WELCOME TO THE CAPACITY4FOOD PROJECT

Agroforestry systems: Implication for ISFM in Africa.

CAPACITY4FOOD

Presented By

Prof. Matthew B. Oyun

Department of Forestry and Wood Technology

Federal University of Technology

P. M. B. 704 Akure

Phone: +234 8070928919

E-mail: banjioyun@yahoo.com

June, 2014

CAPACITY4FOOD

ABOUT US
FEDERAL UNIVERSITY OF TECHNOLOGY AKURE

Senate Building

- The Federal Universities of Technologies in Nigeria were established to give prominence to technological and industrial development.

CAPACITY4FOOD

The Federal University of Technology, Akure (FUTA)

Hill Top Auditorium

CAPACITY4FOOD

Established in 1981

Postal Address:

Federal University of Technology,

P. M. B. 704,

Akure,

Ondo State

Nigeria.

Website:
www.futa.edu.ng
Telephone:
+234 8035525662;
+234 8034016340

E-mail:
vc@futa.edu.ng

contents

Flashback to the meaning of Agroforestry	Pastoral system as source of organic resource for soil fertility management
Classification of Agroforestry	Silvo pastoral systems in Africa
Agrisilvicutural intervention for Soil fertility management	
Soil fertility intervention mechanism of Agrisilvicultural systems	
ISFM intervention strategies in agrisilvicultural systems	

Agroforestry

- Refers to land-use system in which trees are grown in association with agricultural crops, pasture or livestock
- The association may be in time, such as rotation between trees and other components, or in space, with other components grown together on the same piece of land.

CAPACITY4FOOD

Classification:

At the highest level, the classification of agroforestry is based on the component present as:

1. Agrisilviculture- Trees with crops
2. Silvopastoral- Trees with pasture and livestock

CAPACITY4FOOD

Classification contd.

3. Trees predominant- Forestry with other component subordinate e.g farm and village forestry; reclamation agroforestry

4. Special component present- Trees with insect (entomoforestry); Trees with fish (aquaforestry)

CAPACITY4FOOD

- The second level of classification is based on the arrangement of components in space and time which can be rotational or spatial.

- In rotational systems, the association between trees and crops (or pastures) takes place primarily over time.
- Examples: shifting cultivation; managed tree fallow; taungya.

CAPACITY4FOOD

Classification contd.

- In spatial systems, the association is primarily one of trees and crop together on the same land management unit.

- **Spatial systems are divided into mixed and zoned**

- **In spatial mixed arrangement, the trees and other components are grown as intimate mixtures with trees distributed over more or less the whole land area.**

CAPACITY4FOOD

Examples: trees on cropland; perennial-crop combination, home garden; trees on pastures (parkland); perennial crops with pastures

- In spatial zone arrangement, the trees are either planted in some systematic arrangement such as rows or are grown on some element in the farm, like field boundaries or soil conservation structures
- Examples: boundary planting; windbreaks; alley cropping; hedges and live fences

CAPACITY4FOOD

AGRISILVICULTUTAL INTERVENTION FOR SOIL FERTILITY MANAGEMENT

- -Managed tree fallows: rotation of planted trees with crops. After a period of cropping, trees are planted and remain for 1-5 years and possibly more
- Hedgerow intercropping: Also called alley cropping or alley farming.

CAPACITY4FOOD

Hedges are planted as parallel rows with close spacing and crops are grown in alleys between them.

- The hedges are regularly pruned and the prunings may either be removed as fodder or retained on the soil.

CAPACITY4FOOD

ALLEY CROPPING (HEDGE ROW TREE/SHRUB INTERCROPPING)

CAPACITY4FOOD

ALLEY CROPPING (HEDGE ROW TREE/SHRUB INTERCROPPING)

CAPACITY4FOOD

ALLEY CROPPING (HEDGE ROW TREE/SHRUB AND MAIZE INTERCROPPING)

CAPACITY4FOOD

-Trees on crop land: This consist of trees grown on crop land, in an open, mixed spatial system.

-The trees can be natural, left when the land was cleared, or planted.

- Contour hedgerows: variation of hedgerow intercropping practised on slopping land with the primary objective of soil and water conservation.

CAPACITY4FOOD

AGROFORESTRY: TREES AND ARABLE CROP (MAIZE) MIXTURES

CAPACITY4FOOD

AGROFORESTRY: TREE (GMELINA) AND ARABLE CROPS MIXTURES

CAPACITY4FOOD

AGROFORESTRY SYSTEM INVOLVING TREES AND CROP MIXTURES

CAPACITY4FOOD

Biomass transfer:

- This is also called cut-and-carry mulching or tree-litter mulching.
- The trees are grown as a separate block, possibly on less fertile soil of the farm.
- Leaf matter is cut from the tree, transported and added to the soil of the crop land.

CAPACITY4FOOD

Soil fertility intervention mechanisms of agrisilvicultural systems

- For all the agrisilvicutural systems for soil fertility management outlined, the intervention mechanisms are basically dependent on nutrient cycling within the system through decomposition and mineralization of tree litter and crop residue.
- The litter also regulates the soil temperature and enhance soil moisture availability (soil conservation)

Intervention mechanism contd.

- The volume of research and publications in many of the research centres notably IITA, Ibadan Nigeria and ICRAF(now World Agroforestry Centre), Nairobi, Kenya indicated clearly that many of the AGF practices substantially increased crop production on the farm

CAPACITY4FOOD

INTERVENTION CONTD.

-However recent studies has shown that the efficiency of N use from the tree legume litter is low.

- Plant residue (tree litter) decompose rapidly in moist and warm climates of the tropics, causing nutrient release to be poorly timed with the crop demand

CAPACITY4FOOD

- Again, many of the crop residue are of low quality litter with low nutrient concentrations and slow rate of decomposition and mineralization (Vanluwe et al; 2006)
- Under field conditions, the contributions of litter N from prunings of tree legumes to crop nutrition is often small and crop N recovery from the litter prunings are often less than 20% (Giller and Cadisch, 1995)

CAPACITY4FOOD

- The poor efficiency of N use from high quality litter from tree legume (Leucaena; Gliricidia) is attributed to lack of synchrony between crop N demand and N release coupled with losses of N due to leaching (Myers et al, 1997)

-However these difficulties must not preclude the use of plant materials as input to soil but rather require that they be utilized in more efficient and effective ways.

CAPACITY4FOOD

INTERVENTION CONTD.

- ISFM intervention is therefore necessary to increase crop production through improving the agronomic efficiency of applied nutrients.

CAPACITY4FOOD

PROPOSED ISFM INTERVENTION STRATEGIES

1. Manipulation of litter quality by mixing high and low quality litter.

- Several plant quality parameters regulates decomposition and mineralization patterns of plant residues.
- They include lignin; soluble carbon; nitrogen; and soluble polyphenol (Palm and Rowland, 1997)

CAPACITY4FOOD

ISFM INTERVENTION CONTD.

-Plant residues poor in N, but with large concentrations of lignin and polyphenols decompose and release N slowly (low quality litter) while residues rich in N, but with small lignin and polyphenol concentrations decompose and release N rapidly (high quality litter) (Giller and Cadish, 1995)

CAPACITY4FOOD

ISFM INTERVENTION CONTD.

-Therefore mixing high quality and low quality litter as organic input in cropping systems offers major benefit for improving N use efficiency by crops.

-In a study in Nigeria, Gliricidia/Acacia mixture at 100:0; 80:20; 60:40; 20:80; 0:100 significantly increased N storage in the root, stem and leaf of maize at 4,6, and 8WAP compared with sole Gliricidia and Acacia litter (Oyun, 2006)

ISFM INTERVENTION CONTD.

2. Manipulation of litter quality by drying:

-Drying condition for plant residues can alter the amount and types of polyphenols in the litter and hence regulate decomposition and mineralization (Handayanto et al 1997)

-High temp drying can reduce the amount of active polyphenols which are able to bind proteins (Handayanto et al 1997)

CAPACITY4FOOD

ISFM INTERVENTION CONTD.

-In a study in Nigeria, fresh prunings of *Gliricidia sepium* applied without drying resulted to faster decomposition and N release while the sundried prunings decompose more slowly and immobilized N during the early period of decomposition (Oyun et al 2003 a).

CAPACITY4FOOD

ISFM INTERVENTION CONTD.

3. Manipulation of litter input by placement methods

- Although litter quality is a major parameter governing potential decomposition, it is now envisaged that placement (aboveground; belowground) of the plant residue may be a simple tool for manipulation of the environment for decomposition (Cadisch and Giller, 1992)

CAPACITY4FOOD

ISFM INTERVENTION CONTD.

- In a study in Nigeria, aboveground placed Gliricidia leaves had higher rates of decomposition and N-mineralization than belowground placed Gliricidia leaves (Oyun et al 2003b)

CAPACITY4FOOD

PASTORAL SYSTEM AS SOURCE OF ORGANIC RESOURCE FOR SOIL FERTILITY MANAGEMENT

-No doubt, organic residues (dung) from livestocks (cattle, sheep, goats) are rich sources of soil organic input in cropping systems

- However, within most small holder communities, the demand for animal manure is usually greater than its supply.

CAPACITY4FOOD

PASTORAL SYSTEM CONTD.

-Where there are acute fuelwood shortages, they are cheap source of fuel for domestic cooking when dried

-Even in pastoral areas with substantial livestock, free grazing poses difficulties in collecting and transporting this important organic residues for use in the farms (Lekasi et al 2003)

CAPACITY4FOOD

PASTORAL SYSTEM CONT.

-The animals move from place to place in search of grass to graze and fodder to browse.

-To enhance their relevance in soil fertility management, a more integrated approach that combines trees and pasture on a land unit (silvopastoral) is imperative, more so within the context of ISFM.

CAPACITY4FOOD

PASTORAL SYSTEM CONT.

-Silvopastoral system which is widespread in the savanna ecoregion of Africa is the combination of woody plant and pasture on range land.

-Trees and shrubs primarily produce fodder for livestock and improve the soil fertility

-The system maintains the stability of grazing land and combats desertification.

CAPACITY4FOOD

SILVOPASTORAL SYSTEMS IN AFRICA

1. Trees on pastures:

- Also called parkland systems. Trees grow on rangeland in an open, mixed spatial system
- The trees are usually natural and randomly distributed
- The trees provide shelter for grazing animals and often influence the soil and growth of grasses undernath them.

CAPACITY4FOOD

PARKLAND IN AFRICA

CAPACITY4FOOD

PARKLAND IN AFRICA WITH GRAZING ANIMALS

CAPACITY4FOOD

PARKLAND IN AFRICA

CAPACITY4FOOD

SILVOPASTORAL SYSTEM CONTD.

2. Perennial crops with pastures:

-Trees or shrubs are grown in combination with pastures.

-Where these are fruit-trees, an alternative name is multipurpose orchads

CAPACITY4FOOD

SIVOPASTORAL SYSTEM CONTD.

3. Hedges and live fences:

-Boundary hedges, sometimes with trees as standards, are grown as elements in livestock management including homesteads

4. Fodder banks:

Trees are planted as blocks and managed for fodder production.

CAPACITY4FOOD

FODDER BANK

CAPACITY4FOOD

PASTURE

CAPACITY4FOOD

PASTURE

CAPACITY4FOOD

PASTURE

CAPACITY4FOOD

FODDERBANK

CAPACITY4FOOD

FODDER BANK

CAPACITY4FOOD

HEDGES AND LIVE FENCE

CAPACITY4FOOD

Material based mainly in:

Fairhurst, T. (ed.) (2012) Handbook for Integrated Soil Fertility Management. Africa Soil Health Consortium, Nairobi. Accessible from this link

CAPACITY4FOOD

EDULINK

THANKS FOR LISTENING

CAPACITY4FOOD