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Assessing the efficacy of soil conservation measures in reducing soil loss and surface runoff

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Abstract: Historically, agricultural land in the Czech Republic was highly diverse, and fields were commonly bordered by wooded areas. However, consolidation occurred, particularly during the collectivisation phase, resulting in fields of several hundred hectares. In such a uniform landscape, the soil is threatened by water erosion. In addition, there are other negative impacts on the environment, such as a decline in biodiversity. One of the ways to enhance landscape management is to implement soil conservation measures, e.g. strip cropping, contour farming, and agroforestry systems. This article deals with the impact of soil conservation measures on erosion and runoff conditions. Forty-eight variants were proposed. In some variants broad-base terraces were considered. It was observed that the design of the measures resulted in a significant reduction in both soil loss and surface runoff. Among the evaluated measures, strip cropping proved to be highly effective in reducing sediment transport. The combination of strip cropping (winter barley and winter rapeseed), an agroforestry system featuring 6 m wide grass belts with a slight contour deviation, and two broad-base terraces mitigated erosion by approximately 84%. Nevertheless, this management practice introduces a significant spatial footprint of grass belts and unproductive land, around 27%.

Keywords: agroforestry system; broad-base terrace; contour farming; soil erosion; strip cropping; water erosion

In the past, Czech agricultural land was a mosaic of small, diverse fields with many trees alongside or inside the soil blocks. However, this changed significantly with the onset of the communist regime when agriculture was collectivised and intensified to enable the use of large-scale agricultural machinery. This resulted in a landscape consisting of fields of hundreds of hectares. A large number of trees disappeared, and their significance in the agricultural landscape was diminished (Houška 2020; Lojka 2022). Czech agriculture today can be characterised by large-scale industrial farming focused on high yields and economic profit. It regrettably has a lot of detrimental effects on the environment (Lojka 2022; Lojka & Chládová 2022; Weger et al. 2022).

Currently, there are ongoing initiatives to restore the environment to its natural state, lessen the impact of decades of poor management, and attempt

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to preserve our land and landscape for future generations (Horáková & Dumbrovský 2022). A uniform environment created by large soil blocks decreases biodiversity and makes farming more vulnerable to erosion and degradation (Lojka 2022). One of the ways to improve landscape management are agroforestry systems (Houška 2020). These are defined under the European Union's Common Agricultural Policy in Regulation 1305/2013 in Article 23 (European Union 2013) as land management systems where the same piece of land is simultaneously used for growing trees and for agricultural production (Lojka et al. 2020a).

The basic division of agroforestry systems in the Czech Republic follows the trend in other European countries and defines main categories (Dupraz et al. 2018; Lojka et al. 2020a): Silvoarable, Silvopasture, Agroforestry in permanent crops (orchards), Linear planting of trees on the edges of soil blocks, Urban/rural agroforestry. Soil that is exposed during the process of preparing land for crop planting is susceptible to water and wind erosion. Trees in agroforestry systems offer permanent vegetation cover, and the soil is bound together and shielded from erosion by the roots of trees (Dobie et al. 2022).

Trees grown in agroforestry systems have a productive function; they provide useful and profitable goods such as fruit, nuts, animal feed, structural and fuel wood. In addition, they also have important ecosystem and non-productive functions (Lojka et al. 2020a; Gassner & Dobie 2022). Among the most significant are their anti-erosive functions, more positive nutrient balance (agroforestry systems reduce the need for fertilisation), increased biodiversity, soil carbon sequestration, decreased water eutrophication, stabilisation of microclimate, and cooling of the landscape (Lojka et al. 2020b; Houška 2022; Weger et al. 2022).

Agroforestry systems can improve runoff and erosion conditions if they are properly designed and adhere to soil erosion protection regulations. This can be seen in organisational measures as well as in close relation to agrotechnical and biotechnical measures such as contour farming, strip cropping, broad-base terraces, and stabilisation of concentrated runoff paths (Podhrázská et al. 2024).

MATERIAL AND METHODS

Design of strip cropping. Strip cropping is a method that takes advantage of the protective effect of vegetation cover. It is a regular rotation of strips of protected crops (protected strips) with low erosion protection effect (potatoes, sugar beet, maize, sunflower, etc.) and strips of protective crops (protective strips) with high erosion protection effect (grassland, perennial forage crops, densely sown cereals, leguminous crops, etc.) that are established in the direction close to contour lines. The strips of crops with varying erosion protection effects must be alternated so that water flowing from the protected strip and from rainfall falling on the strip itself is caught and infiltrated into the soil (Dumbrovský et al. 2023). The width of protected and protective strips is equal and must not exceed 42 m (Dumbrovský et al. 2023; Podhrázská et al. 2024).

Design of the agroforestry system. In the Czech Republic, the minimum area for the establishment of the agroforestry system on agricultural land is 0.5 ha, which is used as arable land, grassland, and permanent grassland. The agroforestry system should be designed so that protective woody plant belts are at least 1 m and no more than 10 m wide. The spacing of these belts should be between 10 and 100 m. Moreover, there should be a total of 100 viable trees per hectare of land block. Fulfilment of these conditions is necessary to obtain the full amount of the subsidy for the establishment of such a system (Government Decree No. 140/2023 Coll.; Ministry of Agriculture of the Czech Republic 2024).

Calculation of soil loss. Soil loss can be calculated using the so-called Universal Soil Loss Equation (USLE) which was derived by Wischmeier and Smith (1978). The R factor value was considered constant for the study area and was determined based on the methodology of Podhrázská et al. (2024). In the area under consideration, the K factor was predominantly equal to 0.36, only in a small part near the western edge it was equal to 0.33. The LS factor was created using the Usle2D program (Routing Algorithm: Flux Decomposition; LS Algorithm: McCool), and it is different in the variants with broad-base terraces (slope breaks). Soil loss was determined for two variants of the C factor. The first assigns a specific value to grassed areas and to individual crops. While the second represents one single value for the entire area obtained by averaging the unique C factor values with respect to the area. In the variants with contour farming and strip cropping, a reduction of the P factor was considered to 0.6 and 0.3, respectively. In the other variants, the value of P factor was equal to one. P factor was determined based on the methodology of Podhrázská et al. (2024).

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Calculation of runoff. Runoff was calculated using the Soil Conservation Service Curve Number (SCS-CN) method. An average CN value was determined for each variant based on land use and crop. Based on the methodology of Podhrázská et al. (2024), the following values were considered: 76 (winter barley and winter rapeseed), 81 (silage maize), 61 (grassland, unproductive land, and broad-base terrace), and 50 (forest). In the case of contour farming and strip cropping variants, the CN values were reduced to 73 (winter barley and winter rapeseed) and 75 (silage maize), respectively. The hydrologic soil group was determined from the Valuated Soil-Ecological Unit for the entire plot as hydrologic soil group B, following the procedures outlined in the methodology of Podhrázská et al. (2024). For the design of the measures, antecedent moisture condition II (AMC II) was selected. The design rainfall value was obtained from the Czech Hydrometeorological Institute (CHMI) data as P = 88.5 mm.

The direct runoff volume can be calculated using the following equation (Podhrázská et al. 2024):

$$V = P_e \times A \times 1000 \tag{1}$$

where:
V – direct runoff volume (m^3);
P_e – accumulated precipitation excess (mm);
A – area of the contributing catchment area (km^2).

Basic relationship for determining accumulated precipitation excess is as follows (Podhrázská et al. 2024):

$$P_e = \frac{(P - I_a)^2}{(P - I_a + S)} \tag{2}$$

where:
P – accumulated precipitation depth (mm);
I_a – initial abstraction (mm);
S – potential maximum soil retention (mm).

$$I_a = r \times S \tag{3}$$

where:
r – ratio coefficient with a derived value of 0.2.

$$S = 25.4 \times \left(\frac{1000}{\text{CN}} - 10 \right) \tag{4}$$

where:
CN – curve number

RESULTS AND DISCUSSION

For the purposes of this article, a part of the soil block was chosen. It is in south-eastern part of the cadastral area of Modřec (part of the town of Polička), which can be found in the Pardubice Region in the Svitavy District. Several variants of agroforestry systems have been proposed on this part of the soil block. A few abbreviations are used in their designation (Figures 1–3 and Tables 1–3). AFS stands for agroforestry system, in some variants supplemented by an indication of the width of the grass belts with woody plants (1, 3, 6, and 10 m). The letter 'c' indicates the orientation of these belts with a slight deviation from contour lines, while the letter 's' denotes belts along the line of greatest slope. In some variants, two 6 m wide broad-base terraces (the letter 't') at the distance of 114 m, contour farming (CF) or strip cropping (SC) are considered.

In the variants with strip cropping, two crops are always considered. Hence, the designations are supplemented by the abbreviations of the crops (win-

Table 1. Description of individual variants – Part I

Variant designation	Description
V1: 0	without AFS or any soil conservation measures; see Figure 1
V2: AFS1 c – V5: AFS10 c	1 to 10 m wide belts every 24 m with a slight deviation from contour lines (c); V2 see Figure 1
V6: AFS1 s – V9: AFS10 s	1 to 10 m wide belts every 24 m along the line of greatest slope (s); V6 see Figure 1
V10: AFS6 c50 – V11: AFS6 c100	6 m wide belts every 50 m (V10) and 100 m (V11) with a slight deviation from contour lines; V10 see Figure 1
V12: AFS6 s50 – V13: AFS6 s100	6 m wide belts every 50 m (V12) and 100 m (V13) along the line of greatest slope; V12 see Figure 1

AFS – agroforestry system; c – orientation of belts with a slight deviation from contour lines; s – belts along the line of greatest slope

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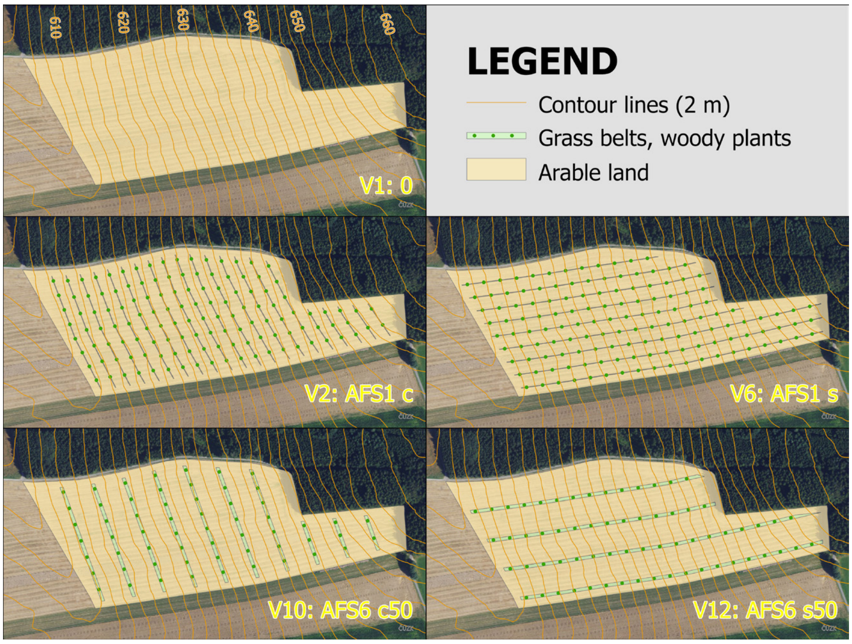

Figure 1. Visualisation of selected variants – Part I

AFS – agroforestry system; c – orientation of belts with a slight deviation from contour lines; s – belts along the line of greatest slope

Table 2. Description of individual variants – Part II

Variant designation	Description
V14: aAFS c	3 and 10 m wide belts every 24 and 60 m with a slight deviation from contour lines (c); see Figure 2
V15: bAFS c – V16: bAFS s	20 m wide belt with a slight deviation from contour lines (V15) or along the line of greatest slope (s) (V16); see Figure 2
V17: dAFS c – V18: dAFS s	two 3 m wide belts at the distance of 10 m with a slight deviation from contour lines (V17) or along the line of greatest slope (V18); see Figure 2

AFS – agroforestry system; c – orientation of belts with a slight deviation from contour lines; s – belts along the line of greatest slope; a, b, d – different variants of agroforestry systems

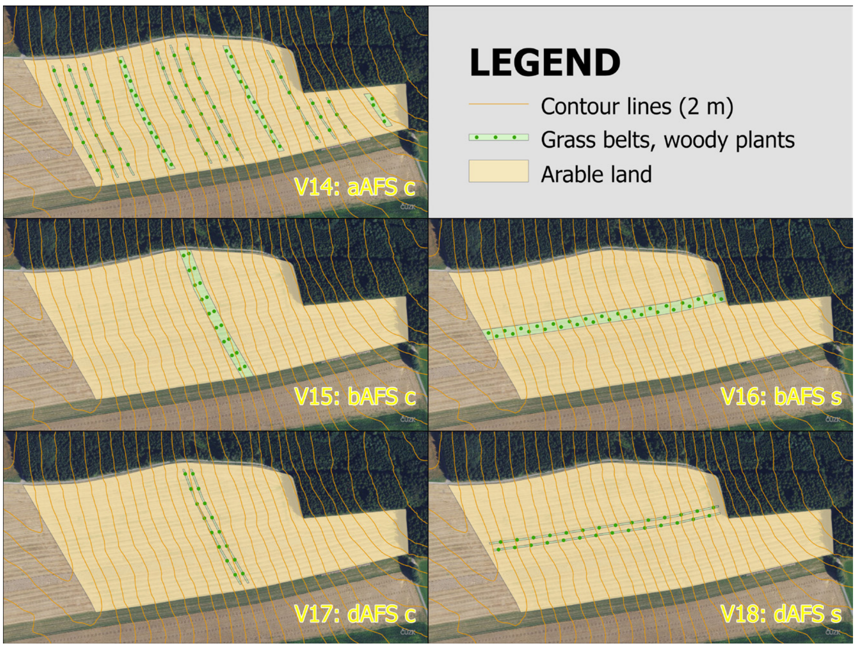

Figure 2. Visualisation of selected variants – Part II

AFS – agroforestry system; c – orientation of belts with a slight deviation from contour lines; s – belts along the line of greatest slope; a, b, d – different variants of agroforestry systems

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Table 3. Description of individual variants – Part III

Variant designation	Description
V19: t c	without AFS, two 6 m wide broad-base terraces (t); see Figure 3
V20: AFS6 t c	6 m wide belts with a slight deviation from contour lines (c), two broad-base terraces; see Figure 3
V21: AFS6 t c50 – V22: AFS6 t c100	6 m wide belts every 50 m (V21) and 100 m (V22) with a slight deviation from contour lines, two broad-base terraces; V21 see Figure 3
V23: bAFS t c	20 m wide belts with a slight deviation from contour lines, two broad-base terraces; see Figure 3
V24: dAFS t c	two 3 m wide belts at the distance of 10 m with a slight deviation from contour lines below each broad-base terrace; see Figure 3
V25: CF	without AFS, like V0 with the difference of considering contour farming
V26: AFS1 c CF – V33: AFS6 t c CF	the same variants as V2–V5, V10–V11, and V19–V20, except that contour farming is considered
V34: AFS1 c SC BR – V45: AFS10 c SC RM	1 to 10 m belts wide with a slight deviation from contour lines, strip cropping; V34–V36 see Figure 3
V46: AFS6 t c SC BR – V48: AFS6 t c SC RM	6 m wide belts with a slight deviation from contour lines, two broad-base terraces, strip cropping; see Figure 3

AFS – agroforestry system; CF – contour farming; SC – strip cropping; BR – winter barley and winter rapeseed; RM – winter rapeseed and silage maize; c – orientation of belts with a slight deviation from contour lines; t – broad-base terraces; b, d – different variants of agroforestry systems

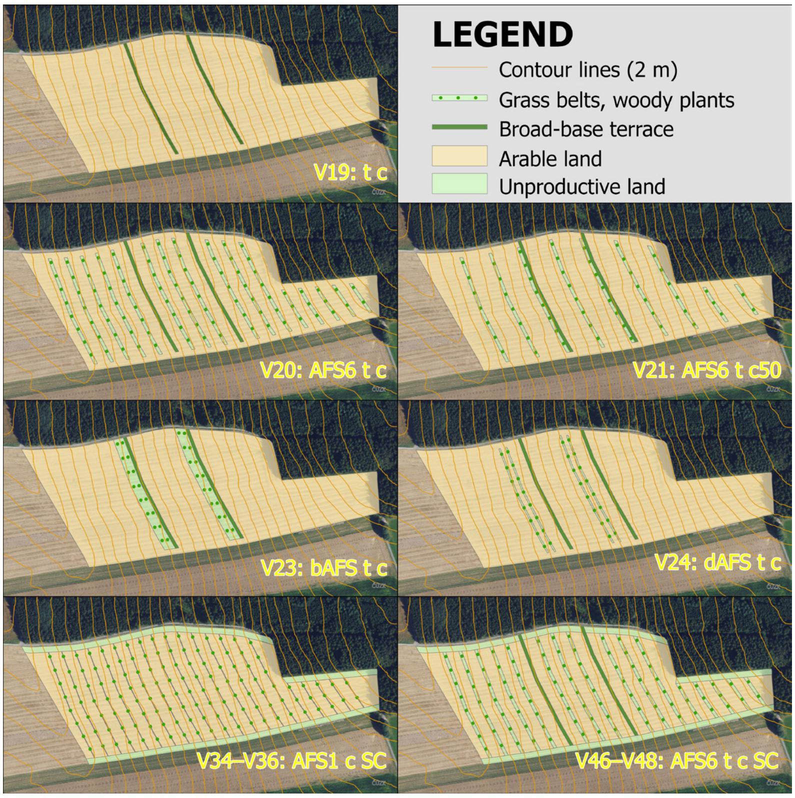

Figure 3. Visualisation of selected variants – Part III
AFS – agroforestry system; c – orientation of belts with a slight deviation from contour lines; s – belts along the line of greatest slope; t – broad-base terraces; SC – strip cropping; b, d – different variants of agroforestry systems

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ter barley and winter rapeseed – BR; winter barley and silage maize – BM; winter rapeseed and silage maize – RM).

In Figure 4 we can see for each variant the percentage of grass land and unproductive land (in the variants with strip cropping). We can also observe erosion reduction compared to variant 0. Additionally, two thresholds have been set: the first for erosion reduction to see which variants will reduce erosion by at least half, and the second for grassed areas (grass belts and unproductive land), which shows a maximum of one-fifth of the total area.

Figure 4 shows that the variant with the highest erosion reduction is AFS6 t c SC BR (V46), i.e. 6 m wide belts with a slight deviation from contour lines, two broad-base terraces, strip cropping of winter barley and winter rapeseed. In the case of this variant, the reduction is approximately 84%. But on the other hand, there is a large percentage of grass belts and unproductive land, namely, circa 27%. According to the methodology of Dumbrovský et al. (2023), it is permitted to allocate up to 30% of the arable land area with strip cropping for grassed lands and unproductive land.

It was found that if agroforestry systems are supplemented by additional soil conservation measures, erosion reduction is much higher. For instance, in the case of variant AFS6 c (V4), the reduction is roughly 16%. However, the addition of two broad-base terraces results in a reduction of almost 47% (V20) or the consideration of contour farming results in a reduction of about 49% (V28). It is very positive that the reduction can be up to approximately 68% in the case of the variant with broad-base terraces as well as with contour farming (V33). As can be evident from the above mentioned, it should be emphasised that the agroforestry systems with contour farming are suitable with regard to higher erosion reduction.

Regarding the percentage of grassed belts with woody plants and unproductive land (in the variants with strip cropping), the optimal variants can be above-mentioned V33 and V34 (AFS1c SC BR), i.e. 1 m wide belts with a slight deviation from contour lines, strip cropping of winter barley and winter rapeseed. These two variants result in a relatively high reduction (approximately 68% and 71%, respectively), while still leaving high percentages of arable land (roughly 14% and 16%, respectively).

Table 4 provides an overview of the soil loss and direct runoff volume for the individual variants. Table 5 is similar; the difference is that it contains variants with strip cropping. Both tables use the above-described designation and abbreviations. Additionally, in the case of soil loss as well as direct runoff volume, 'B' indicates winter barley, 'R' winter rapeseed, and 'M' silage maize.

It is evident from Tables 4 and 5 that the most effective variant for erosion reduction (for the lowest soil loss) is AFS6 t c SC BR (V46), i.e. 6 m wide belts with a slight deviation from contour lines, strip cropping of winter barley and winter rapeseed, two broad-base terraces. The most effective option for reducing runoff

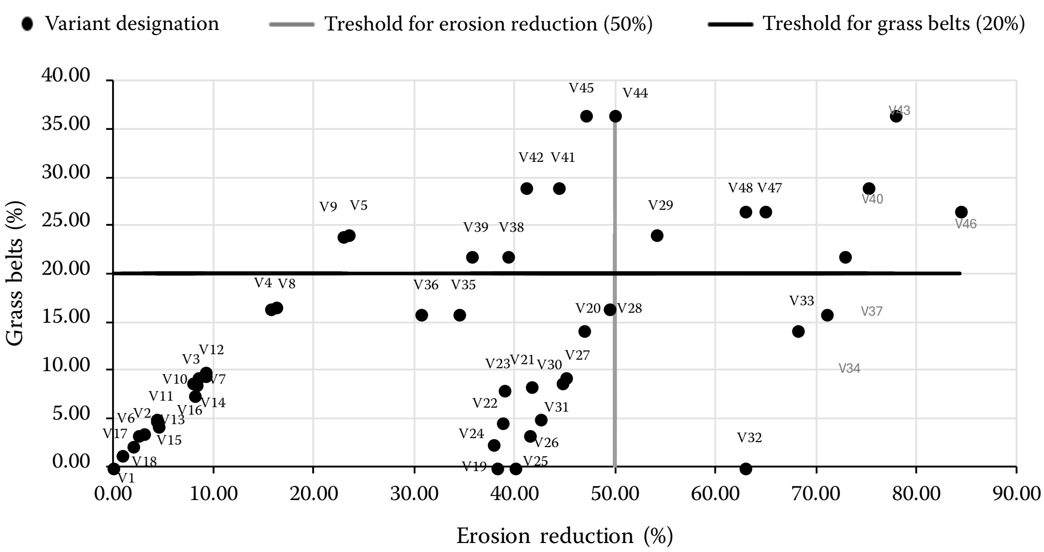

Figure 4. Comparison of variants: erosion reduction and the share of grass belts and unproductive land
For variant designation see Tables 4 and 5

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Table 4. Soil loss and direct runoff volume for the individual variants

Variant designation	Soil loss (t/ha/year)			Direct runoff volume (10^3 m^3)	
	B	R	M	B, R	M
V1: 0	9.72	12.58	41.18	4.17	5.05
V2: AFS1 c	9.49	12.27	40.15	4.09	4.93
V3: AFS3 c	8.91	11.53	37.66	3.94	4.71
V4: AFS6 c	8.22	10.63	34.67	3.76	4.46
V5: AFS10 c	7.47	9.65	31.43	3.58	4.20
V6: AFS1 s	9.43	12.20	39.90	4.08	4.92
V7: AFS3 s	8.85	11.45	37.41	3.93	4.70
V8: AFS6 s	8.16	10.55	34.42	3.76	4.45
V9: AFS10 s	7.53	9.73	31.68	3.59	4.21
V10: AFS6 c50	8.85	11.45	37.41	3.95	4.73
V11: AFS6 c100	9.31	12.05	39.40	4.04	4.86
V12: AFS6 s50	8.97	11.60	37.91	3.92	4.69
V13: AFS6 s100	9.31	12.05	39.40	4.05	4.87
V14: aAFS c	8.97	11.60	37.91	3.95	4.74
V15: bAFS c	9.37	12.12	39.65	4.06	4.89
V16: bAFS s	9.08	11.75	38.41	3.98	4.78
V17: dAFS c	9.66	12.50	40.90	4.14	5.01
V18: dAFS s	9.60	12.42	40.65	4.11	4.97
V19: t c	6.02	7.79	25.48	4.11	4.96
V20: AFS6 t c	5.18	6.70	21.86	3.76	4.46
V21: AFS6 t c50	5.68	7.35	24.04	3.90	4.66
V22: AFS6 t c100	5.96	7.71	25.22	3.99	4.79
V23: bAFS t c	5.94	7.69	25.15	3.91	4.67
V24: dAFS t c	6.05	7.82	25.60	4.05	4.88
V25: CF	5.83	7.55	24.71	3.68	4.00
V26: AFS1 c CF	5.69	7.36	24.09	3.62	3.93
V27: AFS3 c CF	5.35	6.92	22.59	3.51	3.79
V28: AFS6 c CF	4.93	6.38	20.80	3.38	3.63
V29: AFS10 c CF	4.48	5.79	18.86	3.24	3.47
V30: AFS6 c50 CF	5.38	6.96	22.74	3.52	3.80
V31: AFS6 c100 CF	5.59	7.23	23.64	3.58	3.89
V32: t c CF	3.61	4.67	15.29	3.63	3.95
V33: AFS6 t c CF	3.11	4.02	13.12	3.37	3.63

AFS – agroforestry system; CF – contour farming; B – winter barley; R – winter rapeseed; M – silage maize; c – orientation of belts with a slight deviation from contour lines; s – belts along the line of greatest slope; t – broad-base terraces; a, b, d – different variants of agroforestry systems (Figure 2 and Table 2).

appears to be AFS10 c SC BR (V43), which is similar to the previous variant, but differs in the width of the belts (10 m) and the absence of broad-base terraces.

Furthermore, the dependencies of the width of belts on soil loss (Figures 5 and 6), erosion reduction (Figures 7 and 8), and direct runoff volume (Figures 9 and 10) were investigated. Widths of belts were considered in two ways: either the single width of the individual ones (Figures 5, 7, and 9) or their total width (Figures 6, 8, and 10). Comparable vari-

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Table 5. Soil loss and direct runoff volume for the variants with strip cropping

Variant designation	Soil loss (t/ha/year)	Direct runoff volume (10^3 m^3)
V34: AFS1 c SC BR	2.83	3.37
V35: AFS1 c SC BM	6.38	3.82
V36: AFS1 c SC RM	6.74	4.15
V37: AFS3 c SC BR	2.64	4.11
V38: AFS3 c SC BM	5.92	3.59
V39: AFS3 c SC RM	6.26	3.97
V40: AFS6 c SC BR	2.41	3.94
V41: AFS6 c SC BM	5.42	3.43
V42: AFS6 c SC RM	5.73	3.77
V43: AFS10 c SC BR	2.16	3.74
V44: AFS10 c SC BM	4.88	3.26
V45: AFS10 c SC RM	5.16	3.56
V46: AFS6 t c SC BR	1.52	3.54
V47: AFS6 t c SC BM	3.42	3.63
V48: AFS6 t c SC RM	3.61	3.94

AFS – agroforestry system; SC – strip cropping; BR – winter barley and winter rapeseed; RM – winter rapeseed and silage maize; BM – winter barley and silage maize; c – orientation of belts with a slight deviation from contour lines; t – broad-base terraces;

ants were selected, namely variants with 1 m, 3 m, 6 m, and 6 m wide belts with a slight deviation from contour lines. These differ in the method of cultivation, either without (V2–V5) or with contour farming (V26–V29) or with strip cropping (V34, V37, V40, and V43). A single crop was considered, namely winter barley, supplemented by winter rapeseed in variants with strip cropping. It is evident that variants of agroforestry systems with the last-mentioned measure are the most advantageous in all aspects. In addition, the trendline equations (y) and the coefficients of determination (R^2) are visible in these figures. All values of these coefficients are approximately equal to 99%. This suggests that the results are accurate. Thus, the figures can show with a fair degree of confidence what values of soil loss, erosion reduction or direct runoff volume can be expected when choosing any width of belts.

Several comparable studies have also been conducted. As for strip cropping, Karásek et al. (2024) studied the importance of this measure as a tool for reducing erosion and increasing the aesthetic and recreational value of the landscape. In 2023, portable infiltrometers were tested in the municipality of Bošovice. Experiments showed that strip cropping has a very good ability to retain rainwater, which in some cases was even higher than in permanent grasslands. Niacsu et al. (2022) analysed soil degradation in the territory of eastern Romania. Accurate mapping of gullies and landslides was carried out using a Global Positioning System (GPS) and a Trimble total station with a Real-Time Kinematic (RTK) measurement system. The Romanian version of USLE was used to calculate soil losses. 72.7% of agricultural land exceeded the permissible erosion limit. For this reason, among other things, they proposed a change to strip cropping throughout the territory.

Regarding contour farming, Marcinkowski (2025) evaluated soil erosion mitigation strategies in Poland's agricultural landscapes using the RUSLE model by simulating changes in C factor and P factor. The scenarios included specific conservation practices, namely contour farming, reduced tillage, and cover crops. Combined measures could reduce total erosion

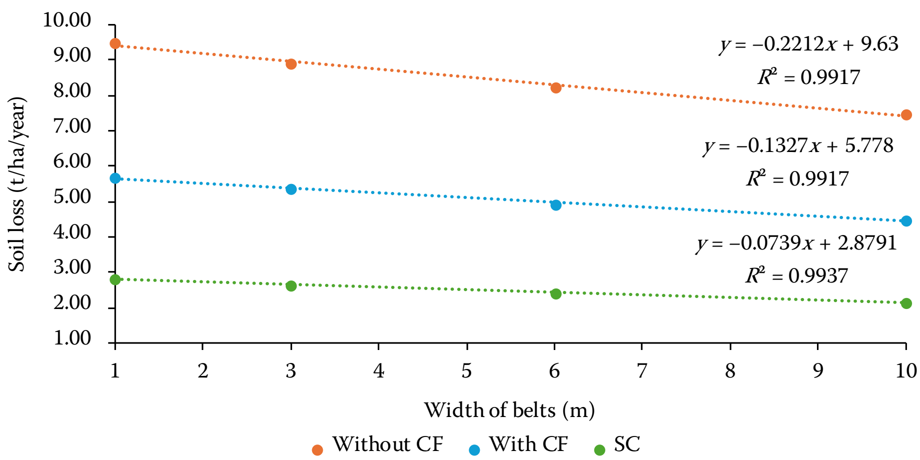

Figure 5. Dependence of width of belts on soil loss CF – contour farming; SC – strip cropping

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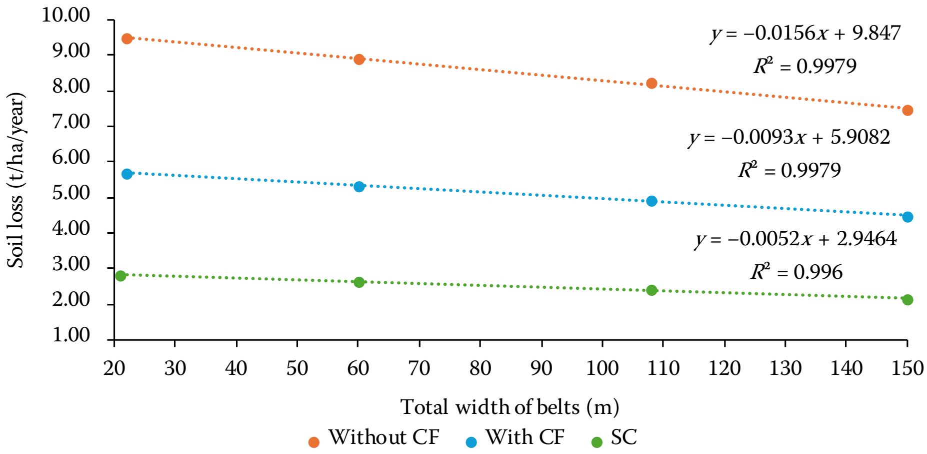

Figure 6. Dependence of total width of belts on soil loss CF – contour farming; SC – strip cropping

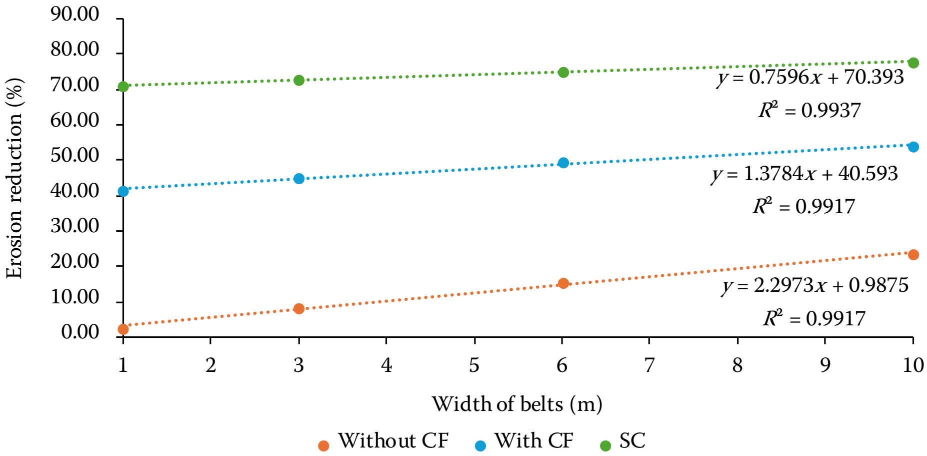

Figure 7. Dependence of width of belts on erosion reduction
CF – contour farming; SC – strip cropping

by 47%. Saggau et al. (2023) conducted their research in northern Germany using the EROSION 3D model. They concluded that contour farming is one of the most effective measures for reducing surface runoff and water erosion, especially in critical locations such as tramlines. In contrast, rows oriented in the direction of the greatest slope act as channels that accelerate water flow and sediment transport.

In the case of agroforestry systems, Jinger et al. (2022) carried out their study during the 4-year period (2017–2020) on three systems: sole crop cultivation (cowpea and castor), agroforestry (sapota, cowpea,

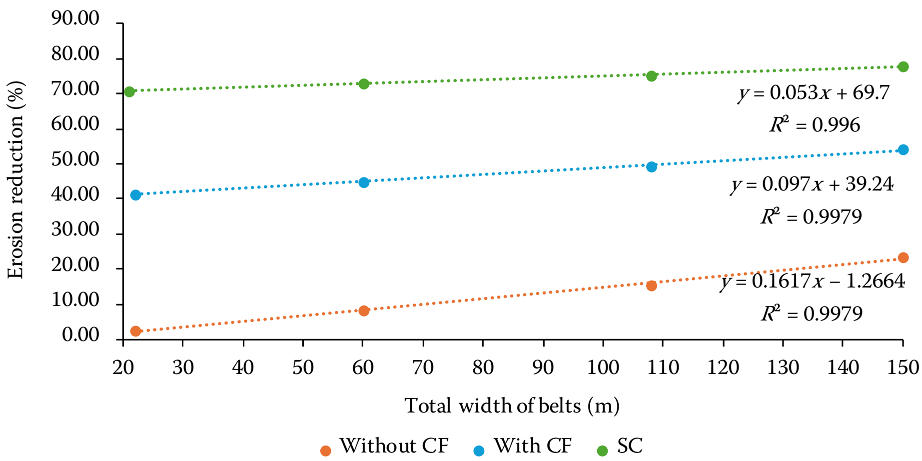

Figure 8. Dependence of total width of belts on erosion reduction
CF – contour farming; SC – strip cropping

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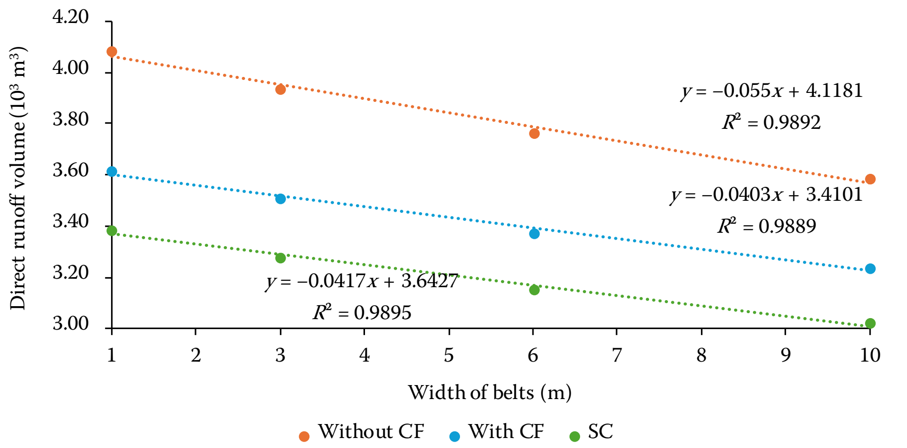

Figure 9. Dependence of width of belts on direct runoff volume
CF – contour farming; SC – strip cropping

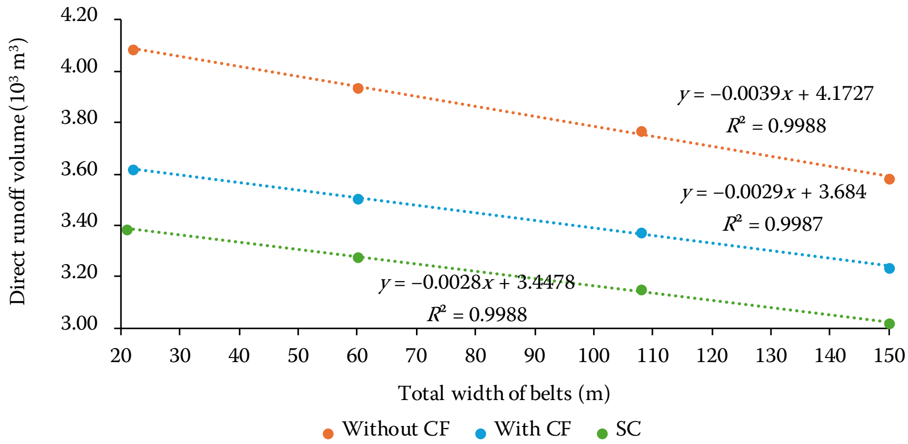

Figure 10. Dependence of total width of belts on direct runoff volume
CF – contour farming; SC – strip cropping

and castor), and sole sapota plantation. The purpose of the study was to assess their impact on soil erosion, runoff, system productivity, profitability, energetics, and carbon sequestration. The findings showed that, in comparison to the sole crop cultivation, agroforestry decreased the total soil loss and runoff by 37.7% and 19.1%, respectively.

Naharuddin et al. (2018) examined the rate of surface runoff and erosion from agroforestry land use types in Central Sulawesi, Indonesia. The results indicated that the non-agroforestry land use type (pure cocoa) had the largest surface runoff (72.67 L/ha), while the agroforestry systems had a positive effect on reducing runoff, namely the system based on teak tree and cocoa (59.82 L/ha) and the system based on candlenut tree and cocoa (45.98 L/ha). In terms of erosion rates, the non-agroforestry land use type (pure cocoa) had the highest erosion (4.13 kg/ha). This was followed by the agroforestry system based on teak tree and cocoa (2.75 kg/ha) and the system based on candlenut tree and cocoa (1.28 kg/ha).

Broad-base terraces, as presented in this article (with their impact on water erosion and runoff conditions), are not implemented as frequently as they are in the Czech Republic. Therefore, the only available study so far is Dumbrovský et al. (2014). Each variant of broad-base terrace was evaluated based on its advantages, such as lessening the impact of erosion, protection of the watercourse against sedimentation, and minimising acquisition, maintenance costs and property damage to local residents. The outcomes of individual variants were compared with variant V0, which represented the current state prior to the design of the measures.

From all the studies mentioned above, it is evident that the design of soil conservation measures has a positive effect on reducing soil loss and surface runoff.

CONCLUSION

This article examined the effect of agroforestry systems and other soil conservation measures on the rate

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of erosion and surface runoff. Both soil loss and the volume of surface runoff were significantly reduced through the design of the measures. As demonstrated, agroforestry systems are most effective when combined with additional measures, such as broad-based terraces, contour farming or strip cropping.

It should be emphasised that the presented findings and results are based on model simulations applied to a specific study area and are inherently linked to the underlying model assumptions. These results provide valid and valuable insights for analytically similar areas that share comparable morphological characteristics, particularly regarding slope gradient, slope length, and soil types.

In addition to protecting soils, agroforestry systems that are properly designed and implemented, together with conservation measures in the process of land consolidation, would offer benefits, particularly in the area of landscape water management. The expense to the state of removing sediments from reservoirs, streams, or other technical features, such as drainage ditches of transportation structures would be decreased by lowering soil loss and sediment transport. Damage in the built-up areas would be lessened as a result of the increased retention capacity. Especially in concentrated runoff channels and unproductive areas, there would be a rise in the diversity of the agricultural landscape.

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