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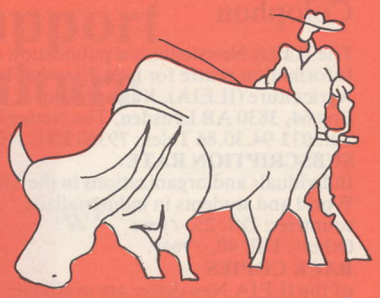

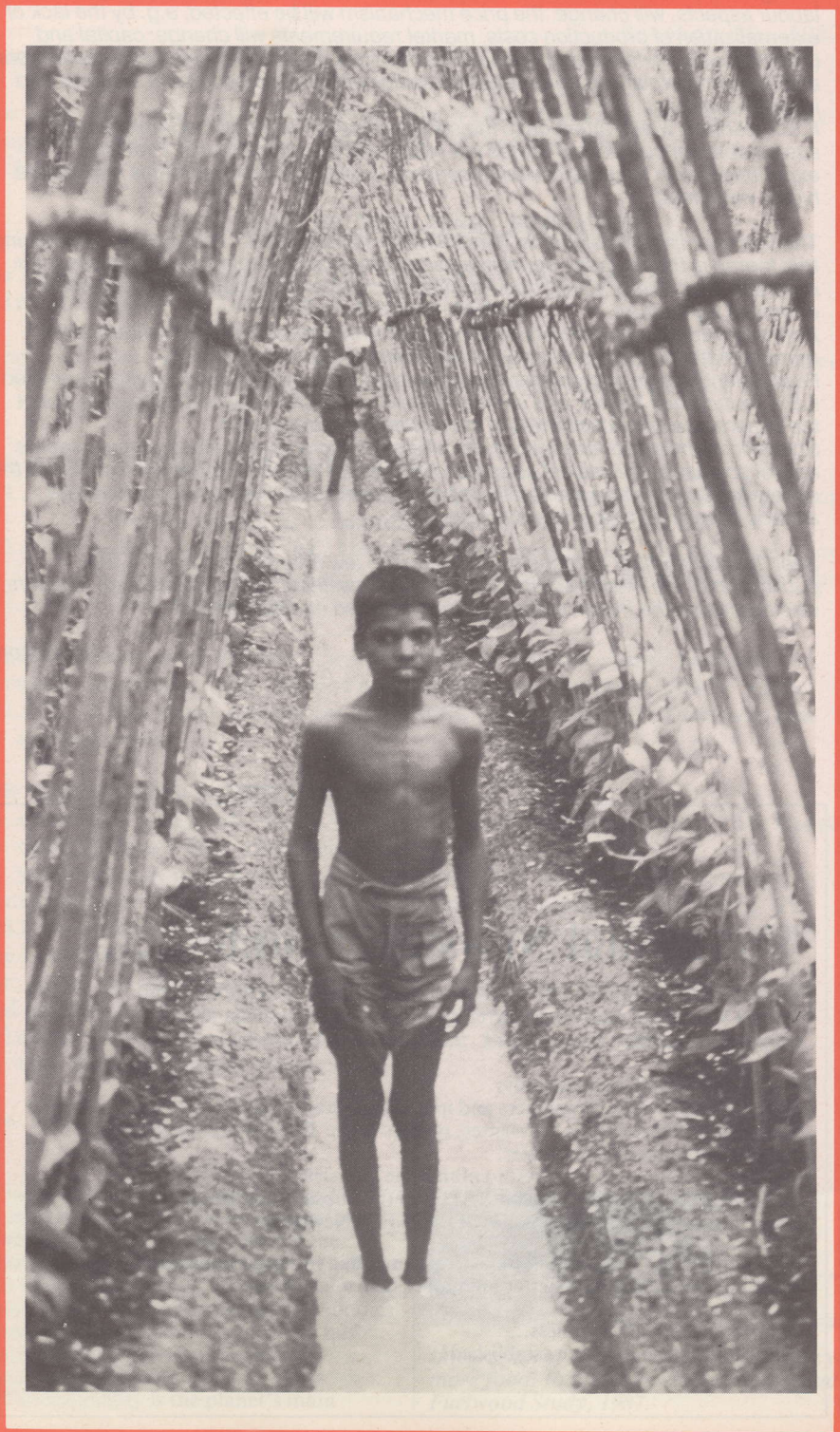

NEWSLETTER

ILEIA-OCTOBER 1987 Vol.3, No. 3

Informationcentre for Low External Input Agriculture

Microclimate Management

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Colophon

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COVER PHOTO:

Betel vine gardens in Southern India. A nice example of microclimate management. See also page 7. Photo: Alrik Copijn.

Dear Readers,

The editors observe an increased interest in sustainable agriculture (see e.g. the next article). We think that at least three factors attribute to this:
- *the ecological problems associated with conventional agriculture are increasingly recognized;*
- *the international market situation of agricultural products leads to a pressure on the off-farm prices, resulting in a more unfavorable term of trade for external inputs;*
- *the technical options being developed with optimal use of locally available resources prove to have perspectives.*

Yet the editors feel that the time is ripe to draw attention to the socio-economic and political implications of the approach. Sustainable agriculture attaches high value to farmer participation and indigenous knowledge and thus implies a different role for farmers, agricultural researchers and extension workers in the process of agricultural development and use of techniques.
Better use of locally available resources, and reduction of external inputs will lead to a change in the economic situation: supply and demand of inputs, especially also the labour aspects, will change; the price mechanism will be effected, e.g. by the lack of externalization of production costs; market requirements will change; capital and (international) credit requirements will be reduced. The relationship between farmers and the commercial and agro-industrial sector will be effected at local, national and international level.
ILEIA wants to widen attention to the socio-economic and political implication of sustainable agriculture and invites her readers to contribute to this. Practical experiences with successful socio-economic or political changes in this respect are highly welcomed.

The theme of this Newsletter is 'Microclimate management'. The reason for choosing this theme is that in many countries microclimates are rapidly worsening e.g. by deforestation, overgrazing, uncontrolled burning and introduction of big-scale chemical agriculture.
Farmers traditionally are very well aware of how important it is to influence the microclimate in a favorable way for agricultural production.
From scientific side microclimate management was, up till recently, rather neglected. ILEIA found Kees Stigter, one of the pioneers in this specialty, willing to write about the importance and possibilities of microclimate management.
Scientific quantitative research on the effects of microclimate manage ment seems not yet so easy by the lack of adapted instruments. So much important it seems to the editors to conserve and eventually improve scientifically the knowledge farmers already have on microclimate management.

Seen the low number of requests and seen the few financial means of ILEIA, publication of the French edition of the ILEIA Newsletter will be postponed. Readers who requested the french edition will be contacted on this matter.

The Editors

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Important Political Support for Sustainable Agriculture

World Commission on Environment and Development urges 'ACTION NOW'

In 1983, the General Assembly of the United Nations appointed a Commission on Environment and Development to formulate a global agenda for change, to propose long term environmental strategies for achieving sustainable development. The Commission was chaired by the Norwegian Prime Minister, Mrs. Harlem Brundtland. Mansour Khalid, former Deputy Prime Minister of Sudan, was vice-chairman. Representatives from more than 20 different countries were members. A few months ago, the Commission produced its report under the title: 'OUR COMMON FUTURE'. The report is commonly referred to as 'The Brundtland Report'. It gives a comprehensive analysis of the 'Common Concerns', describes the 'Common Challenges' and recommends 'Common Endeavours'.
In this article ILEIA reviews the part on food production.

Common Concerns

In the view of the commission, the world's crises, such as the environmental crisis, the development crisis, the food crisis and energy crisis are not separate crises. They are all one.
Present economic and technological developments have locked the global economy and global ecology together in new ways. In the past we have been concerned about the impacts of economic growths upon the environment. We are now forced to consider the impact of ecological stress. Ecology and economy are becoming ever more interwoven, locally, regionally, nationally and globally, into a seamless net of causes and effects.
Impoverishing the local resource base, can impoverish wider areas: Deforestation by highland farmers causes flooding of lowlands; Dryland degradation sends environmental refugees in millions across national borders; Internationally traded hazardous chemicals enter internationally traded food.
The countryside is coming under pressure from increasing numbers of farmers and landless people. Cities are filling up with people, cars and factories. Yet, at the same time, developing countries must operate in a world in which the resource gap between the developing nations and industrial nations is widening, in which the industrial world dominates some key international bodies and in which the industrial world has already used much of the planet's ecological capital.
This inequality is the planet's main 'environmental' problem; it is also its main 'development'problem.

Common Challenges

The Commission is optimistic about the future. Provided the political will is available, humanity has the ability to make development sustainable.
Sustainable development will ensure the needs of the existing population without compromising the ability of future generations to meet their own needs.
A world in which poverty is endemic will always be prone to ecological and other catastrophes. Therefore, the Commission believes that sustainable development requires meeting the basic needs of all people. The Commission reviewed the problems and potential related to population and human resources, food production, species and ecosystems, energy, industry and urbanization.

Common Endeavours

When countries, with untapped agricultural resources, provide food by importing it, they are effectively importing unemployment. By the same token, countries that are subsidizing food exports are increasing unemployment in food importing countries. This marginalizes people, and marginalized people are forced to destroy the resource base to survive.
According to the Commission, global food security depends not only on raising global production, but on reducing the distortions of the world food market and on shifting the focus of food production to food-deficit countries, regions and households.
Yet this shift in location of agricultural production as such will only be sustainable if the resource base is secure. As this is far from secure today, the resource base for food production must be sustained, enhanced, and , where it has been diminished or destroyed, restored. Conserving the agricultural resource base and livelihood security of the poor is mutually supportive in three ways. First, secure resources and adequate livelihoods lead to good husbandry and sustainable management. Second , they ease rural-to-urban migration and stimulate agricultural production from underutilised resources thus reducing the need for food to be produced elsewhere. Third, by combatting poverty, they help to slow population growth.

STRATEGIES FOR SUSTAINABLE FOOD SECURITY

Government Agricultural Policies

* Government interventions, rather than being dominated by short term considertions, should include ecological criteria discouraging environmentally unsound farming practices, but rather encourage farmers to maintain and improve their soils, forests and waters.
* Agricultural policies should, much more than presently, differentiate crop production according to ecological variation.
* Agricultural policies should take into account the need for a proper incentive system. Stable, high prices and access to markets are essentials for agricultural

Integration of well chosen crops and tree varieties can reinforce each other and yield more food, fodder and wood. Photo: Studio 3, Chris Pennaerts, ETC-SADCC Fuelwood Study, 1987.

growth. This will require a major shift in international trading patterns by reducing protectionist barriers. Trade, tax and incentive systems should be based on criteria that include ecological and economic sustainability.

The Resource Base

* Land use systems should be developed according to 'best use' criteria. Three broad land categories should be delineated:
- Enhancement areas, which are capable of sustaining intensive cropping and higher population and consumption levels;
- Prevention areas, which should not be developed for intensive agriculture;
- Restoration areas, which require treatment in order to restore productive capacity.
Classifying land according to 'best use' will determine variations in infrastructure provision, support services, promotional measures, regulatory provisions, fiscal subsidies, and other incentives and disincentives.
* Improvements in water management are essential. Approaches to drainage, maintenance of irrigation systems and other watersystems, as well as cropping practices, should lead to better use of water, less salinization, pollution, alkalization and waterlogging.
Many of these objectives will be easier to realise in small scale irrigation systems where the participation of farmers in the management of the water systems is essential.
* Many countries can and should increase yields by greater use of chemical fertilizers and pesticides. But countries can also improve their yields by helping farmers to use organic nutrients more efficiently.
Use of organic plant nutrients to complement chemicals and pest control based on natural methods are strategies which should receive more attention and which will require a change in public policies which currently encourage the use of chemical pesticides and fertilizers.
* Agroforestry has been practiced everywhere by traditional farmers. The challenge today is to revive the old methods, improve them, adapt them to the new conditions and develop new ones. Well chosen crops and tree varieties can reinforce each other and yield more food, fodder and wood than when grown separately. Moreover, diverse cropping systems are less susceptible to pests and diseases.
* The production of fish in controlled water bodies, such as paddy fields, abandoned mining excavations, small ponds and lakes, has good potential for developing countries.

The Technology Base

The major advances in agricultural technology in recent decades are better suited to stable, uniform, resource rich conditions with good soils and ample water supplies.
New technologies are most urgently needed in those areas which have unreliable rainfalls, uneven topography and poorer soils and hence are unsuited to the green revolution technologies.
To serve these areas, agricultural research has to be less centralized, and more sensitive to farmer's conditions and priorities. Researchers must learn from and develop the innovations of the farmers, and not just the reverse.
Research, design, development and extension capacities in the third world should be enhanced in order to cover the gaps in available techology. Research and extension efforts must be greatly expanded, especially in areas where climate, soils, and terrain pose special problems.

Human Resources/Equity

Development of human resources by educational efforts, aimed not only at farmers but also at researchers and extension workers, should cover the efficient use of land water, and forests.
Women should be given more power to take decisions regarding agricultural and agroforestry programmes.
Systematic efforts to promote equity in food production and distribution should include programmes on land reform, specific programmes for subsistence farmers and pastoralists, women farmers, integrated rural development programmes, and programmes that reduce dangers of the season to season variability in food supplies.

The Need for Action

The Commission concludes its report by stating that the present generation of mankind should begin to work now on the recommendations, in order to keep options open for future generations.
We should begin now, together, nationally and internationally.

COMMENTS

ILEIA feels encouragement and recognition in the recommendations of the Commission. Since the start of ILEIA, we have worked on the collection and distribution of information on the implementation of low external input agriculture. We have worked on one of the wheels of sustainable development. Our focus on the use of locally available resources, the indigenous farmers' knowledge, equity and sustainability has generated a large response, not least the active network of contacts through this Newsletter. There are many signs that lead us to conclude that conventional agricultural institutions and professionals are increasingly aware of the importance of sustainability and the need to reduce costs by minimizing the use of external inputs.
Yet ILEIA is less optimistic than the Commission when it states that '..we have the knowledge we need to conserve our land and water resources. New technologies provide opportunities for increasing productivity while reducing pressure on resources. A new generation of farmers combine experience with education. With these resources at our command we can meet the needs of the human family. Standing in the way is the narrow focus of agricultural planning and policies...'
We agree that a major shift in policies is a necessary condition for achieving a sustainable and equitable development. But to assume that we have the technology at our command is underrating the tremendous effort still required to develop technologies that bridge the opportunity gaps that farmers face in resource poor areas.

Gaps in Technology Development

In our opinion the following gaps appear to be important:
* gaps in investment in technology development;
* gaps as result of western biased research and extension orientation;
* technology gaps as result of economic and commercial dependency;
* gaps in the development of ecologically sustainable technologies;
* gaps in research and development for traditional food crops and animals;
* gaps as result of undervaluation of indigenous knowledge, national and local resources;
* technology gaps as result of male orientation and big farmer orientation of technology development and delivery systems.
The present political support and renewed interest of conventional agricultural professionals for sustainable agriculture are positive developments. But this support is not sufficient to bridge the opportunity gaps in the short run in resource poor agriculture.
Even more important, are the political, social and economic problems which have to be solved to give resource poor people a real change to build a sustainable and equitable livelihood.
How does the Commission propose to stop people from exploiting each other and the earth?

Seal of Credibility

The significance of the Brundtland report is above all political. It is putting a political seal of credibility on much that environmentalists, researchers and non-governmental organizations have been saying. It provides a useful analysis of global problems and an indication of possible solutions. It is optimistic for it is recommending to keep smiling and to accept the 'Challenge'.
Now the task is to the UN General Assembly to transform this report into a UN Programme for Action on Sustainable Development.
Translation of the report to the local situation is needed so that local strategies to change policies, research, education, training and implementation emerge.
However, in our opinion, this UN action alone will not be enough to reach a sustainable and equitable 'Common Future'. Global reflection and action is needed by all members of the human race to change our attitude towards our common ecosystem, our one and only earth.

The editors

OUR COMMON FUTURE is published by Oxford University Press, Walton Street, Oxford OX2 6DP, England. The price of the book is £ 4.95.
A short, popular version of 38 pages, OUR COMMON FUTURE, A READER'S GUIDE, is published by Earthscan Books Ltd., 3 Endsleigh St., London WC1H ODD, England.

Traditional manipulation of microclimate factors: knowledge to be used

Kees Stigter

The American geographer Gene Wilken published in 1972 his review paper 'Microclimate management by traditional farmers' in the Geographical Review, the 'house-journal' of the American Geographical Society of New York. The paper went almost unnoticed into the 'fresh mulch' of literature which covers each scientific field annually with ever increasing thickness. Very likely it was considered more of a curiosity than something to draw conclusions from on an approach to development problems! I knocked ten years later on the doors of the World Meteorological Organization in Geneva with the first results of a newspaper contest in Tanzania on the same subject. My paper was set up systematically along agrometeorological lines implied by the work of Wilken. At that time I got a much more enthusiastic response.

Changes

In those ten years a growing awareness slowly arose, among some of those responsible for funding and carrying out International Agricultural Research in the Third World. Traditional shifting cultivators and smallholders, growing mainly food crops for subsistence and small rural internal markets, were not reached with any valuable advisories (e.g. Greenland, 1975; Gliessman et al., 1981). And when some of us strongly emphasized the idea that the ethnoscientific approach - of understanding farmers existing technology and farming systems first - was a fundamental step in the design of appropriate strategies based on low-external input agriculture (e.g. Egger, 1981; Stigter, 1982; Altieri, 1983), we got the benefit of the doubt. Less than another five years later it appears, among others, from recent Worldwatch Publications (Wolf, 1986, 1987) and (Carlier, 1987) that 'rediscovering traditional agriculture' has made it. Even to within some of the International Agricultural Research Institutes. It appeared at a recent ICRAF/WMO/UNEP Workshop in Nairobi, that a new interdisciplinary area of applied research in agricultural meteorology indeed has been developed (Stigter et al., 1987a). Now we work on traditional and new farming systems.

Manipulation: why and how

The practices of microclimate management and manipulation traditionally applied have recently been extensively reviewed (Stigter, 1986; Stigter and Weiss, 1986). A shortened review table (table 1) will serve the purpose of this introduction. The examples given there indicate that what is done in such manipulation is basically to change deliberately the different flows of energy (radiation, heat and kinetic energy of bulk movement). Consequently their extremely complicated impact on economic yield is changed. This can only be done on a relatively small scale. The goals will be different for low-external input agriculture compared to those for systems with higher inputs from outside. In the former, the sustainability of relatively low production and yield diversification and security in relatively fragile systems are the main aims. In the latter the increase of output and a raise in product quality are wanted. In cases of low-external input agriculture this means, in first instance, the mitigation of extreme conditions and keeping ecological balances. In the higher-external input cases it means the removal of production limits. These differences as such are not absolute.

Once a sustainable production yields properly from the economic viewpoint, new inputs, such as better varieties bred for intercropping, may be carefully tried out to raise sustainable production under new conditions. Calamities like drought, flood, wind and hail storms endanger all production systems. But possible inputs for protection differ in kind and scale. In some moderate-external input systems, such as large-scale tree planting and large-scale gravity irrigation systems, the traditional and the new knowledge (and aims) meet. The traditional aspects, which bear the existing local environmental knowledge, are of interest to us here as a basis for relevant advisory services.

From our worldwide searches for examples of the most promising practices in low-external input agriculture, four areas could be selected: shading, mulching, wind protection and surface modification (e.g. ridging, weeding, irrigation). To those can be added for Africa: drying and storage. Instead of reviewing again the state of the art in these examples (Stigter, 1986), it is shortly discussed here why we should pay scientifically attention to such traditional techniques in our field of applied agrometeorology. This will be illustrated more thoroughly by dealing as an example with research on mulches elsewhere in this newsletter. It is no longer necessary to 'prove' the intimate knowledge the traditional farmer has of his environment. It is, however, useful to illustrate with some examples where the scientific approach could add to this. It could assist the further development of viable farming practices and systems, to meet the changing requirements.

Traditional practices

In the specific traditional techniques of microclimate manipulation, and in other traditional practices/systems with such components there are three kinds: Those still successfully in use, but often only very locally; Those still in use but which no longer meet the increased pressure of changing land use and of other socio-economic changes; And those relatively recently abandoned for various reasons. It has been found that most of the traditional techniques have aspects worthy to be quantified. They need to be better understood from the cause and effect relationship point of view. Such aspects may then be incorporated in improved or new practices and systems, to be tested and validated with small farmers in on-station and on-farm trials. An example of such techniques/systems still successfully in use in restricted areas are the many variants of multistoried

I. **Manipulation of radiation:**
- Shading
- In- of decrease or surface absorption
- Cover for radiation loss at night
- Using solar radiation for field and storage drying

II. **Manipulation of heat and/or moisture flow:**
- (No-) Tillage
- Mulching
- Windbreaks of other shelter (storage)
- Protection for ripening purposes
- Influencing flow processes by changing conditions at/on the surface
- Using warmed air for field and/or storage drying
- Manipulating natural dew fall

III. **Manipulation of mechanical impact of wind, rain and hail:**
- Changing of wind speed and/or direction
- Planting in lower places or pits or where deep rooting is possible
- Improving soil conditions by natural deposits
- Protection from soil erosion by wind, rain and hail
- Protection of crops and produce against impact by rain, hail and wind
- Use of wind for winnowing

IV. **Two general examples:**
- Fitting cropping periods to the seasons
- Making use of superhuman intervention

Table 1 : Catalogue of examples of manipulation of microclimate.

home gardens of Mt. Kilimanjaro (Tanzania). They were only recently described in any detail (Fernandes et al., 1984). Shade and air movement manipulation are especially important. A wider introduction of such agroforestry is expected to have favourable socio-economic implications (O'kting'ati and Mongi, 1986). But this appears presently only to take place, at a declining rate, on neighbouring Mt. Meru. Now that these systems have been described they should be quantified to assist the further use of such techniques.

Also a good example are the sometimes very high (up to 3 m) mounds/ridges, found in different geographically small regions in Africa.

Another still very successful but labour intensive traditional cultivation method with soil conservation and erosion prevention capacities which have attracted more than average attention is Ingola (or Ingoro). It is very locally practised, for example by the Matonga, in Tanzania. Soil dug from pits is spread over the neighbouring soil after the latter has been covered with grass cut on the spot. In this way a network of ridges and holes comes into being, on sloping soils, like a fertile erosion-preventing mulch (Stigter, 1984a). Certainly a method worth disseminating. The sense of such techniques/systems has been challenged even locally because of the labour involved (Allan, 1965). But this is exactly what should be investigated quantitatively, agronomically and economically - in such cropping systems. Among those techniques/systems no longer satisfying changing conditions are some of the traditional small scale-storage techniques, although minor modifications have been shown to give promising results in some cases (Golob, 1984). Also among these are several forms of shifting cultivation and some indigenous agroforestry systems, involving disseminated trees, crops and livestock, which are disappearing because the limits of the carrying capacities having been surpassed. The recent development of systems of alley cropping (Kang et al., 1984) shows how such traditional ideas can be used to develop, test and validate new viable farming systems.

Examples of abandoned techniques/systems are many cases of the use of shade trees (e.g. Willey, 1975). This can specifically be challenged with respect to shade use and the multipurpose use of trees by low external input farmers (Stigter, 1984b; Barradas and Fanjul, 1986). Also quite some labour-intensive practices have been abandoned such as in medium-scale irrigation, in mulching and in underground grain storage. But as we will show also for such cases in the article on 'mulching', elsewhere in this newsletter, better understanding of this not yet completely lost traditional knowledge can be of much value. This is particularly true in attempts, together with local farmers and extension, to improve or replace existing systems. Anyway , quite some recent books show that in many cases the scientist is at best only starting to follow where local farmers were already going (e.g. Wood and Humphreys, 1982; Blaikie, 1985; Richards, 1985).

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Shading in tea growing. Photo: Alrik Copijn.

Traditional Techniques of Microclimate Improvement The TTMI Project

Kees Stigter and
the TTMI-Teams
in Kenya, Sudan and
Tanzania

It is more and more acknowledged that traditional agriculture merits to be and has already been rediscovered as a source of valuable knowledge for further development of present and new low-external input farming systems. This has become clear in the prevailing article in this Newsletter and has been demonstrated in several earlier ILEIA Newsletters as well. The TTMI Project(*) was estabilished mid-1985 on earlier experience with M.Sc. research on some of such traditional techniques in Tanzania (e.g. Stigter,1985b). It exclusively works with co-supervision of local Ph.D. research and associated M.Sc. research at Universities in developing countries. And the research umbrella is formed by the traditional techniques of microclimate improvement found to need priority attention: shading, mulching, wind protection and surface modification (Stigter, 1986).

We exemplify our approach by dealing with quantification attempts in the present TTMI subprojects in Kenya, Sudan and Tanzania, and by reviewing the work done on TTMI within the Commission for Agricultural Meteorology of the World Meteorological Organization. We want to contribute towards the discussions on how to quantify, environmentally and socio-economically, the relevant problems of the low-external input farmer. This implies the further development of, and the acceptability of changes in, their present farming systems. We are still of Wilken's (1972) opinion as to what he called 'traditional climate-meliorating techniques': 'Measurements of radiation, heat, and moisture fluxes under a variety of crop and field conditions are sorely needed to determine the effectiveness and extent of these climate-control measures. Only after basic data of this kind are available can we go on to such larger questions as how crop limits, growing seasons and production are affected by these practices'.

Shading: alley cropping and trees in tea growing

As explained in more detail elsewhere in this Newsletter, alley cropping belongs tc recently developed farming systems in which experience of traditional agroforestry practices have been kept. Alley cropping is presently considered, by trying out its limits, for semi-arid regions. This is supported by organizations like ICRAF, which also is a consultant for the Dryland Agriculture Research Project in Machakos, Kenya, in which we participate. In alley cropping the shade/competition for light is from/with the trees with respect to the adjacent plant rows. Therefore, the alley directions are of prime importance. Incidentally, the contour lines at the National Dryland Field Research Station in the semi-arid area of Machakos (1 S) are such that the tree rows of *Cassia Siamea* are in these experiments almost N/S. This means that we are largely interested in shade influence 'sidewards' from trees, kept from 50 cm to 1 m high, on adjacent maize rows, at a distance of 90 cm, until the maize has reached about that same height. Furthermore, this shading, which will occur in the relatively early morning and late afternoon for the short periods of low tropical sun, will only be of much influence on yields when it causes differences between rows in the duration of stomatal closure. Therefore, stomatal resistances will have to be quantified as well. Indeed, just to determine whether competition for light should be considered as a possible explanation for yield differences observed between rows, rather complicated measurements have to be performed. At the same time we are desperately searching for suitable instrumentation to sample soil moisture gradients to indicate competition for water under semi-arid conditions (Mpelasoka and Stigter, 1987). This all poses very specific spatial and temporal sampling problems with the tube solarimeters and tube near-infra red meters available (their differences give photosynthetically active radiation) and with gypsum moisture blocks. Above and beyond these sampling problems we have reasons to doubt the operability of the commercially available instrumentation for these purposes. This is a recurrent problem in almost all tropical field work. There is not much equipment around that may be considered as appropriate to quantify the complicated farming systems conditions in the tropics (Coulson and Stigter, 1987). A consequence is that much time has to be spent by the candidates and co-supervisors in testing, improving or even developing appropriate instrumentation. To be sure that we measure what we want to measure (Coulson et al., 1987).

In Kenya several decades ago, through extension services all shade trees were banned in tea growth areas, based on locally obtained research results. A reinterpretation of those data, and new results which distinguish between fertilized and non-fertilized tea (Willey, 1975), make it of interest to try to prove the gains of reintroduction of light (low amounts of) shade. That is in the case of the low-external input farmer, having a small plot of tea and no fertilizers. But he is also the one that could benefit from a multi-purpose use of some shade trees in his plot, which he is presently denied. Equipment developed commercially only a decade ago and its trustability in tropical field research play again an important role in our set up. Moreover basic questions, such as whether tea yield is ultimately sink or source limited, still need full proof answers. The art will be to use those hypotheses which are most likely to assist in our approach of reexamining light shade use in tea growing (Squire, 1985).

Wind protection: trees, sand and mechanical damage

Traditional desert or near-desert farmers know the values of scattered trees. Where rivers such as the Nile cross deserts or at oases, the value of tree belts is well known. They are protecting crops and other property from burying and scouring wind borne sand. In the Sudan, in the North-Western part of the Gezira gravity irrigation scheme, sand started a decade ago to invade canals and fields, which had to be taken out of production. FAO and the local Forestry Department established several kilometers of irrigated Eucalyptus in a belt from 250 - 500 meter wide along Sihaimab minor canal. Eucalyptus has been proven to be valuable and suitable trees in the Gezira (Bayumi, 1977). This indeed keeps the sand out and the canal has been rehabilitated. However, nobody knows how in fact the mechanism of sand transport reduction by a tree shelterbelt actually works. Certainly wind speed is reduced and the sand is visibly settled in front of the belt and between the windward tree rows, where it accumulates. But neither such a wind speed (reduction) pattern under conditions of wind borne sand nor sand transport (reduction) and sand accumulation have been quantified anywhere near and within such a belt. And again we find ourselves in a position that we have partly to adapt and partly to develop instruments for simple multi-point sampling of transported sand. Fortunately, the Department of Land Reclamation and Drainage of Wageningen University appears to be one of a very few places where some experience exists in this direction (Oldenziel, 1983). And we developed ourselves, as an extension of earlier research in Tanzania a very simple mass transfer wind (air movement) meter to interpolate between the cup anemometer system in use for wind measurements (Stigter et al., 1987b).

The latter two instruments will also serve in the study of the effect on air movement of scattered trees in Tanzania. Two systems have been selected to begin with: Do shade trees in coffee also have a

In alley cropping, the alley directions are of prime importance.

wind protection function, as they are traditionally believed to have? What modification of the wind regime does low savanna wood land cause when it is met by an initially undisturbed wind field? In the Sahel much of such protecting wood land has disappeared because of mechanization of agricultural production and the increasing need for fuel wood, worsening drought conditions (e.g. Schoch, 1968). The first question will be tackled on the premises of the TARO Coffee Research Institute, in Lyamungu on the Kilimanjaro plateau. The second one is planned to be tackled in part of a game reserve, near the road from Arusha northwards to the Kenyan border, in the rain shadow of Mount Meru.

Surface modification: irrigation and labour

The final example illustrating our approach in the TTMI-Project is again from the Sudan Gezira Scheme. The tenants there have, in the course of time, abandoned their traditional labour intensive method of irrigating their fields sub-plot by sub-plot, guiding the water in full attendance. They prefer these days to have an unattended free flow of water, either day and night or only a long part of that period. The administration of the scheme, also responsible for extension, is blaming the tenants for wasting costly water in this way. But there are no actual figures to show such claims to be justified. Moreover, such wastage, if any, should be compared with evaporative losses from the storage lake at Sennar, the hundreds of kilometers of main canals and the thousands of kilometers of minor canals and field channels. Deep percolation losses are very small in the Gezira, but surface seepage from the canals does occur. We have set ourselves the tasks of estimating these other losses and of actually determining water use efficiency differences under the traditional and present irrigation modes. We work with the food crops sorghum (dura) and groundnut, in the fields of the tenants. A recent farmers' attitudinal survey on their management practices and objectives in the same area has been of much assistance (Mohammed Ahmed and Tiffen, 1986). And collaboration with British colleagues working on canal water management problems is of very much use. So again: quantification of a traditional system, in this case an abandoned one, in a comparison with a system that requires appreciably less labour, appears to be an economical necessity.
Sampling the inhomogeneous tenant fields and measuring within Lake Sennar on a float form the main measurement problems.

International attention

In its eighth session, in 1983 in Geneva, the Commission for Agricultural Meteorology (CAgM) of the World Meteorological Organization established rather unexpectedly a full Working Group on the TTMIsubject. An introductional paper had been presented by the delegation of Tanzania (Stigter, 1983), in which only a rapporteur on the subject was proposed. The final report of this Working Group (Stigter, 1986), was presented at the ninth session in November 1986 in Madrid. The CAgM now nominated a group of Rapporteurs on 'The Application of Microclimate Management and Manipulation Techniques in Low-External Input Agriculture'. This group will be coordinated by the former Working Group Chairman, now on behalf of the Netherlands. It will have members from China, USA and USSR, which have agreed to participate. WMO also supported the present TTMI-Project officially when it searched for funds and candidates in 1985. In addition it has pledged financial support for publications of weather advisories, validated in on-farm trials with low-external input farmers, and geared to their specific information needs, in local languages (for example Kiswahili and Arabic). This international support over the past five years shows that the community of agrometeorologists is considering the TTMI-approach as a serious addition, if not in many cases an alternative, to its present contributions in tropical farming systems research and development.

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Microclimate and its utilization in Indian Farming

A. Balasubramainam

Indian farmers, with their vast experience handed over from generation to generation by informal training, utilise the microclimate in a skilful manner in many agricultural practices. While some practices are designed to induce the microclimate some other practices either utilize the available microclimate or disturb the microclimate according to the crop's requirements. Some of the practices, involving microclimate, adopted by the farmers in Southern India which are quite interesting are given here.

Induced microclimate utilization

* One of the best examples for microclimate utilization is the betel vine gardens of Southern India. The betel vine plants *Piper betle)*, being dwelicate plants, require a cool climate and high humidity during their whole life span of 2 to 3 years. if the plants are exposed to the prevailing outside hot climate, particularly in summer, the leaves will become dark green and brittle, so that it will not be liked by the consumers. Instead, if a cool climate and shade are provided into the garden, the leaves will be feathery with light green colour which will get a good price in the market due to its consumer preference. Therefore, the farmers manipulate the climate in the garden to provide the necessary coolness. They dig deep, long trenches, two and a half feet depth and two feet wide. The space between two trenches is 3 feet. In the edges of the trenches they plant 'Agathi' *(Sesbania grandiflora)*. After the Agathi plant has grown to six feet height, they plant betel vine cuttings by the side of the agathi plants. When these agathi plants grow taller they provide necessary canopy of diffused sunlight. The trenches are impounded with two feet depth of water. The irrigation to the betel vine is done by the splash irrigation method from the trenches and the soil is always kept moist. The border of the gardens are completely closed either by dried banana leaves or by plaited coconut leaves. By this indigenous method the external hot air is prevented from entering the garden and the full grown agathi plants with its dense canopy provide a cool phyto-climate. The impounded water in the trenches increases the humidity within the garden. Totally the garden will act like a cool, air conditioned room and the betel vine will grow luxuriantly with broad, light green yellow, feathery leaves.
* For summer irrigated peanut crop, irrigation is given by splash methods during night periods too. The reason attributed by the farmers is that it will increase the humidity and create the cool climate which is most liked by the peanut crops. Therefore there is a vast scope for introducing sprinkler irrigation for summer peanut crops, because splash irrigation method requires more labour and time.
* In dry farmin tracts, a shallow ploughing is given in the summer, after every receipt of the summer rains. It prevents soil moisture evaporation and stores the soil moisture so that the next crop may utilize this stored soil moisture.
* In some parts of Kerala both coconuts and areca nuts *(Areca catechu)* are grown mixed to get good yield from areca nuts. If areca nut is grown as a sole crop, it will not give good yield. Further the phyto-climate induced by this mixed cropping system is used for growing black pepper utilizing coconuts trees as a standard.

Available microclimate utilization

* In Cauvery delta, black gram *(Phaseolus mungo)* and green gram *(Phaseolus aureus)* are sown as relay crop in paddy fields after the long duration rice crop.
Farmers sow the gram seeds in standing rice crop just one week before the harvest of the long duration rice crop. The microclimate-like moisture level and soil condition in the standing rice crop will be optimum for the germination and establishment of the young gram seedlings. After the harvest, the young seedlings get the required sunshine and yield satisfactorily. The whole crop is grown under zero cultivation level. Only plant protection measures are taken up, if needed. Instead, if the gram seeds are sown after the harvest, the microclimate will not be suitable and the seeds will fail to germinate due to dehydration and the soil hardening. Here the microclimate is utilised for a short period.
* In certain pockets of Tanjore Delta in India, peanut is sown in late December, immediately after the harvest of the rice crops. This peanut is grown without irrigation. It meets its water requirements from the soil moisture stored from the previous rice crop. The farmers will hand weed this peanut at 20th and 40th days after sowing. While hand weeding at 20th day, the soil clods are broken and a fine tilth is produced to act as a soil mulch. This soil mulch maintains the soil temperature and prevents soil moisture evaporation.
* The available microclimate in the bunds of the paddy fields are utilised for growing crops like pulses, vegetables, etc.

Disturbed microclimate utilization

* In paddy rice fields the available microclimate is disturbed many times. While growing summer rice crops the impounded thin film of water will be heated due to high solar radiation. This condition, especially during the tillering phase, will affect the tiller formation and also the health of the plants. To avoid such condition, the farmers increase the frequency of irrigation, even though the water is a costly input, so that the hot water is drained out and the outside cool water, either from the channel or from the well, is irrigated to maintain a cool temperature at the rhizosphere. This practice is followed until the inter spaces are closed by the foliage.
Long-duration rice varieties, most of which are thermo-sensitive, are planted in September. It will come to the panicle initiation stage during the cool period of late December or early January. At this stage, the impounded water in the paddy fields will become cooler than the external channel water. This cool water at the root zone will make the microclimate still cooler and will affect panicle initiation causing increased chaffyness in the panicle. To avoid such losses the farmers will drain the cool water once in three or four days and allow the channel water into the field to maintain the temperature at the root zone till the panicle emergence. This practice will also enhance the supply of oxygen at the root zone in addition to the maintaining of the temperature.
* In Tanjore Delta the early paddy rice crop sown in June-July will come to harvest in September or October. If cloudy weather is prevalent during this period, the microclimate at the root zone will be conducive for the multiplication of brown plant hoppers. So the farmers will immediately disturb the microclimate at root zone by draining the water and drying the fields. Further the plant foliage is set aside lengthwise to allow the direct sunlight and outside air to enter into the root zone to provide hot climate in the root zone and to prevent brown plant hopper multiplication. It also facilitates plant protection measures.
The practices narrated above are only a fraction of the heterogeneous farming systems of India. Further in every cropping systems in one way of other the microclimate is utilised.
Some of these practices, eventhough adopted in specific situations, have to be studied in depth for wider application.

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Mulching with organic materials: knowledge is power

Kees Stigter

To be in line with traditional tropical knowledge, a mulch can be best defined very broadly as a shallow layer that appears at the soil/air interface with properties that differ from the original soil surface layer (Stigter, 1984a).

The traditionally most widely used mulches are: thin layers which manipulate surface colour of dry grass, straw from crop residues, leaves, etc., or fresh organic material from weeds, bushes, treeds, household refuse, etc. Mulching affects many conditions near the soil/air interface where it is applied. These effects depend on the following:
-form of application: whether the mulch material is incorporated into the soil or left on the soil;
-timing of application(s);
-amounts of mulch applied;
-composition and colour of the mulch;
-deterioration and decomposition rates of the mulches, which depend on the form and timing of application and meteorological conditions in soil and air.

Available knowledge

Effects of mulches may be on: soil temperatures, soil moisture, soil physical properties (mechanical, structural, with respect to water behaviour, including erosion, and aeration), soil chemical properties, soil microbial activities, aerial physical properties (radiation and heat flow), mechanical impacts of rain, hail and wind, weed growth and other pest and diseases. In fact all these effects should be considered when applying mulches for one or more actual reasons. Mulches have been abundantly applied for some, but not all, of the above mentioned effects in horticultural practice in the Western world and Japan. But when the horticulture under glass and plastic became of greater importance, a lot of that practice disappeared. On some larger scale fields, mulching was still also applied for several reasons in the forties and the fifties in more developed agriculture. Then it lost its importance due to more mechanization and less labour being used in agriculture. Only to be rediscovered relatively recently when no-tillage and low tillage and residue management practices and more recently alternative agriculture (Altieri, 1983b) gained impetus. So there are two sources of knowledge from which we may borrow in an attempt to synthesize. There is quantitative scientific knowledge earlier and again more recently obtained, largely in the developed world. And there is traditional often qualitative knowledge of the usefulness of mulching in low external input agriculture farming systems. Below we deal with a terminated and an ongoing, recently started, example of research on traditional aspect of mulch application.

Traditional dry grass mulches

In low-input tea growth, small farmers deliberately use mulches for erosion protection, to conserve water, to suppress weeds and to supply nutrients. In experiments set up by the Tea Research Foundation of Kenya (TRFK), at Kericho in Western Kenya, three dry grass mulches *(Napier grass, Guatemala grass, Eragrostis Curvula)* and a live mulch of growing *Kikuyu grass* (with the mowings left on the surface) were used in erosion prevention experiments with young tea. It appeared that with some of the dry grass applications the young tea suffered much more from drought stress after a while. Excavation indicated very shallow root growth in such cases. Unwanted soil temperature differences could be considered as the only cause. At the altitude of Kericho, only a few degrees difference in the top soil would be enough to have appreciable differences in young root growth. Experiments were set up to monitor the diurnal soil temperature patterns under mulches and bare soil for several years at three depths. The average temperatures appeared only partially conclusive. Certainly no conclusions could be drawn form these averages on built-up and seasonal differences of thermal efficiency of mulches. Changes of thermal efficiency with decomposition of the mulches could not be detected. For the latter purposes it would be necessary to quantify more precisely differences in thermal climate which the young tea roots actually experience. But that implied the differences in the actual daily fluctuations of temperature within the soil. How to use these in a meaningful comparison?
In Dar es Salaam (DAP-Project, Stigter, 1982), a theory had been developed and experimentally confirmed, initially at the surface, to understand modifications of soil surface and near-surface temperature fluctuations from manipulation of the surface colour. This subject was chosen in 1976 because it is a traditional method of mulching used in Africa. For example, by blackening with charcoal surfaces used for drying (more heat absorbtion near the drying products) and by whitening with chalk surfaces under which seeds may suffer from too high temperatures (less heat absorbed by the soil). Both these colour manipulations are strict examples of mulching in our broad definition. This theory was then expanded and experimentally confirmed by the data provided from Kenya, and by some additional M.Sc.-experiments in Dar, for mulch covered soils (reviewed in Stigter, 1985a). The result was surprisingly powerful. An operational method was derived which makes it possible, by determining average diurnal temperature fluctuations at only one depth (say between 5 and 10 cm), to quantify and compare the thermal efficiencies of grass mulches on a certain soil. Also their course throughout the year as a function of weather conditions and fresh applications of mulches may be followed. In case of live mulches efficiency may be expressed, in terms of its seasonal growth (reviewed in Othieno et al., 1985). For the dry grasses used, it was now easy to show which one had (in

Measuring the reduction of soil temperature by mulching. Photo: Alrik Copijn.

this case the preferred) lowest thermal efficiency: *Eragrostis Curvula*. The *Guatemala grass* reached the highest efficiency, but lost it fastest in the rainy season, to end below the *Napier grass* before the next application. The growing grass reached a value close to the highest dry grass values before the dry season started. Such indications can be refined, now that we have this simple operational method, by applying different amounts of the same mulch or by different timings. Combined with quantification of erosion prevention or weed suppression, which have to be obtained from separate local experiments like we did on light extinction in layers of dry grass mulch (Stigter et al., 1984), (weather) advisories on mulching may be given to the farmers.

Alley cropping in semi-arid areas

At IITA in Ibadan, Nigeria, alley cropping was developed (Kang et al., 1984) in an attempt to incorporate the good features of shifting cultivation and other traditional concepts of agroforestry into a continuously productive farming system. Such an agroforestry system may have its value for the semi-arid areas as well, but limits will be set by the tree growth rates obtainable. In alley cropping a cereal or an intercrop with a cereal is grown between trees. Trees may be leguminous and hence nitrogen fixing and prunings are used as mulches for nutrients and other purposes. It is one of the examples which is very suitable to show the interdisciplinary character of agroforestry research. The following quantitative knowledge is needed from trials to fully understand the system and to come to (weather) advisories:

- yields per plant between trees and in controls. If the trees do not yield other economic products than mulch, the yield increase between trees should outweigh the losses due to the area now occupied by trees;
- amounts of mulch that become available from the trees at different prunings as well as from weeds, and their composition (organic matter, nutrients);
- decomposition and deterioration rate(s) of the mulches; -relevant differences in soil fertility and soil physical characteristics due to the mulches;
- nutrients from the mulch material that show up in the plants and yields mitigated by competition with the trees themselves and with weeds;
- microclimate differences from the presence of the trees and mulches, due to interactions with respect to space (e.g. air movement), radiation (e.g. shade and plant surface temperature) and water (e.g. soil moisture);
- amounts of other useful products which might come from the trees in a cost/benefit ratio calculation.

We may want to have such quantitative knowledge for different row directions (often determined by contour directions), tree spacings and tree species/crop combinations. Times of prunings and mulch applications, mulch treatments (incorporation or at the surface), macroclimates and soils are other factors to distinguish. The results are often cumulative over years as to some important responses such as in changing physical and chemical characteristics of the soil. They are also site and season specific, making long term projects an absolute necessity.
The TTMI-Project, on which there is an article elsewhere in this newsletter recently started to participate in the Dryland Agroforestry Research Project in Kenya, already ongoing for several years, in such quantification attempts for alley cropping. Results of the earlier seasons show (Arap Sang and Hoekstra, 1987) that yield response interpretations remain difficult if not all of the above mentioned quantitative knowledge is obtained simultaneously. These are almost heroic attempts, under the conditions of on-station and on-farm research work in developing countries. It will be extremely difficult to get and keep such research going in the tropics with sufficient quantity and quality. However, the acquired knowledge and understanding, validated in farmers fields, will contribute to increased small farmer's power to satisfy in a sustainable way his own demands and those of internal markets.
This article is compiled by Kees Stigter from results of research done from 1975 - 1984 at Dar es Salaam, with contributions from 1980 onwards by C.O. Othieno (TRFK), and from present research by C.L. Coulson and the Kenyan TTMI-team.

REFERENCES: See pages 6 and 9.

DAILY NEWS, Friday, November 14, 1980.

WE OFFER PRIZES FOR THE BEST EXAMPLES

WE ARE IN NEED OF INFORMATION ON MANIPULATION OF MICROCLIMATE IN TRADITIONAL FARMING METHODS IN TANZANIA

In 1980 the traditional knowledge on microclimate management in Tanzania was assessed by a newspaper contest. Many replies were obtained of which here examples are given on the use of mulching (Stigter 1984a, 1985b). From the information supplied, it became clear that all generally known mulching methods are employed in Tanzania. However, the participants dealt more extensively with food crops than does the existing literature, which deals mostly with the mulching of cash crops.
Tree leaves, dried or green banana leaves, grass and straw are commonly used. In addition, use is made of chopped maize stalks and stems, intercropping residues, pruning remains, weeded grass and other weed residues, tree branches, cut-down trees, ash, animal dung and household rubbish. Acland (1971) also mentions use of sisal waste, coffee pulp, sawdust, wood shavings and non-traditional black polythene.
Shed leaves, grazing and other grasses, creeping plants and short intercropped plants are specifically mentioned as having natural mulch effects. The ingenious use of natural organic mulch from leaves shed by large trees, in conjunction with shade use (Stigter, 1984), is an example reported from Iringa region.
Evidence was also collected on the use of rock mulches in some places, because of their potential to absorb daytime heat and release it at night (cf. Wilken, 1972). Some other rather special cases collected from replies to the contest are now described.

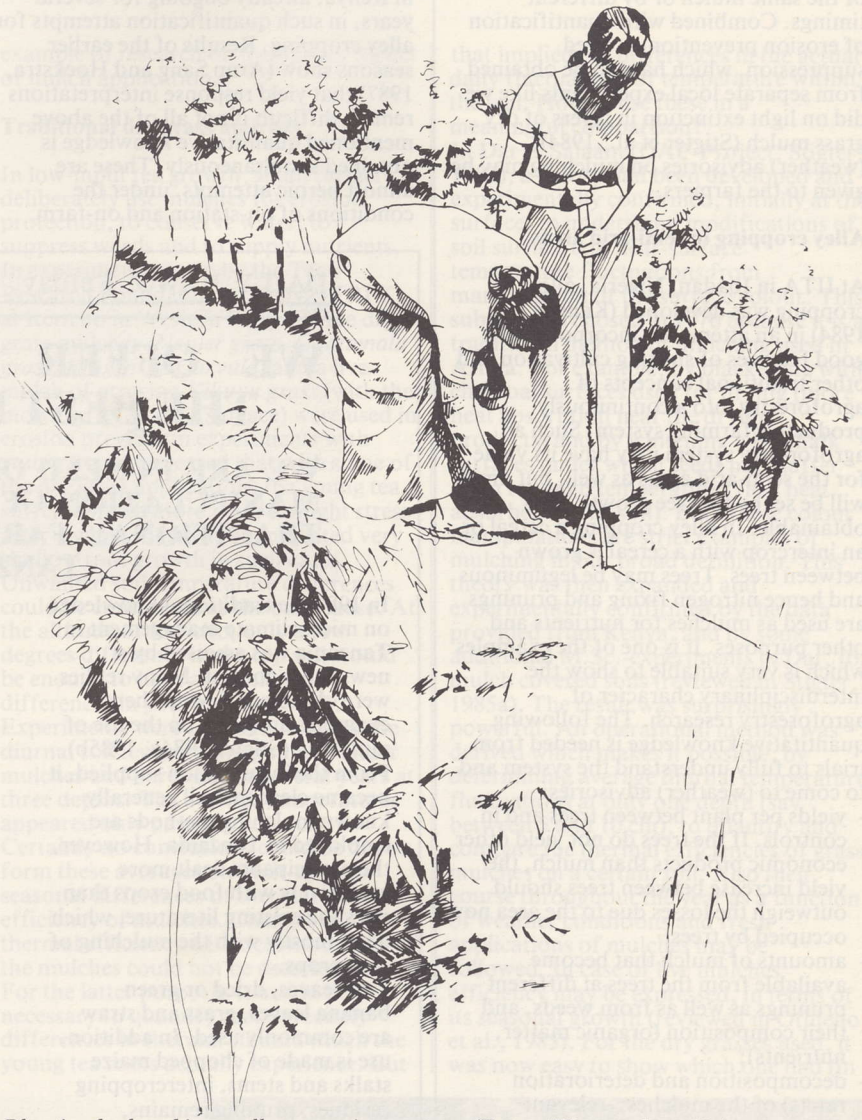
- Tillage of the soil under dry climatic conditions. This is practised in rain-fed production of rice (Morogoro), tomato (Dodoma), and maize (many places). The top soil becomes drier but conserves moisture in deeper layers, the top soil remaining in good condition to receive seeds. In some areas, only the places where seeds are planted are deeply hoed. In that case, accumulated loss of the top soil moisture is believed to be slower. Other farmers combine weeding and tillage deliberately, but non-tillage is advised for areas mulched with residues.
- Flood water is reported to be used to suppress weeds in rice growing, for soil protection ons ugar-cane plantings and over artifically hardened soil in some coffee farming in areas with heavy rainfall (Arusha).
- In wetter and colder areas or seasons, ridges promote good drainage and root growth. Quite often dark, rotten weed residues are placed on top of the ridges. They are believed to absorb more heat, because of theire colour, and thereby help to increase soil temperature.
- Creeping cover crops are believed to trap dew under certain conditions, in addition to other mulch benefits.

Possibilities of Zero Tillage for small-scale farmers in the tropics

Paul W. Unger

Zero tillage (or no-till, no-tillage, slot planting, ecofallow, sod planting, chemical fallow, or direct drilling) is a system of farming that uses herbicides or manual methods to control weeds and maintains crop residues on the soil surface. No seedbed is prepared; and planting is done with minimum soil disturbance, using coulter (iron blade fixed vertically in front of a plough share) or disk openers to cut residues and open a small slit for seed placement. Alternatively, seed can be placed in holes punched in the soil. The crop is not cultivated, and weeds are controlled chemically or manually.

The benefits ascribed to zero tillage systems include improved soil and water conservation, increased use of land, equal or higher crop yields, reduced labour and energy requirements, reduced equipment inventories, reduced wear and tear on tractors and equipment, and greater net returns. These benefits have been realized for various crops at numerous locations. However, adoption of zero tillage is limited by many constraints including those related to soil, climate, crop grown, equipment availability, managerial ability of the farmer, etc.. Adoption of zero tillage undoubtedly is easier in developed countries where suitable equipment and herbicides are readily available, but the principles of zero tillage are just as applicable in developing countries.



Planting by hand in an alley cropping system. (From: Wyewardene, R.)

Zero Tillage in the U.S.A. and other developed countries

Zero tillage in developed countries usually involves management of crop residues on the soil surface for controlling erosion and conserving water, the use of herbicides to control weeds, and the use of suitable equipment for spraying and planting. A common definition of zero tillage (no-tillage) specifies that 30 percent of the soil surface should be covered with residues at planting time. This implies that a greater amount would be left on the surface during the interval between crops. Where residues are limited (under dryland conditions and with some crops) and the potential for erosion is high, a limited tillage system may be necessary because both residue conservation and tillage to ridge or roughen the soil surface may be required to control erosion effectively.

Herbicides are used widely for weed control in developed countries, not only in zero tillage systems, but also in clean or conventional tillage systems. Consequently, herbicide usage often is not increased greatly when zero tillage is adopted. The substitution of herbicides for labour, fuel and machinery frequently increases economic returns to the farmer. Even greater economic returns result when zero tillage increases crop yields.

Zero tillage is most adaptable to soils having 1) a coarse-textured surface or a surface of self-mulching clay with high initial infiltration; 2) low susceptibility to compaction and crusting; 3) good internal drainage; 4) high biological activity; and 5) friable consistency over a wide range of water contents. Zero tillage is not adaptable to severely degraded soils or to soils that undergo severe hardening during dry seasons. On such soils, tillage is required to create a favourable zone for water infiltration, crop establishment, and root penetration. After several well-managed crops, it may be possible to grow subsequent crops on these soils with zero tillage.

Zero Tillage for small-scale farmers in the tropics

The principles of zero tillage are equally applicable to large- and small-scale operations; but in practice, small-scale farmers may not have the financial resources to acquire suitable equipment (sprayers and planters) and herbicides. Herbicides and specific types and sizes of equipment, however, are not prerequisites for successful zero tillage crop production by small-scale farmers. Zero tillage methods involving applied mulch, killed sod as mulch, live sod and alley cropping have been successfully used under small-scale farming conditions in the tropics. Each provides a residue cover for the soil surface, which is an essential component of successful zero tillage.

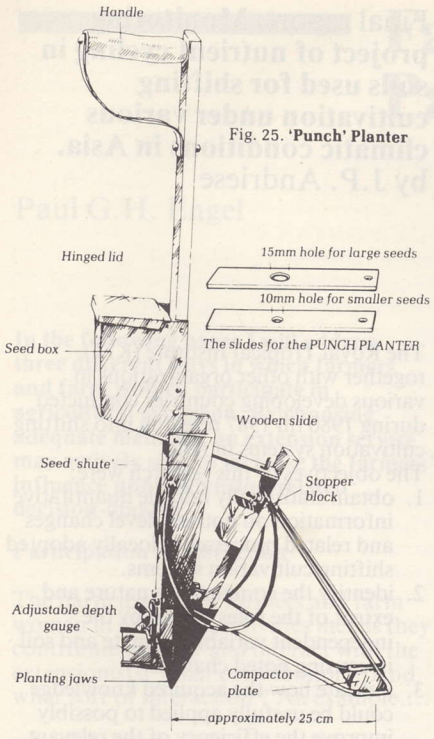


Fig. 25. **'Punch' Planter**

* Mulch farming

Applied mulches may be residues from a previous crop or slashed and hoed weeds. The mulch helps erosion control, enhances water infiltration, suppresses evaporation, moderates soil temperatures and suppresses weed growth, all of which have potential for increasing crop yield.
In mulch farming systems, weeds may be controlled by herbicides, but slashing or hoeing is generally satisfactory. In fact, weed control by slashing or hoeing probably would not be more difficult than in traditional farming systems. The drudgery of manual weed control can be reduced by using improved tools when weed growth is not excessive. If herbicides are used, the amount required can be reduced if rope-wick or controlled droplet applicators (CDA) are used. The use of a CDA also reduces the water requirement for spraying herbicides, with applications of less than 10 liters per hectare possible. Small battery-powered or hand-pulled CDAs are available.

* Killed sod

Zero tillage in a killed grass or legume sod involves herbicides to kill the sod. However, herbicides are not needed when susceptible sod plants die during the dry season or are killed by frost. Crops can then be planted in the resultant surface mulch with a punch planter. Several hand-operated types are available. Subsequent weed control could be achieved by herbicides or manually, as for applied mulches.

* Live mulch

The use of zero tillage in a live mulch is possible if the mulch crop is not highly competitive with the planted crop for light, water, and nutrients. Favourable results were obtained when maize (Zea mays) was established in a low-growing legume (Stylosanthes sp.) that was either sprayed or mowed to suppress its growth. In some cases grasses or climbing legumes greatly reduced maize yields. The advantage of a live mulch is that it provides continuous ground cover and maintains favourable soil structure.

* Alley cropping

The foregoing examples involved residues from previous crops or those of in-place killed or live cover crops. Unfortunately, crop residues often are harvested for fuel or livestock feed in less developed countries. The remaining residues may be eaten by grazing animals or destroyed by termites or fire. Under such conditions, an alternative approach to zero tillage by providing mulch, maintaining ground cover, and providing soil fertility is alley cropping, also called alley farming or avenue cropping.
With alley cropping, deep-rooted perennial shrubs or legume trees are grown in rows or strips far enough apart to permit crops to be grown between them. The shrubs or trees are pruned at the start of, and periodically during, the cropping season to minimize competition for light and water. The pruned leafy materials and twigs are used as mulch. Woody branches are used as fuel. The crop can be grown by zero tillage using either manual or herbicidal weed control. Weed problems often are not severe because the shrubs or trees shade the soil during the interval between crops and the surface mulch suppresses weed growth during the cropping season.
The choice of an appropriate tree or shrub species depends on the soil, the climate, and the crop to be grown. Selected species should grow rapidly, be able to fix nitrogen, have a multipurpose nature (mulch, wood), and be deep-rooting to minimize competition with crop plants. Leguminous species that have performed favourably in an alley cropping systems are *Leucaena leucocephalia and Gliricidia sp.*

Summary and Conclusions

Zero tillage has received much attention throughout the world in recent years because of its various benefits. In developed countries, zero tillage depends on a surface residue mulch and herbicides for controlling weeds. Although used primarily in developed countries for relatively large-scale farming conditions, the principles of zero tillage apply equally well to small-scale farming operations in the tropics. In practice, zero tillage, especially on small farms in less developed countries, may be different because farmers may not have the resources to acquire suitable zero tillage planters or herbicides. However, these are not prerequisites for zero tillage because seeds can be planted in holes punched in soil and weeds can be controlled by slashing or hoeing. Surface residues can be provided by residues from previous crops, slashed or hoed weeds, killed or live sod, or from trees or shrubs in alley cropping systems. Although successful under many conditions, zero tillage has not proved successful under all conditions. While it may not be necessary or desirable to use zero tillage under some conditions, research should be continued to develop satisfactory zero tillage systems for situations where conservation of soil and water is important for maintaining the crop production capability of the land.

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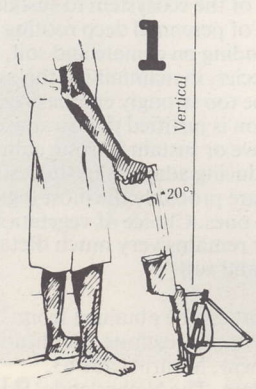

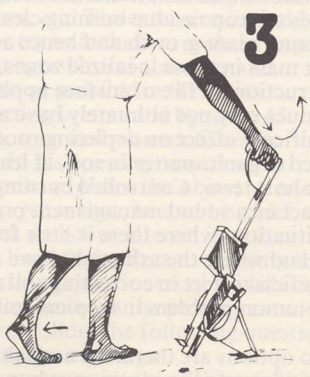

Use of the 'Punch' Planter. (From: Wyewardene, R.)

Soil management options for the disposal of crop residues under low-external input agriculture

Peasants in developing countries cannot, in many cases, afford mineral fertilizers. Thus, practically all the nitrogen and the greater part of phosphorus needed to sustain crop production are supplied by microbiologically-mediated transformations of soil organic matter. Even where symbiotic nitrogen fixation makes a contribution to the N nutrition of legumes, such form of combined N can only become available to a succeeding non-legume after decomposition of the legume residues. The latter phenomenon is indeed the essence of crop rotation involving legumes and non-legumes.

In Tanzania and many of the developing countries, soil scientists or extension officers on the one hand and peasants of the rural communities on the other often have conflicting views on soil management priorities. While scientists believe in and advocate the maintenance of soil organic matter through the deliberate incorporation of crop residues into the soil, peasants have often preferred to burn off crop residues for what they see as obvious advantages. First, burning is an effcient method of field clearing in preparation for the next crop. Secondly, burning helps to destroy residual pests, pathogens and noxious weed seeds. Thirdly, the localized zones of burning, possibly through altered physical properties of soil and the ash produced, has (in the farmers' experience) enhanced plant growth and crop yields. The destruction of crop residues, especially those poor in N content, could also be a way of preventing the microbiological immobilization of nutrients such as N & P with consequent yield reduction unless the application of such residues is accompanied by heavy fertilizer use. Thus, advocates of soil organic matter maintenance through the preservation of crop residues (many of which are N poor) would in many cases be presenting an innovation that cannot easily be accepted by the small farmers. Since it is common observation that the localized zones of crop residue burning clearly enhance plant growth and hence a large root mass in those localized zones, the destruction by fire of surface applied residues may not ultimately have a significant effect on depleting root-mass based organic matter in soil, at least in the short term. Controlled burning could in fact be a sound management practice in situations where there is little fertilizer use and where the ash might have a beneficial effect in correcting soil acidity, a common problem in tropical soils.

Two options are therefore available. One is to advocate the continuous but controlled burning of crop residues with the hope that the physical and chemical properties of the soil will be altered in a manner that enhances vigorous plant growth and hence a larger root mass. The other is to advocate the continuous incorporation of crop residues into the soil regardless of its short-term depressive effect on crop yields. Information is needed on the long-term effects of the two forms of crop residues into the soil regardless of its short-term depressive effect on crop yields. Information is needed on the long-term effects of the two forms of crop residue management on soil fertility and crop yields.

I request that you study this statement and since you are the Informationcentre for Low-External Input Agriculture, I trust you are in the best to pass this document to the appropriate person, people or institution who may be interested in collaborative research on such a problem which may be affecting the lives of many small farmers in the developing countries.

Yours sincerely,

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Note of the Editors:
We fully agree with Mr. Msumali that research on the long-term effects of different management options of crop residues (fallow vegetation) is urgently needed. Farmers, forced to intensify their landuse system, are in need of adequate information on the available options for the management of crop residues for their particular situation. Recently **a collaborative programme of research** has been started by IUBS/UNESCO **on Tropical Soil Biology and Fertilily (TSBF).**
Formal TSBF studies have now started at ten Programme Centres around the Tropical Zone and there are in excess of 100 interested groups connected with the programme. There are also a growing number of related programmes like 'Amelioration of Soils by Trees', and the 'Responses of Savanna to Stress and Disturbance'.
Maybe the above mentioned research could be a part of this programme.
More information on TSBF can be obtained from:
John Ingram, TSBF Programme Officer, Dep. of Biological Sciences, University of Zimbabwe, P.O. Box MP 167, Mount Pleasant, Harare, Zimbabwe.

Final report: **Monitoring project of nutrient cycling in soils used for shifting cultivation under various climatic conditions in Asia.**
by J.P. Andriese

The Royal Tropical Institute (KIT) together with other organizations in various developing countries conducted during 1980 till 1987 research into shifting cultivation systems in Asia.
The objectives of this research were:

1. obtain statistically reliable quantitative information on nutrient level changes and related processes in locally adopted shifting cultivation systems.
2. identify the comparative nature and extent of the roles played by the independent variables climate and soil in causing noted changes.
3. indicate how the acquired knowledge could be usefully applied to possibly improve the efficiency of the relevant systems in terms of sustainable production increase.

"Despite a still existing incompleteness in the knowledge obtained, some findings can already be usefully employed in
devising strategies aimed at improving the management of plant nutrient recycling systems in foodcropping without high fertilizer inputs. Others may indicate ways or give directions as to how to improve sustainability by making better use of the processus lying at the core of the natural nutrient cycling mechanism which, as could be proven beyond doubt, are quite unique for every agroclimatic situation and not necessarily similar in every respect."

"One of the final considerations of the report is that:
Fast growing species with deep rooting systems are required for arresting the leaching down of nutrients in the early years of regeneration, or isolated trees in the original vegetation should remain standing through abstaining from clear felling. It is highly probably that the tradition of only one cropping year is based on the desirability to maintain an adequate stand of still living stumps of deep rooting perennials capable of rapid recovery after the burn, to catch leached nutrients with their deep rooting systems. Too frequent burning kills of this essential capacity of the ecosystem to sustain itself. The role of perennial deep rooting species or, depending on climate and soil, adapted grass species, in maintaining this system cannot be too strongly emphasized. The conclusion is justified that strategies aimed to improve or sustain shifting cultivation by introducing adapted agroforestry systems are probably the most logical and effective ones. Choice of vegetation however remains very much dictated by climate and soil."

The report can be obtained from:
Royal Tropical Institute, Publications Department, Mauritskade 63, Amsterdam, The Netherlands. Price Dfl. 30,- Excl. mailing costs.

Farmers' Participation and Extension

Paul G.H. Engel

No extension without participation. But what is the actual influence of those who participate ?

In the following pages I will address three different ways in which farmers and farm women participate in agricultural extension. By choosing adequate methods, an extension service may actively seek to increase the farmers' influence upon extension-related decision-making.

Participation is interaction

The participation of farmers and farm women in extension activities means they contribute actively and interact with the extensionists. What contribution ? And what sort of interaction ? An example....

'EL MONTE'

A grassroots extension worker visits 'El Monte' (*), a village in the Andean Highlands. He exchanges views with various villagers, in particular some of the heads of households owning small farms, and detects a white grub problem *(Premnotrypex vorax)* in the potato crops. Also, amongst those he visits he notices an interest in doing something about it. Besides, he knows that, on the basis of a region-wide reconnaissance study, potatoes have been selected as a priority crop for the Government's agricultural development efforts in the area. Didactic materials have therefore been developed already by his service, and credit is readily available at the Agricultural Bank.

Programming

As the village has recently been connected to the rural electricity supply network, at the District Office, a step-by-step multi-media campaign is designed:
1. Promotion: To announce the campaign and stimulate interest amongst the villagers.
2. Introductory meeting: Officials of both the Agricultural Extension Service and the Agricultural Bank will explain to the farmers the Government's interest in this campaign and the way in which the farmers may benefit from it. An extension hand-out will be distributed.
3. Problem focussing meeting: A slide serie will be shown, which highlights the importance of controlling the white grub in potatoes. A discussion will be held afterwards.
4. Method demonstration: How do you recognize the different stages of the white grub in the field? When is control most adequate? How to do it? An illustrated practical brochure will be handed to those attending the meeting.
5. Result demonstration: At harvest the difference in production between treated and non-treated plots will be shown.
6. Rounding off meeting: Discussion of results and possible questions.

Implementation

During the campaign an average of 18 villagers, mostly heads of families, attend the meetings, out of a total village population of about 200 families. Ten farms go in for credit an apply the technical recommendations. Of these, 6 attended meetings regularly.

Instructive extension

In the situation described above, the participation of the farmers is limited to attending the meetings. A number of them has been contacted by the extensionist in advance. These contacts, and Government policy, influence his choice of the topic and the planning of the campaign. Those villagers interested in this particular offer attend the meetings, others have no reason to be there.
The interaction between extensionist and farmers, in this case, takes on the nature of an instruction. The extensionist answers the question 'How can I solve the white grub problem in my potatoes?'. The existence of the problem, its importance for all farmers/villagers and its precise identification of it are considered known to the extension service. The farmers' previous knowledge of it and possible solutions envisaged or even developed by (some of) them, are not explicitly taken into consideration.

'EL MONTANERO'

A colleague of the previously mentioned extensionist, using the same approach, hits upon the same problem in 'El Montanero', a village not far away from 'El Monte'. Potatoes are affected by the white grub, and most villagers have potato crops.

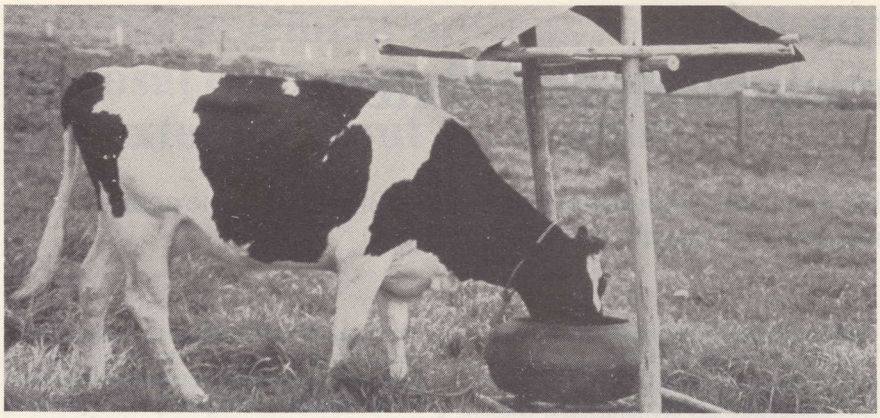
Reasonable doubt

Back at the District Office, he plans a campaign similar to the one in 'El Monte'. However, some doubt creeps into his mind as to the relevance of this particular campaign to the majority of the farm families in the village. Together with his superior, he decides to add one more component to the campaign: A meeting during which the agricultural situation in the village may be analysed, and priorities may be weighed. This participative diagnosis will be held after the promotion, but before the first campaign meeting.

Participative diagnosis

In order to implement the diagnosis they take with them a series of 14 slides, which represent the most important agricultural problems the farmers are faced with. The series includes slides of white grub, infested potatoes, poor grazing areas, undernourished cows, vaccinations, a simple installation for providing mineral salts to the cattle, layering wheat, inadequately pruned fruit trees, etc. The extensionist and his superior try to include as wide a range of relevant agricultural activities and problems as possible in the series.
The meeting is attended by some 45 farmers, men and women from the village. In his opening remarks, the extensionist explains the objective of the evening. After that, he and his chief, who took an active interest into the matter, limit themselves to showing the slides, asking questions and stimulating discussion amongst the participants.
With every slide, the following questions are put to the meeting:
1. Do you recognize this ? What is it ?

Farmers are instructed in 'El Monte' on the white grub problem. Unfortunately, only 18 villagers attended the meetings



In 'El Montanero' participation by the villagers leads to a different priority area: not the white grub problem, but the need of providing dairy cattle with salt.

2. Does it occur in this village ? Are there any problems related to it here ?
3. How important this (problem) is to you, in comparison with others mentioned this evening ?

The extensionist holds his tongue
Even if the farmers ask direct questions, the extensionist refers them back to the group: 'How do the others view this ? What do you do about it yourselves ?' The extension chief in particular sometimes has a hard time in refraining from answering to the questions put. He is supposed to be the expert, isn't it ? After two hours of intensive discussions the meeting has reviewed most of the agricultural and agriculture-related problems affecting the village. By opposing different opinions and analysing them in the group, it has become apparent, that the village community commands a much higher level of technical background knowledge than the extensionist had originally assumed. His chief is particularly impressed by the understanding of technical matters as demonstrated by the villagers.

Set priorities
The extensionist now asks the participants which of the agricultural activities/problems has to be tackled first. Which topic should be addressed first by the agricultural extension service?
After a short discussion, it is agreed, that dairy cattle husbandry is the most important activity for most of them, and also that the use of mineral salts causes serious problems. Although the farmers are convinced of the need of providing the cattle with the minerals, many of them have observed diarrhoea in their animals after they have consumed the salt, so they stopped. Besides, some confusion exists around two different colours of salt available commercially. Some farmers believe that salt of one colour is the right one, others believe the other to be better. Also potatoes are grown by everybody in the village, mainly to prepare the soil before sowing in new pastures. For most people in the village, dairy production appears to be their main source of income and concern.

Make arrangements
It is agreed that a meeting and one demonstration will be dedicated to the topic of properly administering mineral salts to dairy cattle. At the meeting, the extensionist will clarify the different types and colours of salts available, and their uses. He will also comment upon the importance of administering the salt properly in order to avoid undesirable side effects like diarrhoea. A practical demonstration on how to administer the salt will subsequently be held at one participant's farm. The date and place of the meetings are decided upon immediately.

Participative extension

In this second example from the field the extensionist has increased participation by the villagers through introducing a participative diagnosis. 45 people from the village have contributed systematically to the decision-making process. The first impression, held by the extensionist, that the white grub in potatoes was a problem, was correct. However, weighed against other, more pressing ones, the villagers indicated daily cattle husbandry as priority area number one for extension activities.
In this way, the interaction between the extensionist and farmers assumes the character of a dialogue. 'Which problems exist, towards the solution of which the agricultural extension service may contribute ? What exactly is the problem ? What has already been done about it locally ? Which sector or problem has to be tackled first ? How, when and where ? Not an open, uncommitted conversation, then, but a deliberate, combined effort to establish the link between the need for information and instruction on the part of the farmers and what the extension service has to offer. The knowledge and opinions existing within the farmers' community are made explicit and provide the basis for determining extension objectives, messages and programming.

'LA MONTANA'
In the neighboring village of 'La Montana' a group of farm women has been organized. A special programme of the national agricultural extension service guides and supports the group. During their first years the group has been using 'participative diagnosis' techniques in order to formulate more precisely their problems and articulate their needs as far as agricultural extension is concerned.
The group was originally organized around the fattening of pigs, but has gradually been taking up more activities. That is how contact has been made with the public health service, which, at the request of the group, has organized an extension programme in the village on First Aid. Also, two younger women from the village have received additional education on the topic, and are now performing First Aid services at village level.
The agricultural extension service has been asked to initiate an extension campaign on fruit crop growing. The first meetings were held, and some time ago demonstration plots have been established with members of the group. Progress is monitored closely, not only by the members of the group, but also by the other villagers. Although these, initially, looked upon the development of the women's group with apparent reserve, they now seem to be becoming more and more interested. Encouraged by their previous success in cooperating with the extension services, the women make plans to take on other activities as well. The marketing of their produce is one of these.

Participation through organization

In this third example participation takes on the form of organization towards a certain (set of) goals. Training and extension activities with the group, from the very beginning, are geared towards creating autonomous user groups, capable of independent problem identification, priorization and decision-making.

In 'El Montanero' the initiative lies with the farmers. Now 45 people have systematically contributed in the decision-making process.

In this case, agricultural activities, in which the participants could profitably engage in, formed the basis for group formation. Initially, the extension service plays an important role in guiding the group. However, it plans to reduce its involvement systematically. As soon as the group shows itself capable of articulating its needs, and channelling this information through to the relevant institution, it gradually withdraws from the scene. Its task becomes one of providing information on certain topics, as one of many bodies the farmers' community has to deal with.

Participation and influence

Some form of participation is present in any of the three situations roughly sketched above. The different forms vary widely, however, both in scope and intensity. On the one hand, we see the farmers simply attending the meetings programmed by the extension service. On the other, we see the group growing towards a point where they autonomously analyse their situation and call in the extension service they see fit in the particular case at hand, asking it to perform a specific, welldefined task for them. In the first case, the initiative lies completely in the hands of the extension service; in the second, it lies with the organized farmers/farm women. Between the two extremes, we find the extension service adopting methods, like 'participative diagnosis' and flexible planning, in order to increase the possibilities of the farming community effectively to influence the setting of extension objectives and content.

A continuum

In fact, between the extremes mentioned above, we find an infinite number of possible forms of participation. Of these, I have only mentioned one. Many more exist around the globe, and effective ones at that. However, within the scope of this article it is impossible to do justice to the diversity of forms sound in actual practice. It is up to the reader to evaluate his own extension efforts in terms of participation: How far do farmers/farm women indeed take part in the formulation of extension targets, the content and programming of extension activities? Up to what point does policy allow for such influence, or even encourage it? Which extension methods provide the best results in terms of participation and influence?

'La Montana': participation through organization. Initially, the extension service plays an important role in guiding the group .....

Participation and effectiveness

While comparing the situation in 'El Monte' with the one in 'El Montanero', we may appreciate the dangers an overly self-centered extension service is exposed to. Objectives tend to be set, messages developed, and means implemented, according to an inherent institutional logic, which may become disarticulated from reality as it is experienced by the farming community. A more active participation by the farming population in 'El Monte' could possibly have resulted in a more relevant choice of extension activities. In effect, the intensification of participation in 'El Montanero' caused an important reduction of costs, as extension activities could be directed more accurately towards the farmers' needs, and at the same time, could be reduced by weeding out meetings on topics already known to the majority of the farmers in the community.

..... but as soon as the group shows itself capable of articulating its needs, the extension service gradually withdraws from the scene.

Farmers' organizations

The case of 'La Montana' underscores the role of farmers' groups in articulating extension efforts to the needs of the farming community. This is particularly relevant to developing countries, where strong and wide-spread farmers organizations such as the ones that are at the base of Dutch agricultural development - to mention only one example - are mostly lacking. For it to happen, then, farmers' participation in decision-making must be actively pursued by rural extension services, through the use of approaches and methods which actually increase the influence farmers may exert upon extension programming. The cases of 'El Montanero' and 'La Montana' may help to indicate not only the desirability of such an approach, but also its feasibility.

(*)The names of the villages are fictitions. The examples have been recast to support the argument.

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Mr. Reddy's Farm

Participants of the AME-course on Ecological Farming in Pondicherry, India

An eight acre farm, diversified, well managed and based on ecological principles, proves to be very profitable for a family of five persons (man, wife and three sons) and four farm laborers. This is the experience of Mr. Narayana Reddy, a 52 year old Bangalore farmer. As a boy, Mr. Reddy ran away from his parents home and lived and worked for years in cities. After he inherited a small piece of land in 1972, just outside Bangalore, he decided to start farming. The soil is sandy loam and the climate in the area around Bangalore (1000 - 1200 m. above sealevel) is a temperate tropical climate.
Because the soil of the land Mr. Reddy inherited was depleted and bank loans were only available for chemical farmers, he was a 100% chemical farmer in the first years. In fact, he never wanted to be a chemical farmer but was forced to it by his surroundings.
For three consecutive years he was elected as the most progressive farmer in the region. However, he did not make any profit ! Due to high expenses for tractor plowing, fertilizers and pesticides, net returns remained very limited.
After Mr. Reddy received some magazines on organic farming in 1975 from a friend, he started to convert his farm to ecological agriculture. He planted trees and drilled a well of 200 feet depth.
It took Mr. Reddy eight years to change his chemical farm into an ecological farm. In the beginning output was less but costs were also less. After four years, original yield levels were retained just by using organic fertilizers. The net returns increased, since the costs of inputs diminished drastically.

Mr. Reddy explaining his farm to participants of the A.M.E.-course.

Diversity

It is Mr. Reddy's opinion that a healthy farm should be based as much as possible upon a self-sustaining system, hardly dependent on external inputs. Now, the farm produces all the food for the family and provides in the family's need for cash.
Diversity on the farm is very high. There is a maximum utilization of land. He has planted permanent fruit crops like guava, sapote, mango, coconuts and lemon neatly arranged on his fields. In between his coconuts one acre of mulberry is interplanted for the production of silk worms. In between the mulberries, tomatoes and onions are interplanted.
The main cash earners in order of importance are:
- mulberry/silk
- bananas
- fruits, mainly guava.

Mulberry/silk

Moth eggs are bought from a laboratory. The larvae are reared on mulberry leaves. One month later the pupae are sold. The mulberry trees are also the major fodder for the livestock. They eat the leaves and stems which are not tender enough for the larvae, they also eat the larvaes' left-overs. Larval manure is very rich in nitrogen and is used in compost.

Bananas and coconuts

The bananas are interplanted with the coconut palms and cardamon. The banana crop is highly profitable, mainly because instead of the *Robusta* variety, a local variety is planted.
The local variety has the following advantages:
- establishment of the crop is cheaper because suckers can be obtained free;
- maintenance of the crop is cheaper because the variety is resistant to nematodes;
- the bananas are sweeter and thus are more expensive.

For coconut, also a local variety is planted instead of a hybrid;
- mother palms are 120 years old and still productive whereas hybrids have shorter lives;
- hybrids are only good for tender nut production and not for copra production.

Smart Farmer

Being a very smart farmer, Mr. Reddy observes market fluctuations and cultural traditions such as festivities for his products. He says that in his orchard he starves the plants to the point of dying as regards manuring and watering during a few months. Then, at a chosen point in time he starts manuring and pruning them for early blossoming. Thus, his products reach the market ahead of his colleague farmers.

Food crops

Mr. Reddy has alloted one acre for his paddy and plants twice a year. The rice production is enough for his own consumption and it is even possible to sell some bags.
Corn, finger millet and water melon are simultaneously planted in another one and a half acre plot, with water melon as the main crop. Corn acts as ground cover and at the same time for fodder until the melon creeps all throughout the area.
When farmers in Karnataka (150 kms away) suffered from drought in 1986, he (as some fellow farmers) sent a part of his fodder to them as an act of social support.
After three crops (usually two cereals and one pulse) a green manure crop is planted. In this area *Crotalaria juncea* and *Sesbania aculeata* are often used as green manuring crops. The crop is either ploughed in or used as a mulch. Also *Napier grass, Leucaena* and *Gliricidia* are planted along the irrigation bunds to use the irrigation water soaking in the bunds, to provide fodder and to prevent the spreading of weeds. Eventhough the green manure crop is sometimes ploughed in, Mr. Reddy regards ploughing as a waste of both animal and human energy. Ploughing one acre of land equals walking 66 kms. ! So he favours minimum tillage.

Fertilization

Mr. Reddy keeps soil fertility up with the application of compost. A tractor load of chicken manure is bought every four months and partly used for fertilizing the bananas. The chicken manure is watered and kept in a pit before use.
Every two weeks, rabbit manure is applied to weak bananas. All other crops are fertilized with compost. The compost is made of tomato stubbles, dried grasses, chicken manure and cow dung. After four months of composting it is ready and mature.
Mr. Reddy still uses 10% of fertilizer in his farm. He hopes that within a few years no commercial fertilizers will be needed anymore.

Irrigation

Ground water out of the well of 200 feet

deep is used for irrigation. Because of problems with electricity supply during the day, a water tank is being established. The reservoir can be filled during the night. At the same time it serves as a fish pond. The water tank is built on a high point so irrigation can be done through gravity during the day.

Plant protection

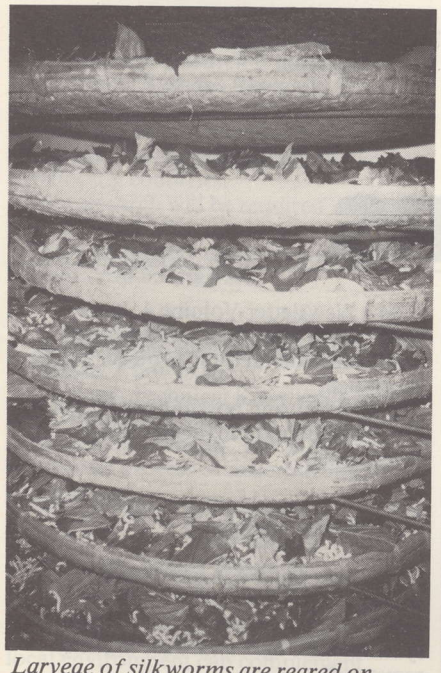
Pests and diseases are mainly prevented through rotation and the use of local, resistant varieties. Some examples are:
- local banana varieties are nematode resistant;
- Tagetes, for flower production, are part of the crop rotation;
- a solanaceae crop is planted on the same field only once in three years.

Mr. Reddy usually handpicks insects in his crops, drowns them in water and feeds them to his chickens. He also uses biosprays like neem leaves, mint, wood ashes and tobacco leaves but he prefers handpicking.
If there is any outbreak of pest, soapy water is used and if the outbreak is serious, wood ash and kerosene are mixed in soapy water.

Animals

Mr. Reddy is not only a crop-oriented man but is also engaged in animal husbandry. There are 2 bullocks for transport and ploughing and 8 cows. The cows give an average of 6 to 8 liters of milk per day per cow. He started with local breeds which have been improved by artificial insemination with Danish and Jersey breeds. The cows are not dehorned because the horns are thought to fix cosmic powers from the atmosphere which benefit the constitution of the cows.

The main fodder is mulberry and fodder grasses. He does not feed his animals with concentrates.



Larveae of silkworms are reared on mulberry leaves.

Corn, finger millet and water melon are intercropped.

A cow stable is built for shelter at night. Dried grasses and straw are spread on the stable floor to catch urine and dung which all is used in composting.
There are 3 rabbits which multiply to 200 or more within a year. The rabbits are mainly fed on mulberry and weeds and produce 6-7 kg. very rich manure every 15 days.

Energy

Cooking is done with firewood produced on the farm (coconut, guava, mulberry, *Leucaena and Gliricidia*). In future however, Mr. Reddy wants to introduce biogas. Thus the manure would be used more efficiently and the firewood could be sold at a higher price as there is a severe shortage in the region.

Conclusion

The net income of Mr. Reddy is higher than that of the average farmer in his area. For the next years he expects a net income which is still higher.
Other farmers in his area now also adopt some of his ecological practices. An average of 50 farmers visit the farm every month. According to Mr. Reddy, within 10 years, 80% of the small farmers in his region will not use chemical fertilizers anymore.
Ecological farming to Mr. Reddy and his family is not just a source of livelihood; it is a way of life.

This article is based on reports of participants of the Agriculture, Man and Ecology course on ecological farming in Pondicherry, India. During the course the farm of Mr. Reddy is visited.
With acknowledgement to Celia Valerio, Enn Ugang, Wilfredo Balneg, Kalimullah Mhd., Ramanayake Gunaratne and others.
For more information on Mr. Reddy's Farm, please write to A.M.E., attn. Erik van der Werf. Address see below.
Photo's: Erik van der Werf.

SEMINARS FOR INDIAN RESEARCHERS

September 12 - 15, 1988	Soil Fertility
September 19 - 22, 1988	Animal Husbandry
September 10 - 13, 1989	Plant Management

Location: 'Gloria Land' Farm, Pondicherry, India

Aims of the seminars:
- to discuss general scientific principles of ecological agriculture
- to present and discuss relevant research findings
- to explore the practical implications for ecologically sustainable farm management
- to strengthen the network of researchers.

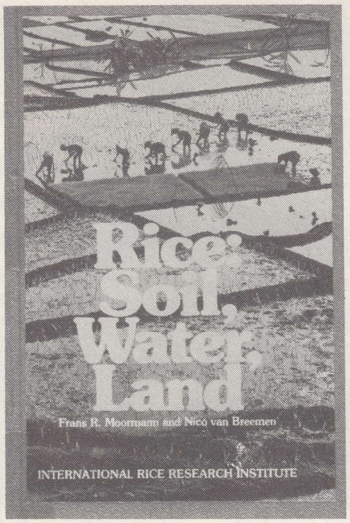
Agricultural researchers are invited for participation. Please give full details about your bio-data, professional experience and your possible contribution.

For all correspondence, please write to :
E.T.C. Foundation, AME Programme
attn. Erik van der Werf
P.O. Box 64, 3830 AB Leusden,
The Netherlands. Telex: 79380 ETC

TOP 5

When one's interests present such great diversity as mine, it becomes a nearly impossible task to come up with a top five. Even more so, because Paul Richards has limited the field considerably, by nominating no less than three books that were also on my list (see ILEIA, July 1987, for Polly Hill's Development Economics on trial, Jane Guyer's Family and Farm in the Southern Cameroon and Pierre de Schlippe's Shifting cultivation in Africa). A top fifty would definitely be easier. Anyway, the nice thing about this exercise is that I was forced to think hard about the criteria for the best books. Are these the books that I consider most influential in their respective field, or are they the books that I found most inspiring at a given time, or the ones that I consult most frequently? In the latter category, 'evergreens' like Purseglove's Tropical Crops (Longmans, London 1974, two volumes) or the Mmento de l'Agronome (Ministre de la Coopration, Paris 1980) and the Mmento du Forestier (idem, 1978) certainly fit, since I cannot remember any lengthy field trip without them. My copies are by now badly torn, but I would advise anybody to invest in these hefty volumes.

1. One of the books in the field of soil science and agronomy that I have found both very helpful and inspiring is **Rice: Soil, Water, Land** by Frans Moormann and Nico van Breemen (The International Rice Research Institute, Los Banos 1978). The strength of this book is its emphasis on the interrelationships between the different physical elements that make up rice-based cropping systems. For the first time, the position of rice fields in the landscape and the effect of various water sources is



carefully defined. The authors succeed in eliminating, once and for all, all confusion about the various rice growing environments. For any agricultural scientist who is not sure about the difference between upland rice an rainfed rice (both terms are abolished!) this book has great relevance.

2. Much has been published on farming systems research and it would require another top five to deal with that. I would like to single out one book on research methodology. **A field guide for on-farm research** by H. Mutsaers, N. Fisher, W. Vogel and M. Palada (The International Institute of Tropical Agriculture, Ibadan 1986) provides a very useful overview of methods of farming systems research, both diagnostic and experimental. In particular, its sections on on-farm testing and statistical analysis are essential for anybody who wishes to embark on this type of work. The book is illustrated with many charts and examples from the team's work in Nigeria.

3. **L'arbre en Afrique tropicale, la fonction et le signe** (Orstom cahiers, vol XVII, no. 3-4, 1980) is a volume of articles on the role of trees, mainly in West African farming systems and their importance to farmers. The contributing scientists come from many disciplines and their work covers such diverse subjects as aerial photography, the linkages between trees and cattle, trees in urban settlements and traditional reafforestation. This book has changed me in the sense that I will never ignore trees any more, wherever I come across them.

4. I feel very strongly about the need to understand farming systems in a historical perspective, rather than looking exclusively at their present structure without seeing their evolution. Although not written by an agricultural scientist, **Agriculture in the Congo Basin tradition and change in African Rural Economies** by Marvin Miracle (University of Wisconsin Press, Madison 1967) presents a very thorough description of cultural practices and cropping patterns in Central Africa, based on colonial sources that is thought-provoking for anybody wanting to study this region today.

5. Finally, **Altered Harvest - agriculture, genetics and the fate of the world's food supply** by Jack Doyle (Penguin pockets, 1985) is an impressive account of the rapidly growing influence of biotechnology in agriculture, its threat and its potential, both in the western and in the third world. Although the author deals with a rather complicated technical subject, he has been able to do this in a very accessible and human way, by linking it to the life histories of the men who have been most involved in this latest agricultural revolution.

Louise Fresco, sept. nr. 87.

Louise Fresco works within the Agricultural University of Wageningen. She has written a book in 1986: 'Cassava in Shifting Cultivation'.

NEXT NEWSLETTERS

ILEIA Newsletter Volume 4, No 1
'Agriculture in mountainous regions'
Amongst the most marginal populations in the world are those living in mountainous regions, estimated to be 10 -25 % of the world's population. Mountain land tends to be of poor quality for agriculture and farmers face a never ending battle against continuous loss of soil.
In this issue we want to look at the special agricultural methods needed to sustain farming in these regions.
Keywords could be: indigenous farming, erosion control, water conservation, animal husbandry.

ILEIA Newsletter Volume 4, No 2
'Participatory approaches in research and extension'
This issue will be published in connection with the workshop mentioned in the article 'Call for experiences', page 22. For more information see the article.

ILEIA Newsletter Volume 4, No 3
'Integrated Pest Management'
This issue will be published in connection with the Congress 'Ecological Crop Protection in the Third World' to be organized in Deventer, The Netherlands, summer 1988. More about this congress will be published in the next ILEIA Newsletter.

ILEIA Newsletter Volume 4, No 4
'Soil fertility and water management'
The discussion on these subjects will be continued.
The necessity and possibility to organize a workshop on these themes will be investigated.

Suggestions and contributions (articles, illustrations) are invited !

For all issues of the ILEIA Newsletter articles on political, social, cultural and economic implications of the introduction of sustainable agriculture are urgently requested!

REVIEW

Farmer participatory research: A review of concepts and practices

Agricultural Administration Network Discussion Paper No. 19, June 1987, by John Farrington and Adrienne Martin

June 1987, by John Farrington and Adrienne Martin

The paper starts with the observation that in recent years it has become clear that large numbers of Resource Poor Farmers (RPF) have gained little from the process of technology transfer that was related to the concept of the green revolution. For resource poor farmers production increases would derive more from evolutionary than from revolutionary processes.

There has been a growing concern to understand the diverse and complex environments in which resource poor farmers operate so that developments in technology can be tailored to suit their circumstances and so that farmers' Indigenous Technical Knowledge (ITK) can be fed into technology development. From these areas of concern the concept of farmers' direct participation in research has arisen.

The paper examines Farmer Participatory Research (FPR) in both a conceptual and practical context.
The paper is divided into five sections: a review of conceptual approaches; FPR in relation to the institutional context of research; the role of ITK; a review of FPR methods adopted by researchers and a concluding section.

The paper takes the position that Farmer Participatory Research is not a substitute for Farming Systems Research, but a complement to client- oriented research and development, which is one component on the agenda for research in developing countries.
Other research will be required into the development of technologies to address opportunities and constraints of which farmers will be unaware.

The authors give ample attention to the importance and meaning of Indigenous Technical Knowledge.
Indigenous Technical Knowledge should not be viewed as a stock of knowledge to be mined by scientists, but as evidence of a dynamic process of experimentation and enquiry.
In the interest of the cost effectiveness of research, Indigenous Technical Knowledge systems should be strengthened so that their capacity to classify, evaluate and to some extent, predict the outcome of innovations in the local environment can complement science based development of technology.
Strong Indigenous Technical Knowledge systems may also facilitate incorporation of a component of farmer demand into the usually supply driven agenda of on-station research.

The analysis further leads to the conclusion that the potential of ITK will vary within and across communities, according not only to the aptitudes of individuals, but also their economic status and function.
ITK will be of high value in those communities which are poor in in frastructure and which have not been subjected to unpredictable external shocks.
It is much more difficult to generalize about the potential of ITK among what is likely to be a minority of resource poor farmers in wellendowed environments.
In these situations interventions other than technology change may also be necessary to reduce poverty.

The authors plead for an approach in which an assessment is made of the way ITK is being broken down or sustained in a community in order to identify appropriate participatory research methods to re-establish community control over resource exploitation and to re-vitalise in digenous knowledge systems.

The paper describes seven methods for participative ways of defining researchable problems and four methods for conducting participative research; discusses the role of the farmers and the official extension workers in a situation in which agricultural research is carried out in a participatory way.

Case studies of practical experiences with the approach in Kenya, Nepal and Thailand, the Phillipines, Columbia, Peru Indonesia and Botswana are mentioned and briefly described.

Experiences so far lead to the conclusion that in the technological development process there are many instances of successful participation in problem identification, as well as a substantial number of cases in which farmer evaluation of technology has provided researchers with new insights and in which farmer-to-farmer dissemination has been successful.
By contrast there are few cases known in which farmers and researchers have worked side by side in the design and conduct of formal trials.
It appears to have been far more common, once agreement has been reached on the problem to be addressed, for researchers either to design the trial and conduct it on farmers' fields with farmers' inputs following an agreed scheme, or, to offer farmers several technological options having a bearing on the problem and leave it to them to experiment in an ad hoc fashion.
Apparently there is a basic conflict between the need for formal experiments to provide a valid assessment of the complex interaction of variables influencing production under farm conditions, and the need to keep them simple enough for farmers to understand and evaluate.

Farmer participation in research has been reported far more frequently in the selection of genetic material than elsewhere.
Examples related to livestock research, crop protection, fertilization and farming equipment are very few.

Practically all farmer participatory research has been located outside the National Agricultural Research Systems.
Most experiences have been reported from the international agricultural research centers, universities and NGO's.
This institutional vacuum leads to the urge to give training to scientists in techniques of learning from farmers and to the development of methods for participatory research that can be assimilated by National Agricultural Research Services.

The booklet contains a number of important references as well as a list of persons or institutions involved or interested in farmer participatory research.

ILEIA is happy with the attention paid by agricultural researchers for farmer participation and indigenous knowledge.
The discussion points brought forward, which are summarised in this article deserve more attention.

However we think that attention to indigenous knowledge should not be limited to the technical aspects.
The knowledge of the farming population related to aspects such as the division of labour, roles and rights between men and women, traditional credit systems, price mechanisms, land ownership, power and communication systems is essential to be known before any intervention in existing agricultural systems should be made.

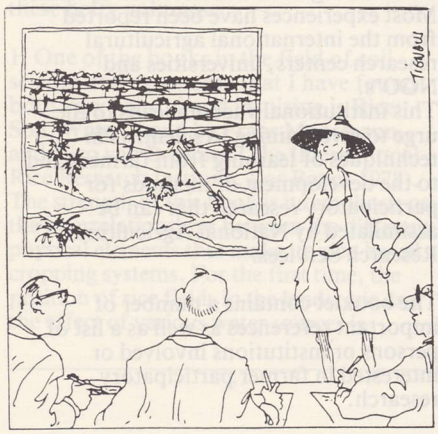
Bertus Haverkort
The paper can be obtained from:
Agricultural Administration Unit,
Overseas Development Institute Regent's College Inner Circle, Regent's Park
London NW1 4NS, England

NETWORKING

Call for experiences

ILEIA intends to produce a special issue of its newsletter on participatory approaches in agricultural technology development. We are interested to receive reports on field experiences on Farmer Participation in Agricultural Research and Farmers Participation in Extension. This could be in the form of Training materials in participating methods, reports of field experiences, description of participatory development strategies, planning procedures, methods for participative analysis, methods for group formation and group actions, participative evaluation etc.
Subscribers are requested to send a description of their experiences, their reports and/or materials they have developed to the editors.
Apart from a thematic issue on this subject we are considering organizing a workshop on this topic as well as the publication of the materials by way of a reader.

Do not hesitate to contribute!



Courses on Extension

The International Agricultural Center (I.A.C.), in co-operation with E.T.C. Foundation, organizes:
* 36th International Course on Rural Extension; 12 June - 9 July 1988
* Training for Trainers of Extension staff participative training methods; 10 July - 23 July 1988
* Management of Extension: Managing human resources. The courses are intended for middle level extension staff, trainers of extension workers and managers of extension activities of government and non-governmental agencies; 10 July - 23 July 1988.

More information: IAC
P.O. Box 88
6700 AB Wageningen
The Netherlands

Developing Countries Farm Radio Network

'We at this radio station are part of a world-wide information network that gathers farming information from developing countries all over the world. It's the Developing Countries Farm Radio Network, sponsored by the Canadian International Development Agency, Massey-Ferguson and the University of Guelph'.

'Through this Network we bring you information on ways to increase food supplies for your family, or to sell, ...ways that other farmers have used successfully'.

'Today, our subject is ..... . Here's George Atkins:'

With this introduction many radio programmes for farmers in Third World countries start their broadcasting of information.

DCFRN is an organization that provides packages of ready radio programmes for farmers in English, French and Spanish. Since the start of the project these packages have been translated by participants in the Network into 110 different languages or dialects. In this way millions of farmers gain access to the information provided by DCFRN. DCFRN has no radio station of its own. The communicators in Africa, Middle East, Asia, the Pacific, Central and South America and the Caribbean are the only link DCFRN has with the farmers. Therefore the organization depends on the participants of the Network to inform on the problems farmers are facing. By suggesting topics and by sending materials, participants provide information which may, in future DCFRN items, help farmers around the world.
These broadcast items are clear and simple to understand and are based on the principle:

'Begin with what people know.....
Build with what they have'.

Some of the many titles provided are:
Item 7/1 - Farming Hints: Crop rotation; Storing seed potatoes; Irrigation: when and how; Mulching crops grown on ridges.
Item 7/2-5 - Vegetable gardening.
Item 7/6 - Handling chickens.
Item 8/3 - Improving manure.
Item 8/4 - Hybrid and open pollinated maize.
Item 8/5 - Farming tools: care and maintenance.
Item 8/10 - Worm eggs and germs spread disease.

People who want to know more about these very practical and interesting radio programmes can write to DCFRN c/o Massey-Ferguson Ltd., 595 Bay Street, Toronto, Ontario M5G 2C3, (English language) or DCFRN c/o University of Guelph, Guelph, Ontario N1G 2W1, CANADA (French and Spanish languages).

Agriculture Man Ecology

TRAINING COURSE AFRICA

After a first successful try out in the Netherlands in July 1987, the Agriculture, Man and Ecology Programme intends to organise again a training course on Ecological Agriculture in The Netherlands explicitly for African extension workers.
Provisional date: June 13 until July 9

For application and further information, please contact:
E.T.C. Foundation, AME Programme, attn. Kees Manintveld,
P.O. Box 64, 3830 AB Leusden,
The Netherlands, Telex: 79380 ETC

WOMEN FARMERS

Agriculture, WOMEN and Ecology

In the A.M.E. course for Africans conducted in July 1987 in the Netherlands one of the discussions was on how male extension workers can work with female farmers. We would like to share the outcome of this discussion with you as it might be applicable to many of our readers.

As there are few female extension workers at this moment, it is a must that male extension workers are trained for female farmers. There is a case in Botswana where almost all the extension workers are males and the majority of the farmers are females. This has made the extension work difficult, because the men find it difficult to go to the women. How do we prepare male extension workers for this?

Methods of communication

The methods which an extension worker can use to communicate with the farmer include the use of the Mass Media, Newsletters and Posters, organizing workshops and seminars or Agricultural Shows and having farm contacts and discussions. Farm visits and demonstration allow the extension worker to make an appointment with the farmer and visit his/her farm for trials and other farming activities. In order to prepare a man for extension work among female farmers (who form a majority of the farming population), he should know certain social problems which the rural women have, and then be able to understand and appreciate such problems.

These problems include:

- **Cultural background:** A married woman farmer is controlled by the husband and as such cannot make appointments easily with a male extension officer. Also she cannot have discussion alone with the officer either on the farm or in the house.
- **The farming women are often shy** to open up for useful discussion with the opposite sex. And also there is the believe that men do not easily accept suggestions from the female and this results in a culture of silence on the part of the woman.
- **Family life problems:** Female farmers have always very little time at her disposal. Frequent pregnancies, many household chores which make her exhausted in combination with family responsibilities will surely affect her ability to communicate with the extension worker.

Preparing a male extension worker for female farmers With the foregoing it cannot be over-emphasized that it would be difficult for a male extension worker who has not been prepared to work with female farmers, to communicate with them. As such in an attempt to prepare men for that task are:

- In the basic educational system, sex education should be compulsory in the schools, in order to establish a cordial interaction between both sexes at an early age to understand, accept and respect each other.
- Also during in service training programmes for extension workers, there should be talk or discussions on the effect of the local culture on the behaviours of their women.
- During farm visits all contacts or correspondence should be initiated with the concern of the husband.
- Discussions about the farming operations should be straight to the point and within time.
- The extension worker should be trained to be a very good listener (because women are found to be talkative) and to give constructive criticisms.
- In the course of any discussion a word of praise as a motivating factor should be used to encourage the female farmer.
- She should not be condemned outright.

Noted down by Comfort Acheampong, Ghana, with thanks to all participants.

Operational Strategies for Reaching Women in Agriculture

How can women in agriculture be reached more effectively with extension messages, credit loans and other means ?

To discuss this, a workshop was held in The Hague, September 1986, hosted by the Dutch Ministry of Agriculture and Fisheries.

The key-note address was presented by Mrs Safelios-Rothschild: **The need for sex-segregated data.**

In order to target projects on women, it is necessary to make the role of women in agriculture visible. Therefore, sex-segregated data on agricultural activities have to be collected.

The range of data needed encompasses:

1. sex-segregated agricultural data;
2. sex-segregated population data;
3. data on intra-household dynamics;
4. data concerning access to agricultural services and resources.

It is than elaborated how these data should be composed.

However, in gathering sex-segregated data, researches will have to cope with a number of **methodological problems:**

* Agriculture as a male domain;
* Women's work is an extension of wifely duties;
* The reference period of economic activity (seasonal unpaid or just a few hours during the day or sometimes not at all working on the field);
* Strict definition of household and head of household.

One must be able to demonstrate the usefulness of these data for agricultural planning and programmes.

The Zambia case: A preliminary document pointed out that women had significantly less access to extension services, agricultural credit and co-operative membership than men, but that women smallholders responded very positively to efforts to improve this situation. It convinced policy maker of the need to rationalize agricultural planning and programmes by reaching women smallholders. This made it possible to formulate concrete recommendations aiming to integrate women farmers into the mainstream agricultural programmes.

The participants of the workshop formulated three additional approaches:

- **Building Networks** among female staff members in development ministries, and between these and women's movements, women in politics and women in donor community.
- **Action research** implemented jointly by development researches, administrators, technical staff and project officers, is effective in building understanding and commitment to action.
- **Building women's movements** through mobilization and organization increases the capacity of women to articulate their needs and represent their interests in agriculture.

The booklet ends with a list of recommendations from the participants. This 24 paged booklet can be ordered form:

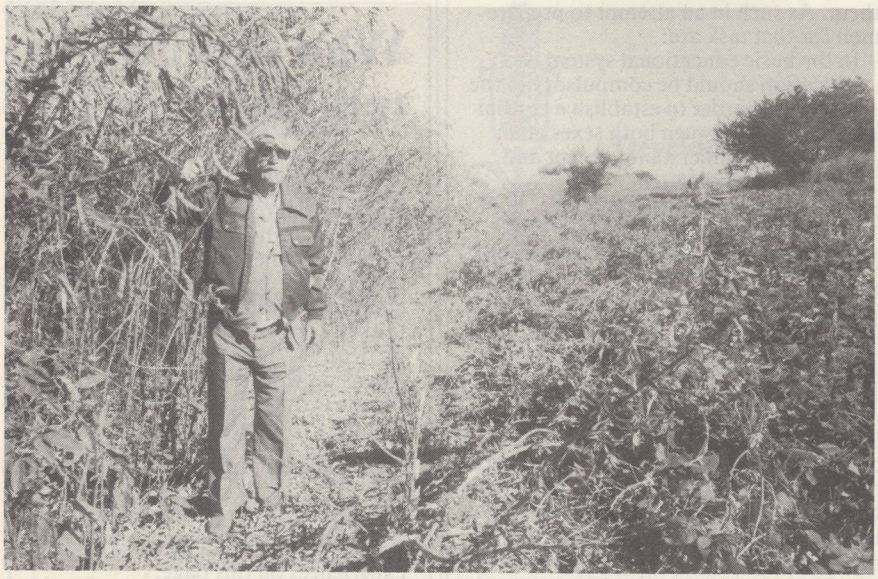
INFOtheek Ministry of Agriculture and Fisheries, P.O. Box 20401, 2500 EK The Hague, The Netherlands.

Who should talk to whom?

Involving women as full partners, or even agents of development, will need a large communication effort: one which recognizes the diversity of methods of information exchange, communications networks and the sex-segregated subjects. One difficulty is, however, how male extension workers can work with female farmers: the 'dilemma' of Female Producers vs. Male Extension Workers. Another difficulty is the invisibility of the role of women in agricultural statistics.

Who takes the challenge to add experiences on this page, 'Women Farmers', dealing with the promise and problems of improved communication with women ?

READERS WRITE



The use of legumes in Brazil

Gentlemen:
Many food and feed problems in Brazil can be solved by applying little known methods of using the legumes PIGEON PEA and LAB LAB BEAN, fattening cattle on the pasture during the dry season without rainfall for three month. The photo shows on the left side rows of pigeon pea in the dry month of July with Schaaffhausen and on the right the green lab-lab beans which have been sown together with maize.
By this method the small farmer can harvest the maize to pay the expense for preparing the land, and cultivating it. The beans of pigeon pea and lab-lab give a nourishing food for the family and after the harvest cattle, sheep horses, etc., eat the green leaves with 26% of protein, increasing health and weight during the critical season. The soil is fertilized by the organic material and nitrogen form the atmosphere as a FREE GIFT OF NATURE.
Pigeon pea is seeded on millions of hectares in India for food. For harvesting the beans, the stems are cut near the ground and the plant does not return. If the beans were harvested by hand, or the stems cut over knee high, the fodder problem in tropical regions can be solved in an easy way.
For further information an article is available written in Portuguese, giving the results of an experiment made on my farm during three months of drought.

Reimar von Schaaffhausen
Estr. Guarapiranga 2033
04901 Sao Paulo, Brazil

P.S. Pigeon pea may be the solution for substituting Leucaena in alley cropping, as it is probably not attacked by the insect Heterophylla incisa.

Alley Cropping

Dear Sirs,

Being an organic farming project in a (former...) tropical rain forest zone we appreciate your newsletter a lot and got many ideas and hints out of it. As to the article in the July 87-issue on diversified alleycropping, we would like to remark that monoculture in alley cropping was expected to be a mistake, because any monoculture is a sure source of problems. Knowing of trials in Kenya and Nigeria we therefore started with mixtures of at least four different trees in 1985 and now established alleys by direct seeding of up to nine different leguminous tree species. Some will do fine, others not, but we are pretty sure that the highly diversified alley is a safe solution. In two years or so there will be first evaluation data. Hopefully we might publish them in ILEIA ? In the Spanish edition? Newsletter ?

Best wishes for your future work,
cordialemente

Finca La Esperanzita
Gerd Schnepel
Nueva Guinea, Zelaya
Nicaragua

ILEIA
P.O. Box 64
3830 AB Leusden
The Netherlands

ILEIA was established in 1982 by the E.T.C. Foundation, Consultants for Development Programmes.

The general aim of ILEIA is to provide development intermedia with relevant information on low external-input agriculture, on practical methods and scientific backgrounds as well as on strategies to introduce low external-input methods in agricultural development.
Low external-input agriculture means to us: agricultural systems which make optimal use of locally available natural and human resources (such as: climate, landscape, soil, water, vegetation, local crops and animals, labour, local skills and knowledge) and which are economically feasible, ecologically sound, culturally adapted and socially just. The use of external inputs such as mineral fertilizers, pesticides, tractors, hybrid seeds, is not excluded but has to meet the above-mentioned criteria of sustainability.

ILEIA is realizing this aim by:
* Documentation. A data-base on low external-input agriculture is being compiled.
* Information Services:
- Question and Answer-service: on request information will be given on documentation on special subjects or organizations and projects in a special country or persons who are active in a special field.
- Permanent Documentation and Information-services to governmental and Non-governmental organizations and projects.
* Quarterly publication of the ILEIA Newsletter.