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Assessing the Impacts of Tillage and Mulch on Soil Erosion and Corn Yield

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Abstract: Conventional tillage practices have been regarded as the major reason for the loss of fertile topsoil in the sloping agricultural lands of the middle hills of Nepal. Reports on the effects of no-till and mulch on soil and corn yield in these regions are scarce, although these farming practices have been recommended to reduce soil erosion and increase crop yields. To assess the impacts of tillage (with +T, without −T) and mulch (with +M, without −M) on soil and soil nutrient losses, and corn yield, we conducted an experiment with five treatments: −T+M, −T−M, +T+M, +T−M, and bare fallow (BF), replicated four times each in an unbalanced complete random block design in Salyan district of Nepal. The results showed the presence of corn and no-till significantly lowered the soil losses. Losses of soil organic matter (SOM) and total nitrogen were also significantly reduced by the presence of corn, no-till, and mulch. However, no effects of mulch on soil losses, and no effects of tillage, mulch and corn on soil phosphorus losses were observed. Soil loss was found to be significantly and positively correlated with total seasonal rainfall, monsoon being the most severe season for soil erosion. While no-till and mulch did not affect corn height, cob height, and stover yield, no-till significantly increased the corn yield by 0.52 Mg ha^{-1} compared to conventional till. We confirm the synergistic interaction of mulch with tillage to reduce the losses of SOM and total nitrogen, and effectiveness of no-till to reduce the soil losses and increase the corn yield in the middle hills of Nepal. As this study is based on the results of two year's data, long-term studies are required to identify the long-term impacts of no-till and mulch on soil losses and corn yield across the country.

Keywords: soil loss; soil organic matter; nutrient losses; sloping land

1. Introduction

Accelerated soil erosion has been an enduring problem since agriculture began [1]. Out of ten major soil threats of the world, soil erosion is considered as the main one by the Food and Agriculture Organisation of the United Nations and Intergovernmental Technical Panel on Soils [2]. Soil erosion is a significant feature in several regions of Nepal, given the hilly topography and rugged mountains, concentrated rainfall events in the monsoon season, and increased human influence in the removal of natural vegetation and soil disturbance [3]. Several research reports suggest that a significant amount of soil loss occurs in Nepal; from as low as zero in the lowlands to up to 105 Mg ha^{-1} year^{-1} in the uplands, and sometimes reaching as high as 420 Mg ha^{-1} year^{-1} in the shrublands [4]. High erosion rates in the shrublands are due to the steep slopes, overgrazing and lack of vegetation, and formation of gullies [4]. As an example, about 21,000 m^3, equivalent to 64 Mg ha^{-1}, is eroded annually from the Khajuri catchment of Nepal. Similarly, soil loss rates of 11.17 and 10.74 Mg ha^{-1} year^{-1} have been observed in the Aringale Khola [5] and Sarada river basin [6] of Siwalik Hills of Nepal, respectively.

Corn is the second most important staple crop of Nepal after rice, in terms of area of cultivation. The total area, production, and yield of improved corn in Nepal have been reported as 891,583 ha, 2.23 million Mg and 2.5 Mg ha^{-1}, respectively [7]. More than 70% of the corn growing area is the middle hills, which also accounts for 71% of the total corn produced in the country [7]. However, this region is extremely vulnerable to soil erosion under traditional annual cropping systems and produces greater soil and soil nutrient losses as a consequence. Data on soil erosion in corn production in Nepal indicates that up to 16.6 and 11.1 Mg ha^{-1} of soil may be lost annually in conventional and reduced till systems [1]. Total annual edible cereal grain production in the country is 5.35 million Mg whereas the requirement is 5.42 million Mg which leaves a deficit of 70 thousand Mg of grain [7]. Increasing corn production can fill this void if soil loss in the middle hills is kept under control.

There is a growing literature that conventional till is the major reason for accelerated soil erosion [8,9]. Frequent hoeing and ploughing have brought about soil loss and soil nutrient decline in farmlands [10]. Ploughing lands immediately after the harvest and leaving them as such without vegetative cover is more common in Nepal [11] which further aggravates soil loss. Reduced till/no-till instead has been effective in reducing the soil and nutrient losses such as organic carbon, nitrogen, phosphorus, and potassium [1]. At worldwide scale, mulching has been long known to reduce soil and water losses in the agricultural lands, rangelands, and fire-affected areas [12], however, little research has been conducted in Nepal to assess its efficacy. The beneficial effects of mulching also come through reduction of overland flow which ultimately reduces the sediment and nutrient load in the runoff water [12].

Conventional till in corn-based upland cropping system encourages extensive soil tillage followed by removal of crop residues from the field, and the soil surface is repeatedly ploughed after farmyard manure application [1]. The soil is left bare until crop growth provides some vegetative cover. This practice increases the loss of topsoil and soil nutrients. No-till and mulch are recommended as prospective researchable options to reduce soil erosion and increase corn yield in Nepal [10], however, very few research has been conducted in such areas. When it comes to soil erosion, the monsoon season is most vulnerable to soil loss as 80% of the rainfall occurs during this season [13]. The aims of the research reported here were to:

- Evaluate the impacts of no-till, mulch, and the presence of corn on soil erosion across diverse seasons during two consecutive years, and
- Determine the interactive effects of no-till and mulch on corn yield during two consecutive years.

2. Materials and Methods

2.1. Study Area

The present research was carried out in the research fields of Ginger Research Program located in the Kapurkot Rural Municipality of Salyan district, Nepal (Figure 1). The Program is home to varietal research and development trials for ginger and turmeric. The research area lies between 28°14′ North latitude and 32°24′ East longitude at an elevation of 1480 m above sea level. The climate is subtropical, and the major crops grown in the region are corn, millet, potato, and ginger. Maximum and minimum temperatures of 38 and 7 °C, respectively, and mean annual rainfall of 1011 mm were recorded. Ministry of Agricultural Development [14] reports indicate that moderate to well-drained loamy skeletal soils of nearly neutral pH (6.6) dominate the study area. Soil profiles are up to 1 m deep, and the soils are commonly low in SOM content (1–2.5%). The terrain is undulating with a slope of around 20–30°.

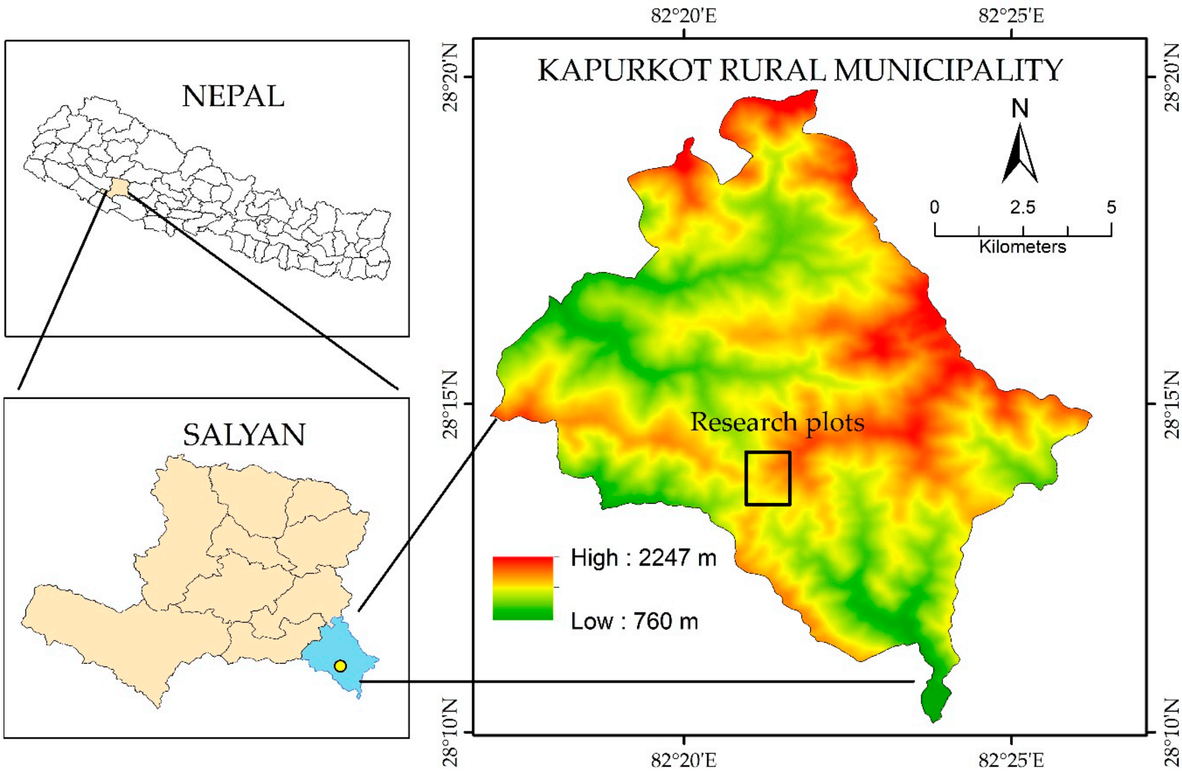

Figure 1. Location of the study area with the digital elevation model (DEM).

2.2. Plot Size and Experimental Design

Replicated four times each, five treatments: −T+M, −T−M, +T+M, +T−M (T = Tillage and M = Mulch) and bare fallow (BF) each with 3 × 3.75 m plot size, were established in an unbalanced complete randomised block design (Figure 2). Corn was grown in all the treatments except in the BF which did not receive any tillage or mulching practices, and it was kept bare of vegetation by repeated hand weeding while minimising disturbing the soils in the plots. Trenches of 50–60 cm depth were dug at the lower end of the experimental plots and covered by polythene sheets to harvest the surface runoff and sediment (Figure 3).

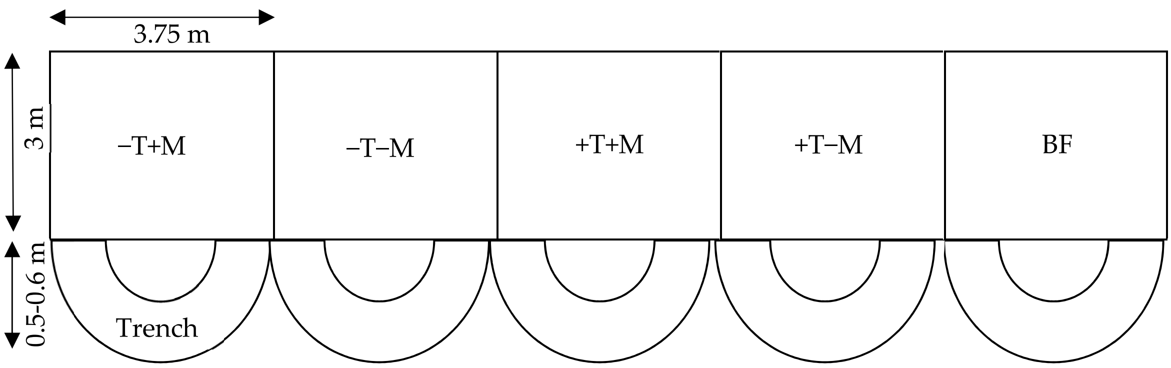

Figure 2. Experimental setup showing one of the replications with treatment combinations (T = Tillage, M = Mulch, and BF = Bare fallow).

2.3. Rainfall Measurements

The months of June, July, August, and September are considered as the monsoon season when around 80% of the annual rainfall occurs [13], however June and July are the months with the most intense and heavy rainfall events. Thus, we considered July and August months as the monsoon season, the period from June to July as early monsoon, and the period from August to October as late monsoon season to analyse how rainfall amounts in these seasons affect soil and nutrient losses.

2.4. Measurements of Surface Runoff and Laboratory Analysis

Harvesting of the surface runoff was done for early monsoon, monsoon, and late monsoon seasons with the collection being more frequent during intense rains to avoid overflow of the soil sediments out of the trenches. As we conducted this research to assess the impacts of soil erosion on corn performance while the crops are intact, the period from November to May was not included although there was some rainfall. Vegetal residues present in the collected soil sediments were removed. The sediments were air-dried, then homogenized, sieved and grinded. Soil sediments were then analysed for total nitrogen by Kjeldahl [15], available phosphorus (P_2O_5) by Olsen [16] and SOM by chromic acid titration [17] methods.

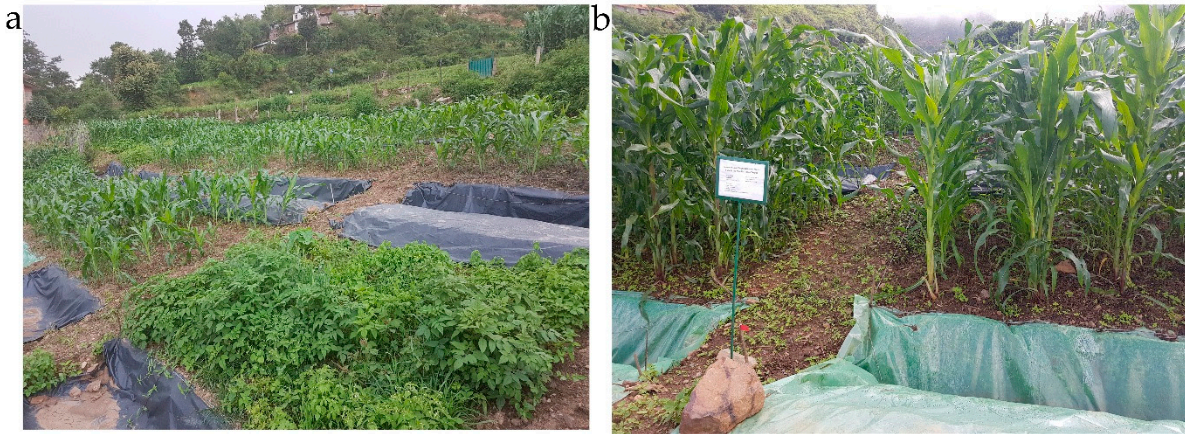

Figure 3. Photos showing the experimental setup (**a**), and trenches (50–60 cm) at the lower end of the plots to harvest the surface runoff (**b**).

2.5. Agronomic Practices

Field preparation was done right after the harvesting of ginger from the experimental plots. The tillage treatment was applied by ploughing and turning the soils upside down with a spade up to a depth of 25 cm. Harvested mustard stems grown nearby the research area were collected, chopped, and applied at the rate of 3 Mg fresh matter ha^{-1} in the mulched plots. Plots under conventional till, as generally done by local farmers, were tilled twice. In all the plots except the BF, seed-sowing was done by the corn planter developed by the Nepal Agricultural Research Council. Manakamana-3, a popular corn variety in the Nepalese hills for human consumption, was sown with a spacing of 75 cm between rows, and 25 cm between plants in the rows. Corn planting was done in June, and the trials were run for 21 weeks for both years 2017 and 2018. The recommended dose of chemical fertiliser 120:60:40 kg NPK/ha was applied for all the treatments except the BF in both years. Weeding/hoeing was done manually for all the plots; the first and second weeding were done after 30 and 60 days after sowing, ensuring all plots had similarly low weed burdens. Harvesting was done manually in both years, and no crops were grown from November to May.

2.6. Measurement of Crop Parameters

As described in the field instruction manual of the National Maize Research Program [18], plant growth measurements (plant and cob height, and grain and stover yield) were recorded. Plant height was measured as a distance from the base to the top of the plant where tassel starts branching whereas the distance from the base of the plant to the uppermost ear-bearing node was taken as the cob height.

These crop parameters were measured by taking 10 random plants from the middle four rows of each treatment.

2.7. Statistical Analyses

Statistical analyses were carried out using the R version 3.5.3 [19] and analysis of variance (ANOVA) was used to evaluate the effect of treatments. A five-way ANOVA was used to assess the effect of tillage, mulch, and corn presence across three consecutive seasons in two consecutive years on soil parameters. A three-way ANOVA was used to assess the effect of tillage and mulch across two consecutive years on crop parameters. ANOVA tables are included in the Supplementary Materials (Tables S1 and S2). Assumptions of homogenous variances and normal distributions were confirmed using residual versus fitted plots and quantile–quantile plots, respectively. Square root (available phosphorus) or log transformations (all other variables) were carried out to stabilise the residuals. Data were tested for significant differences at $p = 0.05$ and significantly different means were separated using 95% confidence limits (standard error × 1.96) [20]. Linear regression was used to evaluate the relationship between soil loss and seasonal rainfall for the soil management treatments (mulch, tillage, and bare fallow). The cor() function was used to calculate p values and correlation coefficients (R^2).

3. Results

3.1. Rainfall at Experimental Site

The amount of rainfall received in different months is presented in Figure 4. The total rainfall received in the years 2017 and 2018 were 1309 and 1555 mm, respectively; quite higher compared to the long term average rainfall (1011 mm) [21]. The amount of rainfall received at the experimental site during the early monsoon, monsoon, and late monsoon seasons were 243, 817, and 72 mm, respectively in 2017 and 183, 1036, and 168 mm, respectively in 2018.

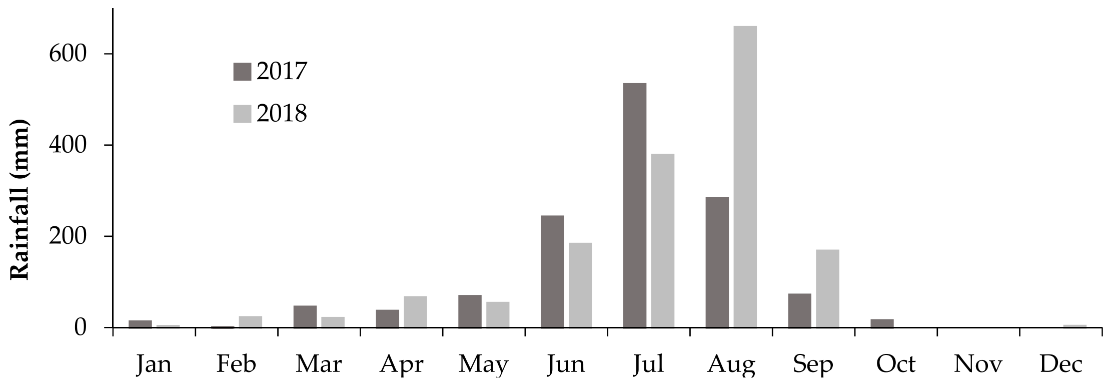

Figure 4. Monthly rainfalls at the experimental site (2017–2018).

3.2. Soil Losses

Soil loss was significantly affected by tillage ($p = 0.020$), no-till reducing the soil losses by 0.42 Mg ha^{-1} compared to conventional till (Figure 5). Interaction effects of corn, season, and year ($p = 0.027$) were also observed. The loss was approximately halved by the presence of corn ($p < 0.001$), i.e., by 1.77 Mg ha^{-1} as compared to the no-corn plots. Soil loss was the highest in the monsoon season (4.05 Mg ha^{-1}) and the lowest in the early monsoon season (1.06 Mg ha^{-1}) for both the years, and the year 2018 lost 2.2 Mg ha^{-1} of soil, 0.14 Mg ha^{-1} more soils than in 2017. The cumulative soil loss throughout the two-year trial (Figure S1) was greatest in the BF treatment (20.6 Mg ha^{-1}), followed by +T−M (15.2 Mg ha^{-1}), with −T+M, −T−M and +T+M being the lowest (mean = 9.5 Mg ha^{-1}).

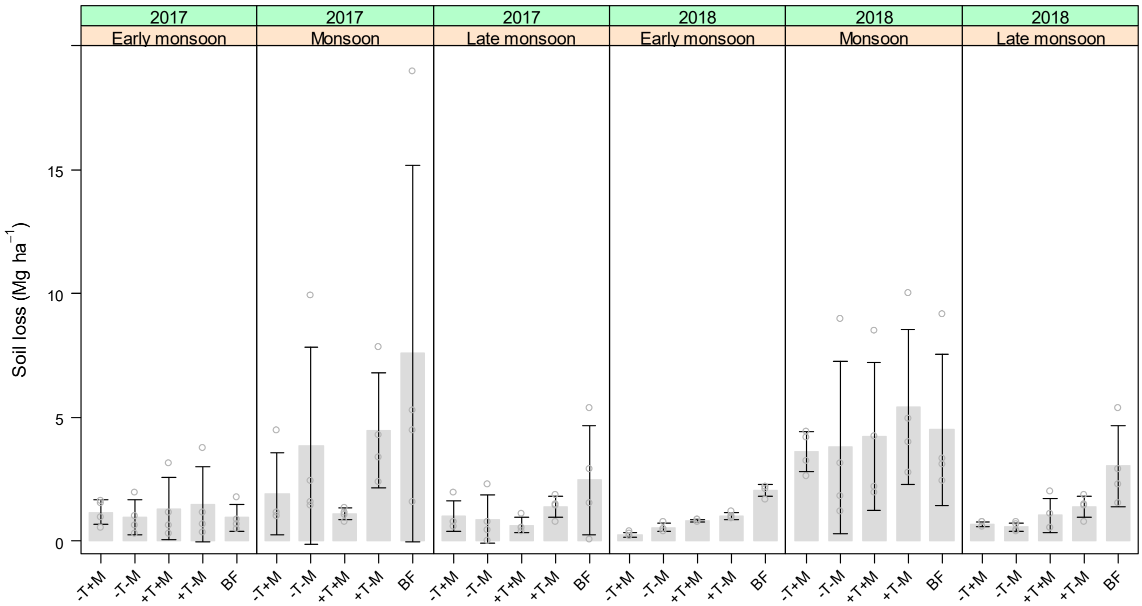

Figure 5. Effect of tillage (−T or +T), mulch (−M or +M), and corn (presence or absence) on soil loss at three sampling times in 2017 and 2018. Means (grey columns) and 95% confidence intervals (error bars) shown with raw data (grey circles).

Linear regression of total seasonal rainfall and soil loss (Figure 6) shows that rainfall was significantly and positively correlated with was soil loss ($p \geq 0$). The regression slope (b) was greatest for +T−M (4.7 kg soil ha^{-1} mm^{-1}) and BF (4.4 kg soil ha^{-1} mm^{-1}), and lowest for the mulched treatments (−T+M and +T+M) at 2.7 kg soil ha^{-1} mm^{-1}.

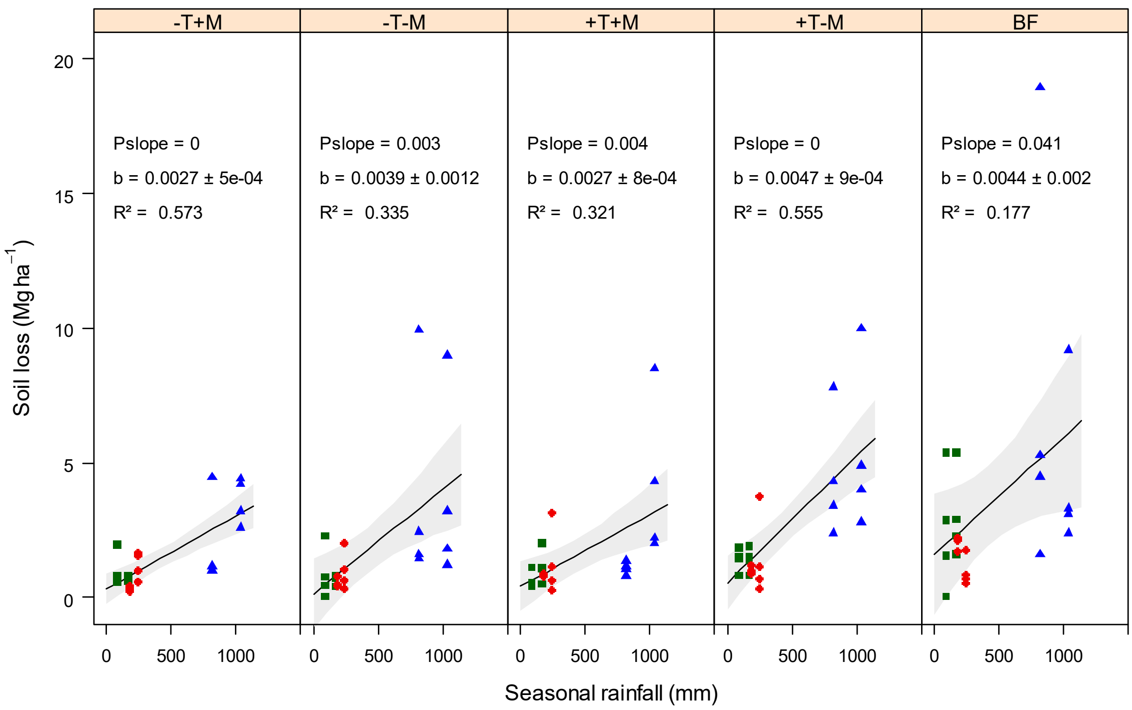

Figure 6. Linear regression of seasonal rainfall on soil loss for tilled (−T or +T) and mulched (−M or +M) plots in the early monsoon (green squares), monsoon (blue triangles), and late monsoon (red circles) seasons (95% confidence intervals shown). Note: Pslope is the probability of the slope being significantly different to zero, b is the slope coefficient (± standard error), and R^2 is the correlation coefficient.

3.3. SOM Losses

SOM loss was approximately halved by the presence of corn (p = 0.001), i.e., by 48.4 kg ha^{-1} as compared to no-corn plots (Figure 7). Interaction effects of tillage and mulching (p = 0.016) were also observed where mulching reduced the SOM loss by 47.2 kg ha^{-1} in the tilled plots, which is almost eight times higher reduction than in the no-till plots. The season also had significant effects on the SOM loss (p = 0.032) where monsoon season lost the highest SOM (81.9 kg ha^{-1}), 35.2 kg ha^{-1} more than the early monsoon and 28.6 kg ha^{-1} more than the late monsoon season. SOM losses were greater in 2017 (p = 0.049). The cumulative SOM loss throughout the two-year trial (Figure S2) followed the same pattern as for cumulative soil loss. Cumulative soil loss and cumulative SOM loss had a correlation of R^2 = 0.88.

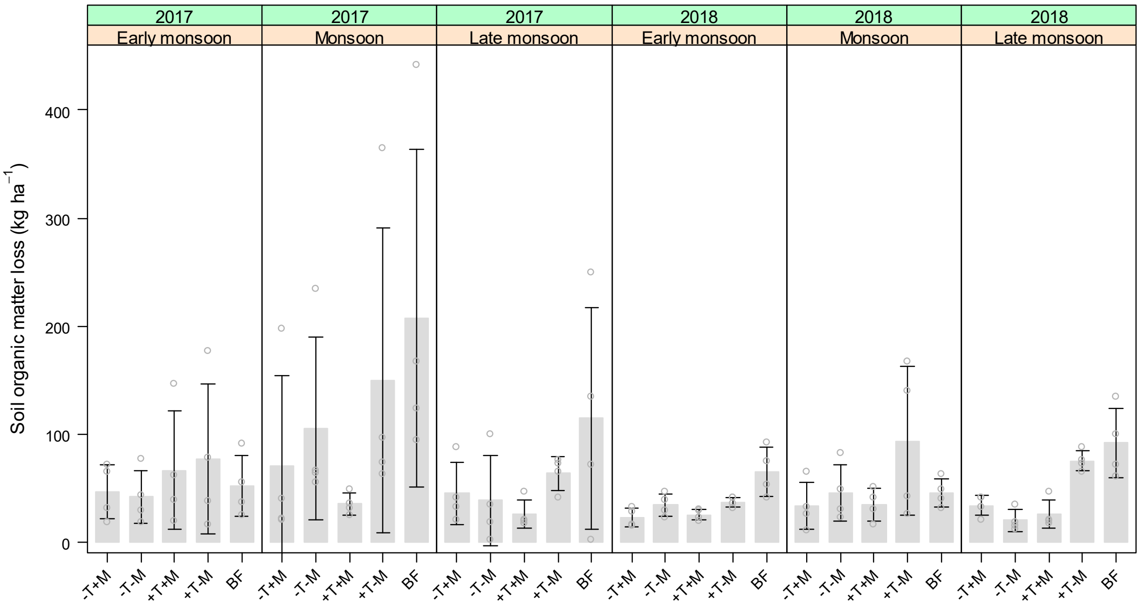

Figure 7. Effect of tillage (−T or +T), mulch (−M or +M), and corn (presence or absence) on soil organic matter loss at three sampling times in 2017 and 2018. Means (grey columns) and 95% confidence intervals (error bars) shown with raw data (grey circles).

3.4. Soil Nutrient Losses

Presence of corn nearly halved total nitrogen losses (p = 0.001), i.e., by 7.04 kg ha^{-1} compared to the no-corn plots (Figure 8). Interaction effects of tillage, mulch, and season (p = 0.047) were observed where mulch reduced total nitrogen losses by 7.67 kg ha^{-1} in the tilled plots, about four times higher reduction than in the no-till plots. Season and year also interacted (p < 0.001) for total nitrogen losses, the loss was the highest in late monsoon in 2017, and in monsoon season in 2018. The cumulative soil nitrogen loss throughout the two-year trial (Figure S3) was greatest in the BF and +T−M treatments (mean = 79.4 kg ha^{-1}) compared with −T+M, −T−M, and +T+M (mean = 35.5 kg ha^{-1}). Cumulative soil loss and cumulative nitrogen loss had a correlation of R^2 = 0.77.

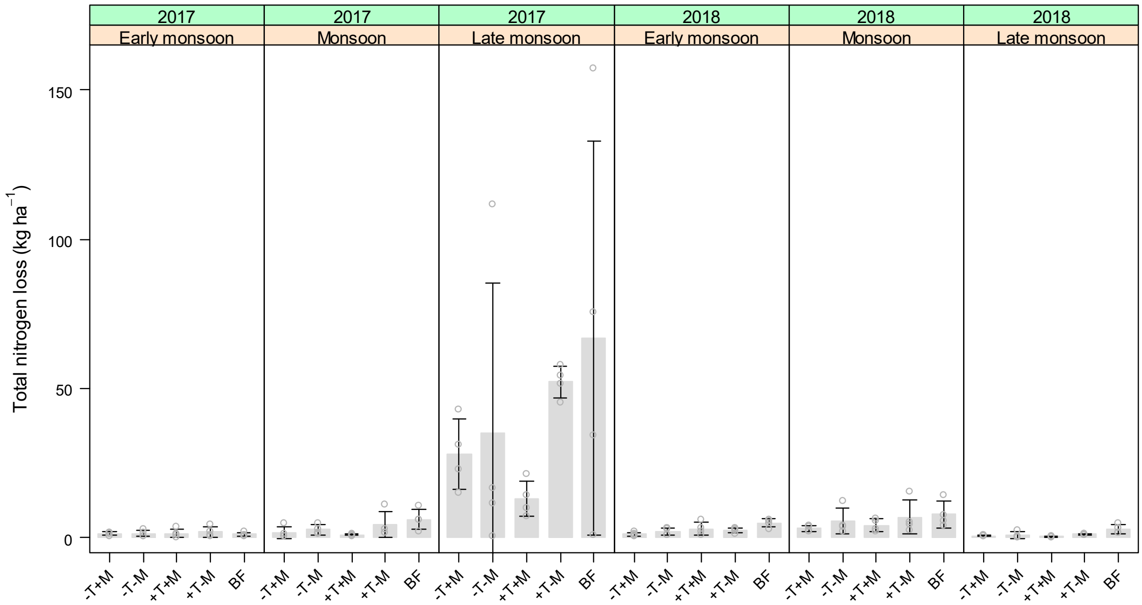

Figure 8. Effect of tillage (−T or +T), mulch (−M or +M), and corn (presence or absence) on total nitrogen loss at three sampling times in 2017 and 2018. Means (grey columns) and 95% confidence intervals (error bars) shown with raw data (grey circles).

Soil available phosphorus loss was not significantly affected by the presence of corn (p = 0.579) whereas tillage weakly increased it (p = 0.051) by 9.2 kg ha^{-1} as compared to no-till corn plots (Figure 9). Interaction effects of season and year (p = 0.045) were also observed for phosphorus loss where the loss was highest in the monsoon season, and higher in 2017 than in 2018. The cumulative soil phosphorus loss throughout the two-year trial (Figure S4) was greatest in the +T−M treatment (222 kg ha^{-1}) compared with the other treatments (mean = 148 kg ha^{-1}).

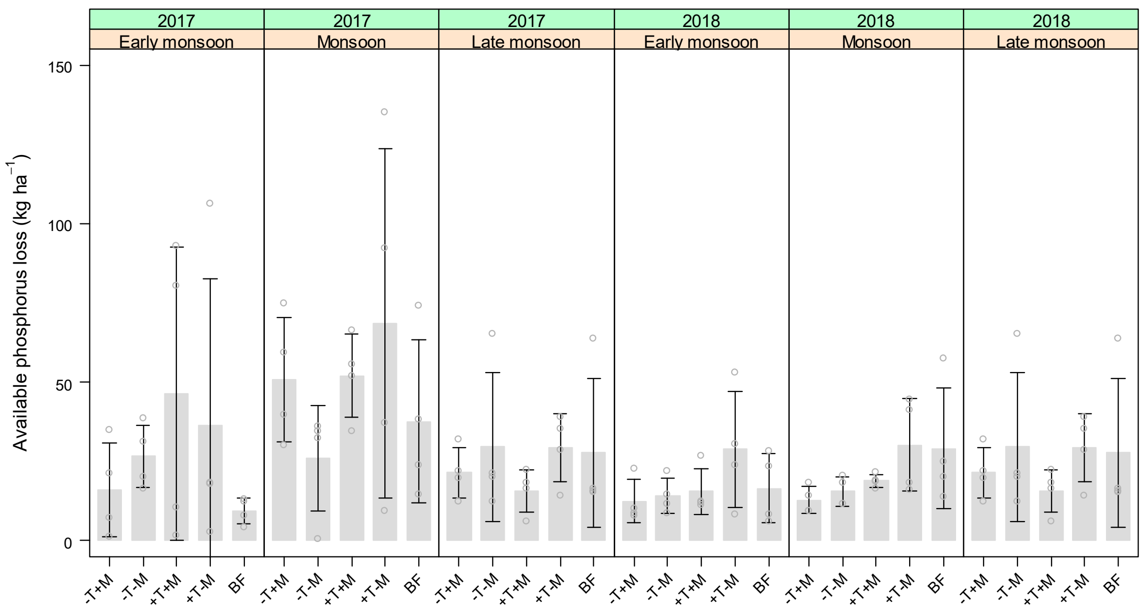

Figure 9. Effect of tillage (−T or +T), mulch (−M or +M), and corn (presence or absence) on available phosphorus loss at three sampling times in 2017 and 2018. Means (grey columns) and 95% confidence intervals (error bars) shown with raw data (grey circles).

3.5. Corn Height and Yield

Plant and cob heights and stover yield were not affected by tillage and/or mulch whereas the interaction effect of tillage and year was observed for grain yield (p = 0.019) (Table 1). Tillage initially increased grain yield in 2017, and later decreased the same in 2018. We reported an average grain yield of 5.75 Mg ha^{-1} in no-till plots across both mulching factors (+M and −M); an increment of 0.52 Mg ha^{-1} over tilled corn plots.

Table 1. Effect of tillage (−T or +T) and mulch (−M or +M) on crop growth in 2017 and 2018 (Means and 95% confidence intervals shown).

Crop Growth Variables	2017				2018			
	−T+M	−T−M	+T+M	+T−M	−T+M	−T−M	+T+M	+T−M
Plant height (cm)	224.2 ± 4.7	227 ± 25	221.8 ± 15.9	231 ± 17	256.8 ± 36.9	254.1 ± 12.6	236.8 ± 20.2	238 ± 14.9
Cob height (cm)	123 ± 7.8	128.8 ± 9.7	129.8 ± 16.4	132.8 ± 9	135 ± 26	133.5 ± 20.3	128 ± 12.3	132.2 ± 11.9
Grain yield (Mg ha^{-1})	5.18 ± 1.27	5.98 ± 1.28	5.51 ± 1.3	7.2 ± 1.7	5.74 ± 2.24	4.8 ± 2.2	3.86 ± 2.04	3.46 ± 0.51
Stover yield (Mg ha^{-1})	8.7 ± 3.1	9.0 ± 3.68	9.2 ± 2.42	10.4 ± 4.4	8.9 ± 3.1	7.5 ± 4.15	6.7 ± 2.79	6.3 ± 2.85

4. Discussion

4.1. Impacts of Tillage, Mulch, and Presence of Corn on Soil and Soil Nutrient Losses across Diverse Seasons

This study showed that no-till significantly lowered the soil losses in the middle hills of Nepal. No-till and mulch were also effective in minimising the SOM and total nitrogen losses, with the effect being interactive, where mulching became important in tilled plots due to the moderating effect of mulch on various hydrological processes related to erosion (e.g., rainfall intensity, surface flow), especially in bare and/or disturbed soils [12]. This kind of synergistic effect was also reported by Kaur and Arora [22] in north-west India where deep tillage and mulch provided greater corn yields by improving soil physical environment as compared to the treatments alone. Our results are also consistent with other studies conducted in Kavrepalanchok district located in the middle hills of Nepal with similar geographical conditions, where conventional tillage practices caused more soil, SOM, and NPK losses whereas mulch and no-till were effective in reducing them [10]. The highest soil loss occurred during the monsoon season whereas total nitrogen loss was greatest during the 2017 late monsoon. It would normally be expected that total nitrogen and SOM losses are well correlated [23], however the higher rainfall during late monsoon sampling time in 2017 might have accounted for greater soil nitrogen losses [24].

While Atreya et al. [10] highlighted the importance of the pre/early monsoon season for soil erosion risk, the present study demonstrated that the monsoon season itself was most prone to soil loss, and was largely correlated with the rainfall in each season. This may be due to different planting and harvesting time of corn, and also the difference in the amount of rainfall received during each season in both studies. Mulch did not have any significant effects on phosphorous loss, however no-till weakly decreased it. Similar findings were also reported by Wang et al. [25] in the Chaohu Lake region of China where no-till reduced phosphorus losses by 23–30% as compared to conventional till, related to significant reduction in seasonal runoff and soil losses.

Findings from other parts of the world with sloping lands also confirm the value of mulch, especially in conjunction with reduced tillage. In Southern China, conservation tillage practices such as no/zero tillage reduced nitrogen losses by 1.83 mg L^{-1} [26]. Zero/reduced tillage practices reduce the detachment of soil particles due to rainfall and runoff, and mulching helps to intercept water as it moves down the slope and permits the soil to settle and increases the roughness of soil surface [27]. Combining conservation tillage and residue retention/mulching can reduce soil erosion further by increasing soil aggregate stability and porosity of topsoil [28].

The presence of corn in the field provided effective amelioration against soil and nutrient losses through the action of the corn roots binding soil particles [29] and corn leaves protecting soil from the direct impact of raindrops [30]. Soil and nutrient losses were the highest in the monsoon season due to higher rainfall, with more than 80% of the annual long-term rainfall occurring during this season [13]. In the current study, the monsoon season accounted for 72% of the total rainfall received by the corn plots during their overall growing season.

4.2. Impacts of Tillage and Mulch on Corn Yield and Height

While the benefits of no-till and mulch for soil health are observable in the short term, the impacts of these practices on crop yields may take longer to manifest, especially where other agronomic practices (e.g., fertilisation, irrigation, crop protection) are sound [31]. Similar results were also reported by Liu et al. [32] in a research conducted during 2003–2015 period in southern Loess Plateau of China, where straw mulching increased wheat yield only after the fourth year of planting but no effects were seen up to the third year of the experiment. We did not observe significant differences with tillage and mulch for corn height, cob height, and straw yield, however larger straw yields were observed in no-till and mulched plots in second year of the experiment. The initial increase in the grain yield in tilled plots in the year 2017 may be due to better root growth [33] and infiltration of water [34]. Beneficial effects of tillage in terms of mineralisation of nutrients [35] and suppressing weed growth [36] may also have positively impacted on crop yield. In the long run, however, conventional till causes the loss of fertile topsoil and soil nutrients [37]. Thus, in the second year of corn planting, the tilled plots have produced lower crop yields than no-till corn plots. Similar results have been reported in other subtropical countries; conventional till produced 53% lower wheat-pea grain yield than no-till with stubble retained plots in China [38], and conventional till yielded 9.1% less corn as compared to yields across fresh beds, reduced tillage, and strip tillage in Bangladesh [39].

However, in 2018, grain yield was significantly reduced for the tilled and un-mulched plots. The rainfall in the monsoon season that year was 25% more than in 2017 and was associated with greater soil and SOM losses which are likely to have impacted on yield. Minimum/no-till practices in some parts of Nepal were found unsuitable as they reduced crop yields [1,10,40,41]. Similar trends have been documented in other studies conducted in different parts of the world too [42,43]. For example, conventional till produced 40–55% higher corn yield in Ethiopia [44] and deep tillage increased wheat-corn yields by 35% in China [45] compared with the no-till.

Decreased yields in tilled plots can be explained by the experimental results described above, i.e., tillage producing greater losses of soil, SOM, and total nitrogen. When erosion occurs, the layer of soil that first washes away is the topsoil which is generally well structured and fertile and holds water to supply crop roots. Excessive tillage breaks the soil structure, loosens the soil, and makes the soils susceptible to soil erosion. Yield decline can also be related to the reduced SOM [46] resulting from conventional till in the corn plots. Reduced total nitrogen decreases photosynthesis per unit leaf area, ultimately reducing crop yields [47]. Here, tilled plots are losing more nitrogen thus reduction in corn yield has been reported in those plots.

5. Conclusions

This study presents the short-term effects of tillage and mulch on soil and nutrient losses, and corn yield in the middle hills of Nepal. No-till and mulch lowered the soil and nutrient losses compared to the conventional till and no-mulch practices. The crop yields were also higher in the no-till plots in the second year of the experiment. Excessive tillage can be a major cause of soil losses (and associated nutrients) in the sloping lands of middle hills of Nepal. There is a need to modify conventional tillage practices to protect soil and plant nutrients in the cornfields. No-till and mulch can be suitable alternatives to conventional agricultural practices for reducing soil and nutrient losses, and increasing crop yield in the long run, especially when used in combination. Since the study was based on only two seasons of data, it is suggested that long-term field experiments are established, preferably in an area with differing soil types, to analyse the longer-term impacts of tillage and mulch on soil fertility and function, and corn yields in the middle hills of Nepal.

Supplementary Materials: The following are available online at http://www.mdpi.com/2073-4395/10/1/63/s1, Table S1: ANOVA for soil data, Table S2: ANOVA for crop data, Figure S1: Effect of tillage (−T or +T), mulch (−M or +M), and corn (presence or absence [BF]) on cumulative soil loss at six sampling seasons (early monsoon, monsoon and late monsoon in 2017 and 2018), Figure S2: Effect of tillage (−T or +T), mulch (−M or +M), and corn (presence or absence [BF]) on cumulative soil organic matter (SOM) loss at six sampling seasons (early monsoon, monsoon and late monsoon in 2017 and 2018), Figure S3: Effect of tillage (−T or +T), mulch (−M or +M), and corn (presence or absence [BF]) on cumulative soil nitrogen loss at six sampling seasons (early monsoon, monsoon and late monsoon in 2017 and 2018), Figure S4: Effect of tillage (−T or +T), mulch (−M or +M), and corn (presence or absence [BF]) on cumulative soil phosphorus loss at six sampling seasons (early monsoon, monsoon and late monsoon in 2017 and 2018).

Author Contributions: Conceptualization, D.C., P.K., L.K. and R.S.; Methodology, D.C., P.K. and L.K.; Formal analysis, D.C. and P.K.; Data curation, D.C., P.K. and L.K.; Writing—original draft preparation, D.C.; Writing—review and editing, D.C., P.K., L.K. and R.S. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest: The authors declare no conflict of interest.

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