
Managing Land Degradation for
Enhancing Fram Productivity

Managing Land Degradation for Enhancing **Fram** Productivity

Editors:

P.R. Bhatnagar

D. Dinesh

Vijaysinha Kakade

V.C. Pande

Omprakash Meena



SATISH SERIAL PUBLISHING HOUSE

403, Express Tower, Commercial Complex

Azadpur, Delhi-110033 (India)

Phone : 011-27672852, Fax : 91-11-27672046

e-mail : info@satishserial.com, hkjain1975@yahoo.com

Website : www.satishserial.com

Published by :

SATISH SERIAL PUBLISHING HOUSE

403, Express Tower, Commercial Complex, Azadpur, Delhi-110033 (INDIA)

Phone : 011-27672852 Fax : 91-11-27672046

E-mail : info@satishserial.com, hkjain1975@yahoo.com

© **Publisher**

ISBN : 978-93-53870-00-00

© 2021. All rights reserved, no part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise without the prior written permission of the publisher and also the copyright, rights of the printing, publishing , e-book of this edition and subsequent editions will vest with the publisher. All Computer floppies, CD's, e-book and in any other form relating to this book will be exclusive property of the publisher.

This book contains information obtained from authentic and highly regarded sources. Reasonable efforts have been made to publish reliable data and information, but the publisher cannot assume responsibility for the validity of all materials or the consequences of their use. The publisher have attempted to trace and acknowledge the copyright holders of all material reproduced in this publication and apologize to copyright holders if permission and acknowledgements to publish in this form have not been obtained. If any copyright material has not been acknowledged please write and let us know so that we may rectify it.

Composed, Designed & Printed in India

About the Authors

Dr. Pratap Ray Bhatnagar, Former Head and Principal Scientist (Soil and Water Conservation Engineering), ICAR- Indian Institute of Soil and Water Conservation, Research Centre, Vasad has excellent career in agricultural research and research coordination at different levels through 33 years of service period. A graduate in agricultural engineering from CTAE, ML Sukhadia University (presently under MPUAT), Udaipur, Master of Technology in Water Resource Development and Management from Indian Institute of Technology, Kharagpur and Ph.D. in Irrigation and Drainage Engineering from GB Pant University of Agriculture and Technology, Pantnagar, Uttarakhand. Obtained Senior Research Fellowship of ICAR as well as CSIR, and opted for CSIR - SRF during Ph.D. Course. After selection under Agricultural Research Services (ARS) delivered services as Scientist and Scientist (Senior Scale) and contributed in the field of rainwater harvesting based water resource development in hilly terrain and its effective utilisation for field crops and vegetable cultivation in terraced field. Gravity fed micro irrigation with an innovative star configuration was developed for judicious water application in hills. A new fin type light trap has been developed and standardised which was patented by the VPKAS, Almora later on. Low cost polyhouse designs and other plasticulture interventions were developed along with their spread in hill farmers. As Senior Scientist, worked as Project Coordinator in-charge (1998-2003) of AICRP on Groundwater and based on the performance during IX plan period, the project was survived against recommended phasing out, but expanded with four new centres and new dimension of ground pollution studies. Strategies for multiple uses of water in different agro-ecosystem e.g. canal irrigation, groundwater irrigation, rainwater harvesting in eastern plateau, as well as for arid region (later on in Vasad) were developed. Under a DFID, UK funded project, demonstrated the excel based equitable water delivery model efficacy and different dimensions of utilisation of poorly utilised land due to water logging in canal command areas. As Key collaborating scientist, also started a tribal area based watershed management project in Purulia district with funding of ACIAR, Australia. On the position of Project Coordinator with full tenure renewal, of AICRP on Application of Plastics in Agriculture (renamed as Plasticulture Engineering and Technology) worked to enhance the farmer's productivity in farmer's field through various plasticulture interventions. The project was termed as "Action Research Project" and "Project in field" by respective QRTs. It won ChDevilal Award for Best AICRP - 2013 award of ICAR. Expanded

to 14 centre by XII plan as compared to only 9 centre in X plan with new dimensions of plasticulture in animal shelter and animal husbandry with animal based two centres. Participated SIL Congress in August 2004 at Lahti, Finland sponsored by the organiser and IWMI-India. Undertook training-cum-visit to International Water Management Institute, Colombo in 2004 and had interactional learning about water balance modelling. Participated in the Brainstorming Meeting to discuss important issues in groundwater management in China and India, sponsored and organized by IRRI, Philippines at Dujiangyan City, Sichuan, China in 2003. Sponsored by ACIAR, Australia undertook visit to participate in project workshop at Toowoomba, Queensland and interactions at ANU, Canberra. Also visited NARC, Kathmandu, Nepal under the ICAR-NARC work plan 2009-10 to study the Plastic houses constructed and used by farmers of Nepal to grow off-season vegetables. Apart from AICRP award, he received ICAR award for Team research for outstanding contribution under IVLP programme, Shankar memorial award of ISAE for outstanding SWCE research. He has contributed more than 100 papers in different categories including national and international research papers and presented in seminar and symposium along with several book chapters.

Dr. D. Dinesh born in Vellore district of Tamil Nadu, completed his B.Sc. (Ag.) Adhiparasakthi Agricultural College, Vellore, from Tamil Nadu Agricultural University, did master from master's PAJANCOA & RI Agriculture Agricultural College Karaikal, Puducherry; and Doctoral degree in Soil Science & Agricultural Chemistry from TNAU, Coimbatore, and his mastery with developing Nitrogen management strategies for System of Rice intensification (SRI); during doctorate his specialised in utilisation of distillery industrial waste as source of nutrients for crop plants. He started his career as a Scientist (Soil Science) from ICAR-Indian Institute of Soil and Water Conservation and served at Research Centre-Udhagamandalam, Tamil Nadu During his service, actively involving assessing soil erosion relationship with crop productivity; nutrients losses in runoff and sediments. He is presently working as a Soil Scientist at ICAR-Indian Institute of Soil and Water Conservation, Research centre Vasad, engaged in developing of soil carbon stock and soil quality index for various land use system across ravine affected lands. He has also published national and international research articles, popular articles, and book chapters in his specialised areas.

Dr. Vijaysinha D. Kakade is a scientist (fruit Science) at ICAR-IISWC, Research Centre, Vasad (Gujarat). He graduated from Dr. P.D.K.V., Akola (Maharashtra); did his Master and Ph.D. in abiotic stress management and crop improvement in areas of fruit sciences from ICAR-IARI, New

Delhi. During his service, he has developed his expertise in the areas of development of bio-engineering measures for management of ravine lands, water management in fruit crops under rain-fed conditions, improvement of establishment of young plants under degraded ravine lands with use of different soil and water conservation measures and microsite improvement techniques and also identified some new fruit and tree crops which are suitable for remunerative agroforestry systems in ravine lands. He has also published national and international research articles, popular articles, and book chapters in these areas.

Dr. V. C. Pande Presently working as Principal Scientist (Agril.Economics), has about 28 years of research experience in the areas of resource conservation and management; socio-economics of conservation agronomy/agroforestry production. He specializes in resource economics and his works include studies on economics of soil & water conservation and watershed management, impact evaluation of watershed management, community managed water resources, ecosystem service valuation. He has wide experience in preparation and execution of watershed management plan along with impact evaluation. He has attended 17 professional national and international training programmes and worked in several projects funded by ICAR, National Bamboo Mission, consultancy projects funded by NABARD, Narmada Control Authority, Extramural Fund Scheme. Publications to his credit include 37 research papers in national and international journals, 45 conferences papers presented in national and international conferences, 08 extension bulletins, 01 book and 15 book chapters.

Mr. Omprakash Meena is a scientist (Soil Science) at ICAR-CAZRI, Jodhpur (Rajasthan). Earlier he was posted at ICAR-IISWC, Research Centre, Vasad (Gujarat). He graduated from S.D.A.U. (Gujarat); did his Master from Soil Science department of A.A.U. (Gujarat). During his service, he has developed his expertise in the areas of soil health management of ravine lands, water management in fruit crops under rain-fed conditions, He has also published national and international research articles, popular articles, and book chapters in these areas.



त्रिलोचन महापात्र, पीएच.डी.
एफ.एस.ए., एफ.एन.एस.सी., एफ.एन.एस.ए.
सचिव एवं महानिदेशक

TRILOCHAN MOHAPATRA, Ph.D.
FNA, FNASc, FNAAS
SECRETARY & DIRECTOR GENERAL

भारत सरकार
कृषि अनुसंधान और शिक्षा विभाग एवं
भारतीय कृषि अनुसंधान परिषद
कृषि एवं किसान कल्याण मंत्रालय, कृषि भवन, नई दिल्ली 110 001
GOVERNMENT OF INDIA
DEPARTMENT OF AGRICULTURAL RESEARCH & EDUCATION
AND
INDIAN COUNCIL OF AGRICULTURAL RESEARCH
MINISTRY OF AGRICULTURE AND FARMERS WELFARE
KRISHI BHAVAN, NEW DELHI 110 001
Tel: 23382625; 23366711 Fax: 91-11-23384773
E-mail: dg.ican@icr.in

Foreword

The western region of the country has wide variation in agricultural system and opportunity to grow varied crops and allied production systems. It comprises of 85.03 million ha (25.87% of total area of the country) in the states of Rajasthan, Gujarat, Maharashtra, Goa along with union territories of Daman and Diu, and Dadra and Nagar Haveli. Large variation in topography and climatic conditions along with natural vagaries in this region render farmers striving hard to sustain the production systems remunerative and hence the farmers are mostly resource poor. The climate varied from too harsh arid conditions in desert of Rajasthan having rainfall less than 250 mm to more than 2500 mm in Western Ghats and coastal area of Maharashtra and Goa pose difficult conditions for farming. The erratic climatic conditions, frequent draughts, unexpected floods in some parts, fast land degradation processes are some of the major issues that make farming difficult in this area. Even with such harsh conditions, the farmers are striving hard to make their farming and allied production better with hard work and adoption of some of modified and modern innovative techniques of rainwater harvesting and irrigation strategies. Research Institutions and universities are making good efforts in alleviating the difficulties of farming communities in most suitable way as per demand and varied conditions.

Research and participatory field demonstrations carried out by various research organizations established that resource conservation techniques, water harvesting and its efficient utilisation, adoption of improved cultivation practices have the potential to utilise the natural resources more efficiently and substantial enhancement in productivity without further degradation. Protection of land resources from further degradation, reclamation and productive utilisation, restoring and

enhancing the ecosystem services, etc., are imperative to ensure sustainability for which active involvement of all stakeholders will be desirable. The book entitled “**Managing Land Degradation for Enhancing Farm Productivity in Western India**” includes information and research recommendations to achieve the goal of sustainable agricultural development in this region.

I appreciate the contributors and editors of the book and compliment for bringing out the very useful book for benefit to the farmers of western India.

Dated 24th June 2020

New Delhi



(T. Mohapatra)

Preface

The natural resource management becomes very important when such resources availability for the agricultural production are scarce and difficult to put in productive use without skillful efforts. In western region of the country the availability of land and water resources are too difficult to manage due to undulating and sloppy terrains in hilly areas in Aravali and other hill ranges in Maharashtra, harsh climatic and soil conditions in thar desert of Rajasthan, black cotton soils in Gujarat and Maharashtra, heavy soil erosion occurrence in alluvial plains in arid region and salinization and sea water ingress in coastal region having more than 2000 km length, etc. Burgeoning population growth and consequent pressure on natural resources and ecosystems warrant effective Natural Resource Management (NRM), soil and water conservation and participatory watershed management. Different research organization under ICAR and agricultural universities are being working to develop effective techniques and practices for effective management of natural resources at different levels e.g. field level, watershed level or basin level. Such efforts are also being implemented with active involvement of different agencies e.g. NABARD, State Departments, NGOs, KVKs *etc.* and active participation of farmers and other stakeholder since long. However due to few reasonable bottlenecks in terms on lack awareness on the associated issues and technologies, which points out the need of widespread sensitization. The continuing and poorly assessed impacts of human activities on land degradation, availability of water, sustainability of production systems and upstream-downstream linkages are point to this.

More attention is deserved in such fragile systems that also have ecological interactions with other regions and have not been adequately heeded by the policy so far. Focus is now given to a more sustainable road-map to development backed by indigenous knowledge and participation through regional planning. The key to such a plan can be provided by the analysis of Farmers view point on regional strengths and weaknesses. Such a strategy can be drawn on the observed responses evinced by the concerned stakeholders to the incentives and limitations imposed by the mainstream development process. At this context, the Conference “Farmers First for Conserving Soil and Water Resources in Western Region- 2018 (FFCSWR-2018)” held on 1-3 February 2018 at Anand, Gujarat, brought out wisdom and experience of farmers on the management and conservation of soil and water, forests, streams and

rivers complementing the research outputs and scientific knowledge to solve prevailing problems by harnessing potentials and available solutions for the sustainability of the region. The participants comprised of representatives from all stakeholder institutions in the region who deliberated in response to farmer's experiences and policies.

The present book contains selected papers presented in FFCSWR-2018 and is compilation of various topics on the prime concerns of natural resource conservation in arable and non-arable lands, soil-water resource development and conservation, diversification of crops and farming systems, management of various ecosystems, people's participation, livelihoods, socio-economic development, success stories, etc. with reference to western Rajasthan, east and south Rajasthan, Saurashtra, central Gujarat, south east Maharashtra, coastal south Maharashtra and Goa which occupies 85.03 million ha i.e. 25.87% of the total geographical area of the country. Papers from other state relevant to resource conservation have also been included in the present compilation having common interests and implications for the regional development are also included. The book is organized in 6 sections: Natural resource management in farming systems, issues of soil and water conservation and resource management, integrated participatory resource conservation and management, Ecosystem Management for Livelihood Sustainability, socio-economic issues in resource conservation and governance and policy issue.

The authors are grateful to the office bear of Indian Association of Soil and Water Conservationists (IASWC), Dehradun and The Director, ICAR -Indian Institute of Soil and Water Conservation (IISWC), Dehradun for granting permission to publish the book.

18 June 2020


Vasad, Anand District 

Authors

Acknowledgements

We express hearty gratitude Dr T. Mohapatra, Secretary, Department of Agriculture Research and Education (DARE) and Director General (DG), Indian Council of Agricultural Research (ICAR), New Delhi for his constant support and inspiration to work for farmers and in their fields. His that inspired us to organize this conference, Farmers First for Conserving Soil and Water Resources in western Region, 2018 (FFCSWR 2018) and bring out this useful book. We are also grateful to Dr. K. Alagusundaram DDG (NRM) for his consistent support and guidance in conducting the FFCSWR-2018. Authors are also thankful to Dr. S.K. Chaudhary, ADG (SWM) for his keen interest and encouragement for bringing out this publication.

The whole hearted participation from the following organization is highly appreciated and their valuable contribution as papers in this compilation is thanked.

The participants from the following Institutes/Organization attended the conference and shared their work in different forms 

- ICAR-Indian Institute of Soil & Water Conservation, Dehradun. And its Research Centres,
- Anand Agricultural University, Anand
- Navsari Agricultural University, Navsari, Gujarat
- Junagadh Agricultural University, Junagadh
- Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Gujarat
- Orissa University of Agriculture & Technology, Bhubaneshwar
- Assam Agricultural University, Jorhat, Assam
- Agriculture University, Kota, Rajasthan
- School of Engineering, R.K. University Rajkot
- ICAR-Indian Agricultural Research Institute, New Delhi
- ICAR-Central Coastal Agricultural Research Institute, Ela, Old Goa-403402, Goa
- ICAR-Agricultural Technology Application Research Institute, Pune

- ❑ ICAR-Central Soil Salinity Research Institute, Regional Research Station, Bharuch (Gujarat)
- ❑ ICAR- Central Research Institute for Dryland Agriculture, Santoshnagar, Hyderabad
- ❑ ICAR-National Institute of Abiotic Stress Management, Baramati, Maharashtra ;
- ❑ ICAR-National Research Centre for Banana, Trichy, Tamil Nadu
- ❑ ICAR-Central Soil Salinity Research Institute, Karnal, Haryana
- ❑ ICAR-Indian Institute of Soil Science, Nabi Bagh, Berasia Road, Bhopal, MP
- ❑ ICAR-Central Arid Zone Research Institute, Regional Research Station, Bikaner, Rajasthan
- ❑ ICAR-National Institute of Agricultural Economics and Policy Research, New Delhi
- ❑ ICAR Research Complex for NEH Region, Umiam
- ❑ ICAR-National Research Centre on Pomegranate, Kegaon, Solapur, Maharashtra
- ❑ ICAR-Central Soil Salinity Research Institute, RRS, Bharuch, Gujarat
- ❑ ICAR-Directorate of Medicinal and Aromatic Plants Research, Boriavi, Anand, Gujarat
- ❑ Tata Consultancy Services, Thane Innovation Labs, Mumbai
- ❑ Gujarat Green Revolution Company Limited, Vadodara, Gujarat
- ❑ Renown Polyplast Pvt. Ltd., Junagadh
- ❑ Reliance Foundation, Near Pratap Circle, Shiv Colony, Banswara, Rajasthan

The Conference was sponsored financially by the following organizations besides the organizers, the IASWC and ICAR-IISWC, Dehradun:

- ❑ Indian Council of Agricultural Research (ICAR), New Delhi
- ❑ Government of Gujarat, Gujarat
- ❑ Ministry of Agriculture and Farmers Welfare, Government of India
- ❑ National Rainfed Area Authority, New Delhi

- NABARD, Department of Economic Analysis and Research, Mumbai
- Protection of Plant Varieties and Farmers' Rights Authority, New Delhi
- National Biodiversity Authority, Chennai
- Coastal Salinity Prevention Cell, Ahmedabad, Gujarat
- Tata Trusts, Gujarat
- Gujarat Green Revolution Company Limited, Vadodara
- Gujarat Council on Science and Technology, Government of Gujarat, Gandhinagar
- ATMA, Gandhinagar, Gujarat
- Gujarat State Land Development Corporation Limited, Gandhinagar
- Tribal Development Department (Vanbandhu Kalyan Yojana) Government of Gujarat, Gandhinagar

Innovative farmers who shared their wisdom, lead speakers, special guests, awardees of the IASWC and learned participants are the origin for this publication. All the authors of the papers included in this book are sincerely thanked.

The Satish Serial Publishing House, New Delhi who made to publish this book need appreciation.

Editors

Contents

<i>About the Authors</i>	<i>v</i>
<i>Preface</i>	<i>ix</i>
<i>Acknowledgements</i>	<i>xi</i>

1. Enhancing Productivity of Degraded Coastal Land of Gujarat by Managing Natural Resources
2. Soil – site suitability evaluation for rainfed crops in Tipukjan watershed of Assam using remote sensing and GIS techniques
3. Use of ArcGIS interface for preparation of erosion susceptibility map of Dhaman Khadi sub-watershed in Western India
4. Soil Degradation: A Threat to Agriculture in Gujarat - Review
5. Effect of slope land cultivation on runoff, soil loss and Pearl millet (*Pennisetum glaucum*) yield under rainfed condition
6. Performance of different multipurpose trees and their effect on physical and chemical properties of loamy sand soil under rainfed condition

Anil R. Chinchmalatpure

Marami Dutta, R. M. Karmakar and Bipul Deka

A. P. Lakkad and P. K. Shrivastava

Patel Alpesh K., Dabhi Manthan, Satpute Nitin R.

D. Dinesh, Gopal Kumar, Vijaysinh Kakade, P. R. Bhatnagar, A.K. Vishwakarma. Nyo nand and R S Kurothe

K. N. Patel, R. R. Shakhela and K. M. Patel

7. Efficacy of rainwater harvesting structure and its utilization for optimum pomegranate production in western part of Maharashtra, India
DT Meshram, Dinesh Babu, Jyosnhna Sharma and RK Pal
8. Effect of Different Cropping Patterns on Runoff and Soil Loss For Junagadh Region
K. P. Oza, G. R. Sharma and D. K. Dwivedi
9. Response of semi *Rabi* castor (*Ricinus communis* L.) To irrigation and nitrogen fertigation
K. M. Patel, B. J. Patel and K.N. Patel
10. Water Saving Technologies In Western India: An Overview
S.V.Baria, S.M. Pandya, M. M.Damor, J.B. Bhimani
11. Root and shoot growth influenced by length of cutting in Dragon fruit: 'A Future fruit crop for water scarce areas'
Vijaysinha Kakade, D. Dinesh, P.R. Bhatnagar, V.C. Pande & O. P. Meena
12. Estimating Groundwater Recharge Using SWAT Model and Compare With Empirical Formula
H.M. Bhatu, H.D. Rank, H.S. Nedariya, J.S. Karena & S.R. Pansuriya
13. Soil fertility and crop productivity improvement through diversification of rice-based cropping system under south Gujarat condition
Desai, L. J. and Thanki, J. D.
14. Spring Water Harvesting is the key for Doubling Farmers' Income in North Western Himalayan Region
D.V. Singh, S. Patra, P.K. Mishra, N.K. Sharma and D.M. Kadam
15. Resource-use efficiency under cotton-wheat system as influenced by rotational tillage and residue management
Kuldeep Kumar, A.R. Sharma and U.K. Behera

16. Water harvesting and its management through farm pond and utilization of conserved water for vegetable crops for sustainable production in upland areas.....
C.R.Subudhi, Sagara Chandra Senapati, and R.Subudhi
17. Watershed Management for resource conservation and livelihood security in Central Gujarat
V C Pande, R S Kurothe, D R Sena, B K Rao, Gopal Kumar, Anand Vishwakarma, Nyonand, G L Bagdi, M L Gaur, P R Bhatnagar
18. Mahi ravine ecosystem – Farmers’ Perception, Ecosystem Services and suggested Interventions for Conservation.....
V C Pande, P R Bhatnagar, Raj Kumar, D Dinesh, Suraj Patel
19. Assessment of carbon sequestration potential in well-managed ravine plantations versus natural forest of Chambal ravines ecosystem.....
S.Kala, Ashok Kumar, B.L.Mina, V.C.Pande, H.R.Meena, I.Rashmi and R.K.Singh
20. Mangroves for protection of coastal areas from high tides, cyclone and tsunami
Swati Shedage, P. K. Shrivastava and Nilam Surve
21. Response of greengram (*Vigna radiata* (L.) varieties to integrated nutrient management
Sweta A. Patel, Neha Chaudhary and P. P. Chaudhari
22. Enhancing farmers income through off-season vegetable cultivation in bamboo based poly house: A lesson learnt
Bipul Deka and Sarat Saikia
23. Impact of interventions of Integrated Farming System approach on productivity at farmer’s field in Bundelkhand region
Dev Narayan, Rajeev Ranjan and Pradeep Dogra
24. Impact analysis of micro irrigation system in Kodinar region of Gujarat
Ram Vaibhav and Makwana Ajay D

25. Status, Uses, Institutional arrangement and Impact of Community Based Water Storage Structures in Udaipur District of Rajasthan State
Ashok Kumar, Shakir Ali and R.K. Singh
26. Institutional innovations in canal irrigation management system in India: Constraints and way forward
Subhash Chand, N. Ravisankar, Shiv Kumar, RC Srivastava, Madhusudan Bhattarai, Prabhat Kishore and Dinesh Kumar
27. Resource Conservation Technologies and Livelihood Activities for Doubling Farming Income in Eastern Ghats Region
Madhu, M., Adhikary, P.P., Sahoo, D.C., Ch. Jyotiprava Dash, Hombegowda, H.C., Praveen Jakhar, Naik, G.B., Karma Beer, Barla, G.W., Meena, M.K., S. Kindal and Nabin Kumar Das
28. Useful technologies for doubling farmers' income
Vithlani Nipa S.