Soil Conservation and Fertility Management

S. C. Panda

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AT THE FEET OF
LORD SHREE JAGANNATH,
PURI, ORISSA

DEDICATED TO MY
FATHER, SHYAM SUNDAR PANDA
AND MOTHER, SHNEHALATA PANDA

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FOREWORD

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 severe wind erosion. The semi-arid regions, viz., the foothill regions of the Aravallis and Siwaliks, are subject to 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.

Owing to heavy rainfall in the north-east region, floods, stream-bank cuttings and sand bar deposition have made farming a hazardous task. The south and south-east are characterized by rugged and undulating terrain with a high degree of erosion in the black and red laterite soils. The activity of road, building and other development activities have led to the blocking of drainage ways in the flatter areas and caused water logging. Road construction and mining activities in hill areas have resulted in serious landslides and slips. Loss of agricultural lands, under serious pretexts, has driven the people to encroach on to steeper slopes and marginal lands for agriculture.

The pressure of increasing population neutralizes all efforts to raise the standard of living and of nutrition, whereas loss of efficiency in the soil itself nullifies the value of any improvements made. That the present situation is very serious, all agree. Therefore, soil and water conservation along with soil fertility management is the only way to protect the lands.

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.

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, temperature, and pests. A hungry world needs an acceleration of this research to adequate food for the increasing billions.

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 option include more research on soil, water, and plant production, more education of people to use new technologies, and family planning to reduce population.

The author presented the book entitled, **"Soil Conservation and Fertility Management"** 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 production in the areas of low rainfall and its erratic distribution. The whole philosophy of soil fertility management for 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 conservation and fertility management for 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 soil conservation, management of pasture and waste lands, soil and watershed management, 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 **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).

We increasingly face ecological and environmental problems as a result of injudicious use of fertilizers and other chemicals (pesticides, herbicides etc.) in intensive agriculture. The deteriorating soil and water quality, and the raising agrochemical toxicity in farming are serious concerns. All these factors jeopardize efforts to sustain growth in food production. The big questions before us are "Can we sustain high productivity with deterioration of soil and water environment?

Most of the additional food grain production must come from irrigated and potential rainfed lands. We need to use more complex technologies and management practices to further intensify crop

production systems and to conserve resource base from which all food is produced. The immense task before us is “How to orient our research to generate innovative technologies”.

Plants like human being, animals, birds and other living organisms need energy for their survival and proper functioning. Unlike other living organisms, they use to manufacture their food through conversion of solar energy into chemical energy vide process called as photosynthesis. The photo-synthates, thus synthesized, are partly consumed by plants for their growth and development till their active vegetative growth and rest is accumulated which we harvest. The entire process is regulated by various elements which are known as plant food elements. The list of such elements, is gradually enlarged with the advancement of physiological and biochemical knowledge. These elements, though present in soil yet the quantity being so meager need to be supplemented through their respective carriers called as fertilizers.

Role of fertilizers in boosting agricultural production has already been proved and they have become so essential that the cultivation of present day plant types without them is rather a dream. There has been ever increasing trend in fertilizer consumption starting from negligible quantity in 1950 to over 13 million tones of nutrients or over 28 million tones of fertilizer materials in 1992-93.

Concern about environmental safety and sustainability of land productivity is increasing among scientists, administrators and environmentalists. With increasing population, it is also becoming clear the food security to the teeming millions will not be possible unless the available resources are efficiently utilized for increasing the productivity. The strategy adopted during the green revolution era can not be valid anymore under the prevailing conditions. A new strategy of living with the nature and nurturing it for sustainable high productivity should be evolved. Though use of chemical inputs can not be altogether avoided, their use in agriculture has to be rationalized. Soil conservation and fertility management for agriculture show us the way of effectively use the available natural resources for the benefit of the mankind. But, unfortunately there are a lot of misconceptions about organic agriculture and fertility management. Though a large amount of information has been generated on various aspects of agriculture, they are scattered in literature. A compilation of the available information has been a felt need for students, teachers, research workers and administrators in agriculture.

At present, there is no comprehensive text book on ‘**Soil Conservation and Fertility Management’** 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 book makes an attempt to present the available information on soil conservation and fertility management for agriculture in a cogent and easily understandable manner. This is a book containing all sorts of chapters on soil conservation and soil fertility management for 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 Vigyna 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

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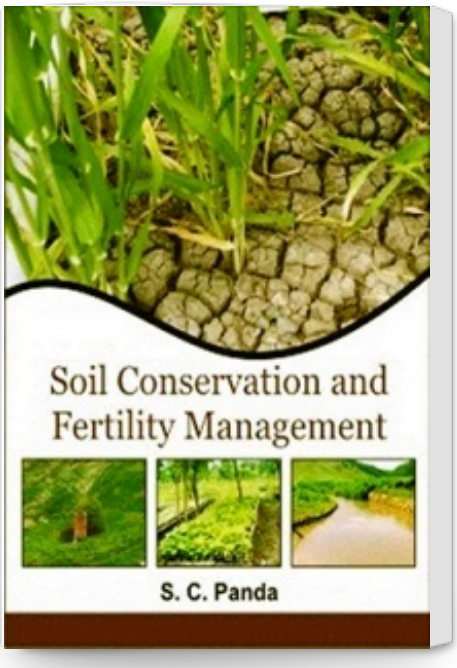

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