

Reference 8

England, JR; OGrady, AP; Fleming, A; Marais, Z; Mendham, D 2020 Trees on farms to support natural capital: An evidence-based review for grazed dairy systems SCIENCE OF THE TOTAL ENVIRONMENT, 704, 135345. 10.1016/j.scitotenv.2019.135345

Background and objective

Understanding and quantifying the ecosystem services and benefits provided by integrating trees into grazed dairy farming systems would allow their incorporation into farm planning and decision-making. It may also help to incentivise the protection/enhancement of natural capital. However, the status of the current evidence base is unclear. The aim was to review the relevant literature using an evidence-based or systematic review approach to assess the evidence for the services and benefits and/or disbenefits to dairy enterprises provided by different systems of woody vegetation on farms.

Search strategy and selection criteria

The review approach consisted of three stages: i) the generation of keywords, (ii) a systematic search, and (iii) collation of the data. Keywords were generated based on the results of an initial survey of existing reviews and other material such as extension notes, 'fact sheets', etc. which identified a number of potential key ecosystem services, benefits and disbenefits from trees for dairy enterprises. Keywords specific to each ecosystem service and woody system were selected. Literature was searched (to January 2019) using the database 'ISI Web of Science' (Clarivate Analytics). Different combinations of the following search terms were used to find references containing relevant information: dairy OR cattle AND tree OR forest* AND agroforestry, "shelterbelt", "shelter belt", "windbreak", "wind break", "tree belt", "tree planting", "alley farm", *silvopast*, plantation, "farm forestry", revegetation, reforestation, riparian, "ecosystem service", shade, shelter, "heat stress", erosion, "soil stability", biodiversity, "pasture production", "water quality", "carbon sequest*", forage, wood, or timber. Additional references were also identified by searching the reference lists of relevant papers and reviews for secondary references which may be of interest (termed 'snowballing'). Only publicly-available literature (books, journals, conference proceedings, published reports, and theses) were included in this analysis. Unpublished data were not included because they are generally inaccessible to other researchers, cannot be fully critically analyzed, and the methods used are often difficult to verify. 1) Studies reported on biophysical aspects of on-farm woody vegetation associated with dairy enterprises – this included studies that were specific to dairy only, mixed dairy and beef enterprises; 2) Relevant data on at least one provisioning or regulating and maintenance ecosystem service and associated benefit or disbenefit were reported. These included animal production/health, pasture production/quality, wood production, biodiversity, water quality, soil quality or function, carbon sequestration and/or erosion; 3) An appropriate comparison with the non-revegetated agricultural land use (i.e. grazed dairy pasture) was reported.

Data and analysis

Three variables summarising the effect of each woody system type on ecosystem services were calculated: (i) the level of support given – this reflects the number of publications providing the same evidence for a particular effect; (ii) the strength of evidence (SOE) – an average ranking of the strength of evidence for the particular effect ranging from 1 (very weak) to 5 (very strong); and (iii) the predominant direction of the evidence for the relationship.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
83	Grazed dairy systems	1) Shelterbelts; 2) Riparian plantings; 3) Pasture trees; 4) Vegetation remnants	Grazed dairy pasture without trees	Metric: Invertebrate, stream macroinvertebrate and vertebrate biodiversity (mainly species richness, but also abundance and composition); Effect size: Not applicable	37.5

Results

- Species richness was the most common biodiversity attribute measured. For all studies, the focus was on animal species.
- The only relationship with high confidence was the provision of habitat by remnant native vegetation resulting in increased vertebrate biodiversity. One reason for this may be that remnants are likely to be older than the young plantings studied, and it may take decades for plantings to obtain the structure required to provide appropriate habitat for vertebrates, such as tree hollows and fallen timber.
- Relationships for the provision of habitat resulting in increased invertebrate biodiversity had medium confidence for shelterbelts and pasture trees, and only low confidence for remnant native vegetation.
- Relationships were identified for riparian systems where provision of a greater diversity of substrates improved channel/bank stability improved habitat quality and stream macroinvertebrate biodiversity.

Factors influencing effect sizes

- No factors influencing effect sizes to report

Conclusion

The effects reported are generally positive. Reviewers' note: We labelled the results as uncertain due to the lack of statistical testing.