



# Soil Tillage in the Tropics and Subtropics

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## 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.
- If need be, take a hammer too, in order to demolish the toughest clods.
- Roll the field flat and fence it round!

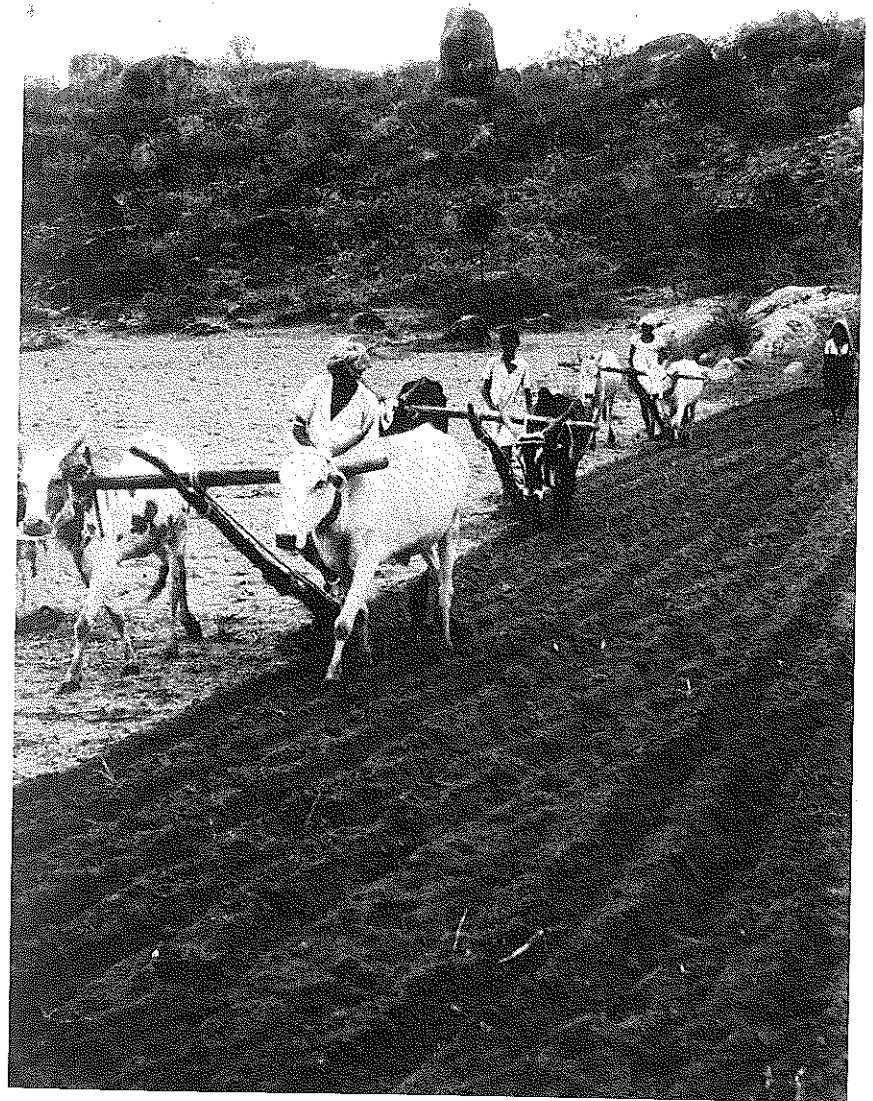
What could better substantiate the expert's "lore":  
Advising means first of all: Learning how to listen!

Klaus J. Lampe

## PART I

### Principles of Soil Tillage

## 1.0 INTRODUCTION



Soil tillage is an integral part of crop production. The aim of these farming operations should be to influence the biological, chemical and physical characteristics of the soil in such a way as to create the optimum conditions for the germination and development of the plants.

These operations should also take account of the conservation and improvement of soils as an environment for the plants' growth to ensure high yields in the long term.

The second objective is equally important but is often difficult to achieve in both humid and dry tropical regions. Soil tillage consists of mechanical manipulation of the complex and sensitive "system" soil. The effects of this manipulation may be particularly pronounced in tropical and subtropical climates. The risks involved should be suitably recognized when planning and carrying out tillage operations: a greater danger of soil erosion by wind and water, increased destruction of organic matter and more evaporation losses, especially in areas with summer rains. High levels of salinity - often linked with high pH values - and the constant input of salts with the irrigation water cause further problems in the soil in these climatic zones.

The delicate balance of the soils - often characterized by a high degree of weathering - can easily be disturbed and produce serious and usually irreparable damage. Many steppe and desert regions have not been created by nature but by man and provide examples of incorrect land-use and soil tillage. Crop production is more problematic in tropical and subtropical climatic conditions than in temperate humid climates. In the latter zones mistakes in soil tillage can - to some extent at least - be remedied by the action of frost, low evaporation and reduced plant activity in the cold season.

Many cultivated plants derive from regions which are ecologically different from their present region of production. Breeding aimed principally at high yields results in plant varieties which make heavy demands upon their environment. When competing with weeds which have become properly adapted to their habitat, these crops cannot survive without protection and assistance from the farmer.

In this book we can present only a general framework within which the soil system is constantly protected in order to obtain an optimum environment for plant growth. We also describe technical equipment and systems for use in solving the complex problems.

For further reading, literature is given at the end of each chapter. It is obvious that soil tillage is a multi-disciplinary science, closely linked with soil science (physics), agronomy, economics as well as agricultural engineering.

## 2.0 THE OBJECTIVES OF SOIL TILLAGE

