Transforming **U**nsustainable management of soils in key agricultural systems in EU and China

Developing an **i**ntegrated platform of alternatives to reverse soil degradation

Erosion Control in potato production with in-furrow micro-dams and cover crops

This project receives funding from the European Union's Horizon 2020 Research and Innovation action under grant agreement No 101000224.

Short description

Potatoes are a crop that is particularly susceptible to erosion due to their need of a special seedbed structure with dams and late plant development. Surface runoff is concentrated in the furrows between the crop rows, thus developing a high transport energy and causing increased soil erosion. A cultivation technique with cross dams offers good soil protection. By piling up the cross dams, small water retention areas are created in which surface water accumulates. The cross dams immediately limit surface runoff and keep the water on site and thus improve water storage and distribution and reduce soil erosion.

Target area

It makes sense to build cross dams on all potato fields. The largest effect will be achieved in areas susceptible to erosion, considering the parameters slope gradient, soil type, and climatic site conditions as decisive factors. However, the erosion potential should not be underestimated even for only slightly sloped areas. In addition, this technology is also particularly interesting for regions with scarce water resources, as the rainwater is kept better and directly at the place of precipitation on the field. The formation of cross dams is particularly useful

for organic farms where weed control is achieved by repeated harrowing or mounding of the potato ridges. If the technology is adapted, it may certainly also make sense for other ridges and root crops.

Problem identification

The problem can be identified by classic erosion assessment and uneven field emergence. Erosion assessment can be supported by the TUdi soil erosion app **dev-tudi.web.app**

Detailed description of protection

Cross dams are preferably constructed together with the main dams during the planting process to ensure immediate protection against erosive rain events. When shaping the cross dams, the height and spacing of the dams and the distance between each other must be optimised to local conditions. Based on investigations with the Austrian Federal Agency for Water Management, a height of 20 cm and a distance between the

Fig. 1: Potato planter with cross-dam ridger.

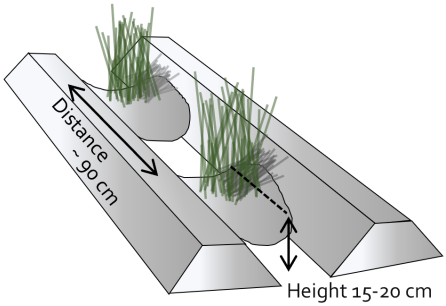


Fig. 2: Ideally, the cross-dam height should be 15-20 cm and the distance between the cross dams about 90 cm.

dams of 90 cm are considered to be effective. For particularly steep areas and longer slopes or flatter fields with a short slope, however, these should be adapted. It is recommended not to go below a cross dam height of 15 cm in order to prevent the cross dams from breaking or filling in. For additional erosion protection through washing-out or tunnelling of dams, fast-growing grasses, such as oats, are suitable companion crops to stabilize the cross dams. The grasses can be spread during the potato planting process easily controlled at a later stage using selective herbicides. Rough or sandy oats in particular are very well suited, as they are fast-growing and form pronounced root systems. The longer the companion seed is allowed to grow in the potato crop, the better the protective effect. Oats should reach a height of 30 cm to ensure good rooting and long-term stabilizing effects for the cross dams. Planning the herbicide strategy in advance, care must be taken to ensure that the herbicides applied pre-emergence of the potatoes have little or no effect on the grasses. In general, a seed rate of 30-50 kg/ha is recommended. For sites with serious erosion potential, it is advisable to increase the sowing rate of oats slightly to

Fig. 3: Oat sowing on cross-dams shortly before the tolerable growth height of approx. 30 cm.

approx. 60 kg/ha. To avoid yield losses due to water competition, the companion crop may be sprayed away from the start of bolting (sprouting) or from a height of around 30 cm, especially in dry areas. The oats can remain on the field as a mulch layer until harvest.

In addition to the direct protective measures of cross-dams and companion sowing, all other measures that can stabilise the structure or slow down the runoff are also useful. These include cover crops before potatoes, reduced tillage, reduced tyre pressure, addition of mulch, reduction of crossings, and the creation of cross ridges. This refers to erosion barriers (dams) placed at right angles to the direction of cultivation or the slope, which can be placed several times depending on the length of the slope.

Pros/Cons of technique, obstacles to implementation

On the positive side, water and soil loss can be reduced effectively from the start of vegetation. On the negative side, additional costs for equipment and through a reduction in travelling speed occur. The required tools can be built by crafty farmers with well-equipped workshops, however this needs a lot of skill, time, and experience. In some countries (e.g., Austria, Germany) some companies already offer planting technology for creating cross dams.

Effects/results/case studies

Both bare cross dams and cross dams with a stabilising oat seed are able to minimise surface runoff and thus significantly reduce soil erosion. Compared to sowing oats in the furrow without cross dams, which already promises a reduction in soil erosion of over 50 %, cross dams are able to reduce the erosion of soil material up to 95 %. This is due in particular to the improved water retention within the field and more homogeneous plant development within the field. Not only is surface water retained more effectively (up to 81 % for cross-dams with oat sowing compared to 7 % for oat sowing alone without cross-dams), but the soil water content can also be increased by a few per cent. In general, it may be noted that high cross dams at the shortest possible distance from each other guarantee a high protection potential.

More literature

Video available at **https://tudi-project.org/media-center/videos**

Additional information at **www.optero-kartoffel.at**

Publication at **https://doi.org/10.1016/j.still.2023.105911**

Conference contribution: **https://doi.org/10.5194/egusphere-egu24-5554**

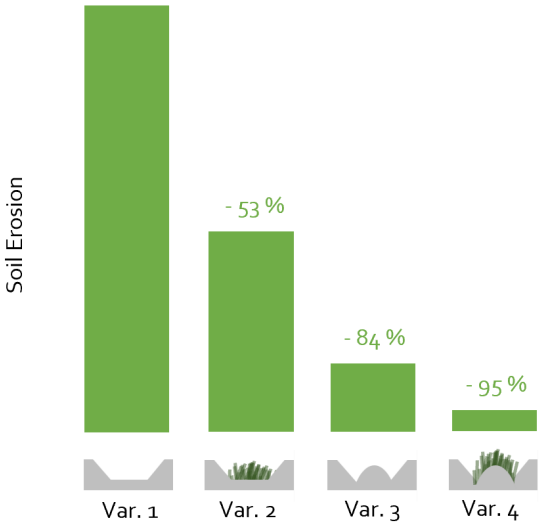
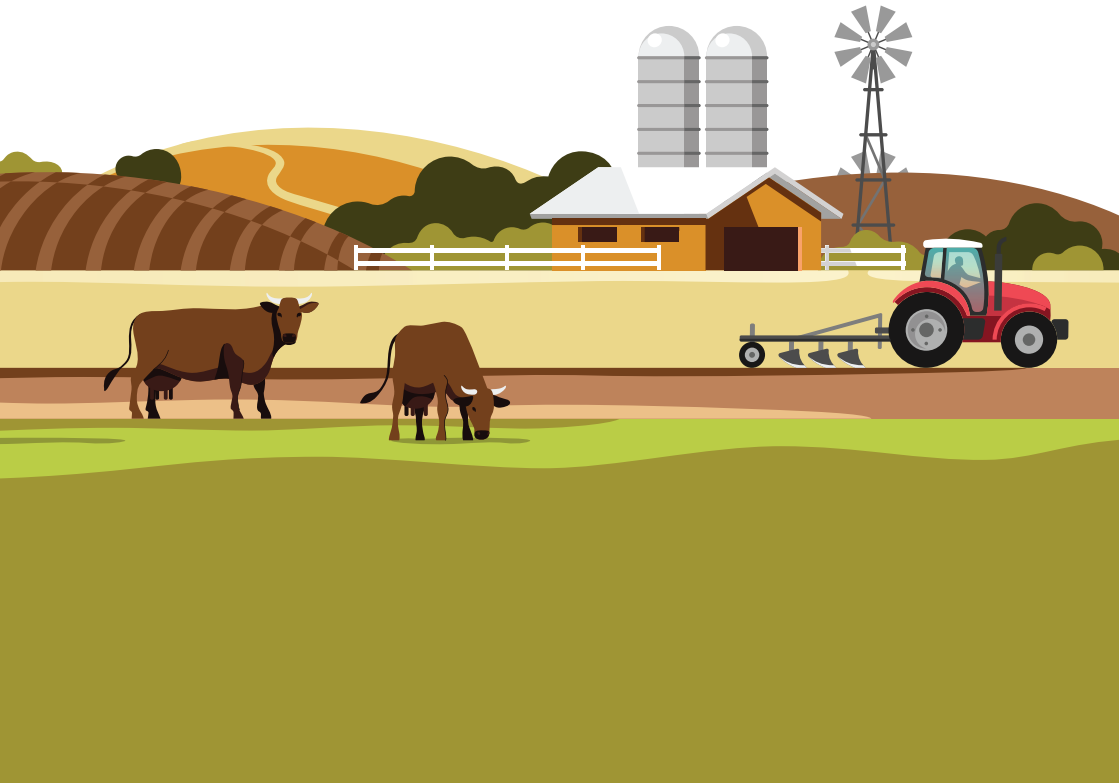


Fig. 4: Reduction of soil erosion through various erosion control variants. Variant 1: Control variant (no protective measure); Variant 2: Oat sowing in furrow; Variant 3: cross dams; Variant 4: cross dams with oat sowing.

Summary

Potato cultivation is susceptible to erosion. A cultivation technique with cross dams, optionally also with dam stabilization by use of grasses, offers good soil protection. By piling up the cross dams, small water retention areas are created in which surface water accumulates. The cross dams immediately limit surface runoff and keep the water on site and thus improve water storage and distribution and reduce soil erosion. For shaping the cross dams, a height of 20 cm and a distance between the dams of 90 cm are considered to be effective, with adaptions maybe needed to local conditions. In case of using grasses for further stabilization, a seed rate of 30-50 kg/ha is recommended.



Summary table

	Rating	Comments
Soil health overall	**	
Water budget	***	
Soil structure	*	
Erosivity	***	
Nutrient balance	*	
Soil life	*	
Practicability	*	
Economy	*	Additional costs for equipment; loss of valuable soil is prevented; cost-covering funding available in Austria

Consortium

Agrisat; Beijing Forestry University; Beijing Normal University; Centre for Agricultural Research; China Agricultural University; Czech Technical University in Prague; Lincoln University; New Bulgarian University; Northwest A&F University; Northwest UNIVERSITY; Pensoft Publishers; Spanish National Research Council; University of Lancaster; BOKU University, Vienna; University of Turin; Federal Agency for Water Management, Austria

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