



PROCEEDINGS

**International Conference on Climate Change
Water, Agriculture and Food Security**

2-3 November 2016

ICRISAT Campus, Hyderabad, India



Norwegian Embassy



Release of book of ABSTRACTS



Release of video CD on water saving and adaptation practices to climate change

INTERNATIONAL CONFERENCE ON CLIMATE CHANGE, WATER, AGRICULTURE AND FOOD SECURITY

2-3 November 2016, ICRISAT Campus, Hyderabad, India

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	Uncertainties in projections of land use and climate change impacts on water and nutrient fluxes in a Danish agricultural catchment
	Jens Christian Refsgaard, Geological Survey of Denmark and Greenland (GEUS), Copenhagen, Denmark
	An integrated approach to improve climate change adaptive capacity of agriculture and water sectors in Tamil Nadu Dr. V. Geethalakshmi et al, colleagues from Tamilnadu Agriculture University Coimbatore
	Combating Effect of Climate Variability and Climate Change on Indian Agriculture through Smart Weather Forecasting and ICT Application. Dr. Nabansu Chattopadhyay, India Meteorological Department, Pune
	Impact of Climate Change and Human Intervention on River Flow Regimes Rajendra Singh, IIT Kharagpur
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Session 2:	Climate variability, extreme events and preparedness
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	Implementation of cost effective method for early warning of rainfall induced landslides in South and North India. Rajinder Bhasin, NGI, Oslo
	Impact of climate change and extreme climatic events on coastal aquaculture – Preparedness and Policy measures for sustaining food security, Muralidhar, CIBA-ICAR, Chennai
	Observed and Future Changes in the Climate over Hyderabad Projected by a COSMO Model Under RCP 4.5. Dr. Dhanya P, EPTRI
	Interaction entropy base model for vulnerability assessment in a granitic terrain, Southern India. N.C. Mondal, from NGRI, Hyderabad
Session 3:	Sustainable intensification of agriculture systems.
	FAO's Regional Rice Initiative: From policy advice to field-based action for sustainable intensification of rice production in Asia. Jan Willem Ketelaar, FAO, Bangkok
	Precision Nutrient Management under Conservation Agriculture-Based Cereal Systems in South Asia. Tek B Sapkota, CIMMYT, New Delhi
	Effect of organic, inorganic and slow-release urea fertilisers on CH ₄ and N ₂ O emissions from rice paddy fields. Bui Thi Phuong Loan, Vietnam Academy of Agricultural Sciences (VAAS)
	Climate change impacts and policy options for farm households in groundnut growing regions of India. Dakshina Murthy Kadiyala, ICRISAT

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	Coastal Lagoons in Europe - Integrated Water Resource Strategies Per Stålnacke, NIBIO
	PMKSY- A Comprehensive Water Resources Development and Utilization Plan T. B. S. Rajput, Emeritus Professor, IARI
	Impact of climate change on Water Use Efficiency of rice in Tamil Nadu. K.Bhuvaneshwari
Session 5:	Strengthening Agriculture, Water, Energy nexus
	Analyzing the Land-Water-Energy-Food Nexus in Eastern India for Breaking the Agrarian Impasse. M. Dinesh Kumar, IRAP
	Assessment of Growth, Distribution and Impact of Agriculture Subsidies on farmers Economy in NEK Region of Karnataka. Dr. Siddayya, NIRD & PR
	Water and Energy Efficient technologies to address climate change in Ganges Krishna Reddy, IWMI
	Smart Technologies for Water Monitoring and Improved On-Farm Water Management Kaluvai Yella Reddy, WALAMTARI
Session 6:	Increasing WUE/Water Productivity
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	Climate smart rice production systems: Studying the potential of Alternate wetting and drying irrigation. K. Suresh Reddy, IWMI
	Improving Equity and Efficiency in Irrigation through PIM and Entitlements in Maharashtra, India. Suresh A. Kulkarni, Maharashtra Water Resources Regulatory Authority
	Hydrological Modeling and Water Resources Management in Context of Climate Change Using MIKE Models. Sunil D. Gorantiwar, Department of Irrigation and Drainage Engineering, MPKV, Rahuri
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	Climate variability and extremes: Relevance of agro-ecological based farming systems in the sub-Saharan Africa. S. Ghimire, Kenya
	Climate-Smart Agriculture and Adaptation to Climate Change: Case Studies from China. Mei Xurong, Beijing, China
	Integrated Soil Management practices to adapt and mitigate climate change. Mehreteab Tesfai, NIBIO, Norway
	Seasonal and inter-annual variability of soil moisture stress function in dryland wheat field, Australia. Venkata Radha Akuraju, University of Melbourne, Australia

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	System of Rice Intensification: a climate-smart rice cultivation system for changing climate Dr. A. P. Ramaraj,
	SRI method of rice – a potential tool to enhance the water productivity and mitigating climate change. Dr. R. Mahender
	Sub-surface drainage pays-experiences in irrigated project commands of Andhra Pradesh & Telangana states India. Dr. T.V. Satyanarayana
Session 9:	Mainstreaming gender and social innovations in adaptation
	Climate Induced Agrarian Stress, migration and Gender Vulnerability on the Eastern Gangetic Plains. Manita Raut-IWMI Nepal
	Women and drought: Waging battles against climate variability and flawed policies. Seema Kulkarni, Independent Researcher, New Delhi
	Gender variabilities in technology adaptations strategy to changing climate: Experiences from South India. Dr G Nirmala, CRIDA
	Gender Mainstreaming in Climate change adaptation among Small holders in canal irrigated areas in Tamil Nadu and Andhrapradesh. Rengalakshmi, TNAU
	Gender, Food Security and Climate Change in Agrarian Economies in Northern India. Amit Mitra, Independent Researcher, New Delhi
Session 10:	Improving markets and product value chains /promoting bioeconomy
	Biofertilization with Blue green algae and Azolla minimizes the global warming potential of rice ecosystem. Dr. A. Lakshmanan, TNAU
	Neglected and Underutilised Small Millets: Holistic Value Chain Approach for Conservation and Use. E.D. Israel Oliver King, MSSRF
	Post Harvest Technology Innovations for Future Food Security. Dr. R.T. Patil, Benevole Welfare Society for Post-Harvest Technology, Bhopal
	Bottom of the Pyramid in Value Chain Contract Farming of Onion - A Success Story Dr. D. N. Kulkarni, Jain Irrigation System Limited
	Development of Solar powered Portable Cold storage System Vasantha Kumar G D, UAS, Raichur
Session 11:	Main streaming gender and social innovations in adaptation
	Enabling policies, institutions, and stakeholders engagement: Drivers of success for enhancing impacts. Suhas P Wani, ICRISAT
	International Conference on Climate Change, Water, Agriculture and Food Security Gender, Institutions and Climate Change Policies Gender in the Paris Agreement & Implications of the Sendai Framework and the SDGs. Aditi Kapoor, Alternative Futures, Delhi
	Climate smart agricultural practices adaptation and its up-scaling strategies: A case of direct seeded rice. K. Gurava Reddy, ANGRAU, Guntur
	Climate change and future rice production in India: Policies for future prioritization. K.Palanisami, IWMI

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	Growth, Yield And Water Productivity of Drip Irrigated Maize (Zea Mays L.) In Southern Peninsular Region of India. Kadasiddappa M M, RARS, Vijayapur, Karnataka
	Development of Decision Support System (DSS) for estimation of field level runoff using Soil Conservation Service Curve Number (SCS-CN) Method. Prasannakumar, CRIDA, Hyderabad
	A bottom-up approach to deal with large uncertainties in climate change Riddhi Singh, IIT Hyderabad
	Uncertainty Comparison in Simulating River Discharge by Hydrological models and its Ensemble. Arun Kumar, IIT, Kharagpur
	Spatial Response of Rainfed Maize To Changing Climate : Opportunities and Adaptations in Tamil Nadu. R. Gowtham, TNAU, Coimbatore
Session 13:	Enabling policy, institutions and stakeholder engagement
	Sustainable Management of Groundwater Resources by Smallholder farmers Konda Reddy Chavva, FAO, Hyderabad
	International Conference on Climate Change, Water, agriculture and Food Security Nancy J Anabel, MSSRF
	Climate Smart Extension for Food Security and Development Goals. Dr.M.Surya Mani, PJTSAU
	Plant Clinics Towards Sustainable Crop Health Management and Food Security Manju Thakur, CABI International, New Delhi
Session 14:	Innovations in agricultural extension-communicating science to stakeholders
	Earth Observation Technologies for Operational Hydrologic Services Dr. V. Venkateshwar Rao, NRSC
	Making weather insurance index rational and effective for agriculture and livestock production. Krishna Reddy Kakumanu, IWMI
	Spatial Flood Early Warning and Damage Mitigation - Role of Space Technology Dr. V. Venkateshwar Rao, NRSC
	Farmers need based Mobile ICT tool for Agro, Animal Husbandry and Fisheries Advisory. Dr. W R Reddy, NIRD &PR
	e-Governance in Farming Sector: A Roadmap to enhance Agricultural and Food Security in India. Prof. M. Moni, Centre for Agricultural Informatics and E .Goverance Research Studies, Government of India
Session 15:	Climate Services
	Future Change in Rice and Wheat Yield under Different Climate Change Scenarios using Multiple Global Climate Model. Madhuri Dubey, IIT Kharagpur
	Analysis of wet and dry spells, long term spatial and temporal rainfall trends and homogeneity in Warangal, J. Niharika, NIT, Warangal
	Evaluation of Micro irrigation Beneficiaries - APMIP Experiences Ch. Sneha, G. Paavan Kumar Reddy, WALAMTARI
	Women Self-Help Groups (SHG) As a Platform for Mainstreaming Women In Climate Change Adaptation. Subash, S.P
	"Millets (Nutri-cereals) for food and nutritional security in dryland ecosystems Dr. Amasiddha, IIMR

LIST OF POSTERS

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2. Geoinformatics based assessment of climate change impact on rural livelihood W. R. Reddy, V. Madhava Rao, T. Phanindra Kumar and N. Ramakrishnanl, NIRD, Hyderabad
3. Aerobic Rice is the better alternative under changed rainfall paradigm during kharif season B. BalajiNaik, G. Sreenivas, D..Raji Reddy and P. Leela Rani
4. Watershed management strategies for sustainable resource utilization as climate change adaptation Manoranjan Kumar and Ch. Srinivasa Rao
5. Analysing earth observations for climate change and disaster vulnerability W. R. Reddy, V. Madhava Rao, T. Phanindra Kumar and D. S. R. Murthy

POSTERS-YOUNG PROFESSIONALS

1. Growth, yield and water productivity of drop irrigated maize (*Zea mays* L.) in southern peninsular region of India. Kadasiddappa Malamasuri, V. Praveen Rao, K. Yella Reddy, V. Ramulu, M. Uma Devi, and S. Narender Reddy
2. Economics of efficiency estimation in rice cultivation under different irrigation systems in Tamil Nadu V. Balamurugan, K. Mani, M. Balakrishna, S. Arivarasan, R. Sangeetha
3. Trends of extreme rainfall in Mahanadi basin and its linkage to frequent flood occurrence Prachi Pratyasha and Jena and Chatterjee
4. Impact of ENSO induced climate variability on rainfed maize productivity in Tamil Nadu M. Vengateswari, K. Bhuvaneshwari, Gowtham Ramaswamy and V. Geethalakshmi
5. Growing Degree Days: Climate Smart Way for Managing the Major Insect Pests of Rice Narayanasamy Manikandan, J. S. Kennedy and V. Geethalakshmi
6. Phenology model for predicting seasonal cycles of cotton mealybug, rice leaf folder and rice planthoppers under climate change scenario Sailaja Vallabuni and Yenumula Gerard Prasad
7. Changing Rainfall Patterns in Godavari and Krishna River Basins Deepak Singh Bisht, Chandranath Chattarjee, and Narendra Singh Raghuwanshi
8. Crafting adaptation options for future rice production considering uncertainties A. P. Raaraj and Geethalakshmi
9. High Resolution Climatic Scenario for Climate Change Impact Studies in West Bengal Pradnya Dhage, Narendra Singh Raghuwanshi, and Rajendra Singh
10. Flood forecasting using observed and forecast rainfall data from numerical weather prediction models Archana R. Mohite, Chandranath Chattarjee and Rajendra Singh
11. Desiccation Sensitivity of Photosynthesis in Seven Fruit crops Rohit babar, Pratiksha Kakade, Dhananjay D. Nangare, Mahesh Kumar, Yogeshwar Singh and Jagadish Rane
12. Development of user friendly software model for gully control structures Sai Gangadhar Rao, G Pavan Kumar Reddy, G. Naveen Kumar, Naveen Kumar Reddy, E. Ramesh Naik and C. Ramana

CLIMAADAPT POSTERS

1. Process of Gender main streaming in Climate change adaptation practices, Rengalakshmi
2. Are climate change adaptations efficient in economics too? A case of direct seeded rice from Andhra Pradesh, India, Krishna Reddy Kakumanu, K. Gurava Reddy, Udaya Sekhar Nagothu, K. Palanisami, K. Yella Reddy
3. Adaptation to climate change: Studying the potential of different rice production methods in Southern India, Krishna Reddy Kakumanu, K. Gurava Reddy, Udaya Sekhar Nagothu, K. Palanisami, K. Yella Reddy
4. Assessing the carbon sequestration potential of Azolla and Blue green algae in rice soil eco system as climate change mitigation strategy, M. Kalaiselvi & A. Lakshmanan, TNAU, Coimbatore
5. Combined influence of different rice cultivation systems with azolla and Blue green algae on water productivity and yield, A. Lakshmanan & N. Jeyapandiyan, TNAU, Coimbatore
6. Analysing the impact of climate change on productivity of dairy cows using Liv sim model, S. Muthu pandiyan & V. Geethalakshmi, TNAU, Coimbatore
7. Study on carbon sequestration of BGA in rice cultivation eco systems. A. Lakshmanan & N.Jeyapandiyan, TNAU, Coimbatore
8. ENSO linked variability in climate over Tamil Nadu and its associated impact on rainfed maize productivity. M. Venkateswari and V. Geethalakshmi, TNAU, Coimbatore
9. An Integrated Science - Stakeholder -Policy Linkage for Upscaling of Adaptation Measures. Yella Reddy Kaluvai, Narayan Reddy Llati, Udaya Sekhar Nagothu, Sunitha Karanam and Kakumanu Krishna Reddy
10. Capacity Building of Stake Holders in Krishna Basin to Address Climate Change Impacts. Yella Reddy Kaluvai, Narayan Reddy Llati, Udaya Sekhar Nagothu, Sunitha Karanam
11. Sensor Technology for Efficient On-Farm Water Management. Yella Reddy Kaluvai, Narayan Reddy Llati, Udaya Sekhar Nagothu, Sunitha Karanam
12. Institutional and Technological Challenges in India for Improving Water Use Efficiency in Irrigated Agriculture. Yella Reddy Kaluvai, Narayan Reddy Llati, Udaya Sekhar Nagothu, Sunitha Karanam and Kakumanu Krishna Reddy
13. Water and climate change: Perceptions of school children, WALAMTARI-IWMI-NIBIO-MSSRF
14. Farmer Melas: Communicating science and technologies to farmers, WALAMTARI-IWMI-NIBIO-MSSRF
15. Dissemination and knowledge exchange at international conferences, WALAMTARI-IWMI-NIBIO-MSSRF
16. Dissemination and knowledge exchange at national conferences, WALAMTARI-IWMI-NIBIO-MSSRF
17. Coping capacity of farming community through village knowledge centre: ICT action platform, Nancy J Anabel and Rajkumar
18. Climate literacy and climate smart knowledge management system, Nancy J Anabel and Rajkumar

KEYNOTE SPEAKER 1

Mr. Jeremy Bird*,
Director General,
International Water Management Institute,
Colombo



Adapting to climate change - an increasing necessity for a water secure world

Abstract

As the world prepares for implementing the Paris climate accord and the SDG agenda, we see a greater focus on water security. More than ever before, there is a need for improving the way this fundamental natural resource is managed. Rainfall and river flows are becoming more variable and the extremes of drought and flood are intensifying. Many of the responses needed to manage variability and increase resilience are already known and yet still require a change in planning and management processes before they can be effectively implemented. Take for example water storage that provides a buffer for the uncertainty of rainfall. Traditional surface storage systems will continue to play a role, but storage options are far more numerous, including recharging of groundwater aquifers and improving soil moisture and landscape management. Reducing the demand for water through crop selection as well as efficiency improvement measures will play a role, as will an increased emphasis on affordable and transparent insurance products. Big data and communications will inevitably become a more central element of climate responses, going beyond monitoring systems to improving forecasting capabilities. Other solutions are yet to be discovered and underlying concepts proven through adaptive research. In the short term though, there is a need to ensure that planning, institutional and cross-sectoral cooperation mechanisms are in place to make best use of the solutions already within our grasp.

*Jeremy specializes in water resources policy, law, management and institutions. As DG of IWMI since 2012, he oversees a research-for-development agenda covering bio-physical and socio-economic aspects of water resources management across Africa and Asia. This includes responsibility for the CGIAR's multi-partner research program on Water, Land and Ecosystems. Prior to joining IWMI, Jeremy was CEO of the Mekong River Commission providing support services and facilitating inter-governmental dialogue on river management among its member countries and development partners. Earlier he was part of the Secretariat of the World Commission on Dams - a multi-stakeholder global policy initiative on the governance, environmental and social issues surrounding dam planning and implementation. As a staff member of the Asian Development Bank, he worked on program and project development in the region. In 2011, Jeremy advised the German Government on framing of the Bonn Conference on the Water, Food and Energy Security Nexus and supported UNEP in developing its operational strategy for freshwater.

KEYNOTE SPEAKER 2

Dr. Andrew Borrell*

Associate Professor,
University of Queensland



Drought adaptation in cereals: combating climate change with genetics and management

Abstract

The Earth is a water-scarce planet. Feeding more people with less water is a major challenge facing humanity, requiring crops that are highly adapted to dry environments. Global food demand is expected to increase by up to 70% by 2050 and this requires another 1 billion tonnes of cereals and 200 million tonnes of livestock products to be produced yearly. Rain-fed farming is practised on 80% of cultivated land and accounts for 60% of the world's food production. Because water supply in rain-fed cropping systems is highly variable, adaptation strategies for crop plants to dry environments become increasingly important. Plant traits such as semi-dwarfism and enhanced responsiveness to nitrogen fertilizer increased food production in the so-called Green Revolution in the 1960s and 1970s. Now, a new set of plant traits is needed to further increase crop yield in a Blue Revolution, making plants resilient to the challenges of a water-scarce planet where climate change and global warming threaten food supplies. This paper reviews genetic and management solutions for developing resilient crops in highly variable environments. Many different management systems are possible to combat drought (e.g. combinations of planting dates, fertilizers, irrigation, row spacing, population, cropping systems). Many different genotypic solutions are also possible. The challenge is to identify favourable combinations of genotypes and management practices in a complex system. Understanding the interaction between genotypes, management and the environment is critical to improving grain yield under dry conditions. Strategies that specifically target genetic and management solutions for adaptation to drought are recommended, including case studies for sorghum, wheat, rice and barley.

*Dr Andrew Borrell is an Associate Professor with The University of Queensland and Centre Leader of the Queensland Government's Hermitage Research Facility. Andrew's research interests include the physiological/molecular basis of drought adaptation in cereals and the efficiency with which resources (radiation, water and nitrogen) are utilized by crop plants. He currently works on projects in sub-Saharan Africa, India, Vietnam and Australia to develop drought-adapted sorghum, wheat, rice and barley for highly variable climates.

INTERNATIONAL CONFERENCE ON CLIMATE CHANGE, WATER, AGRICULTURE AND FOOD SECURITY

2-3 November 2016, ICRISAT Campus, Hyderabad, India

I. About the Conference

Two of the greatest current challenges we are facing today are climate change (and variability) and food security. Achieving global food security whilst reconciling demands on the environment is a daunting task for humanity. Globalization, economic growth, urbanization and change in consumption habits will further increase the burden on natural resources. Lessons learnt from the Green Revolution are important to keep in mind while we develop new paradigms of development for the future. Overall, it will require integrated efforts aimed at adaptation and mitigation. We need to make rapid strides, active stakeholder participation, higher quality science and innovation to overcome the challenges due to climate and economic risks.

At this Conference, it was aimed to better understand and synthesize the biophysical, technological, institutional, social, economic, gender, and political drivers for future agricultural development and food security. Practical on-the-ground studies of practices and innovations across a broad spectrum of new paradigms, including climate resilient agriculture, precision farming, sustainable intensification, agroecology and conservation agriculture, future of food and nutritional security. Keeping this in view, ICCCWAFS was organized by the ClimaAdapt project Partners i.e, Water and Land Management Training and Research Institute (WALAMTARI), Norwegian Institute of Bio Economics (NIBIO), International Water Management Institute (IWMI), MSSwaminathane Research Foundation (MSSRF) and Tamilnadu Agriculture University (TNAU) organized International Conference on Climate Change, Water, Agriculture and Food security (ICCCWAFS 2016) at ICRISAT Campus, Hyderabad during 2-3 November, 2016. The importance of communicating science to farmers, policy makers and media was emphasized. The Conference brought together more than 200 delegates including scientists and development practitioners from international agencies, government bodies, policy makers, farmer and civil society organizations, private sector and the media, to share their experiences and knowledge.

Around 250 delegates from 16 International Organizations across the world and 22 National Institutes of India have participated in the Conference including scientists and development practitioners from international agencies, government bodies, policy makers, farmer and civil society organizations, private sector and the media and shared their experiences and knowledge. Seventy papers were presented at the conference covering 13 themes mentioned below.

- Climate change, impacts and adaptation
- Climate variability, extreme events and preparedness
- Sustainable intensification of agricultural systems
- Water resource management- Smart systems and integrated approaches
- Strengthening Agriculture, Water, Energy nexus
- Increasing WUE/Water Productivity
- Small holders and innovative technology approaches to address food security
- Climate smart rice farming systems
- Main streaming gender and social innovations in adaptation
- Improving markets and product value chains/promoting bioeconomy
- Enabling policy, institutions and stakeholder engagement
- Innovations in agricultural extension-communicating science to stakeholders
- Climate Services

II. Inaugural Session

Dr. K. Yella Reddy, Director, WALAMTARI, welcomed all the dignitaries and participants on behalf of the organising team. The Conference was inaugurated by His Excellency, Mr. Nils Ragnar Kamsvåg, Ambassador of Norway, The Royal Norwegian Embassy, New Delhi. Mr. Nils Vagstad, Director, NIBIO, Norway, Dr. David Bergvinson, Director General, ICRISAT, India, Er. G.S Jha, Chairman, Central Water Commission, India, Mr. Jeremy Bird, Director General, IWMI, Sri Lanka, Er. L. Narayan Reddy, Director General, WALAMTARI were present at the inaugural of the conference. Along with Book of Abstracts, the Book titled 'Climate Change and Agricultural Development' edited by Dr. Udaya Sekhar Nagothu was released in the Inaugural session of the conference. Video CDs produced by ClimaAdapt project on "Use of Sensors for Improved On-Farm Water Management" and "New Inventions on Water Saving and Adaptation Practices to the Changing Climate" were also released in the Conference.

Dr. Udaya Sekhar Nagothu, Coordinator- NIBIO explained about addressing the grand global challenges. Nearly 90% of climate models have shown that climate is changing. There are many uncertainties in modelling. For agriculture, this means understanding and adapting to change in monsoon patterns. In recognition, the Norwegian government has signed an agreement with the Government of India for implementation of ClimaAdapt project in Andhra Pradesh, Tamilnadu and Telangana states. He suggested that multi-disciplinary approach (linking to knowledge from different sectors) is needed to deal with climate change issues. Knowledge platforms are needed to reflect on current status of knowledge, identifying gaps and setting research priorities. There should be emphasis on capacity building, and equity and gender issues. The conference, he hoped, would capture learning from current work and conveying it to all the stakeholders.

Inaugural Program



Lighting of the lamp



Book release "Climate Change and Agricultural Development" edited by Dr. Udaya Sekhar Nagothu

Dr Jeremy Bird, Director General, International Water Management Institute, Colombo in his key note address discussed on 'adapting to climate change - an increasing necessity for a water secure world. As the world prepares for implementing the Paris climate accord and the SDG agenda, we see a greater focus on water security. More than ever before, there is a need for improving the way this fundamental natural resource is managed. Rainfall and river flows are becoming more variable and the extremes of drought and flood are intensifying. Many of the responses needed to manage variability and increase resilience are already known and yet still require a change in planning and management processes before they can be effectively implemented. Traditional surface storage systems will continue to play a role, but storage options are far more numerous, including recharging of groundwater aquifers and improving soil moisture and landscape management. Reducing the demand for water through crop selection as well as efficiency improvement measures will play a role.

Dr Andrew Borrell, Associate Professor, University of Queensland in his key note discussed on 'Drought adaptation in cereals: combating climate change with genetics and management'. The Earth is a water-scarce planet. Feeding more people with less water is a major challenge facing humanity, requiring crops that are highly adapted to dry environments. Global food demand is expected to increase by up to 70% by 2050 and this requires another 1 billion tonnes of cereals and 200 million tonnes of livestock products to be produced yearly. Rain-fed farming is practiced on 80% of cultivated land and accounts for 60% of the world's food production. Because water supply in rain-fed cropping systems is highly variable, adaptation strategies for crop plants to dry environments become increasingly important. Now, a new set of plant traits is needed to further increase crop yield in a Blue Revolution, making plants resilient to the challenges of a water-scarce planet where climate change and global warming threaten food supplies. The challenge is to identify favorable combinations of genotypes and management practices in a complex system. Understanding the interaction between genotypes, management and the environment is critical to improving grain yield under dry conditions. Strategies that specifically target genetic and management solutions for adaptation to drought are recommended, including case studies for sorghum, wheat, rice and barley.

Inaugural addresses



Mr. Nils Vagstad, DG, NIBIO



Nils Ragnar Kampsvag, Ambassador of Norway



Sri G.S. Jha, CWC, Chairman



Dr. David Bergvinson, DG, ICRISAT

David Bergvinson, Director General ICRISAT, Patancheru expressed that there is a need to value water otherwise people take water for granted until they don't pay for it. Pricing of water is an important issue. He opined that, more crop per drop, more nutrition per drop, and getting more rupees per drop is most important.

Nils Ragnar Kampsvag, Ambassador of Norway said that Climate change is the biggest challenge in the world. It will be a very long struggle to limit the negative effects of climate change. He questioned that "who pays for the consequences of climate change – municipalities or insurance companies? Who is responsible?". In his opinion nobody is able to compensate the loss and being successful in adaptation to climate change is critical for economic growth.

Panel Debates

There were two Panel Debates on -1. Climate change, Agriculture and Food Security: Technological, social and policy innovations for improving small holder adaptation and 2. Climate proofing Agriculture: The role of Public-Private partnerships and investments.

Dr.W.R Reddy, IAS, Director General, National Institute of Rural Development & Panchayat Raj, Hyderabad moderated a Panel debate on “Climate change, Agriculture and food security: technological, social and policy innovations for improving small holder adaptation”. Er. G.S. Jha, Chairman, Central Water Commission, Government of India, New Delhi Dr.V.Selvam, Executive Director, MSSRF, Chennai and Dr. C. Suvarna, IFS, Member Secretary, Telangana State Biodiversity Board, Hyderabad participated as panellists.

Panel discussed on How small is the smallholder? To sustain the small holder Community – managed sustainable Agriculture is required. Participation of women is low particularly in decision making. Panel concluded that community based integrated approach will be encouraged for sharing of water resources, sustainable agriculture and also for employment of land less poor.

Dr.Jan Willem Ketelaar, FAO, Bangkok moderated a panel debate on Climate Proofing Agriculture: the role of Public-Private Partnerships and investments. Sri K V Satyanarayana, IAS, Govt of AP, Dr.Aditi Kapoor, Alternative Futures, New Delhi Dr.N.Chattopadhyay, Director, Agri-Met Division, IMD, Pune, Dr M Satyanarayana, Advisor, National Water Mission, New Delhi and Dr.Dilip N. Kulakarni, President, Agri-Food Division, Jain Irrigation System Limited participated as panellists in the debate and concluded that there is a need to look at peri –Urban agriculture. Panel also discussed that water should at least be valued, if not priced. Panelists also opined that focus should be diverted from high yielding varieties to high yielding soil. Regarding finance in agriculture, panel concluded that agricultural finance needs to look at the climate variability factor, financial institutions need to have a climate lens in lending loans to farmers.



Panel discussions



Exhibition Inauguration



Interaction at NIRD &PR Stall



Exhibition of micro irrigation equipment



Explaining about the ultra sonic sensor



Interaction at the JAIN irrigation stall



Display of Micro Irrigation equipment

Stalls were put up at the Exhibition by 1. ClimaAdapt Project, 2. National Institute of Rural Development & Panchayati Raj (NIRD & PR), 3. Netafim Irrigation India Pvt. Ltd. and 4. Jain Irrigation Systems Ltd.

In the ClimaAdapt project stall posters related to water saving techniques and various water measuring devices like boumen tube and sensors were exhibited. Various food items that are able to process in small scale industries in villages for additional income like honey, papads, jams and jellys etc Were exhibited in NIRD stall. Netafim Irrigation India Pvt. Ltd. and. Jain Irrigation Systems Ltd have exhibited latest equipments available with them related to micro irrigation.

Session 1: Climate change, impacts and adaptation

Refsgaard J.C from Geological Survey of Denmark and Greenland (GEUS), Copenhagen, Denmark presented on climate change impacts on the hydrological and nitrate cycle for the 486 km² Odense catchment in Denmark. The scenario analysis have been made with three agro-hydrological models MIKE SHE/DAISY, SWAT and NAM and concluded that uncertainty sources of land use scenarios, climate models, and agro hydrological models influence the prediction uncertainties on water and nitrate fluxes.

Geetha Lakshmi and colleagues from Tamilnadu Agriculture University Coimbatore presented how the establishment of ICT-enabled Village Knowledge Centres contributed to the creation of climate-smart farming societies. This is a 'transferable concept' that could be scaled-up in India and elsewhere. ClimaAdapt project interventions like selected adaptation measures such as alternate wetting and drying method of rice cultivation, direct sowing of rice, green manure application, bio-inoculants application, integrated pest management, integrated nutrient management, crop insurance for transferring the risk in the event of extreme weather conditions, and alternate livelihoods have resulted in increased knowledge level of the farming community and improved productivity of the study region.

Chattopadhyay from India Meteorological Department, Pune in his paper "Combating effect of climate change on Indian Agriculture through smart weather forecasting and ICT application" highlighted that the availability of seasonal and short-term weather forecasts to small-holder farmers at the village-level has the potential to revolutionize decision-making. Seasonal forecast can also be used to decide which crops to grow; seed varieties for planting, purchase seed and inputs, prepare their land accordingly. Shorter real time meteorological information of less than ten days and daily forecasts further help in determining timing of various activities such as sowing, weeding, spraying and harvesting.

R. Singh from IIT Kharagpur presented on impact of climate change and human interventions on river flow regimes and showed that climate change alone reduces the high peaks where as a combination of dam and climate change significantly reduces variability by affecting both high and low flows, there by further disrupting the functioning of riverine ecosystems. Analysis of dam shows that influence of dam is greater than that of the climate change, thereby emphasizing the significance of direct human intervention.

T.Prabhakar Reddy from Oxfam India, New Delhi opined that for improving irrigation efficiency and agricultural productivity convergent approach at local level by involving water user associations and functional committees of local self governing institutions is required.

Session 2: Climate variability, extreme events and preparedness

Giriraj from IWMI, Colombo expressed that if floods and droughts are managed at the basin scale monsoon water can be stored underground in upstream areas and used for irrigation in the dry season while maintaining the supply demand balance downstream. He showed that the cost of natural disasters exacerbated by climate change is already substantial (USD 165 billion a year), and predicted to increase threefold to USD 450 billion by 2030, primarily from floods. Remote-sensing technologies to understand the supply and demand for water at the catchment scale is suggested as one solution for managing extreme events.

Rajinder Bhasin and Bhoop Singh from NGI, Oslo suggested a cost effective method for early warning of rainfall induced landslides. They described a cost effective method for early warning of rainfall induced landslides in India and some other Asian countries for monitoring of landslides.

By keeping in view of highest investments in aqua industry M.Muralidhar et al. from Central Institute of Brackish Water Aquaculture studied about the need and necessity of framing policy measures in the assessment of damage and provision of immediate relief from the government and crop insurance to coastal aquaculture due to extreme climatic events.



Dhanya.P and J. Sessa Srinivas from EPTRI, Hyderabad developed COSMO model under RCP 4.5 trajectory and found that mean changes in the temperature shows an average increase of 1.17 degree centigrade and there is no noticeable change in precipitation for Hyderabad region.

N.C. Mondal et al from NGRI, Hyderabad presented on their study 'Interaction entropy bas model for vulnerability assessment in a granitic terrain, Sothern India' and deduced vulnerable zones with the help of interaction entropy base model and found that the results are in good agreement with that of DRASTIC model.

Session 3: Sustainable intensification of agriculture systems.

Jan Willem Ketelaar of FAO, Bangkok is promoting the concept of increased policy support and intensification of training programmes in agro ecology literacy and climate smart agriculture training involving small holder farmers.

Tek B. Sapkota etal, CIMMYT, New Delhi found that subsurface drilling of fertilizer during planting as well as in the standing crops has been found to be effective in improving nutrient use efficiency and increasing crop yield in conservation agriculture and also there is a need to fulfill the gap between nutrient dynamics and nutrient management.

Bui Thi Phuong Loan et al, Vietnam Academy of Agricultural Sciences (VAAS) observed that neem coated urea and organic urea reduced N₂O emissions significantly compared to inorganic urea when applied in the paddy fields. But there is no significant reduction observed in methane emissions. Based on the results they declared that biochar along with organic and neem coated urea could be a viable option to reduce both methane and N₂O emissions from rice soils.

Dakshina Murthy etal of ICRISAT advocated that policy interventions related to price stability along with assured life saving irrigations under climate change conditions will sustain the farm house hold incomes in groundnut growing regions of India.

G.Sreenivas etal of PJTSAU studied on maize crop and found that climate resilient farming practices like sowing maize from 23rd June to 2 July, selection of crop/variety based on length of the growing period and use of crop calendar in respect to probability of two and three consecutive dry weeks during crop season helps the farming community to forward farming in a sustainable manner under rain fed situations in different agro climatic zones of Telangana.

Session 4: Water resource management- Smart systems and integrated approaches

Matthew McCartney etal of IWMI presented that 'climate smart agriculture' requires changes in the management of natural resources and greater efficiency in the use of those resources, including water. Highlighted different approaches to improve water management can be used to ameliorate some of the major impacts of climate change on agricultural production by reducing greenhouse gas emissions.

Perstalnache, NIBIO found that work in lagoons has highlighted that multidisciplinary scientific knowledge combined with participatory methods can contribute to better management of coastal lagoons in terms of environmental concern and growth of human activities and well being.

T.B.S. Rajput, Emeritus Professor, IARI presented that integration of micro – irrigation with watershed projects particularly for utilization of harvested water are likely to result in efficient utilization of available water resources in agriculture with significant savings of water required for extending the effective irrigation command area.

Bhuaneswari et al, from TNAU, investigated that changes of rice water consumption (ET) and Water Use Efficiency (WUE) in future climatic conditions relative to current (1981 to 2010) climate in Trichy district, Tamil Nadu state, India were assessed using climate models. ET is expected to increase on average by 6.2/4.9, 2.1/0.6, 5.1/3.7, 1.2/-0.3 (decrease) and 2.7 /1.3 % for CanESM2, inmcm4, IPSL-CM5A-MR, MIROC 5 and HadGEM2-AO under without/with CO₂ enrichment.



Session 5: Strengthening Agriculture, Water, Energy nexus

M.Dinesh Kumar et al, IRAP based on their study revealed that a policy which is based on a strategy for intensifying the use of land and water will not work in Eastern India. Instead, a new policy for agricultural growth, which is driven by the strategy of enhancing the productivity of land and water and which is built on the concept of multiple use systems, is needed.

Krishna Reddy Kakumanu et al, IWMI worked on electricity supplies to agriculture at Ramganga sub basin of Indo gangetic region. They found that solar irrigation pumps found to be more feasible option in the long term to meet the ground water and energy demands with socio economical benefits. Establishment of photo voltaic plants on community basis with a guaranteed long term buy – back contracts by the state government would improve the investment and livelihoods of farmers.

Yella Reddy et al presented pilot initiative of WALAMTARI under ClimaAdapt project on use of smart technology for obtaining real time information and establishing decision support system. Low cost sensors were developed and used in the field area for field channel water flow information and on farm water and environmental parameters.

Session 6: Increasing WUE/Water Productivity

Johannes Deelstra et al, NIBIO studied on water productivity under different rice growing practices and found that largest water application leads to lowest water productivity. A general trend in the results was that under reduced water application, mainly under alternative rice growing practices, the yield increased when water application was reduced, leading to a higher water productivity.

Krishna Reddy et al from IWMI found that the alternate wetting and drying in paddy improves water use efficiency from 0.14 to 0.3 in light soils and 0.3 to 0.6 in black clay soils and also the crop production and farmer income.

Kulakarni SA, from Maharashtra Water Resources Regulatory Authority discussed the status and impact of participatory irrigation management, entitlement of programme, volumetric supply and pricing of irrigation water in improving the equity and efficiency of water deliveries in the command areas of public irrigation schemes in Maharashtra with the help of Water User Associations. The reforms and initiatives taken up by the Maharashtra government improved the irrigation systems performance.

S.D Gorantiwar et al from Department of Irrigation and Drainage Engineering, MPKV, Rahuri presented importance of appropriate hydrological modeling and water resources management in context of climate change using MIKE models.

Presentations of the speakers at conference



Johannes Deelstra NIBIO, Norway



Dr. Warwick Easdown, AVRDC, Hyderabad



Dr. Seema Kulkarni, SOPPECOM



Dr. T. V. Satyanarayana, ANGRAU, Guntur



J. Niharika, NIT, Warangal



Dr. Arun Kumar, IIT, Kharagpur

Session 7: Small holders and innovative technology approaches to address food security

Warwick Easdown and Hugo Desprez from World Vegetable Centre, Hyderabad stressed on importance of robust low cost protective structures to vegetable cultivation in view of their vulnerability to climate changes and also the importance of vegetables in the quality diet especially to Asian and African people.

Sita Ghimire, ILRI – Beca Hub, stated that Climate change affects most to the people who are relatively resource disadvantaged, In many SSA countries involvement of farmers in technology generation process is negligible and the governments continue to promote high input agriculture technologies e.g. inorganic fertilizers and improved crop varieties , The integration of agroecology and CSA approaches is crucial to enhance sustainability of agricultural production systems by reducing overreliance on external production inputs and input intensive crop varieties and animal breeds.

Nicholas Clarke, NIBIO presented a case study of China and opined that Climate change is expected to have great impacts on Chinese agriculture, affecting soils, water, and both crop and livestock production. The Chinese government attaches great importance to climate change, and has included this issue in its long-term socioeconomic development plan. Strategies must focus on improvement of food productivity and effective supply, redevelopment of an intensive farming system for income increase and climate resilience, and reduction of GHG emissions from agriculture. Where scientific knowledge is not yet available, the need for practically useable management guidelines might be filled by expert opinion given to the authorities.

Mehreteab Tesfai et al, NIBIO, Norway found that need based fertilizer management, green manuring, biofertilizers, biochar, SWC measures and conservation agriculture fulfilled one or more of the climate smart agriculture principles and can therefore be labeled as climate smart soil management technologies.

Venkata Radha Akuraju of University of Melbourne, Australia found that in the early and harvesting crop growth stages, ET is constrained mostly by surface soil moisture (0 – 5 cm) in the mid growth stages, ET is strongly influenced by soil moisture in the root zone (0 – 60 cm). It was inferred that different temporal rainfall patterns between the years caused wheat's different response to water stress.

Session 8: Climate smart rice farming systems

Abha Mishra from AIT, Bangkok studied on Adaptive capacity of rainfed farmers to sustainably improve agricultural productivity and food security through farmer's led action research. Stressed on the importance of coordination among local, national, regional and international actors to support innovation through farmers participatory action research and collaboration among agricultural actors and organizations for enhancing food security.

Nguyen Thanh Phuong, Vietnam Academy of Agricultural Sciences, Hanoi and Udaya Sekhar, NIBIO stated that Rice production is constrained by water requirement and salinity. Salinity tolerant varieties and farmers access to good quality seed should be enhanced for salt tolerance. Genetic solutions include growing climate-smart rice varieties in salt-water intruded areas of Vietnam (Tsfai et al). Management solutions could include alternative irrigation strategies and cultivation of climate smart rice varieties.

The novel water-saving strategies like AWD (Kakumanu et al) and SRI (Geetha Lakshmi et al; Mahendra Kumar, Dr. A. P. Ramaraj, et al). in rice reduced water use and emissions of both CH₄ and N₂O, increased grain yield, and increased farmers' income. Such climate-smart practices will only be adopted if they are profitable!

K.Yella Reddy et al, WALAMTARI studied on sub-surface drainage for controlling salinity and water logging problems and presented their experiences of impact of sub-surface drainage for enhancing land productivity in farmers fields at five pilot areas located in three irrigated projects.

Session 9: Mainstreaming gender and social innovations in adaptation

Manita Raut-IWMI, reviewed the complex relationship between the climate induced agrarian stresses, migration and gender vulnerability on the Eastern Gangetic plains of Nepal and India. Women in these migrant households, is adversely affected, with their exposure to increasing responsibilities in the agricultural sector and additionally carrying out other household chores and meeting the food needs for their family, and under the circumstances of access to limited resources, lack of information and agricultural knowledge

Seema Kulkarni and Amit Mitra from, Independent Researcher, New Delhi discussed about changing family and agrarian systems are adding the burden on women to manage the farm and do the physical work apart from social, reproduction and care work. They stressed that there is a serious need to enhance the capacities of women farmers by way of trainings and also improve women's access to resources for meaningful livelihood in the present scenario.

According to G.Nirmala et al. CRIDA, Hyderabad there is a lot of difference in adaptation measures to climate change among men and women. Keeping In view of their knowledge levels separate training programmes have to be framed for better adaptation.

Rengalakshmi and Sekhar Nagothu from TNAU, Coimbatore highlighted that the impacts of climate change are disproportionately greater on women farmers. They showed that a strong focus on gender mainstreaming, and especially the inclusion of women farmers, could strengthen the resilience of canal-irrigated agro ecosystem communities.



Session 10: Improving markets and product value chains /promoting bioeconomy

Lakshmanan.A etal, TNAU found that application of blue green algae and azolla in rice could be a potential climate change adaptation strategy for minimizing global warming potential besides increasing the productivity,improving markets and product value chains/promoting bioeconomy.

Israel Oliver King, MSSRF felt that even though millets are rich in nutrients they are neglected from some years M.S. Swaminathan Research foundation addressed the challenges in millet production in 7C holistic approach like Chronicling, conservation, cultivation, consumption, commerce, collectives and communication .

Patil, Benevole Welfare Society for Post-Harvest Technology, Bhopal noted that to keep farmers interested in agriculture, we need to help farmers to increase their income. Proper storage and off-season sales could help to achieve higher prices.

According to Kulkarni, Jain Irrigation System Limited rice provides many smallholders with food, but for cash income, they need to grow higher-value crops, e.g. vegetables and fruits.

Kumar, UAS, Raichur reported that the utilization of solar cold storage units in villages and markets leads to a reduction in post-harvest losses of fruits and vegetables, contributing to nutritional food security and also reducing the GHG emissions to the atmosphere.

Session 11: Main streaming gender and social innovations in adaptation

According to Suhas P.Wani, ICRISAT farmer participatory models like bhuchetana in Karnataka and Rythukosam in Andhra pradesh which are led by ICRISAT consortium are showing good results in overcoming the yield gaps.

Aditi Kapoor, Alternative Futures, Delhi studied many gender related programmes and she felt that in most of them focus on technical solutions to climate change and do not offer solutions that are gender just.

According to Guravareddy etal and K.Palanisami, Acharya N G Ranga Agricultural University, Guntur several adaptation strategies such as Direct seeding rice, Modified system of rice intensification, Supplemental irrigation, alternate wetting and drying, improved management practices and weather based crop insurance products to rice crop to address the variability in rice production are suggested.

Session 13: Enabling policy, institutions and stakeholder engagement

According to Konda Reddy, FAO, Hyderabad participatory hydrological monitoring process helped individual ground water users to become water literate and recognise the need for collective management of the common resource.

Nancy et al, MSSRF studied on empowering knowledge and found that convergence of various knowledge stake holders has evolved as a strong network of institutions that builds knowledge partnership contributing to the outreach of information and improvement of the adaptive capacity of farmers.

M.Surya Mani etal, PJTSAU, Hyderabad opined that extension systems and research on best practices can build resilience capacities of farming communities in climate risk management and increasing farmer awareness of potential adaption response options.

According to Manju Thakur, CABI International, New Delhi there is indeed a dire need for exploitation of new interventions like plant clinics for timely and improved crop health advice for working towards global challenge of feeding more and loosing less.



Session 14: Innovations in agricultural extension-communicating science to stakeholders

V.Venkateswararao et al. of NRSC in their paper covers that hydrological services for a host of applications using a combination of earth observation technology derived parameters using either national scale macro distributed hydrological model or regional theme specific models specifically addressing basin wise water availability, irrigation water management and disaster applications which forms the key for sustainable water management decisions. In recent years, flash floods have increased in India due to high intensity rainfall, and have been attributed to climate change.

Rao et al, NRSC Hyderabad reported that satellite technology has become extremely important in providing cost-effective and reliable mechanisms for preparedness, damage control, and relief management of flood disasters.

Kakumanu et al, IWMI highlighted that the agricultural insurance system in India has been revised from a general insurance corporation to the village level weather index insurance. The challenge is to make weather index insurance rational and effective for agriculture and livestock production in India.

W.R.Reddy et al, NIRD found that data transmitted through voice, text, images and videos from farmer to expert and back works as an integrated model as an excellent outreach and knowledge dissemination tool for the farmers.

Madaswamy Moni, Centre for Agricultural Informatics and E .Governance Research Studies, Government of India discussed about adoption of e-Governance in farming sector to enrich agricultural and food security in India, through a road map – An actionable plan.

YOUNG SCHOLARS SESSION:

Session 12: Improving markets and product value chains/promoting bioeconomy

Kada Siddappa Malamsuri et al, RARS, Vijayapur, Karnataka found that sub optimal or 20 % deficit irrigation scheduling through drip compared with full surface furrow irrigation method resulted in achieving an additional yield of 2212 kg/ha in maize and helps in saving of large quantity of water under present scarce conditions in agriculture.

Prasanna Kumar and Satish Kumar, CRIDA, Hyderabad developed a model to know precisely about field runoff potential and its moisture availability.

Riddhi Singh et al, IIT Hyderabad found that critical changes in precipitation and temperature will lead to vulnerability of water availability in the water shed regions.

Arun Kumar et al of IIT, Kharagpur evaluated the impact of ensemble size on hydrological uncertainty and found that uncertainty level decreases with increase in ensemble size up to ensemble size four and then increases with further increase in ensemble size.

Gowtham Rama swamy et al, TNAU, Coimbatore found that early sowing and application of additional dose of fertilizer had positive response with yield increase under future climatic conditions.

Session 15: Climate Services

Madhuri dubey et al, IIT Kharagpur worked on multiple global climatic models in paddy and wheat crop and found that there will be a definite reduction in yield of both the crops.



J.Niharika and K.V.Jayakumar, NIT, Warangal found that analysis of wet and dry spells long term temporal rain fall trends can help in analysis of water availability and in effective utilisation.

Pavan Kumar Reddy and Sneha, WALAMTARI conducted detailed field investigations on Andhra pradesh micro irrigation project and found an increase in crop productivity, reduction of labour cost and over all increase in area of cultivation.

Subash, S.P from NAARM studied on Women Self-Help Groups (SHG) As a Platform for Mainstreaming Women In Climate Change Adaptation. According to him Women are often excluded from decision making on access to and use of land and other productive resources, seed being one of them. The paper narrates how introduction of Stress Tolerant Rive Varieties (STRVs) through women SHGs amongst farmers and their seed production and management by SHGs and their federations can be a good platform for mainstreaming gender and adaptation for climate change

Ama siddha, ICAR-IIMR, Hyderabad worked on millets and opined that millets are the best choice for cultivation because of their health benefits and high grain production under stress environments in the changing climate.

Dr Andrew Borrell, Centre Leader, Hermitage Research Facility, UQ, Australia Presented fianl wrap of the two days international conference on Climate Change, Water, Agriculture and Food Security (ICCCWAFS). In his concluding remarks he said taht "The future is not yet determined. It is in our hands – and it can be crafted into whatever shape we choose. But one thing is certain in relation to climate change. We cannot be complacent. Rather, we need to embrace the big ideas that have been presented here and, collectively, run with them. The future will depend on the extent to which we act on these ideas now."



Delegates



Participants interaction



Presentation of wrapup



Vote of thanks

Dr. K. Krishna Reddy concluded the session with vote of thanks.

ICCCWAFS Organising Committee



Dr. Udaya Sekhar Nagothu is a Director (International Department) at NIBIO (The Norwegian Institute of Bioeconomy Research), Norway. He has nearly 25 years of research, consultancy and development experience and worked in Asia, Europe and Africa extensively including India, Bangladesh, the Philippines, Sri Lanka, Vietnam, Balkans, Czech Republic, Norway and the EU. He mainly works with issues related to institutional and policy analysis, integrated natural resources management, climate change and adaptation in agriculture, aquaculture and water sectors in several countries. For nearly a decade, he has been a member of the Indian Forest Service (1987 to 1999). He has been a visiting Faculty at the University of Sydney (February to May 2014) and at Cornell University (September to November 2015). He has edited two books recently on Food Security, Climate Change and Agricultural Development.



Dr Kaluvai Yella Reddy is a Director for Agriculture and Research at Water and Land Management Training and Research Institute (WALAMTARI), Hyderabad. He graduated in Agricultural Engineering, obtained M.Tech and Ph.D degrees from IIT, Kharagpur and PG Diploma from University of Arizona. He joined ANGR Agricultural University in 1985 as faculty. He has more than 30 years of experience in teaching, research, and extension and project management. His areas of interest include on-farm water management, water use efficiency, virtual water, climate change and sub-surface drainage. He was Technical Head for AP Micro Irrigation Project for 5 years, which has brought over 1.2 million ha under micro irrigation. He has developed 'Solar Powered Micro Irrigation System' and 'Semi-Permanent Sprinkler System'. He has been the first Indian to receive the 'ICID WatSave Technology Award'.



Krishna Reddy Kakumanu is a Regional Researcher at International Water Management Institute (IWMI), New Delhi, India. He has wide experience on the economics of conjunctive use of water, energy pricing and climate change impact assessment and adaptation in agricultural and water sectors in India. He has 10 years of research experience and published several research papers in international journals and books. He has also wide experience in project implementation through stakeholder's integration.



Dr. V. Geethalakshmi has doctoral degree in Agronomy and serving as Professor in Tamil Nadu Agricultural University for 27 years. She has specialized in Agricultural Meteorology and Climate Change and has published more than 40 research papers in International and National Peer reviewed Journals. She has completed 21 research projects funded by international and national organizations. She is responsible for development of weather based agro advisory for the benefit of the farming community in rural areas and has created a communication network through electronic and mass media that paved way for reaching larger farming sector.



Nancy J. Anabel is a Director of Information Education and Communication programme at M. S. Swaminathan Research Foundation, Chennai in India. She has 22 years of professional experiences as a development practitioner, social scientist and as a researcher on various national and international programmes and projects in India and South Asia. Her major focuses have been on the application of ICT in themes such as Climate Change, Sustainable Agriculture and Fisheries, Health, Nutrition and Sanitation. Her professional competence are also in strategic planning and advocacy, capacity /institution building, monitoring & evaluation, gender mainstreaming and participatory rural appraisal techniques. She is an alumni of Carleton University, Canada. The work on Fisher Friend Mobile Application won South Asia mBillionth award. She was actively involved in the advocacy team for charging drinking water, which was passed and followed by GoTN.