# Agroforestry: A land-use system with potential on Irish farms

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#### Definition

#### Agroforestry

 A dynamic, ecologically based, natural resources management system that, through the integration of trees on farms and in the agricultural landscape, diversifies and sustains production for increased social, economic and environmental benefits for land users at all levels

(ICRAF, 2002)

#### Agroforestry is a new name for old practices

ICRAF (2002). What Is Agroforestry? *http://www.worldagroforestrycentre.org.* ICRAF. Accessed 30/10/02

## History

 First defined in 1978 in the context of the Tropics

Agroforestry as a land-use system is ancient
Majority of research based in the Tropics
Interest increased in Temperate regions

Silvoarable
Trees and crops
Alley cropping
Orchard
intercropping

#### Cocoa under coconut, Malaysia

Silvoarable Trees and crock Alex cropping Orchard intercropping

Rubber and tea, China

Silvoarable • Trees and crop • Alley croppink • Orchard intercropping

#### Arable crops and poplar, Uni. Leeds experiment

 Silvoarable
 Trees and crops
 Alley cropping
 Orchard intercropping

Intercropping with strawberries in an immature peach orchard, Ontario

Forest grazing, B.C., Canada

Silvopastoral • Trees and livestock • Forest grazing • Pannage

#### Dehesa, S.W. Spain

Silvopastoral • Trees and livestock • Forest grazing • Pannage



- Agrisilvopastoral
  - Trees with crops and livestock
- Others
  - Shelterbelt
  - Riparian zones
  - Fodder banks
  - Home gardens

#### Arrangement of components

Spatial arrangementTemporal arrangement

#### SCHEMATIC ILLUSTRATION

**TEMPORAL ARRANGEMENT** 

#### EXAMPLES

COINCIDENT		Coffee under shade trees; pasture under trees
CONCOMITANT		Taungya
INTERMITTENT (space dominant)		Annual crops under coconut Seasonal grazing of cattle in pastures under trees
INTERPOLATED (space- and time-dominant)		Homegarden
OVERLAPPING		Black pepper and rubber
SEPARATE		Improved "fallow" species in
(time-dominant)	time	shifting cultivation
	(time scale will vary for each combination)	
woody of	component nonw	voody component
<i>ligure 3.2.</i> Arrangement of components in	agroforestry systems.	

### **Component interactions**



# Micro-climateResources

#### Shared above-ground space

#### Possible facilitation

- ✓ +ve shade and shelter, for crops and livestock
- ✓ Litter and mulch effects
- ✓ Improved topsoil water status
- ✓ Fodder

#### Possible competition

- For light, depending on canopy structure and relative times of canopy activity
- × Soil compaction

## Shared rooting zone

#### Possible facilitation

- ✓ Improved resource capture
- ✓ Improved soil physical and chemical properties
- ✓ Mycorrhizas
- $\checkmark$  N-fixation
- ✓ Enhanced numbers and activity of soil biota

#### Possible competition

 For nutrients, depending relative
 times of root activity and niche
 requirements

# Deep rooting zone occupied by one plant component

#### Possible facilitation

- ✓ Improved resource capture
- ✓ Nutrient `pumping'

#### Possible competition

× None apparent

### Publications











AGROFORESTRY FOR

SOIL MANAGEMENT

2 N D EDITION





### **European Extension**





#### Context

#### EU agricultural policy

- Sustainability
- Environment
- Decoupling

#### Context

Commission Regulation (EC) No 796/2004 of 21 April 2004

Article 8

 A parcel that contains trees shall be considered an agricultural parcel for the purposes of the area-related aid schemes provided that the agricultural activities ... or the production envisaged can be carried out in a similar way as on parcels without trees in the same area.

#### Context

EU agricultural policy Sustainability Environment Decoupling Government forest strategy ♦ 9%-17% land area by 2030 Kyoto agreement

#### Afforestation

 Private > Public since introduction of Annual Premia (1987)



## Private afforestation

#### Majority by farmers



## Farming systems

#### Majority of Irish farms have cattle



## Model

Inputs

#### Systems

Forestry Pasture Agroforestry

#### Economics

Timber price-size data Grants and subsidies Discount rate



# Model



#### Model - Agroforestry interaction



## Model



## **Bio-economic model**

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## **Bio-economic model**

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			Graphs	Comparisons		
Crop enterprise	Poplar agroforestry file		Poplar pl	antation		
Winter wheat (Feed Wheat)	File:	8x8u14	File:			4x4u14
Output (tonnes/hectare) 8.6	Stems/ha	156	Stems/ha			625
	Yield class	14	Yield clas	s		14
Grants and subsidies	Grants		Grants			
Area Aid payable?	Afforestation Grant payable for agrofo	restry?	Affore	station grant payable	e for poplar?	
Current or User defined? Current	Afforestation grant (£)	937.50	Afforesta	tion grant (£)		1875
	Maintenance payable for agroforestry?		Mainte	enance grant payable	for poplar	
Current Area Aid	Maintenance grant (£)	312.50	Maintena	ance grant (£)		625
Area Aid (£) 290	Premium payable for agroforestry?		Premiu	ım payable?		
	Annual Premium (£)	86.86	Annual F	Premium (£)		348
User Defined Area Aid	Premium (no. of years)	12	Premium	(no. of years)		12
Area Aid (£) 280	Second formative shaping grant payabl	e?	Second formative shaping grant payable?		?	
	Formative shaping (£)	200	Formative	e shaping (£)		200
	Formative shaping (year)	3	Formative	e shaping (year)		3
Livestock enterprise	Grants for pruning available for agrofor	estry?	Grants	s for pruning available	for poplar?	
Early fat lamb						
Stocking per hectare 10.4	Forest Service or User Defined? Forest	st Service 💻	Forest Se	rvice or User Defin	ed? Forest	Service 💻
Output per Ewe 1.4	Forest service high pruning grants		Forest Se	rvice high pruning	grants	
	Year	Value (£)	Year			Value (£)
	4	171.6			4	550
Grants and subsidies		5 202.8			6	650
Subsidies payable?						
Current or User Defined? Current	User defined pruning grants		User defi	ned pruning grants		
	Year	Value (£)	Year			Value (£)
Current subsidies	5	5 125	_		5	125
Value per Ewe 17.07	7	138			7	138
User defined						
value per Ewe 10						

## Bio-economic model - sensitivity

		Sensitivity							Homepage
Discount rate		0.0%	New discount rat	te:	5.0%				Graphs
									Front page
								Components	Comparisons
Agri	ricultural costs and revenues Poplar plantation costs and re			enues					
Factor		Sensitivity	Factor			Sensitivity	Factor		Sensitivity
A gricultural subs	idies (total)	0.0%	Poplar agroforest	try subsidies (	(total)	0.0%	Poplar subsidies (total	D	0.0%
Agnetitulaisubs		0.078	i opiai agioiores		(Otal)	0.070	i opiai subsidies (total		0.078
Annual or total a	gri-costs change? (a/t)	t							
Agricultural costs	s (annual)	0.00%	Silvoarat	ble Tree/Cro	p interac	tion			
Agricultural costs	s (total)	0.0%							
			Crop yield (total)	)		0.00%			
Annual or total ci	rop price change? (a/t)	t 0.00%					Poplar yield and price		
Crop price (total)		0.0%					Factor		Sensitivity
crop price (cotal)		0.070							<u>oonsarray</u>
Annual or total li	vestock price change? (a/t)	t					Poplar yield (total)		0.0%
Livestock price cl	hange (annual)	0.00%	Width of tree row	w (m)		2.0			
Livestock price cl	hange (total)	0.0%					Poplar price (total)		0.0%
			Silvopastor	al Tree/Lives	tock intera	action	Poplar costs		
			Yield change (tot	tal)		0.00%	Annual or total poplar	cost change? (a/	t) t
			Tield entailige (tot			0.0070	Poplar costs change (a	annual)	0.00%
							Poplar costs change (t	otal)	0.0%
				Agrisilvopas	toral				
			Fordinate searce of the			7			
		Earliest year of In	Cost of posture ostablishment (f /ba)		100				
			Cost of pasture e	staonsninent	(J/11a)	100			

#### Results - livestock



#### **Results – Winter wheat**



# Results – Sensitivity to product price

% change in product price	Cattle	Silvopasture
+ 20	+ 27.1	+ 20.9
- 20	- 27.2	- 20.9

% change in product price	Winter wheat	Silvoarable
+ 20	+ 30.4	+ 25.2
- 20	- 30.4	- 24.5

# Results – Sensitivity to input costs

% change	Winter wheat	Cattle	Silvoarable	Silvopastoral
+ 20	- 22.4	- 22.0	- 23.2	- 17.0
- 20	+ 22.4	+ 22.0	+ 26.7	+ 17.0

# Results – Sensitivity to interaction equation



8<sup>th</sup> Institutes of Technology, Science and Computing Research Colloquium, WIT, 26-28 May, 2004

#### Results – Sensitivity

The silvopastoral system is less sensitive to price changes than the monocultural system

The interaction equation can have an affect on conclusions derived from the model

#### Conclusions

Silvopastoral system shows economic potential
 Model verification is required
 Real data required for model improvements
 Experiments
 Field trials



8<sup>th</sup> Institutes of Technology, Science and Computing Research Colloquium, WIT, 26-28 May, 2004