European Commission

NWRM

Natural Water Retention Measures

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Individual NWRM

Strip cropping along contours

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I. NWRM Description

Strip cropping is a method of farming used when a slope is too steep or too long, or otherwise, when one does not have an alternative method of preventing soil erosion. It alternates strips of closely sown crops such as hay, wheat, or other small grains with strips of row crops, such as corn, soybeans, cotton, or sugar beets. Strip cropping helps to stop soil erosion by creating natural dams for water, helping to preserve the strength of the soil. Certain layers of plants will absorb minerals and water from the soil more effectively than others. When water reaches the weaker soil that lacks the minerals needed to make it stronger, it normally washes it away. When strips of soil are strong enough to slow down water from moving through them, the weaker soil can't wash away like it normally would. Because of this, farmland stays fertile much longer. There is no available information on the extent of strip cropping in Europe. The practice has been widespread in North America as a means of mitigating soil erosion from wind and water.

II. Illustration

Illustration 1: Example of strip cropping along contour lines

Source: http://www.britannica.com/EBchecked/media/149126/Contour-farming-and-strip-cropping-on-sloping-farmland

III. Geographic Applicability

Land Use	Applicability	Evidence
Artificial Surfaces	No	
Agricultural Areas	Yes	Strip cropping concerns crops and is thus applicable in agricultural areas.
Forests and Semi-Natural Areas	No	
Wetlands	No	

Region	Applicability	Evidence
Western Europe	Yes	According to Stella study (Stella consulting , 2012), strip cropping is applicable in any climate zone of Europe.
Mediterranean	Yes	
Baltic Sea	Yes	
Eastern Europe and Danube	Yes	

IV. Scale

	0-0.1km^2	0.1-1.0km^2	1-10km^2	10-100km^2	100-1000km^2	>1000km^2
Upstream Drainage Area/Catchment Area	✓	✓				
Evidence	Strip cropping concerns fields and is thus applicable at field scale. In terms of drainage, the concerned area is the field itself. In Europe, field size can vary across states and agriculture types in each state; in France (Latruffe, 2013) and Denmark (Levin, 2006) for instance, mean field size is a slightly more than 4ha.					

V. Biophysical Impacts

Biophysical Impacts		Rating	Evidence
Slowing & Storing Runoff	Store Runoff	None	
	Slow Runoff	High	Strip cropping contributes to slowing down runoff by introducing strips of row plants which absorb water more efficiently due to the use of closely sown crops in the alternating strips. Across slopes, it helps to intercept water runoff compared to up-down slope cropping (BIO Intelligence Service with support from Hydrologic, 2014). US Department of Agriculture (1997) explain that hay strips have higher hydraulic resistance than clear-tilled areas.
	Store River Water	None	
	Slow River Water	None	
Reducing Runoff	Increase Evapotranspiration	None	
	Increase Infiltration and/or groundwater recharge	Medium	According to US Department of Agriculture, strip cropping increases infiltration. That contributes to groundwater/aquifer recharge.
	Increase soil water retention	Low	By slowing down runoff and increasing water infiltration (Carman), strip cropping contributes to increase water retention.
Reducing Pollution	Reduce pollutant sources	None	
	Intercept pollution pathways	None	
Soil Conservation	Reduce erosion and/or sediment delivery	High	Densely vegetated strips increase surface roughness and hydraulic resistance to flow; that reduces the transport capacity of the runoff. Strip cropping greatly reduces the rate of sediment moving down the slopes (US Department of Agriculture, 1997). A strip is efficient in reducing erosion when its width is sufficient for the sediment transport capacity to be reduced to less than the sediment load being transported by the runoff. In this case, deposition happens (US Department of Agriculture, 1997).
	Improve soils	Medium	According to US Department of Agriculture (1997), the rotation of crops among the strips enable clear-tilled crops to benefit from the sediment deposited in the previous year by the rough strip.

Creating Habitat	Create aquatic habitat	None	
	Create riparian habitat	None	
	Create terrestrial habitat	None	
Climate Alteration	Enhance precipitation	None	
	Reduce peak temperature	None	
	Absorb and/or retain CO_2	None	

VI. Ecosystem Services Benefits

Ecosystem Services		Rating	Evidence
Provisioning	Food provision	None	
	Water Storage	None	
	Fish stocks and recruiting	None	
	Natural biomass production	None	
Regulatory and Maintenance	Biodiversity preservation	None	
	Climate change adaptation and mitigation	None	
	Groundwater / aquifer recharge	Medium	According to US Department of Agriculture, strip cropping increases infiltration. That contributes to groundwater/aquifer recharge.
	Flood risk reduction	Medium	Strip cropping contributes to slow runoff and increase water retention (US Department of Agriculture, 1997). Thus, it has a positive impact on flood risk reduction.
	Erosion / sediment control	High	Densely vegetated strips increase surface roughness and hydraulic resistance to flow; that reduces the transport capacity of the runoff. Strip cropping highly reduces the rate of sediment moving down the slopes (US Department of Agriculture, 1997).

	Filtration of pollutants	Medium	According to US Department of Agriculture, strip cropping also have a beneficial impact on the filtration of pollutants, since strips plants absorb and assimilate nutrients efficiently.
Cultural	Recreational opportunities	None	
	Aesthetic / cultural value	None	
Abiotic	Navigation	None	
	Geological resources	None	
	Energy production	None	

VII. Policy Objectives

Policy Objective		Rating	Evidence
Water Framework Directive			
Achieve Good Surface Water Status	Improving status of biological quality elements	None	
	Improving status of physico-chemical quality elements	None	
	Improving status of hydromorphological quality elements	Medium	Strip cropping has a significant impact on reducing erosion and sediment loss (see above). This has a positive impact on hydromorphological status.
	Improving chemical status and priority substances	None	
Achieve Good GW Status	Improved quantitative status	Medium	According to US Department of Agriculture, strip cropping increases infiltration. That contributes to groundwater/aquifer recharge.
	Improved chemical status	None	

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Prevent Deterioration	Prevent surface water status deterioration	Medium	Strip cropping has a positive impact on filtrating pollutants and above all reducing sediments loss (see above). Consequently, it has a beneficial impact on preventing surface water status deterioration.
	Prevent groundwater status deterioration	None	
Floods Directive			
Take adequate and co-ordinated measures to reduce flood risks		High	Strip cropping contributes to slowing down runoff by introducing strips of row plants which absorb water more efficiently than closely sown crops. Across slopes, it helps to intercept water runoff compared to up-down slope cropping (BIO Intelligence Service with support from Hydrologic, 2014). This measure contributes to reduce flood risks. US Department of Agriculture explains that strip cropping is more effective when used in a planned conservation system including a combination of measures such as crop rotation, conservation tillage and field borders.
Habitats and Birds Directives			
Protection of Important Habitats		None	
2020 Biodiversity Strategy			
Better protection for ecosystems and more use of Green Infrastructure		High	Depending of crop selection, strip cropping can provide a greater diversity of crop types and habitats (such as hay) in agro-systems (US Department of Agriculture, 1997). Strip cropping is part of green infrastructures which can be implemented in order to reach policy objectives in Europe.
More sustainable agriculture and forestry		Medium	Strip cropping is part of the measures increasing agriculture sustainability. Indeed, it enables maintaining good conditions for further cropping: soil stability, nutrients availability, biodiversity...
Better management of fish stocks		None	
Prevention of biodiversity loss		Medium	Strip cropping increases biodiversity into agro-ecosystems by providing habitats (like hay), which can increase species richness.

VIII. Design Guidance

Design Parameters	Evidence
Dimensions	Strip width should be defined depending on the planning objective (i.e. reducing sediment transport, wind or water erosion) and the erosion prediction technology (US Department of Agriculture, 1997). This means that strip width should reflect the local conditions of slope, erosion risk and soil type.
Space required	The measure may be restricted by the space available to establish two or more strips within existing field boundaries and to allow access of farm machinery to each strip.
Location	
Site and slope stability	Slope is one of the context elements which can lead to the choice for strip cropping. However, slope constraints can impact on possibilities for mechanized agriculture (Stella consulting , 2012).
Soils and groundwater	
Pre-treatment requirements	
Synergies with Other Measures	Strip cropping is part of "soil conservation practices". According to the US Department of Agriculture, it should be combined with other soil management practices such as reduced tillage, crop rotation and border strips to meet resource management goals.

Design recommendations	US Department of Agriculture provides some recommendations about strip cropping implementation: - Strip crops have to provide protective cover in periods when erosion is expected to occur. Protective cover can be composed by grasses, legumes, grass-legume mixture, standing stubble, residues... - Strip boundaries should be parallel to each other and as close to the contour as practical. Strip directions have to take into account wind direction if it is a concern. - Strip width depends on the planning objectives (i.e. reducing wind or water erosion, or limiting sediment transport) and the erosion prediction technology. - Strips susceptible to erosion (row crops or fallow with less than 10% surface residue cover and low surface roughness) have to be alternated down the slope with strips resistant to erosion (dense grass or legumes, hay crops or row crops with more than 75% surface cover). - Strip cropping should be combined with other conservation practices in order to reach resource management objectives. - Strips should be designed to facilitate operation of machinery. - Strip cropped fields should be consistent with the farm enterprise crop mix and associated livestock. - Sediment accumulation along strips edges should be removed and distributed around the field to maintain the effectiveness of the practice. - All farming operation should be conducted parallel to the strip boundaries.

IX. Cost

Cost Category	Cost Range	Evidence
Land Acquisition		
Investigations & Studies		
Capital Costs	Low	Stella Consulting (2012) does not identify any information on investment costs for strip cropping, but assesses them as low. US Department of Agriculture also considers that strip cropping is one of the least costly conservation practices to install. This investment cost includes labor and/or fuel, and may involve a change in planned cropping sequences. The primary cost for installation could include the cost of establishing grasses and legumes in a long-term crop rotation (US Department of Agriculture, 1997).
Maintenance Costs	Low	Maintenance costs may include redistributing deposited sediments, but these would be offset by the reduction in costs arising from erosion.

Additional Costs	110€/ha	Subsidies for soil management, which might include practices such as strip cropping have been estimated at 110€/ha/year in Europe (Stella consulting , 2012).

X. Governance and Implementation

Requirement	Evidence
Efficiency demonstration: research and experimentation, exchanges, communication	Strip cropping is implemented on private areas (fields) and thus depends on farmers' strategy. Strip cropping's impact on yields is not necessarily positive and arguably the restriction placed on farm efficiency relative to mono-cropping, or single crops in rotation means the practice is not very common in Europe. Adoption in North America has been driven by erosion risks that may be different or managed in alternative methods in Europe. Communication and diffusion of information, and demonstration, have an important role to play in convincing farmers to test strip cropping and supporting them in choosing appropriate systems. Field size may also be an important factor in allowing efficient use of strip cropping, similar functions may be performed by field boundaries in smaller fields.
Coordination and animation	So as to be efficient on reaching some policy objectives, strip cropping should be part of a wider program of measures and be considered at a sufficient scale. If implemented only on individual will and at field scale, the measure will not be sufficient to impact on flood risk reduction. Coordination of measures and animation at a relevant scale (watershed) can make the implementation of the measure more efficient and relevant. Local authorities, local water or agricultural stakeholders (consular chambers, watershed agencies...) have a role to play.

XI. Incentives supporting the financing of the NWRM

Type	Evidence
CAP Pillar II: agri-environment-climate measures, organic farming	Strip cropping are potential agri-environment and climate measures under article 28 of Regulation 1305/2013. They may also be encouraged under article 29 on organic farming.

XII. References

Reference
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