

Climate Change Adaptation Strategies in Agriculture and Allied Sectors



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FOREWORD

Agriculture can be defined as the process of using natural resources (sunlight, air, water and soil) to produce a consumable product (e.g. food, fuel and fiber), while maintaining sufficient resources for the next generation. Future agricultural production systems will need to be sufficiently flexible to respond to rapid changes in climate, uncertainties in global markets, declining natural resources and to changing political, and population demands.

There is now mounting evidence and wide spread acknowledgement that climate change has already occurred, that future change is inevitable and that we will have to develop strategies to adapt to these changes. Human activities on the planet are affecting the global climate. Global mean temperatures have risen approximately 0.76°C since the mid 1800s and change in rainfall patterns. Sea levels, and rates of glacial retreat have also been detected which are consistent with expectations of 'greenhouse' climate change.

The classical examples of climate related incidents are the heat wave in 2003 in the European Union, drought of 2004 in southern African countries, drought in Australia and other wheat growing counties in 2006 and recent droughts in 2002 and 2009 in India during which the food grain production was adversely affected. For the first time, food price escalation was noticed in 2007 and being continued even now globally due to declining rate of major grain (rice, wheat and maize) production. Rise in current food prices, as a result of increase in global prices, inadequate monsoon and severe droughts in addition to increase in support prices, are major issues facing Indian Agriculture. Crop simulation models indicate that area under rice and wheat globally is likely to decline in coming decades and food grain production is under threat as a result of increase in temperature and rainfall uncertainties associated with climate change and variability. Therefore, it is high time to develop climate change adaptation strategies to mitigate ill effects of weather aberrations and sustain food production under projected climate change scenario.

I suggest that strategic approaches for agricultural research, development and extension should target:

- (i) improved technologies for increased and profitable production and sustainable conservation of natural resources;

- (ii) diversified novel farming systems that reduce risk, improved resource-use efficiency leading to improved returns to growers;
- (iii) enhanced vertical integration from grower to consumer;
- (iv) training of new generation agricultural graduates and post-graduates with modern scientific, analytical communication and business skills
- (v) organisational and policy reforms

I am pleased to know that the Kerala Agricultural University (KAU) is taking initiatives in climate change adaptation strategies through capacity building and research in agriculture, animal production, forestry, fisheries land and water resources management. I am delighted that the organisers has brought some eminent scientists from India and overseas at this national seminar.

I am delighted to know that M/s. Scientific Publishers has brought out the Proceedings of the National Seminar as an excellent publication for the benefit of the readers. I hope the information from this publication will immensely benefit agricultural researchers, teachers, students, policy makers and progressive farmers. I take this opportunity to congratulate all the scientists who contributed their papers to this valuable publication.

I look forward further collaborative initiatives between KAU and The University of Western Australia (UWA) to address climate change related issues, capacity building in teaching and research and develop viable technologies for dynamic - integrated agricultural production systems.

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PREFACE

Global warming is real. Polar ice is melting. Rise in sea level is expected. Land and ocean biodiversity are in threat. African and Asian countries are likely to suffer more due to food and nutritional insecurity under projected climate change scenarios. Rise in temperature is likely to be around 2-2.5°C by end of this century along with uncertainties in rainfall and its distribution. Effects of climate changes, even smooth trends, will not be uniform in space or time. Uncertainty even in year-to-year monsoon behaviour over India is expected as seen in recent years. Occurrence of heat and cold waves, floods and droughts are not uncommon. These weather related disasters impact on agriculture, water resources, forestry, land and ocean bio-diversity, fisheries, human and animal health and infrastructure. Effects of extreme weather events on crops are very severe and may lead to considerable loss to agricultural production to challenge food security. All-India drought in 2002 caused a loss of about 24 million tonnes in foodgrains production and rice production in *kharif* 2009 was lowered by 10 million tonnes due to deficient rainfall. Vulnerability to extreme events generally is higher than vulnerability to changing average climatic conditions.

In the past one-hundred years, Kerala experienced decline in annual and monsoon rainfall and increase in temperature at the region scale. Year-to-year variations in onset, amount and distribution of monsoon rainfall are likely to be influenced under projected climate change scenarios. The State of Kerala is situated in the humid tropics with plenty of rains and greenery, where severe summer droughts were noticed in 1983 and 2004 during which the surface water resources became scarce, led to hydrological droughts and the State's economy was hit very badly. Recent drought during summer 2004 over Kerala, led to increase in maximum temperature of 1-3°C during Feb-Mar and thermo-sensitive crops like black pepper, cocoa and cardamom across the high ranges and several other perennial crops suffered to a large extent. In 2007, heavy monsoon rains prolonged the crop season and adversely affected the paddy production. Again, unusual rains in March 2008 devastated the rice, when it was in harvesting stage. Sunburns were noticed during March 2010 due to high intensity of radiation and day maximum temperature in Palghat District, which was unprecedented in Kerala. Such weather

aberrations are not uncommon across the World and almost all society linked sectors are likely to be adversely affected and a threat to livelihoods of the people at large. Aberrations in weather are being experienced more frequently and Agriculture and allied sectors being the most vulnerable to climate changes, it is an urgent imperative that adaptation strategies need to be developed for sustaining and enhancing agricultural production for achieving food security to the ever-increasing population. To review and identify gaps in our knowledge in climate change adaptation strategies, a national seminar on “Climate Change Adaptation Strategies in Agriculture and allied sectors” was organized at KAU during 3-4 December, 2009 with the following themes:

Climate Change Adaptation in
Agriculture, Horticulture and Plantations
Water Resources
Forestry
Fisheries
Animal Sciences and Biodiversity

The Proceedings of national seminar, with international participants, spread in six technical sessions. Altogether, 44 research papers were presented. Out of 44, 13 were invited papers from eminent scientists working in various sectors related to climate change adaptation strategies.

The invited papers revolve around climate change impact and its adaptation strategies in agriculture, horticulture, plantation crops in the humid tropics, livestock, fisheries, forestry, water resources and biodiversity. These conceptual papers provide clues for developing adaptation and mitigation strategies in coping up with the expected climate change in future. These studies may also pave way in identifying suitable solutions for minimizing the ill effects of climate change/variability risks and stabilize food security. Deforestation with increase in temperature in high ranges along the Western Ghats may lead to shift in biomes and crop boundaries which are thermo-sensitive. Some of the forest native species may also become extinct. As a part of adaptation strategies against climate change, early weather warnings on short and long term and agro advisory service at farm level play a vital role in minimizing crop losses to a greater extent. Increase in temperature due to global warming may directly influence rice and wheat production in the tropical country like India. It was already experienced in *rabi 2004* as low wheat output was noticed due to temperature rise during the reproductive phase of

wheat across the wheat growing regions of the Country. Similarly, rice output was low in *kharif 2009* due to bad Indian summer monsoon. Globally also, wheat production was low in 2006 due to severe drought persisted across the wheat growing nations. These conditions resulted in price escalation of food grains world over and food insecurity is realized due to global warming. Increase in sea surface temperature has potential impact on fish diversity, distribution, abundance and phenology. It has far reaching consequences for food and livelihood security of a sizeable section of the population.

The contributory papers in Session II revolve around air-sea interactions involved in climate change/variability. It also includes preliminary studies in location wise climate trends and Astrometeorology. The climate change impacts and adaptation strategies were discussed in Session III with reference to natural resources management. Low cost sub surface dykes, rainwater harvesting, drinking water issues and soil health were the main topics discussed in the session. Some of the technologies like rooftop rainwater harvesting are being practiced in few households. This technology can be extended on large scale. Awareness on appropriate water harvesting techniques will go a long way in addressing water scarcity across the country during summer months as a part of climate change adaptation. The climate change adaptation strategies in agriculture, which includes horticulture, plantations, medicinal plants, spices and vegetables, are discussed in Sessions IV and V. Majority of the research papers dealt with understanding the relationships between weather and crops. Such studies are essential as a part of climate change adaptation to develop strategies when the weather related disasters occur and re-occur. To some extent it is also dealt with impact of climate change. Several agronomic practices have been suggested in the case of tea plantations and medicinal plants. Protected cultivation in vegetables was highlighted as a part of climate change adaptation strategy. The climate change adaptation in fisheries and animal sciences were dealt in Session VI. To revolutionize the animal husbandry sector, one of the tools can be National Animal Disease Referral Expert System which will help in daily animal disease forecast; thereby the farmers can adopt suitable control measures such as vaccinations well in advance. Through the national seminar dealt with climate change adaptation strategies, studies in this direction need to be institutionalized and strengthened with technically suitable resource personnel since know how is not based much on research findings for which a national effort based on sound scientific research and matching policy is required. At present, climate change adaptation and mitigation research is at nascent stage

in India. Recognizing the urgency in climate change adaptation and mitigation, the National Action Plan on Climate Change has been announced. The plan identifies eight core “national missions”. Out of these missions, missions on sustainable agriculture, conserving water, creating green India and establishing strategic knowledge platform for climate change will have a bearing on agriculture and allied sectors. Such a policy is yet to be announced at the regional level by various state governments in India. Research and education policy in climate change adaptation and mitigation is the need of the hour to address the climate issues in ensuing years as the frequency of occurrence of floods and droughts, cold and heat waves are likely to increase under projected climate change scenarios. Of course what is said and done, many times not possible to mitigate fully the ill effect of weather extremes in the field of Agriculture and allied sectors. Therefore, two pronged strategy is to be formulated on priority. The prime importance should be given for mitigating the ill effects of weather abnormalities on Agriculture and allied sectors as their frequency is likely to increase under the projected climate change scenario. Equally important is that the Indian Council of Agricultural Research and State Agricultural Universities must have a policy in climate change education and research as the challenge is how to adapt crops to future climate change. Although global grain production is likely to increase in tune with rising population and demand in ensuing decades, the foodgrains production may suffer unless new approaches to adapt crop plants to climate change are adopted. It is true in other society linked sectors too. These approaches are to be chalked out in such a way that the mitigation aspects are to be addressed at the macro level while adaptation strategies at micro level. Of course, they are interlinked and supplementary to each other.

I hope the invited papers including research papers in climate change adaptation and mitigation brought out in the form of publication by M/s. Scientific Publishers will be read immensely and used by the policy makers, researchers, teachers and students. I take this opportunity to acknowledge all the researchers who have contributed the material for bringing out this valuable publication.

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