinctions. Entering the ARS as a Scientist at CSSRI, Karnal, he rose to the positions of Principal Scientist; Head, Division of Crop Production, IGFRI, Jhansi (2000-2001); Assistant Director General (Agronomy), ICAR, New Delhi (2001-2005); Director, Central Soil Salinity Research Institute, Karnal (2005-2010) before assuming the current charge of Agriculture Commissioner, Government of India, New Delhi.

Dr. Singh's scientific contributions focused on developing alternate approaches for sustainable use of salt affected soils. His research on bio-amelioration of sodic soils by trees and grasses has been acknowledged in the esteemed journal SCIENCE. He authored more than 270 articles, including 25 research papers in high impact factor international journals. He is reviewer for several peer journals including Agroforestry Systems, Land Degradation and Development, Biology and Fertility of Soils, Plant and Soil, Experimental Agriculture, Journal of Professional Association of Cactus Development, Acta Horticulture, Geoderma and many more.

Dr. Singh is recipient of several prestigious awards including Hari Om Ashram Trust Award; Dr. K.A. Shankarnarayan Award; Sukumar Basu Memorial Award; Rafi Ahmed Kidwai Award; Recognition Award of National Academy of Agricultural Sciences; Chaudhary Charan Singh National Award; Sardar Patel Outstanding ICAR Institution Award and Ground Water Augmentation Award. He is on the Editorial Board of "Experimental Agriculture" UK; Advisory Board of Indian Journal of Dryland Agricultural Research and Development; Fellow of National Academy of Agricultural Sciences, Indian Society of Agronomy and Indian Society of Soil Salinity and Water Quality. Dr. Singh is presently chairman of several national committees and was also a member of Management Committees of several organizations including the RAC of CAZRI, CRIDA, NRCWS, PDCSR. He is Founder President of Indian Society of Soil Salinity and Water Quality. He is Scientific Advisor to International Foundation for Science, Sweden; FAO CACTUSNET Regional Coordinator for West Asia and Member of the International Commission on Irrigation and Drainage (ICID) Working Group on Drainage.

Dr. Singh is a widely traveled person having visited several countries: USA, Canada, England, Germany, Holland, Australia, China, Israel, Mexico, Brazil, Thailand, Philippines, South Korea, Pakistan, Bangladesh, Hungary, Nepal, Italy and Iran.

CLIMATE CHANGE AND SUSTAINABLE ARID LAND MANAGEMENT

Dr. Gurbachan Singh
Agriculture Commissioner, Ministry of Agriculture,
Govt. of India, New Delhi

Arid lands occupy large area of the earth mostly in the sub-tropical region. The water scarcity in such locales is created either due to low precipitations or high evaporation, or both. Also in the cold deserts water is often locked in solid form as snow or ice. The areas falling in the rain shadows of major mountain ranges are also arid. It may sound bizarre to talk about the arid lands amid the audience constituted by the very people who are responsible for generating information about the arid regions. However, the occasion demands sharing some of the very pertinent issues so that solutions may be developed for the snags in coming times.

Climate change has become a buzzword in the present times. And whereas none in the country is exposed more to the vagaries of precarious climate than the people of the Thar Desert, of which this city of yours is the gateway, please allow me to express my apprehension that the rest of the world too will not be spared. With the rapid changes occurring in the environment and beyond, be these owing to the nature, or to the so called development, the stage is set for the inevitable. Whether that occurs shortly if not very soon is not the moot point, for decades may be too small a unit of time in the history of the earth and yet smaller in the clock of the universe.

The confluence of frequent droughts, desertification and overpopulation has been the hall mark of the arid lands in the recent past. It is true that change is the law of nature. In fact the arid lands are a consequence of the change in climate. While the mild changes over the millenia may have been absorbed quite smoothly, it is the rapid

pace of the changes that has come to be a cause of concern among the intelligentsia. A resource rich zone may be capable of offering resilience to the changes for a while, but the fragile arid ecosystem appears more vulnerable. In the backdrop of this situation let us ponder over the consequences of climate change in the dry environs.

Let us look at the hypothetically projected scenario of global warming.

Impact on water resources: The changes in temperature, precipitation and humidity may have long term implications on the quantity and quality of water. A decline in run off by more than two-thirds is anticipated for the *Luni* basin. However, an increasing trend of monsoon over the century has been found in north-western India, which is a welcome event for the arid regions.

Impact on agriculture and food production: Studies project a reduction in wheat yield with every degree of rise in temperature. Change in temperature and rainfall may have effect on quality of fruits, vegetables, crops and medicinal plants. Climate change may also affect the dynamics of pests and pathogens.

Impact on health: Climate change is likely to influence the distribution and transmission window of vectors such as mosquitos, implying that mosquitoes in Rajasthan may be active for 3-5 months more than at present.

Studies have shown that higher CO₂ levels lead to reduced plant uptake of nitrogen and some trace elements such as zinc, resulting in crops with lower nutritional value. Reduced nitrogen content in grazing plants has also been shown to reduce animal productivity in sheep, which depend on microbes in their gut to digest plants, which in turn depend on nitrogen intake

An increase in atmospheric temperatures is expected to lead to a more vigorous hydrological cycle, with increased extreme rainfall

events that will cause soil erosion and degradation, resulting in loss of soil fertility. The possible evolution of the organic matter in the soil is a highly contested issue: while the increase in the temperature would induce a greater rate in the production of minerals, lessening the soil organic matter content, the atmospheric CO₂ concentration would tend to increase it. Well, there could be several more issues awaiting consensus, as enough evidence is yet to be generated.

In the context of the arid regions, deforestation is a far cry in the landscape of an already sparse tree cover. The fact is that in contrast to the other regions, forest cover has increased over the years in the Indian arid zone. Rice cultivation is uncommon here and fertilizer use too is on the lower side of the curve, the area being mostly rainfed. Livestock-related activities of course abound here. Add to this the erosion in grasscovers, still the contribution to greenhouse gases is a miniscule proportion of the global emission. Evidently, the region appears a far less culprit compared to intensely cultivated lands and high concentration industrial corridors. That said, there should be no hesitation in confessing that global warming is an acknowledged phenomenon and the arid regions too will have their fair share of worries whether they contribute to the process in a big way or not; as these areas are part and parcel of the globe.

Livestock husbandry and pastoralism were the prime vocations of the desert dwellers until a few decades past, when crop cultivation began gaining ground. Mining and developmental activities have provided alternative occupations. Agriculture related activities with livestock included still remain the largest employer in the arid regions. Global warming is the most talked about facet of climate change. According to the Intergovernmental Panel on Climate Change, the three main causes of the increase in greenhouse gases observed over the past 250 years have been fossil fuels, land use, and agriculture. Agriculture contributes to greenhouse gas increase in four main ways:

- Release of CO₂ due to deforestation
- Methane release from rice cultivation
- Methane release from enteric fermentation in cattle
- Nitrous oxide release from fertilizer application

It has been estimated that agricultural processes contribute 54% of methane emissions, about 80% of nitrous oxide emissions and virtually all carbon dioxide emissions tied to land use. As per the Greenhouse Gas Emission Inventory 2007 published under the aegis of Indian Network for Climate Change Assessment (INCCA), agriculture sector contributed 17% of the net green house gas emissions from India in 2007.

The Indian Council of Agriculture Research initiated a project titled “Impact, Adaptation and Vulnerability of Indian Agriculture to Climate Change” in 2004 to study the impact of climate change and global warming on agriculture crops, horticulture, forests, livestock, fishery etc. The Government has prepared the National Mission for Sustainable Agriculture under National Action Plan on Climate Change to identify key dimensions for promoting sustainable agriculture practices which will be realized by implementing a Programme of Actions that covers both adaptation and mitigation measures through four functional areas, namely Research & Development, Technology Products & Practices, Infrastructure and Capacity Building and sponsored research. Very recently, a new “National Initiative on Climate Resilient Agriculture (NICRA)” has been launched in the year 2011, and I have been told that this prestigious Institute is a partner in research in this programme. It is expected that the knowledge generated through these projects will be of utmost utility in vindicating the role of climate change in our production systems and the ways to mitigate the ill effects, if any. We look forward to the creation of wealth of information through these ventures.

And whereas all this while global warming was being shouted at top of the roof, the scientists here were already pursuing development of techniques to mitigate the effect of droughts. The preparedness of the organization is manifested in having in store a basket of technologies. It may give a sense of pride to this Institute that it has a leadership position in developing techniques that could be deployed to minimize the ill effects of climate change.

The early maturing varieties of cereals and legumes developed by CAZRI and the associated research organizations fit the bill ideally. The varieties are capable of utilizing the limited moisture available in soil and attain maturity in consonance with arid conditions. There lies huge opportunity around the corner for these varieties to expand coverage over much larger areas should a regime of high temperature as projected by the science academies of many an advanced countries and vetted by IPCC, induce stressed conditions in the more comfortable zones of the present times.

With enhanced intensity of rains will prop up the problem of soil crusting interfering with germination of the sowed seed. CAZRI has developed a simple technique of FYM mulching to mitigate the effect of crusting.

Another anticipated event of extreme climate is higher occurrence of cold and heat waves. The arid regions have been experiencing such extremes at a rather frequent if not regular recurrence. The effect of heat waves and cold waves could be averted or minimized through erecting shelterbelts or wind breaks in proper directions. The ICAR Institutes including this Institute of yours have carried out detailed studies on this aspect which should be made use of. While other techniques like smoke generation and mild acid application may be adopted to serve instant purpose, shelterbelts and wind breaks offer permanent and economic solution with no external input involved. Besides, there are other benefits too.

Water conservation is considered a potent weapon in fight against climate change. The inhabitants of the arid region had long back developed traditional water conservation practices, which may be adopted as models by rest of the world. This Institute has worked to improve the traditional water harvesting and conservation practices such as artificial recharge of ground water, *in situ* rain water harvesting, roof-top water harvesting, etc.

Afforestation is being looked at as a means of creating carbon sinks to absorb the excess CO₂. The giant canal system in the desert provides opportunity for large scale plantation and a large area has been covered already. That may look a simple solution but a word of caution here may not be inappropriate. The trees fix carbon only during the growing periods. After reaching maturity, they are carbon neutral. A felling and replanting schedule therefore needs to be developed keeping in view the habits of the tree species.

In the context of the arid regions, afforestation has some other dimensions too. I need not elaborate the pioneering work carried out by this Institute, which was originally established as Desert Afforestation Station. The recommendations of the Institute have benefitted forest departments and development agencies on national and international scales. The evaluation of woody species suitable for arid environment has been an important area of the research agenda. Other aspects like protection have also not been ignored. The solution developed for preventing mortality of *khejri* bears testimony to this. At this juncture may I suggest to focus attention towards energy plants that could replace fossil fuels, for example, for wood based methanol, or wood-based power generation. I hope the Green India mission to be launched through Compensatory Afforestation Management and Planning Authority (CAMPA) will hopefully cover the degraded forest lands as well.

Increased use of renewable energy and increased energy efficiency are suggested as tools to mitigate the effect of global

warming. The arid regions are favourably placed in this respect. Sunshine is available here for longer hours and in greater intensity. CAZRI had long back initiated steps to capitalize this resource for the benefit of the community. A number of solar appliances have been developed, tested and improved to cater to different requirements of households and commercial entrepreneurship. With photovoltaic cells becoming cheaper with technology, there is great potential to harness energy through this route. There is, however, need of expanding the efforts towards wind energy harnessing and developing solar storage devices.

Industrial effluents are a cause of environmental pollution. A number of textile dyeing units have come up here that dispose the waste into the water streams, vitiating ground water quality and adversely affecting the biodiversity. There is lack of data as of now to directly link this to climate change or global warming. But it certainly contributes to soil degradation, which is an acclaimed process limiting land for crop production in an area already deprived of good soils. I remember some studies carried out by CAZRI to utilize industrial waste water for raising certain plants. There is need to develop interventions to mitigate the ill effects of the effluents. Solid wastes are also an important source of green house gas emission. Management of solid waste through recycling may also be looked into.

Another policy response includes adaptation to climate change, which is closely linked to social systems. The inhabitants of the arid regions have for long adapted to the scorching temperatures and survived successfully. The vividness is exhibited in the behaviour of desert dwellers who are content with the little resources they possess and whatever production they could garner. In this context it is pertinent to mention at this juncture that contrary to what is witnessed in many resource rich territories; there are seldom instances of death due to starvation here, thanks to the local social fabric. As far as this part of the world is concerned, adaptation appears to be no issue.

Equally resilient is the livestock of the arid zones. This region is a repository of breeds of sheep, goat and cattle which not only survive the extremes of weather, but are very good producers too be it milk, wool or meat. The inequilibrium in cow and buffalo ratio developing of late is not to blame on the adaptability of the local cattle breeds, but for some religious considerations and failure to utilize males for alternative uses. Friends we all talk about clean energy. May I suggest developing small power generating units using bullock and camel power to supplement solar and wind generated electricity. This will go a long way in conserving some of the best breeds in the world.

Risk financing systems like Crop Insurance Scheme for farmers to cover risk of crop failure and Credit Support Mechanism to facilitate extension of credit in the event of crop failure are outside the ambit of activities of the research organizations and are to be taken up by the governments. But weather forecasting may play an important role in the farmer advisory and I am happy to learn that CAZRI is already rendering this service. Considering the inventory of technologies developed and the support systems available, I am quite confident that the arid lands will be able to weather the storm of climate change.

Thank you.

The **Central Arid Zone Research Institute**, or CAZRI, as it is popularly known, was first established as Desert Afforestation Station in 1952 and was later expanded into Desert Afforestation and Soil Conservation Station in 1957, and finally upgraded to a multidisciplinary research institute in 1959 under Indian Council of Agricultural Research, New Delhi. There are four Regional Research Stations of the Institute located in different agro-climatic zones to work on location-specific problems. The Institute has the mandate to undertake basic and applied research that will contribute to the development of sustainable farming systems in the arid ecosystem; to act as repository of information on the state of natural resources and desertification process and its control, in the form of digital database; to develop livestock-based farming systems and range management practices for the chronically drought-affected areas depending on livestock species; also aquaculture in water; to utilize high and precision technologies in production systems; to provide scientific leadership and to develop collaboration with State Agricultural Universities, State line departments and other national and international agencies for generating location-specific technologies and transfer of the technologies; to act as a center of learning for arid land management technologies; and to provide consultancy and other services for utilizing the available expertise.

Website: www.cazri.res.in

Phone: +91 291 2786584, Fax: +91 291 2788706



केन्द्रीय शुष्क क्षेत्र अनुसंधान संस्थान

(भारतीय कृषि अनुसंधान परिषद्)

CENTRAL ARID ZONE RESEARCH INSTITUTE

(Indian Council of Agricultural Research)

JODHPUR 342 003 INDIA

