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Crops/ fruits/ vegetables

Information on crop husbandry, water and soil management, preventive and curative pest and disease management

Pests/ diseases/ weeds

Description and identification and management of plant pests and diseases

Medicinal plants

Medicinal plants and their uses:

Nutrition and nutritional diseases

Ariboflavinosis, Beriberi, Goiter, Peptic Ulcer Disease, Rickets/Osteomalacia

Insect Transmitted Diseases

Malaria: integrated and preventive

control (water management, bed-nets, medical treatment)

Water Borne Diseases

(under construction)

Air Borne Diseases

(under construction)

Animal husbandry and beekeeping

Information on organic animal husbandry and nutrition, Animal diseases prevention and management by categories of domestic animals

(Bees, Chicken, Camels, Cattle, Donkeys, Fish-farming, Geese, Goats, Pigs, Rabbits, Record keeping etc.)

Animal diseases

Brucellosis, Tuberculosis,

Agro-Ecological Zones

FAO System, Kenya System

Water Management

Water cycle and rain,

Rainwater harvesting, Shallow ground water, Water for domestic use, Water for irrigation, Community management of water

15 March 2010 - Updated edit infonet-biovision is online

infonet-biovisio a web-based information too offering trainers extension workers and farme mainly in Africa a quick acces up-to-date and locally relevar information in order to optimi their livelihoods in a safe, eff

and ecologically sound way.

The information presented is specifically relevant for the a continent and its inhabitants, examples and case studies a Kenya or East African countr can be useful for other tropic countries as well. The topics presented on infonet like cro managment, diseases, pests

Artemisia, Modia, Moringa, Neem, Ocimum kilimandscharicum, Pelargonium, Prunus africana, Sutherlandia, Tamarind

Fruit and vegetable processing

Drying of fruit and vegetables, pulp, jam, construction of a dryer

Natural pest control

When to apply control methods: Plant extracts (galic, neem, pyrethrum), Soap spray, Bio-pesticides (Bt,

copper, sulphur), Natural enemies, Traps and bagging.

Zoonotic diseases

(under construction)

Hygiene and Sanitation

(under construction)

Contagious Pleuropneumonia, Anthrax, Milk fever, Mastitis, Diarrhea, Mucosal disease, Foot and mouth disease,

Foot rot, Bloat

Fodder Production and Conservation

Hay making, Silage making

Products

Leather production, Manure, Bee products, Milk and dairy products

sources, Water storage, Surveys, designs and permits for water

projects, Construction of water projects, Seeking funds, Water as business, etc

Soil Management

An Introduction to soil degradation, An introduction to soil

conservations measures, How to improve soil

environmenally sound techno are focused on the ecology a species that are prevalent in Africa.

Key Features:

- Information on major crop vegetables and fruits preva East Africa, including crop husbandry, soil and water management, cultural meth and organic pest managem with illustrated descriptions quick and accurate identific of crop pests and diseases

- Information on major mai pests, diseases, weeds and natural enemies common in Africa; common names in d languages, regional distribu

maps and lots of images an illustrations for easy identif

- Many more information o

Biofumigation etc.

Cultural practices

Organic plant nutrition, Composting, Field sanitation, Green manure, Crop rotation, Intercropping, Push-pull, Mulching, Conservation tillage, Weed

management etc.

fertility, Kenyan Soils, Soil monitoring - Know your soil

Sustainable and Organic agriculture

The concepts of Organic Farming and Biodynamic

Farming (under construction)

Conservation Agriculture

Conservation agriculture, Soil cover, Conservation tillage systems, Mixed cropping and crop rotation

medicinal plants, fruit prese and cultural methods, soil, and land management, anir husbandry and animal disea etc...

- **Publications and databas TOF Organic Farmer Magaz (Search by keywords or iss audio and text versions)**

- **Over 1300 images allowin identification of majour pes diseases and illustrations o methods promoted.**

Just click on the area you are interested in on the left side..

The information-platform will continue to be enhanced and quality of the data maintained Latest developments include:

- **Integrated comment-func sharing information and ex with experts and extension services is implemented accompanied by a pilot-tria**

Agroforestry

Agroforestry

introduction, A guide to tree planting in Kenya

Processing and Value addition

Hygiene requirements, Lables and barcodes, Prepacking fruits and vegetables, Processing facilities, Juice making,

Machinery and utensils

Energy

(under construction)

Inbuilt option for sending t voice messages from webs mobile phones

- **Reference addresses of l products/trade/providers/s are included continuously**

We're always interested in re comments on the information platform and new data; pleas

contact us here

[more news]

implementing agency: biovision Foundation for ecological development

funding: LED LIECHTENSTEIN DEVELOPMENT SERVICE

partner institutions: African Insect Science for Food and Health; icipe; FiBL; AVALLAIN ENHANCING EDUCATION; TOF Magazine For sustainable agriculture; KARI; WOCAT; KENFAP; ACT; AfOC; KEFRI

Here you find the Infonet Biovision Offline Version for Download.
Please click here to download the newest version

Mar 24, 2010 - Disclaimer

Information of www.infonet-biovision.org

Home

The INFONET-BioVision Farmer Information Platform

Access to knowledge for ecological development in Africa

Access to knowledge and information sharing is one of the critical factors for sustainable development of farmers and rural communities.

The INFONET-BioVision Information Platform aims to strengthen sustainable development of farmers and

rural communities in Africa by making information on key topics available through an internet platform and other creative solutions and dissemination strategies.

On the platform you find local relevant and effective information with contributions of farmer groups, local experts and international scientists on:

- **organic agriculture and crop husbandry for food security**
- **effective ecological prevention and control of plant-, human- and animal targeting pests and diseases**
- **simple and environmentally safe technologies and approaches to improve your life and generate income while at the same time protecting the environment and the natural resources**

The information platform is used as a resource pool for disseminating information inside and outside the internet through active cooperation with partner organizations and local farmer- and women's groups and with information and communication technologies (ICTs).

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Information of www.infonet-biovision.org

Biovision Foundation for Ecological Development - Who we are

BioVision Foundation http://www.biovision.ch is a Swiss non-profit organization with a

global mission to alleviate poverty and improve the livelihoods of rural people in Africa while maintaining the natural resources and diversity that sustains life. Our chairman is Dr. Hans Rudolf Herren, one of the world's leading researchers in biological pest control. He has been living and researching in Africa for over 20 years. In 1995 he won the World Food Prize, the first Swiss to receive this honour. From 1994 until 2005 he has been the CEO and Director of the International Centre of Insect Physiology and Ecology *(icipe)* in Nairobi, Kenya. In May 2005 Dr. Herren officially took over presidency of ther internationally active Millenium Institute in Washington DC. This institute supports the governments of developing countries by providing resources for sustainable development.

While *icipe* plays a major role in the control of pests, parasites and disease vectors in developing countries. Biovision Foundation functions as an intermediary between research institutes and local users in order to ensure that benefits of science reach the people who need them most.

What is Infonet-Biovision?

www.infonet-biovision.org is an independent project of Biovision Foundation Switzerland. Infonet-Biovision is an Internet information tool offering trainers, extension workers and farmers a quick access to up-to-date and locally relevant information in order to optimise their livelihoods in a safe, effective, and ecologically sound way.
The information presented is specifically relevant for Africa and its inhabitants, many examples, case studies are from Kenya or East African countries, but are valid for other tropical countries as well.

We provide a relevant range of different topics which contribute to a sustainable livelihood, namely on agriculture, livestock and health promotion and environmentally safe technologies. We believe that through this holistic approach we have the greatest potential/outreach/impact to improve the rural populations life and generate income while at the same time protecting the environment and the natural resources.

Infonet-Biovision's aim is to contribute to poverty reduction and environmental protection by disseminating appropriate and locally adapted methods for crop and livestock production and for human and environmental health.

If thank you would print out the current content which is available on infonet today; you would get 3,000 pages A4 filled with most recent, scientifcally proven, illustrated and easy-to-understand information about ecological and sustainable methods and applications, for prevention and control of pests and parasite infestations of plants, humans and animals; adjusted on East African conditions.

And this is just the beginning!

Project Team and Management of Infonet-Biovision

- **Concept, Coordination and Quality Control**

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Scientific Advisors

The project team works closely with scientific experts from ICIPE, FIBL and others. The scientific advisory board contains experts from Human-, Animal- and Environmental Health.

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- **Dr. Eric Wyss, Organic Plant Protection / Pests and Beneficial Insects Specialist, FIBL Frick, www.fibl.ch**

- **Dr. Hanspeter Liniger, NRM /Soil & Water Management, CDE/WOCAT Bern, www.wocat.org**
- **Prof. Peter Lüthy, Malaria Specialist, Institute for Microbiology, Swiss Federal Institute of Technology, 8093 Zurich, Switzerland**
- **Prof. John Traxler, University of Wolverhampton, Applied Innovative Digital Technologies Research Group**
- **Marc Steinlin, Knowledge management specialist, Cape Town www.i-p-k.ch**

Specific Objectives

- **Priorise, compile, tailor and disseminate user relevant content through direct contact and feedback from farmer groups and other users (i.e. according to baseline studies, usability studies, evaluations and feedback mechanisms)**
- **Revise and update content with local relevant information and knowledge through a network of local and international partner organisations, experts and scientists**
- **Increase dissemination and awareness about Infonet-Biovision as an internet-based electronic information platform and its content through different paths (i.e. through collaboration with partners/extension network/offline version/awareness campaigns)**
- **Integrate an active feedback system by expanding and adapting content and services according to the needs in the field, thus empowering farmers and rural communities in handling their own sustainable development activities**

Main Topics and Content:

a) Sustainable agriculture and organic crop husbandry for food security
b) Effective ecological prevention and management of plant-, human- and animal targeting pests and diseases
c) Simple and environmentally safe technologies and approaches to improve rural livelihoods and generate income while at the same time protecting the environment and the natural resources - to preserve and

sustain the quality of our air, water, food and land for current and future generation

Unique Features

- **Covers a relevant range of local species, varieties and topics for East-African users (plants, health, livestock, agriculture, ecology, environment, income generation)**
- **Contains solely/exclusively information on sustainable, ecologically sound[1] and environmentally friendly methods**
- **Content is understandable for practitioners, with rich illustrations and applicable descriptions**
- **Free Internet access (no subscription) for basic information - different membership schemes for partnerships and donors will be developed**
- **Reviewed content, quality control and scientifically secured information is provided through a network of partner organizations as well as local and international experts**
- **Available on CD-ROM or USB Memory flash stick, for computers without internet access**

[1] Ecologically sound means measures that promote sustainable production of food, feed and fibre. These measures will improve soil fertility over time, and pay attention to the multifunctionality of agriculture and assure the provision of ecosystem services.

How do I order the CD / (infonet-offline Version)?

The infonet-CD is useful if you do not have internet access but have access to a computer to read the infonet-CD.

Contact for ordering the infonet-CD (offline version): Farmers interested to receive the CD only need to send airtime worth KSH 200 to our partner organisation 'The Orgainc Farmer' in Kenya, through either:

- **Safaricom lines 0717 551 129 (New Number) or**
- **Celtel /Zain lines 0738 390 715.**

After sending this airtime, please send an SMS detailing your full name and correct address. The CD shall be sent to you by registered mail. Pls note that the CD is only produced once a year and does therefore not contain the latest and updated contents, the most updated version of infonet is only accessible through internet, also the feedback function works only, if you are connected to the internet.

Background

In East Africa agriculture is the main source of income for over 70% of the rural population (in Kenya about 20 million people) and represents 25% of the region's gross domestic product (GDP). Most of the farming is small-scale or subsistence. Crop pests (insects, weeds, plant diseases, rodents etc.) represent a considerable limiting factor in the production of local food crops and are a major cause of agricultural under-production, malnutrition and poverty. At the same time the workforce is plagued by the major health problems that arise from numerous diseases caused by parasitic infections in humans (HIV/Aids, malaria) and productive livestock (tsetse-born trypanosomiasis, tick-born East Coast fever). Despite agriculture's significance, the rural population in Africa often lack access to extension services, productivity augmenting techniques and know-how. In particular, up-to-date information on affordable, effective and ecological methods for the sustainable management of plant-, human- and animal- targeting pests and disease vectors, for adequate nutrition, as well as methods to maintain a healthy and productive environment lay dormant in academic journals and research institutes, beyond the reach of farmers and rural communities that need them the most.

The idea of Infonet-Biovision

To actively support dissemination initiatives at the ICIPE and other organisations in the area of agriculture and health, BioVision provided the initial finances in order to begin preliminary work on an Internet platform whose purpose was to act as a tool for information sharing and dissemination of knowledge and experience gained in various pilot projects. Later the Liechtenstein Development Service provided funding to proceed

the work for Phase I (2005-2007) of implementation.

The design of Infonet-BioVision incorporates a bottom-up approach in the sense that the topics, content and structure of the platform was defined in consultation with local farmer groups and communities. Infonet-BioVision also encourages user's feedback on experiences and on the situation on-the-ground which eventually is lead back to the board of advisory scientists so that the information presented can be continuously adapted and expanded. This two-way flow of information is an integral aspect of ensuring the applicability, relevancy and usefulness of the platform.

Information dissemination and awareness

For effective outreach, Infonet-Biovision aims to collaborate with research institutions such as ICIPE's Technology Transfer Unit as well as other training and extension networks in the field of sustainable agriculture, environment, lifestock and public health.

We aim to collaborate with organisations which have experience in awareness rising and sensitation for farmers and rural communities in East Africa. In addition, such collaborators ought to be receptive in in using new information and communication technologies to disseminate the necessary information to farmers and rural communities. We are aware that access to computer, literacy, language and cultural differences are major limitations in reaching the defined target groups. Therefore, we endeavour to collaborate with organisations that will translate relevant information into local languages for an effective transfer of information. We are also aware that the internet can only become an established medium for the transfer of knowledge if it is used by existing institutions and access points and if it supports their work.

Infonet-BioVision has the potential to increase the impact of existing training and extension programs from GO's and NGO's as it can be easily combined with various existing local approaches.
To ensure that the information reaches the end-users directly, a wide range of media such as posters, brochures, local radio, marketplace and other "low-tech" media are used.

Sustainability

The sustainability of the platform largely depends on the ability to bring the information to the farmers and to ensure the relevancy of the information provided. The project is characterised by a participatory approach involving farmer groups, local collaborating partners and communities.

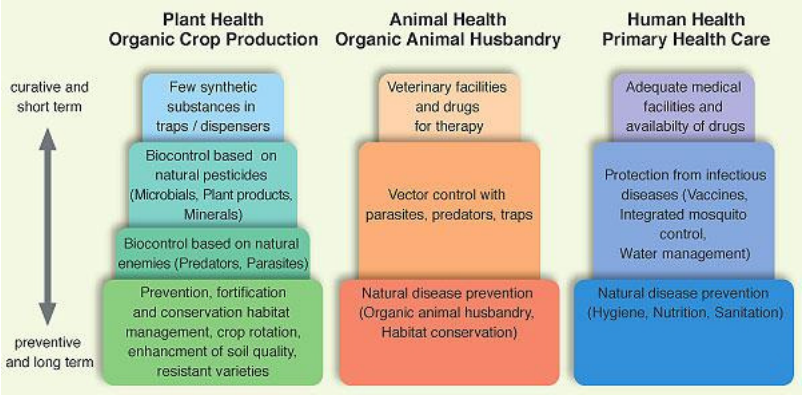
Concept Design

The core concept of Infonet-Biovision is the database with its processed information and pre-defined structure which facilitates the rapid and easy incorporation of new data. As the needs of users with varying levels of knowledge and experience ought to be catered for, the platform around the database is conceived in such a way that the users can access its content through different entry points. These include databases on sustainable pest and crop management, animal, human and environment as well as training modules in these areas. Furthermore, it will be possible for the users to send feedback information to the project team-members regarding their experiences.

Contents

The platform provides comprehensible content with up-to-date information on preventive and curative control of plant-, human- and animal- targeting pests and disease vectors and on sustainable agriculture and environmental health. Where available, effective traditional management methods will also be incorporated. With the use of photos, images, illustrations and clear advice, we provide practical tools for the correct identification and recognition of pests, disease vectors and parasites and their damaging symptoms. Such information is also useful to non-experts. All information can be compiled, saved and printed in tailor-made training material by users. In all categories, external web-links lead to related web-sites with additional information.

Preventive and curative measures in Organic Farming and Human Health

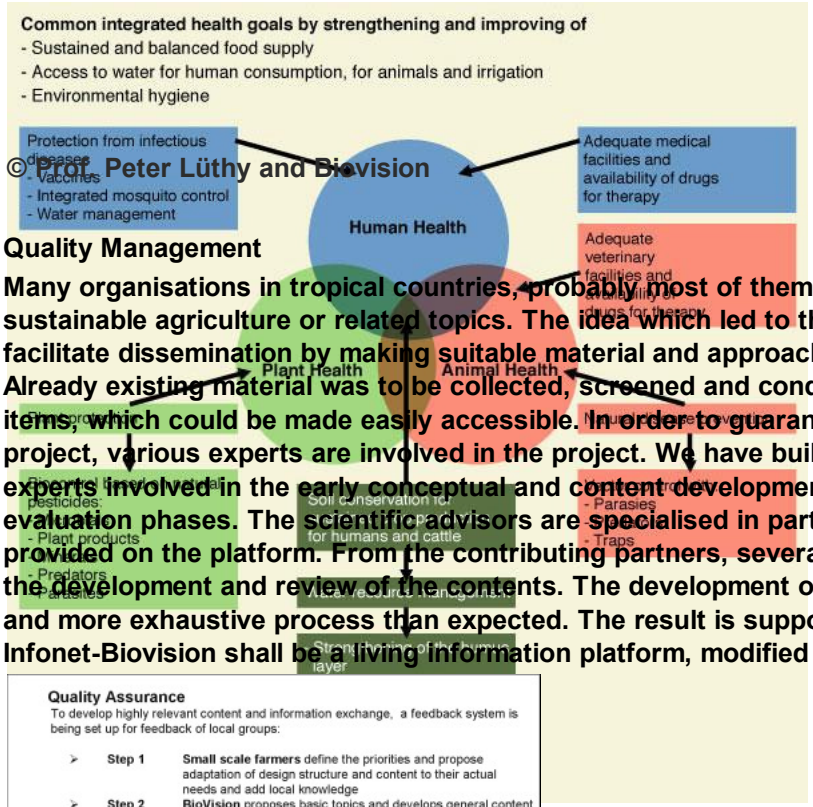


Methods shown at the bottom have a long-term effect, while methods shown at the top have a short-term effect. In organic farming systems, methods with a long-term effect are the basis of crop production and animal husbandry and should be used with preference. On the other hand methods with a short-term effect should be used in emergencies only. In human health, preventive measures reduce peoples' dependency on medicine and drugs. They include the provision of safe water supply, sanitation, the promotion of safe food supply, proper nutrition as well as other environmental control measures.

In the plant health part the database contains biological and ecological background information, scientific and local names, images and photographs used for the identification of pests and diseases. The description on the prevention and cultural measures which have long term effects is also provided. This is then followed by direct control measures such as Bio-control Agents and Bio-Insecticides which have short-term effects. The data on preventive control measures is the core part of the information we provide.

In organic farming systems, methods with long-term effects are the basis of crop production and animal husbandry, and should be used with preference. On the other hand, methods with short-term effects should

be used in emergencies only. Infonet-Biovision has extended this approach to human health systems. This is because the advance in the development of vaccines and chemotherapeutic agents has brought many diseases under control. However, there are still many communicable diseases for which environmental control measures are indispensable, especially in the field of water supply and sanitation. Such diseases include cholera, diarrhoeal diseases, leishmaniasis, malaria and schistosomiasis. In all these instances, the environmental measures, either as an integral part of primary health care or undertaken outside the health sector, form an indispensable component of overall disease control strategies together with education on health and hygiene. In some cases they are the only component.



Quality Management

Many organisations in tropical countries, probably most of them NGOs, are engaged in training activities on sustainable agriculture or related topics. The idea which led to the development of infonet-biovision was to facilitate dissemination by making suitable material and approaches available over an internet platform. Already existing material was to be collected, screened and condensed into comprehensive information items, which could be made easily accessible. In order to guarantee the optimum implementation of the project, various experts are involved in the project. We have built up a team of international and local experts involved in the early conceptual and content development phases and in the monitoring and evaluation phases. The scientific advisors are specialised in particular fields for the review of all information provided on the platform. From the contributing partners, several were selected for active collaboration in the development and review of the contents. The development of this platform was a much bigger, longer and more exhaustive process than expected. The result is supposed to be a start of a continuing process. Infonet-Biovision shall be a living information platform, modified and further developed by those who use it.

The source of information is derived from Biovision projects, research institutions, project reports, books, publications, web-sites and partner organisations in East Africa as well as from local farmers` groups and communities and extension workers feedback.

Technical Information

The database interface and the user interface are based on the same technical principles.

Overview

Infonet Biovision is a Web application. The content is stored in a database and viewed and modified via Browser. The following browsers are supported:

- **Internet Explorer (tested from version 6.0 ? works also on version 5.0)**
- **Firefox from version 1.0**
- **Netscape from version 6.0**

The application is compatible with Windows (tested), Macintosh and Linux.

Client

The client is implemented in Html and Javascript.

Server

Javaservlets are used to generate the client code. Java version 1.5 and a Servlet container are necessary. For the servlet container we recommend Tomcat or Resin. Java 1.5 is working on different OS including Windows, MacOSX 10.4 and Linux.

Database

A relational database is used as a backend. At the moment we have Mysql version 4.1.14 implemented.

Mysql runs on different platforms including Windows, MacOSX and different Unix-Versions. It should be possible to use other relational databases with acceptable change effort.

party content found on a Infonet-BioVision site.

- **Other parts of the site may also include third party content that is licensed on different terms. Where that use is not a fair use, the different license terms of that content are either indicated or the content is acknowledged to be 'Used with permission'.**

Disclaimer

Biovision Foundation is attempting to offer information of sound quality to the users of the online plattform and information service, Infonet-Biovision. Due to the fact that ecological approaches cannot be standardized because of the diversity of local factors influencing its performance, BioVision does not assume any responsibility for damages which may arise from the use of the information presented in Infonet-Biovision. This covers any direct, indirect or consequential damages.

Biovision Foundation encourages the users to test the information presented first on a small scale within their location with the aim to study the performance of the presented information under local condition and to adapt it, if necessary. This local validation should be conducted in cooperation with competent local partners.

Note: Hyperlinks to other Internet sites do not imply any official endorsement of or responsibility for the opinions, ideas, data or products presented at these locations, or guarantee the validity of the information provided. The sole purpose of links to other sites is to indicate further information available on related topics.

Applicable Law

This site is founded and hosted by Biovision Foundation in the canton of Zurich, Switzerland. This site, its

contents, and any disputes arising therefrom shall be construed and interpreted exclusively under the laws of the canton of Zürich and applicable Swiss federal laws.

Mar 16, 2010 - Disclaimer

Information of www.infonet-biovision.org

Biovision Foundation for Ecological Development - Who we are

BioVision Foundation http://www.biovision.ch is a Swiss non-profit organization with a global mission to alleviate poverty and improve the livelihoods of rural people in Africa while maintaining the natural resources and diversity that sustains life. Our chairman is Dr. Hans Rudolf Herren, one of the world's leading researchers in biological pest control. He has been living and researching in Africa for over 20 years. In 1995 he won the World Food Prize, the first Swiss to receive this honour. From 1994 until 2005 he has been the CEO and Director of the International Centre of Insect Physiology and Ecology *(icipe)* in Nairobi, Kenya. In May 2005 Dr. Herren officially took over presidency of ther internationally active Millenium Institute in Washington DC. This institute supports the governments of developing countries by providing resources for sustainable development.

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And this is just the beginning!

Project Team and Management of Infonet-Biovision

- **Concept, Coordination and Quality Control**

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- **Regional Coordination and Awareness**

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Scientific Advisors

The project team works closely with scientific experts from ICIPE, FIBL and others. The scientific advisory board contains experts from Human-, Animal- and Environmental Health.

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- **Dr. Eric Wyss, Organic Plant Protection / Pests and Beneficial Insects Specialist, FIBL Frick, www.fibl.ch**
- **Dr. Hanspeter Liniger, NRM /Soil & Water Management, CDE/WOCAT Bern, www.wocat.org**
- **Prof. Peter Lüthy, Malaria Specialist, Institute for Microbiology, Swiss Federal Institute of Technology, 8093 Zurich, Switzerland**
- **Prof. John Traxler, University of Wolverhampton, Applied Innovative Digital Technologies Research Group**
- **Marc Steinlin, Knowledge management specialist, Cape Town www.i-p-k.ch**

Specific Objectives

- **Priorise, compile, tailor and disseminate user relevant content through direct contact and feedback from farmer groups and other users (i.e. according to baseline studies, usability studies, evaluations and feedback mechanisms)**
- **Revise and update content with local relevant information and knowledge through a network of local and international partner organisations, experts and scientists**
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development activities

Main Topics and Content:

a) Sustainable agriculture and organic crop husbandry for food security
b) Effective ecological prevention and management of plant-, human- and animal targeting pests and diseases
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Unique Features

- **Covers a relevant range of local species, varieties and topics for East-African users (plants, health, livestock, agriculture, ecology, environment, income generation)**
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How do I order the CD / (infonet-offline Version)?

The infonet-CD is useful if you do not have internet access but have access to a computer to read the infonet-CD.

Contact for ordering the infonet-CD (offline version): Farmers interested to receive the CD only need to send airtime worth KSH 200 to our partner organisation 'The Orgainc Farmer' in Kenya, through either:

- **Safaricom lines 0717 551 129 (New Number) or**
- **Celtel /Zain lines 0738 390 715.**

After sending this airtime, please send an SMS detailing your full name and correct address. The CD shall be sent to you by registered mail. Pls note that the CD is only produced once a year and does therefore not contain the latest and updated contents, the most updated version of infonet is only accessible through internet, also the feedback function works only, if you are connected to the internet.

Background

In East Africa agriculture is the main source of income for over 70% of the rural population (in Kenya about 20 million people) and represents 25% of the region's gross domestic product (GDP). Most of the farming is small-scale or subsistence. Crop pests (insects, weeds, plant diseases, rodents etc.) represent a considerable limiting factor in the production of local food crops and are a major cause of agricultural under-production, malnutrition and poverty. At the same time the workforce is plagued by the major health problems that arise from numerous diseases caused by parasitic infections in humans (HIV/Aids, malaria) and productive livestock (tsetse-born trypanosomiasis, tick-born East Coast fever). Despite agriculture's significance, the rural population in Africa often lack access to extension services, productivity augmenting techniques and know-how. In particular, up-to-date information on affordable, effective and ecological methods for the sustainable management of plant-, human- and animal- targeting pests and disease vectors, for adequate nutrition, as well as methods to maintain a healthy and productive environment lay dormant in

academic journals and research institutes, beyond the reach of farmers and rural communities that need them the most.

The idea of Infonet-Biovision

To actively support dissemination initiatives at the ICIPE and other organisations in the area of agriculture and health, BioVision provided the initial finances in order to begin preliminary work on an Internet platform whose purpose was to act as a tool for information sharing and dissemination of knowledge and experience gained in various pilot projects. Later the Liechtenstein Development Service provided funding to proceed the work for Phase I (2005-2007) of implementation.

The design of Infonet-BioVision incorporates a bottom-up approach in the sense that the topics, content and structure of the platform was defined in consultation with local farmer groups and communities. Infonet-BioVision also encourages user's feedback on experiences and on the situation on-the-ground which eventually is lead back to the board of advisory scientists so that the information presented can be continuously adapted and expanded. This two-way flow of information is an integral aspect of ensuring the applicability, relevancy and usefulness of the platform.

Information dissemination and awareness

For effective outreach, Infonet-Biovision aims to collaborate with research institutions such as ICIPE's Technology Transfer Unit as well as other training and extension networks in the field of sustainable agriculture, environment, lifestock and public health.

We aim to collaborate with organisations which have experience in awareness rising and sensitation for farmers and rural communities in East Africa. In addition, such collaborators ought to be receptive in in using new information and communication technologies to disseminate the necessary information to farmers and rural communities. We are aware that access to computer, literacy, language and cultural differences are major limitations in reaching the defined target groups. Therefore, we endeavour to collaborate with organisations that will translate relevant information into local languages for an effective

transfer of information. We are also aware that the internet can only become an established medium for the transfer of knowledge if it is used by existing institutions and access points and if it supports their work.

Infonet-BioVision has the potential to increase the impact of existing training and extension programs from GO's and NGO's as it can be easily combined with various existing local approaches.
To ensure that the information reaches the end-users directly, a wide range of media such as posters, brochures, local radio, marketplace and other "low-tech" media are used.

Sustainability

The sustainability of the platform largely depends on the ability to bring the information to the farmers and to ensure the relevancy of the information provided. The project is characterised by a participatory approach involving farmer groups, local collaborating partners and communities.

Concept Design

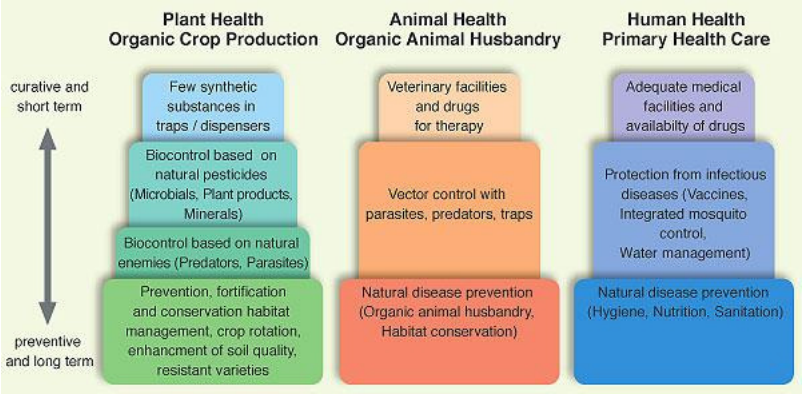
The core concept of Infonet-Biovision is the database with its processed information and pre-defined structure which facilitates the rapid and easy incorporation of new data. As the needs of users with varying levels of knowledge and experience ought to be catered for, the platform around the database is conceived in such a way that the users can access its content through different entry points. These include databases on sustainable pest and crop management, animal, human and environment as well as training modules in these areas. Furthermore, it will be possible for the users to send feedback information to the project team-members regarding their experiences.

Contents

The platform provides comprehensible content with up-to-date information on preventive and curative control of plant-, human- and animal- targeting pests and disease vectors and on sustainable agriculture and environmental health. Where available, effective traditional management methods will also be incorporated. With the use of photos, images, illustrations and clear advice, we provide practical tools for

the correct identification and recognition of pests, disease vectors and parasites and their damaging symptoms. Such information is also useful to non-experts. All information can be compiled, saved and printed in tailor-made training material by users. In all categories, external web-links lead to related web-sites with additional information.

Preventive and curative measures in Organic Farming and Human Health

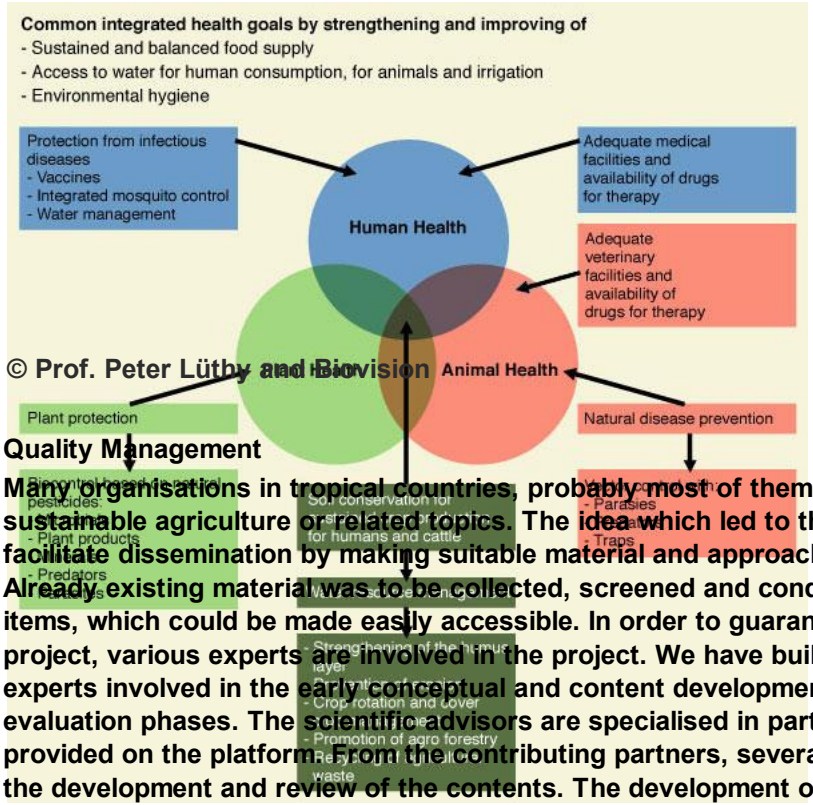


Methods shown at the bottom have a long-term effect, while methods shown at the top have a short-term effect. In organic farming systems, methods with a long-term effect are the basis of crop production and animal husbandry and should be used with preference. On the other hand methods with a short-term effect should be used in emergencies only. In human health, preventive measures reduce peoples' dependency on medicine and drugs. They include the provision of safe water supply, sanitation, the promotion of safe food supply, proper nutrition as well as other environmental control measures.

In the plant health part the database contains biological and ecological background information, scientific and local names, images and photographs used for the identification of pests and diseases. The description

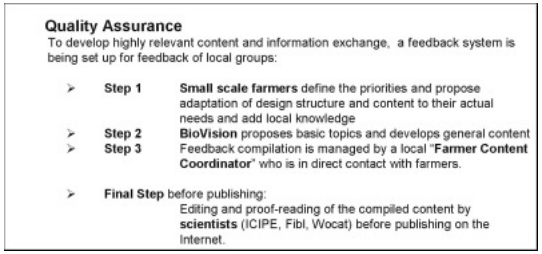
on the prevention and cultural measures which have long term effects is also provided. This is then followed by direct control measures such as Bio-control Agents and Bio-Insecticides which have short-term effects. The data on preventive control measures is the core part of the information we provide.

In organic farming systems, methods with long-term effects are the basis of crop production and animal husbandry, and should be used with preference. On the other hand, methods with short-term effects should be used in emergencies only. Infonet-Biovision has extended this approach to human health systems. This is because the advance in the development of vaccines and chemotherapeutic agents has brought many diseases under control. However, there are still many communicable diseases for which environmental control measures are indispensable, especially in the field of water supply and sanitation. Such diseases include cholera, diarrhoeal diseases, leishmaniasis, malaria and schistosomiasis. In all these instances, the environmental measures, either as an integral part of primary health care or undertaken outside the health sector, form an indispensable component of overall disease control strategies together with education on health and hygiene. In some cases they are the only component.



Quality Management

Many organisations in tropical countries, probably most of them NGOs, are engaged in training activities on sustainable agriculture or related topics. The idea which led to the development of infonet-biovision was to facilitate dissemination by making suitable material and approaches available over an internet platform. Already existing material was to be collected, screened and condensed into comprehensive information items, which could be made easily accessible. In order to guarantee the optimum implementation of the project, various experts are involved in the project. We have built up a team of international and local experts involved in the early conceptual and content development phases and in the monitoring and evaluation phases. The scientific advisors are specialised in particular fields for the review of all information provided on the platform. From the contributing partners, several were selected for active collaboration in the development and review of the contents. The development of this platform was a much bigger, longer and more exhaustive process than expected. The result is supposed to be a start of a continuing process. Infonet-Biovision shall be a living information platform, modified and further developed by those who use it.



Quality Assurance

To develop highly relevant content and information exchange, a feedback system is being set up for feedback of local groups:

- **Step 1** **Small scale farmers** define the priorities and propose adaptation of design structure and content to their actual needs and add local knowledge
- **Step 2** **BioVision** proposes basic topics and develops general content
- **Step 3** Feedback compilation is managed by a local "**Farmer Content Coordinator**" who is in direct contact with farmers.

- **Final Step** before publishing: Editing and proof-reading of the compiled content by **scientists** (ICIPE, Fibl, Wocat) before publishing on the Internet.

The source of information is derived from Biovision projects, research institutions, project reports, books, publications, web-sites and partner organisations in East Africa as well as from local farmers` groups and communities and extension workers feedback.

Technical Information

The database interface and the user interface are based on the same technical principles.

Overview

Infonet Biovision is a Web application. The content is stored in a database and viewed and modified via Browser. The following browsers are supported:

- **Internet Explorer (tested from version 6.0 ? works also on version 5.0)**
- **Firefox from version 1.0**
- **Netscape from version 6.0**

The application is compatible with Windows (tested), Macintosh and Linux.

Client
The client is implemented in Html and Javascript.

Server
Javaservlets are used to generate the client code. Java version 1.5 and a Servlet container are necessary. For the servlet container we recommend Tomcat or Resin. Java 1.5 is working on different OS including Windows, MacOSX 10.4 and Linux.

Database
A relational database is used as a backend. At the moment we have Mysql version 4.1.14 implemented. Mysql runs on different platforms including Windows, MacOSX and different Unix-Versions. It should be possible to use other relational databases with acceptable change effort.

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Biovision Foundation encourages the users to test the information presented first on a small scale within their location with the aim to study the performance of the presented information under local condition and to adapt it, if necessary. This local validation should be conducted in cooperation with competent local

partners.

Note: Hyperlinks to other Internet sites do not imply any official endorsement of or responsibility for the opinions, ideas, data or products presented at these locations, or guarantee the validity of the information provided. The sole purpose of links to other sites is to indicate further information available on related topics.

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Information of www.infonet-biovision.org

Agroforestry

more Images

Management

Sustainable and Organic agriculture

Conservation Agriculture

Agroforestry

A guide to tree planting in Kenya

Agroforestry

Processing and Value addition

Energy

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Ecological Aspects of Agroforestry
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Introduction

Agroforestry is an old practice, consisting of growing perennial trees and shrubs in association with agricultural crops, pastures and/or keeping livestock in the same field. Agroforestry aims to use agro-biodiversity in generating multiple services. Trees and shrubs provide mulching material, green manure, animal fodder, soil erosion control, shade, nutrient cycling and improved soil fertility and also socioeconomic benefits e.g. saleable products such as fruits, fuel wood and charcoal, timber for construction, craft materials, etc.

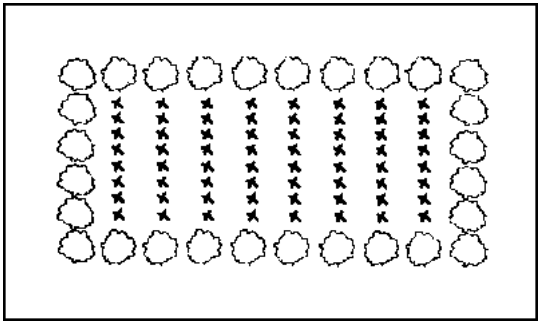
The classification of the different types of agroforestry is based on the type of environment and on the combination of the components. In the humid lowland tropics, the broadest range of homegardens and multi-level cropping are found, whereas agro-silvopastoral systems dominate in semi-arid and subhumid zones. In tropical highlands vegetation strips are common, in order to reduce erosion risk.

Basically, there are three categories of agroforestry systems:

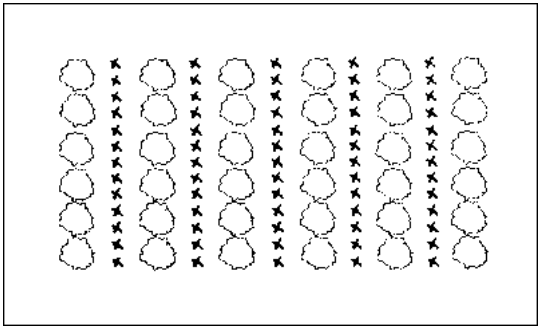
- Agrosilvicultural systems: Trees with crops e.g. taungya and alley cropping
- Silvopastoral systems: Trees with livestock/pasture e.g. trees and shrubs on pastures and multipurpose trees, fodder trees and shrubs grown on or around cropland
- Agrosilvopastoral systems: Trees with both crops and livestock e.g. compound farming.

Next to climatic conditions and soil type, success of agroforestry depends on the right choice of species combination, management practices and the understanding and motivation for using it. An agroforestry system involves two or more plant species and/or animals (including at least one woody perennial), it has more than two outputs and has a cycle of more than one year.

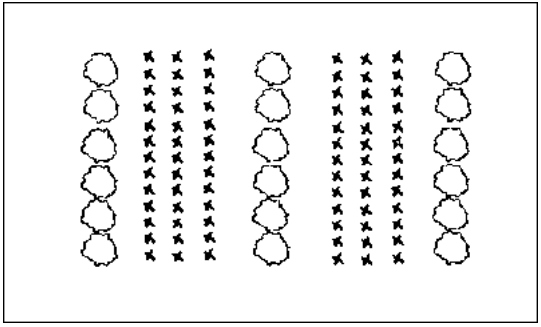
Distribution of the plant components can vary in space and time. Plant components can be mixed in different densities (see images below) and have a separate long/short cropping/fallow cycle.



Trees along borders of fields.



Alternative rows of plant components.



Alternative strips or alley cropping.
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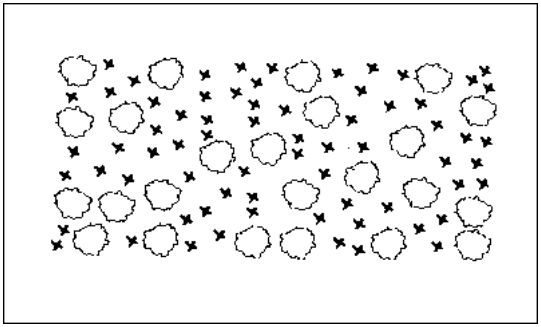

Random mixture of plant components.
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Ecological Aspects of Agroforestry

Agroforestry systems have the following basic principles:

- **Competition between the plants must be minimised.**
  This can be achieved by planting the plants in such a way that they are not using resources all at the same time. For instance, acacia trees (*Faidherbia albida*) loose their leaves during the millet growing season, and are suitable to feed cattle, as their pods are rich of proteins. Therefore, many African farmers grow acacia trees combining with millet and cattle.
- **Complementarity among the plants must be maximised.**
  Complementarity and competition depend on the root system of the crops and trees/shrubs, i.e. on the depth or shallowness of the roots. If one has deep, the other one shallow roots, they will not compete for nutrients and water, but might complement/ benefit from each other.

(Sanchez 1995)

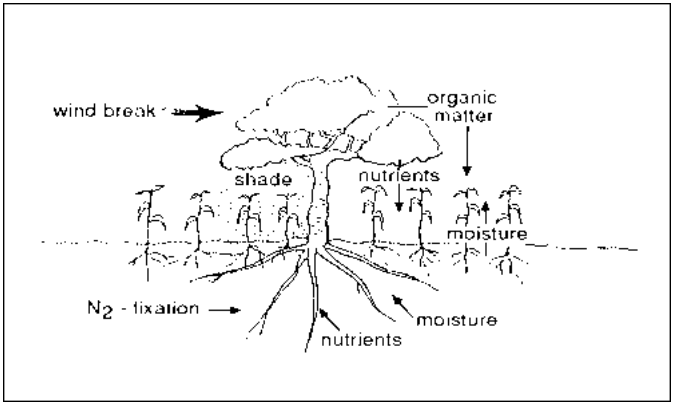
Agroforestry has following advantages:

- **Improvement of soil fertility. Trees provide mulch when their leaves, fruits and branches fall down and decompose. This results in an increase of organic matter and recycling of nutrients from deep in the soil, and leguminous trees fix nitrogen that can benefit food crops.**
- **Effects on soil moisture and microclimate. Shading and windbreak effects of trees influence microclimate and help to conserve soil moisture. Shade helps reducing the soil temperature and the amount of water that evaporates into the air. Though their roots may also deprive crops of moisture.**
- **Soil conservation. Trees can conserve the soil in many ways. They cushion the impact of raindrops on the soil and reduce the amount of rain-splash erosion. Their roots bind/stabilise the soil. Planted along contours, they can interrupt the flow of water running off the surface. They can act as windbreaks protecting the soil against wind erosion**

- **Improvement of biodiversity. Agroforestry systems improve diversity and quantity of animals/wildlife by offering a greater variety of habitats**

Drawbacks to agroforestry:
One is labour is required. However, it can be reduced by proper planning. Rows of trees can be planted, weeded and guarded at the same time as the food crops. Surface mulching with leaves involves less labour than digging them in. Any digging needed can be done at the same time as the land is prepared for the crops.

Trees need to be watered and protected when young. Later on they can survive on rain water alone.
Trees can also lower yields of maize and other food crops. However, if both crop and tree products are taken into account, a higher total yield from unit of land will be achieved than in a monoculture. Though a field of maize may produce a high yield, it is not sustainable in a long run as problems associated with pests and diseases and soil exhaustion will soon lead to decline in yields and higher production costs.



Interactions in agrosylvicultural systems.

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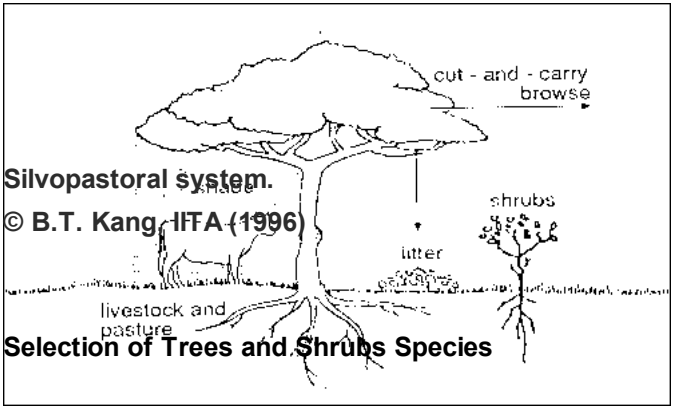

Silvopastoral system.
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Selection of Trees and Shrubs Species

The multipurpose trees

Following species were found to perform well, in terms of survival, growth, and wood and foliage production, across diverse agro-ecological zones:

- ***Moringa oleifera***
- ***Senna siamea***
- ***Senna spectabilis***
- ***Acacia auriculiformis***
- ***Leucaena leucocephala*** **(except in acidic soils)**
- **Some provenances of *Gliricidia sepium***

Fodder trees

Fodder refers to the green parts of the tree, for example leaves or sometimes flowers and pods, eaten by browsing or grazing animals. Fodder trees include species of *Acacia*, *Leucaena*, *Prosopis* and many others.

One of the best fodder trees is *Calliandra*, having high protein content. *Calliandra* grows up

to 4 to 6 metres, requires rainfall above 1000 mm per year and grows well in well-drained soils. Nine months after planting, fodder can be harvested. Harvesting can be done 4 to 6 times per year.

Criteria for selection of fodder species:

- **Edible to livestock and rich in protein**
- **Easy to manage**
- **Drought tolerant**
- **Tolerant of trampling if to be grazed**
- **Able to resprout easily**

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Taungya system (= shamba system)

The Taungya system combines forestry crops and agricultural crops during the first years of establishment of the forestry plantation. The main objective of taungya is wood production. Generally, the land belongs to the forestry departments, who allow subsistence farmers to grow their crops for two or three years. Farmers have to take care of the forestry seedlings, getting in return part or all of the agricultural produce.

The Taungya system comes originally from Myanmar (Burma) and means hill (*Taung*) cultivation (*ya*). In East Africa it is known as Shamba system.

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Dispersed trees on cropland

The practice of growing trees in fields while crops are grown alongside or underneath can be done either by protecting and managing the trees that are already there or by planting new trees.

There are different spacing patterns and densities of placement depending on the type of tree chosen and of crop grown, but trees are generally planted at least 8-10m apart.

Advantages:

- **Growing trees with crops can increase crop yields due to shading and the addition of nutrients and organic matter to the soil.**
- **Trees can be a breeding place for beneficial insects and other creatures that can reduce crop pest numbers.**
- **Trees can provide products of commercial and subsistence value.**

Disadvantages:

- **Trees can attract birds and crop pests, which can damage crops.**
- **Competition with crops for water, nutrients. It is important to plant trees with deeper roots than those of the crops grown alongside.**

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Compound farming (= Home gardens)

Compound farming is also known as home garden, village-forage garden, kitchen garden and haushold garden. In Africa, they are known as:

- **Compound farms in Southeast Nigeria, humid lowlands**
- **Chagga homegardens in Mt. Kilimanjaro, Northern Tanzania, highlands**
- **Ka/Fuyo gardens in Hounde region in Burkina Faso, semi-arid to sub-humid lowlands**

Compound farming consists on growing trees, shrubs, vines and herbaceous plants in or around the homesteads, aiming mostly food production for household consumption. In home gardens perennial crops and annual crops are grown side by side. Home gardens are characterised by the intensive use of multi-purpose trees, shrubs, food crops and animals. Typical is also the high species diversity and the complex, layered structure (3-4 vertical canopy layers). Near the ground there is a herbaceous layer consisting of plants such as beans, pulses, root crops grasses and medicinal plants, which grow to about 1.5 metres. The middle layer (1-3 m height) consists of small trees that tolerate some amount of shade such as coffee, tea, banana, papaya or food plants such as cassava, etc. The upper layers are usually about 20 metres high and consist of trees for fruit, fuel, timber, shade and fodder.

Animals are also usually included in the system.
The Chagga home gardens in Tanzania are based on Arabica coffee and banana for commercial purposes.

Advantages:

- **Production of food is continuous and diverse.**
- **Farmers have easy access to food, timber, fuel, fodder, spices and medicines.**
- **Home gardens protect the soil and conserve water.**
- **Labour can be used efficiently because home gardens are situated close to houses.**
- **Produce may be sold locally and act as a financial buffer in times of need.**

Disadvantages:

- **The high diversity of plants in a home garden can provide a habitat for species that**

could become pests or introduce diseases.

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Alley cropping

Alley cropping is also known as alley farming or hedgerow intercropping. It consists in growing food crops between hedgerows of shrubs and trees, specially leguminous species. The arrangement of the components is uniform (not mixed), consisting of strips with different widths.
During growing of the crops, the hedges get pruned regularly, to avoid shading of the crops and to provide biomass, enhancing the nutrient status and physical properties of the soil.

Alley cropping is developed to improve or maintain crop yields by improving soil fertility and micro-climate through the cycling of nutrients, mulching and weed control. This can be reached by using specific tree species that produce foliage and fix nitrogen, enriching the soil. By planting deep-rooted trees and shrubs that grow quickly in hedgerows, essential plant nutrients are recycled to the benefit of crops planted in alleys between the hedgerows. Furthermore, a good mixture of trees and shrubs can provide animal fodder, protection against soil erosion, shade and windbreaks, fuel wood and construction material.

Alley cropping is mostly used in humid or subhumid tropical areas on fragile soils and seems to work best where farmers need to intensify crop production but have soil fertility problems.

The technique of alley cropping requires careful planning and management. It is preferable that the species used have a light open crown that lets sunlight pass through onto the crops that are being grown. It is also possible to prune species with a denser crown. The trees used must also be capable of rapid resprouting after coppicing.

Alley cropping management cycle

1. The trees are planted in lines and crop grown between the rows.
2. When the shade from the trees begins to interfere with the crops they are coppiced or pollarded.
3. The coppiced branches are placed between the rows. Leaves will fall to the ground adding organic matter to the soil when they breakdown. Branches and twigs can be gathered for fuel or other purposes.
4. Trees resprout.
5. The cycle is repeated.

Advantages of alley cropping:

- **Improvement of soil fertility and structure and micro-climate conditions, thereby benefiting crops.**
- **A longer cropping period and higher land use intensity.**
- **Trees used can provide products of commercial and subsistence value.**

Disadvantages:

- **The technique will take some years to establish, so farmers will have to wait for the benefits.**
- **Farmers may not have the capital available for the investment in trees.**
- **Alley cropping requires considerable labour and management - results will be poor if planting and pruning schedules are not carried out properly.**
- **Competition with crops for water and nutrients. It is important to plant trees with deeper roots than those of the crops grown alongside.**

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Improved Fallows

Fallows are defined as following:
1) Allowing crop land to lie idle, either tilled or untilled, during the whole or greater portion of a growing season. Tillage is usually practised to control weeds and encourage the storage of moisture in the soil.
2) Land rested from deliberate cropping, not necessarily without cultivation or grazing but without sowing.
3) State of land left without a crop or weed growth for extended period, often to accumulate moisture.

Improved fallow is the replacement or enhancement of natural fallow vegetation by the introduction of selected trees or shrubs. The purpose of improved fallow is to shorten the fallow period and/or increase the yield of subsequent crops. This is done by planting trees or shrubs which can help to restore nutrients to the soil and to suppress weeds as well as providing useful by-products. The trees therefore enrich the fallow both biologically and economically.

In this practice the cropping period usually alternates with the tree-growing period. However, it is possible to keep some trees during the cropping period and many farmers have combined the method of improved fallow with alley cropping.

By planting soil enriching species, the minimum fallow period can be shortened from 15 to 20 years to about 8 to 10 years. However in Kenya, *Sesbania* is grown in a 3 year rotation and *Tephrosia* in a 1 year rotation.

Advantages:

- **The time required for soil enrichment can be shortened; the tree canopy and fast growing species can suppress weeds.**
- **Soil erosion is minimised.**
- **The use of a wide variety of species can reduce pests, weeds and diseases.**
- **This method is relatively inexpensive to establish and maintain.**
- **The wood can be used or sold at the end of the fallow period.**

Disadvantages:

- **The planting of seedlings and tree cutting must be done during the same period of crop planting - labour may be a limiting factor at this time.**
- **The fallow will need protection from browsing animals.**

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Contour vegetation strips

Contour vegetation strips are living barriers of trees and shrubs which are planted along the contour lines of a slope, in order to control water and soil erosion. These lines of vegetation can also provide useful products such as food, fuel, building poles, fodder or gum.
There are many factors to consider when building contour strips as bad design can lead to even more severe erosion. The effectiveness of the vegetation strips depends on the type of trees planted, the spacing of the trees and the width of the strip, the steepness of the slope, the amount of rainfall and the soil type.

Advantages:

- **Strips can provide additional nutrients and organic matter into the soil. This can be increased by using nitrogen-fixing plants.**
- **Excess vegetation can provide food for animals. These can be allowed to browse through the strip to feed on crop remains after harvesting.**

Disadvantages:

- **Contour strips take up land which could be used for crops.**

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Planting on terraces

Terraces are normally used as soil and water conservation measures on slopes. They provide flat areas of land that can be planted with crops.
Building terraces involves digging ditches and making ridges. Along the contours of a slope, grasses, trees and shrubs can be planted on the ridges, helping to stabilise the ground, providing leaf mulch, protecting crops from wind and providing other useful products such as food, fuel, building poles or fodder.

Trees can be planted on the ridge of the terrace or at the back of the terrace. If the tree is planted at back of the terrace it will get all of its water requirements. If a tree is planted on the ridge of the terrace, it will be on drier ground but the leaves will spread around more evenly and provide more nutrients for crops. Trees can be planted in both locations if the terrace is wide enough.
The type of tree or hedge used will depend on the site it is planted on and on the kind of

products or services you wish it to provide. If the aim of the terrace is to stabilise the soil, trees and shrubs with strong roots systems should be planted. These will be able to withstand the movements of soil and water.

Advantages:

- **Stabilisation of the slope, which results in soil and water conservation and a better environment for crops to grow in.**
- **Shelter from wind.**
- **Pest control by providing a breeding place for beneficial insects.**
- **Increased area of land that can be cropped.**
- **Useful by-products such as food, fuel, building poles or fodder.**

Disadvantages:

- **As the structure of the land is changed quite dramatically, land tenure rights may first need to be established or secured.**
- **Building terraces require adequate skills and material, labour and capital and also the capacity to maintain the structures for years to come.**

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Information Source Links

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A guide to tree planting in Kenya

Description: This guide was designed by scientists from Kenya Forestry Research Institute (KEFRI) to provide useful working information to field workers and farmers involved in tree planting in Kenya. It includes information on the requirements of various tree species in different agro-ecological zones regarding soil, climate, uses and expected rotation.

Introduction

Forests and trees play important roles in peoples' lives. They provide unquantifiable benefits such as improving the climate, regulating stream and river flows, conserving and protecting the soil mantle; and providing stable habitats for wildlife. The latter, together with wilderness values, are the foundation of Kenya's important tourist industry.

Forests and trees are also the backbone of many important economic activities. They are the source of virtually all the nation's supply of building timber, poles, veneers and plywood, wood-fuel, pulp and paper. Other commodities and services from forests and trees include fruits, oils, tannins, resins, medicines, fibre, shade, browse and fodder. The last three are of

particular importance to man and livestock, especially in the arid and semi-arid land areas.

Kenya has a small area of reserved forest estate (about 7%). The bulk of the forest estate (200 million ha) support the indigenous forests which provide protective functions as well as yielding wood of high commercial value. Plantations forests (about 0.15 million ha) provide the bulk of wood demand for domestic and commercial needs.

Sustainable forest management and the development of social forestry have become important agenda at national and international fora during the last two decades.
By the late 1970, a number of major international aid agencies and non-governmental organisations became more involved in tree planting and other forestry activities in the country in rural areas. The Forest Department established forestry extensions service in 1971. However, the effort of tree planting outside the forest reserve has created no more than a marginal impact while deforestation has increased.

The choice of species for planting depends on:

1) The purpose of planting: Species selected must be able to fulfill the objective for planting them - e.g. soil and water conservation - in catchment areas, improvement of soil fertility (supply of mulching material, green manure), animal fodder, shade, and saleable products such as fruits, fire wood and charcoal, timber for construction, craft materials, etc.

2) The environment e.g. climatic conditions, soiltype and altitude

3) The ability of the species to establish and provide a wide range of utility, preferable for more than one purpose and a high degree of profitability

Availability of good quality seed on time is a pre-requisite for all tree planting activities. The Kenya Tree Seed Centre, a programme within KEFRI, supplies good quality seed. The centre also provides technical advice on selection of good seed sources. The work of the centre is supported by sub-centres ar Nyeri, Londiani, Kakamega, Kitale, Kibwezi, Gede and Turkana.

Quality seed can also be obtained from any sub-centre, field officers of the Kenya Forestry Department or from the Tree Seed Centre at Muguga. Click here to open the KEFRI seed catalogue.

It would be important for farmers to be able to obtain tree/shrub seeds from the open market and raise their own seedlings as they do with other farm crops, such as maize, cabbages, etc.

The most important species for five of the seven of Kenya's ecological zones have been listed in an alphabetical order under each ecozone (AEZ). Ecological zones I and VII have been excluded because currently there is hardly any tree planting taking place in these zones.

The remaining five ecozones are deemed as receiving annual rainfall as follows:

Ecozone II (over 1400 mm)
Ecozone III (800 to 1400 mm)
Ecozone IV (400 to 800 mm) and
Ecozone V and VI (less than 400 mm)

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Trees used in Agroforestry

Species	Altitude (m) Ecozone	Soil Type	Management System	End Use	Rotation
Grevillea	0 - 2500	Most variable	Plantation, hedge	Timber, fuel,	Short (6 yrs

robusta	**II and III**	**but loves deep red soils**	**planting, agroforestry, woodlot, shelterbelt system**	**transmission, posts, construction**	**- pole) (30 yrs for timber)**
Sesbania sesban	**1400 - 2500 II, III,**	**Variable**	**Agroforestry/ mixed system conservation**	**Firewood, soil enrichment, water**	**Short (2 - 3 yrs)**
Croton megalocarpus **(Mukinduri)**	**1000 - 2000 III**	**Well adaptable to variable highland soils**	**Mixed, woodlot, boundary agroforestry managements**	**Fuel, shelterwood, charcoal, hedge, boundary planting**	**Short (10 - 25 yrs)**
Cordia abyssinica **(Muringa)**	**1400 - 2500 III,**	**Mainly red loamy soils**	**Plantation, mixed woodlots, amenity, agroforestry**	**Timber, amenity, fuel**	**Short to medium (30 - 60 yrs)**
Markhamia lutea **(Zusiala)**	**1000 - 2000 III**	**Red loamy soils**	**Plantation/ amenity/ agroforestry systems**	**Timber/ amenity agroforestry**	**Short (15 - 30 yrs)**
Markhamia lutea **(Siala)**	**1400 III**	**Red loam to clay loamy soil**	**Plantation/ woodlot/ amenity agroforestry systems**	**Timber/ amenity/ soil nutrient input**	**Short (15 - 30 yrs)**
Calliandra	**0 - 1400**	**Variable**	**Agroforestry**	**Fuel, soil**	**Short**

calothyrsus	**III**		**system**	**nutrient enhancing**	
Casuarina equisetifolia **(Whispering pine)**	**0 - 1400 III**	**Sandy soils**	**Plantation/ agroforestry**	**Timber, fuel, amenity**	**Short (4 - 6 yrs)**
Gliricidia sepium	**0 - 1600 III**	**Clay-loamy to sandy soils**	**Woodlots/ agroforestry systems**	**Fuel, fodder, nutrient, enhancement trees**	**Short**
Leucaena leucocephala	**0 - 1400 III 0 - 2000 IV**	**Variable but prefers slightly alkaline - clay loamy to sandy soils**	**Woodlots/ mixed agroforestry systems**	**Fuel, fodder, nutrient enhancement trees**	**Short**
Acacia tortilis	**1000 - 1400 IV**	**Sandy to sandy-clay soils to riverine clay/ sandy soil**	**Mixed enrichment/ agroforestry**	**Fuel, poles fodder**	**Short**
Prosopis chilensis **(Algaroba)**	**0 - 1400 IV**	**Sandy to sandy-clay soils to riverine clay/ sandy soils**	**Enrichment/ agroforestry systms**	**Fodder, fuel, soil protection and nutrient enhancement**	**Short**

Melia volkensii **(Mkau)**	**1000 - 1400 IV**	**Sandy to sandy-clay soils to riverine clay/ sandy soils**	**Mixed/ agroforestry systems**	**Fuel, poles, fodder**	**Short**
Tamarindus indica	**1000 - 1400 IV**	**Sandy to sandy-clay soils to riverine clay/ sandy soils**	**Mixed/ agroforestry systems amenity**	**fuel, poles, fodder, fruits**	**Short**

Sesbania sesban	**Grevillea tree**
	
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Trees suitable for Eco-Zone II (over 1400 mm rainfall)

Species	Altitude (m)	Soil Type	Management System	End Use	Rotation
Acacia mearnsii (Black wattle)	1600 - 2000	Deep to medium red to red loamy	Plantation/ woodlot	Tanning, fuel	Short - (6 - 10 yrs)
Acacia melanoxylon	2000 - 3000	Variable deep red to loamy sandy soils	Plantation/ mixed planting	Soil conservation, timber, fuel	Short (8 yrs) (30 yrs timber)
Arundinaria alpina (Bamboo)	2200 - 3000	Deep red to volcanic loamy soils	Plantation, boundary, groves, soil protection	Building, fencing, handicraft, soil protection	Short (6 - 10 yrs)
Bischofia javonica (Bischof wood)	1200 - 1600	Deep red/ loamy soils	Plantation, enrichment planting	Timber	Short (30 - 40 yrs)
Chlorophora excelsa	0 - 1400	Variable sandy	Plantation/ mixed planting	Timber	Medium to long

(Mvule)		**to deep soils**			
Cordia abyssinica **(Muringa)**	**1400 - 2500**	**Variable and wide spectrum but deep**	**Plantation**	**Timber/ shade**	**Medium to long (30 - 60 yrs)**
Croton megalocarpus **(Mukinduri)**	**1000 - 2000**	**Variable deep red to loamy sandy soils**	**Plantation/ mixed/ enrichment/ natural systems**	**Fuel, poles, construction, peeler wood**	**Short to medium**
Cupressus lusitanica	**1800 - 3000**	**Highland (variable) soils**	**Plantation**	**Timber/ hedge shelterbelt**	**Short (25 - 30 yrs)**
Eucalyptus regnans **(Mountain ash)**	**2500 - 3000**	**Deep highland forest soils**	**Plantation/ woodlots**	**Fuel, poles, building timber**	**Short (4 - 6 yrs - poles) (10 -20 yrs for timber)**
Eucalyptus saligna/ grandis **(Blue gum)**	**1400 - 2500**	**Variable, medium to deep soils**	**Plantation/ woodlots**	**Fuel, transmission posts construction, potential timber, pulp**	**Short (15 - 25 yrs - for timber) (5 - 12 yrs for other uses)**
Fagara microphylla	**1200 - 1900**	**Deep red to sandy loamy soils**	**Plantation, enrichmenr planting system**	**Timber**	**Short to medium (40 -80 yrs)**
Maesopsis eminii	**1200 - 1600**	**Deep red/ loamy soils**	**Plantation/ mixed**	**Timber**	**Short (25 - 50 yrs)**

(Mutere)			**enrichment systems**		
Ocotea usambarensis **(Camphor)**	**1600 - 2500**	**Volcanic deep loamy soils**	**Plantation/ mixed systems**	**Timber**	**Medium to long**
Olea welwitchii **(Elgon Teak)**	**1600 - 2400**	**Deep loamy soils**	**Plantation/ mixed natural systems**	**Timber**	**Long**
Phoneix reclinata	**0 - 3000**	**Swampy and riparian soils**	**Mixed systems amenity**	**Water conservation, basketry, ornamental**	**Medium to long**
Pinus patula	**1600 - 300**	**Deep wet loams**	**Plantation**	**Timber/ paper**	**Short (16 - 20 yrs - pulp) (25 - 30 yrs for timber)**
Polyscius kikuyuensis **(Mutati)**	**1600 - 2500**	**Variable, red to loamy clay soil**	**Mixed, enrichment and natural management systems**	**Peeler wood for boards mainly**	**Short (30 - 40 yrs)**
Prunus africanum **(Muiri)**	**1600 - 2500**	**Variable**	**Plantation/ mixed and natural**	**Timber**	**Medium to long**
Syzygium species	**1000 - 2500**	**Swampy and riparian soils**	**Mixed systems in water**	**Water conservation**	**Medium to long**

			courses	timber	
Vitex Keniensis **(Meru oak)**	**1700 - 2200**	**Deep volcanic, red to loamy clay soil**	**Plantation/ natural management system**	**Timber**	**40 - 50 yrs**

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Trees suitable for Eco-Zone III - Highland region (800 -1400mm rainfall)

Species	Altitude (m)	Soil Type	Management System	End Use	Rotation
Aberia caffra **(Kei apple)**	**1400 - 2200**	**Variable soils**	**Hedge Management**	**Hedge**	**Short to long**
Acacia xanthophloea	**1000 - 2000**	**Riparian soils**	**Mixed system**	**Water conservation, soil conservation , soil enrichment**	**Medium**
Brachylaena huillensis **(Muhugu)**	**200 - 1850**	**Mainly red loamy and sandy soils**	**Woodlot, mixed enrichmenr system**	**Timber, fencing, carving**	**Medium to long (60 - 100 yrs)**
Cupressus lusitanica	**1800 - 2500**	**Well adaptable to**	**Plantation**	**Timber/ hedge/ shelterbelt**	**Short (25 -30 yrs)**

		variable highland soils			
Eucalyptus saligna/ grandis (Blue gum)	1400 - 2500	Highland loamy soils	Plantation/ woodlots/ shelterbelts	Fuel, poles, posts, fencing	Short (5 - 12 yrs - for poles) (15 -25 yrs - timber)
Jacaranda	1600 - 2500	Variable soils	Single tree management	Amenity	Short
Juniperus procera (Cedar)	1500 - 300	Red loam to rocky shallow drained soils	Plantation/ woodlots/ mixed	Timber, posts, fencing, protection	Medium to long (60 - 100 yrs)
Macheria tippu (Tipuana tipu)	1600 - 2000	Red loams to black cotton soils	Plantation/ mixed	Timber	Short to medium (20 - 40 yrs)
Olea africana (Mutamaiyu)	1600 - 2200	Red clay loamy soils	Mixed planting	Beams, posts, carvings, fencing, wood fuel	Long (80 - 120 yrs)
Podocarpus gracillor (Podo)	1800 - 2400	Red to loamy clay and volcanic soils	Plantation/ mixed/ amenity	Timber, amenity	Medium to long (50 - 80 yrs)
Pinus Patula	1600 - 3000	Adaptable to variable soils but poor in	Plantation	Timber and paper manufacture	Short (16 - 20 yrs - pulp) (25 - 30 yrs -

		clay and water-logged soils			timber)
Phoenix reclinata	0 - 3000	Swampy and riparian soils	Mixed system, amenity	Water conservation, basketry, ornamental	Medium to long
Prunus africanum (Muiri)	1600 - 2500	Highland red loamy to volcanic deep soils	Plantation/ mixed/ enrichment planting systems	Timber	Medium to long
Schinus molle (Pepper tree)	1500 - 3000	Variable red to cotton loamy soils	Boundary/ ornamental planting	Amenity, fuel	Short (10 - 20 yrs)
Spathodea nilotica (Nandi flame)	1200 - 2200	Variable Soils	Amenity system	Amenity	-
Syzygium species	1000 - 2500	Swampy and riparian soils	Mixed system in water courses	Water conservation, timber	Medium to long

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Trees suitable for Eco-Zone III - Lowlands (800 - 1400mm rainfall)

Species	Altitude (m)	Soil Type	Management System	End Use	Rotation
Azadirachta indica (Mwarobaini)	0 - 1400	Sandy to sandy-loam	Plantation /mixed	Timber, fuel, fencing, amenity, medical	Short
Borassus aethiopum (Borassus palm)	0 - 1400	Variable but mainly riparian	Mixed systems	Water conservation, palm wine, basketry	Medium to long
Brancylaena huillensis (Muhugu)	200 - 1850	Red loamy to clay loam sandy soils	Mixture/ enrichment natural system	Timber, fuel, carvings, construction, fencing	Medium to long
Brachystegia spiciformis (Mrithi)	0 - 200	Red loamy to clay loam sandy soils	Mixture/ enrichment/ natural system	Timber, railway sleepers	Medium to long (60 - 100 yrs)
Cassia siamea	0 - 1400	Sandy to sandy-loam	Plantation/ mixed	Timber, fuel, fencing	Short
Chlorophora excelsa (Mvule)	0 - 1400	Red clay-loamy to sandy loamy soils	Plantation/ mixed systems	Timber	Short to long
Dalbergia	0 -	Variable, sandy to	Plantation/	Timber, fuel	Long

melanoxylon **(Mpingo)**	**1400**	**sandy - clay**	**mixed**	**fencing, wood carving,**	
E. camaldulensis	**0 - 1400**	**Red clay-loamy to sandy-loamy soils**	**Plantation/ shelter-belt woodlot systems**	**Fuel, poles, construction**	**Short (6-8 yrs)**
E. europhylla	**0 - 1400**	**Sandy to clay loams**	**Plantation/ woodlots**	**Fuel, poles, posts**	**Short (5 - 12 yrs)**
Ficus sycomorus	**0 - 2000**	**Riparian soils**	**Mixed systems**	**Water conservation fodder**	**medium to long**
Gmelina arborea	**0 - 1400**	**Sandy to sandy loam soils**	**Plantation**	**Timber, paper, match box light construction**	**Short (15 - 25 yrs)**
T. brownii **(Koloswo)**	**0 - 1400**	**Sandy to sandy/ clay loams**	**Woodlots, mixed plantings**	**Fuel, fodder, posts**	**Short**

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Trees suitable for Eco-Zone IV (400-800mm rainfall)

Species	Altitude (m)	Soil Type	Management System	End Use	Rotation

Acacia albida	**1000 - 14000**	**Sandy to sandy-clay soils to riverine clay/sandy soils**	**Mixed, woodlot, riverine plantings**	**Fuel, poles**	**Short**
A. senegal **(Gum arabicum)**	**1000 - 1400**	**Sandy to sandy-clay soils to riverine clay/ sandy soils**	**Woodlot/ mixed enrichment**	**Fuel, poles, gum arabic production**	**Short (15 - 25 yrs)**
Acacia plycantha	**1000 - 14000**	**Sandy to sandy-clay soils to riverine clay/ sandy soils**	**Mixed/ woodlot systems**	**Fuel, poles**	**Short**
Acacia seyal	**1000 - 14000**	**Sandy clay to sandy loam soils**	**Woodlot, mixed enrichment planting systems**	**Fuel, poles posts**	**Short**
Azadirachta indica **(Mwarobaini)**	**0 - 14000**	**Sandy to sandy-clay soils to riverine clay/ sandy soils**	**Mixed/ enrichment planting system**	**Timber, fuel, poles, fodder**	**Short**
Balanites aegyptiaca	**500 - 1400**	**Sandy to sandy-clay soils to riverine clay/ sandy soils**	**Mixed/ enrichment planting system**	**Timber, fuel**	**Short**
C. megalocarpus **(Mukinduri)**	**1000 - 2000**	**Sandy to sandy-clay soils to riverine clay/ sandy soils**	**Woodlot/ mixed enrichment systems**	**Fuel, agropoles**	**Short to medium (15 - 25 yrs)**

Dalbergia melanoxylon	**0 - 1400**	**Sandy to sandy-clay soils to riverine clay/ sandy soils**	**Woodlot/ mixed/ enrichment systems**	**Timber, fuel, poles, carvings**	**Medium to long**
E. camaldulensis	**0 - 1400**	**Sandy to sandy-clay soils to riverine clay/ sandy soils**	**Plantation/ woodlot/ boundary plantings**	**Fuel, poles, posts**	**Short (6 - 8 yrs)**
Ficus sycomorus	**0 - 2000**	**Riparian soils**	**Mixed systems**	**Water conservation**	**Medium to long**

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Trees suitable for Eco-Zone V-VI (under 400mm rainfall)

Species	Altitude (m)	Soil Type	Management System	End Use	Rotation
A. Senegal (Gum arabicum)	1000 - 1400	Sandy clay to sandy loam soils	Woodlot/ mixed enrichment planting	Fuel, poles, gum arabicum	Short
Cordia sinensis	1000 - 1500	Sandy clay to sandy loam soils	Woodlot/ enrichment systems	Fuel, poles, fodder	Short and medium

Hyhaena ciriacea **(Doum palm)**	**0 - 1000**	**Sandy riparian soils**	**Mixed systems**	**Water conservation, basketry**	**Medium to long**
Salvadora persica	**1000 - 1500**	**Sandy clay to sandy loam soils**	**Woodlot/ enrichment systems**	**Fodder, soil protection, amenity**	**Short to medium**
Syzyphus mauritiana	**1000 - 1500**	**Sandy clay to sandy loam soils**	**Hedge planting management**	**Life fencing, fruits**	**Short to medium**

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Information Source Links

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- **Seed catalogue: www.kefri.org. To view KEFRI seed catalogue click here document or refer to page on "Publications".**

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Images

Sorghum grown under *Faidherbia albida* and *Borassus akeassii* near Banfora, Burkina Faso

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Planting trees

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Agroforestry

s an old practice, consisting of growing perennial trees and shrubs in association with agricultural crops, pastures and/or keeping livestock in the same field. Agroforestry aims to use agro-biodiversity in generating multiple services. Trees and shrubs provide mulching material, green manure, animal fodder, soil erosion control, shade, nutrient cycling and improved soil fertility and also socioeconomic benefits e.g. saleable products such as fruits, fuel wood and charcoal, timber for

construction, craft materials, etc.

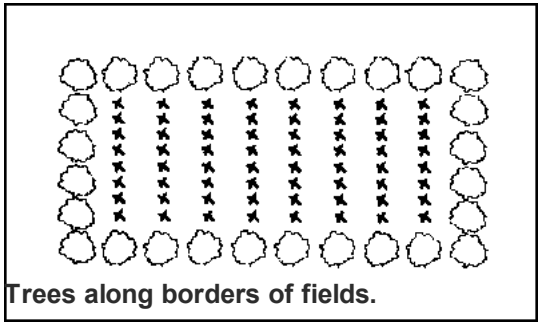
The classification of the different types of agroforestry is based on the type of environment and on the combination of the components. In the humid lowland tropics, the broadest range of homegardens and multi-level cropping are found, whereas agro-silvopastoral systems dominate in semi-arid and subhumid zones. In tropical highlands vegetation strips are common, in order to reduce erosion risk.

Basically, there are three categories of agroforestry systems:

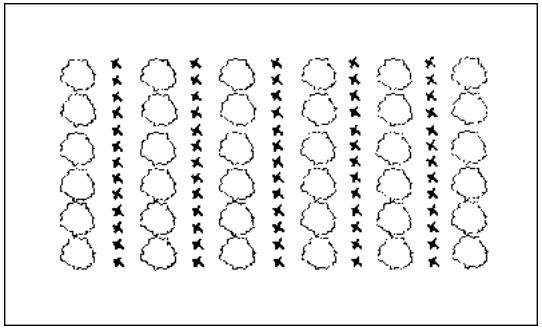
- **Agrosilvicultural systems: Trees with crops e.g. taungya and alley cropping**
- **Silvopastoral systems: Trees with livestock/pasture e.g. trees and shrubs on pastures and multipurpose trees, fodder trees and shrubs grown on or around cropland**
- **Agrosilvopastoral systems: Trees with both crops and livestock e.g. compound farming.**

Next to climatic conditions and soil type, success of agroforestry depends on the right choice of species combination, management practices and the understanding and motivation for using it. An agroforestry system involves two or more plant species and/or animals (including at least one woody perennial), it has more than two outputs and has a cycle of more than one year.

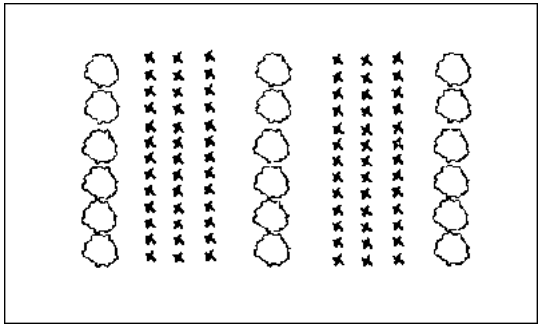
Distribution of the plant components can vary in space and time. Plant components can be mixed in different densities (see images below) and have a separate long/short cropping/fallow cycle.



Trees along borders of fields.



Alternative rows of plant components.



Alternative strips or alley cropping.

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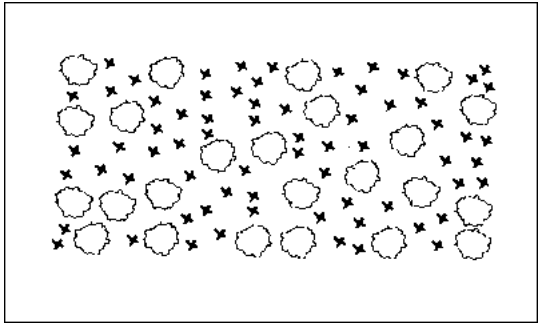


Random mixture of plant components.

Ecological Aspects of Agroforestry

Agroforestry systems have the following basic principles:

- **Competition between the plants must be minimised.**
  This can be achieved by planting the plants in such a way that they are not using resources all at the same time. For instance, acacia trees (*Faidherbia albida*) loose their leaves during the millet growing season, and are suitable to feed cattle, as their pods are rich of proteins. Therefore, many African farmers grow acacia trees combining with millet and cattle.
- **Complementarity among the plants must be maximised.**
  Complementarity and competition depend on the root system of the crops and trees/shrubs, i.e. on the depth or shallowness of the roots. If one has deep, the other one shallow roots, they will not compete for nutrients and water, but might complement/ benefit from each other.

(Sanchez 1995)

Agroforestry has following advantages:

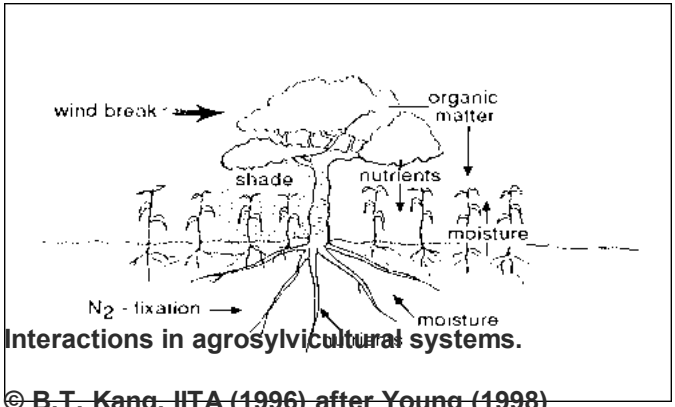
- **Improvement of soil fertility. Trees provide mulch when their leaves, fruits and branches fall down and decompose. This results in an increase of organic matter and recycling of nutrients from deep in the soil,**

and leguminous trees fix nitrogen that can benefit food crops.

- **Effects on soil moisture and microclimate. Shading and windbreak effects of trees influence microclimate and help to conserve soil moisture. Shade helps reducing the soil temperature and the amount of water that evaporates into the air. Though their roots may also deprive crops of moisture.**
- **Soil conservation. Trees can conserve the soil in many ways. They cushion the impact of raindrops on the soil and reduce the amount of rain-splash erosion. Their roots bind/stabilise the soil. Planted along contours, they can interrupt the flow of water running off the surface. They can act as windbreaks protecting the soil against wind erosion**
- **Improvement of biodiversity. Agroforestry systems improve diversity and quantity of animals/wildlife by offering a greater variety of habitats**

Drawbacks to agroforestry:
One is labour is required. However, it can be reduced by proper planning. Rows of trees can be planted, weeded and guarded at the same time as the food crops. Surface mulching with leaves involves less labour than digging them in. Any digging needed can be done at the same time as the land is prepared for the crops.

Trees need to be watered and protected when young. Later on they can survive on rain water alone.
Trees can also lower yields of maize and other food crops. However, if both crop and tree products are taken into account, a higher total yield from unit of land will be achieved than in a monoculture. Though a field of maize may produce a high yield, it is not sustainable in a long run as problems associated with pests and diseases and soil exhaustion will soon lead to decline in yields and higher production costs.



Interactions in agrosylvicultural systems.

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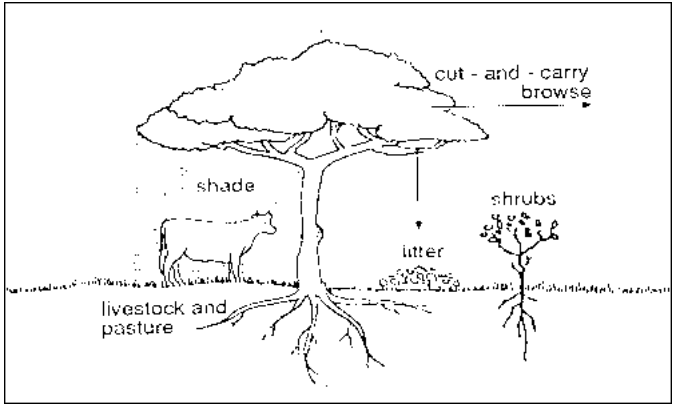

Silvopastoral system.

Selection of Trees and Shrubs Species

The multipurpose trees

Following species were found to perform well, in terms of survival, growth, and wood and foliage production, across diverse agro-ecological zones:

- ***Moringa oleifera***
- ***Senna siamea***
- ***Senna spectabilis***
- ***Acacia auriculiformis***
- ***Leucaena leucocephala*** **(except in acidic soils)**
- **Some provenances of *Gliricidia sepium***

Fodder trees

Fodder refers to the green parts of the tree, for example leaves or sometimes flowers and pods, eaten by browsing or grazing animals. Fodder trees include species of *Acacia*, *Leucaena*, *Prosopis* and many others. One of the best fodder trees is *Calliandra*, having high protein content. *Calliandra* grows up to 4 to 6 metres, requires rainfall above 1000 mm per year and grows well in well-drained soils. Nine months after planting, fodder can be harvested. Harvesting can be done 4 to 6 times per year.

Criteria for selection of fodder species:

- **Edible to livestock and rich in protein**
- **Easy to manage**
- **Drought tolerant**
- **Tolerant of trampling if to be grazed**

- **Able to resprout easily**

Taungya system (= shamba system)

The Taungya system combines forestry crops and agricultural crops during the first years of establishment of the forestry plantation. The main objective of taungya is wood production.
Generally, the land belongs to the forestry departments, who allow subsistence farmers to grow their crops for two or three years. Farmers have to take care of the forestry seedlings, getting in return part or all of the agricultural produce.

The Taungya system comes originally from Myanmar (Burma) and means hill (*Taung*) cultivation (*ya*). In East Africa it is known as Shamba system.

Dispersed trees on cropland

The practice of growing trees in fields while crops are grown alongside or underneath can be done either by protecting and managing the trees that are already there or by planting new trees.

There are different spacing patterns and densities of placement depending on the type of tree chosen and of crop grown, but trees are generally planted at least 8-10m apart.

Advantages:

- **Growing trees with crops can increase crop yields due to shading and the addition of nutrients and organic matter to the soil.**
- **Trees can be a breeding place for beneficial insects and other creatures that can reduce crop pest**

numbers.

- **Trees can provide products of commercial and subsistence value.**

Disadvantages:

- **Trees can attract birds and crop pests, which can damage crops.**
- **Competition with crops for water, nutrients. It is important to plant trees with deeper roots than those of the crops grown alongside.**

Compound farming (= Home gardens)

Compound farming is also known as home garden, village-forage garden, kitchen garden and haushold garden. In Africa, they are known as:

- **Compound farms in Southeast Nigeria, humid lowlands**
- **Chagga homegardens in Mt. Kilimanjaro, Northern Tanzania, highlands**
- **Ka/Fuyo gardens in Hounde region in Burkina Faso, semi-arid to sub-humid lowlands**

Compound farming consists on growing trees, shrubs, vines and herbaceous plants in or around the homesteads, aiming mostly food production for household consumption. In home gardens perennial crops and annual crops are grown side by side. Home gardens are characterised by the intensive use of multi-purpose trees, shrubs, food crops and animals. Typical is also the high species diversity and the complex, layered structure (3-4 vertical canopy layers). Near the ground there is a herbaceous layer consisting of plants such as beans, pulses, root crops grasses and medicinal plants, which grow to about 1.5 metres. The middle layer (1-3 m height) consists of small trees that tolerate some amount of shade such as coffee, tea, banana, papaya or food plants such as cassava, etc. The upper layers are usually about 20 metres high and consist of trees for fruit, fuel, timber, shade and fodder.

Animals are also usually included in the system.
The Chagga home gardens in Tanzania are based on Arabica coffee and banana for commercial purposes.

Advantages:

- **Production of food is continuous and diverse.**
- **Farmers have easy access to food, timber, fuel, fodder, spices and medicines.**
- **Home gardens protect the soil and conserve water.**
- **Labour can be used efficiently because home gardens are situated close to houses.**
- **Produce may be sold locally and act as a financial buffer in times of need.**

Disadvantages:

- **The high diversity of plants in a home garden can provide a habitat for species that could become pests or introduce diseases.**

Alley cropping

Alley cropping is also known as alley farming or hedgerow intercropping. It consists in growing food crops between hedgerows of shrubs and trees, specially leguminous species. The arrangement of the components is uniform (not mixed), consisting of strips with different widths.
During growing of the crops, the hedges get pruned regularly, to avoid shading of the crops and to provide biomass, enhancing the nutrient status and physical properties of the soil.

Alley cropping is developed to improve or maintain crop yields by improving soil fertility and micro-climate through the cycling of nutrients, mulching and weed control. This can be reached by using specific tree species that produce foliage and fix nitrogen, enriching the soil. By planting deep-rooted trees and shrubs that grow quickly in hedgerows, essential plant nutrients are recycled to the benefit of crops planted in alleys between the hedgerows. Furthermore, a good mixture of trees and shrubs can provide animal fodder, protection against soil erosion, shade and windbreaks, fuel wood and construction material.

Alley cropping is mostly used in humid or subhumid tropical areas on fragile soils and seems to work best where farmers need to intensify crop production but have soil fertility problems.

The technique of alley cropping requires careful planning and management. It is preferable that the species used have a light open crown that lets sunlight pass through onto the crops that are being grown. It is also possible to prune species with a denser crown. The trees used must also be capable of rapid resprouting after coppicing.

Alley cropping management cycle

1. The trees are planted in lines and crop grown between the rows.
2. When the shade from the trees begins to interfere with the crops they are coppiced or pollarded.
3. The coppiced branches are placed between the rows. Leaves will fall to the ground adding organic matter to the soil when they breakdown. Branches and twigs can be gathered for fuel or other purposes.
4. Trees resprout.
5. The cycle is repeated.

Advantages of alley cropping:

- **Improvement of soil fertility and structure and micro-climate conditions, thereby benefiting crops.**
- **A longer cropping period and higher land use intensity.**
- **Trees used can provide products of commercial and subsistence value.**

Disadvantages:

- **The technique will take some years to establish, so farmers will have to wait for the benefits.**
- **Farmers may not have the capital available for the investment in trees.**
- **Alley cropping requires considerable labour and management - results will be poor if planting and pruning schedules are not carried out properly.**
- **Competition with crops for water and nutrients. It is important to plant trees with deeper roots than**

those of the crops grown alongside.

Improved Fallows

Fallows are defined as following:
1) Allowing crop land to lie idle, either tilled or untilled, during the whole or greater portion of a growing season. Tillage is usually practised to control weeds and encourage the storage of moisture in the soil.
2) Land rested from deliberate cropping, not necessarily without cultivation or grazing but without sowing.
3) State of land left without a crop or weed growth for extended period, often to accumulate moisture.

Improved fallow is the replacement or enhancement of natural fallow vegetation by the introduction of selected trees or shrubs. The purpose of improved fallow is to shorten the fallow period and/or increase the yield of subsequent crops. This is done by planting trees or shrubs which can help to restore nutrients to the soil and to suppress weeds as well as providing useful by-products. The trees therefore enrich the fallow both biologically and economically.

In this practice the cropping period usually alternates with the tree-growing period. However, it is possible to keep some trees during the cropping period and many farmers have combined the method of improved fallow with alley cropping.

By planting soil enriching species, the minimum fallow period can be shortened from 15 to 20 years to about 8 to 10 years. However in Kenya, *Sesbania* is grown in a 3 year rotation and *Tephrosia* in a 1 year rotation.

Advantages:

- **The time required for soil enrichment can be shortened; the tree canopy and fast growing species can**

suppress weeds.

- **Soil erosion is minimised.**
- **The use of a wide variety of species can reduce pests, weeds and diseases.**
- **This method is relatively inexpensive to establish and maintain.**
- **The wood can be used or sold at the end of the fallow period.**

Disadvantages:

- **The planting of seedlings and tree cutting must be done during the same period of crop planting - labour may be a limiting factor at this time.**
- **The fallow will need protection from browsing animals.**

Contour vegetation strips

Contour vegetation strips are living barriers of trees and shrubs which are planted along the contour lines of a slope, in order to control water and soil erosion. These lines of vegetation can also provide useful products such as food, fuel, building poles, fodder or gum.
There are many factors to consider when building contour strips as bad design can lead to even more severe erosion. The effectiveness of the vegetation strips depends on the type of trees planted, the spacing of the trees and the width of the strip, the steepness of the slope, the amount of rainfall and the soil type.

Advantages:

- **Strips can provide additional nutrients and organic matter into the soil. This can be increased by using nitrogen-fixing plants.**
- **Excess vegetation can provide food for animals. These can be allowed to browse through the strip to feed on crop remains after harvesting.**

Disadvantages:

- **Contour strips take up land which could be used for crops.**

Planting on terraces

Terraces are normally used as soil and water conservation measures on slopes. They provide flat areas of land that can be planted with crops.
Building terraces involves digging ditches and making ridges. Along the contours of a slope, grasses, trees and shrubs can be planted on the ridges, helping to stabilise the ground, providing leaf mulch, protecting crops from wind and providing other useful products such as food, fuel, building poles or fodder.

Trees can be planted on the ridge of the terrace or at the back of the terrace. If the tree is planted at back of the terrace it will get all of its water requirements. If a tree is planted on the ridge of the terrace, it will be on drier ground but the leaves will spread around more evenly and provide more nutrients for crops. Trees can be planted in both locations if the terrace is wide enough.
The type of tree or hedge used will depend on the site it is planted on and on the kind of products or services you wish it to provide. If the aim of the terrace is to stabilise the soil, trees and shrubs with strong roots systems should be planted. These will be able to withstand the movements of soil and water.

Advantages:

- **Stabilisation of the slope, which results in soil and water conservation and a better environment for crops to grow in.**
- **Shelter from wind.**
- **Pest control by providing a breeding place for beneficial insects.**

- **Increased area of land that can be cropped.**
- **Useful by-products such as food, fuel, building poles or fodder.**

Disadvantages:

- **As the structure of the land is changed quite dramatically, land tenure rights may first need to be established or secured.**
- **Building terraces require adequate skills and material, labour and capital and also the capacity to maintain the structures for years to come.**

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A guide to tree planting in Kenya

A guide to tree planting in Kenya
Description: This guide was designed by scientists from Kenya Forestry Research Institute (KEFRI) to provide useful working information to field workers and farmers involved in tree planting in Kenya. It includes information on the requirements of various tree species in different agro-ecological zones regarding soil, climate, uses and expected rotation.

Introduction

Forests and trees play important roles in peoples' lives. They provide unquantifiable benefits such as improving the climate, regulating stream and river flows, conserving and protecting the soil mantle; and providing stable habitats for wildlife. The latter, together with wilderness values, are the foundation of Kenya's important tourist industry.

Forests and trees are also the backbone of many important economic activities. They are the source of virtually all the nation's supply of building timber, poles, veneers and plywood, wood-fuel, pulp and paper. Other commodities and services from forests and trees include fruits, oils, tannins, resins, medicines, fibre, shade, browse and fodder. The last three are of particular importance to man and livestock, especially in the arid and semi-arid land areas.

Kenya has a small area of reserved forest estate (about 7%). The bulk of the forest estate (200 million ha) support the indigenous forests which provide protective functions as well as yielding wood of high commercial value. Plantations forests (about 0.15 million ha) provide the bulk of wood demand for domestic and commercial needs.

Sustainable forest management and the development of social forestry have become important agenda at national and international fora during the last two decades.

By the late 1970, a number of major international aid agencies and non-governmental organisations became more involved in tree planting and other forestry activities in the country in rural areas. The Forest Department established forestry extensions service in 1971. However, the effort of tree planting outside the forest reserve has created no more than a marginal impact while deforestation has increased.

The choice of species for planting depends on:

1) The purpose of planting: Species selected must be able to fulfill the objective for planting them - e.g. soil and water conservation - in catchment areas, improvement of soil fertility (supply of mulching material, green manure), animal fodder, shade, and saleable products such as fruits, fire wood and charcoal, timber for construction, craft materials, etc.

2) The environment e.g. climatic conditions, soiltype and altitude

3) The ability of the species to establish and provide a wide range of utility, preferable for more than one purpose and a high degree of profitability

Availability of good quality seed on time is a pre-requisite for all tree planting activities. The Kenya Tree Seed Centre, a programme within KEFRI, supplies good quality seed. The centre also provides technical advice on selection of good seed sources. The work of the centre is supported by sub-centres ar Nyeri, Londiani, Kakamega, Kitale, Kibwezi, Gede and Turkana. Quality seed can also be obtained from any sub-centre, field officers of the Kenya Forestry Department or from the Tree Seed Centre at Muguga. Click here to open the KEFRI seed catalogue.

It would be important for farmers to be able to obtain tree/shrub seeds from the open market and raise their own seedlings as they do with other farm crops, such as maize, cabbages, etc.

The most important species for five of the seven of Kenya's ecological zones have been listed in an alphabetical order under each ecozone (AEZ). Ecological zones I and VII have been excluded because currently there is hardly any tree planting taking place in these zones.

The remaining five ecozones are deemed as receiving annual rainfall as follows:

Ecozone II (over 1400 mm)
Ecozone III (800 to 1400 mm)
Ecozone IV (400 to 800 mm) and
Ecozone V and VI (less than 400 mm)

Trees used in Agroforestry

Species	Altitude (m) Ecozone	Soil Type	Management System	End Use	Rotation
Grevillea robusta	0 - 2500 II and III	Most variable but loves deep red soils	Plantation, hedge planting, agroforestry, woodlot, shelterbelt system	Timber, fuel, transmission, posts, construction	Short (6 yrs - pole) (30 yrs for timber)
Sesbania sesban	1400 - 2500 II, III,	Variable	Agroforestry/ mixed system conservation	Firewood, soil enrichment, water	Short (2 - 3 yrs)

Croton megalocarpus **(Mukinduri)**	**1000 - 2000 III**	**Well adaptable to variable highland soils**	**Mixed, woodlot, boundary agroforestry managements**	**Fuel, shelterwood, charcoal, hedge, boundary planting**	**Short (10 - 25 yrs)**
Cordia abyssinica **(Muringa)**	**1400 - 2500 III,**	**Mainly red loamy soils**	**Plantation, mixed woodlots, amenity, agroforestry**	**Timber, amenity, fuel**	**Short to medium (30 - 60 yrs)**
Markhamia lutea **(Zusiala)**	**1000 - 2000 III**	**Red loamy soils**	**Plantation/ amenity/ agroforestry systems**	**Timber/ amenity agroforestry**	**Short (15 - 30 yrs)**
Markhamia lutea **(Siala)**	**1400 III**	**Red loam to clay loamy soil**	**Plantation/ woodlot/ amenity agroforestry systems**	**Timber/ amenity/ soil nutrient input**	**Short (15 - 30 yrs)**
Calliandra calothyrsus	**0 - 1400 III**	**Variable**	**Agroforestry system**	**Fuel, soil nutrient enhancing**	**Short**
Casuarina equisetifolia **(Whispering pine)**	**0 - 1400 III**	**Sandy soils**	**Plantation/ agroforestry**	**Timber, fuel, amenity**	**Short (4 - 6 yrs)**
Gliricidia sepium	**0 - 1600 III**	**Clay-loamy to sandy soils**	**Woodlots/ agroforestry systems**	**Fuel, fodder, nutrient, enhancement trees**	**Short**
Leucaena leucocephala	**0 - 1400 III 0 - 2000 IV**	**Variable but prefers slightly alkaline - clay**	**Woodlots/ mixed agroforestry systems**	**Fuel, fodder, nutrient enhancement trees**	**Short**

		loamy to sandy soils			
Acacia tortilis	1000 - 1400 IV	Sandy to sandy-clay soils to riverine clay/ sandy soil	Mixed enrichment/ agroforestry	Fuel, poles fodder	Short
Prosopis chilensis (Algaroba)	0 - 1400 IV	Sandy to sandy-clay soils to riverine clay/ sandy soils	Enrichment/ agroforestry systms	Fodder, fuel, soil protection and nutrient enhancement	Short
Melia volkensii (Mkau)	1000 - 1400 IV	Sandy to sandy-clay soils to riverine clay/ sandy soils	Mixed/ agroforestry systems	Fuel, poles, fodder	Short
Tamarindus indica	1000 - 1400 IV	Sandy to sandy-clay soils to riverine clay/ sandy soils	Mixed/ agroforestry systems amenity	fuel, poles, fodder, fruits	Short

Sesbania sesban	Grevillea tree

	
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Trees suitable for Eco-Zone II (over 1400 mm rainfall)

Species	Altitude (m)	Soil Type	Management System	End Use	Rotation
Acacia mearnsii **(Black wattle)**	**1600 - 2000**	**Deep to medium red to red loamy**	**Plantation/ woodlot**	**Tanning, fuel**	**Short - (6 - 10 yrs)**

Acacia melanoxylon	**2000 - 3000**	**Variable deep red to loamy sandy soils**	**Plantation/ mixed planting**	**Soil conservation, timber, fuel**	**Short (8 yrs) (30 yrs timber)**
Arundinaria alpina **(Bamboo)**	**2200 - 3000**	**Deep red to volcanic loamy soils**	**Plantation, boundary, groves, soil protection**	**Building, fencing, handicraft, soil protection**	**Short (6 - 10 yrs)**
Bischofia javonica **(Bischof wood)**	**1200 - 1600**	**Deep red/ loamy soils**	**Plantation, enrichment planting**	**Timber**	**Short (30 - 40 yrs)**
Chlorophora excelsa **(Mvule)**	**0 - 1400**	**Variable sandy to deep soils**	**Plantation/ mixed planting**	**Timber**	**Medium to long**
Cordia abyssinica **(Muringa)**	**1400 - 2500**	**Variable and wide spectrum but deep**	**Plantation**	**Timber/ shade**	**Medium to long (30 - 60 yrs)**
Croton megalocarpus **(Mukinduri)**	**1000 - 2000**	**Variable deep red to loamy sandy soils**	**Plantation/ mixed/ enrichment/ natural systems**	**Fuel, poles, construction, peeler wood**	**Short to medium**
Cupressus lusitanica	**1800 - 3000**	**Highland (variable) soils**	**Plantation**	**Timber/ hedge shelterbelt**	**Short (25 - 30 yrs)**
Eucalyptus regnans **(Mountain ash)**	**2500 - 3000**	**Deep highland forest soils**	**Plantation/ woodlots**	**Fuel, poles, building timber**	**Short (4 - 6 yrs - poles) (10 -20 yrs for**

					timber)
Eucalyptus saligna/ grandis (Blue gum)	1400 - 2500	Variable, medium to deep soils	Plantation/ woodlots	Fuel, transmission posts construction, potential timber, pulp	Short (15 - 25 yrs - for timber) (5 - 12 yrs for other uses)
Fagara microphylla	1200 - 1900	Deep red to sandy loamy soils	Plantation, enrichmenr planting system	Timber	Short to medium (40 -80 yrs)
Maesopsis eminii (Mutere)	1200 - 1600	Deep red/ loamy soils	Plantation/ mixed enrichment systems	Timber	Short (25 - 50 yrs)
Ocotea usambarensis (Camphor)	1600 - 2500	Volcanic deep loamy soils	Plantation/ mixed systems	Timber	Medium to long
Olea welwitchii (Elgon Teak)	1600 - 2400	Deep loamy soils	Plantation/ mixed natural systems	Timber	Long
Phoneix reclinata	0 - 3000	Swampy and riparian soils	Mixed systems amenity	Water conservation, basketry, ornamental	Medium to long
Pinus patula	1600 - 300	Deep wet loams	Plantation	Timber/ paper	Short (16 - 20 yrs - pulp) (25 - 30 yrs for timber)
Polyscius kikuyuensis	1600 - 2500	Variable, red to loamy clay soil	Mixed, enrichment and	Peeler wood for boards mainly	Short (30 - 40 yrs)

(Mutati)			**natural management systems**		
***Prunus africanum* (Muiri)**	**1600 - 2500**	**Variable**	**Plantation/ mixed and natural**	**Timber**	**Medium to long**
Syzygium species	**1000 - 2500**	**Swampy and riparian soils**	**Mixed systems in water courses**	**Water conservation timber**	**Medium to long**
***Vitex Keniensis* (Meru oak)**	**1700 - 2200**	**Deep volcanic, red to loamy clay soil**	**Plantation/ natural management system**	**Timber**	**40 - 50 yrs**

Trees suitable for Eco-Zone III - Highland region (800 -1400mm rainfall)

Species	Altitude (m)	Soil Type	Management System	End Use	Rotation
***Aberia caffra* (Kei apple)**	**1400 - 2200**	**Variable soils**	**Hedge Management**	**Hedge**	**Short to long**
Acacia xanthophloea	**1000 - 2000**	**Riparian soils**	**Mixed system**	**Water conservation, soil conservation , soil enrichment**	**Medium**
***Brachylaena huillensis* (Muhugu)**	**200 - 1850**	**Mainly red loamy and sandy soils**	**Woodlot, mixed enrichmenr system**	**Timber, fencing, carving**	**Medium to long (60 - 100 yrs)**

Cupressus lusitanica	**1800 - 2500**	**Well adaptable to variable highland soils**	**Plantation**	**Timber/ hedge/ shelterbelt**	**Short (25 -30 yrs)**
Eucalyptus saligna/ grandis **(Blue gum)**	**1400 - 2500**	**Highland loamy soils**	**Plantation/ woodlots/ shelterbelts**	**Fuel, poles, posts, fencing**	**Short (5 - 12 yrs - for poles) (15 -25 yrs - timber)**
Jacaranda	**1600 - 2500**	**Variable soils**	**Single tree management**	**Amenity**	**Short**
Juniperus procera **(Cedar)**	**1500 - 300**	**Red loam to rocky shallow drained soils**	**Plantation/ woodlots/ mixed**	**Timber, posts, fencing, protection**	**Medium to long (60 - 100 yrs)**
Macheria tippu **(Tipuana tipu)**	**1600 - 2000**	**Red loams to black cotton soils**	**Plantation/ mixed**	**Timber**	**Short to medium (20 - 40 yrs)**
Olea africana **(Mutamaiyu)**	**1600 - 2200**	**Red clay loamy soils**	**Mixed planting**	**Beams, posts, carvings, fencing, wood fuel**	**Long (80 - 120 yrs)**
Podocarpus gracillor **(Podo)**	**1800 - 2400**	**Red to loamy clay and volcanic soils**	**Plantation/ mixed/ amenity**	**Timber, amenity**	**Medium to long (50 - 80 yrs)**
Pinus Patula	**1600 - 3000**	**Adaptable to variable soils but poor in clay and water-logged soils**	**Plantation**	**Timber and paper manufacture**	**Short (16 - 20 yrs - pulp) (25 - 30 yrs - timber)**

Phoenix reclinata	**0 - 3000**	**Swampy and riparian soils**	**Mixed system, amenity**	**Water conservation, basketry, ornamental**	**Medium to long**
Prunus africanum **(Muiri)**	**1600 - 2500**	**Highland red loamy to volcanic deep soils**	**Plantation/ mixed/ enrichment planting systems**	**Timber**	**Medium to long**
Schinus molle **(Pepper tree)**	**1500 - 3000**	**Variable red to cotton loamy soils**	**Boundary/ ornamental planting**	**Amenity, fuel**	**Short (10 - 20 yrs)**
Spathodea nilotica **(Nandi flame)**	**1200 - 2200**	**Variable Soils**	**Amenity system**	**Amenity**	**-**
Syzygium species	**1000 - 2500**	**Swampy and riparian soils**	**Mixed system in water courses**	**Water conservation, timber**	**Medium to long**

Trees suitable for Eco-Zone III - Lowlands (800 - 1400mm rainfall)

Species	Altitude (m)	Soil Type	Management System	End Use	Rotation
Azadirachta indica **(Mwarobaini)**	**0 - 1400**	**Sandy to sandy-loam**	**Plantation /mixed**	**Timber, fuel, fencing, amenity, medical**	**Short**