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Abstract by F.I. Woodward, UK

VII AGROFORESTRY

397 89 - 7/21

Agroforestry
Africa, Nigeria, humid zone, economic analysis, alley farming, small ruminants, models
SUMBERG, J.E. et al.
Economic analysis of alley farming with small ruminants.

ILCA Bulletin 28, 1987, 2-6

Several evaluations of the economics of alley cropping have been conducted. None of these analyses have considered livestock. While alley cropping was conceived primarily for crop production, it offers considerable potential for integrating crop and livestock production by supplying mulch for crops and high-quality fodder for animals.
In humid West Africa, sheep and goat production is generally a minor enterprise using few inputs. Production is limited by a viral disease.
However, realisation of the potential of small ruminants, following disease control, may eventually be constrained by feed resources.
Alley farming, which is the addition of animals to an alley cropping system, offers the opportunity to realise this potential by producing high-quality feed year round.
In this paper alley farming models are evaluated with small ruminants, based on field and experimental data from southwest Nigeria, and compare them with basic alley cropping and with fallow systems. The analysis is used to define key management areas within alley farming, as well as areas where further information is needed.
These models indicate that under conditions found in southwest Nigeria maize production with alley cropping is more profitable than with a 3-year fallow system. While alley cropping requires more labour than the fallow system, this is more than offset by the increased maize yields, and relative profitability of alley cropping is insensitive to changes in labour requirements.
The amount of tree foliages and the method of mulching affect alley cropping profitability. The models assume a low tree foliage yield of 3000 kg/ha/year based on difficulties of obtaining good tree stands in village conditions. Low foliage yields reflect farmers' hesitancy to plant densely to obtain high populations. Better methods of tree establishment (or better instructional methods) that assure good stands would therefore add to the overall attractiveness of alley cropping. Mulch incorporation, particularly if done at tillage or weeding times and thus not requiring additional labour, can increase the profitability of alley cropping.
With control of viral diseases particularly for goats, increases in net output of 20 to 30% per dam from 25% supplementary feeding are needed to make small ruminant feeding competitive with maize

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production. The reproductive potential of West African dwarf goats and sheep has been well documented; the principal goal of future research must be to demonstrate that supplementary feeding of high-quality fodder species such as leucaena and gliricidia is effective in realising this potential.

398 89 - 7/22

Agroforestry
Agroforestry, data base, principles, information,ecology
YOUNG, A.
An environmental data base for agroforestry.

ICRAF Working Paper No.5, 1985, 32 pp.

Agroforestry is based on plants: trees, crops and grasses. Plant growth is dependent on the physical environment; different crops are suited to particular environmental conditions, and multi-purpose tree species will respond in different ways to variations in climatic conditions, soils and drainage. The choice of plant species suited to the environmental conditions of an area is fundamental to the success of any agroforestry practice. Equally there are environmental influences upon agroforestry practices which involve livestock, acting both directly on the animals and indirectly through effects on the growth of pastures.
There is a second, equally important, aspect: the effects of agroforestry on the environment. Such effects can be either positive (i.e. beneficial) or negative. Frequently, they involve interaction between two or more components of an agroforestry system, e.g. trees and crops. Such interactions do not take place directly, but through the medium of climate and soil, modifying, for example, the microclimate and the soil moisture, organic matter and nutrient content.
Hence many types of information in the science of agroforestry are environment-specific: what grows well, or interacts effectively, under one set of physical conditions may not do so under another. This applies very obviously at the broad scale of major climatic zones, e.g. the humid tropics or rain forest zone, the subhumid tropics or savannas, and the semi-arid land. At more detailed scales also there will be differences between efficient agroforestry designs on, for example, sandy soils as compared with clays, or on steeply-sloping lands as compared with gentle slopes.
An environmental data base has the function of relating different kinds of information in agroforestry research to a common basis of environmental information. The paper outlines the principles and structure of the data base, the information contained within it, and its potential uses. Information is included on geology, landforms, climate, hydrology, soils, vegetation, fauna and disease, and land-use, including agroforestry practices. There are three levels of detail: a Summary Level, an Intermediate Level 1, and Level 2 containing detailed information. Data are transferred from an input form to computerized storage, using the data base management system. Potential uses of the data base include, first,

the collection, storage and selective retrieval of information on individual aspects of agroforestry: multipurpose trees, agricultural crops, agroforestry systems, and agroforestry experimental work. Secondly, it may be used for synthesis of these different kinds of information, as in land evaluation, diagnostic and design studies, and advisory work.
This paper is intended primarily for those working permanently or temporarily with ICRAF, that is, the scientific staff together with research fellows, trainees, and others who join the organization for short periods. It may also assist individuals and organizations who make use of the results of ICRAF studies by providing an explanation of the basis and terminology employed for environmental information.

399 89 -7/23

Agroforestry
Review, developing countries, marginal lands, food, trees, agroforestry systems, GTZ, ICRAF,
VON MAYDELL, H.J.
Food from multipurpose trees on marginal lands.

Highlights of German Research Projects in the Tropics and Subtropics; IJT - International Cooperation and Transfer GmbH, Berlin in Coop. with ATSAF, Bonn, 1988, pp. 63-68

Multipurpose trees are those which are deliberately grown or kept and managed for more than one intended use, especially in agroforestry systems.
The various potential uses of such trees on marginal lands as found in the Sahel Zone of Africa have been classified into broad categories as follows:
- Food
- Energy
- Raw materials
- Environment
- Socio-economic benefits

Food supply is one of the main concerns of development policy. More than ninety per cent of all living biomass of the globe lies in the forests, and the area covered by trees and shrubs, especially in the tropics, is still very large.
Therefore, it may rightfully be expected that forests and woody species growing outside forest lands contribute more to human nutrition than previously assumed. This can be achieved by increasing the production of food, (primarily fruit and leaves) and through the protective and soil and water balance improving functions. Both can be realized by applying agroforestry practices on a variety of sites (including those otherwise not suitable for growing food crops) and should therefore be seen as a challenge and opportunity for a future-oriented tropical forest management.
In the various tropical and subtropical marginal regions there may be many hundreds of wild trees and shrubs suitable for food production. They are supplying food, either permanently,

seasonally or in times of need, often important enough to sustain the very existence of the people. These species provide fruit, seeds, nuts and oil, and various other products: spices and food supplements and medicines which are widely used in the area. The collection of leaves, buds and young shoots as vegetables is of relatively great importance, particularly in dry areas where fresh vegetables are otherwise difficult to obtain. The abundance and variety of such tree and shrub produce that are helpful to nutrition in the widest sense is amazing and the rural population is extremely well-informed on how to produce and use it in various forms.
There are hardly any statistical records available on the quantities and value of food products obtained from the woody vegetation of a region as for example the Sahel. Thus, the overall importance of such food has been - and still is - seriously underestimated.
An evaluation of food production from multipurpose trees should be done according to checklist given in the paper.
Besides improving food supplies from woody perennials by quantity and quality through biological and technical research, a multitude of system-related questions will have to be answered. Only three of them shall be mentioned here.
- Diversity:
Under marginal site conditions the number of species is generally reduced. As the amount of marginal lands in the tropics is high by nature and increasing through human interference, the loss of diversity is creating increasingly more concern, both with regard to the environment (including genetic resources) and to meeting human demands. On the other hand, many tropical regions still offer outstanding facilities for diversity of production, unparalleled by other regions off the world. This is why, with a view to food production from trees and shrubs, the management of more species and the extension to different uses from one species ("multipurpose") should be investigated.
- Reduction of risks:
This may, in some tropical regions, prove to be even more important than increased yields. Risks include the natural (e.g. pests, diseases, floods, fire, drought, etc.) as well as the socio-economic (markets, tenural rights, agricultural policies, management, etc.) sphere. Long-lasting (as compared with annual crops) woody plants may prove to be less flexible ("resilient") but more reliable and resistant ("persistent"). The interaction of both "strategies" appears to be of importance for long-and medium-term land use planning.
- Sustainability:
Forestry is often said to be "the" sustainable land use, which may be true in specific situations. However, under increasing pressure, due to population growth and environmental degradation, ways will have to be found to maintain or even increase the overall carrying capacity of a given region. Better use of more sites (including those which were considered unsuitable for agricultural crops and livestock) by food-tree management and the introdution of multi-storey systems are ways in which agroforestry has already proven to be a successful land-use system. More

knowledge, based on hard facts is needed to define indicators of sustainability of such integrated land-use systems, to evaluate their applicability both ecologically and economically, and to optimize tropical rural development by incorporating the hitherto somewhat neglected and thus underutilized potential of trees and shrubs for food production.

400 89 - 7/24

Agroforestry
Review, tropics, subtropics, land-use systems, agroforestry, practices, associated crops, woody perenniala, animals, spatial mixture, temporal sequence, ecology, economics, sociology, sustainability, potential, future role
STEPPLER, H.A. and B.O. LUNDGREN
Agroforestry: Now and in the Future.

Outlook on Agriculture, 17, 4, 1988, pp. 146-151

In this paper current status and the future of agroforestry is discussed. Included are the aspects of social acceptability and sustainability.
Agroforestry is a collective name for all land use systems and practices where woody perennials are deliberately grown on the same land management unit as agricultural crops and/or animals, either in spatial mixture or in temporal sequence. There must be insignificant ecological and economic interactions between the woody and non-woody components.
The information provided on the various systems is largely descriptive. There is relatively little rigorous production data arising from controlled measurement - much could even be labelled as anecdotal. This does not invalidate the systems inventory; rather, it underlines the need for research to understand and to quantify the performance of these systems. Advice to farmers, development projects, etc., on choice of system and expected impact/outputs is of necessity based on such information. Production performance is available only for tree crops and alley-cropping and, in this latter case, in a limited humid zone in West Africa.
The unique feature of agroforestry which distinguishes it from all agriculture systems is the deliberate introduction of trees into the landscape. These are not the conventional timber-producing trees of forestry but, rather, the MPT's of agroforestry.
None of the genotypes of economic crops currently being tested in agroforestry systems has been specifically bred for a mixed cropping system.
The integration of the animal with the woody perennial and the crop component becomes of high priority.
There is an urgent need for quantified information on animal production in agroforestry systems and for the development of research methodologies, in particular experimental designs, appropriate for such studies.

Social acceptability implies that the technology, in this case some agroforestry systems, will not create any social problems and might even be socially desirable. Thus, there should not be any labour demands which are in conflict with current practices.
Sustainability of agriculture production is a key issue as one looks at the impact of increasing population pressure and the movement of agriculture into less favourable areas. The issue, however, is not merely sustainability, but, hopefully, sustainability at higher levels of productivity.
For a system to be sustained, there will be costs depending on the level of production which one wishes to maintain. The prevention of leakage from the system, recycling of nutrients, enhancement of nutrient status by biological activity, are all ways of attaining sustainability but by no means exhaustive of the means. While there has been in very recent times a significant increase of interest in sustainability, there have to date been few objective data published on the subject.
With population expected to reach 10 billion early in the next century and with increasing expectation for better nutrition, the demand will continue to grow. Agricultural enterprises have to move into more marginal areas and in more intensive management of currently used areas. A critical concern of all faced with the problem is that the systems shall be sustainable; not just capable of maintaining the status quo, but dynamic and capable of meeting the increasing demands while still avoiding environmental degradation.

401 89 - 7/25

Agroforestry
Review, tropics, subtropics, developing countries, land-use systems, traditional systems, agrosilvopastoral systems, homegardens, plantation, farm forestry, marginal lands, constraints, ecology, sustainability, future trends
SWAMINATHAN, M.S.
The promise of agroforestry for ecological and nutritional security.

In: Agroforestry - a decade of development. Eds. Steppler, H.A. and P.K.R. Nair, ICRAF, Nairobi, Kenya, 1987, pp. 25-41

This paper gives a brief account of agroforestry systems, some recent successes, and the potential of these systems for increasing food and environmental security.
Sustainable food security is a major human goal.
Enduring food and nutrition security can be built only on the foundation of ecological security, i.e. the security of the basic life-support systems of land, water, flora, fauna, and the atmosphere. It is in this context to assess the role of agroforestry systems in helping to achieve sustainable nutritional and ecological security.
It is predicted that between 1980 and 2000, world population will increase by 1.7 billion. Ninety percent of this growth will occur

in developing countries. This tremendous increase will require at least 50-60 percent greater agricultural output than in 1980.
Any increase in food production has to come primarily from raising the productivity of currently tilled soils rather than from bringing new land resources into farming. In fact, a large portion of currently tilled marginal areas will have to be phased out of agriculture for economic and ecological reasons. Land for agriculture is a shrinking resource, because some land is being taken out of production all the time and diverted to uses such as roads, housing, and industry.
Modern agricultural production technology has raised the hope that hunger can be eliminated and the carrying capacity of the land increased through better use of soil, water, and air. Nevertheless, the ecological sustainability and economic viability of new technologies are increasingly at stake. The rising populations of humans and animals, with their ever expanding food, fodder, and feed needs, exerts great pressure on the stabilizing elements of agro-ecosystems. As productive land becomes scarce, marginal farmers are pushed into fragile crop lands and forest areas unsuitable for modern agriculture. If the present trend of population growth persists, forest and pasture lands will be further reduced.
A major cause of soil erosion is deforestation. The World Resources Institute has estimated that 160 million hectares of upland watershed in the Himalayas and Andean range, and in the Central American, Ethiopian and Chinese highlands, have been seriously degraded due to human interference.
It is obvious that the maintenance of tree cover is of utmost importance for ecological and economic sustainability of food-production systems. Agroforestry involving the integrated cultivation of woody perennials, crops, and animals provides one answer to the problem. A typical agroforestry system allows symbiotic economic and ecological interactions between the woody components to increase, sustain, and diversify the total land output. Some of the dominant agroforestry systems are: (a) shifting cultivation, (b) taungya afforestation, (c) homegardens, (d) silvopastoral, (e) agrisilvicultural, and (f) windbreaks and live fences. Farming systems that incorporate perennial trees and shrubs have the advantage of producing fuelwood, fruit, fodder, and other products along with annual crops. In addition, they decrease the farmer's exposure to seasonal environmental variations and, over the long-term, maintain and improve soil health.

402 89 - 7/26

Agroforestry
Review, tropics, subtropics, developing countries, land-use systems, land-tenure, shifting cultivation, sustainable agriculture, marginal lands, fallows, alley cropping, intercropping, trees, agropastoral systems, mixed farming
RAINTREE, J.B.
Agroforestry pathways: Land tenure, shifting cultivation and sustainable agriculture.

Unasylva 154, 38, 4, 1986, pp. 2-15

From a project standpoint there are two fundamental ways of arriving at agroforestry: by integrating trees into farming systems or by integrating farmers into forests.
Appropriately selected woody components may contribute to both the productivity and sustainability of farming systems on marginal land in several ways: by enhancing the production of organic matter; by maintaining soil fertility; by reducing erosion; by conserving water; and, by creating a more favourable microclimate for associated crops and livestock. These "service roles" are above and beyond the direct "production roles" trees can also play in supplying food, fodder, fuelwood, building materials and other raw materials for rural industries. In traditional land-use practices, agroforestry is also important in maximizing and diversifying the productivity of even highly fertile lands. Intensive agroforestry systems are most commonly found in areas with a long history of population pressure, indicating their general efficiency as a land-use system.
All tropical land-use systems exhibit varying degrees of "leakiness" with respect to the cycling of nutrients held in the soil-vegetation complex, although systems such as irrigated rice paddies, permanent tree crops and forests are inherently more sustainable than others. It is a fundamental contention of agroforestry that trees have good prospects for plugging many of the holes in tropical farming systems. The degree of "infilling" can vary from slight to virtually complete. Essentially, the decision as to how many and which kind of trees it is profitable to add to the existing pattern of land-use depends on what useful niches for trees can be identified. An agroforestry "niche" in this sense has three components: a functional role within the land-use system; a place within the landscape; and a time within the life cycle of a particular land-use system.
Although many of the recent research thrusts in agroforestry have been directed toward the integration of trees into farming systems, agroforestry also has a role to play in the preservation of forests and the improvement of forest management systems. By providing farmers with a means of producing fuelwood, timber, building poles and other forest products on farmland, agroforestry can significantly reduce the demand on forests and natural woodlands. By doing this in ways that enhance and sustain agricultural productivity, agroforestry can also alleviate some of the pressure for the conversion of forest land into farmland.

Moreover, the integration of farmers into forest management schemes through the use of "compromise" land-use systems based on agroforestry may be one of the few realistic ways of sustaining forestry production on agriculturally pressured forest land.
The purpose of this article is to provide some mental images of the scope and potential role of agroforestry to serve as a background to the discussion of tenure issues. The main assumption is that the interactions between agroforestry and tenure issues are basically of two types: first, tenure factors may pose constraints to the realization of the potential ecological and socio-economic benefits of agroforestry in many land-use systems; and second, agroforestry may offer ways of resolving some existing tenure problems. Tenure issues are far more varied and complex than are reflected here. However, attention is focussed on some of the major changes in tenure that arise in conjunction with the main developmental trends in tropical land-use. These changes are then viewed in ecological and evolutionary perspectives.
Agroforestry can perhaps provide a simple, equitable, all-round solution in developing countries to the related problems of biomass energy supply, decentralization of rural industry, and the participation of pastoralists in national development.
The purpose of this article has been to raise some questions and provide some images for a positive approach to tenure questions in agroforestry.

403 89 - 7/27

Agroforestry
Central America, Costa Rica, CATIE, review, coffee, cacao, laurel, *Erythrina poeppigiana*, litterfall, nitrogen fixing, nutrient cycling, shade trees
BEER, J.
Litter production and nutrient cycling in coffee (*Coffea arabica*) or cacao (*Theobroma cacao*) plantations with shade trees.

Agroforestry Systems, 7, 1988, pp. 103-114

This paper reviews the published data on litter production, nutrient cycling and nitrogen fixation in shaded coffee or cacao plantations, in order to discuss the relative importance of these possible benefits of the shade trees.
High crop production levels from unshaded coffee (*Coffea* spp. L.) and cacao (*Theobroma cacao* L.) plantations can be obtained on fertile soils given intensive management. Many possible advantages of using the so called "shade trees" have convinced most farmers in Central America to continue to manage these crops under a partial tree canopy. Obviously shade itself is not always necessary.
In Central America some of the best known shade trees are *Erythrina* spp. and *Cordia alliodora* (R + P) Oken, which are used individually or in combination. An obvious reason for including *C. alliodora* is the production of high value timber. In contrast the *Erythrina* spp. give no commercialized products.

In Costa Rica it seems significant that farmers who have encouraged natural regeneration of *C. alliodora* in coffee or cacao plantations do not eliminate the existing *Erythrina* spp. which suggests that the latter possesses desirable characteristics which are not provided by the former. The Rhizobium associated with the roots of leguminous shade trees such as *Erythrina* or *Inga* spp. can fix 35-60 kg N/ha/a. This is sufficient to replace the N exported in crop harvests, from plantations where no or little inorganic fertilizers are applied, assuming that all the fixed N becomes available to the coffee. Many partially shaded coffee plantations in Costa Rica are heavily fertilized at rates of up to 270 kg. N, 60 kg P and 150 kg K/ha/a. Thus it seems improbable that N fixation is the reason why these coffee farmers have continued to use *Erythrina* spp.
Comparisons are made between the leguminous shade tree *Erythrina poeppigiana* and the non-leguminous timber tree *Cordia alliodora*. The former, when pruned 2 or 3 times/a, can return to the litter layer the same amount of nutrients that are applied to coffee plantations via inorganic fertilizers, even at the highest recommended rates for Costa Rica of 270 kg.N, 60 kg.P, 150 kg.K/ha/a. The annual nutrient return in this litterfall represents 90-100 percent of the nutrient stored in above-ground biomass of *E. poeppigiana*, and hence the consequences of competition with the crop should not be a serious limitation. In the case of *C. alliodora*, which is not pruned, nutrient storage in the tree stems, especially of K, is a potential limiting factor to both crop and tree productivity.
These trees contribute 5.000-10.000 kg organic material/ha/a.
It is concluded that, in fertilized plantations of cacao and coffee, litter productivity is a more important shade tree characteristic than N fixation.

404 89 - 7/28

Agroforestry
Review, book, ecological zones, dissertation, land-use systems, marginal lands, deforestation, food security, grazing, desertification, ecology, sustainability, agroforestry systems, agriculture, education, environment
BOEHNERT, J.
Agroforestry in agricultural education with a focus on the practical implementation.

Tropical Agriculture 2, 1988, 182 pp.; Verlag J. Markgraf, Eichendorffstr. 9, D-8074, Gaimersheim, ISBN 3-8236-1117-8, price DM 49,- USD 29,-

The world wide destruction of natural environment which is the base of life and that of future generations, is calling urgently for practical solutions. In this respect agroforestry has a great deal of potential to offer, but it is far from being a panacea. Other political, economical and educational solutions have to come

first before a natural sound way of farming like agroforestry can show its full potential.
As long as farmers in the developing countries are encouraged to mono cash crop production on land that should be used for growing locally needed food, to pay back the debts of their countries and to satisfy their urban elite, and as long as environmental education and conservation is regarded as an "unnecessary luxury" - the world wide destruction of natural resources will continue.
There are indications for hope. The world wide growing interest in agroforestry is one. The author hopes that this dissertation will contribute to the further extension and education in agroforestry.
The main objective of this publication is to study and to identify ways in which agroforestry can become a vital part of agricultural education and a sustainable way of farming for school and college farms.
Methods of the study include a review of existing literature on the subject (Chapter 1), knowledge gained from a study course and the writer's experience gained from working on a Teacher Training College (Agriculture Department) in Zambia and for over two years in a Agroforestry Project in the semi-arid areas of Kenya, as well as journeys in South America and Africa.
Chapter two attempts to present agroforestry systems as a possible "solution" to most of the problems mentioned in chapter one. The chapter will go into detail about the possibilities and potentials of agroforestry.
Chapter three is focussed on three potential "Fields of Expansion" for agroforestry: the tropical and sub-tropical regions, the semi-arid to arid regions and the temperate regions of the world.
Chapter four is devoted to a study of formal and non-formal education and training in agroforestry. This chapter is suggesting a detailed agroforestry training programme,its concepts and objectives.
Finally the study attempts to make suggestions on the practical implementation, management and utilisation on agroforestry-systems for school and college farms.
The main point is not layed on a particular country, climatic region or continent, but all climatic regions of the world are included in the study with preference towards tropical and sub-tropical regions.

405 89 - 7/29

Agroforestry
Asia, India, semi-arid tropics, studies, agroforestry systems, cropping systems, sustainability, alley cropping, intercropping, economics, annual crops, Alfisol, Vertic Inceptisol, land equivalent ratio
ICRISAT
Assessing sustainability - agroforestry - .

ICRISAT Annual Report 1988, pp. 184-185; ICRISAT, Patancheru, Andhra Pradesh 502 324, India, 1989

Agroforestry experiments with *Leucaena leucocephala* began at ICRISAT Center in 1984 in conjunction with a study funded by the Ford Foundation to examine the potential role of agroforestry in the semi-arid tropics (SAT). The findings of the Ford Foundation study, highlighted two major constraints to the introduction of agroforestry and alley cropping in SAT India. First, trees compete strongly with crops, a fact that has subsequently been shown to be due to competition for water. Second, the close association of trees and crops does not have the positive interactions often observed in conventional intercropping. Indeed, many agroforestry combinations may be economically inferior to combinations of annual crops in the SAT, but data to demonstrate this are lacking.
There is now sufficient information on alley-cropping systems based on leucaena to allow to examine: (1) the evidence for positive interactions, especially in terms of productivity and microclimate amelioration, and (2) the economic comparison of alley cropping and annual cropping over a large range of fodder prices. The hypotheses that alley cropping is less productive than sole leucaena in terms of biomass was explored previously by measuring the total amount of solar radiation intercepted by leucaena hedgerows and three cropping systems on a Vertic Inceptisol. These calculations showed that when sole leucaena was managed optimally, the total land equivalent ratio (LER) of the alley crop reached 0.58. None of the sole leucaena treatments was managed optimally for biomass production because they were pruned in the rainy season even when there was no demand for fodder, but they provide a comparison of an alley-cropping system where prunings are used as green manure during the rainy season.
A multidisciplinary experiment was started on shallow Alfisols to determine the advantage of incorporating prunings of leucaena (cv Cunningham) into annual cropping systems and the consequences on runoff and yield. Leucaena in paired rows at alley spacings of 3.0 and 5.4 m, and pruned hedges regularly was grown. Annual crops were pearl millet /pigeonpea intercrop in 1984 and 1986, castor in 1985, and groundnut in 1987. Sole leucaena spaced at 1.2 m x 0.25 m which was optimal for canopy development and dry matter production.
Incorporation of prunings per annum had a negligible effect on crop production, so results for both mulched and non-mulched treatments were combined. This observation is consistent with the bulk of the evidence in SAT India. Dry matter production in 1984 and 1985 was poor in all three treatments, probably because of exceptionally low rainfall. With more rain during 1986 and 1987, the biomass production of all treatments during these years increased markedly. Over the 4 year period, sole leucaena still produced the greatest amount of biomass per unit field area, closely followed by the yields in alley cropping. The annual crop treatment produced 66% of the sole leucaena over the same period. The superiority of the sole leucaena stand over the alley crop was clearer during the off-season from January to early June, when the demand for fodder is greatest. Calculations of LER show no advantage at 5.4 m and at 3.0 m spacings. The values of LER is insufficient to compensate for the loss in economic return from grain yield at 3.0 m. This finding supports the hypotheses that

alley cropping based on leucaena is not more productive than sole leucaena even when leucaena is not managed optimally. A similar conclusion was drawn from an alley cropping trial of leucaena/sorghum/pigeonpea on Vertic Inceptisols reported previously, in which the highest LER was 1.14, using the best annual crop treatment as a base.
An economic comparison of the most remunerative alley- and annual crops was carried out over a wide range of prices for leucaena dry fodder for both the Alfisol and Vertic Inceptisols trials. The best alley crop treatments were the widest spacings in both trials, 5.4 m for the Alfisol and 5.55 m for the Vertic Inceptisol. Both trials revealed that the economic superiority of alley cropping was small and was confined to the price range of Rs 0.8-1.6 kg^{-1}. Below this price range, the annual crop gave the best economic returns, and sole leucaena dominated above Rs 1.6 kg^{-1}. The poor comparative performance of alley cropping on the Alfisol was partly due to the lack of response to mulching, but even if response to both mulching and fertilizer were significant, applying more fertilizer to annual crops will always be economically preferable to sacrificing land to leucaena hedgerows.

89 - 7/30

406

Agroforestry
Europe, Spain, study, highlands, mediterranean region, land-use system, dehesa, oak trees, agrosilvopastoral system, soil fertility, animal integration
JOFFRE, R. et al.
The dehesa: an agrosilvopastoral system of the Mediterranean region with special reference to the Sierra Morena area of Spain.

Agroforestry Systems, 6, 1988, pp. 71-76

The various characteristics of the dehesa system are described and evaluated in this paper based on the results of a six year study undertaken at Sierra Norte area, north of Sevilla, Western Andalusia, Spain.
In South Western Spain the word "dehesa" is used to denote the land-use system in rural areas, mainly rangelands, which are occupied by scattered oak trees (*Quercus rotundifolia, Q. suber, Q. faginea*). The system has been known for many centuries for its multiple, mainly silvopastoral, use of renewable resources, and its strong linkages of recurrent cereal cropping in rangelands.
There are many bibliographical references to the past importance of the oaks producing sweet acorns both for human food consumption and to feed domestic animals such as pigs. Early livestock farmers of the South Western Spain had legal rights for the use of grazing resources belonging to rural areas "with trees". These indicate the long history of land-use systems involving oak trees in the appropriation of rural areas in the Iberic Peninsula.
The scattered tree layer dominated by sweet-acorn-oaks has a strong link with animal husbandry and, as such, the dehesa could basically be considered as an orchard system which produces feed-

stuff for domestic animals. But looking more carefully, one can say that this orchard-like system is also a producer of forestry resources, such as timber for various uses, charcoal, tannin, cork (*Q. suber*) etc. Besides, it plays a very important role in improving soil conditions, and also in giving shelter for grazing animals; the system also contributes to the comprehensive ecological equilibrium of the rural area and to its environmental quality and stability, both at regional and very local levels.
Considering on the one hand the very rapid ecological change during the last two decades, and the powerful techniques available today to contribute to these changes on the other, the dehesas become a very sensitive agrosystem and also a subject of controversial judgement and evaluation. Looking at the ecological advantages, in terms of biological productivity and metastability, it can be said that some positive synergic effects could be observed and measured when scattered oak trees are associated with various components of grassland vegetation, unless management practices favour mainly tree and perennial grasses associations. Still, much more research is required in order to give substantive data to decision-makers, managers and farmers.
The dehesa-like systems could be considered for adoption as potential multiple use agro-ecosystems for all the fragile areas of Mediterranean region, from semi-arid to sub-humid conditions. This concerns millions of hectares in the countries bordering the Mediterranean Basin, as well as other millions of hectares in countries of the rest of the world where mediterranean climates occur. For instance in Chile the dehesa-like system of *Acacia caven* in semi-arid and sub-humid regions has the same ecological and socio-economic role as of oak dehesas of the Old World. Positive synergic effects between tree canopy cover of *A. caven* (a legume tree) and the best grassland conditions (*Lolium multiflorum*) have been demonstrated in farm systems, with sheep and cattle.
More experiments at farm level need to be undertaken with management practices applicable to the complex of the dehesas, both for the benefit of the environmental conservation and of the farmers and the countries concerned. New package of management techniques must be implemented.
Adoption of management techniques could lead to better conservation of renewable resources, land, water and genetic pools. The socio-economic benefits from such a programme should be considered on the basis of long-term benefits for the whole society.

407 89 - 7/31

Agroforestry
Review, land-use systems, sociology, land tenure, conservation, labour, nutrition, marketing, organisation
HOSKINS, M.W.
Agroforestry and the social milieu.

In: Agroforestry - a decade of development; Edts H.A. Steppler and P.K.R. Nair, ICRAF, Nairobi, Kenya, 1987, pp. 191-203

This paper deals with the following issues: local uses and knowledge, tenure, organization, conservation, landlessness/distance, enterprises and marketing, labour, nutrition, and gender/age.
Much agroforestry research has been based on topics selected through an expanded farming systems type approach, the diagnosis and design (D&D) methods. D&D uses a multidisciplinary problem-solving focus originating from the perspective of farmers. Establishing research priorities from within the social milieu in this manner promises to put agroforestry research results ahead of much traditional forestry and agricultural research in being of great relevance to farmers. However, the methods of making new innovations available to farmers are not yet clear.
The uniqueness of the socio-economic factors involved in tree promotion is important to examine and to work with extension and development ministries and agents already in place. Probably agroforestry awareness and training will be needed for various extension agents dealing with farmers. However, if methods commonly used in agricultural promotion programmes are adopted without careful modification for use with agroforestry they may indeed defeat the promotion of farmer adoption, causing such programmes to come to a dead end, if they begin at all.
It is not easy to select and describe the crucial socio-economic variables in a universal way: situations differ depending on the locality, environment and the major traditional production activities; issues overlap and are not easily considered in isolation. Variables will need to be studied case by case. However, examples of common issues, even if incomplete, may serve to highlight some of the questions which should be raised in order to tailor agroforestry promotion policies and the training of promoters in an effective manner.
Agroforestry helps focus agriculture on sustainable practices and on ways to make smaller parcels of land produce the range of plant and animal products required for subsistance or for market. It offers hope where land pressure has made traditional agriculture and herding practice unviable. When well designed, it can provide a more diverse production system thereby reducing risks. However, when not designed to respond to the social milieu, the benefits can completely miss the poor.
It will be a challenge to develop testing methods easily understood and used by farmers in developing realistic but rapid ways to examine plant inter-relationships in the context of their own objectives. This must become a two-way process because only

through farmer management and adoptation of these suggested new approaches will the real socio-economic aspects of agroforestry be more fully understood. This final step needs to be designed to complete the information circle, giving data back to the on-station researchers. If attention is given to plan the full cycle of research and trials and the effective information flow, the speed of providing socially appropriate agroforestry interventions and their adoption will be greatly enhanced. It is only through this testing of methods and information that technical and social scientists can refine their tools and interventions to be, in fact, relevant. Trainers of extensionists are going to have to stay abreast of this dynamic field as more is learned about tree specific issue in different settings. Agroforestry extension agents will need to be trained to approach extension as a service which makes information available and encourages farmers themselves to experiment and to actively participate in the adaption of research results to fit their needs.
The use of agroforestry in the overall development context needs to be critically assessed. Agroforestry cannot become the development tool of choice only when poor land-use practices by commercial loggers or by poorly designed irrigation or other large-scale agricultural schemes have left denuded hillsides or salt marshes. Policies need to be designed to support agroforestry as an integral part of better land-use planning and to strengthen access to these new technologies for the poor not only on wasted lands.
Agroforestry offers solutions to many problems. Its promises are extremely encouraging and attractive. However, as a development tool, agroforestry will be helpful only if it can be put effectively into the hands of men and women farmers, and if the political decisionmakers see this as a tool for achieving equity in development.

408 89 - 7/32

Agroforestry
Asia, India, review, rural development, tree planting, non-governmental organizations
SHAH, S.A.
Tree Planting for Rural People-Involvement of Non-Governmental Organizations.

The Int. Tree Crops Journal, 4, 1987. pp. 195-207

Rural tree planting differs from conventional planting in recognised forest areas in being extremely sensitive to local social and economic conditions, and designed to meet local needs rather than commercial requirements, usually in a multiple land use context. Thus, rotations are short, multiple-use trees are planted instead of timber trees, the involvement of local people is essential and the distribution of benefits to economically and socially backward people, who largely follow a non-monetarised economy, has the highest priority.

This paper reviews the experiences, assesses the requirements for improved performance and suggests ways by which these needs may be met.
Only since 1980 have international organizations perceived the need for and accorded a high priority to social forestry in India. Progress in aided project development has been phenomenal.
There is a great need for improvement. As a result of application of a poor technology package, enthusiasm and motivation suffer a set-back. A few NGOs have made a beginning in organising training programmes. But they leave much to be desired. The course content is not properly identified and the training material not developed adequately. The trainers are field personnel who themselves need training.
Almost all the NGOs find it difficult to procure quality seed and planting material. Some of them are exploited by unscrupulous traders in this matter. Similarly, quite a few of them who are involved in nurseries find it difficult to dispose of the seedlings raised by them. As such, a tie up with the consumers is essential.
Tree planting activity needs continuous and sustained attention. This requirement demands strong local institution support.
A few NGOs find it difficult to deal with Governments to ensure a timely and a steady delivery of inputs they are eligible for, such as planting material etc..
Tree planting activities should start with education strongly supported by audio-visual aids. It is this which should secure full commitment of the local groups and NGOs. Forest Science Centres should be established to develop and provide appropriate literature, conduct tours to demonstration areas, organise discussions, screen suitable films, etc. Care should be taken to ensure that women and children take full advantage of the programmes. Backyard planting is one of the most attractive and appealing components of tree planting. It is women who need to be motivated. Nursery raising is another activity very well suited to women. Greater progress is achieved if a village-level forester is accessible to the local group all the time.
Establishment of a village level institution is a priority. It is essential that the local group entrusted with the planting responsibility be highly motivated. The NGO should provide managerial support to the local groups and will need to build up its own capabilities and evolve a suitable structure, as and when its activity expands laterally, so that it is able to guide, oversee and monitor the activity. None of the existing NGOs has developed such a structure so far. Very few farmers' tree societies or cooperatives have been formed. Cooperatives are needed for timely delivery of inputs and financial assistance, securing loans and sharing equipment.
Training will have to be designed for different target groups. A few NGOs and state governments have made efforts to design suitable courses but a lot remains to be done. There is a great deficiency of training materials and competent trainers. All NGOs suffer from inadequacy of trained personnel. Regional, state and national seminars would bring NGOs together and ensure better coordination and cooperation.

409 89 -7/33

Agroforestry
Asia, India, ICRISAT, semi-arid tropics, report, agroforestry research, recommendations
VAN DEN BELDT, R.J.
Agroforestry research in the semi-arid tropics.

ICRISAT, India, A report on the working group meeting, ISBN-92-9066-116-x, 1986, 55 pp.

The genuine needs of the poor for fuel and fodder, the needs of subsistence farming, and neglect of soil and water conservation principles in these fragile environments have all contributed to the rapid decline of forest cover in India.
Inappropriate agricultural and forestry production systems and population growth (animal and human) outstripping production lead to land degradation. The problem is severe in the tropics, where the presure of population is high, ecosystems fragile, and exploitation of forest cover ruthless. The consequence is that wood supplies are dwindling.
The effects trees have on crop production call for intensive scientific studies. The competitive effect for moisture, nutrients, and light in a mixed crop and tree culture, the problems of pests, diseases, and birds, and the effects -- long and short term -- on soil and water conservation are all important aspects, which assume great importance in agroforestry studies especially under the rainfed conditions of the SAT.
Agroforestry research should emphasize: (1) increasing productivity of marginal lands in both the dry and wet-dry SAT, wastelands (or wasted lands), and land affected by salinity and alkalinity; (2) monitoring nutrient recycling and nutrient and moisture depletion from soil profiles by agroforestry mixes; and (3) developing systems relevant to farmers and adaptable by them.
A workshop was held at ICRISAT Center on 5 and 6 August 1985, with discussions designed to assist in exploring the potential of agroforestry in the semi-arid tropics.
The workshop brought together participants from Indian industries, research institutes, universities, and nongovernment organizations (NGOs), as well as representatives from foreign aid missions, ICRISAT, and the International Council for Research on Agroforestry (ICRAF, Nairobi) to share ideas, methodologies, and results on agroforestry research.
The objectives of the workshop were:
- To review agroforestry research under way in India.
- To foster dialogue between the various sectors, in order to facilitate development in the semi-arid tropics.
- to prepare broad guidelines on priorities for agroforestry research in the semi-arid tropics.

The contents of this report are:
- Foreword
- Preface

- Position Papers
  . Agroforestry Research - An Introduction
  . Making Agroforestry Research Relevant to the Needs of Small Farmers
  . International Funding Agencies and Agroforestry Research
- Working Group Recommendations
  . Bioscientific Research
  . Socioeconomic Research
- The Indian Program
- The ICAR Program
- The Role of Industry
- The Role of Nongovernment Organizations
- ICRISAT's Program
- Collaboration and Linkages
- Appendix: List of Participants

Although the workshop was traditionally structured, with topical sessions, discussions, working groups, and plenary sessions, this volume does not closely follow that structure. As such, it is not a proceedings but rather a report on the workshop.
No formal papers as such were presented; rather, summaries of research methodologies and objectives of the various institutions were outlined. In preparing this report, therefore, more emphasis has been placed on the content of the papers rather than on authorship.

410 89 - 7/34

Agroforestry
Tropics, sub-tropics, agroforestry systems, nitrogen fixing, legumes, actinomycete associations, shrubs, crops, animals, fodder, green manure, fuelwood, pulp, timber, shade, windbreak, soil amelioration, multiperpose trees, deforestation
BREWBAKER, J.L.
Significant nitrogen fixing trees in agroforestry systems.

In: Agroforestry: Realities, possibilities and potentials; Ed. H.L. Gholz, Martinus Nijhoff Publishers in association with ICRAF, ISBN 90-247-3591-2 (paperback), 1987, pp. 31-45

N-fixation characterizes most legumes (over 90% of mimosoids and papilionoids, and 34% of caesalpinioids). At least 90% of these represent tropical centers of origin. Selected genera in 9 other plant families also fix nitrogen: *Betulaceae, Casuarinaceae, Coriariaceae, Cycadaceae, Elaeganaceae, Myricaceae, Rhamnaceae* and *Ulmaceae*. Legume N-fixing nodules are rhizobially infected, while those of the other families involve actionomycetes of the genus Frankia. Nitrogen fixation characterizes about 650 known tree species and several thousand suspected ones.
The list of potential NFT species for use in agroforestry is expanded greatly if one generously includes all plants from which wood is an economic product. Many N-fixing species are shrubs or secondary forests and grasslands. They often lend themselves

better to crop- and animal-based agroforestry systems than the premier forest trees do. In this paper NFT are divided in:
- Fodder trees:
- Alley farming and nurse trees:
- Fuelwood and charcoal trees:
- Food and medicinal trees:
- Windbreak and fence row trees:
- Pulpwood and roundwood trees:

These groups of NFT are discussed in detail.

411 89 -7/35

Agroforestry
Asia, Thailand, land-use systems, forst village, reforestation, taungya method
WATANABE, H. et al.
Combinations of trees and crops in the taungya method as applied in Thailand.

Agroforestry Systems, 6, 1988, pp. 169-177

Agroforestry systems, particularly those using the taungya method, have been initiated to rehabilitate large land areas abandoned after over-use (i.e., shifting cultivation or overlogging), in southeast asian countries. The taungya method has been applied to regions where it was never traditionally practiced. It is usually defined as a reforestation method in which trees and agricultural crops are simultaneously planted at the initial stage of reforestation and later only trees are left to complete reforestation.
In Thailand a government enterprise, began establishing Forest Villages to accelerate reforestation efforts in 1967, and the taungya method has been introduced as the primary reforestation method. At present, forty one Forest Villages have been established throughout the country.
The objectives of the Forest Village Programme are to resettle landless people and establish sustainable agriculture in each forest unit. Each family member is allotted a 10 rai (1.6 ha) plot of land in a reforestation area to raise their crops simultaneously with tree planting and another 1 rai (0.16 ha) in a forest village on which to live, build a house and establish a backyard garden. All lands allotted belong to the Forest Industry Organization but cultivators can use the land without cost within the specified time limit.
In addition to growing agricultural crops as a source of income, labour for forestry work is recruited from the villages to ensure continuous employment for additional income. Therefore, this system is called a "modified taungya system" in Thailand.
Since the establishment of the programme, many trials of introductions of exotic trees and agricultural crops have been conducted, and various combinations of trees and crops have been tried. As a result, the remarkably fast growth rates of several trees species, such as *Eucalyptus camaldulensis*, have been

selected, and these are widely recommended for planting throughout the country. Planting of eucalyptus is an effective measure to recover green as quick as possible, however, when trees attain age of cutting, it is doubtful whether enough demand is there.
The combinations of trees and crops in the taungya method which have been practiced in the Forest Village Programme differ from village to village, and even more so from region to region due to the differences in climate, soil fertility, market demand, and skills or preferences of the cultivators involved.
Combinations of trees and crops in the taungya method are probably best classified into the following four main types reflecting the differences in climatic conditions, though there are various other combinations of trees and later crops on a lesser scale:
Type A: Teak (*Tectona grandis*) - Upland rice - Vegetables
Type B: Fast-growing trees - Cassava
Type C: Fast-growing trees - Maize
Type D: Para-rubber (*Hevea brasiliensis*) - Fruit trees/coffee
Fast-growing trees *Dipterocarpus alatus*
In the taungya method practiced in Thailand, one main tree species and one main crop, namely, cereals like upland rice, maize, sorghum, or cash crops like cassava and fruit trees are usually inter-planted in a given area. Additionally, beneath the cereals or fruit trees, various kinds of vegetable subcrops (e.g. pumpkin, chili and beans) or other cash crops (e.g. pineapple, mungbean or castor bean) are often inter-planted.
Tree and crop combinations are changed depending on the season. Maize is usually cultivated in the rainy season, from May to August. After the maize is harvested, sorghum is planted where the maize was grown in reforestation areas in the west region. Sorghum is more tolerant to drought. Occasionally, maize and sorghum are mix-planted on the same land in the northern region.
Vegetables like beans, pumpkins and sesame, are not normally inter-planted with tall cereals, such as maize or sorghum, because those vegetables would be too shaded to yield a large enough harvest. However, vegetables are occasionally inter-planted with maize and sorghum in cases where the latter two have been sparsely planted.
The interaction between trees and crops, particularly advantages and disadvantages as a whole, should be further clarified to find much productive and stable combinations.

412 89 - 7/36

Agroforestry
Latin America, Costa Rica, CATIE, land-use systems, living fences, fuelwood, fodder, food, windbreaks, wildlife protection, trees, sustainability, ecology, cultural practices
BUDOWSKI, G.
Living fences in tropical America, a widespread agroforestry practice.

In: Agroforestry: Realities, possibilities and potentials, Ed. H.L. Gholz, Martinus Nijhoff Publ. in Cooperation with ICRAF, ISBN 90-247-3591-2 (paperback), 1987, pp. 169-177

Living fence posts are a characteristic feature of the landscape of many tropical American countries from sea level to well above 2500 meters, and from relatively dry environments to some of the very wettest areas (over 4000 mm annual rainfall). As here described and analyzed, living fences refer only to those that are established by planting large cuttings (usually about 2.5 m long and from 8-20 cm in diameter), that easily produce roots and on which several strings (usually 3) of barbed wire are attached with the obvious purpose of keeping livestock in or out. Besides fencing, many other possible benefits are derived from the trees, including the production of various goods and services. Although publications in this area are few, a pioneer research effort has been carried out in recent years at the Tropical Agricultural Center for Research and Training (CATIE) in Turrialba, Costa Rica. More recently, studies on the best frequency of pruning *Gliricidia sepium* for fodder and current management practices of farmers for preparing *Gliricidia* cuttings and planting showed other promising lines of research. Moreover, various CATIE staff members have been producing information on species selection, productivity, socio-economic implications, advantages and drawbacks of live fences compared with "dead" fences.
Besides holding wire, live fences produce fuelwood, fodder, and food, and act as windbreaks and protection for wildlife, but the greatest benefit is derived from the use of branches to establish more fences or to "fill in" old fences. Many trees are used, depending on ecological zones, availability of large cuttings for planting, and special needs dictated by preferences and beliefs of the farmers. Planting practices, studied in detail in Costa Rica, also vary.
With a decreasing supply of naturally resistant wooden posts, formerly cheap and easily available, and the prohibitively high cost of artificially treated posts, living fences are bound to become more common. If one adds the other secondary products that can be derived, this appears to be a remarkable instrument for improving the quality of life of low-income farmers.
To this must be added the fact that very little effort has been made to genetically improve the most desirable fence post species for vigor, biomass production, pruning response, nitrogen fixation, form, and so on. An important factor that lends itself to genetic selection is the relationship between wood and leaves,

which could be modified depending on whether stakes, fuelwood or a large amount of leaves are desired.
This paper attempts to summarize the present information.
Advantages and drawbacks of living compared to non-living wood fences are discussed. Some speculations of future prospects and the possible involvement of scientists are advanced.

413 89 - 7/37

Agroforestry
Latin America, Peru, humid tropics, land-use systems, ecology, swidden-fallow, management practices, fallow utilization, site nutrient recovery
UNRUH, J.D.
Ecological aspects of site recovery under swidden-fallow management in the Peruvian Amazon.

Agroforestry Systems, 7, 1988, pp. 161-184

Mechanized farming does not necessarily provide permanently greater agricultural yields in energy-limited tropical countries. This has re-focused scientific interest on traditional subsistence farming systems which are able to provide sustained yields.
Recent research attests to the ecological viability of swidden (cyclic, or slash and burn) agriculture at appropriate levels of population. In fact much attention is currently being placed on improving shifting cultivation - in order to cope with increasing population pressure rather than trying to replace it.
A problem with fallowing as a means to overcome agriculture difficulties in the cropping cycle, is that it requires a great deal of time; time that is traditionally spent in an unproductive state.
This paper discusses the ecological "fit" of an existing fallow utilization scheme in Peruvian Amazon in the context of the changes in plant succession and nutrient dynamics which result in a favourable site nutrient recovery.
Following a brief description of the fallow management scheme, information is drawn from the author's observations in the Iquitos region of Peru and from the ecological literature to explain how management practices interact with specific aspects of swidden ecology - from the point at which the field is cleared, through the phases of burning, cultivation, harvesting, site abandonment, and distinct stages of succession - to allow a variety of economic fallow plants to thrive while setting the stage for continued favourable re-use of managed sites.
The ecologic attributes involved in promoting site recovery primarily include:
- Less destruction of the nutrient cycling root-mat in the swidden cycle, and its quicker re-formation in the fallow cycle.
- Discouraging the establishment of exotic weeds and grasses such as imperata, while encouraging the colonization of local, early successional species.

- Encouraging the earlier establishment of woody plants in abandoned swiddens.
- A natural litterfall higher in nutrients than in unmanaged fallows.
- Additions of "slash" litterfall higher in nutrient content than natural litterfall in the proximity of valuable managed plants.
- The increased capacity of the managed stand to limit nutrients such as N and P from, and leach unneeded quantities of non-limiting nutrients such as K, Ca and Mg to, thoughfall.
- Increasing the alkalinity, possibly resulting in less soil cation leaching in managed fallows.
- Staggering seed production, germination and maturation times of the rapid nutrient cycling softwood trees.
- Increasing the spontaneously occuring abundance of valuable fallow plants with management of successive fallow cycles, thereby possibly reducing the labour requirement, and increasing the value of this agroforestry scheme over time.

Development of the techniques of swidden-fallow management into a workable agroforestry system necessitates consideration of the ecologic relationships between the productive managed fallow and the productive swidden. The fallow period serves to reduce problems of soil impoverishment, diseases and weeds. Utilization of the fallow cycle ideally should either enhance or maintain the natural ability of the fallow to overcome these agricultural problems.

414 89 - 7/38

Agroforestry
Latin America, Brazil, semiarid woodlands, clearcutting, goat, sheep, nutrition, leaf litter production, herbage production, herbage chemical composition
KIRMSE, R.D. et al.
Clearcutting Brazilian caatinga: assessment of a traditional forest grazing management practice.

Agroforestry Systems, 5, 1987, pp. 429-441

Caatinga is the name of the vegetation growing in the semiarid portion of northeastern Brazil. This vegetation type covers approximately 830,000 km² of the region referred to the Northeast and constitutes about 10 percent of the total surface area of Brazil. Generally, caatinga is composed of trees and shrubs with an understory of annual herbs. Production of sheep and goats under extensive grazing programs is an integral component of the mixed-farming system of the Northeast and provides a source of dietary protein and cash reserve for subsistence farmers. Sheep and goats are dependent on caatinga vegetation for survival and production. The seasonality of rainfall and periodic droughts, however, place severe constraints on the dry season forage supply and resultant production of these small ruminants.
Clearcutting, a common practice for removing woody vegetation in the semiarid tropics of northeast Brazil is currently promoted at

state and national levels. The prevalent belief is that clearing increases the capacity to support livestock by increasing production of herbaceous vegetation. Little empirical evidence exists, however, to support this belief. African and Australian researchers report impressive increases in herbaceous yields after reducing overstorey canopies.
In northeast Brazil, increasing herbaceous production during the wet season, a time when forage quantity and nutritional quality are not generally limiting, may not enhance livestock production during the dry season, a time when forage quantity and nutritional quality are often limiting. In addition, leaf litter from trees is an important forage reserve during the dry season. Conversely, coppice produced by most tree species in this area following cutting still contributes, although to a lesser degree, to dry season forage reserves. Furthermore, many trees may enhance livestock production, provided the foliage is both palatable and nutritious.
The overall objective of the research program is to assess the validity of clearcutting as a means for increasing livestock production in caatinga woodlands. The study investigated the effects of clearcutting on forage production and quality throughout the year for small ruminants in the semiarid tropics of northeast Brazil. Specific objectives were to determine the effects of clearing on (1) herbage standing crop and chemical composition; (2) nutritive value of the vegetation to goats and sheep; and (3) botanical composition of the diets of goats and sheep.
It has been found that biomass of herbaceous species increased sixfold following cutting of trees, but much of this increase was in the form of poorly palatable stem. The large supply of leaf litter from woody species that was typical of uncleared areas during the dry season was replaced by persistent green foliage on cropping trees the year following clearing. This green foliage may enhance the nutritional quality of the diets of sheep and goats during the dry season.
Additional research is needed to determine whether or not the nutritional quality of trees that coppice is adequate for meeting small ruminant requirements during the dry season and whether or not palatability can be increased, perhaps through repeated cutting or fertilization or both. While this study attempted to assess the value of clearcutting to small ruminant nutrition in caatinga woodland, it did not attempt to address the question of ecological changes (e.g. water, soils, plants) that may or may not accompany clearcutting. That is an important next step prior to designing national grazing management policy in northeast Brazil.

415 89 - 7/39

Agroforestry
Review, humid and subhumid tropics, ILCA, IITA, alley cropping, land-use systems, soil management, soil fertility, planted fallow, sustainable crop production, farming systems, outlook
KANG, B.T. and G.F. WILSON
The development of alley cropping as a promising agroforestry technology.

In: Agroforestry - a decade of development, Eds. H.A. Steppler and P.K.R. Nair, ICRAF, Nairobi, Kenya, 1987, pp. 227-243

To meet the ever-increasing demand for food in the tropical and subtropical (developing) countries, more land must be brought under cultivation. This is feasible for much of Africa and Latin America where only 18 and 19 percent, respectively, of the potentially-arable lands are under cultivation. This will, however, provide only a temporary solution to the food-production problem if it is not followed up by viable and sustainable food-production technologies.
In alley cropping, arable crops are grown between hedgerows of planted shrubs and trees, preferably leguminous species, which are periodically pruned to prevent shading the companion crop(s). The shrubs and trees grown in the hedgerows retain the same functions of recycling nutrients, suppressing weeds, and controlling erosion on sloping land as those in the bush fallow. Prunings from the trees and shrubs are a source of mulch and green manure. Leguminous woody species also add fixed nitrogen to the system. The alley cropping technique can, therefore, be regarded as an improved bush-fallow system with the following advantages:
- Cropping and fallow phases are combined;
- Longer cropping period and increased land-use intensity;
- Rapid effective soil fertility regeneration with more efficient plant species;
- Reduced requirements for external inputs; and
- The system is scale-neutral, being flexible enough for use by small-scale farmers and for large mechanized production.

By integrating small-ruminant production with alley cropping, the International Livestock Centre for Africa (ILCA) project in Ibadan, Nigeria, has developed the alley-farming concept in which prunings from the hedgerows provide high-quality supplementary fodder. So alley farming can be defined as the planting of arable crops between hedgerows of woody species that can be used for producing mulch and green manure to improve soil fertility and produce high-quality fodder.
Various field trials were carried out by IITA scientists over the past ten years on strongly acid soils (Ultisols) and slightly acid soils (Alfisols) in the humid and subhumid regions of Nigeria to test the suitability and benefits of alley cropping.
On Alfisols and associated soils *Leucaena leucocephala* and *Gliricidia sepium* were the most promising woody species for alley cropping and alley farming. They can be established by direct seeding in association with a growing crop. Once established, the

hedgerows can be repeatedly pruned to produce large amounts of biomass that can be used as green manure, mulch or fodder.
Even on degraded land, *L. leucocephala* and *G. sepium* prunings had higher nutrient yields than those of some widely used native fallow species such as *Acioa barterii* or *Alchornea cordifolia*. The high nutrient yields are maintained when prunings are added to the soil. However, under a cut-and-carry system where prunings are continuously removed as fodder, the soil can also become improverished unless nutrients from other sources are added.
The performance of maize, cassava and cowpea in alley cropping with *L. leucocephala* and *G. sepium* has been studied. Higher maize and cassava yields were obtained when alley cropped than in control plots. It is estimated that *L. leucocephala* can contribute about 40 kg N ha^{-1} to the companion maize crop. Cowpea yield, however, showed either no increase or reduction in yield when alley cropped with *L. leucocephala*. Upland rice alley cropped with *L. leucocephala* does not respond to added fertilizer nitrogen, but the control plot (not alley cropped) responded to 30 kg of applied nitrogen per hectare.
An important aspect of alley cropping is how it affects yield sustainability. Under long-term observations on a sandy soil, maize yields were significantly higher when alley cropped with *L. leucocephala* than in control plots with or without applied nitrogen. Similar results were observed in long-term alley cropping trials on degraded Alfisols. With or without applied nitrogen, maize yielded more when alley cropped. This trial also showed that, in addition to nitrogen, improved soil conditions resulting from alley cropping had a positive effect on maize yields.
Results of long-term studies showed significant improvement in soil properties under alley cropping. These soils had higher soil organic matter and nutrient status than in soils receiving no prunings. Prunings added as mulch also substantially increased moisture retention in the topsoil.
The development of a sustainable production system suitable for large parts of the subhumid and humid regions, particularly in Africa, will have the additional benefit of reducing the land area needed for food production. Expanded alley cropping could help to arrest rapid deforestation.

416 89 - 7/40

Agroforestry
Africa, humid regions, ILCA, agroforesty, alley farming, hedgerow intercropping, *Leucaena*, evaluation
SUMBERG, J.E. and A.N. ATTA-KRAH
The potential of alley farming in humid West Africa - a re-evaluation.

Agroforestry Systems, 6, 1988, 163-168

A previously published paper examined the potential of a *Leucaena leucocephala*/maize alley farming system (hedgerow intercropping)

for the lowland humid tropics. Using data from the literature, the potential nitrogen and firewood contributions from the Leucaena hedgerows and the productivity effects on maize yields were estimated for a range of alley widths (between-row spacing of Leucaena) and maize yield environments. With the assumption that a 30% increase in maize productivity would be needed to motivate farmers to adopt a new technology such as alley farming, the paper concluded that alley farming would be acceptable only where existing maize production levels are lower than 1500 kg ha^{-1}. In addition, alleys wider than approximately 3 m would probably not be acceptable where existing maize production levels are greater than 1000 kg ha^{-1}.

This analysis suggests that alley farming is a potentially valuable crop production technology over a broad range of conditions in humid West Africa.

The central assumptions of the alley farming approach that the trees can draw and recycle nutrients from the lower levels of the soil profile, and that the trees can be managed in a way that minimizes competition with the crop have now been reasonably well documented. Further research and development with alley farming should be focussed on adapting this approach to local crop production conditions. It is ultimately of little value, for example, to investigate various pruning regimes which attempt to maximize the amount of mulch produced, when under farm conditions time and frequency of pruning are determined rather ridigly by the need to minimize shading of the crop. Similarly, height of pruning will probably be determined more by considerations of ease and speed than by pruning effects on re-growth and the life of the tree.

ILCA's experience in West Africa indicates that the work of adapting alley farming to local conditions can probably be done most effectively by the farmers themselves. The potential of alley farming can be realized through true "adaptive research", where farmers and researchers, working together, attempt to adapt a loosely defined technology to suit a range of farmers' needs and production environments.

VIII HOMEGARDENS

417 89 - 8/15

Homegardens
Review, developing countries, homegardens, household garden, CIP, garden types, ecology, sustainability, socioeconomy, practical approaches, policy
NIÑEZ, V.K.
The household garden as a lifeboat.
Ceres, 19, 112, 1986, pp. 31-36

Home garden programmes aimed at nutritional improvement of low-income groups in developing countries have been launched repeatedly during the past 25 years.

Failure to transfer model gardens was blamed on the clients' lack of interest rather than on the project's shortcomings. This "start and stop" pattern finally caused gardens to be discredited as a valuable food and nutrition strategy for developing countries.

Recently, interest in small-scale food production has come up, and advocates of the home garden strategy are looking for new avenues to make it work.

Household gardens have come to address many pressing development concerns. They help overcome seasonal or chronic food shortage, distribution bottlenecks, and high food costs. Low-technology and resource-wise production methods save energy and help reduce dependence on food imports. Native food gardens represent truly appropriate technology, a highly personalized self-help measure and a vital mechanism in the preservation of underexploited species. Furthermore, as gardens traditionally exist in space that is marginal and not in competition with large-scale field production, they help confront the problem of increasingly scarce new land ecologically sound for agricultural exploitation.

The tropical garden, is marked by high species density arranged in several vegetation "layers". This gives tropical homesteads the unkempt appearance that often misleads temperate gardeners to undue prejudice. Layering, in fact, is highly functional in tropical ecosystems: it prevents soil erosion, nutrient washing, and sun baking; it provides for beneficial plant symbiotic relationships (support, nutrient exchange, disease control), and it supplies a great variety of foods.

Household gardens differ depending on the type of household economy they serve. Subsistence farming households derive the bulk of their food from permanent or shifting field cultivation nutritionally complemented by mixed garden and field margin plantings. Garden staples often replicate field staples (in the case of maize, starchy roots, and tubers), but may be planted at different times and for immediate consumption.

Garden production supplements wage earnings for urban and rural labourers and helps stretch family income through savings. In Lima, Peru, for example, urban budget gardens produce the equivalent of 10 per cent of monthly wage earnings for low-income

for the lowland humid tropics. Using data from the literature, the potential nitrogen and firewood contributions from the Leucaena hedgerows and the productivity effects on maize yields were estimated for a range of alley widths (between-row spacing of Leucaena) and maize yield environments. With the assumption that a 30% increase in maize productivity would be needed to motivate farmers to adopt a new technology such as alley farming, the paper concluded that alley farming would be acceptable only where existing maize production levels are lower than 1500 kg ha^{-1}. In addition, alleys wider than approximately 3 m would probably not be acceptable where existing maize production levels are greater than 1000 kg ha^{-1}.

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VIII HOMEGARDENS

417 89 - 8/15

Homegardens
Review, developing countries, homegardens, household garden, CIP, garden types, ecology, sustainability, socioeconomy, practical approaches, policy
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The household garden as a lifeboat.
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households. Only if earnings are high and retail markets close, can gardening become a hobby not necessary for household survival. Consequently, garden cropping lists were compiled utilizing Eurasian vegetables for which nutritional analyses and field horticultural technology existed. Often, no attempt was made to investigate locally grown or collected fruits and vegetables. Northern Hemisphere gardening techniques and inputs frequently not available in target areas were exported as a package.
Serious efforts for formulating successful, long-term programmes must consider the following guiding principles:
- Household food production must be given higher priority and must be treated as a serious development objective in its own right. To be successful, household food production has to be understood in its full complexity involving production, processing, storage, preparation, and consumption all performed by the same unit. Home garden programmes, therefore, must be carried beyond often spontaneously organized women's clubs and children's groups and given better preparation and longer project duration, addressing individual household units.
- Project objectives must be clear and simple. Specific approaches cannot expect general results while a general approach (food production) may bring about specific results. Thus, the major focus of promotional campaigns should be food production.
- Existing garden infrastructures must be researched. If water, soil, inputs (seed, chemical), time, or space are not available or affordable, "pushing" a garden project makes little sense in the long run. What might be considered by Third World governments is an allotment policy - similar to the European experience which offers garden space and infrastructure on long-term leases at low cost.
- Ecological, economic, and cultural feasibility of cultivars must be considered. Species selection and programme design must take into consideration household needs and objectives. A basic principle for producers, whether small or large, is: if it costs it has to earn. Vegetables that require costly inputs (so-called urban vegetables) may be sold rather than consumed at home, leading to neglect local species, which as a rule have greater overall nutritional value with lower production cost and established processing, storage, and consumption patterns.
- Appeal, extension, and advertising must be priority elements in project design. Home garden promotion should not limit its audience to "the poorest" or temporary disaster situations but should appeal to wider social strata on a permanent basis. Extension efforts must be structured to meet the educational level and interest of population segments addressed.
Though often limited in supplying all household needs, gardening is still vital for the survival of resource-poor households throughout the developing world. As a cost-effective approach for development agencies and clients alike, household food production is one of the best strategies at disposal.

418 89 - 8/16

Homegardens
Asia, Philippines, developing countries, case study, vegetable production, farming systems research, upstream research
CALDWELL, J.S.
Assessing Rainy Season Vegetables Production Alternatives: a Case Study in "Upstream" Farming Systems Research".

Trop. Vegetable Inf. Service, Techn. Bulletin No. 16, AVRDC Publ. No. 86-260, ISBN 92-9058-0024-3, 1986, pp. 30

Within FSR/E, a distinction is made between "upstream" and "downstream" FSR/E. "Upstream" FSR/E refers to crop and/or animal research based on diagnosis of farm conditions, but done on-station. It is designed to generate prototype solutions that can be further adapted to each recommendation domain in the target region where the diagnostic work is done. "Downstream" FSR/E, on the other hand, refers to crop and/or animal research done on-farm. In many cases, diagnosis can lead directly into "downstream" research, if available technology from previous station matches farm family priorities and constraints. Where such station technology is not available, however, "upstream" research may be needed to provide technology alternatives for "downstream" on-farm testing.
For the past 10 years, the Asian Vegetable Research and Development Center (AVRDC) has worked to expand the range of technology alternatives for vegetable crops in Southeast Asia. In a very broad sense, all of AVRDC's work could be called a type of "upstream" research for Southeast Asia as a whole.
AVRDC research is aimed at two different types of clientele. The first type is specialized vegetable producers, usually located either in highland areas or around large urban centers in Southeast Asia. These producers are highly commercialized and can readily utilize new, advanced technology. There is less need to take a system' approach to the introduction of new technology for these specialized producers.
The other type of clientele served by AVRDC are diversified, small-scale producers. These farm families grow vegetables as one component of a complex mix of activities, including staple crops, fruits, animals, fuelwood plots, and non-agricultural activities. Their objectives in growing vegetables include both sale and home consumption.
For these clientele, a systems approach is essential, in order to target opportunities for technology development most likely to be compatible with all the diverse activities and goals that comprise their farming systems.
The study reported here is one part of the AVRDC Development Program effort. It built on the earlier work by Calkins and colleagues in Taiwan, and sought to expand its scope, both in methodology and in target area. The study was conducted with the goal of developing a methodology for integrating surveys of vegetable production, consumption, and marketing with experiments based on AVRDC crop managment research. The target area was two

municipalities in Ilocos Norte, Philippines. The study had begun in 1978 with the stated objective of assessing the potential for increased rainy season vegetable production within the context of the "farmer's system".
The case study is presented with three objectives. First, it documents one way in which AVRDC has sought to develop farming systems methodology for its diversified clientele. Second, it provides an example of the application of some of the tools of farming systems analysis to a vegetable-centered problem. Third, it illustrates the importance of policy and infrastructure support.
The problem was limited availability of vegetables in the rainy season, in an area where vegetables are important in the diet. Survey data and observations were combined with rainfall pattern data and previous crop management research to select four crops for "upstream" production experiments. The four crops were common cabbage, tomato, mungbean, and sweet potato.
The survey techniques used in this study had strengths and weaknesses. Their strengths were in the use of secondary data, both environmental and market. Their weaknesses were over-reliance on formal methods and inadequate use of more open-ended questioning. Open-ended questioning within an interview guide format allows better insight into farm family member perceptions, while retaining a useful degree of structure and comparability.
This study focused on the main farmer of each household. With the exception of a few female-headed households, this meant only the male "farmer". The term used at the conception of this study, "farmer's system", reflected that focus.
The economic analysis of this study is an example of what is now called "ex ante" analysis in FSR/E. That is, the economic analysis is done "ex ante" (meaning "prior to") a program of on-farm trials.

419 89 - 8/17

Homegardens
Asia, Southeast Asia, study, vegetable production, permanent compost beds, soil fertility, sustainability, low-input system
STEARN, W.C. and CHEN, L.C.
Feasibility Studies on the Use of Permanent Composting Beds for Intensive Vegetable Production in Southeast Asian Countries.

In: AVRDC Publ. No. 87-273, ISBN 92-9058-028-3, AVRDC, Shanhua, Tainan, Taiwan, 1988, pp. 40-47

The addition of composted organic matter to the soil has long been recognized as an essential component of any good cropping system to maintain good soil tilth, release plant nutrients over the growing season, maximize yield, retain soil moisture, etc.
Composting is done on a commercial scale in Taiwan for mushroom growing, and to a lesser extent for agricultural use. The more traditional labour intensive methods are being replaced with inorganic chemical fertilizers, pesticides, and herbicides.

Traditional methods, however, are still being practiced on subsistence type farms.
Realizing the importance of maintaining organic matter, especially in the tropics, a composting component was initated in the Garden Program at the Asian Vegetable Research and Development Center (AVRDC) in Tainan, Taiwan.
This component was eventually dropped due to the unfamiliarity with the process of composting as well as the lack of enthusiasm for turning piles in the hot tropical sun.
A modified sheet composting method was designed to eliminate the intensive labour requirement usually associated with more traditional composting methods. The objectives of this project were to determine the feasibility, cost, water requirements and impact of this type of sheet composting within the Home Garden Project objectives.
The compost-growing beds were designed to be constructed once and then maintained with the addition of organic household or agricultural waste materials.
Some of the general concepts employed came from traditional sheet composting methodology, layering composting techniques as well as methods described by Permaculture movement in Tasmania.
Results showed that compost-beds allow tremendous root penetration and proliferation, thus, allowing optimal nutrient feeding. Generally, the composting/planting bed concept, with reduced labour input, potentially reduced watering requirements (due to the high organic matter content), gave good yield, better insect and disease resistance, and the ability to plant high density crops year-round, appears to have potential for tropical areas. The evaluation of this type of growing bed, however, is still in the early stages and overall recommendations cannot be made yet.

420 89 - 8/18

Homegardens
Review, handbook, tropics, vegetable production, homegardens, garden tools, type of garden, cultivation practices, soil fertility, propagation methods, seeds, watering, crops, diseases, pests
AGROMISA
The vegetable garden in the tropics - with special reference to Africa.

Agrodok 9, pp. 54, Agromisa, P.O.B. 41, 6700 AA Wageningen, The Netherlands

Agromisa is a volunteer organization of students and graduates of the Agricultural University Wageningen, the Netherlands.
Agromisa aims at improving the position of socially and economically underprivileged groups in developing countries by transferring agricultural knowledge to those organizations and persons who are working for the benefit of these groups.

Agromisa co-operates with the TOOL Foundation, the Dutch umbrella organization whose participating groups together cover the fields of tropical agriculture, technology and health.

The booklet mentioned above contains the following chapters:
- Why gardening?
- Fruits and vegetables in the diet
- Which type of garden?
- Garden tools
- Preparing the site
- The best site for a garden
- Size and design of the garden
- Clearing the site
- Cultivation of the soil
- Preparing the beds
- Fences
- Soil improvement
- Soil conditioning
- Plant nutrients
- Organic manure
- Chemical fertilizers
- Crop rotation
- Sowing and propagation by cuttings
- Seeds
- Sowing in situ
- Sowing in a nursery
- Transplanting
- Taking cuttings
- From sowing to harvest: techniques of cultivation
- Watering
- Control of diseases, insects and other pests
- Other techniques of cultivation
- Choosing the right crops
- Bibliography

This booklet does not pretend to be an original work. It is an anthology of the literature mentioned in the bibliography. Especially "Le jardin en zone tropicale" is quoted frequently.
The main objective of this Agrodok is to serve as a general manual for those who practise or teach gardening in developing countries.

421 89 - 8/19

Homegardens
Asia, Philippines, China, developing countries, food production, sustainability, small-scale households, low-input system, recycling, space-intensive, labour-intensive, water conservation, appropriate technology, nutrition, pest control, genetic resources, ecology
GONSALVES, J.F.
Characteristics of the Bio-intensive Approach to Small-scale Household Food Production.

AVRDC Publ. No. 87-273, Proc. of the Vegetable Improvement Gardening Workshop; AVRDC, Shanhua, Tainan, Taiwan, ISBN 92-9058-028-3, 1988, pp. 93-99

The bio-intensive approach, as the name suggests, is a biological (as opposed to chemical) form of agriculture in which a small area of land is intensively cultivated with the use of nature's own ingredients to rebuild and then maintain the soil's productivity. At the heart of the approach is the effort to improve the soils capability to nurture and sustain plant life. What a bio-intensive gardener tries to do on his small plot is to stimulate or replicate a natural forest (with the constant recycling of nutrients and maintenance of soil, moisture, and microbial conditions). Many countries of the world (and China is particularly notable) have farmed biologically for thousands of years and have been able to sustain output levels over those years. In sharp contrast the "efficient" but short-sighted approaches being used in many Western and Third World countries have often been disruptive of the natural resource base.
Farmers in many parts of the world are experiencing the fact that they have to use steadily increasing quantities of fertilizers and pesticides to sustain previous yield levels.
In the bio-intensive approach being recommended here for small-scale plots, the soil is gradually enhanced and the composition of beneficial microbial life actually improves from season to season. The soil structure and humus content is also supported. The nutrient content of the soil is built up, rather than depleted, after each crop. A healthy soil means a healthy stand of plants, and that means less insects and diseases. In the bio-intensive approach, yields continue to rise for the first few years and then tend to stabilize at an overall higher yield. Such systems and the outputs (i.e. yields) are easily sustained at that level for many years with unchanging or even reduced levels of material and labour inputs.
The bio-intensive system is characterized by a greatly reduced dependence on expensive inputs that are generally used in conventional food production approaches. Many of these nonrenewable inputs, such as chemical fertilizers and pesticides, are produced at high energy costs (usually petroleum-based). Instead of chemicals, plant and animal wastes and natural mineral substitutes are used. In the methods being advocated here, the

inputs required are bones, wood ash, eggshells, compost, ipil-ipil leaf meal or fish meal.
Locally available seeds are advocated rather than hybrid and other imported substitutes. Experience suggests that it is feasible to achieve a 100% self-reliance in recurring input needs. Other than hand tools, all material inputs are usually available locally or within easy access. This reduces significantly or eliminates the need for cash outlays. It also provides the producers with a sense of control over the required production resources. Finally, by emphasizing the use of local and biological resources, rather than energy-intensive, fossil-fuel-based chemical imports, a small step is being made in the direction of conserving the world's nonrenewable resources.
The bio-intensive approach to food production at the household level differs considerably from the conventionally introduced gardening systems because of its stress on deep-bed preparation, nutrient recycling, building up of the soil's biological base, diversified cropping, and a balanced and integrated ecosystem.

422 89 - 8/20

Homegardens
Review, handbook, tropics, vegetable gardening, tools, equipment, planning, cultural practices, crops
AGUSIOBO, O.N.
Vegetable gardening.

Macmillan Publ. Ltd., London, UK, ISBN 0-333-34472-3, 1984, pp. 57

In human nutrition, vegetables are an essential protective food containing vitamins and minerals. Any balanced diet should include vegetables and fruits for this reason. The proportion of vegetables required in a balanced diet per capita per meal is of the order of 45% of the total volume of the food.
In addition to growing vegetables in gardens, it is possible to produce some in boxes, or in large pots. In some parts of the world vegetables are grown in water, without soil. This method of growing plants is called hydroponics. It requires special equipment.
This book seeks to introduce all those interested to the improved production of vegetables. This will provide greater profits for the farmer, and better produce for the domestic vegetable grower.
The author bases his writing on his considerable experience in instructing students in vegetable garden practices, and on the results of successful experiments conducted on growing vegetables in the tropics.
Simple tools for use in vegetable production are discussed, as are methods of land preparation, seed-bed preparation, storage and the cultivation of specific vegetables.
"Vegetable Gardening" is one of a series of inexpensive books which have been designed to treat a variety of individual agricultural topics in greater depth than could be expected in a general textbook. They are particularly of interest to students

and teachers in Schools of Agriculture and to students in their preliminary year at University.

423 89 - 8/21

Homegardens
Asia, Indonesia, review, historical view, homegardens, traditional system, agroforestry, soil erosion, structure, composition
SOEMARWOTO, O.
Homegardens: a traditional agroforestry system with a promising future.

In: Agroforestry - a decade of development, Eds. H.A. Steppler and P.K.R. Nair, 1988, pp. 157-169

Homegardens may have originated in prehistoric times when hunters and gatherers deliberately or accidentally dispersed seeds of highly valued fruit trees in the vicinity or their camp sites.
These ancient gardens may have originated as early as the seventh millenium BC. They were attached to temples, palaces, elite residences and the homes of the common people. The homegarden was mentioned in an old Javanese charter of AD 860.
From this very brief historical sketch there is evidence that homegardening is a very old tradition which may have evolved over a long time from the practices of the hunters/gatherers and continued in the ancient civilizations up to modern times.
This paper is not intended to present a literature review of homegardens, but rather to discuss their features, based on the author's experience in Indonesia, as related to their potential and opportunities for future development, and the associated constraints and pitfalls.
The term agroforestry denotes land-use systems consisting of a mixture of perennials and annuals, and often also animals. A major concern in agroforestry research is sustainability. It is determined by the structure of the system, its ecological functions and its continued ability to fulfil the socio-economic needs of the people. Thus, as is implied by the term, homegardens as an agroforestry system should ideally combine the ecological functions of forests with those of providing the socio-economic needs of the people. The ecological functions of forests include hydrologic benefits, microclimatic modification and soil erosion control, and genetic-resource conservation.
A prominent structural characteristic of the homegarden is the great diversity of species with many life forms varying from those creeping on the ground, such as the sweet potato, to tall trees of ten metres and more, e.g. the coconut palm, and vines climbing on bamboo poles and trees. These create the forest-like multistorey canopy structure of many homegardens.
The socio-cultural functions of homegardens have not received much attention so far. In many areas products for religious rituals and ceremonies are very important, e.g., in Bali and Thailand.
Studies in villages in West Java have shown that homegardens are an important social-status symbol. People who do not have a

homegarden and hence, have to build their house on someone else's homegarden, are considered of low status. In traditional Indonesian villages, people can freely enter homegardens, e.g., to get water from a well, or just to pass through them. Although there may be fences around them, they are seldom completely closed nor are there locked gates. The concept of trespassing does not exist. Those who close off their gardens completely are considered conceited. Fruits and other products are traditionally shared with relatives and neighbours, and products for religious or traditional ceremonies and medicine are given away freely when requested. However, this equitable social situation is now gradually changing.

Animals in homegardens are important elements in the cycling of matter. In West Javanese villages, plants, goats, sheep, horses, chicken and fish, and also man, are components of the recycling of wastes. In non-Muslim regions the pig plays the role of fish. Thus man is an integral part of the trophic system from which he obtains nutrients and income. Naturally, there is a health hazard attached to this recycling system. Therefore, although the recycling of wastes does present an excellent opportunity for the efficient use of resources and helps in the maintenance of soil fertility, it should not be accepted uncritically.

Since homegardens are a part of the total agro-ecosystem and linkages exist between them and the other parts of the system, i.e., the rice and the dry fields, their development cannot be considered in isolation.

In conclusion one can say that homegardens do have a promising future. However, while it is relatively easy to increase yields and income, there are difficult problems in achieving long-term sustainability. These difficulties are both in the biophysical and in the socio-economic realm. It is recommended to look into these problems and stimulate research to seek appropriate solutions.

424 89 - 8/22

Homegardens
Developing countries, LDC's, homegardens, activities, constraints, funding strategies, research, extension, AVRDC
GERSHON, J.
Funding of Gardening Activities in LDC's: Thoughts and Suggestions.

AVRDC Publ. No. 87-273, ISBN 92-9058-028-3, Shanhua, Tainan, Taiwan, 1988, pp. 111-116

Gardening is often one of the activities of development projects in less developed countries (LDC's) generally started by national programs in response to national needs. Support for such projects often initially comes from the national programs. Once this commitment is made and a particular development project shows feasibility, additional support is often obtained from donor agencies under their international development founds.

Gardening as a project component has not yet attracted additional funds from donor agencies. This is partly due to lack of proper technology development and testing, poor transfer of the technologies to recipients, and inadequate assessment of the impact of gardening. In the past three years, AVRDC has addressed itself to these constraints, producing good gardening technologies, designing ways of transferring the technologies to LDCs, and developing methodologies for assessing impact. The AVRDC-type gardens established in Thailand, show good promise. Published reports on these garden activities may assist Thailand in obtaining future support. It is now time to look into that possibility, not only for Thailand, but for all LDC's.

This paper examines some of the problems and prospects of gardening activities in LDCs and offer some suggestions. It attempts to address itself to one general question: can technical collaboration with AVRDC help national programs attract additional donor-agency support for development projects containing gardening components?

In order to obtain funding for garden-related activities in less developed countries (LDC's), these activities should be promoted within the context of projects that are of interest to donor agencies. It might best attract funds if the activity is part of an international development project.

A number of constraints have contributed to this problem in funding. Among them are the lack of information, planting materials, research, training for extension workers, evaluation, impact. etc.

One funding strategy is to utilize existing AVRDC outreach programs which are linked to national programs. A second possibility is to link AVRDC garden programs directly to an in-country institution. The third is to seek funds for gardening technology development and transfer to specific projects, such as the northeast rainfed project in Thailand, transmigration project in Indonesia, homestead food production projects in Bangladesh, and cropping systems projects in the Philippines.

A collaborative effort with AVRDC might assist national programs in achieving funding goals.

425 89 - 8/23

Homegardens
Africa, Nigeria, leaf vegetables, homegardens, backyard crops, nutritional value, potential, crop management, preservation, cultural practices
LUCAS, E.O.
The Potential of Leaf Vegetables in Nigeria.

Outlook on Agriculture, 17, 4, 1988, pp. 163-168

The term vegetable is frequently used to refer to soft leafy plants whose leaves or shoots may be eaten raw as salads or cooked in stews. In preparing them as food they may require considerable seasoning and salting. In Nigeria's farming systems, as well as in

other farming systems in West Africa, leaf vegetables are usually regarded as "backyard crops" which are given little or no cultural attention. In the few areas where there is sustained production, the production of leaf vegetables is through peasant agriculture in which a relatively small area of land is cultivated and the vegetables are usually intercropped with one or two staple food crops, such as cereals and root crops. In drier parts of the country, leaf vegetable production is restricted to those types that are hardy, drought-resistant, and of easy cultivation.
The country abounds with a large number of plant species which are used by the people as leaf vegetables. Very few of them have been brought into proper cultivation and the majority are still in the wild, used only by the people who know and can recognize their value. This article aims at highlighting the potentials of the very few of these vegetables that have come under some measure of research studies in Nigeria.

426 89 - 8/24

Homegardens
Asia, Southeast Asia, review, survey, AVRDC, vegetable research, training, funds, time allocation, literature, research facilities
TSOU, S.C.S. and J.T.S. TSAY
Vegetable Research in Southeast Asia - An Overview.

AVRDC Publ. No. 88-303, ISBN 92-9058-034-8, Shanhua, Tainan, Taiwan, 1988, pp. 119-132

Vegetables are the major source of vitamins and minerals in the Asian diet. In 1983 the per caput supply of vegetables varied from 35 to 123 g per day in this region. There are between 60 and 100 crops consumed as vegetables in various diets, and vegetables also serve as important cash for Asian farmers. Although vegetables are receiving increasing attention from the national governments and scientific communities, information on the research environment, support, major interests, and constraints is still lacking.
In order to augment the country reports presented in this Workshop, a survey of Vegetable Research Scientists in Southeast Asia was conducted.
The specific interests of individual scientists are investigated in the survey. The main constraints or problems of selected crops are listed. The problems reported can be classified into 10 groups. Diseases receive the most concern of all problems in all the countries; this was expected to be one of the most important constraints limiting vegetable production in humid tropical Asia. Various approaches are undertaken to resolve these constraints. The types of approaches used are listed. Breeding is the most popular approach to relieve various constraints.
This survey revealed that there are active research programs on 55 vegetables at various institutes in this region. A literature survey also shows that at least 63 vegetables have been studied by the scientific community since 1975. However, the survey result also indicates that most of the research resources are

concentrated on a few vegetables. More than 76% of the publications are on 10 vegetables and 93% of the available publications are for the top 20 vegetables.
The survey on vegetable research scientists indicated that 132 respondents are working on the 10 most popular crops, namely tomato, peppers, common cabbage, mungbean, soybean, potato, sweet potato, legumes, common bean and eggplant. Among the ten crops, the first five crops have breeding programs for various objectives in all four countries. Cassava, soybean, mungbean, corn, potato, sweet potato and legumes are vegetables which are recognized as a calorie and protein source. The important vegetables for vitamins and minerals are tomato, common cabbage, onion, common bean, eggplant, pepper and garlic. Among them there is only one leafy vegetable, common cabbage, which is not a really nutritious dark green vegetable. This clearly suggests that the leafy vegetables, especially the tropical vegetables, are neglected by the scientific community in this region.
In order to use the limited resources effectively, two types of research networks seem to be needed; one concentrates on the major vegetables such as breeding efforts on tomato, peppers, cabbage, etc. to improve the research efficiency of ongoing research programs. The resources saved from improvement of efficiency should be shifted to vegetable crops which are important, yet have been neglected in the past. A collaborative test network to determine performances of those vegetables under various tropical environments could be an effective way to distribute accumulated experiences from each country to other corners of the region.

427 89 - 8/25

Homegardens
Developing countries, urban families, urban garden, pot garden, nutrition, children
AVRDC
Urban garden and 45-pot garden.

AVRDC Progress Report 88-305, Shanhua, Tainan, Taiwan, ISSN 0258-3089, 1988, pp. 349-353

Urban migration to large cities in developing countries has resulted in shifts of population and has created large urban areas. The people live in somewhat cramped quarters with little in the way of land to grow even a small 4 x 4 m^2 home garden. Growing vegetables in boxes or pots could be a way for these people to provide their small children with needed micronutrients on a daily basis.
The project aims to determine daily yields of box and pot gardens, and to measure the percentage for selected nutrients that the gardens can provide for preschool children.
A small selection of crops was planted in two city gardens - an urban garden and a 45-pot garden. The urban garden crops were planted in eight wooden boxes, 115 cm x 35 cm high. The total planting area of the eight boxes is 3.2 m^2. Boxes were stacked in

stepwise fashion on a metal frame to receive equal and maximum sunlight and still utilize a small area of land. Each box was harvested 1 to 9 times and then replanted with another crop when the box was completely harvested.
The 45-pot garden is designed for city areas where there are a number of small sunny places around a house or apartment but no single area in which to plant the urban-type garden. Rooftops, window ledges, edges of walkways or stairways, or outside walls can all be used for pot gardening. Forty-five pots were chosen because that is the minimum number of pots to use to ensure a harvest each day if one desires a reasonable variety of crops. The pot size is 12 cm x 12 cm x 20 cm high. As each pot was harvested, it was replanted with a different nutritious vegetable.
The same agricultural procedures were practiced in the boxes and pots as in the larger home garden, such as the use of compost for fertilizer, hand-weeding, hand insect removal, the use of rice straw as mulch, and the use of mosquito-net screening over boxes during the early stages of growth. The yield of the city gardens was not expected to be high enough to contribute significantly to a family of five persons. But these gardens could make a contribution to the RDA of the two preschool children (between ages 1 and 6) in the family of five. The city gardens were evaluated as such. The number of times harvested was also recorded for each seasonal period.
The yields and nutritional output of the crops grown throughout the year in the urban home gardens are summarized. This garden produced an average of 0.3 kg/day of nutritious vegetables with something to harvest 273 times during the year. The nutritional contribution for the two preschool children is good for protein and calcium, and more than adequate for iron and vitamins A and C.
Average daily yields were 0.2 kg/day with something to harvest 342 time during the year. Nutritional output was excellent for vitamins A and C and good for iron.
Both of the city gardens show that something nutritious can be harvested throughout the year. The gardens can also make significant contributions to the nutrition of two preschool children in terms of vitamins A and C.

428 89 -8/26

Homegardens
Europe, France, experiment, urban compost, vegetable production
CTIFL
L'Emploi de Composts Urbains et de Composts de Boues de Station d'Epuration en Cultures Legumières. (Utilization of Urban Composts and Mud Composts from Purification Stations for Vegetable Crops.).

C.T.I.F.L. Lahier No. 18, 1985, pp. 67; available at CITFL, 22 Rue de Bergère, F-75009, Paris, France

This publication describes an experiment on the effect of its differents composts on yield and quality of vegetables cultivated under controlled conditions and in the field. No significant

results came out concerning specific accumulation of trace elements or of heavy metals in the soil.
The examination of the composts themselves has given on the whole equivalent results, casually varying according to the crops. Only cattle dung was found to be slightly superior at equal proportion.
This document gives numerous technical data and will be of interest to those utilizing or intending to utilize urban composts.
Abstract from Alternatives actualité

IX SEED PRODUCTION

429 89 - 9/8

Review, cassava, seed multiplication
CIAT
Promisoria la uca sembrada por semilla (Seed-grown cassava shows promise).

CIAT Report 1987, pp. 31-33

Throughout history cassava has been vegetatively propagated that is, farmers have grown new plants from stakes or cuttings that are planted into the ground and left to root. CIAT cassava scientists believe there are advantages in growing the crop from seeds and that commercial production from seed may be a promising alternative for the future.
Producing cassava from seed offers several advantages over the vegetative method of growing the crop. For example, in vegetatively propagated plants viruses build up over generations and can cause major yield losses. Since cassava seed are not known to transfer viruses this problem is averted.
Storing stakes for the next crop also produces problems. Most farmers have to store planting material for the next crop over time, that is, from a few weeks to several months. Loss of nutrients during storage reduce germination and planting vigor, resulting in lower yields. This does not happen with cassava seed which can be stored for a year or more without such losses.
The dependence on the availability of enough stakes to increase the area sown to cassava or to introduce a new variety is another constraint on production. This could be avoided if seeds were used because their multiplication rate is higher than that of stakes. It is estimated that there could be at least a 1:100 multiplication rate for seed compared to about 1:10 for vegetative propagation.
Seed are less costly to transport than stakes and they make management of the planting process easier.
However, commercial production from seed cannot begin immediately because both knowledge and technology need refining. There are problems in the areas of genetics and management. There is optimism that many of the genetic problems can be eventually solved. The management-related problems are, on the whole, similar to those of other seed crops.
The biggest question relates to the potential productivity of seed-derived plants. Stakes produces plants with higher initial vigor because of the larger carbohydrate reserves they contain. Research at CIAT has shown that the production of seed-derived plants can equal that of stake-derived plants under favourable conditions. A recent study shows that there is potential for achieving even higher yields with seed by using higher plant densities.

It is expected that in the future, farmers can look forward to using a combination of vegetative and seed propagation to obtain the best advantages of both methods.

430 89 - 9/9

Seed production
Developing countries, climates, Vietnam, Peru, Burundi, Philippines, daylenghts, seed technology, true potato seed, clones, tubers, cuttings, seedlings
CIP
Seed technology.

CIP Annual Report, Lima, Peru, 1988, pp. 24-26

The major focus of the true potato seed (TPS) breeding work was on testing advanced progeny selections for tuber yields under a wide variety of locations with different climates and daylenghts. Clones AVRDC-1287.19;377964.5 and LT-8 were good combiners for wide adaptation in TPS crosses and most crosses had a high degree of adaptation to short-day conditions. Twenty six crosses were found to have an acceptable tolerance to early blight and late blight diseases during seedling screening.
An index criteria for acceptable TPS vigor was developed, using both the coefficient of velocity of emergence calculated from daily counts after sowing and seedling dry weight. Data showed that seedling vigor evaluations among different TPS crosses must be conducted using nondormant seed. Although the standard treatment with gibberellic acid (GA) was shown to promote final emergence in dormant TPS, seedling vigor was impaired by GA. Priming TPS in solutions of low-water potential was found to be the most effective presowing treatment for optimizing seed vigor in nondormant TPS.
In two crosses, the optimal stage of TPS maturity at harvest was 10 to 12 weeks post pollination. Nevertheless, the maturity of berries from the cross, Atlantic x LT-7, could not be extended beyond nine weeks. Seedling vigor in this cross was superior to the other crosses tested. The importance of proper storage conditions for preserving vigor prior to testing was clearly demonstrated in all seed tests. Eight open-pollinated progenies were identified with acceptable performance in a large scale screening test for germination at high temperatures. Pollen selection and seed size separation techniques were found promising in certain crosses for the enhancement of progeny uniformity characteristics.
Continuing international TPS trials have resulted in the identification of several new progenies for use by national programs. Three TPS progenitors C83.199, 377964.5, and Maine 28- were introduced into the seed program for clean up. Following several testing cycles, two new potato progenitors, 377250.7 and C83.551, are now ready for clean up. All of these progenitors transmit yield, earliness, and tuber uniformity. Ten TPS progenies that maintain a stable yield from the F_1 generation through four

generations of successive open-pollination have been identified. This will facilitate the use of TPS by farmers, since they will be able to produce needed TPS from open pollinated berries produced in their own fields.
The superiority of raised bed systems for seedling transplanting was confirmed this year with respect to yield advantages. The application of a layer of gypsum to the soil surface during seedling tuber production in beds increased tuber yields and acted as an effective tuber moth control system.
The most important pathogens causing damping off in seedlings are in the AG-3 group or race of R. solani. These organisms were shown to be present only in cool areas while the more pathogenec AG-4 group was found in the warmer areas.
Potato flowering was increased with a four-hour night interruption of the night period under short-day environments. Factors involved in reducing TPS yields generally included increasing stem densities and berry loads per plant, as well as producing the berries at the end of the flowering period (in lower order inflorescences). The collaborative project between INIA in Chile and CIP on commercial scale TPS production determined that the average costs of non-emasculated TPS were US$ 246 per kilogram, ranging from $ 128 to $ 307 depending on the cross. Pollination tasks - especially labour and technical management costs - were the most expensive inputs in TPS production. The collaboration between CIP and INIA will continue for a fourth season, but a foreign commercial seed company is interested in contracting large-scale TPS production by farmers. This will probably start in 1988-89 with several hectares of production.
It was shown that warm climate-produced seeds (tubers, cuttings, and TPS seedlings) are likely to yield lower than those produced in cooler areas. The production efficiency of cuttings was lower than that of seed tubers, but the larger size of tubers produced from cuttings still makes this alternative suitable for direct production of consumer potatoes.
A case study conducted in the Philippines showed that institutional and nontechnical factors are closely associated with the level of success of a seed potato program. In Burundi, the basic seed production programm has redesigned the strategy to eliminate latent bacterial wilt disease. This new system is based on in-vitro micropropagation methods with subsequent transplanting of plantlets to large plastic bags for production of small tubers. The use of sprout cuttings for planting materials is now well advanced in Vietnam.

431 89 - 9/10

Seed production
world, review, germplasm conservation, crops, livestock, genetic erosion, management, germplasm system, genetic resources collections, economics, sustainability
PINO, J.A. and M.S. STRAUSS
The Preservation of Germplasm.

In: Proc. of the Seventh Agric. Sector Symposium: Sustainability Issues in Agricultural Development, The World Bank, Washington, D.C., ISBN 0-8213-0909-9, 1987, pp. 252-269

Some people consider germplasm to be the world's most valuable natural resource, yet its great value remains largely unrecognized.
In its simplest sense, agricultural germplasm is nothing more than the plants or animals from which modern agriculture has derived present-day varieties and breeds. Germplasm, although applied to whole organisms or their parts (e.g., seeds, tubers, pollen, semen), also refers to their genetic composition. In essence, the term germplasm refers to the genetic variability within a population.
Natural habitats for many wild species are disappearing and indigenous agricultural systems are giving way to the practices and varieties of modern agriculture. The preservation of wild species and landraces in their environments (in situ) is becoming increasingly difficult. Most nations have not taken this matter seriously and there has been a lack of creative thinking about how traditional agroecosystems and natural environments of wild crop relatives could be preserved.
Germplasm used in crop and livestock development has been most frequently and efficiently maintained in ex-situ collections - collections of plants or animals stored outside of their natural habitat. Preservation of genetic resources as seed or live vegetative materials originated with the collections maintained by plant breeders, botanists, or botanical garden curators.
Collection and maintenance of germplasm today includes in-situ conservation of natural habitats or planted pure stands in the place of origin; and ex-situ conservation by cold storage, tissue culture, or field collections of plants. In the future it may be possible to maintain germplasm as DNA-libraries from which plants or animals could be reconstructed or specific traits selected.
Increased interest in the managment of genetic resources is based on several general concerns. First, there is a growing awareness worldwide that species of plants and animals are being lost both due to and in spite of development efforts. Second, the emergence of biotechnology and its potentials for crop and livestock development have left many nations, particularly those in the developing world, with concerns about their future ability to compete scientifically on a global scale. Third, a political has arisen over proprietary rights to germplasm and the crop varieties derived from it. Along with these specific concerns has been a frequently stated unsureness about how well present systems for

collection, maintenance, and management of crop and livestock germplasm are functioning.
Since the beginning of scientific plant breeding there has been a decline in both the number of crop species and the genetic variation within species. The range of genetic diversity of the world's major crops may well be declining rapidly. The drive to develop high-yielding, uniform crops has significantly increased production, but at the expense of sharply reducing the genetic base (particularly in terms of loss of landraces) on which these crops are founded. As use of these improved varieties has spread, they have accelerated the loss of the genetically diverse traditional landraces through displacement. The result is increased risk of vulnerability to disease and pest losses due to increased genetic uniformity and the loss of the broad genetic base (variation) necessary for continued crop improvement.
One rational argument for preserving genetic diversity is that it is insurance against future agricultural catastrophe, investment for future needs, and a matter of moral principle. Plant breeders have drawn extensively on the genetic diversity of crop germplasm to achieve the tremendous gains seen in the past two decades. Future gains, however, will require the continued availability of such materials and the expansion of existing collections.
The major needs and issues associated with the collection, maintenance, evaluation, and use of crop and livestock germplasm are divided in this paper into four general categories: Scientific or technical, management, regulatory, and resources.
In conclusion the collection and maintenance of genetic resources in all nations has progressed considerably in the past decade. The advances in developing nations have largely been due to the efforts of international agencies and technical assistance from researchers, institutions, and foundations in the developed world. Although significant international collections exist for the crops of major importance to global agriculture, considerable work remains to be done in establishing national and regional programs for many minor but important food crops, livestock, forages, and forest species as well as those of purely esthetic value. Perhaps most important is the need for many of these nations to develop a germplasm maintenance and plant breeding infrastructure that will lay a foundation for their own food security. The primary constraints to this development are human and financial resources.

432 89 - 9/11

Seed production
Review, study guide, audiotutorial unit, handbook, CIAT, developing countries, tropics, subtropics, bean seed, management, ecology, production, harvest, standards, activities, evaluation
DOUGLAS, J. et al.
Good Quality Bean Seed.

Study Guide, CIAT, Apartado Aéreo 6713, Cali, Colombia; Series 04EB-12.03,1981, 36 pp.

An effective seed program comprises many and diverse elements and activities which must be coordinated to attain the principal objective: produce and distribute good quality seed of improved varieties. Therefore, the success of a seed program is founded on producing and providing a sufficient quantity of good quality seed, at the required time, at a reasonable cost, and at a location where it is needed, so that the majority of the farmers can enjoy the benefits provided by using this seed.
This study guide is complementary material to the audiotutorial unit "Good-Quality Bean Seed". Its principal objective is to provide useful information relating to the practices of production, quality control and processing of bean seed.
The audiotutorial unit is a translation of the Spanish unit entitled "Semilla de Fríjol de Buena Calidad" which was produced by CIAT through a special project on the development and utilization of training materials on improved agricultural production technology.
The handbook contains the following chapters:
- Objectives
- Introduction
- What is Good Quality Seed?
  . Varietal purity
  . Physical purity
  . Good germination
  . Freedom from seed-borne diseases
- Why is Good Quality Bean Seed important?
- What is Needed to produce Good Quality Bean Seed?
  . Varietal pure seed
  . Freedom from seed-borne diseases
  . A site that provides an unsuitable environment for development of pathogenic organisms
  . A suitable field
  . Special management of the crop
  . Removal of foreign, off-type and diseased plants
  . Harvest of the seed
- Steps to follow after harvesting Good Quality Seed
  . Drying
  . Cleaning
  . Treatment
  . Sampling
  . Evaluation
  . Storage
  . Transport
- Activities of Different Groups in Obtaining Good Quality Seed
  . Seed certification authorities
  . Research programs
  . Seed growers, seed enterprises and marketing groups
- EVALUATION
- BIBLIOGRAPHIE

This handbook together with the audiotutorial unit provides useful information for the practice of quality bean production.

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432 89 - 9/11

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Review, study guide, audiotutorial unit, handbook, CIAT, developing countries, tropics, subtropics, bean seed, management, ecology, production, harvest, standards, activities, evaluation
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433 89 - 9/12

Seed production
Developing countries, review, seed supply, food crops, traditional systems
LINNEMANN, A.R. and G.H. DE BRUYN
Traditional seed supply for food crops.

ILEIA, 3, No. 2, 1987, pp. 10-11

In this paper some aspects of traditional seed supply systems are discussed.
Seed supply systems in developing countries can be subdivided into traditional and modern systems. In traditional systems it is common practice that the farmer produces his own seed, or gets some or all of it from other farmers, locally or in the region. In modern systems a part or all of the seed is bought from seed producers. These systems are characterized by a high degree of specialization. Seeds are produced for the market and often there is an ample use of hired labour and inputs such as fertilizers and pesticides. Combinations of both systems exist as well; some farmers use traditional and modern systems on their farm, either or not for different crops.
At least 80 percent of the planted seed of the main crops is produced by the farmers themselves.
Thus, the contribution of the modern sector to the seed supply of food crops in most developing countries is restricted to 20 percent at the most.
Small farmers need varieties with a good yield which is reliable and stable through the years, also when the environmental conditions are adverse. For this purpose, they often use a mixture of varieties. These varieties must by compatible with their farming systems.
This could mean that a variety must be adapted to intercropping and staggered harvesting for instance, and that it should fit into the labour pattern. Subsistence farmers also attach much importance to a specific taste and culinary quality, while byproducts that can be used as forage, building material, etc., are appreciated too. As a result, seeds of their own varieties that are carefully selected by the farmers themselves during generations for the properties mentioned above and also for characteristics such as healthiness, shape, size and appearance are more likely to suit their individual wishes than seed of modern varieties, which is produced for a large group of customers.
The way in which farmers produce and select their seed varies enormously. Most farmers take a part of their grain of bean crop after the harvest as seed, while others make their choice in the field. Farmers who select after harvesting may just put aside part of their harvest, but they can also make a careful selection for a particular seed appearance. Also in selection before harvest several methods are applied. In a few cases, farmers walk through their fields and mark the plants they will use for next year's crop, while other farmers grow the plants that will give the seed

for the next season on a separate plot at some distance of the main crop. They pay extra attention to this plot by applying manure or fertilizer, discarding off-types and keeping it free of weeds, pests and diseases. Careful visual selection gives farmers the opportunity to compose a seed mixture that will satisfy their needs. Thus, they strive for a uniform crop, but they can also choose to maintain a certain variation in earliness, shape, colour and taste of the product. In many cases farmers have successfully developed their own methods to produce and select their seeds.
Farmers may have different reasons for buying seed instead of using a part of their own production. These reasons are often associated with necessity and/or economic aspects. Necessity to buy seeds arises when erratic rains repeatedly lead to failures of a crop. In general, farmers save enough seed to resow at least twice. However, in drought-prone areas farmers run out of seeds and come to depend on seed from other sources. It is also necessary to buy seeds of those crops for which farmers can not adequately store the seeds. For instance, in areas with merely one short growing season each year, farmers are forced to get fresh seed from elsewhere.
Economic considerations play a major role in the decision by farmers to buy seeds or to use their own produce. As a rule, farmers invest more in their cash crops than in their food crops. In cash crops a somewhat higher yield is directly reflected in higher monetary returns. Moreover, specific taste preference are of less importance than in a food crop. Finally, the most obvious motive for farmers to purchase seed is of course the conviction that this material satisfies their demands better than their own produced seed, but often farmers are not convinced of this. They prefer their own seed for its adaptation of their farming system.
Although a slow change from traditional seed production to modern seed production may be foreseen, the extent of the area which is planted with farmer-produced seeds and the diversity in the wishes and needs of the majority of the farmers with regard to the characteristics of their crops, call for a strengthening of farmerbased seed supply at community level, rather than just a focus on the modern, commercial sector. Results can be expected from even minor improvements in traditional seed production practices such as selection in the field and better drying, protection and storage. It seems worthwhile to stimulate experienced farmers to specialize in seed production for their region.

434 89 - 9/13

Seed production
Africa, tropics, developing countries, review IITA, seed production, sweet potato, yam, cocoyam
ALVAREZ, M.N. and S.K. HAHN
Seed Production in Sweet Potato, Yam, and Cocoyam at IITA.
In: Proc. of a Global Workshop on Root and Tuber Crops Propagation, CIAT, Cali, Colombia, ISBN 84-89206-53-8, 1986 pp. 219-224

This paper describes the process of seed production for sweet potato, yam, and cocoyam (cassava is excluded) as practiced at IITA in Abadan. In contrast with sweet potato, it is only recently that yam and cocoyam seed production has been intensified and problems are yet to be adequately researched.
The Root and Tuber Improvement Program at IITA has as its main objectives: (1) to improve yield and quality characteristics of cassava, yams, sweet potatos, and cocoyams, including disease resistance and storage ability; and (2) to provide seeds from various regions to national programs for selection.
In conclusion, it is clear that there has been progress in seed production of these crops due to the efforts of the many scientists and breeders who have worked on them. However, there is continued need for superior cultivars with disease resistance. Because of the narrow germplasm base in some of these crops, new plant explorations to collect species are needed.
IITA's strategy in fulfilling its responsibility for crop improvement is to generate improved genotypes and introduce them to national programs, predominantly as true seeds, but also in tissue culture form. The systems described and employed at IITA have given satisfactory results for seed production in all these root crops except *D. alata*. Ways of stabilizing seed production in yams will receive special attention in the future along with efforts that are, at present, underway to investigate methods of improving seed production and quality generally.

Seed production
Review, tropics, CIAT, developing countries, cassava, propagation, rapid multiplication techniques, multiple shoot system
COCK, J.H.
Rapid propagation techniques for cassava.
In: Proc. of a Workshop on Root and Tuber Crops Propagation, CIAT, Cali, Colombia, ISBN 84-89206-53-8, 1986, pp. 109-116

The inherently slow propagation rate of cassava delays the testing of new varieties and their subsequent release to farmers. Over the years a number of more rapid techniques for propagation have been developed.
CIAT has refined these methods and developed two basic rapid propagation techniques. The first of these, multiple shoot production from two-node cuttings, is moderately rapid and can be carried out with a minimum of infrastructure. The second technique, using the axillary buds of green stems, is considerably faster but requires better infrastructure and more skillful handling of the plant material. Nevertheless, both systems are simple and require no highly sophisticated equipment for their operation. The two systems are described in detail.

The two methods described greatly increase propagation rates. Starting from a mature mother plant, it is possible to produce

12,000-24,000 commercial stakes in one year with the multiple shoot method, as compared to 100-400 using traditional methods. The axillary bud method is even more rapid, producing 100,000-300,000 commercial cuttings from a 3-4 month old mother plant.
The systems described here have been used successfully under the conditions of CIAT-Palmira. Modifications may be necessary under different conditions. For example, when average temperatures are less than 20°C, rooting will be much delayed, and when average temperatures are above about 25°C, it may be necessary to shade the propagation and rooting chambers.