Comparing the Sustainability within UK Agriculture: Agroforestry's Potential

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Introduction

- Sustainable resource base: lithosphere vs biosphere
- Land-use: - varying degrees of ecological change and ecosystem services
  - compartmentalised
- Agriculture schism: holistic, systemic & ecological vs technological
- Paradox of conflicting sustainable agriculture definitions (Norton, 2005; Bell and Morse, 2008)
- Agroforestry: an intensive, low-input, sustainable, multifunctional, land-use system, integrating agricultural, forestry and conservational land-use practices.

Agroforestry and Sustainability

What is the potential of silvoarable agroforestry for increasing the sustainability of UK agriculture when comparing other agroecological and integrated and conventional farming systems?

Methods Summary

1. Define sustainability agriculture
2. Identify issues (factors) from definition
3. Identify a benchmark agroecosystem representing maximum sustainability
4. Use a structured literature analysis (SLA) to identify factors, indicators, weighting and technical knowledge base
5. Design system influence diagrams
6. Repeat processes 3 to 5 refining benchmark and influence diagrams
7. Use system influence diagrams to inform the design of a structured hierarchy to model the association of indicators and factors
8. Design theoretical agricultural system scenarios to be assessed
9. Repeat processes 4 to 8. Incorporate info from SLA to better understand mechanisms, processes and procedures within agroecosystems
10. Design a spreadsheet model using the structured hierarchy and enter normalised sustainability scores for each indicator
11. Test weighing sensitivity and integrity of model
12. Results and analysis

Define Sustainable Agriculture

"Sustainable agriculture must secure favourable conditions for the richness of life on Earth, and provide future life with a biosphere and lithosphere resource base to cater for its well-being and needs."

Sustainable Agroecosystem Benchmark

- The AMOEBA approach (marine ecosystem sustainability assessment): self-regulation, biodiversity, and yield (Ten Brink *et al*, 1991)
- Self-regulation has been linked to concepts such as ecological complexity, integrity, diversity, stability and resilience (Parrott, 2010)
- AF systems mimicking the diversity and structure of natural ecosystems, improvements in the agroecosystem may include stability and sustainability (Sinclair *et al*, 2000)

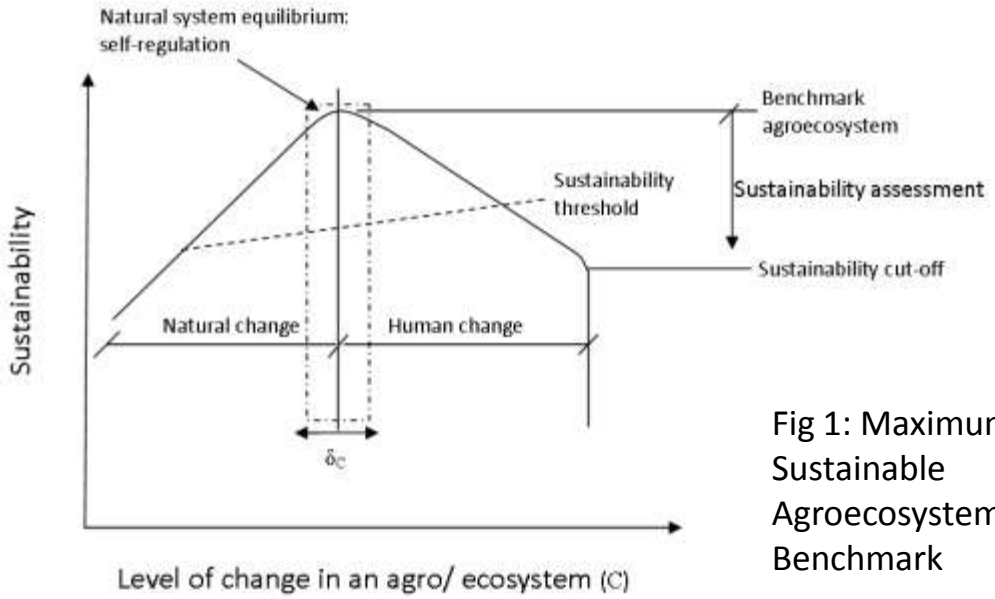


Fig 1: Maximum Sustainable Agroecosystem Benchmark

"Nature has sustained plant life for over 450 million years; during the last 10,000 years ago, human land-use has vastly degraded the environment and threatens life on Earth"

Structured Literature Analysis

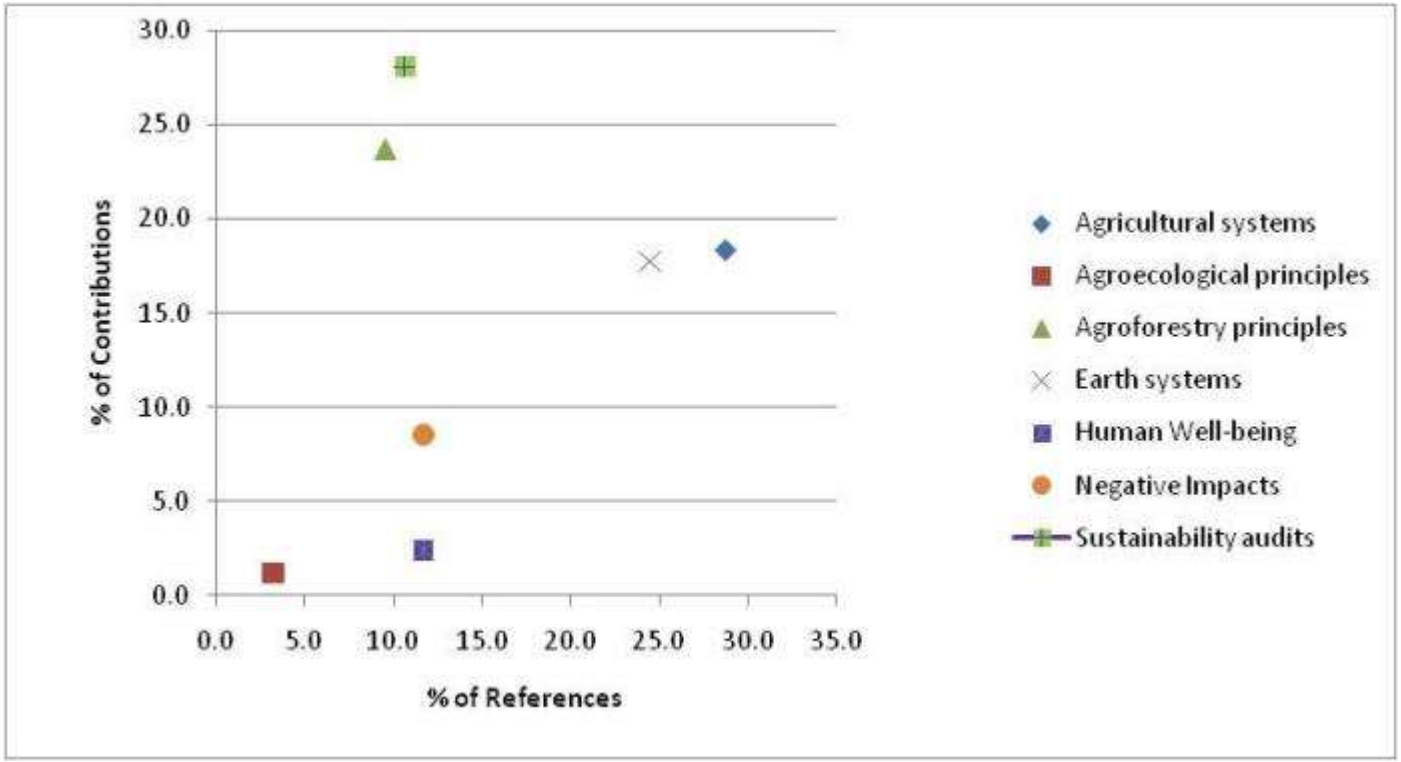


Fig 2: Depth of Research for Structured Literature Analysis

System Influence Diagrams

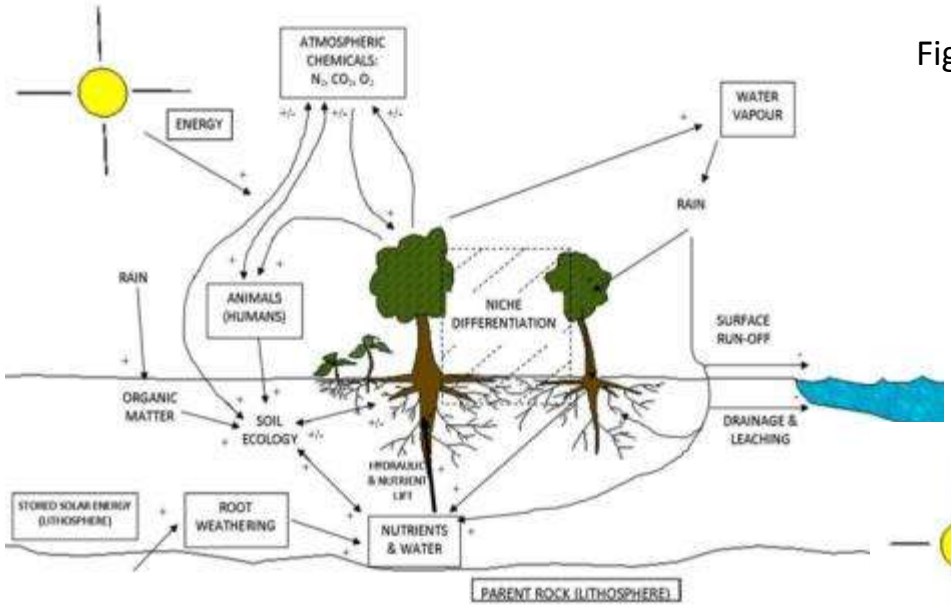


Fig 3: Self-regulation Ecosystem

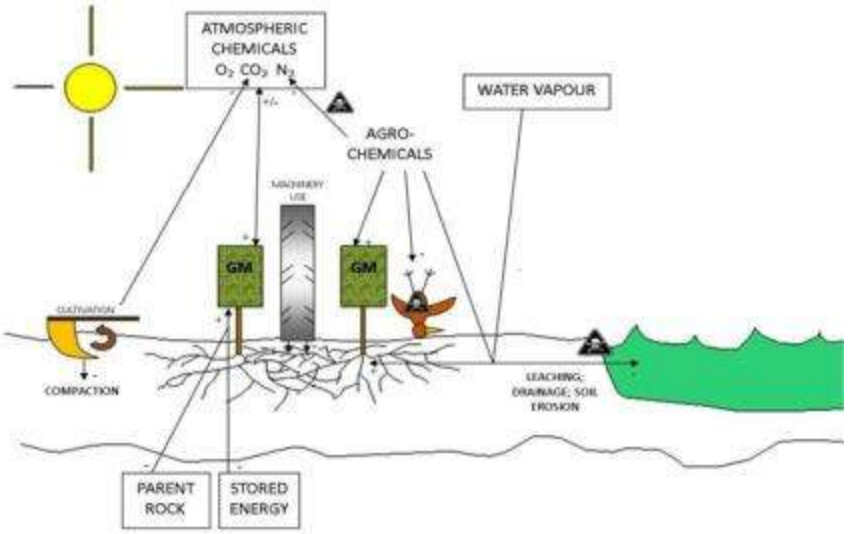


Fig 4: Negative Impacts

Agricultural Systems Compared

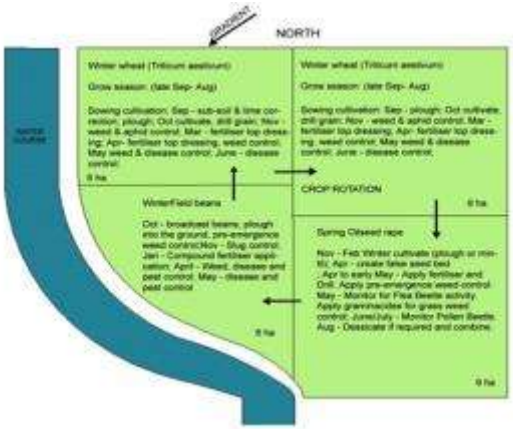


Fig 5: Intensive

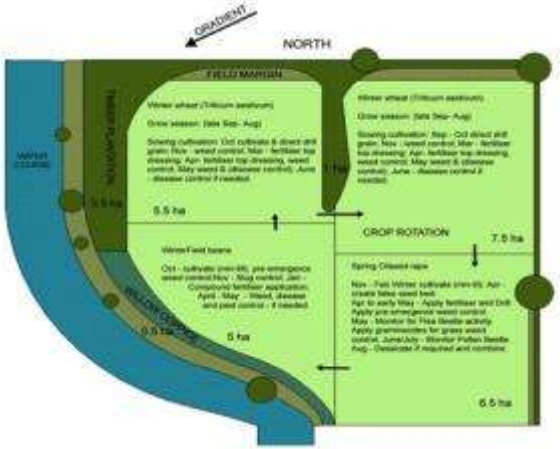


Fig 6: Integrated Farm Management Mosaic (IFM Mosaic)

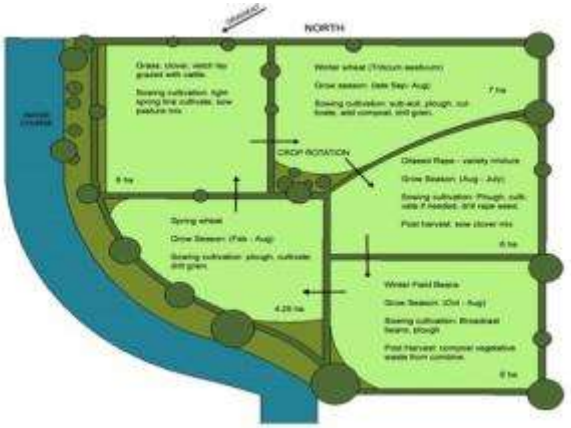
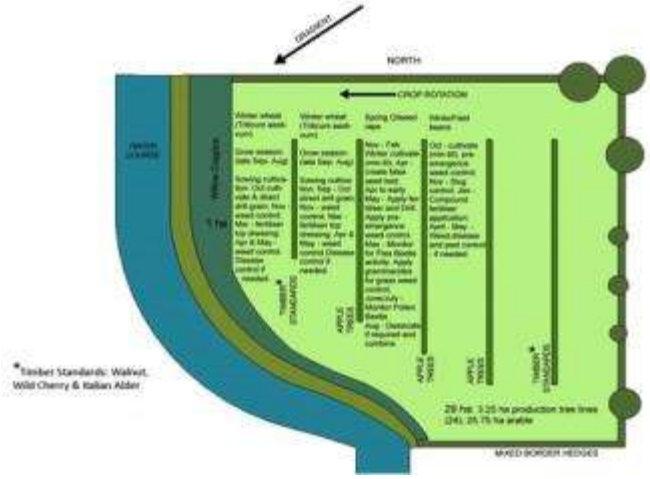


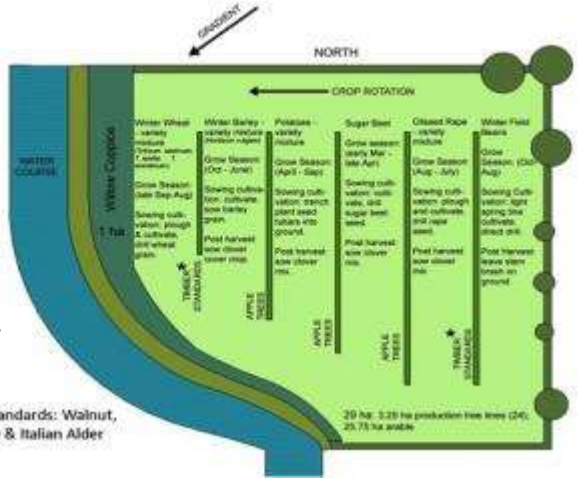
Fig 7: Organic



*Timber Standards: Walnut, Wild Cherry & Italian Alder

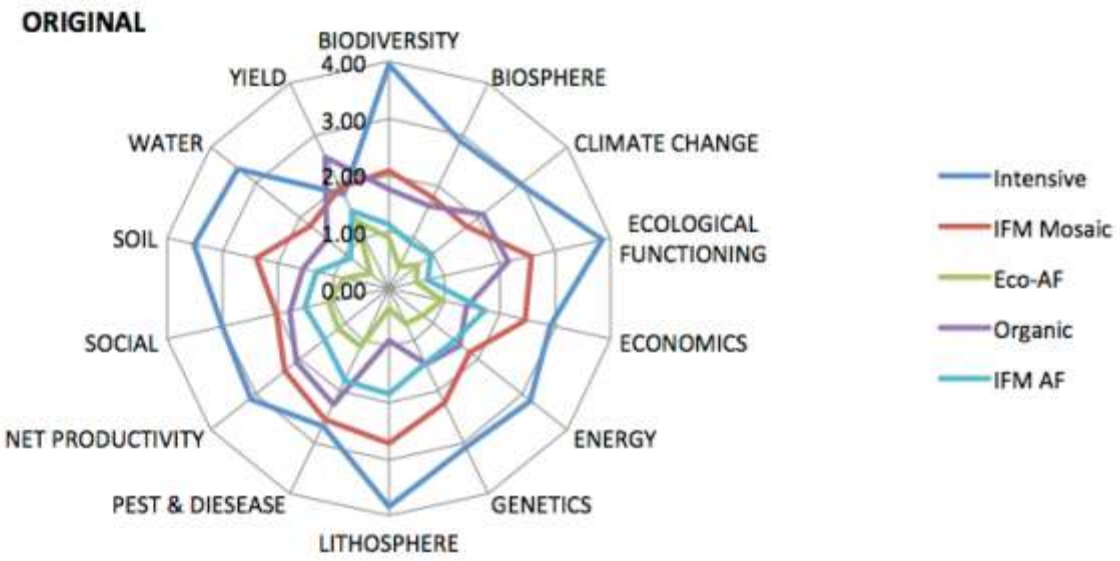
Fig 8: IFM silvoarable agroforestry (IFM AF)

Fig 9: Ecological silvoarable agroforestry (Eco-AF)



*Timber Standards: Walnut, Wild Cherry & Italian Alder

Results



1. Eco-AF 79%
2. IFM AF 65%
3. Organic 54%
4. IFM Mosaic 43%
5. Intensive 18%

Fig 10: Score Results

Sensitivity Analysis

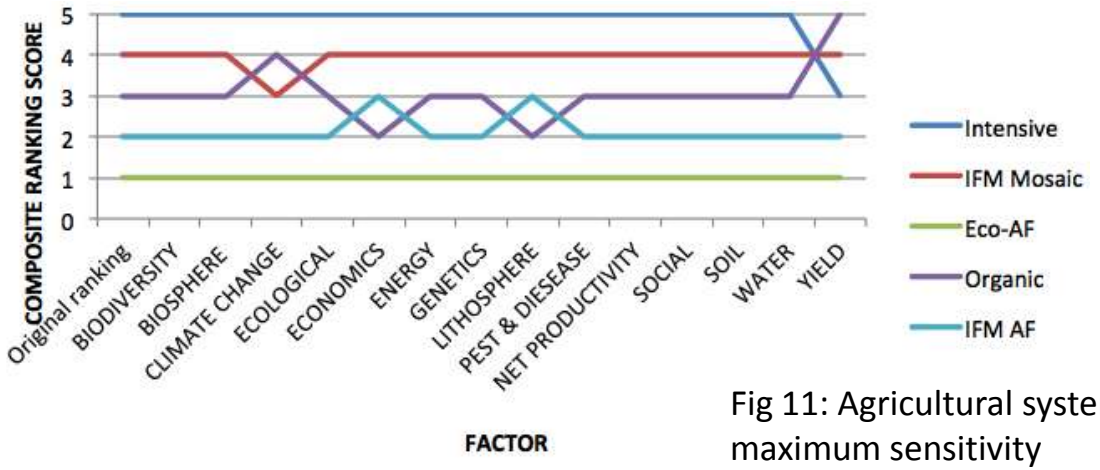


Fig 11: Agricultural system ranking at maximum sensitivity

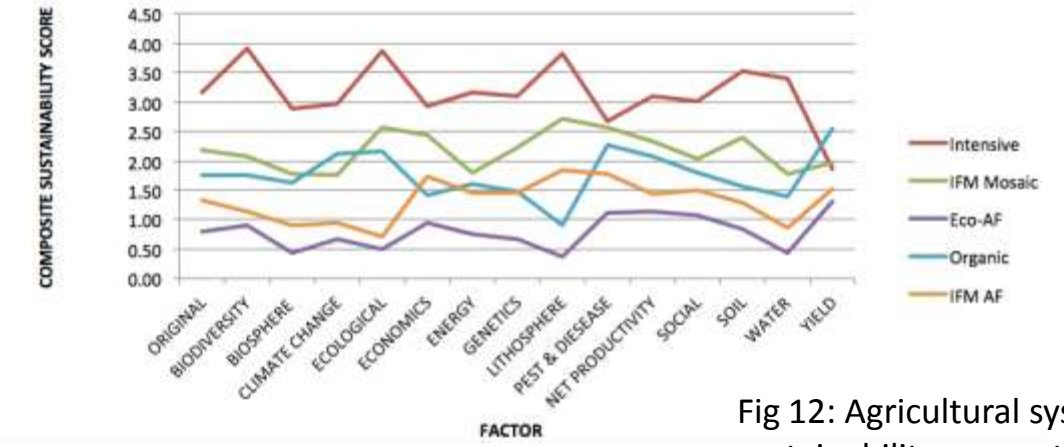
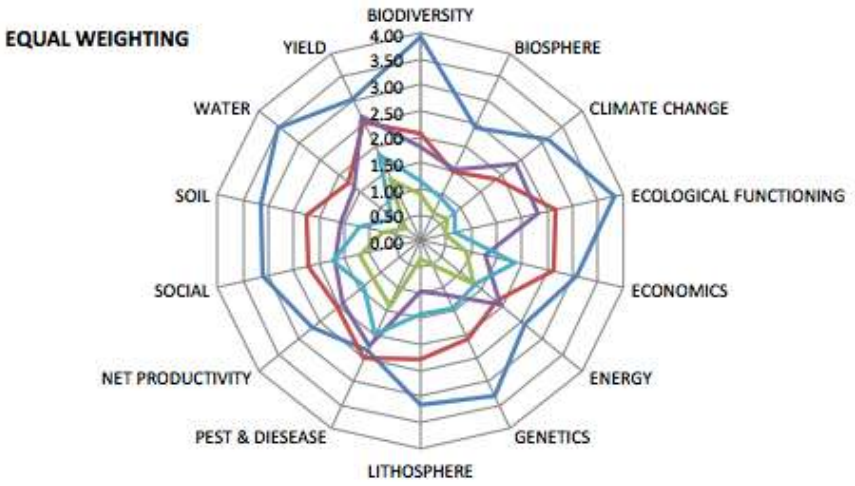
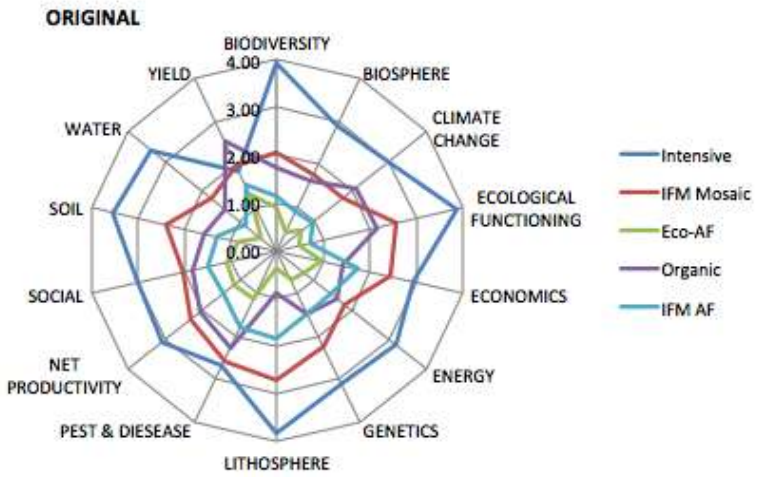


Fig 12: Agricultural system composite sustainability score at maximum sensitivity

Model Variations – Equal weighting

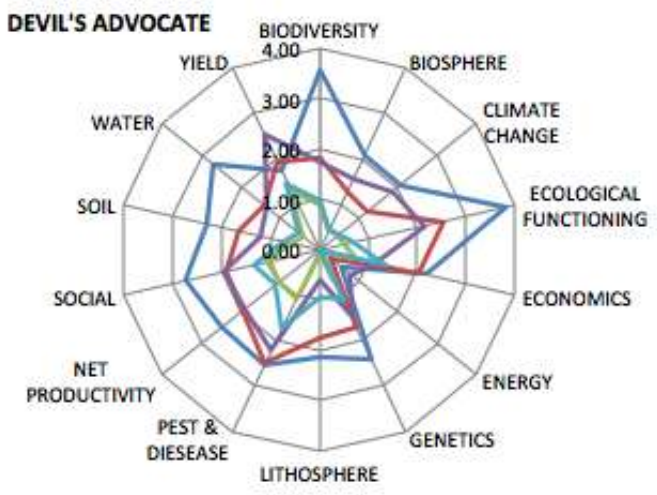


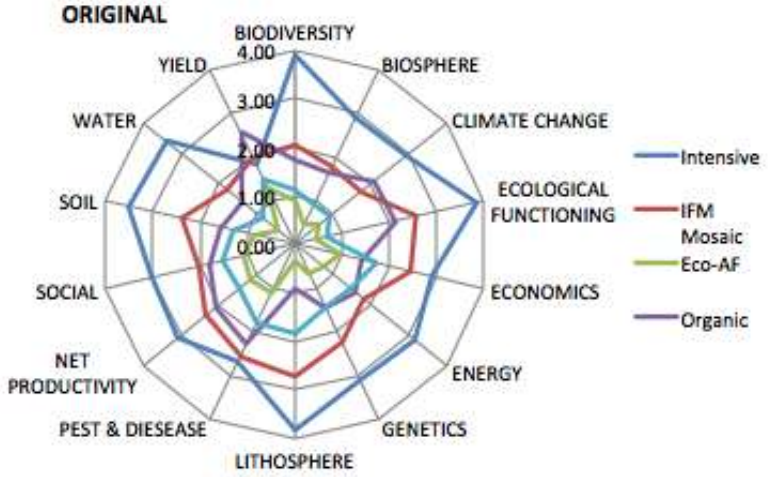


1.	Eco-AF	78%	79%
2.	IFM AF	66%	65%
3.	Organic	53%	54%
4.	IFM Mosaic	44%	43%
5.	Intensive	19%	18%

Fig 13: Equal Weighting Results

Model Variations – Devil's Advocate

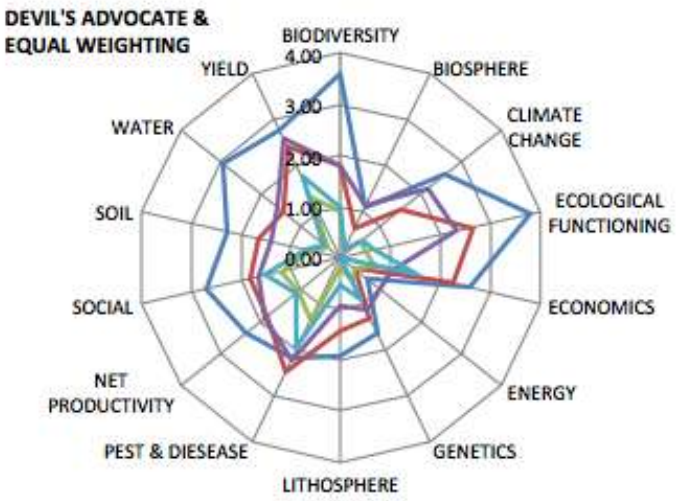


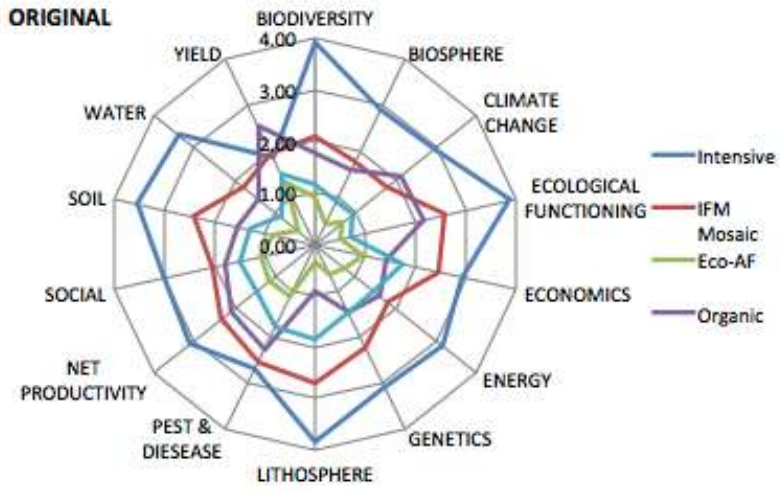


1.	Eco-AF	83%	79%
2.	IFM AF	76%	65%
3.	Organic	58%	54%
4.	IFM Mosaic	55%	43%
5.	Intensive	38%	18%

Fig 14: Devil's Advocate Results

Model Variations – Devil's Advocate with Equal Weighting





1.	Eco-AF	82%	79%
2.	IFM AF	76%	65%
3.	Organic	57%	54%
4.	IFM Mosaic	56%	43%
5.	Intensive	38%	18%

Fig 15: Devil's Advocate with Equal Weighting Results

Conclusions

- The research results suggest:
  - The integration of trees into UK arable agriculture can increase sustainability.
  - Supports the case for a review of Article 44 RDP for the UK: increase the sustainability of agriculture by accommodating agroforestry.
  - A systemic land use approach by integrating agriculture, forestry, conservation and urban compartments increases sustainability.
  - By applying systemic approaches and ecological engineering to agriculture, land need not be taken out of production in order to maintain ecosystem services, and incorporate conservation and environmental practice.

- Further developments
  - Incorporate a consensus of views from participation experts.
  - Use quantitative data. More UK SAF data, including productivity, is essential in order to accurately measure the sustainability and viability of these systems.

References & Acknowledgements

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