Principles and Practices of Water Management

S. C. Panda
Principles and Practices of Water Management

Dr. S.C. Panda (Ph.D.)
Emeritus Scientist, ICAR,
Former Dean, College of Agriculture,
Dean of Research, Dean PGF cum DRI, OUAT,
Professor & Head, Dept. of Agronomy, ADR,
Chief Scientist (Water Management.)

AGROBIOS (INDIA)
Published by:
AGROBIOS (INDIA)
Agro House, Behind Nasrani Cinema
Chopasani Road, Jodhpur 342 002
Phone: 91-0291-2643993, 2643994, Fax: 2642319
E. mail: agrobiosindia@gmail.com; agrobios@sify.com
Website: agrobiosindia.com

AGROBIOS (INDIA)

First Edition: 2014
© (2014) All Rights Reserved

"No part of this publication which is material protected by this copyright notice may be reproduced or transmitted or utilized or stored in any form or by any means now known or hereinafter invented, electronic, digital or mechanical, including photocopying, scanning, recording or by any information storage or retrieval system, without prior written permission from the publisher".

Information contained in this book has been published by AGROBIOS (INDIA) and has been obtained by its authors from sources believed to be reliable and are correct to the best of their knowledge. However, the publisher and its authors shall in no event be liable for any errors, omissions or damages arising out of use of this information and specifically disclaim any implied


Published by: Dr. Updesh Purohit for Agrobios (India), Jodhpur
Laser Typeset at: Yashee Computers, Jodhpur
Cover Design by: Reena
Printed at: Babloo Offset, Jodhpur
Human being depends on agriculture for food, clothing and shelter. After 50 years of independence, though India is self sufficient in food grain production, still in comparison with other developed nations its food grain productivity is very much less. The major reason could be attributed to the improper management of inputs and resources use. Water, being the most important resources and input its management is essential for achieving the target. So considerable emphasis is, therefore, placed for obtaining maximum, profitable production per unit of water from a unit of land in unit time.

Though a lot of books are available on this very subject, still the author feels the paucity of a complete book. This is a book containing all sorts of chapters including the farming and cropping systems. Though this book is primarily written to serve as a text/reference for students of agriculture in under graduate and post graduate levels and technologists in developing organisations, it is hoped that this book will be valuable for similar groups in the third world countries of Asia and Africa. This book will also serve as a valuable reference for the candidates preparing for Agricultural Research Services and other competitive examinations. Professional institutions in soil conservation and water technologies, Krishi Vigyan Kendras and rural institutions and similar other institutions would find this book very much helpful.

The author is deeply indebted to ICAR for its assistance provided at various levels for preparing this manuscript. Special mention is made for the valuable help received from Sri K.C.Sahoo, Research Fellow of the Emeritus Scientist Project, OUAT Bhubaneswar.

In preparing this book, I have received helps, suggestions and encouragements from Dr. D. Sahu, Dean, College of Agriculture, OUAT; Dr. P.K. Mohapatra. Professor and Head, Dr. B.C. Nayak, Professor, Agronomy and other staff members of Dept. of Agronomy, College of Agriculture, Bhubaneswar. I am grateful to all of them.
I express my profound love and affection to my wife Mrs Kalpana Panda and son Ar. M. Panda for their immense help in preparing this manuscript.

I also wish to thank the Agrobios (India), Jodhpur for the publication of this book.

Bhubaneswar

S.C. Panda
Contents

1 Soil Water Relationship ................................. 1

Soil ............................................................................................................. 1
Properties of Soil ................................................................................... 1
Soil Texture ........................................................................................... 1
Classification of Soil Particles .............................................................. 2
Soil Structure ......................................................................................... 2
Genesis of Soil Structure ...................................................................... 3
Mass and Volume Relationship .............................................................. 4
Particle Density/ Real Specific Gravity/ True Density ......................... 4
Bulk Density/ Apparent Specific Gravity/ Volume Weight ................... 4
Porosity ..................................................................................................... 4
Soil Aeration ........................................................................................... 5
How to Measure the Aeration Status of Soil .......................................... 5
Water ......................................................................................................... 6
Properties of Water ................................................................................ 7
Soil Water Relationships ....................................................................... 8
Soil Water Retention ............................................................................. 8
Soil Characteristics Influencing Water Retention ................................. 9
Soil Moisture Constants ....................................................................... 11
Gravitational Water ................................................................................ 11
Field Capacity ......................................................................................... 11
Hygroscopic Water ................................................................................ 11
Permanent and Ultimate Wilting Point ............................................... 12
Moisture Equivalents ............................................................................ 13
Available Soil Moisture (ASM) ............................................................. 13
Concepts of Soil Water Availability to Plants ...................................... 13
Soil Moisture Characteristic Curve ....................................................... 14
Hysteresis ................................................................................................ 16
Soil Water Potential Concept ................................................................. 16
Gravitational Potential .......................................................................... 17
Pressure Potential/Submerged Potential .............................................. 17
2 Plant – Water Relationship ......................... 44

Role of Water ............................................. 44
Ecological Roles of Water .............................. 44
Physiological Importance of Water .................. 44

Plant–Water Relationships .............................. 44
Role of Water in Plants ................................. 45
Plant Structures ......................................... 46
Water in the Soil–Plant–Atmosphere System ....... 48
Plant Water Status ...................................... 48
Energy Concept of Water Absorption ............... 49
3 Soil–Plant–Water Relationship ................. 51
   Soil–Plant–Atmosphere–Continuum (SPAC) ....................... 51
   Pathway ........................................................................ 52
   Leaf Water Potential .................................................. 52
   Plant Characteristics .................................................. 53
   Root Characteristics .................................................. 53
   Moisture Extraction Pattern ....................................... 54
   Moisture Sensitive Period .......................................... 55
   Water Absorption Process ......................................... 57
   Water Availability and Nutrient Uptake ......................... 57
   Water Stress and Plant Growth .................................. 58
   Water Deficit .............................................................. 58
   Why Stress Occurs in Plants? ...................................... 58
   Water Relations .......................................................... 58
   Photosynthesis ............................................................ 59
   Respiration ................................................................. 59
   Metabolic Reactions ................................................... 59
   Hormonal Relationship ............................................... 59
   Nutrition ................................................................. 59
   Growth and Development ............................................ 60
   Yield ........................................................................... 60
   Excess Water ............................................................. 60

4 Hydrologic Cycle .................................................... 62
   Components of the Hydrologic Cycle ............................ 62
   Precipitation .............................................................. 62
   Infiltration ................................................................. 62
   Runoff ........................................................................ 62
   Evaporation ............................................................... 63
   Transpiration ............................................................. 63
   Sources of Water ........................................................ 63
   Precipitation .............................................................. 63
   Atmospheric Water other than Precipitation ................... 65
   Flood Water ................................................................. 65
   Ground Water ............................................................. 65
   Irrigation ..................................................................... 65

5 Methods of Irrigation .............................................. 67
   Surface Method .......................................................... 67
   Sub–Surface Method .................................................. 67
Sprinkler Method ...................................................... 67
Drip Irrigation .............................................................. 68
Surface Method of Irrigation .......................................... 68
Wild Flooding ................................................................. 70
Controlled Flooding ...................................................... 70
Basin ............................................................................. 70
Check Basin ................................................................. 70
Border–Strip ................................................................. 71
Furrow Irrigation Method .................................................. 72
  Alternative Furrow Irrigation ........................................... 72
  Skip Furrow Irrigation ................................................ 72
Surge Irrigation ................................................................. 74
  Cablegation ................................................................. 74
  Corrugation ................................................................ 75
Pitcher Irrigation ............................................................. 75
  Sub–Surface Irrigation Methods ...................................... 75
Overhead or Sprinkler Irrigation Methods ......................... 76
  Adaptability of Sprinkle System .................................. 76
  Advantage and Disadvantages of Sprinkler Irrigation ........ 77
  Classification of Sprinkler System ................................. 78
  Types of Sprinkler Irrigation Systems ......................... 79
  Nozzle Line Sprinkler System ....................................... 79
  Rotary Head Sprinkler System .................................... 79
  Fixed–Head Sprinkler System ...................................... 79
  Propeller Type Sprinkler System ................................. 79
  Perforated Pipeline System ....................................... 80
  Efficiency of Sprinkle Irrigation ................................ 80
  Principles of Selecting Sprinkler System ....................... 81
  Spacing of Sprinklers and Laterals ............................. 81
Trickle (Drip) Irrigation .................................................... 83
  Surface Trickle Irrigation ......................................... 86
  Sub–Surface Trickle Irrigation ................................... 87
  Low–Head Bubbler Irrigation ..................................... 87
Micro–Spray Irrigation ...................................................... 87
  Mechanical–Move Irrigation ..................................... 87
Pulse Irrigation ............................................................... 88

6 Sources of Irrigation ................................................. 89
  Introduction .................................................................. 89
  Water Resources of the world .................................... 89
7 Problems of Irrigation Water ............... 107

Introduction ......................................................... 107
Terminologies ........................................................ 107
Problems with Poor Quality Water ...................... 111
Water Quality Criteria .............................................. 113
Classification of Irrigation Water ......................... 113
Salinity Classification ............................................... 115
Sodium Classification .............................................. 115
CSSRI Classification ............................................... 116
Interpretation of Water Quality ............................... 117
Origin and Causes of Salt Build up in Irrigated Soils ... 118
Origin of Salts in Irrigation Water ............................. 118
Causes of Salt Accumulation ...................................... 119
Causes of Salt Problems in India ............................ 120
Salt Problem in Eastern India ................................. 120
Principles and Practices of Water Management

Publisher: Agrobios Publications ISBN: 9788177541830
Author: Panda SC

Type the URL: http://www.kopykitab.com/product/8514

Get this eBook
UN initiatives that are helping to raise the issue UN-Water Task Force on Indicators, Monitoring and Reporting (2008-2010) In 2006 a Task Force on IWRM was created by UN-Water, with members drawn from UN-Water agencies and from partner organizations.