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# Agroforestry in the UK

In the run up to the forthcoming conference, **Paul Burgess** of Cranfield University explains the significance of agroforestry to productive land use in the UK.

The Royal Forestry Society, the Woodland Trust and the Soil Association are hosting a one-day conference on 'Agroforestry: Improving Productivity for Farmers and Foresters' at Cranfield University, Bedfordshire on 22 June 2017. This will be followed by a one-day Farm Woodland Forum workshop, including a field visit to the apple and cereal agroforestry system of Stephen Briggs. To set these events in context, this article explains why UK agroforestry is important, topical, how it is being used to market food products, improve productivity, address climate-change and flood management, and how it depends on dynamic farmers and foresters.

## Agroforestry is important and topical

Agroforestry can be concisely described as the "integration of trees and farming". However, whilst agroforestry is a useful word in scientific and policy contexts, it struggles to resonate with UK farmers and consumers. Instead terms such as grazed forests and orchards, wood pasture and parklands, shelterbelts, hedgerows, wooded buffer strips, and isolated trees on grass or cropland have more public appeal. These are all forms of agroforestry.

Agroforestry is a significant land use in the UK. As part of the AGFORWARD project, den Herder et al. (2016) have used the LUCAS Land Use/Cover Area frame survey (which

*Figure 1. Many parts of lowland England, for example Herefordshire, have an agroforestry landscape. (Photo: Paul Burgess)*

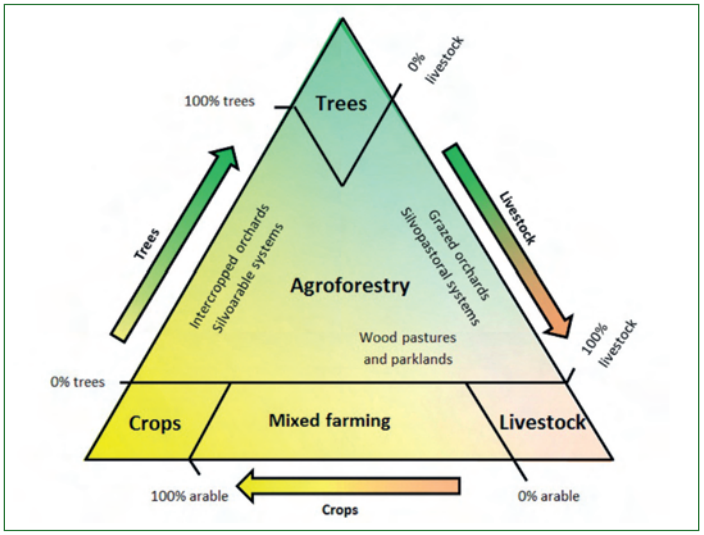


*Figure 2. Schematic representation of some types of agroforestry, i.e. where trees interact with livestock and/or crops (after Burgess et al., 2015). Monoculture forestry, crop or livestock production could be considered as extreme forms of agroforestry.*

records multiple land use) to determine the extent of agroforestry in each European country. For the UK they calculated that multifunctional land use involving trees with either grazing or crops occupies about 552,000ha, i.e. similar to the area of oilseed rape (650,000ha). Petit et al. (2003) also report that there are 468,000km of hedgerows in Great Britain with an additional 138,700km comprising lines of trees and shrubs.

According to the LUCAS survey (Eurostat, 2017), the UK has a substantially higher proportion of land categorised as cropland, grassland and shrubland (73%) than any country in Europe with the exception of Ireland (75%) and Denmark (72%). By contrast UK woodland cover (15%) is amongst the lowest in Europe, with the exception again of Ireland (11%) and the Netherlands (13%). Hence, whilst the areas of forest in some EU countries are quite distinct from the areas of agriculture, much of tree cover in the UK is closely associated with farmland, and often in a mosaic arrangement. This is particularly the case in England and Northern Ireland. In fact, international visitors to the UK often comment that the mosaic of trees, cropland and grassland observed in lowland England is an agroforestry landscape (Figure 1).

Agroforestry is topical in that it encourages farmers, foresters and policy-makers to engage in joined-up thinking about multi-functional land use (Figure 2). However, this is often a struggle as public payments and monitoring need to take place within administrative and legal constraints. Many of these are established at a national level whilst others are determined at European or international scales. Angela Leadsom, the Secretary of State for Environment, Food and Rural Affairs, speaking at the Oxford Farming Conference in January 2017 said that there should be “no more existential debates to determine what counts as a bush, a hedge, or a tree”. However, such debates are currently important when farmers are implementing agroforestry. The basic payments (paid on a per hectare basis) within the EU Common Agricultural Policy assume that the land is being used for agricultural practices beneficial to the climate and the environment (Article 43; EU 2013). Some types of trees, e.g. apple trees, are deemed as agricultural whilst others are not, and basic farm payments can be received on some hedgerows widths but not others (e.g. Scottish Government, 2015). In the current uncertainty regarding the form of UK agricultural and rural support beyond 2020, developing policies that recognise the agricultural and environmental

*Figure 3. Commercial free-range egg producers, such as this example in Lincolnshire, are planting trees to provide shelter and improve hen welfare. (Photo: Paul Burgess)*

benefits of agroforestry should help ensure that the UK has a joined-up approach to multi-functional land use. Some of these benefits are considered in the second part of this article.

## Marketing of food products

The current UK Government has highlighted the importance of export-led food production. Agroforestry is unlikely to offer the most efficient way of producing a single commodity in terms of just one criterion such as cheapness. However, it offers opportunities where products are bought on the basis of at least two criteria, such free-range eggs, which are purchased on the basis of an improved level of animal welfare and price.

Woodland egg production builds on the work of John Widdowson (British Hen Welfare Trust, 2017) and is an example where consumers are willing to pay a premium for an agroforestry product. The provision of trees allows free-range hens to exhibit more natural behaviour and woodland cover can also improve eggshell quality (Bright and Joret, 2012). Burgess et al. (2014) reported that at least 3.4% of the eggs being sold in the UK in 2013 were produced with 20% tree cover within the free-range area. 'Woodland eggs' have been specifically marketed by Sainsbury's plc and companies such as the Happy Egg Co (2017) supply woodland-produced eggs to various retailers. In addition, since 2014 producers of free-range eggs bearing the Freedom Food label have been required to meet a condition of 5% of the range comprising tree or shrub cover (RSPCA, 2013). Pickett et al. (2014) report that the Freedom Food label now covers "the vast majority of the non-cage egg production sector" (Figure 3).

In addition to 'woodland eggs', there is also 'free-range woodland chicken' (Traditional Norfolk Poultry, 2017) and 'woodland pork' (Riverwood Farm, 2017). In Brazil there has been interest in marketing 'carbon-neutral beef', which originates from cattle reared on ranches where afforestation is taking place (Alves et al., 2015). There should be potential for such a product in the UK. There is also interest in agroforestry-related breeding stock. For example, the Shropshire Sheep Breed Association has been successful in marketing Shropshire sheep, which are perceived to cause minimal damage to trees, to orchard owners in France (Geddes and Kohl, 2009).

## Shelter, fodder and productivity

The UK is one of the windiest locations in Europe and trees in pasture can provide shelter thereby reducing animal suffering during extreme weather and improving survival and productivity. Examples of shelter include forest grazing, wood pasture, parkland, and shelterbelts. Gregory (1995), reviewing research in New Zealand, quotes Egan et al. (1972) who showed that lamb mortality in the first 48 hours decreased from 20% to 7% in the presence of a 5-8m cypress hedge. Gregory (1995) also quotes Alexander and Lynch (1976) who showed that the growth rate to 21 days of age in lambs from sheltered paddocks was 7% greater than for unsheltered lambs. Lastly, Gregory (1995) quotes research indicating that adequate livestock shelter may require 3% of the land on flat or gently undulating slopes, whereas as much as 20% may be required in hill areas. In the UK there are tools such as the 'Farm Shelter Audit' that help to identify the potential benefit to farms of different types of shelter (Hislop et al., 1999).

*Figure 4. The silvopastoral paddock-grazing system for dairy heifers operated by Peter Aspin in Shropshire. (Photo: Paul Burgess)*

Recent work has also focused on how providing access to trees can provide dairy cattle with a more varied diet. This was one of the objectives when Peter Aspin planted rows of different tree species within a grassland paddock system for dairy heifers in Shropshire (Figure 4). Similarly, organic dairy farmer Tim Downes, also based in Shropshire, has established a nutritional browsing system with sycamore, hornbeam, small leaf lime and elm in one paddock and a medicinal browsing trial with white and crack willows in another (The Woodland Trust, 2015). Research in France has shown that the leaves of some tree species, for example large leaf lime and white mulberry, can have crude protein levels as high as 21-24% (Emile et al., 2016). The use of 'tree hay' has also been recently tested with longhorn cattle and ponies on the Knepp Estate in West Sussex (Green, 2016).

## Climate-smart farming and wood-fuel

Whereas the UK is currently about 60% self-sufficient in food (Defra, 2016), it is only 20% self-sufficient in wood products (Forestry Commission, 2016). Appropriate management of trees on a farm can provide a means of both increasing fuelwood supply and/or to store carbon. Work by the Organic Research Centre has highlighted how up to 50% of hedges on a farm could be managed for woodfuel (Chambers et al., 2015) (Figure 5). The planting of trees on pasture or crop land on mineral soils in the UK consistently results in an increase in overall carbon storage. This is because of the increased above- and below-ground carbon stored by the trees, even though the effects of tree planting on soil carbon may initially be variable (Beckert et al., 2016; Saunders et al., 2016; Upson et al., 2016). A particular source of carbon loss in the UK is from the peat soils of Eastern England with typical annual rates of soil loss of around 2.1cm reported by Holman (2009). Hence Stephen Briggs, who is a tenant of a peatland farm near Peterborough, has planted rows of apple trees and wildflower strips at 24m intervals on his organic cereal farm. Stephen explains that it creates a "three-dimensional" production system that increases land productivity, produces an additional crop, and protects the soil from wind erosion (Figure 6). A visit to the site is planned as part of the Farm Woodland Forum workshop on 23 June 2017.

## Flood management

A key role that can be played by trees in a farmed landscape is the reduction of runoff. At Pontbren in Wales ten hill farmers have worked together to improve the productivity and environmental effects of about 1000ha comprising improved pasture and woodland (Wheater et al., 2012). Experiments at the site have demonstrated that areas planted with trees had higher rates of infiltration (Carroll et al., 2004). Using the data from the detailed field measurements at Pontbren, Wheater et al. (2012) have also predicted the effect of tree planting on water flows from a 400ha sub-catchment. Relative to a baseline scenario, removing all trees increased the median flood peak by 20%, adding tree shelterbelts reduced the peak by 20%, whilst full afforestation reduced the peak by 60%. Whilst Wheater et al. (2012) note that these changes were reduced for more extreme flood events, the results highlight that tree planting can reduce runoff and flooding for 'median' events. In South West France agroforestry is also being promoted at a larger scale to improve flood management and reduce soil erosion as part of the Agr-eau project in the Adour-Garonne watershed (Balaguer, 2016), an approach that it would be good to replicate in the UK.

*Figure 5. The Organic Research Centre has provided guidance on the use of hedges for woodfuel. (Photo: Jo Smith)*

*Figure 6. Stephen Briggs of Whitehall Farm, near Peterborough, has planted apple trees and wildflower strips at a 24m spacing to provide an additional crop, protect the soil, and enhance biodiversity within an organic cereal system. (Photo: Stephen Briggs)*

*Figure 7. An agroforestry system, developed by Bill Ackworth in Berkshire, was a silvoarable system (i.e. trees with an arable crop) in 2001 (left), but in 2015 the grass below the trees was being grazed by sheep (a silvopastoral system) (right). The trees are being grown for timber and pollarded for firewood.*

## Social aspects, dynamic systems and individuals

A key driver of much agricultural innovation has been the drive to maximise labour productivity. For example, between 1953 and 2000 whilst output per unit area in the UK doubled, the output per unit labour increased at least five-fold (Burgess and Morris, 2009). In some situations this increase in labour productivity results in higher wages, but there is sometimes a cost to social interaction and the number of people employed on farms. For example, during a Farm Woodland Forum visit in 2014 Martyn Bragg of Shillingford Organics in Devon explained that moving from an intensive arable system to an organic vegetable farm that made use of tree-lined alleys allowed him to increase his workforce from one to seven (Pilbeam and Burgess, 2014). Dartington Hall, also in Devon, has recently announced the establishment of a new silvoarable system including elder and apple trees and pepper plants that brings together the farm tenants with a drinks company and a peppermonger (Derrick, 2017). Elsewhere the integration of agriculture and forestry skills has been used in the rehabilitation of people who have struggled to become active members of society (Willowdene Farm, 2017). Hence whilst some people may view agroforestry as complex, others are inspired by the increased management skills and social interactions that it creates.

My final observation about agroforestry is that it is a non-static practice that requires dynamic individuals or groups of individuals. It requires farmers to learn about trees and foresters to learn about farming, or for farmers and foresters to work together. Because the cumulative growth of the trees over time, and depending on the tree spacing, best practice may change during the rotation of the tree crop (Figure 7) and this may require different skills and resultant changes in land use. Whilst there is an obvious need to preserve ancient woodland, the introduction of agroforestry on a livestock farm may result in some pasture areas being planted with trees whilst other areas of secondary woodland are harvested and opened up with grazing. At a time when there is substantial global change, perhaps there is much to be gained from an agroforestry way of thinking.

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## References

Alexander, G. & Lynch, J.J. (1976) Phalaris windbreaks for shorn and fleeced lambing ewes. *Proceedings of the Australian Society of Animal Production*, **11**:161-164.

Alves, F.V. et al. (2015) Carbon neutral Brazilian beef: a sustainable concept for beef production. Presentation at the World Congress on Integrated Crop-Livestock-Forest Systems, Brazilia, Brazil, 2015. https://www.embrapa.br/gado-de-corte/busca-de-publicacoes/-/publicacao/1023656/carbon-neutral-brazilian-beef-a-sustainable-concept-for-beef-production (Accessed 25 January 2017).

Balaguer, F. (2015) Agr'eau: Developing a Resource-Efficient, Ecofriendly, Climate-Smart Agriculture across the Adour-Garonne Watershed (South-West France). Presentation at the Agroforestry Event at EXPO 2015, Milan, Italy. 12 September 2015. https://www.agforward.eu

/index.php/en/news-reader/id-12-september-2015.html

Beckert M.R., Smith, P., Lilly A. & Chapman, S.J. (2016) Soil and tree biomass carbon sequestration potential of silvopastoral and woodland-pasture systems in North East Scotland. *Agroforestry Systems*, **90**:371-383.

Bright, A. & Joret, A. (2012) Laying hens go undercover to improve production. *Veterinary Record*, **170**:228.

Burgess, P.J., Belot, V., Buachie, E., Cuartero de Frias, F., Nedved, K. & Rodríguez Arquero, E. (2014) The economics of woodland eggs in the UK. In: *2nd European Agroforestry Conference 04-06 June 2014 Cottbus – Germany, Book of Abstracts* 67-70 (Eds. J.H.N. Palma et al.) European Agroforestry Federation.

Burgess, P.J. & Morris, J. (2009) Agricultural technology and land use futures: the UK case. *Land Use Policy*, **26S**:S222-S229.

Burgess, P.J., Crous-Duran, J., den Herder, M., Dupraz, C., Fagerholm, N., Freese, D., Garnett, K., Graves, A.R., Hermansen, J.E., Liagre, F., Mirck, J., Moreno, G., Mosquera-Losada, M.R., Palma, J.H.N., Pantera, A., Plieninger, T. & Upson, M. (2015) AGFORWARD Project Periodic Report: January to December 2014. Cranfield University: AGFORWARD. 95 pp. http://www.agforward.eu/index.php/en/news-reader/id-27-february-2015.html

Carroll, Z.L., Bird, S.B., Emmett, B.A., Reynolds, B. & Sinclair, F.L. (2004) Can tree shelterbelts on agricultural land reduce flood risk? *Soil Use Management*, **20**:357–359.

Chambers M., Crossland, M., Westaway, S. & Smith, J. (2015) Guidance on bringing England's hedges back into the farm business by managing them for woodfuel. http://www.organicresearchcentre.com/?i=articles.php&art_id=798 (Accessed 25 January 2017).

Defra (2016) Food Statistics Pocketbook 2016. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/553390/foodpocketbook-2016report-rev-15sep16.pdf

Defra (2017) Environment Secretary Andrea Leadsom addresses the Oxford Farming Conference 2017. https://www.gov.uk/government/speeches/environment-secretary-sets-out-ambition-for-food-and-farming-industry (Accessed 24 January 2017).

Derrick, C. (2017) Dartington Hall Trust gets behind groundbreaking agroforestry plan. *Brixham News*, 3 January 2017. http://www.brixham-today.co.uk/article.cfm?id=105849 (Accessed 24 January 2017).

den Herder, M., Moreno, G., Mosquera-Losada, M.R., Palma, J.H.N., Sidiropoulou, A., Santiago Freijanes, J., Crous-Duran, J., Paulo, J., Tomé, M., Pantera, A., Papanastasis, V., Mantzanas, K., Pachana, P. & Burgess, P.J. (2016) Current Extent and Trends of Agroforestry in the EU27. Deliverable Report 1.2 for EU FP7 Research Project: AGFORWARD 613520 (15 August 2016). 2nd Edition. 76 pp. http://www.agforward.eu/index.php/en/current-extent-and-trends-of-agroforestry-in-the-eu27.html

Egan, J.K., McLaughlin, J.W., Thompson, R.L. & McIntyre, J.S. (1972) The importance of shelter in reducing neonatal lamb deaths. *Australian Journal of Experimental Agriculture and Animal Husbandry*, **12**:470-472.

Emile J.C., Delagarde, R., Barre, P. & Novak, S. (2016) Nutritive value and degradability of leaves from temperate woody resources for feeding ruminants in Summer. In: *Book of Abstracts 3rd European Agroforestry Conference 2016* 409-410 (Eds. M. Gosme et al.) Montpellier 23-25 May 2016.

European Union (2013) Regulation (EU) No 1307/2013 establishing rules for direct payments to farmers under support schemes within the framework of the common agricultural policy. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:347:0608:0670:EN:PDF (Accessed 27 January 2017).

Eurostat (2017) Land Cover/Use Statistics. http://ec.europa.eu/eurostat/web/lucas/data/database

Forestry Commission (2016) *Forestry Statistics and Forestry Facts & Figures*. http://www.forestry.gov.uk/forestry/infd-7aqdgc

Geddes P. & Kohl R. (2009) The use of Shropshire sheep in tree plantations and commercial fruit cultures. http://www.shropshire-sheep.co.uk/sheepintrees.html (Accessed 24 January 2017).

Green, T. (2016) Forgotten food – tree hay. In: *Book of Abstracts 3rd European Agroforestry Conference 2016* 406-408 (Eds. M. Gosme et al.) Montpellier 23-25 May 2016.

Gregory, N.G. (1995) The role of shelterbelts in protecting livestock: A review, *New Zealand Journal of Agricultural Research*, **38**:423-450.

Happy Egg Co (2017) Hen Welfare. https://thehappyegg.co.uk/our-girls/free-range-hen-welfare/ (Accessed 25 January 2017).

Holman, I.P. (2009) An estimate of peat reserves and loss in the East Anglian Fens http://www.rspb.org.uk/Images/Fenlandpeatassessment_tcm9-236041.pdf

Hislop, A.M., Palmer, H.E. & Gardiner, B.A. (1999) Assessing woodland shelter on farms. In: *Farm Woodland for the Future* 31-43. (Ed. P.J. Burgess, E.D.R. Brierley, J. Morris & J. Evans). Oxford: BIOS Scientific Publishers Ltd.

Petit, S., Stuart, R.C., Gillespie, M.K. & Barr C.J. (2003) Field boundaries in Great Britain: stock and change between 1984, 1990 and 1998. *Journal of Environmental Management*, **67**:229–238.

Pickett, H., Crossley, D. & Sutton, C. (2014) Farm Animal Welfare: Past, Present and Future: A Review of Farm Welfare in the UK. The Food Ethics Council and Heather Pickett https://www.rspcaassured.org.uk/media/1041/summary_report_aug26_low-res.pdf (Accessed 25 January 2017).

Pilbeam, D. & Burgess, P.J. (2014) Farm Woodland Forum Field Visit Report. http://www.agroforestry.ac.uk/sites/www.agroforestry.ac.uk/files/Field%20visit%20report(2).pdf (Accessed 25 January 2017).

RSPCA (2013) RSPCA welfare standards for Laying Hens. 70 pp. https://www.berspcaassured.org.uk/media/1083/rspca-welfare-standards-laying-hens-sept2013-amendments.pdf (Accessed 23 January 2017).

Riverwood Farm (2017) Riverwood Farm Woodland Pigs. http://www.riverwoodfarm.co.uk/woodland_pigs.html (Accessed 23 January 2017).

Saunders, M., Perks, M., Slee, B., Ray, D. & Matthews R. (2016) Can silvo-pastoral agroforestry systems contribute to Scotland's emission reduction targets? Climate Exchange. http://www.climatexchange.org.uk/files/4614/7619/2023/CXC-Woodlands_agroforestry_policy_brief.pdf (Accessed 23 January 2017).

Scottish Government (2015). Mapping rules for land managers. https://www.ruralpayments.org/publicsite/futures/topics/all-schemes/basic-payment-scheme/basic-payment-scheme-full-guidance/mapping-rules—-bps/ (Accessed 26 January 2017).

Traditional Norfolk Poultry (2017) Traditional Norfolk Poultry. http://www.tnpltd.com/chickens/ (Accessed 23 January 2017).

Upson, M.A., Burgess, P.J. & Morison, J.I.L. (2016) Soil carbon changes after establishing woodland and agroforestry trees in a grazed pasture. *Geoderma*, **283**:10-20.

Wheater, H.S., Ballard, C., Buygina, N., McIntyre, N. & Jackson, B.M. (2012) Chapter 22. Modelling Environmental Change: Quantification of Impacts of Land Use and Land Management Change on UK Flood Risk In: *System Identification, Environmental Modelling, and Control System Design* (Eds: L. Wang & H. Garnier) Springer-Verlag London Limited.

Willowdene Farm (2017) Willowdene Rehabilition. http://ritesocialenterprises.org.uk/ (Accessed 23 January 2017).

Woodland Trust (2015) Trees Provide Fodder and Boost Production. 3 pp. The Woodland Trust. http://www.woodlandtrust.org.uk/publications/2015/10/trees-provide-fodder-boost-production/ (Accessed 27 January 2017).

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