



Soil Tillage in the Tropics and Subtropics

R. Krause, F. Lorenz, W. B. Hoogmoed



Schriftenreihe der GTZ No. 150

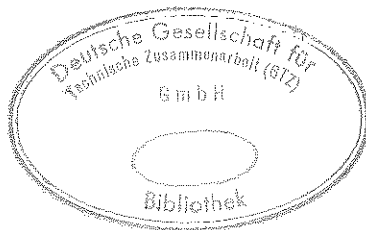
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W. B. Hoogmoed



Titel - Nr. 84-1476

Published by
Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH,
Dag-Hammarskjöld-Weg 1-2, D 6236 Eschborn 1

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Layout / Technical Editing
Anna Krafczyk

Printed by
Hoehl-Druck GmbH + Co., Bad Hersfeld

Distribution
TZ-Verlagsgesellschaft, Bruchwiesenweg 19, D 6101 Rossdorf 1

ISBN 3-88085-200-6
ISSN 0723-9637
I/4840/2

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PREFACE TO THE FIRST EDITION

More than ever before, an increase in the production of food crops is the main aim of the developing countries, nearly all of which are located in tropical and subtropical zones. The ideas and proposals as to how this increase can be achieved cover a wide range. On the one hand, we find a highly capital-intensive production system aimed at obtaining maximum yields and employing every available means, including intensive soil tillage, similar to the system applied in the industrial countries; on the other hand, we have a suitable crop production system requiring minimum inputs and taking account of the employment and skills of the indigenous population, the availability of energy, the agricultural structure and the infrastructure.

In every case soil tillage forms a serious bottleneck in all the plant production operations. As the basis for more intensive cropping, correctly timed tillage can often be achieved only by a higher standard of mechanization in the form of tractors and large implements. The preservation of the productivity of the sensitive tropical and subtropical soils depends principally upon the correct choice and use of tillage equipment and tillage systems.

This book is intended primarily for agricultural specialists and their colleagues, extension workers and farmers and also for teachers and students of agricultural engineering and agronomy in the tropics and subtropics. Part I deals with the objectives, principles and problems of soil tillage in different climatic zones while Part II examines the main implements and systems from the point of view of their purpose, limitations, method of operation and technical data, such as linkage and drive systems, adjustments.

The implements discussed here are not chosen on the basis of any specific standard of mechanization, nor are they restricted to a specific farm-size or farming structure; instead, this book examines primarily the equipment available in countries with a fairly high standard of mechanization and the essential criteria for assessing its suitability for various locations in developing countries. Hand tools and animal draught implements are not examined; a special work in this series is devoted to the last-named group. Tools classified as "intermediate technology" are not examined separately because the principles of soil tillage also apply to them and any special problems concerning their design and manufacture are too site-specific. Special implements and tillage systems for wet (paddy) rice-growing are not considered. Nor does this work deal with systems and implements for land clearance, levelling, subsoiling and drainage since these operations are usually performed by contractors or government authorities and not by the individual farmer. This is also true of systems and machinery for removing stones and rocks from land.

Two major subjects are given only cursory consideration - if at all - because they are so important that they deserve a book of their own. These are:

- Zero-tillage (direct drilling), a valuable alternative for sites where there is a danger of erosion and where rainfed farming systems are used.
- Systems and equipment for mechanized weed control and the way in which they can be combined with herbicides.

We should like to express our gratitude to the Deutsche Gesellschaft fuer Technische Zusammenarbeit (GTZ), GmbH for its support and funds. We also wish to thank all contributors and especially Prof. Dr. Ing. E.E. Schilling, Ing.grad. D. Trenker, Ing.grad. R. Vetterlein and Ing.grad. W. Winter for their valuable suggestions and are also grateful to everyone who helped with the typing, preparation of drawings and proof-reading.

This first edition appears only in German; it is hoped that a second revised edition will soon be published in English, incorporating any suggestions and additional material by practical experience in the climatic zones under discussion.

In view of the wide diversity in the design, technical details and sizes of implements only typical characteristics and ranges can be given but we invite manufacturers to inform us of any corrections required or send us any additional material. In particular, any major new developments could be included in Section 3.1.

*1979

THE AUTHORS*

PREFACE TO THE REVISED ENGLISH EDITION

A large number of reactions with additional information and suggestions was received after publication of the first edition. These contributions, which are gratefully acknowledged, encouraged the revision and translation into English of the original issue. Ir. Willem Hoogmoed of the Tillage Laboratory of the Wageningen Agricultural University, The Netherlands, carried out this laborious job, where his experience in tillage research in various tropical countries was most helpful.

We fully realise that again this second edition cannot be more than an aid to become acquainted with, to choose and to use properly tillage implements. It is not within the scope of this publication to treat the complex subject of "soil tillage" exhaustively, nor is it possible to present all available equipment.

The layout of the book has remained unchanged. Part I deals with the fundamentals of soil cultivation in tropical and subtropical climates and Part II discusses soil tillage methods in those climatic zones and the equipment employed for them.

The chapters on "The Objectives of Soil Tillage" and "Erosion" in Part I have been expanded to permit a better appreciation of the complexity of the processes affected by soil tillage operations.

Special equipment for animal traction (as a link with the publication on this matter by P. Munzinger, Nr. 120 of this series) is now also examined in Part II. Tillage equipment for paddy rice production, including the "powertiller" as the standard implement for soil tillage in large parts of southeast Asia is briefly discussed. The chapter on zero-tillage has been expanded. Some recent developments are mentioned.

One major improvement is the considerable increase in the number of references cited. A search of the literature was carried out by the Centre for Agricultural Publishing and Documentation (PUDOC) in Wageningen, The Netherlands. We have tried to include relevant literature for every implement or group of implements in case more detailed literature - practical rather than theoretical - is needed.

A number of figures and tables have been revised and corrected.

We should like to thank all those who have kindly sent us comments on the original edition; many of their suggestions have been incorporated in this text. Special thanks are due to Professor H. Kuipers, Head of the Tillage Laboratory of the Wageningen Agricultural University, for his encouragement and support, including use of the scientific and technical facilities of his laboratory. The authors are particularly grateful to Mr. Rolf Derpsch, GTZ/IAPAR, Londrina, Brasil for his substantial contribution to the chapters on erosion and zero-tillage. Dr. Chris Dirksen of the Laboratory for Soil Physics, Wageningen Agricultural University, undertook the correction of the English text.

We would like to thank, not in the last place, the GTZ for the appropriation of funds for the preparation of this issue and in particular Dipl. Ing. agr. Rudolf Holtkamp for his encouragement and enthusiasm in the realisation of this publication.

Finally, the reader is encouraged again to give comments and suggestions to help improving the quality of possible future editions.

1984

THE AUTHORS

FOREWORD

The professional quality of project staff is a determining factor for the quality of rural development projects planned and implemented by the GTZ on behalf of the German Federal Ministry for Economic Cooperation (BMZ). A supply of appropriate, up-to-date, specialised information during their studies when preparing for a project and particularly during their project assignments can play a major role in maintaining high know-how levels. To this end the GTZ is collecting and processing available know-how on specific subject areas and disseminating it as publications.

Soil tillage -one of the basic tasks in crop production- has a very old tradition. Climate and production systems determine the work input. In addition, practical farming demands continuous updating to take account of progress in the biological (breeding), chemical (fertilizers and plant protection), organisational and technical sectors. Impacts on the ecology and on the socio-economic environment must be considered. The availability and cost of energy demand not only that it be used economically, particularly for energy-intensive tilling systems, but also that appropriate mechanisation strategies be developed which account for the risks of supply-bottlenecks.

The present publication is a second, revised and completed edition. We hope that the English version will be widely read by our non-German co-workers in the projects and particularly by extension workers and students in tropical and sub-tropical countries.

The 3500 year old, Mesopotamian farmers' almanac found in Nippur contains observations on soil cultivation, some of which could have been written in our times.

- Before you till your fields, open the sluices of the irrigation ditches but take care not to inundate the fields too much!
- When you water the land, make sure that the surface remains even, it should be as flat as a board.
- Do not allow the wandering oxen to churn up the soil!
- Then prepare the fields for sowing.
- Clear the weeds with a pick and tear out the stubble by hand!
- If the ground scorches in the sun, divide it into four parts.
- Then water them one at a time, so that you are not held up in your work.
- Before you begin to plough break up the earth twice with the mattock, and once with the hoe.