

Financial and Economic Benefits of Integrated Crop-Livestock-Tree Systems in Europe

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14 July 2015



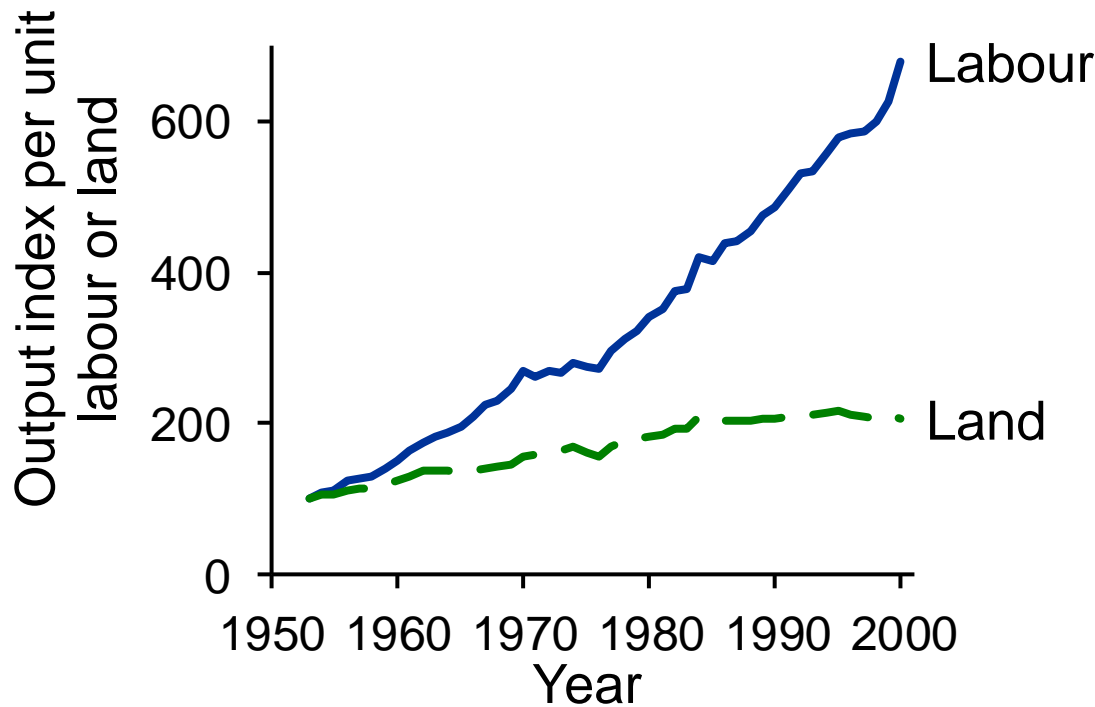
European Union's Seventh Framework Program for research, technological development and demonstration under grant agreement no 613520

Content



- Agricultural monocultures have societal costs
- Role for agroforestry
- Introducing AGFORWARD
- Two case studies on the financial and economic benefits of agroforestry in Europe

Simplification of systems



Separation of arable, livestock, and tree-crop enterprises in Europe has provided production benefits per unit land and per unit labour.

Levels of output per unit of land (dashed line) and unit of labour (solid line) in the UK between 1953 and 2000 (1953=100) (Thirtle and Holding, 2003).

Negative externalities



Value of provisioning and other ecosystem services of UK agricultural systems (after Chatterton et al 2014)

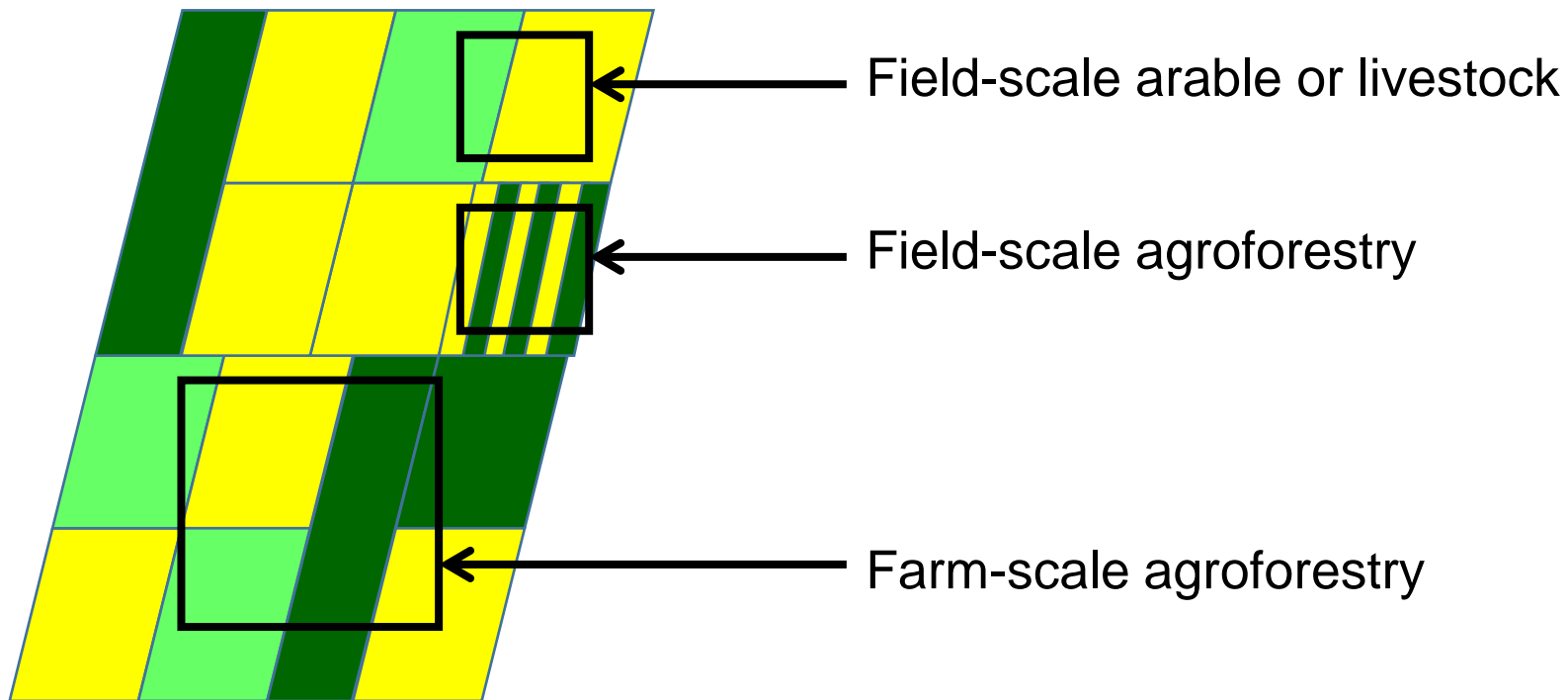
Agricultural system	Annual output (£ ha ⁻¹)	Annual ecosystem dis-services (£ ha ⁻¹)
Eggs	2114	-325
Pigs	1532	-375
Dairy and dairy beef	1479	-425
Chicken	1433	-277
Arable	634	-308
Suckler beef	422	-194
Sheep	247	25

Although agriculture monocultures results in positive outputs of goods, most systems result in ecosystem dis-services (such as greenhouse gas emissions and reduced water quality) which can be valued.

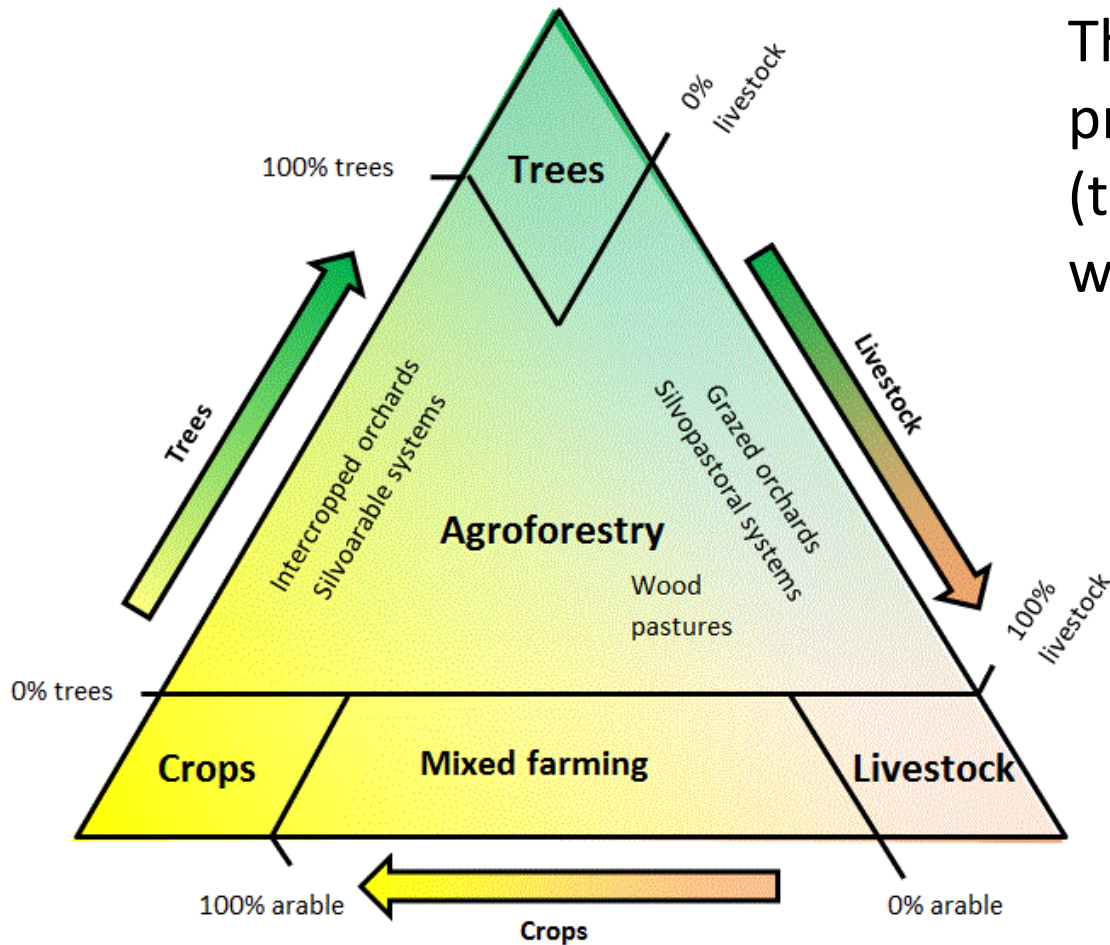
Role for agroforestry



Policy makers in Europe are attracted by agroforestry (crop-livestock-tree systems) to reduce negative externalities.



Introducing AGFORWARD



The AGFORWARD project is promoting agroforestry (the integration of trees with farming)



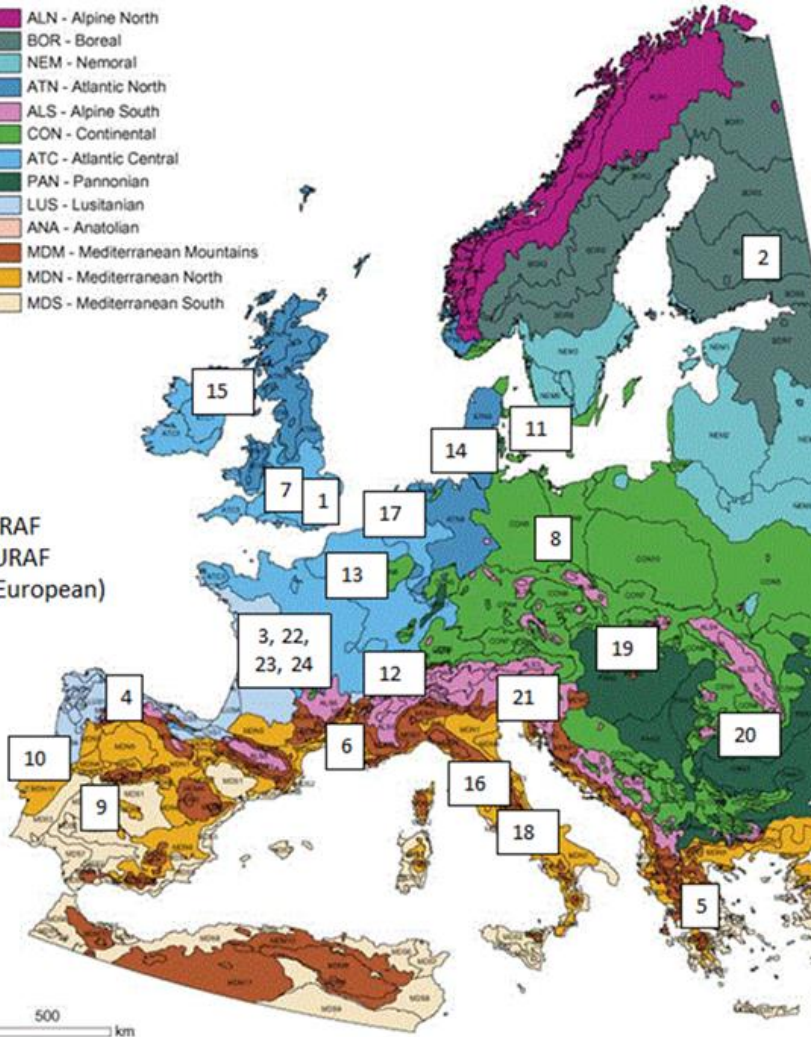
Partners



Environmental Stratification of Europe

Environmental Zone

- ALN - Alpine North
- BOR - Boreal
- NEM - Nemoral
- ATN - Atlantic North
- ALS - Alpine South
- CON - Continental
- ATC - Atlantic Central
- PAN - Pannonian
- LUS - Lusitanian
- ANA - Anatolian
- MDM - Mediterranean Mountains
- MDN - Mediterranean North
- MDS - Mediterranean South



1.	Cranfield University	14	Aarhus University
2.	European Forest Institute	15	AFBI
3	ACTA	16	CRA
4	University of Santiago de Compostela	17	Louis Bolk Institute
5	TEI Stereas Elladas	18	CNR
6	INRA	19	NYME
7	Organic Research Centre	20	Universitatea Babeş-Bolyai
8	BTU Cottbus	21	Veneto Agricoltura
9	Universidad de Extremadura	22	Agroof
10	Instituto Superior de Agronomia, Lisbon	23	APCA
11	University of Copenhagen	24	Association Française d'Agroforesterie
12	Research Station FDEA-ART Zurich	25	World Agroforestry Centre
13	Wervel vzw	26	European Agroforestry Federation

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AGFORWARD has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 613520

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Published by Paul Burgess [?] · June 12 at 4:46pm · 🌐

Gerardo Moreno and colleagues, from the University of Extremadura, together the Dehesa stakeholder group in Spain have released their ambitious research and development protocol. The protocol covers tree regeneration, the use of triticale and legumes, rotational grazing, GPS collars, agroforestry products, and carbon sequestration. It is an impressive 71 page document. Watch this space!

<http://www.agforward.eu/index.../dehesa-farms-in-spain.html>



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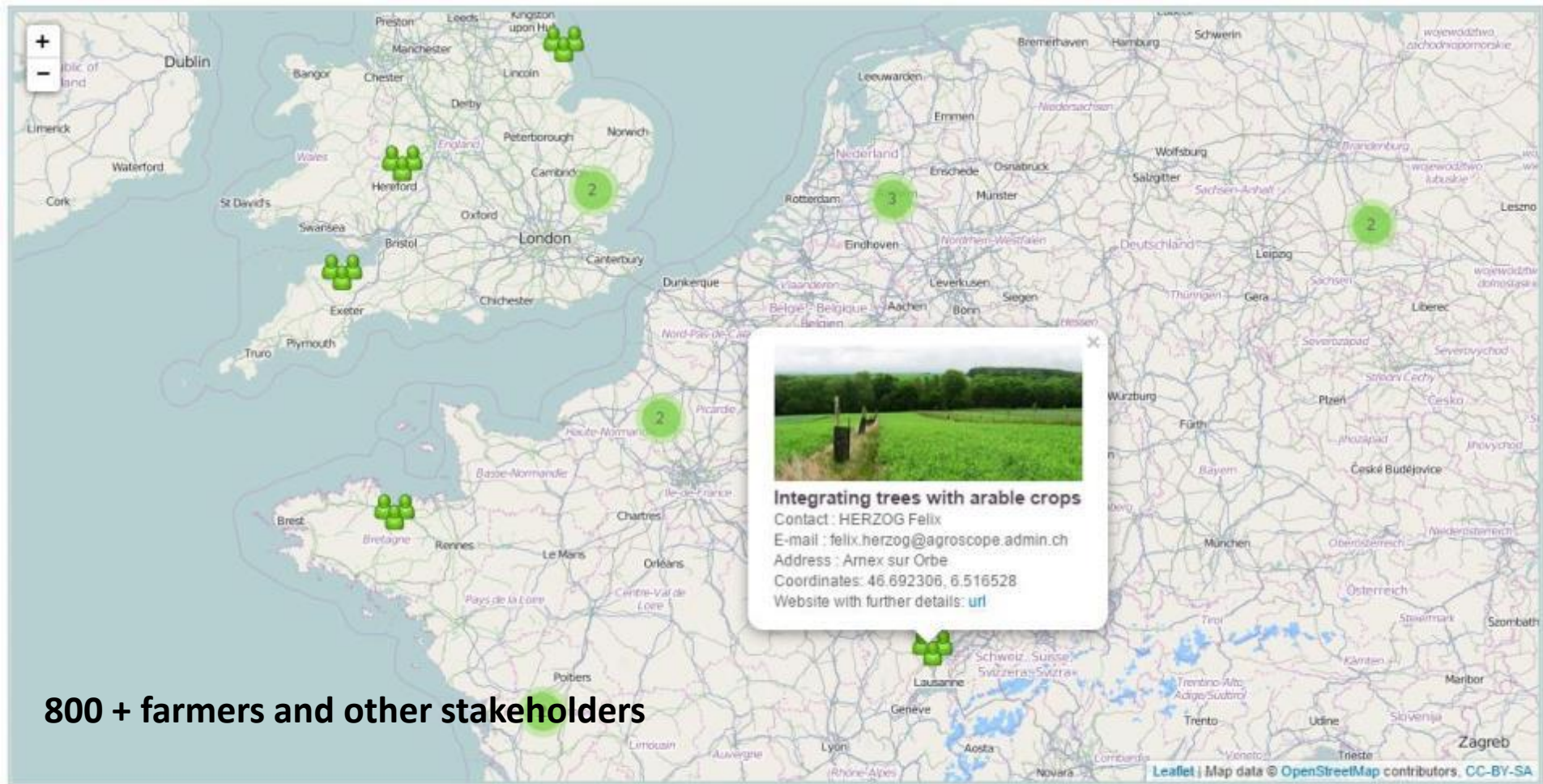
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Establishment on 40 agroforestry stakeholder groups across Europe



Legend

- AGFORWARD stakeholder group
- AGFORWARD replicated experiment
- AGFORWARD demonstration or trial site
- Other agroforestry replicated experiment
- Other demonstration and trial site

Agroforestry of high nature and cultural value



Dehesa, Spain and Montado, Portugal



Bocage agroforestry, France

Credit: INRA Rennes, 2014



Agroforestry with reindeer, Sweden

Other systems

- Silvopastoral systems with oak, Greece
- Bocage agroforestier, Bretagne, France
- Oak wood pasture in Sardinia, Italy
- Wood pasture, UK
- Agroforestry in the Spreewald floodplain, Germany
- Wood pasture, Hungary
- Wood pasture, Transylvania in Romania

Agroforestry with high value trees



Intercropping and grazing of olive systems in Italy



Intercropping oranges in Greece



Grazed orchards in England, Northern Ireland, and France

Other systems

- Chestnut agroforestry, Galicia, Spain
- Intercropping and grazing of walnut plantations in Spain
- Intercropping of olives in Greece
- “Bordure” trees in France

Integrating trees into arable systems



Switzerland



Mediterranean regions of France



Italy

Other systems

- Alley cropping, Hungary
- Trees in arable systems in Greece
- Silvoarable agroforestry in S.W. France
- Silvoarable agroforestry in Western France
- Silvoarable agroforestry in Northern France
- Silvoarable agroforestry in UK
- Alley cropping in Germany

Integrating trees into livestock systems



Agroforestry with Celta pigs in Spain



Poultry agroforestry in the UK



Agroforestry with ruminants, France

Other systems

- Agroforestry for poultry in the Netherlands
- Agroforestry with organic poultry in Denmark
- Agroforestry with free-range pigs, Italy
- Agroforestry with free-range pigs, Denmark
- Fodder trees for goats and sheep in the Netherlands

Developed research protocols



AGFORWARD
Agroforestry for Europe

Research and Development Protocol
for Iberian Dehesas in Spain

Project name	AGFORWARD (613520)
Work-package	2: High Natural and Cultural Value (HNCV) agroforestry
Specific group	Iberian Dehesas in Spain
Milestone	Milestone A (2,3) Part of experimental protocol for WP2
Date of report	23 February 2015
Authors	Gerardo Moreno, Yonatan Cáceres, Enrique Juárez, Manuel Bertomeu, Fernando Pulido, Paula Gaspar, Francisco J Mesias, Miguel Escribano, Pablo Burtos, University of Extremadura, Plasencia, Spain
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Reviewed	Paul Burgess (1 June 2015)

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Each group has developed a protocol, available on the AGFORWARD website.

About 20-30% of the interventions are being addressed by a clearer assessment of the inputs and outputs of the systems using biophysical and economic models

Case study 1: Woodland eggs in the UK (Burgess et al., 2014)



Price (£ per six eggs) of free range and woodland eggs (source: retailers' websites, April 2014)

Supermarket	Free-range	Woodland
Aldi	1.00	1.19
Morrisons	1.39	1.59

UK consumers are willing to pay a premium of £0.20 for six woodland eggs in two supermarkets

UK egg packers are willing to give a price premium of £0.01 for six woodland eggs compared to “free-range” (IGD, 2008)

Financial analysis of woodland eggs

(Burgess et al. 2014)



Benefits	(£ ha⁻¹ a⁻¹)
Price premium (1 p per 6 eggs)	933
Improved egg quality (less seconds)	327
Sub-total	1260

Assumed one-off costs	(£ ha⁻¹)
Cost of tree planting	380
Reduction in land value	1700

Assumed annual costs	(£ ha⁻¹ a⁻¹)
Loss of more eggs in the field	174
Maintenance cost of trees	60
Sub-total	234

Financial analysis: benefits and costs to the farmer

Assuming a premium of 1 pence per six woodland eggs and an 8% discount rate, a farmer could gain an additional £700 ha⁻¹ (3500 R\$ ha⁻¹) per year over the first 15 years.

Economic (societal) benefits



www.defra.gov.uk

A guide to the practical management of feather pecking & cannibalism in free range laying hens



Animal welfare: Injurious feather pecking

Bright and Joret (2012) also report reduced injurious feather pecking by laying hens in a woodland environment

Ammonia capture and carbon sequestration

benefits of the trees is small: less than 0.01 pence per six eggs

Amenity value of the trees (calculated using the Arboriculture Association method) may be worth up to 0.18 pence per six eggs

Woodland eggs make sense from financial and economic perspectives

Case study 2: Financial analysis of trees in arable systems



Unfortunately trees in Europe do not grow as fast as in Brazil

There is increasing interest in tree planting in arable systems, particularly in France where it is possible to grow high value trees within rotations of 40-60 years.

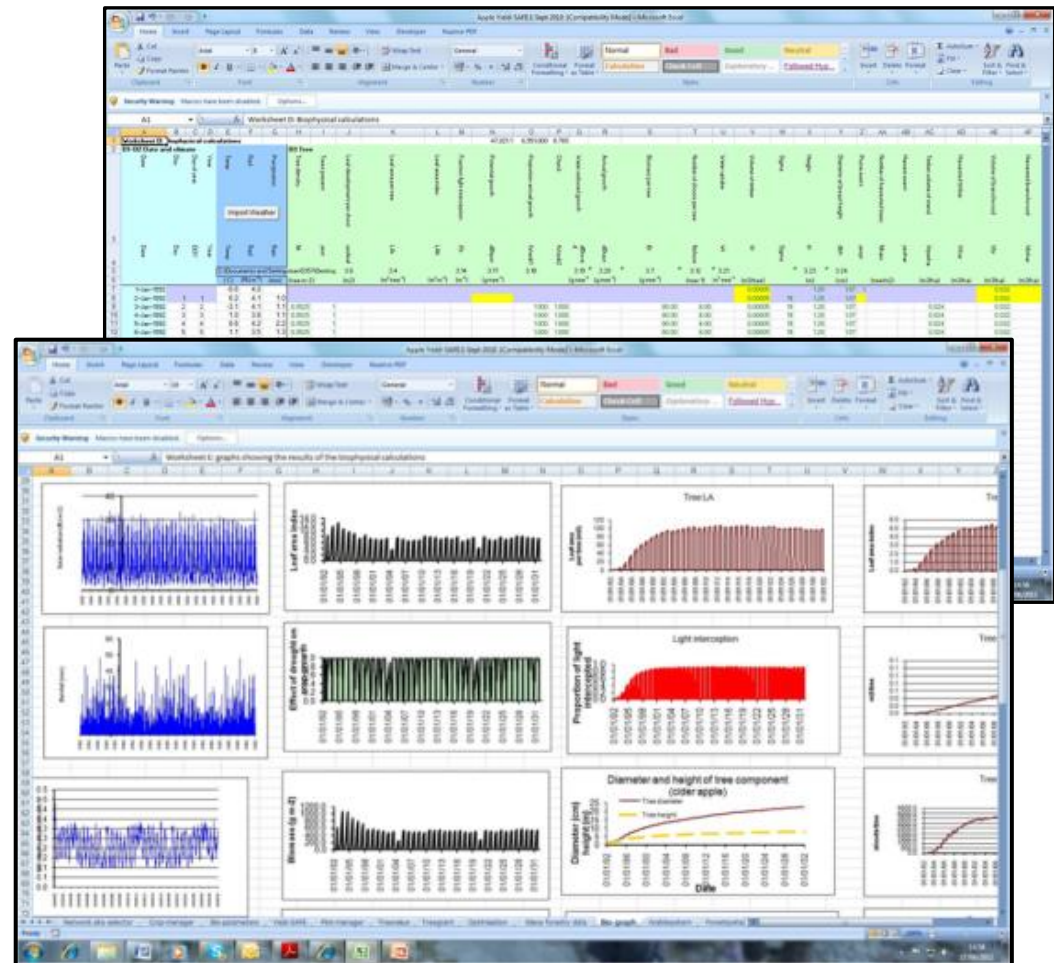


Biophysical models



We cannot wait 60 years, so we use a parameter-sparse biophysical model called **Yield-SAFE** to describe tree, grass and arable yields on a daily time-step in different combinations (van der Werf et al, 2007)

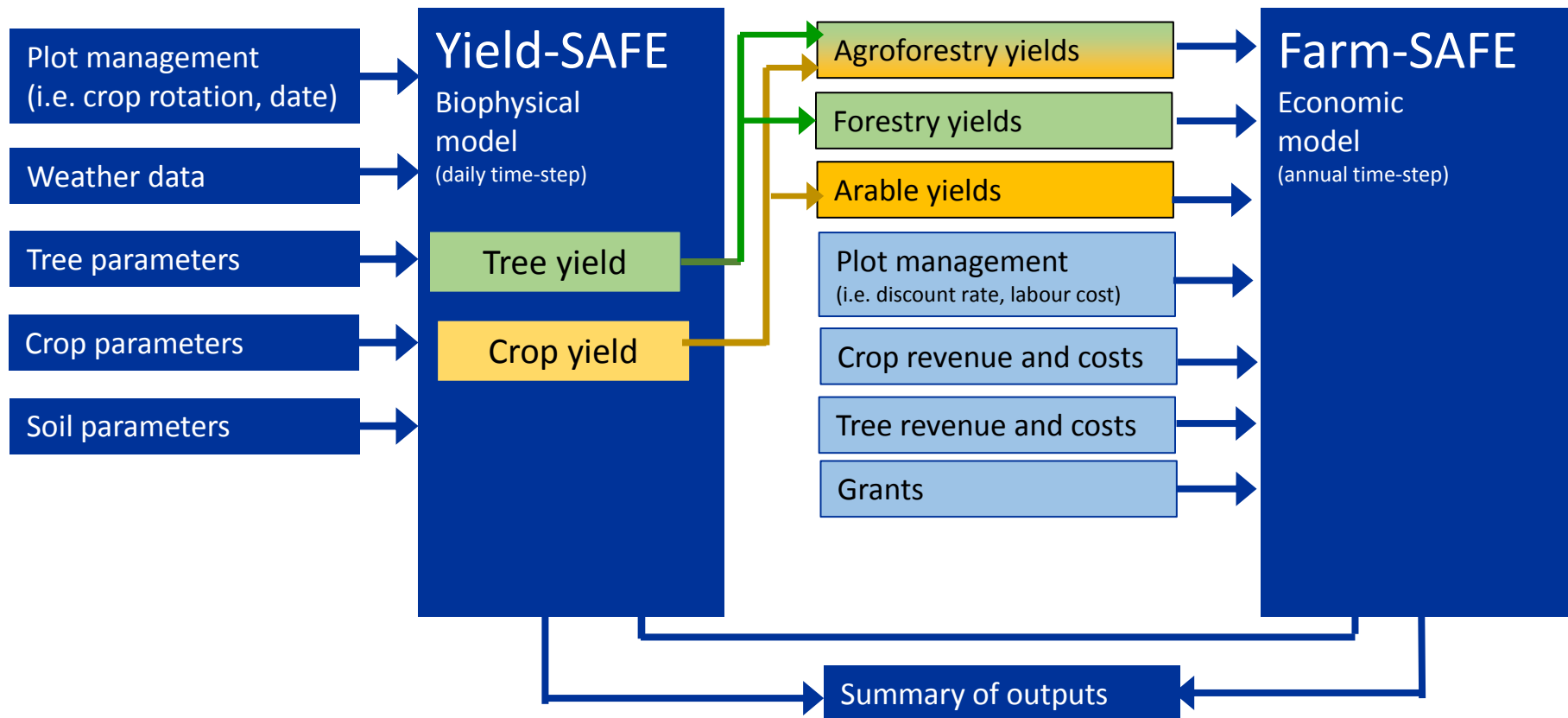
A more detailed 3-D model called **Hi-sAFE** has also been developed by INRA



Financial analysis using Farm-SAFE



A spreadsheet model to integrate the results of the biophysical model with data on costs, values, and grants, and discount rates



Case study 2: Financial analysis for silvoarable systems



Equivalent annual value (EAV) (2005) of silvoarable systems compared with arable and forestry monocultures in W. France (Graves et al., 2007)

Wild cherry	Without grants (€ ha ⁻¹ a ⁻¹)	With EU grants (€ ha ⁻¹ a ⁻¹)
Arable	14	381
Forestry	-111	63
Silvoarable	68	336

Walnut	Without grants (€ ha ⁻¹ a ⁻¹)	With EU grants (€ ha ⁻¹ a ⁻¹)
Arable	91	459
Forestry	227	394
Silvoarable	296	504

Case study 2: Financial analysis for silvoarable systems



Equivalent annual value (EAV) (2005) of silvoarable systems compared with arable and forestry monocultures in W. France (Graves et al., 2007)

Wild cherry	Without grants (€ ha ⁻¹ a ⁻¹)	With EU grants (€ ha ⁻¹ a ⁻¹)
Arable	91	584
Forestry	227	417
Silvoarable	296	598

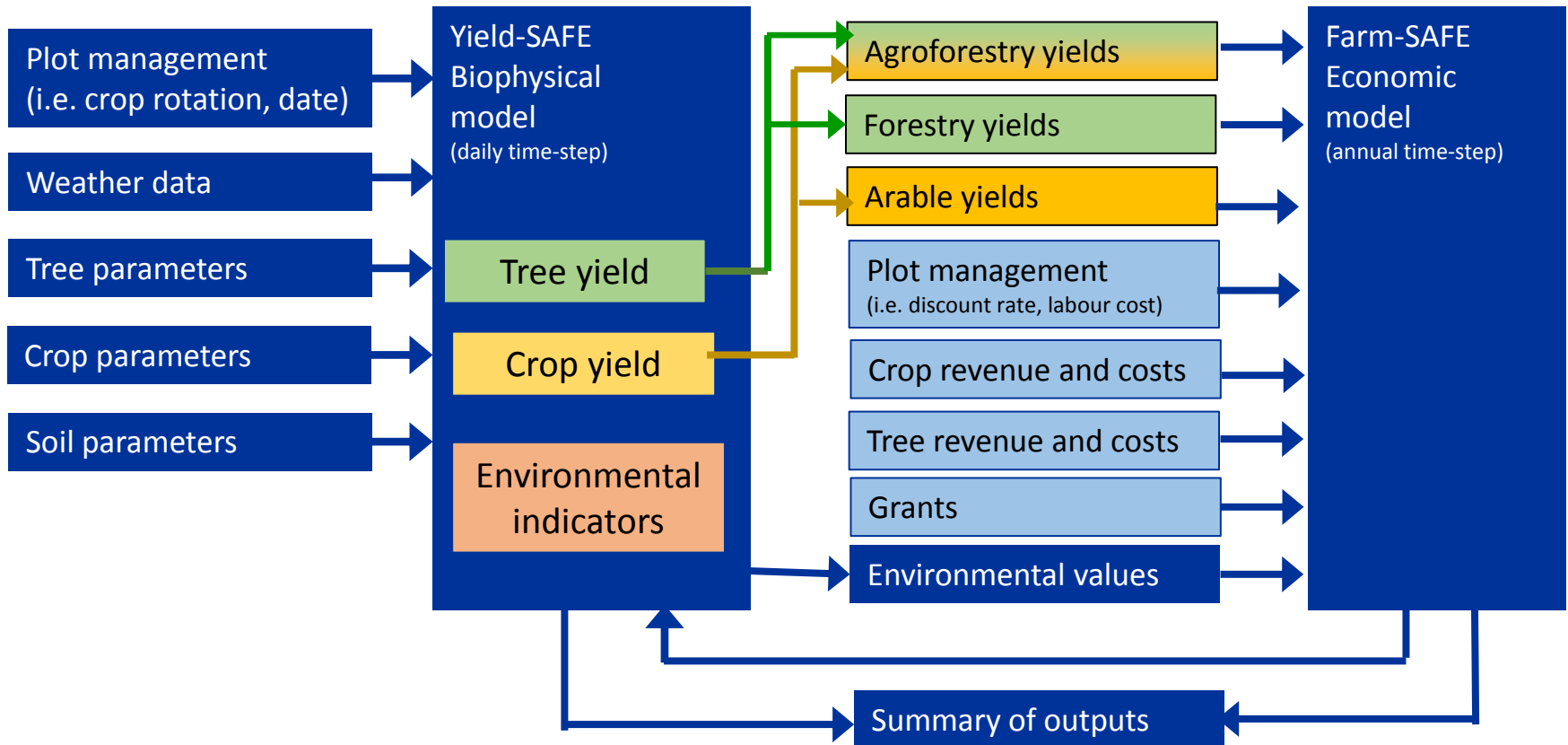
Note: these values from 2005 do not include the management and administrative costs associated with complexity



Economic analysis using Farm-SAFE



A spreadsheet model to integrate the results of the biophysical model with data on costs, values, and grants, and discount rates



Environmental services provided by agroforestry



Equivalent annual value (EAV) of silvoarable systems relative to arable monoculture, assuming discount rate of 4% (after Andreola, 2014).

Cherry	Wild cherry (€ ha ⁻¹ a ⁻¹)	Walnut (€ ha ⁻¹ a ⁻¹)
Carbon sequestration ¹	36	99
Improved water quality ²	42	42
Improved air quality ³	3	3
Sub-total	81	144

¹ Assuming Carbon price increasing from 0 in 2020 to £30 per t C from 2050.

² Assuming reduction in nitrogen leaching

³ Assuming reduction of pollution due to NO₂, SO₂, PM₁₀ and PM_{2.5}

Conclusions



- Through AGFORWARD (www.agforward.eu) the EU is seeking to promote trees in agriculture in Europe
- We are working with over 800 farmers and other stakeholders
- We are developing existing financial and economic analysis tools (Yield-SAFE and Farm-SAFE) to predict the financial and economic effects of integrated crop-livestock-tree systems, relative to existing practice
- There are systems that work
- Tools to address complexity?
- Join us at <https://www.facebook.com/AgforwardProject>

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Thank you



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