Example Agroforestry Systems

Complex systems: homegardens-Ethiopia

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important for women's participation

Example Agroforestry Systems

Complex systems: Polynesian example

Example Agroforestry Systems

Understory crops: Coffee under native ohia forest

Example Agroforestry Systems

Understory crops: Sorghum with palms and N-fixing tree (Burkina Faso)

Example Agroforestry Systems

Silvopasture: Livestock grazing under a koa plantation

Example Agroforestry Systems

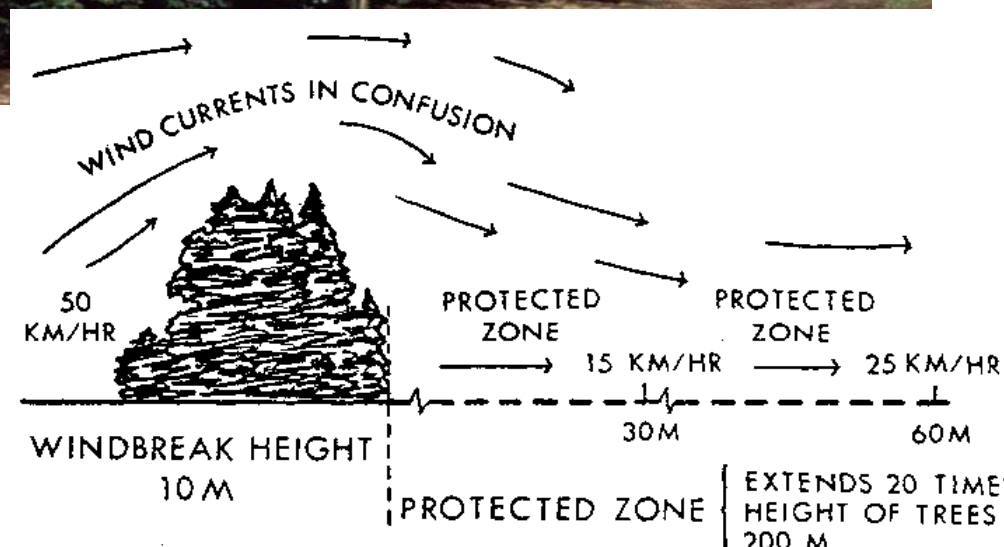
Alley-cropping: rows of trees with alleys of crops (Europe)

Example Agroforestry Systems

Intercropping: citrus and vegetables in India

Example Agroforestry Systems

Windbreaks: protecting wind-sensitive crops like coffee or cacao



Example Agroforestry Systems

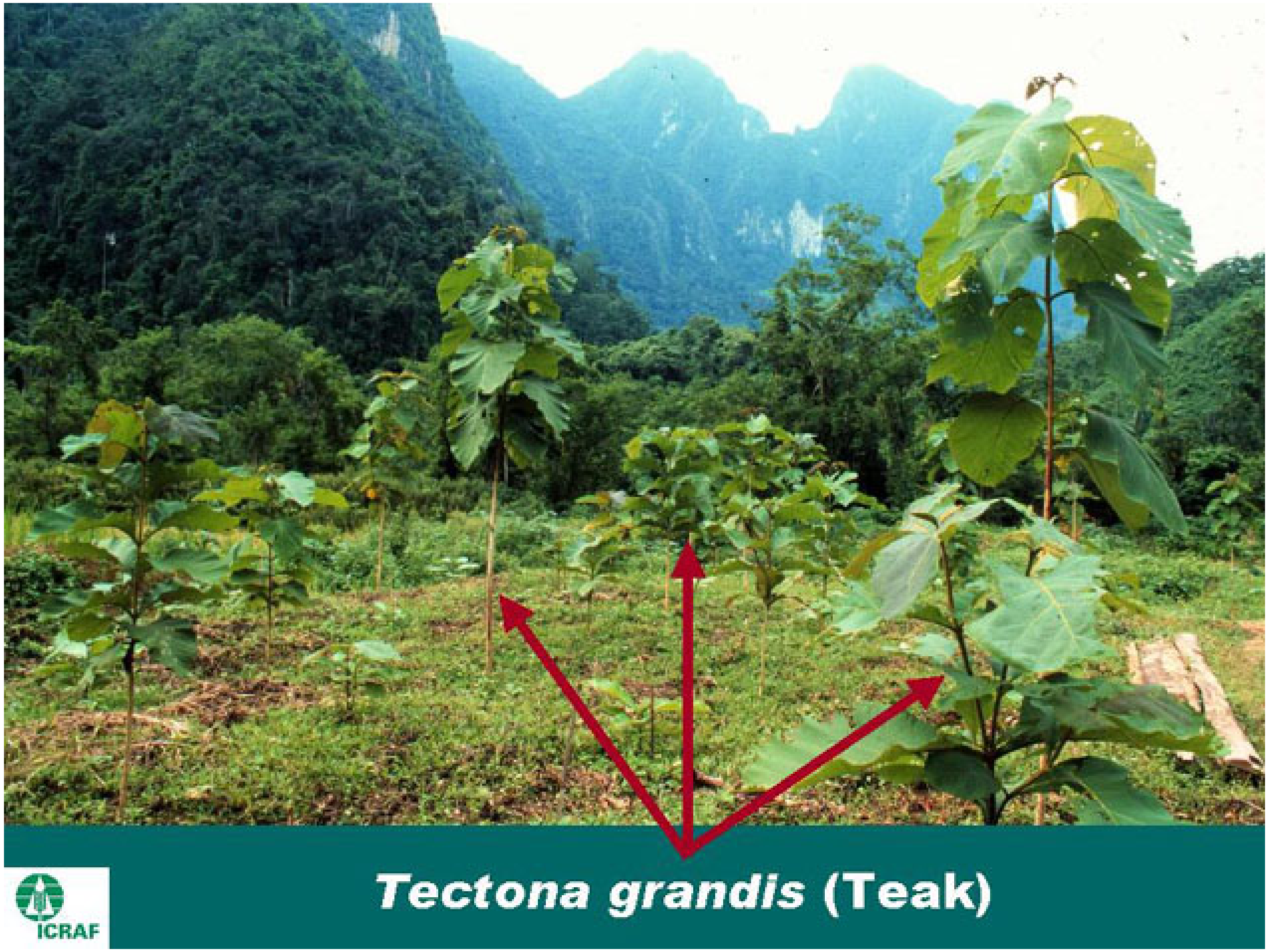
Hedgerows: break up slope, provide green manure

Example Agroforestry Systems

Live fences: physical barrier to animals or fence posts for barbed wire

Example Agroforestry Systems

Sequential systems (taungya): crops grown with teak trees in Laos



Example Agroforestry Systems

Sequential systems: shifting cultivation

Example Agroforestry Systems

Pantropical agroforestry species: banana, breadfruit, coconut, taro, citrus
Micronesian example

Agroforestry Systems: NREM 301

Definition

-variable, depends upon specific *system* and particular *practices*

-basic definition is a set of *multi-species* agriculture or forestry practices

-generally includes the following components

1. *multiple* plant species, including at least one *woody species*
2. deliberate or managed *interactions* between woody and non-woody spp, either *biological* or *economic*, but often both
3. often *more than one* product or output, including one from the trees
4. if the focus is on products from crops or animals, then the trees usually provide at least one *service function*, such as shelter, shade, soil conservation, animal fodder, or green manure

Spatial or Temporal?

-agroforestry practices and arrangements can be considered as either *simultaneous* or *sequential*

I. Simultaneous practices, in which trees and other crops are grown *at the same time*

-the type of interactions desired generally influence the *arrangement* of trees and crops in space

A. trees are *intermixed* throughout the system

1. Home gardens are complex, multi-storey, and usually small mixed species systems in which many plants, some animals and a variety of products are grown with intensive management

2. Understorey crops are generally shade-tolerant and can produce acceptable yields underneath trees
-trees may provide a service role in this case, reducing temperature and humidity stress or providing vertical support for vines
-the reduction in crop yield is balanced by lower resource demands, generally healthier plants, and lower management requirements
-some trees may fix nitrogen (N), improving soil fertility
-other trees provide a product, such as fruits, nuts, or timber

3. Silvopasture
-here, trees provide shade, reducing stress on animals
-pasture forage (grass and herb) yields are usually lower, but again, the trees may provide useful products to compensate for loss of yield

B. trees are planted in *zones* that are partially separated from crops or animals

-the most familiar is *alley-cropping*, where trees are planted in widely spaced rows to provide light and space for crops
-this way, both crop and tree *products* can be grown with less interference
-and, fertilizer or irrigation or weed control benefits both crops and trees

-often, trees are planted in zones to provide *services* for the crops

1. Hedge rows: these are usually N-fixers; they are pruned regularly to minimize shading and provide green manure and soil cover
2. Wind breaks, common in Hawaii, protect trees from wind and salt spray
3. Insect barriers: trees may naturally repel insects (e.g. neem) or "hide" crops from insects
4. Live fences protect crops from animal herbivores; thorny trees and shrubs deter animals or stems can be used as living *fence posts*
5. Silvopasture trees can be scattered or in clumps to provide refuge for livestock while minimizing reduction in forage yields
6. Soil conservation; trees are planted along terrace borders on sloping lands to hold soil in place; can be combined with hedgerow service
7. Woodlots; trees are grown in a separate block for animal feed, green manure, or as sources of nectar for bees in honey production
   -in drier environments areas with trees and shrubs are protected to serve as browse material during the dry season

II. Sequential practices shift between emphasis on crops to trees over time

1. crops and trees may be interplanted *at the same time*, with cropping eventually being phased out as the trees increase shade levels and begin to bear fruit or other products (leaves, sap, timber, etc.)

2. trees are used to rejuvenate soils during a *fallow period* after cropping
   -this is known as *shifting cultivation, swidden*, or *slash-and-burn*
   -in some cases, specific tree species, especially nitrogen-fixers, are used to recover soil fertility more rapidly and completely
   -this is known as *improved fallow*, where the trees are mainly for *service*
   -in *shifting cultivation*, useful trees are planted in fallows to be harvested later, so they have both a *product* and a *service* role

-these are known as *multi-purpose trees*, MPTs; often they are N-fixers that provide useful products, such as animal fodder

-the balance of product and service roles are flexible to farmer needs

<u>Advantages of Incorporating Trees</u>

1. Maximize use of space and available resources
   -multiple vertical layers capture more available light
   -fertilization and irrigation are more efficiently captured by crops + trees
   -many agroforestry farms are small and cannot separate crops and trees

2. Product substitution: timber, fuelwood, fodder, fruits/nuts, green manure, fence posts, etc. are products that do not have to be purchased

3. Additional income source: many trees provide marketable products

4. Diversify risk and opportunity:
   -having multiple crops and products diversifies the risk of the failure of individual crop species
   -conversely, as market prices rise and fall for crops, farmers "average out" the overall market prices (sort of like mutual funds) and can shift production levels of crops and trees based on market trends

5. Resource conservation: trees help to conserve and protect soil and nutrients on the farm and stabilize sloping lands

6. Aesthetics: trees define boundaries, provide shade for homestead and farm workers, attract wildlife, instill a sense of pride, etc.

Managing Tree-Crop Interactions is Key to Making Agroforestry Work

-too much shade reduces yields of other plants to unacceptable levels

-too large trees are hard to prune

-large or tall trees become dangerous or damaging to crops due to limb fall or storm breakage

-too many trees require lots of labor to keep them under control

-aggressive rooting robs crops of water and nutrients

-prolific seeders tend to reproduce in the crop areas

-some trees are alternate hosts for crop pests and diseases

-the most common drawback is the increased labor needed to manage the interactions with crop species

-this is mainly a problem for *simultaneous* practices, so *sequential* practices are more common, with the possible exception of *home gardens*

Can We Predict Tree-Crop Interactions?

Yes! Agroforestry is not uniquely different than ag, forestry, or ecology

1. Shade, water and nutrient competition are all well-understood in general
2. Changes in understory microenvironment are also predictable
4. Seasonal cycles of plant activity are also known for many species
5. Responses to management have also been studied for trees and crops

No! Agroforestry requires *quantitative* information on tree-crop interactions

1. We still need to measure levels of shade and resource competition
2. Estimating trade-offs requires specific information on yields
3. Tree *services* are generally not quantified in basic biology or ecology
4. Need to combine ecological interactions with management requirements and capacities with economic implications and farmer perceptions of risk and opportunity