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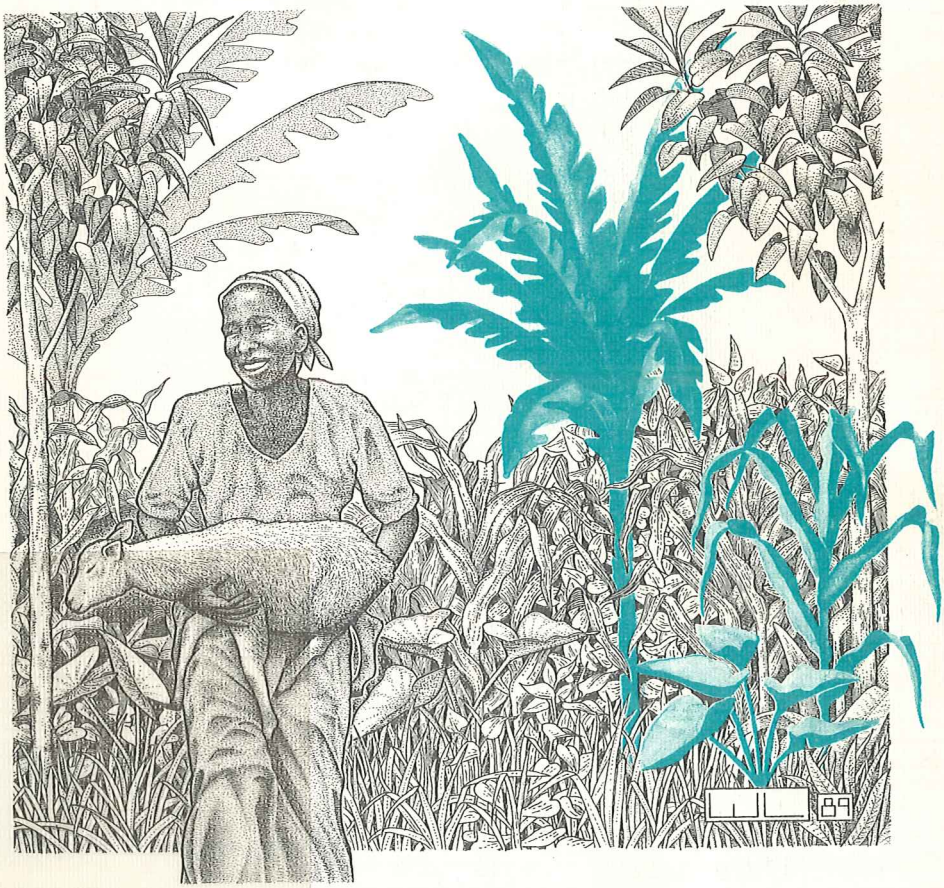
gtz

ECOFARMING

in agricultural development



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The government-owned GTZ operates in the field of Technical Cooperation. Some 4,500 German experts are working together with partners from some 100 countries in Africa, Asia and Latin America in projects covering practically every sector of agriculture, forestry, economic development, social services and institutional and physical infrastructure. – The GTZ is commissioned to do this work by the Government of the Federal Republic of Germany and by other national and international organizations.

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- provision of materials and equipment for projects, planning work, selection, purchasing and shipment to the developing countries
- management of all financial obligations to the partnercountry.

As a member of GTZ staff from 1980 to 1984, Johannes Kotschi was concerned particularly with questions of ecologically oriented agriculture, and has since been working as consultant in this field.
In the compilation of this book, Ann Waters-Bayer collaborated as consultant and Ulrich Hoesle and Reinhard Adelhelm as members of GTZ headquarters staff.

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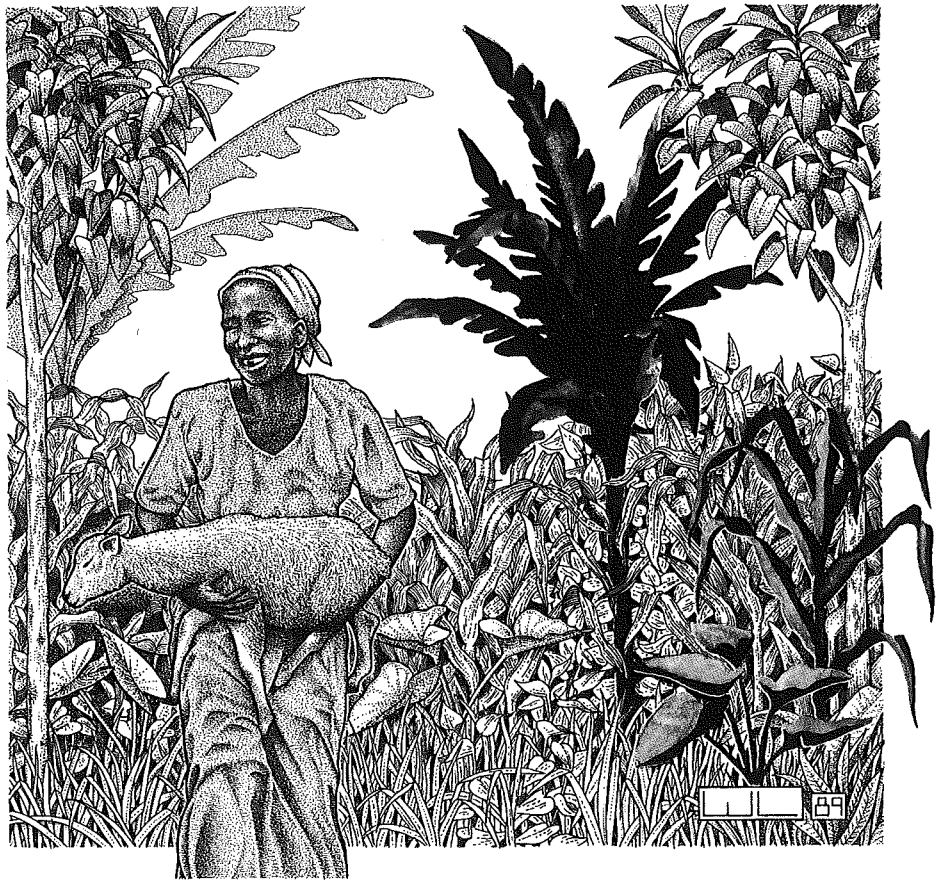

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Foreword

The present study is a further contribution to the discussion of the principles and methods of sustainable agricultural development which appeared in the Kotschi and Adelhelm (1984) report on ecofarming (German: Standortgerechte Landwirtschaft zur Entwicklung kleinbäuerlicher Betriebe in den Tropen und Subtropen). For the benefit of English-speaking readers, an abbreviated version of the above-mentioned report is given in the first two chapters of this study. In Chapter 1, ecofarming is defined and its importance for the development of smallholder agriculture in the tropics and subtropics is discussed. Chapter 2 contains an outline of the major ecofarming techniques from the point of view of formal agricultural science, the major results of a GTZ survey of ecofarming development activities, and a commentary on the state-of-the-art of ecofarming development within Technical Cooperation.

Since the GTZ survey and the report by Kotschi and Adelhelm, numerous other activities related to ecofarming have been commenced or have become known to the authors. Questions regarding promotion of *self-help* and *target-group participation* in agricultural development have been more widely discussed by development theorists and practitioners. Some researchers have delved into indigenous technical knowledge and have drawn attention to environmentally-sound farming systems which smallholders in the Third World have developed and are still developing.

This spurred the authors of the present study to take a closer look at indigenous agricultural knowledge and ecofarming practices in the tropics (Chapter 3) and possibilities of collaboration between local farmers and agricultural scientists in developing site-appropriate techniques of sustainable agriculture. This led, in turn, to consideration of the implications of this approach for project and advisory work, professional training, research emphases, and planning and organization of Technical Cooperation (Chapter 4).

Many of the activities mentioned in Chapter 4 were not covered by the original GTZ survey. We apologize to the people concerned for not including them in the contact addresses listed in the annex, which refers only to survey respondents. We would welcome reports from additional individuals, groups and institutions involved in ecofarming research and development, to permit more detailed and up-to-date documentation of activities and wider dissemination of information between interested parties. We hope that this volume will stimulate further thought and discussion among development workers in the field as well as in the head offices of Technical Cooperation agencies.

Numerous development institutes and concerned individuals provided information and ideas for this study; most of them are mentioned in the address list or references. We express our gratitude to them all. Special thanks are extended to ILEIA in the Netherlands and Agrecol in Switzerland for their assistence in compiling material.

THE AUTHORS

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Abbreviations and acronyms

ACIAR	Australian Centre for International Agricultural Research
ACORDE	Asociación Coordinadora de Recursos para el Desarollo, Honduras
AFPRO	Action for Food Production, India
AIT	Asian Institute of Technology, Thailand
AVRDC	Asian Vegetable Research and Development Center, Taiwan
BBA	Biologische Bundesanstalt, Germany
CABO	Centrum voor Agrobiologisch Onderzoek, Netherlands
CATIE	Centro Agronómico Tropical de Investigación y Ensenanza, Costa Rica
CENTEP	Centro de Technología Popular, Ecuador
CET	Centro de Educación y Technología, Chile
CIAT	Centro Internacional de Agricultura Tropical, Colombia
CIMMYT	Centro Internacional de Mejoramiento de Maíz y Trigo, Mexico
CIP	Centro Internacional de la Papa, Peru
CPATU	Centro de Pesquisa Agropecuária do Trópico Umido, Brazil
CSAT	Colegio Superior de Agricultura Tropical, Mexico
EMBRAPA	Empresa Brasileira de Pesquisa Agropecuária, Brazil
FAO	Food and Agricultural Organization of the United Nations, Italy
FR	Rwandan franc

GROW	Action Group of the Organic Soil Association of South Africa
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit (German Agency for Technical Cooperation)
ICARDA	International Center for Agricultural Research in the Dry Areas, Syria
ICARM	International Center for Aquatic Resources Management, Philippines
ICRAF	International Council for Research in Agroforestry, Kenya
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics, India
IDRC	International Development Research Centre, Canada
IDS	Institute of Development Studies, England
IFPRI	International Food Policy Research Institute, USA
IICA	Instituto Interamericano de Ciencias Agricolas, Trinidad and Tobago
IITA	International Institute of Tropical Agriculture, Nigeria
ILEIA	Information Centre for Low External Input Agriculture, Netherlands
ILRI	International Institute for Land Reclamation and Improvement, Netherlands
INCAP	Instituto de Nutrición de Centro América y Panama, Guatamala
IRHO	Institut de Recherches pour les Huiles et Oléagineux, France
IRRI	International Rice Research Institute, Philippines
ISS	Institute for Social Studies, Netherlands
ITTA	Institut Tunesien de Technologie Appropriée, Tunisia

IUCN	International Union for Conservation of Nature and Natural Resources, Switzerland
JICA	Japan International Cooperation Agency
LER	land equivalent ratio
NAS	National Academy of Sciences, USA
ODI	Overseas Development Institute, England
OEKOTOP	Gesellschaft for Angepaßte Technologie in ländlichen Entwicklungsgebieten (Society for Appropriate Technology in Rural Development Areas), Germany
OISCA	International Organization for Industrial, Spiritual and Cultural Advancement, Japan
OXFAM	Oxford Committee for Famine Relief, England
PAC	Proyecto Agrobiología Cochabamba, Bolivia
R & D	Research and Development
SAREC	Swedish Agency for Research Cooperation with Developing Countries
SARH	Secretaria de Agricultura y Recursos Hidraulicos, Mexico
TC	Technical Cooperation
UNESCO	United Nations Educational, Scientific and Cultural Organization
USAID	United States Agency for International Development
ZOPP	Zielorientierte Projektplanung (Goal-Oriented Project Planning)

1. Why "ecofarming"?

1.1 What is ecofarming?

The mainstream approach to modernizing agriculture has led to dependency on external inputs, e.g. of seed, fertilizer, pesticides, machinery and fossil fuels. In recent years, concern with both resource limitations and the ecological repercussions of modern technology has led to a growing awareness of the need for environmental protection and ecologically sound practices, in agriculture as well as other forms of resource use and management. Specifically in agricultural development, the need is gradually being recognized to find ways of meeting production requirements without excessive strain on nonrenewable natural resources.

Parallel to and partially within the mainstream approach in agricultural development, efforts have long been made to promote and practise forms of land use which make efficient use of locally available resources. In this sense the German concept of site-appropriate agriculture *(standortgerechter Landbau)* builds on a long tradition of location economics and farm management theory. In other countries in various parts of the world, similar concepts are being promoted, e.g. ecologically sound agriculture, biological husbandry, organic farming, conservation agriculture, sustainable agriculture. All refer to forms of agricultural land use which depend primarily or almost exclusively on local resources to achieve lasting productivity, i.e. **sustainable agriculture with low levels of external inputs.** For the sake of brevity, this will be referred to here as "ecofarming".

Ecofarming strives to create a cultivated but balanced ecosystem designed to sustain human life. It is not an attempt to restore nature to a close to pristine form. It is a way of using natural resources without destroying (mining) them, or – where environmental decline has already set in – regenerating resources so that they can support man once again. Not only productivity and sustainability in the

long term but also stability of production, i.e. minimized fluctuation of output around the mean, are major aims of ecofarming. These are achieved through high degrees of cohesiveness (STEINER 1975, HARTMANN 1973), functional diversity and complexity (EGGER 1979). The complementarity and interaction of the various components within the agricultural region or individual farm moderate unexpected adverse events and permit the year-to-year survival of the inhabitants and, thus, the continuation of agricultural production.

For each specific location, ecofarming involves the search for the optimum rather than the maximum in cohesiveness and functional diversity (KOTSCHI 1981, KOTSCHI et al 1983). The fairly general nature of these properties makes it clear that the designation "ecological" cannot be applied in an absolute sense nor can it be expressed in quantitative terms. It relates, rather, to a developmental process in which changes in the ecosystem must be continuously assessed to determine whether or not specific measures are of value. This means that farming techniques are not good or bad per se; their value depends on their applicability within a particular system, e.g. whereas minimum tillage may be recommendable in one case, ploughing may be necessary in another. There are scarcely any objective and generally valid criteria for assessing the extent to which a technique is environmentally appropriate for a given farm situation.

Instead of giving the label "ecological" or "unecological", it would be more correct to refer to the degree of appropriateness of a farming technique for a specific site and time.

Modern agricultural production has developed in a direction contrary to the requirements of productive and sustainable ecosystems for cohesiveness and functional diversity:

- Rather than being cyclical, modern agricultural production tends toward an *open* flow of material. The growing use of off-farm production inputs (mineral fertilizers, plant protection agents, machinery etc.) means that largely *closed* systems are being increasingly opened up and, thus, losing their cohesiveness.

- Instead of being complex and diverse, modern farming systems tend to be one-sided (specialized) in response to pressures toward economic rationalization. Production is becoming increasingly confined to only a few lines of activity, limited crop rotations and a small number of species and varieties, generally with a greatly restricted genetic base (e.g. hybrid varieties).

The aim of this development is production according to industrial considerations in order to maximize yields in the short to medium term. This is backed up by agricultural research which investigates the immediate, and not so much the long-term effects of isolated production factors (e.g. nitrogen or water) on crop yield. This monocausal approach does not take account of the multifunctional nature and close interlinkages of the individual factors in the farm ecosystem.

In contrast, ecofarming systems and techniques have been developed on the basis of a holistic view of man within the biosphere and the awareness of man's dependence on scarce natural resources. In some cases recognition may have been reached that the use of certain external production inputs is undesirable from the ecological point of view or is, under certain circumstances, even unprofitable. In other cases, as in some developing countries, the inputs may not be available on account of supply constraints. Where this level of consciousness or these economic conditions prevail, intensification of farming is sought through more productive use of available resources such as soil nutrients, rain water and local energy, together with the knowledge, labour and initiative of the people.

The term "ecofarming" implies that farming regions and individual farms must be treated as ecological systems. Ecology is a science which deals with the relationships between organisms and their environment. But in this context the environment is not confined to the natural conditions (e.g. soil, climate); it encompasses the entire complex of physical, economic, social and cultural conditions which affect the growth and development of an organism or organic system.

Man, with his culture, needs and customs, must be viewed as a part of the ecological system and not as an outsider.

Farming is practised in Africa, Asia and South America under a wide range of climatic and economic conditions and by a great diversity of cultures. In view of the localized nature of many agricultural problems, widely applicable solutions can rarely be offered and must remain relatively abstract. Agricultural development efforts must be location-specific. Just as recommendations for use of chemical fertilizers cannot be made for an entire country or region without consideration of, e.g. different soil types and rainfall patterns or fertilizer availability, so also the recommendations for ecofarming techniques must suit the specific ecological environment and socioeconomic situation of those applying the techniques.

It is clear that Technical Cooperation agencies cannot draw up an ecofarming development plan for each distinctive farming ecosystem or for each distinctive farm. The aim is, rather, to seek collaboration with farmers to assist them in their efforts to develop the most appropriate strategies and techniques for their particular site, which will permit them to achieve high and sustained agricultural production.

1.2 Why is the promotion of ecofarming necessary?

Why must ecofarming be promoted within Technical Cooperation between the industrialized and the developing countries? The answer must be sought through a critical assessment of agricultural development and its repercussions in both industrialized and developing countries.

According to BRINKMANN (1914), farm systems arise out of the tension between opposing groups of forces: those which draw towards specialization and those which draw towards diversification. In the development of agriculture in the industrialized countries, the

Plates 1 and 2:
On this smallholder compound in Rwanda, the dwelling (centre), kitchen (left) and stall (right) are clearly separated from each other. The compound is enclosed by a "living fence" of *Euphorbia*.The nearby toilet, which can be shifted periodically, ensures that also human faeces are returned to the nutrient cycle. The compound illustrates the unity of the smallholder farm, which should be kept in mind when promoting individual enterprises within the farm.

forces favouring specialization have steadily gained in strength since the beginning of this century, while those favouring diversification have declined. Concerted efforts to assist agricultural development in the less industrialized countries were commenced only in the second half of the century. By this time, the concept of specialization had become so widespread and a "matter of course" that it strongly affected the agricultural concepts for and in the developing countries. As a result, here too, little attention was paid to the interrelations of various production lines within a farm or to specific environmental conditions and needs. It was unconsciously assumed that the same set of forces were operating in the developing countries as prevailed in the industrialized countries.

Major economic differences exist between the two groups of countries. In the industrialized countries with their low population growth rates, the number of people employed in agriculture has declined – and is still doing so – in both absolute and relative terms, as a result of rapid growth of the nonagricultural sectors (VON URFF 1982). From the point of view of the individual farm, this necessitates increased labour productivity (largely through farm mechanization), greater specialization and disintegration of production lines, growing involvement in the market, and reduction of subsistence farming. These trends have been fostered by the seemingly unlimited availability of external inputs and – as most industrialized countries lie in temperate areas – by a relatively low climate-related production risk and lower danger of mechanization to the soils than in tropical areas.

In simplified terms, the respective conditions in most developing countries are the opposite of those in the industrialized countries (Table 1). The prevailing conditions, particularly the high production risks and the limited availability of and purchasing power for external inputs in developing countries, appear to favour diversification and integration of production lines within individual farms.

Greater efforts must be devoted to promoting diversification and integration of production lines with a view to ecological compatibility and sustainability of production.

Table 1: Conditions for agricultural development: differences between industrialized and developing countries

Criteria	Industrialized countries	Developing countries
Climate-related production risk	lower	higher
Potential negative impact of mechanization on environment	lower	higher
Population growth	slow	rapid
Proportion of population employed in agricultural sector	decreasing	constant
Transport and market structure	good	poor
Degree of market involvement	higher	lower
Purchasing power and availability of external inputs	higher	lower
Specialization and labour productivity	higher	lower

This demand is directed not primarily to the farmers in the tropics and subtropics, many of whom could teach scientists a great deal about complex, integrated farming systems. It is directed, rather, to the agencies of Technical Cooperation, development planners, agricultural researchers and extension personnel, who – having been trained according to the concepts of modern agriculture in industrialized countries – must be made more aware of the principles of ecofarming. Only then will they be able to assist the farmers in strengthening diversification and integration in the use of limited resources in agricultural production.

In view of the high population growth rates in developing countries, food production must be increased to meet dietary requirements yet, at the same time, land productivity must be maintained to ensure a viable basis for the survival of future generations. The simultaneous demands for high productivity and sustainability of land use systems are often regarded as an irreconcilable conflict between short-term and long-term aims (and often also between the economic interests of the individual farm and those of the nation) or between economic and ecological considerations. As is obvious from the development path of agriculture in industrialized countries, increasing commercialization often leads to decisions in favour of short-term aims which put excessive strain on natural resources. Where ecological degradation has resulted, in both the industrialized and the developing countries, particularly strong efforts must be made to encourage forms of agriculture which make optimal use of on-farm and renewable resources in order to halt degradation, ameliorate the environment, and achieve high and sustainable levels of production.

A prime reason for promoting ecofarming in Technical Cooperation is that smallholders, who comprise the vast majority of the rural population in developing countries, cannot afford to practise any other form of agriculture. For example, most smallholders in the Third World are using very little or no mineral fertilizers (WOLF 1986) as they are generally too expensive, too unreliable in supply or simply not there.

Technical Cooperation in rural development must place more emphasis on improving the efficiency of local resource use, minimizing dependence on purchased inputs, and enhancing the rural people's capacity for self-reliant production and development.

But also in the industrialized countries, in view of the exponential rise in use of nonrenewable resources and in view of the environmental damage caused by many types of fertilizers, pesticides, herbicides etc., agricultural production will eventually have to find alternatives to the "modern" forms of production and re-

source management. In order to sustain the world food supply, ecofarming methods must be explored and developed in all parts of the world – not only on small-scale farms in developing countries.