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SOIL WATER CONSERVATION AND DRY FARMING

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FOREWORD

National progress is dependent upon the rapid development of agriculture. Agricultural production is mainly dependent upon the maintenance and improvement of soil productivity. Farmers should be educated to use lands according to their capability and to adopt proper soil conservation measures. The students of agriculture today, will be the architects of the agricultural development of the country, in future they will serve the agricultural departments of the different states of India. They must therefore, be well trained in different agricultural subjects especially, soil science, agronomic aspects of soil water conservation and farming.

The maintenance and improvement of soil productivity for sustained agricultural production necessitates the acquisition of thorough knowledge of soil science and agronomy. Therefore, the teaching of soil science and agronomy is at least one of the most important factors for the agricultural development of the country because the tillage of the soil is involved in every kind of farming.

Our country has made an appreciable progress in the industrial and agriculture sectors and have ensured, to a large extent, well being and food security for an ever-increasing population of our country. The over exploitation and lack of proper management have caused a serious damage to availability and quality of water. Its demand for irrigation, industry, and domestic use is increasing. This natural resource is fast getting depleted and degraded. As per the Food and Agriculture Organization (FAO) of the UN, with 852 million

chronically hungry people in the world today and a global population expected to increase by an additional 2 billion people by 2030, feeding this growing population and reducing hunger will only be possible if agricultural yields can be significantly increased. Agriculture is by far the biggest water user, accounting for some 70 per cent of all water withdrawals (industry: 20 %, domestic: 10 %). Though irrigation covers just around 20 per cent of the world's crop land, irrigated land contributes 40 per cent of total food production. As water resources shrink and competition for water from other sectors grows, the agriculture sector faces a complex challenge of producing more food of better quality with less water while ensuring environmental sustainability.

The author presented the book entitled, **"Soil water conservation and dry farming"** in a scientific and systematic manner to understand the fundamentals clearly and easily which is the beauty of this book. The text-cum-reference book to meet precisely the felt need is an out come of the author's activity involved in teaching, research and extension guidance in the field of agronomy for over thirty years.

Potential can only be achieved under ideal management in an optimal physical, chemical and biological environment. Thus, this is a well recognized and urgent need for development of dry farming technology for increasing agricultural production9in the areas of low rainfall and its erratic distribution. The whole philosophy of dry 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. This book is very comprehensive covering all the basic principles of agronomy and soil science towards soil and water conservation and dry farming.

I am confident that this book will serve a text book for agronomy, soil science and engineering students, a reference for research scientists and teachers in the areas of crop production, integrated farming systems, dry land agriculture, cropping systems, production technology management under different situations, soil fertility management. This book will also serve as a guide to extension officials of the department of agriculture and soil and water conservation engineering. I congratulate Dr. S. C. Panda for his pain taking effort in bringing out this book covering the latest technologies for crop production conserving soil and water in different situations 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 the book.

Bhubaneswar
Date. 25. 12. 2004. **Dr. Bhagabat Panda**

PREFACE

Soil and **water** are the basic resources of the country and must be conserved as carefully as possible. The pressure of increasing population neutralizes all efforts to raise the standard of living and nutrition, while loss of efficiency in the soil itself nullifies the value of any improvements made. The present position is very serious, all experts agree. It is well known to every farmer that it is the topsoil layer which sustains agricultural production and once this layer is lost or destroyed, nothing can ever replace it.

In the words of Lord John Boyd Orr, the first Director-General of FAO in 1948, "Increases in agricultural production are possible through modern methods. But, these advances in science will be useless, unless there is enough good land for farming. If the soil on which all agriculture and all human life depend is wasted away then the battle to free mankind from want can not be won". To feed the world's population in the year 2010, agriculture production has to be increased by 60 per cent and this was expected to come from an intensification of agriculture on lands already under cultivation. In addition, FAO experts that an additional 600 million hectares (FAO, 1979) of cultivated lands would be required to meet the additional food demands. An uncertainty in these estimates is the amount of land, being lost through degradation.

Total historic loss of land through soil degradation is put at 2 billion hectares, the present arable area of the world being about 1.5 billion hectares. Kovda (1977) has put the annual loss of productive land at 5-7 million hectares. In India, out of 328 million hectares of

geographical area, 68 million hectares are critically degraded while 107 million hectares are severely eroded (Anonymous, 1982).

In our country, out of an estimated 175 million hectares of degraded and cultivated lands, nearly all of them are subject to serious erosion hazards. The arid areas are subject to serve wind erosion. The semi-arid regions, viz., the foothill regions of Aravalli and Siwaliks, are subject to severe sheet and gully erosion. The ravines of the Yamuna and the Chambal are continuing to move in the fertile Gangetic plans. People are still trying to cultivate much of these areas, and thus, contributing to further destruction.

The pressure of increasing population neutralizes all efforts to raise the standard of living and of nutrition, where as loss of efficiency in the soil itself nullifies the value of any improvements made. That the present position is very serious, all agree. Soil and water conservation is the only known way to protect the lands and realizing its importance, the Government of India had established during the First and Second Five Year Plans, a chain of Soil Conservation Research, Demonstration and Training Centres. These Centres were later on transferred to the Indian Council of Agricultural Research (ICAR) on 1.10.1967. The ICAR combined these Research Centres and stashed on 1.4.1974 the Central Soil and Water Conservation Research and Training Institute (CSWCRTT) with the headquarters located in Dehradun.

The demand for plant and animal products is increasing continuously with the increase in population and standard of living. The basic resources needed to meet the demand are soil and water, without which the growing of plants is not possible. Wise use of these resources should really be the concern of all people, whether they are involved in agricultural production activities or not. The result of abuse of these resources is starvation. The implications are yet to be fully realized in many parts of the world. Continuous and earnest efforts are needed to develop proper attitudes and also practices to avoid catastrophe.

Agricultural scientists all over the world have been striving to know more and more about soil and water resources and how best they can be managed under varying conditions. The objective has to be to continuously enhance the productivity of land without polluting the environment.

Survival and well-being of animals and people depend on plants growing on a productive soil with adequate water. However, scientists have selected and bred food plants to tolerate stresses of fertility, water, temperatures, and pests. A hungry world needs an acceleration of this research to assure adequate food for the increasing billions.

For growth and reproduction, plants require 16 elements; animals and people need 14 of the same plus six more. Since plants absorb elements which they do not need, including the six needed exclusively by animals and people, many species and individuals of the animal kingdom live exclusively on plants. Proper fertilization can balance plant nutrition and composition, and accelerate growth; the result can be higher yields as well as more and more nutritious food and feed for people and their animals.

More food and feed for more people and livestock can be produced by greater yields per hectare and/or the use of more land. Both techniques are being used with success but at an accelerating cost. The ultimate options include more research on soil, water, and plant production, more education of people to use new technologies and family planning to reduce population growth.

The availability of quality water is the most pressing problem the world over. Presently we in India have 16.8 per cent population of the world but only 4.2 per cent population land. The per caput per annum availability of water that is about 2100 m^3 is likely to fall below 1700 m^3 by 2030 and to the scarcity levels a few years later. The stress on water resources is a result of multiple factors namely urban growth, increased industrial activities, intensive farming, and the overuse of fertilizers and other chemicals in agricultural production. The excessive mining of ground water for irrigation especially in the intensively cultivated areas of Haryana, Punjab and U.P. has caused drop in the water table at a rate that ranges between 0.5-0.8 m per year. Untreated water from urban settlements and industrial activities, and runoff from agricultural land carrying chemicals, is primarily responsible for the deterioration of water quality and the contamination of lakes, rivers, and ground water aquifers. Animal wastes dumped in the inhabited areas are also potential sources of nitrates in drinking water drawn through hand pumps. Over mining of ground water has triggered saline water intrusion, into aquifers in coastal areas, resulting in deterioration of water quality.

The book includes scientific principles as well as technological advances made in this area of soil water conservation and dry farming. The general public interested in the topic would be able to grasp the principles as well as practices of soil and water conservation not only in general but also in the context of raising specific field crops.

India contains about 47 m ha as dry lands out of 108 m ha of total rainfed are 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 dry lands for stabilizing income of the farmer. Watershed management programme in dry lands 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, eco-farming 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

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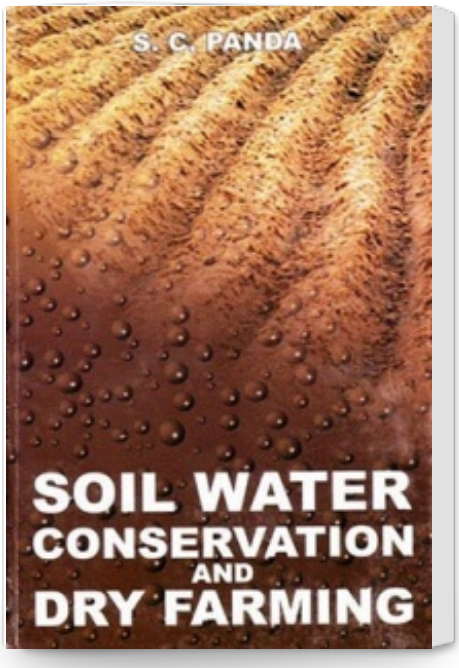

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