Front Matter [Preface and List of Contributors]

National Organizing Committee, International Grassland Congress

Follow this and additional works at: https://uknowledge.uky.edu/igc

Part of the Plant Sciences Commons, and the Soil Science Commons

This XXIII International Grassland Congress (Sustainable use of Grassland Resources for Forage Production, Biodiversity and Environmental Protection) took place in New Delhi, India from November 20 through November 24, 2015.


Published by Range Management Society of India

This Event is brought to you for free and open access by the Plant and Soil Sciences at UKnowledge. It has been accepted for inclusion in International Grassland Congress Proceedings by an authorized administrator of UKnowledge. For more information, please contact UKnowledge@lsv.uky.edu.
Sustainable use of grassland resources for forage production, biodiversity and environmental protection
Proceedings–23rd International Grassland Congress

Keynote lectures

Editors
D Vijay, M K Srivastava, C K Gupta
D R Malaviya, M M Roy, S K Mahanta
J B Singh, A Maity, P K Ghosh

Published by
Range Management Society of India,
Jhansi -284003, India
Sustainable use of grassland resources for forage production, biodiversity and environmental protection

Proceedings–23rd International Grassland Congress

Keynote lectures

EDITORS

D Vijay
M K Srivastava
C K Gupta
D R Malaviya
M M Roy
S K Mahanta
J B Singh
A Maity
PK Ghosh

Published By
Range Management Society of India,
Jhansi -284003, India
FOREWORD

Grasslands, including rangelands and other grazing lands, are among the largest ecosystems in the world and contribute to the livelihoods of more than 800 million people. These grasslands play a major role in the economy of the country as these are used as pastures/forage resource for domestic grazing animals, habitat for wildlife and wonderful place for eco-tourism. These are good source of forage, food, energy with substantial contribution towards carbon sequestration and water harvesting.

In tropical world, particularly developing and underdeveloped countries, the grassland are subsistence resource for large proportion of population. The estimates of grasslands and shrub lands in India vary from 3.7% to as much as 12% of the total area. In many parts of the world, due to heavy grazing pressure, the grasslands are in denuded form and not able to sustain. Hence, comprehensive strategy for rejuvenation of these important resources is required.

23rd International Grassland Congress is, for the first time, being organized in India by Range Management Society of India (RMSI) and ICAR-Indian Grassland and Fodder Research Institute (IGFRI) on the theme "Sustainable Use of Grassland Resources for Forage Production, Biodiversity and Environmental Protection" during November 20 to 24, 2015 at New Delhi. During the congress deliberation will take place in plenary lectures, key note lectures, forum discussions, research paper presentations and also informal discussion during breaks. The present compilation of Key Lectures is of immense value to scientists, academicians, policy makers and farmers to take grassland development a step forward.

I invite active participation of all researchers, policy makers, farmers, entrepreneurs and students in the congress, as a platform for exchanging ideas, having intense brainstorming and sharing experiences, that would aid in formulating useful policies for all perspective improvement in grassland of world.

Dated the 10th November, 2015
New Delhi

(S. Ayyappan)
PREFACE

Grassland ecosystem is the largest ecosystem in the world, which was the source to all modern food crops and serves as a supporting system for the food and environment security. Spreading over 50 million square kilometers, they constitute more than one third of world land area and 70 percent of world agriculture area. Grasslands are present in all continents and are habitable to the human and livestock populations. In some countries these are primary source of intensive livestock production in contrast to some tropical arid and semi-arid areas where the grassland productivity is not sufficient to sustain the profitable livestock production. The need of time is to utilize these vast natural resources as “Global Resource” with clear understanding of resolving socio-political issues.

Since more than 8 decades, the International Grassland Congress is highlighting the importance of world grasslands through organizing conferences across the globe and has taken lead role in converging the grassland research for its improvement and further use by other iso-climatic conditions. Grasslands have specific significance to India and Indian subcontinent which represents almost all types of grasslands. Organizing IGC in India provides a great opportunity to the scientists from Indian Subcontinent and many countries in south East Asia/ Africa to participate in the knowledge exchange. Hence, for the first time, International Grassland Congress (XXIII IGC-2015) is being organized at New Delhi, India by Range Management Society of India (RMSI) and ICAR-Indian Grassland and Fodder Research Institute during November 20 to 24, 2015.

The main essence of the 23rd International Grassland Congress is “Sustainable use of grassland resources for forage production, biodiversity and environmental protection”. The deliberations in the congress are oriented towards following five themes:

1. Grassland Resources
2. Grassland Production and Utilization
4. Biodiversity, conservation and genetic improvement of range and forage species
5. Environmental Issues related to Grassland

These subthemes will be deliberated in 30 specialized technical sessions and in each session two eminent scientist/ planner/ NGOs will share their experience. The present book is compilation of keynote lectures to be delivered by the eminent grassland workers across the globe. The valuable information presented by the contributors contains a wide range of knowledge on various aspects of grassland science. The experts from different countries were invited for key lectures on focused topics related to following subthemes in order to cover all relevant aspects of grasslands:

- Dynamics of grassland resources – global database
- Global monitoring of grasslands
Quality, production, conservation and utilization
Integration of plant protection to optimize production
Soil-plant-animal-human interrelationships
Water management to increase grassland and forage production
Validation and dissemination of traditional knowledge
Interdependence of grassland and arable lands for sustainable cereal, forage and livestock production
Seed production, storage, availability and quality
Grassland-market linkage
Alternative uses for tropical and temperate grasslands
Multi-stakeholder learning platforms for grassland management
Factors affecting grassland and forage resources
Sustainable use of grassland resources
Improving grasslands through education and practice
Policy issues related to sustainable grassland production
Public-private partnership in managing common property resources
Plant genetic resources and crop improvement
Climate change and grassland management

We wish that deliberations during the congress on most important aspects of grassland such as sustainability, productivity and environmental issues will be helpful in making research and development policies for grassland of not only this continent but for whole world.

We wish to extend sincere gratefulness to all the contributors who accepted our invitation and could spare time to prepare this invaluable information. We also wish to thank all those who have directly or indirectly contributed in making our efforts successful.

The financial assistance received from Research and Development Fund of National Bank for Agriculture and Rural Development (NABARD) towards printing of proceedings of the congress is gratefully acknowledged.

Editors
CONTENTS

<table>
<thead>
<tr>
<th>Title</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grassland Resources</td>
<td></td>
</tr>
<tr>
<td>Grassland resources and protections in the Yellow River Source Zone on the Qinghai-Tibet Plateau</td>
<td>01</td>
</tr>
<tr>
<td>Production, persistence and diversity of species in temperate grasslands</td>
<td>10</td>
</tr>
<tr>
<td>Promising forage options to enhance livestock production in Mediterranean climate agricultural systems</td>
<td>21</td>
</tr>
<tr>
<td>New methodologies for grasslands monitoring</td>
<td>30</td>
</tr>
<tr>
<td>Grassland production and utilization</td>
<td></td>
</tr>
<tr>
<td>Grazing management options for maintaining optimum pasture composition and utilization</td>
<td>41</td>
</tr>
<tr>
<td>Using various lactic acid bacteria strains during forage conservation towards fermentation, storage, nutritive value and safety improvement</td>
<td>49</td>
</tr>
<tr>
<td>Ecofriendly control of insect pests for enhancing grassland production</td>
<td>57</td>
</tr>
<tr>
<td>Enhancing grassland productivity through disease management of grass and forage species</td>
<td>67</td>
</tr>
<tr>
<td>Traditional livestock production and growth opportunities in India</td>
<td>69</td>
</tr>
<tr>
<td>Nutrient movements through ruminant livestock production systems</td>
<td>79</td>
</tr>
<tr>
<td>Management of pasture soils: biochar stability, carbon storage potential and its effect on production and quality</td>
<td>95</td>
</tr>
<tr>
<td>Grassland renovation and consequences for nutrient management</td>
<td>105</td>
</tr>
<tr>
<td>Nitrogen management of forages in relation to gaseous emissions – new approaches and considerations</td>
<td>117</td>
</tr>
<tr>
<td>Productivity and biological nitrogen fixation of different species of vetches (Vicia spp.) under the rainfed conditions of West Asia</td>
<td>129</td>
</tr>
<tr>
<td>Rainwater harvesting and its impact on farming systems</td>
<td>138</td>
</tr>
<tr>
<td>Livestock production from grasslands with improved management compared to traditional management</td>
<td>147</td>
</tr>
<tr>
<td>Strengthening livelihood of rural farmer populations through improved grasslands</td>
<td>154</td>
</tr>
<tr>
<td>Potential of forages in crop diversification and crop rotation</td>
<td>161</td>
</tr>
<tr>
<td>Forage seed quality: dormancy, standards and quarantine</td>
<td>167</td>
</tr>
<tr>
<td>Quality seed production and effective marketing systems for development of grasslands</td>
<td>176</td>
</tr>
<tr>
<td>Impact of market forces on product quality and grassland condition</td>
<td>184</td>
</tr>
<tr>
<td>Exploitation of Wastelands for Fodder Production and Agroforestry</td>
<td>198</td>
</tr>
<tr>
<td>Scouting benefits and developing innovations in temperate grassland to sustainable agriculture production</td>
<td>208</td>
</tr>
</tbody>
</table>
**Sustainability of grasslands: Social and policy issues**  
Stakeholders integration for sustainable use of temperate forage/livestock agriculture  
215  
Socio-cultural factors challenging development interventions in cattle production in the remote areas of Vietnam  
225  
Ever Graze: a partnership between researchers, farmers and advisors to deliver effective grassland management  
236  
Problems and prospects of grassland development: policy issues  
248  
Sustainable grasslands: resolving management options for livelihood and environmental benefits  
259  
Changing grassland Scenario in developing countries- Economical and Social Perspective  
270  
Management of grazing lands through educating communities  
279  
Ecologically and socially sustainable livestock development in marginal areas  
283  
Valuing variability. New perspectives on climate resilient dryland development  
289  
Participatory and holistic approaches with grassland farmers and development of policies  
290  
Livestock and Local Development: Going to a New Human-Animal Relationship  
306

**Biodiversity, conservation and genetic improvement of range and forage species**  
Conservation of grassland plant genetic resources through people participation  
318  
Breeding strategies to improve fodder legumes with special emphasis on clover and medics  
327  
Genomic approaches for dissecting complex traits related to quality production of range grasses  
333  
Recent trends in breeding of tropical grass and forage species  
337

**Environmental issues related to grasslands**  
Climate change impact and adaptation in temperate grassland and livestock industries  
349  
Climate-smart *Brachiaria* for improving livestock production in East Africa: Emerging opportunities  
361  
Tropical Grassland Ecosystems and Climate Change  
371  
Emission of Green House Gases from Grasslands and their Mitigation  
374
Contributors

Abdelmoneim A.
Former Senior Forage Legume Breeder,
ICARDA. Syria
E-mail: amoneim_46@yahoo.com

Adesogan A. T.
Department of Animal Sciences,
Institute of Food and Agricultural Sciences
University of Florida, PO Box 110910,
Gainesville, FL 32606.
Email: adesogan@ufl.edu

Aiken G.
USDA-ARS Forage-Animal Production Research
Unit
N220 Ag Science North;
University of Kentucky Campus;
Lexington, KY 40546.
Email: glen.aiken@ars.usda.gov

Ariungerel D.
Livestock Early Warning System Project,
Suite # 33, Diplomatic-Compound -95,
4th Khoroo, Chingeltei district,
Ulaanbaatar, Mongolia.
Email: arvingerel@yahoo.com

Ates S.
International Center for Agricultural Research
in the Dry Areas (ICARDA),
Amman, Jordan.

Ayala W.
INIA - Instituto Nacional de Investigación
Agropecuaria
Ruta 8 km 281. CP 33000, Treinta y Tres,
Uruguay, South America.
Email: wayala@inia.org.uy

Babu C.R.
School of Environmental Studies,
Centre for Environmental Management of
Degraded Ecosystems (CEMDE),
University of Delhi, Delhi - 110 007.
Email: crb26@hotmail.com,
crbabu26@gmail.com

Badgery W.
Orange Agricultural Institute,
NSW Department of Primary Industries,
Orange NSW, Australia, 2800.
Email: Warwick.Badgery@dpi.nsw.gov.au

Ball D.
Professor, 120 Extension Hall, 334-844-5491,
Auburn University, AL 36849.
Email: balldon@auburn.edu

Barrios E.
INIA - Instituto Nacional de Investigación
Agropecuaria.
Ruta 8 km 281. CP 33000,
Uruguay, South America.
Email: wayala@inia.org.uy

Binhua Y.
State Key Laboratory of Grassland Agro-
ecosystems,
College of Pastoral Agriculture Science and
Technology,
Lanzhou University, China.

Bittman S.
Agriculture & Agri-Food Canada, Agassiz,
British-Columbia, Canada.
Shabtai.bittman@agr.gc.ca

Boersma M.
University of Tasmania,
Tasmanian Institute of Agriculture, Burnie,
Tasmania 7320, Australia.

Bonney L.
TIA, School of Land & Food,
University of Tasmania,
Australia.

Brierley G. J.
Professor, School of Environment,
The University of Auckland,
New Zealand Private Bag 92019,
Auckland, New Zealand.
Email: g.brierley@auckland.ac.nz
Ebina M.
National Agriculture and Food Research Organization (NARO),
NARO Institute of Livestock and Grassland Science (NILGS),
Sembon-matsu 768, Nasushiobara,
Tochigi 329-2793, Japan.
E-mail: triticum@affrc.go.jp

Ebro A.
Livestock and Irrigated Value Chains for
Ethiopian Smallholders/International Livestock Research Institute, P.O. Box 5689,
Addis Ababa, Ethiopia
Email: a.ebro@cgiar.org

Entz M. H.
Natural Systems Agriculture Laboratory,
Department of Plant Science,
University of Manitoba,
Winnipeg, Canada.
Email: M_Entz@umanitoba.ca

Fang Y.
NSW Department of Primary Industries (DPI),
Elizabeth Macarthur Agricultural Institute,
Menangle, NSW 2568, Australia.

Gao J. K.
Associate Professor, School of Environment,
School of Biological Sciences,
The University of Auckland,
New Zealand Private Bag 92019, Auckland,
New Zealand.
Email: jg.gao@auckland.ac.nz

Gatkowska M.
Institute of Geodesy and Cartography Remote Sensing Center,
Warsaw, Poland.

Ghahramani A.
GPO Box 1600, Canberra ACT 2601,
Australia.
Email: af.ghahramani@csiro.au

Ghimire S.
Biosciences eastern and central Africa -
International Livestock Research Institute Hub
(BecA-ILRI Hub),
Nairobi, Kenya.
Email: S.Ghimire@cgiar.org,
hub.africa@biosciences.org

Gichangi E. M.
Kenya Agricultural & Livestock Research Organization (KALRO),
Nairobi, Kenya.
Email: gichangim@yahoo.com

Golińska B.
Poznan University of Life Sciences
Department of Grassland and Natural Landscape Sciences,
Poland.
Email: bgolinsk@up.poznan.pl

Goliński P.
Poznan University of Life Sciences
Department of Grassland and Natural Landscape Sciences,
Poland.

Hampton J. G.
Lincoln University Seed Research Centre, PO Box 85084
Lincoln University, Lincoln 7647,
New Zealand.
Email: john.hampton@lincoln.ac.nz

Hand G.
CEO, STIPA, 150 Caroona Lane,
Branxholme Vic 3302,
Australia.
Email: graeme.hand@bigpond.com

Hubert B.
Agropolis,
France.

Hunt D.
Agriculture & Agri-Food Canada, Agassiz,
British-Columbia,
Canada.
Email: derek.hunt@agr.gc.ca

Isselstein J.
University of Göttingen,
Department of Crop Sciences,
Von-Siebold Str. 8, 37075 Göttingen,
Germany,
Phone: +49 551 22253,
Email: jissels@gwdg.de

Ives S.
TIA, School of Land & Food,
University of Tasmania,
Australia.
Jatkauskas J.
Institute of Animal Science,
Lithuanian University of Health Sciences,
Zebenkos 10, Baisogala, LT-82317,
Lithuania.
Email: lgipts@gmail.com

Johnson L.
AgResearch, Palmerston North,
New Zealand.
www.agresearch.co.nz

Jorgensen M.
Norwegian Institute of Bio-economy Research,
Norway.

Kaushal P.
ICAR-Indian Grassland and Fodder Research
Institute,
Jhansi-284003, India.
Email: pkaushal@rediffmail.com

Kayser M.
Department of Crop Sciences,
University of Göttingen,
Germany.

Kemp D.
Charles Sturt University,
Graham Centre for Agricultural Innovation,
Orange NSW, Australia 2800.
Email: dkemp@csu.edu.au,
dm.hainan@gmail.com

Khadka S.
FAO Representative in India,
FAO-UN, 55 Lodi Estate,
New Delhi 110003, India.
Email: Shyam.Khadka@fao.org

Köhler-Rollefson I.
Projects Coordinator,
League for Pastoral Peoples and Endogenous
Livestock,
Development Pragelatostr. 20, 64372 Ober-
Ramstadt, Germany.
Email: ilse.koehlerroll@gmail.com

Kräti S.
IED, London, UK.
Email: saverio.krati@gmail.com

Kumar Dinesh
Crop Science Division
Indian Council of Agricultural Research,
New Delhi, India

Lacefield G.
University of Kentucky;
832 Hardwoods Drive,
Bowling Green, KY 42104.
Email: glacefie@uky.edu

Lane P.
TIA, School of Land & Food,
University of Tasmania,
Australia.

Leiber F.
Research Institute of Organic Agriculture (FIBL),
5070 Frick,
Switzerland.
Email: florian.leiber@fibl.org

Lescoat P.
INRA-AgroParisTech,
France.

Li X.
Professor, College of Agriculture and Animal
Husbandry,
Qinghai University, Xining 810016,
China.
Email: xilai-li@163.com

Macdonald L. M.
CSIRO Agriculture Flagship,
Glen Osmond, SA 5064,
Australia.

Macedo I.
INIA - Instituto Nacional de Investigación
Agropecuaria.
Ruta 8 km 281. CP 33000,
Treinta y Tres,
Uruguay, South America
Email: wayala@inia.org.uy

Malaviya D. R.
ICAR-Indian Institute of Sugarcane Research,
Lucknow-206002, India
Email: drmalaviya47@rediffmail.com
Teasdale S.
AgResearch, Palmerston North,
New Zealand.
www.agresearch.co.nz

Terra J.
INIA - Instituto Nacional de Investigación Agropecuaria.
Ruta 8 km 281. CP 33000, Treinta y Tres,
Uruguay, South America,
Email: wayala@inia.org.uy

Tingyu D.
State Key Laboratory of Grassland Agro-ecosystems,
Lanzhou University, China,
College of Pastoral Agriculture Science and Technology,
Lanzhou University, China.
Email: duanty@lzu.edu.cn

Tomaszewska M.
Institute of Geodesy and Cartography Remote Sensing Center,
Warsaw, Poland.

Tourrand J. F.
CIRAD,
France.
Email: tourrand@aol.com

Tran-The C.
Faculty of Economics and Rural Development,
Vietnam National University of Agriculture,
Vietnam.

Tran-Van L.
Faculty of Economics and Rural Development,
Vietnam National University of Agriculture,
Vietnam.

Vijay Kumar
School of Environmental Studies,
Centre for Environmental Management of Degraded Ecosystems (CEMDE), University of Delhi, Delhi - 110 007, India

Vilma Vrotniakiene
Institute of Animal Science,
Lithuanian University of Health Sciences,
Zebenkos 10, Baisogala, LT-82317, Lithuania.

Vivek Kr. Choudhary
School of Environmental Studies,
Centre for Environmental Management of Degraded Ecosystems (CEMDE),
University of Delhi, Delhi - 110 007, India

Walsh A.
Moorna Station, NSW 2648.
Ph: (03) 5028 2250; Mobile: 0427 282 262.
Email: annabelwalshmoorna@gmail.com

Yadav V.K.
Crop Improvement Division
ICAR-Indian Grassland & Fodder Research Institute, Jhansi, U.P. India

Yanzhong L.
State Key Laboratory of Grassland Agro-ecosystems,
Lanzhou University, China,
College of Pastoral Agriculture Science and Technology,
Lanzhou University, China.

Zhibiao N.
State Key Laboratory of Grassland Agro-ecosystems,
Lanzhou University, China,
College of Pastoral Agriculture Science and Technology,
Lanzhou University, China.
Email: zhibiao@lzu.edu.cn

Zwieten L. V.NSW DPI,
Wollongbar Primary Industries Institute,
Wollongbar, NSW 2477, Australia.
The Range Management Society of India (RMSI) was founded in 1978 to promote client-oriented ecologically sustainable range and forage husbandry with economic productivity and to support excellence in scientific research in agriculture with focus on grassland and fodder resources, agroforestry, plant-animal inter-relationships, environment, dairy industry and allied sciences. One of the major objectives of the Society is to provide national and global platform to the scientists, development workers, practitioners, planners and policy makers, industrialists, financial managers and donors related to grassland and fodder resources development for exchange of ideas for the benefit of the humanity. The Society has organized several workshops, seminars, symposia and conferences in the past, in addition to the III International Rangeland Congress in 1988 and International Conference on Agroforestry for the Asia-Pacific region in 1994.

The society publishes a scientific peer reviewed journal “Range Management and Agroforestry” at half yearly interval.

The International Grassland Congress promotes interchange of information on all aspects of natural and cultivated grasslands and forage crops for the benefit of mankind, including sustained development, food production and the maintenance of biodiversity. There are many common elements across these diverse systems and the great benefits of the Grassland Congresses is that people are brought together from diverse fields and this interaction between colleagues facilitates learning that stimulates future research.

An International Grassland Congress normally is held every 4 years, with the presentation and discussion of papers and reports and other activities including the conduct of tours to fulfill the aims of the Congress. Since 1927, the International Grassland Congresses have been the premier event where the current status of grasslands is updated and the latest themes of grassland research and development are presented.