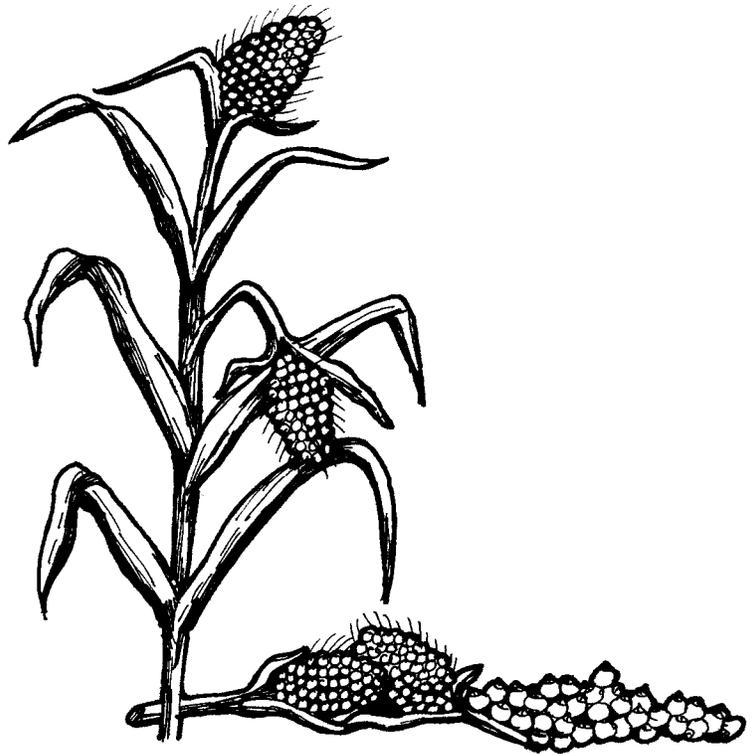


DRYLAND



AGRICULTURE

S. C. PANDA



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FOREWORD

Students of agricultural science play the important role in the department of agriculture as agriculture is the backbone of our country. The need for comprehensive information on the Dry land Agriculture for sustainable crop production relevant to Indian conditions has been felt for quite some time. The text-cum-reference book to meet precisely the felt need is an outcome of the author's active involvement in teaching, research and extension guidance in the field of agronomy for over thirty years.

The author presented the book entitled, "Dry land Agriculture" in a scientific and systematic manner to understand the fundamentals clearly and easily which is the beauty of this book. Potential yield can only be achieved under ideal management in an optimal physical, chemical and biological environment. The future of humanity lies in the arid and the semi-arid lands, as the humid and more favourable rainfall areas have been extensively and intensively cultivated and heavily populated by the human beings. It is also recognized that even if all the available financial resources are mobilized to develop irrigation for the arid and semi-arid areas, still largest percentage of land in these areas will remain unirrigated and practice dryland farming. Thus, there is a well recognized and urgent need for development of dry farming technology for increasing agricultural production in these areas of low rainfall and its erratic distribution.

The whole philosophy of dryland farming revolves around the principle that water is a limiting factor in these areas and one needs to maximize the efficiency of the natural rain water for agricultural production. Research work was done in relation to the agricultural conditions and methods of cultivation in vogue in various dry tracts in the country, rainfall and other climatic factors which affect crop production, disposal of rain water and soil erosion, cultural and manurial methods of preventing run-off and conserving soil moisture, physio-chemical characters of the soil in the dry tracts, physiological studies of important crops grown in arid regions and agronomy or soil management. There are three types of agriculture possible in dryland areas viz., Crop production, Animal husbandry with pastures

management and Agro-forestry. All the aspects of dryland farming are of great significance for successful agriculture under these conditions.

I am confident that this book will serve as a text book for agronomy and veterinary students, a reference for research scientists and teachers in the areas of crop production, integrated farming systems, dryland agriculture, cropping systems, production technology management under different situations, soil fertility management, avian and animal sciences. This book will also serve as a guide to the extension officials of the department of agriculture. I congratulate Dr. S. C. Panda for his pains taking effort in bringing out this book covering the latest technologies for crop production associated with integrated enterprises in dryland farming to meet the growing interest in sustainable agriculture. I am confident that this book will be widely accepted among the students. I extend my best wishes to Dr. Sharat Chandra Panda for the success of this book.

Bhubaneswar
Date. 25. 10. 2003.

DR. BHAGABAT PANDA

PREFACE

The pressure of an ever increasing population and periodic famine due to unexpected flood and drought has forced and awakened the agricultural scientists of India to evolve new plant types and develop a suitable production technology for such high input responsive crop plants under dryland farming. From time immemorial, mankind has been struggling hard to get the maximum yield per unit area per unit time. In modern times, this struggle takes the form of multiple cropping, intensive cultivation of high yielding varieties, integrated farming and mixed cropping with a view to keeping land, labour, capital and other resources occupied for the maximum period during the year, maintaining their productive efficiency at the highest level and thereby, attaining the highest yields in terms of agricultural production as well as return on the resources employed.

The semi-arid tracts are not only large but also agriculturally important. In India, such tracts cover 84 districts, spreading over 47 million hectares which is more than one-third of India's net sown area. They constitute 60 per cent of the total area under cotton, 83% under sorghum, 74% under groundnut, 73% under chickpea, and 81% under pearl millet, 66% under *ragi* (*Eleusine coracana*), 40% under barley, 30% under wheat, 47% under pigeon pea and 36 % under oil seeds. But their out turn constitutes about a fifth of the total food grain production in the country. The need for a scientific approach towards farming in rainfed dryland areas was felt with the increasing realization that the occurrence of drought is more or less inevitable. The only way to beat the drought is to join hands with it. Instead of waiting and hoping for adequate rain, the modern concept is to make the cropping strategy so flexible that it can be suitably changed even at short notice to suit the pattern of rainfall available. Short duration varieties, the concept of rationing, high yielding fodder crops and water harvesting techniques, all make this basic strategy feasible. New agronomic practices like balanced nutrient management, tillage and weeding are strongly recommended. In dry regions, crop production is not a simple question of introducing new varieties and supplying adequate fertilizers. In dryland agriculture each season is a particular season, and therefore, cropping practices must considerably be geared to the dictates of that particular season. The factors on which yield depends must be identified, often in the face of the differing interpretation of the data and no proper understanding of casual relationships.

India contains about 47 m ha as drylands out of 108 m ha of total rainfed area which amounts nearly 43 per cent. Besides being water deficient, such areas are characterized by high

evaporation rates, exceptionally high day temperature during summer, low humidity, high run-off and soil erosion. The soil of such areas often turns to be saline and poor in fertility. As water is the most important single factor of crop production, inadequacy and uncertainty of rainfall often cause partial and complete failure of crops which leads to periodic scarcities and famines. Thus, the life of both human being and cattle in such areas becomes difficult and unsecured. Agro-forestry is an alternative land use system in drylands for stabilizing income of the farmer. Watershed management programme in drylands is aimed at optimizing the integrated use of land, water, vegetation in an area for providing an answer to alleviate drought, moderate floods, prevent soil erosion, improve water availability and increase food, fodder, fuel and fibre on sustained basis. In watershed management, more specifically, soil conservation is enmeshed with crop management and alternate land use system and allied agricultural activities such as animal husbandry, pisciculture, sericulture, etc. for increasing and stabilizing farm production and income. There is imbalance in the use of nutrients resulting in low use efficiency. Decline in quality and quantity of organic matter in most soils is adversely affecting soil biodiversity and biological regulation of soil process. There is growing interest in promoting sustainable agriculture which is also referred to by other names such as alternative farming, regenerative agriculture, natural or organic farming, ecofarming and permeaculture. Crop rotations that mitigate weed, disease and insect problems, increase soil productivity and minimize soil erosion. Management systems to control weeds by preventive measures, tillage, timely inter cultivation and crop rotation to improve plant health. Major factors affecting ecological balance are deforestation and over grazing rangelands, accelerated soil erosion, irrigation related problems, over exploitation of ground water and indiscriminate use of agrochemicals. The productivity and production increase was moderate in eastern and central India and Deccan plateau and even in area with no serious limitations for production technology adopted for enhancing productivity has also simultaneously weakened the resource base resulting in a series of second generation problems.

At present, there is no comprehensive text book on 'Dryland Agriculture' and applied aspects suitable for farmers. This book will provide comprehensive information on the subject matter and fulfil the needs of students and other professionals. This is a book containing all sorts of chapters on integrated dryland farming. Though this book primarily written to serve as a text book/reference for the students of agriculture in under graduate and post graduate levels and technologists in developing organizations, it is hoped that this book will be valuable for similar groups in the third world countries of Asia and Africa. This book also serves as a valuable reference for the candidates preparing Agricultural Research Services and other competitive examinations. Professional Institutions in Soil Conservation, Krishi Vigyana Kendras and Rural Institutions and similar other Institutions would find this book very much helpful. The farmers may refer this book to practice integrated farming, dryland farming and cropping systems as the considerable emphasis is placed for obtaining maximum, profitable production per unit area per unit time.

The author acknowledges his indebtedness to authors of books from which most of the material in the text has been drawn. In several cases, it has not been possible to obtain permission for reproduction for which the author and publishers offer their sincere apologies.

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

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In preparing this book, I have received helps, suggestions and encouragements from Dr. B. C. Nayak, Dean, College of Agriculture; Dr. P. K. Mahapatra, Professor and Head, Agronomy; Dr. L. M. Garnayak, Associate Professor, Agronomy and other staff members of the Department of Agronomy, College of Agriculture, OUAT, Bhubaneswar. I am grateful to all of them who communicated the encouraging comments regarding the text and constructing suggestions for the improvement of the book.

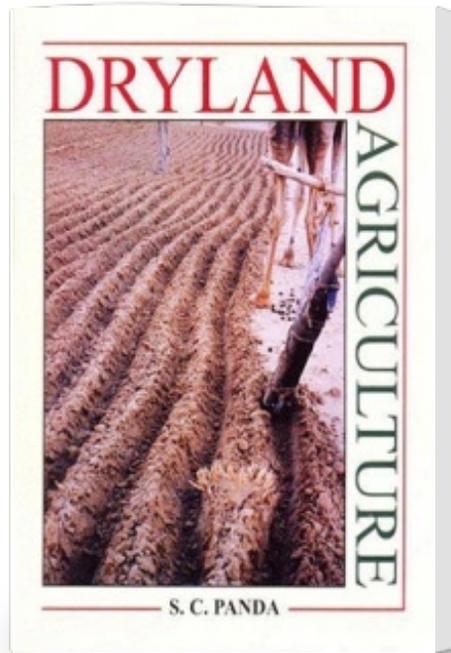
I express my profound love and affection to my wife Mrs Kalpana Panda and son Ar. Mrutyunjay Panda for their immense help in preparing this manuscript.

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