Enhancing biodiversity in crop production: Cost-benefit analyses of six measures in Finland

The overall objective of EcoStack is to develop and support ecologically, economically and socially sustainable crop production via enhancement of ecosystem services provision and protection of functional biodiversity.

Introduction and context

A loss of biodiversity in agricultural landscapes has been observed in the last decades. To counterbalance the negative effects of some conventional agriculture practices, the maintenance of semi-natural landscape elements such as hedgerows, buffer and flower strips is promoted and funded by the European Union as Agro-Environmental and Climatic Measures and the new Eco-schemes. Semi-natural habitats and agro-ecological measures have the potential to support ecosystem services by providing a wide range of food resources, habitats for numerous species, biological control, pollination and soil conservation.

However, their implementation could lead to additional costs such as the purchase of specific machinery or additional farmer workload. This joint study by ProAgria and JKI aims to determine the costs and benefits of several measures enhancing functional biodiversity in order to determine whether or not they are viable for farmers in Finland.

Methodology

Research issue

Six measures were chosen according to their practicability and their effectiveness concerning protection and support of biodiversity.

Off-crop measures

Grass margins, buffer strips
Field margins with sown or natural vegetation dominated by grasses and herbs

Flower strips
Agricultural land sown with seed mixtures of flowering plants

Hedgerows
Lines of bushes and small trees planted between fields or along roadsides

In-crop measures

Intercropping, mixed cropping
Mixing two species

Undersowing
Catch crops / cover crops are established with the main crop

Organic mulching
Organic material (straw, clover-grass, triticale-vetch) is applied between the main crop

Methodology

The study was conducted in Finland in 2022 and included farms specializing in arable crops or dairy farming. The main crops grown were barley, oats, wheat and grasses. The average farm size was 52 ha. Data on the costs of the measures were obtained from production cost calculations from the ProAgria field database and from input suppliers. Benefits were estimated based on available research results and experts or farmers views.

To understand the incentives that affect farmer decision making, each cost-benefit analysis was conducted for 1 ha. Machinery costs include workload and fuel costs, calculated for a 100 ha farm.

Results

Costs-benefit analysis

Measure	Costs	Benefits from the farmers' point of view	Drawbacks from the farmers' point of view
Grass margins Buffer strips	300 €/ha	54 €/ha subsidy Used as buffer strip for erosion control and as hunting lane Use of low yielding land Good for aesthetics and farmers' image	Farmers do not observe effects of grass strips on yield, pollination, diseases nor pests Additional costs for pest and weed control may occur
Flower strips	630 €/ha	300 €/ha subsidy Same functions as buffer strips Use of low yielding land Attraction of pollinators Good for aesthetics and farmers' image	No effects on yield
Hedgerows Agroforestry Tree lines	3970 €/ha	No subsidies Same functions as buffer strips and windbreak effect Field separation Biodiversity increase	No effects on yield High installation costs Long maintenance time
Mixed cropping (oats and faba bean)	62 €/ha	If used for feed, no sorting Decrease in disease pressure Less fungicides needed (30 €/ha)	Lack of information on suitable cultivars Additional costs for seeding For marketing, harvest must be sorted (28 €/t)
Undersowing catch crops (cereals and clover)	70 €/ha	100 €/ha subsidy Yield increase (3 %) Fertilizer savings (30-50 €/ha) Higher soil moisture (13 €/ha)	Lack of information on suitable combinations Yield decline also possible Herbicide costs for removal
Organic mulching (potatoes)	206 €/ha	40 €/ha subsidy Yield increase (5-10 %), better quality Less aphids (virus vectors!) and other pests, weed control, erosion control, soil moisture, fertilizing effect	Lack of information Obtain mulch material Spreading labor intensive and require own machinery

Costs and benefits for implementation are presented per hectare. Opportunity costs are not included.
For in-crop measures, the result presented is the difference from the costs of the respective common practice.

Conclusions

For **off-crop measures**, costs increase as diversity increases in terms of species and vegetation layers. Grass margins are a less costly measure, but also provide less diversity due to few number of species in seed mixtures. Flower strips are more costly, but also provide more species diversity. Hedgerows are the most cost intensive measure, but provide more habitat layers (trees, shrubs and grasses) and thus also high species and micro-habitat diversity. Hedgerows are not widely used in Finland mainly because field parcel size is quite small: 3.2 ha, and usually surrounded by forests.

For **in-crop practices**, mixed cropping and undersowing do not add much costs compared to conventional cultivation of pure stands but improve soil fertility and decrease disease pressure. Organic mulching is more cost-intensive but benefits plant and soil health, especially during extreme weather conditions.

Farmers statements for implementation

The willingness of farmers to apply the targeted measures varies. The most important statements of the farmers about these measures are:

- Buffer strips, grass margins are common practice along waterways and useful in areas that are difficult to cultivate or sensitive to soil erosion
- Flower strips or biodiversity fields receive increasing interest among farmers to support pollinators and improve the image of farming
- Hedgerows are not common in Finland and expensive to plant, but lately gain interest as “agroforestry”, wind breaks and shelterbelts
- Mixed cropping – an old idea, but now interesting to control difficult pests
- Undersowing – increasing interest to diversify crop rotations and increase soil organic matter
- Organic mulching can be used in areas where material is available with low transport costs

For more information contact: sari.peltonen@proagria.fi or info@ecostack-h2020.eu
Visit our web site: www.ecostack-h2020.eu

EcoStack

This project receives funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 773554.
Duration of project: September 2018 - September 2023

22 PARTNERS FROM 13 COUNTRIES