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Review Article

Effect of Tillage, Crops Residues and Crops Management Practices on Runoff Erosion, Soil Loss and Soil Properties in Ethiopa: Review

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Abstract

The conducted investigations showed that tillage practices with crop residue and proper cropping systems protect loss of soil from runoff erosion which depletes soil nutrients and affects soil physical and chemical properties. The review was conducted with aim of reviewing the effect of tillage, crops residues and crops management practices on runoff, soil loss and soil properties in Ethiopia. The three years study conducted in the Upper Blue Nile basin of Northwestern Ethiopia showed that reduced tillage reduced soil loss over conventional tillage, row planting reduced soil loss over broadcast planting, without trampling reduced soil loss over with trampling planting, and the sediment concentration was ranged from 0.01 to 5.37g/L and total soil loss was 0.20 to 0.50t/ha. The study conducted in the humid highlands of Ethiopia showed that the lower average soil loss was 16 t/ha.yr under zero tillage with crop residue and maximum was 30 t/ha.yr in conventional tillage without crop residue. The investigation indicated that zero tillage with maize soya bean intercrop, maize rotation, continuous maize and continuous soya bean improved soil properties than conventional tillage system. The investigation which was carried out to evaluate the effects of tillage and cropping system on soil properties showed that enrichment ratio ≤1 under no tillage with intercropping and no tillage with mulch reduce nutrient losses and enrichment ratio. The study conducted at Derashe and Arba Minch Zuriya in Ethiopia showed that some selected properties were statistically significant ($P<0.05$) and conservation tillage is favored for soil management relative to conventional tillage. Therefore, tillage practices like zero tillage and minimum tillage with crop residue management like mulching and crop management such as intercropping and crop rotation reduce surface runoff erosion, soil loss and soil fertility depletion, but additional continual research is needed to reveal trends in tillage, crops residues and crops management.

Keywords

Erosion, Runoff, Soil Loss, Tillage and Crops

1. Introduction

Soil erosion has been a major national agenda and remains an important issue that requires solutions in Ethiopia because of its negative impact on the environment, soil productivity, food security and quality of life [2, 19, 20]. The annual soil loss due to erosion from Ethiopian highlands ranged from 20 to 80 t/ha.yr [1, 5, 10] and the mean rate of soil loss from cultivated lands was estimated as 42t/ha.yr [2]. Soil erosion by water is the dominant degradation process and occurs partic-

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ularly on cropland, with average annual soil loss rates of 42t/ha.year [7, 17]. The sustainable use of soil resources can be affected by soil erosion through its impact on soil properties [3]. Traditional tillage practices are among the major drivers of land degradation in Ethiopia due to greater plow frequency and complete crop residue removal [17, 21]. The adversity of soil erosion due to tillage methods can be varied based on crop type, plot scale, time, tillage frequency and duration, soil type, and climatic variables [17, 22]. Conservation tillage can be preferred to protect land degradation and reclaim degraded lands [4, 8]. Conservation tillage is an approach to reduce surface runoff and soil degradation and reduced tillage systems can offer a solution that can be compromised [8]. Continuous cereal-legume rotation managed with zero tillage favor soil hydrological properties than conventional tillage [18] and management of intercropping and mono-cropping of maize managed with conservation agriculture improved grain yield compared with conventional agriculture by 32% and 40%, respectively [15, 18]. Zero tillage with intercropping retained more nutrients than conventional [3]. Minimum soil disturbance such as no till and reduced tillage with sufficient crop residue is intended to be a strategy to reduce soil erosion, nutrient depletion and increase crop productivity [2, 11, 12, 16]. Crop residue with reduced tillage improved soil organic matter and accelerate the formation of macro-aggregate through increasing microbial biomass content in soil [13, 18]. The well distributions of crop residues can improve workability of the soil and protect soil from soil erosion and compaction [4]. Higher soil losses were observed under tillage practices without crop residue treatments in relation to tillage practices with crop residue [2]. The implementation of zero-tillage practice under permanent pasture improves soil physical and chemical properties and soil quality [9, 18].

Different conservation managements options were there to be reviewed and implemented to reduce various adverse effect of surface runoff erosion on soil loss and soil properties, but the combined effect of tillage, crop residue and crop management practices on soil loss and soil properties against surface runoff erosion was preferred to review several impacts of soil erosion against soil detachment, soil loss and soil properties. Furthermore, different tillage, crop residue and crop management practices that have been conducted in Ethiopia to alleviate the impacts of runoff erosion on soil loss, soil properties, and crop yield, but the output of investigation can be varied due to soil type and relief variability, ecology, climate condition, and variation of technology advancement from country to country. Due to this, reviewing of what have been conducted before at specific country is very crucial to find the best option for its extension i.e to promote research results from investigation to stakeholders and also to observe problem behind investigations. The core objective of review article is to review the effect of tillage, crops residues and crops management practices on runoff erosion, soil loss and soil properties in Ethiopia and to discuss the role of tillage, crops residues and crops management practices in protecting soil loss and soil properties from adverse impact of runoff erosion in Ethiopa.

2. Method of Review

The Article review was reviewed using results of published Research Journals. Reviewed Journals are [2, 3, 6, 14, 17, 18]. The focus of each reviewed research Journals is stated as following. The investigation was conducted at the Aba Gerima watershed in northwestern Ethiopia, to investigate the effects of two tillage practices (reduced tillage and conventional tillage, two planting methods (row planting and broadcast planting), and two compaction options (with and without trampling) on soil loss and teff yields in a split-split plot arrangement [17]. The research was conducted on Eutric Nitisols of Holeta Agricultural Research Center in the humid highlands of Ethiopia to study the effect of tillage and crop residue management on runoff, soil loss and wheat (*Triticum aestivum L.)* yield [2]. The investigation was conducted to investigate the response of tillage practices and cropping pattern systems on soil properties and yield of crop focusing on the dominant cereal and pulse crops in Pawe area, Benishangul Gumuz Regional State [18]. The study was carried out at Assosa Agricultural research center to evaluate the effects of tillage and cropping system on soil chemical and in situ moisture conservation with six treatment in factorial combinations from three cropping systems (sole maize, sole soya bean and intercropping of maize with soya bean) with tillage system (no tillage and convectional tillage) [3]. The study was conducted at Derashe and Arba Minch Zuriya at southern Ethiopia to investigate the effect of conservation agriculture and conventional tillage on the soil physicochemical properties as an adaptation strategy known as Targa-na-Potayta with zero tillage, and mixed/rotational cropping [14]. The effect of tillage and cropping system on maize yield and some soil properties were investigated at Malkassa Agricultural Research Center and Wolenchity Research Substation to ensure sustainable maize crop production in the dryland Ethiopia, [6]. This article review was prepared from these results of published journals.

3. Discussions of Review

3.1. Effect of Tillage, Crops and Crops Residues Management on Runoff Erosion and Soil Loss

Sediment concentration ranged from 0.01 to 5.37g/L (mean, 0.25 g/L) and the estimated total soil loss (August to October) ranged from 0.20 to 0.50 t/ha (with mean, 0.30 t/ha) and the sediment concentration and total soil loss were significantly influenced ($P<0.05$) by tillage, planting methods, and trampling only in the third monitoring year and RT reduced soil loss by 19% relative to that of CT, whereas RP resulted in a 13% reduction in soil loss over BP and the T plots showed a 15% reduction in soil loss as compared to T plots [17].

The statistical data analysis showed that sediment concentration and soil loss were significantly affected at (P<0.05) by tillage in 2019, but not significant in 2017 and 2018 as it can be observed from table 1. Sediment concentration wasn't affected significantly at (P<0.05) by planting method, but soil loss was affected significantly (P<0.05) in 2017. The tillage* planting method* trampling interaction effect was significant on sediment concentration in 2019, but no interactions effect wasn't observed from tillage* planting method, tillage* trampling, planting method* trampling on sediment concentration and soil loss as it can be observed from table 1.

Table 1. *The main and interaction effects of tillage (TL, planting method (PM) and Trampling (T) on sediment concentration (g/L) and soil loss (t/ha).*

Treatments	**Sediment Concentration**			**Soil loss**	
Main Effects	2017	2018	2019	2017	2019
TL	0.02	0.35	4.89*	0.21	4.66*
PM	0.01	0.07	1.47	0.02*	0.00*
T	1.50	0.67	6.82*	1.41	4.37*
Interactions effect	2017	2018	2019	2017	2019
TL*PM	0.84	0.67	3.64	0.01	1.4
TL*T	0.21	0.49	0.67	0.08	0.21
PM*T	0.42	1.32	3.25	0.52	0.65
TL*PM*T	2.10	0.83	6.69*	1.20	3.01

Source: [17]

Table 2. *The effects of tillage, planting method, and trampling practices on total soil loss (t/ha) August to October.*

Treatments	**2017**				**2019**			
Main Effects	**August**	**September**	**October**	**Total**	**August**	**September**	**October**	**Total**
Tillage								
CT	0.27	0.06	0.07	0.40a	0.18	0.04	0.05	0.26a
RT	0.29	0.04	0.07	0.39a	0.11	0.06	0.04	0.21b
Planting method								
BP	0.25	0.04	0.07	0.36a	0.14	0.07	0.06	0.27a
RP	0.20	0.03	0.06	0.29a	0.16	0.04	0.04	0.25b
Trampling								
T+	0.27	0.04	0.07	0.38a	0.16	0.06	0.05	0.26a
T-	0.28	0.05	0.07	0.39a	0.14	0.05	0.04	0.22b

Source: [17]
Means with the same letter are not significantly different at P<0.05. T+: with trampling; T-: no trampling.

As it is observed from table 2 the reduced tillage reduced the soil loss by 2.50% and 19.23% relative to conservation tillage in 2017 and 2019 respectively, and row planting reduced soil loss by 19.44% and 7.4% over broadcast planting in 2017 and 2019. The without trampling plots decreased soil loss by 2.56% and 15.38% over with trampling plots in 2017 and 2019. Even though it was observed that reduced tillage reduced over conversion tillage, row planting reduced soil loss over broadcast planting, without trampling reduced soil loss over with trampling planting, but practices soil loss protection wasn't in similar trend.

Three years study showed that decreasing tillage frequency and increasing the rate of crop residue reduced soil loss and the highest soil loss was 30t/ha.yr) from conventional tillage treatment and the lowest was 16.30t/ha.yr from zero tillage with 2.0t/ha.yr crop residue (T_0C_2) treatments, but the annual soil loss (16 t/ha.yr) was higher than tolerable soil loss for the Ethiopian highlands (2 to 10 t/ha.yr) [2].

Table 3. *Runoff (mm) and runoff coefficients (%) from each treatment.*

Treatments	Runoff (mm)			
	2009	**2010**	**2011**	**Average**
T_0C_0	364.5(95.0)a	323.8(24.9)a	306.8(7.0)a	331.6(35.4)a
T_0C_1	245.3(5.6)bc	321.9(7.8)a	252.6(9.1)b	273.3(35.9)b
T_0C_2	219.7(35.6)c	304.1(9.3)ab	245.7(29.1)b	256.5(42.2)b
T_1C_0	296.5(24.0)b	335.2(25.1)a	241.5(23.5)b	291.1(45.9)b
T_1C_1	213.3(13.1)c	283.3(6.2)b	197.5(17.7)c	231.4(43.0)b
T_1C_2	198.5(23.4)c	290.3(24.2)b	190.4(11.8)c	226.4(51.2)c
T_2C_0	280.2(94.9)b	316(19.3)a	203.7(15.4)c	266.-17(52.6)b
T_2C_1	261.8(29.8)b	237(17.5)c	144.7(20.8)a	214.6(49.2)c
T_2C_2	227.8(11.1)c	230.2(21.2)c	136.5(18.8)a	198.2(11.1)c
Runoff coefficient%	2009	2010	2011	Average
T_0C_0	61.5(16.0)a	41.6(3.2)a	36.7(0.8)a	46.1(14.0)a
T_0C_1	41.4(0.1)c	41.3(1.0)a	30.2(1.1)b	37.1(5.30)a
T_0C_2	37.1(5.9)c	39.0(1.2)a	29.4(3.5)b	34.9(5.6)b
T_1C_0	50.1(4.0)	43.0(3.2)a	28.9(2.8)b	39.5(9.8)a
T_1C_1	36.0(2.2)c	36.4(0.8)b	23.6(2.1)c	31.4(6.8)c
T_1C_2	33.55(3.9)	37.3(3.1)b	22.8(1.4)c	30.8(7)c
T_2C_0	47.3(3.1)	40.6(2.5)	24.3(1.8)c	36.2(10.6)a
T_2C_1	44.2(5.0)	30.5(2.3)c	17.3(2.5)d	29.2(12.2)c
T2C2	38.5(1.9)ab	29.5(2.7)c	16.3(2.3)d	26.9(10.0)c

Source: [2]

Note:=T_0C_0: Zero tillage (land was not disturbed) without crop residue, T_0C_1: Zero tillage with 1 t/ha.yr crop residue, T_0C_2: Zero tillage with 2 t/ha.yr crop residue, T_1C_0: Minimum tillage without crop residue, T_1C_1: Minimum tillage with 1 t/ha.yr crop residue, T_1C_2: Minimum tillage with 2 t/ha.yr crop residue, T_2C_0: Control treatment (Conventional tillage without crop residue), T_2C_1: Conventional tillage with 1 t/ha.yr crop residue and T_2C_2: Conventional tillage with 2 t/ha.yr crop residue

The effect of tillage and crop residue management practices on runoff and soil loss from 2009 to 2011 is discussed as following as it can be observed from table 3. In 2009, surface runoff was 364mm with 61.50% runoff coefficient under zero tillage without crop residue mulching and the lowest was 199mm runoff with 33.50% runoff coefficient from minimum tillage with 2 t/ha.yr crop residue mulching. The runoff was 280mm from conventional tillage which was lower than the runoff obtained from zero tillage without crop residue mulching and minimum tillage without crop residue. In 2010, the highest surface runoff was 335mm with 43% runoff coefficient under minimum tillage without crop residue and the lowest surface runoff in 2010 was recorded from conventional tillage with the highest crop residue mulching.

In 2011, the highest surface runoff was 307mm with 36.70% runoff coefficient from zero tillage without crop residue.

***Table 1**. The effect of tillage, crop and crop residue management on soil loss (t/ha.yr).*

Treatments	**Soil Loss (t/ha.yr) from 2009 to 2011**			
	2009	**2010**	**2011**	**Average value**
T0C0	26.3(6.5)b	22.9(2.2)a	30.7(1.5)b	27.0(1.4)a
T_0C_1	23.0(1.5)b	18.7(1.5)a	18.5(1.8)c	19.3(1.1)b
T_0C_2	16.3(3.7)c	12.2(1.1)a	17.7(2.1)c	16.3(1.1)c
T_1C_0	29.7(4.5)a	27.6(4.5)a	30.6(0.7)b	28.5(1.6)a
T_1C_1	25.3(5.7)b	23.0(1.5)a	20.1(3.0)c	23.1(2.8)b
T_1C_2	21.5(2.1)b	20.8(2.7)a	18.9(1.6)c	21.8(1)b
T_2C_0	27.4(1.8)b	22.8(2.3)a	38.4(5.5)a	30.(2.9)a
T_2C_1	26.0(6.4)b	20.9(4.1)	31.33(7.5)b	27.0(3.0)a
T_2C_2	25.5(4.1)b	11.9(0.7)a	31.16(0.4)	23.2(2.9)b

Source: [2]

The effect of soil tillage and crop residue on soil loss from 2009 to 2011 was discussed as tabulated in table 4. In 2009, the highest soil loss was 29.70 t/ha under minimum tillage without crop residue (T_1C_0) while the lowest soil loss was 16.30 t/ha from zero tillage with 2 t/ha.yr crop residue (T_0C_2) treatment. In, 2010 the highest soil loss was 27.60 t/ha from minimum tillage without crop residue and the lowest soil loss was 11.90t/ha from conventional tillage with 2t/ha.yr crop residue. In, 2011, soil loss from conventional tillage (T_2C_0) treatment was higher (38.40 t/ha) than the other treatments.

The treatments had shown non-significant variation for all parameters showing enrichment ratio of ≥1 except for some no tillage treatments and nutrient enrichment ratio (ER) was determined per plot by dividing the average concentration of a nutrient in the sediment by the average nutrient concentration of in-situ soil after harvest [3]. Cropping system with no tillage treatments especially intercropping retained more nutrients than conventional tillage by reducing runoff and soil loss to enrichment ratio of ≤1 and no tillage with soya bean and no tillage with intercropping treatments had shown the value of ≤1 for total nitrogen and phosphorus than conventional tillage treatments [3].

***Table 2**. The effects of tillage and cropping system on Sediment Enrichment ratios (ER).*

Treatments	**Parameters**		
	SOC (%)	**TN (%)**	**AP(ppm)**
Conventional tillage with maize (T1)	2.18	1.90	3.45
No tillage with maize (T2)	1.63	1.56	1.04
Conventional tillage with intercropping (T3)	1.83	1.66	0.66
No tillage with intercropping (T4)	1.04	0.90	0.19
Conventional tillage with soya bean (T5)	1.89	1.80	1.94
No tillage with soya bean (T6)	1.11	1.50	0.22
%CV	56	25.30	115.25

Source: [3]

Soil available phosphorus was retained under no tillage with intercropping (T4), no tillage with soya bean (T6) and conventional tillage with intercropping (T3) with 0.19, 0.22 and 0.66 sediment enrichment ratio (ER) respectively relative to other treatments, but organic carbon, total nitrogen and available phosphorus were highly depleted under conventional tillage with maize (T1) and conventional tillage with soya bean (T5) as it can be observed from table 5.

3.2. Effect of Tillage, Crops and Crops Residues Management on Soil Properties

The effects of tillage practices (reduced tillage and conventional tillage) and two planting methods (row planting and broadcast planting), and two compaction options (with and without trampling) on soil properties revealed that reduced tillage and without trampling significantly increased soil total carbon and nitrogen [17].

Table 3. The effects of tillage, planting method, and trampling treatments on total nitrogen (TN), total organic carbon (TOC), and bulk density of soil samples collected before and after experiment.

Treatment	TN (g/Kg)	TOC (g/Kg)	BD (g/cm^3)	pH	AP(P_2O_5) mg/Kg	EK (cmol(+)/Kg
Base 2017	120	1.03	1.12	5.60	160	1.10
Tillage						
CT	12.0b	0.9b	1.20	5.70	17.70	1.0
RT	13.8a	1.3a	1.20	5.50	15.40	1.20
pvalue	0.04	0.02	0.10	0.23	0.29	0.90
BP	120	1.10	1.20	5.60	16.30	1.10
RP	11.90	1.10	1.20	5.60	16.70	1.20
pvalue	0.11	0.52	0.5	1.12	0.99	0.99
Trampling						
T+	8.7b	0.8b	1.2a	5.70	17	0.90
T-	13.0a	1.2a	1.1b	5.60	16.30	1.20
pvalue	0.02	0.02	0.01	1.0	0.33	0.05

T+: with trampling; T-: no trampling Source: [17]

The reduced tillage increased total nitrogen and organic carbon content of the soil against runoff in relation to conservation tillage and planting method showed variation on total nitrogen, organic carbon and bulk density in relation to reference base 2017 as it is stated in table 6. This implicate that zero tillage and trampling method of planting can reserve organic matter from runoff erosion.

The land management and crop cover significantly affect bulk density, porosity, nitrogen, organic carbon and available phosphorus and maize soya bean intercropping managed under zero tillage improved capillary porosity, non-capillary porosity, organic carbon, available phosphorus and total nitrogen relative to conventionally tilled continuous maize with a response ratio of 1.7, 2.7, 1.3, 2, and 1.3, respectively [18]. Zero tillage maize soya bean intercrop, maize rotation, continuous maize, and continuous soya bean improved soil organic carbon content than conventional tillage system by 20%, 22%, 13%, and 11% respectively [18].

Table 4. Effect of tillage and cropping management on soil physical properties.

trt	CP	NCP	Porosity	AP(ppm)	SOC %	TN%
ZTMSI	0.58a(17.5)	0.04a(172.5)	0.61a(22)	4.36b(0.94)	3.16a(1.32)	0.24a(1.27)
ZTRM	0.57a(17)	0.02bc(82.5)	0.60b(19)	3.96b(0.85)	2.94ab(1.23)	0.22ab(1.19)
CTMSI	0.55b(12.6)	0.01c(7,5)	0.57c(12)	7.08a(1.52)	2.64bc(1.10)	0.20bc(1.09)

trt	CP	NCP	Porosity	AP(ppm)	SOC %	TN%
ZTM	0.56ab(14)	0.03ab(132)	0.59b(17)	4.82b(1.04)	2.71bc(1.13)	0.21bc(1.11)
CTRM	0.52c(6.5)	0.01c(7,5)	0.54d(6.5)	4.36b(0.94)	2.41c(1)	0.19c(1.00)
ZTS	0.51cd(3.4)	0.02bc(57.5)	0.52d(3.7)	4.49b(0.97)	2.66bc(1.11)	0.20bc(1.09)
CTM	0.49dc(--)	0.01(--)	0.50c(--)	4.65b(--)	2.40c(--)	0.19c(--)
CTS	0.48c(-2.5)	0.02bc(57.5)	0.50c(--)	3.30(0.71)	2.51c(11.04)	0.20c(1.08)
$LSD_{0.05}$	0.02	0.02	0.02	2.19	0.39	0.02
CV%	1.99	28.28	1.79	26.98	8.22	6.25

Source: [18]

Note: Means with the same latter are non-significant; Values in the parenthesis are percent improvement, CTM=Maize with conventional tillage, ZTM=Maize with zero tillage, CTMSI=Maize soya bean intercrop with conventional tillage, ZTMSI=Maize soya bean intercrop with zero tillage, CTRM=Rotated maize with conventional tillage, ZTRM=Rotated maize with zero tillage, ZTS=Soya bean with zero tillage, CTS=Soya bean with conventional tillage, trt=treatment.

As it is tabulated above table 7 the soil physical properties capillary porosity and non-capillary porosity were affected significantly by cropping system management and tillage practices. Maize soya bean intercrop with zero tillage significantly affected capillary porosity, non-capillary porosity, porosity, organic carbon and total nitrogen and improved relative to maize soya bean intercrop with conventional tillage, but available phosphorus was improved under maize soya bean intercrop with conventional tillage relative to other treatments. The capillary porosity, non-capillary porosity and porosity were improved under maize with zero tillage relative to rotated maize with conventional tillage, soya bean with conventional tillage, maize with conventional tillage, soya bean with conventional tillage as it can be observed from table 7.

The tested soil properties showed that soils under conservation agriculture FC 47.8±1.09%, AWHC 15.20±0.37%, pH 8.02±0.07, SOC 1.8±0.02%, and sum of cations 68.20±1.66meq/100g were statistically significant ($P<0.05$) relative to conventional tillage and favored as good soil management practice as compared to conventional tillage [14].

Table 5. *The effects of conservation agriculture and conventional tillage on the selected soil the properties in the selected kebeles of Arba Minch Zuriya and Derashe districts.*

Parameters	Conservation agriculture	Conventional tillage
Field capacity	47.8 ± 1.09^{a}	42.9 ± 1.21^{b}
Permanent wilting capacity	32.5±0.85	32.2±1.19
Available water holding capacity	15.2 ± 0.37^{a}	10.6 ± 0.09^{b}
pH	8.02 ± 0.07^{a}	7.69 ± 0.06^{b}
Organic carbon	1.8 ± 0.02^{a}	1.6 ± 0.05^{b}
Organic matter	3.09 ± 0.03^{a}	2.75 ± 0.08^{b}
Available phosphorus	47.35 ± 1.62^{a}	90.53 ± 7.6^{b}
Exchangeable calcium	44.69 ± 3.52^{a}	34.95 ± 1.63^{b}
Exchangeable magnesium	15.97±2.86	14.27±0.32
Exchangeable potassium	0.94 ± 0.04^{a}	1.46 ± 0.23^{b}
Exchangeable sodium	1.05±0.10	0.96±0.05
Cation exchange capacity	68.20±1.66 a	60.67±1.52b

Source: [14]

Soil properties such as field capacity, permanent wilting capacity and available water holding capacity under conservation agriculture were statistically significant and higher in comparison to conventional tillage from table 8. Soil pH, organic matter, available phosphorous, exchangeable calcium and cation exchange capacity were improved relative to conventional tillage among soil chemical properties whereas available phosphorus and exchangeable potassium were increased under conventional tillage from table 8 but this might be due to unutilized applied phosphorus and potassium fertilizer.

Higher amount of nutrient were retained under no tillage treatment as compared to conventional tillage treatments after harvesting which is directly related to removal of finest soil particles by water erosion (sheet and rill erosion) from the experimental plots [3]. No tillage had retained more nutrients by (11.10, 12.36 and 10.52 % for total nitrogen, 23.31, 26.49 and 26.89 % for available phosphorus and 12.37, 26.05, and 26.82 % for organic carbon) as compared to conventional tillage under sole maize, sole soya bean and their intercropping respectively [3].

Table 9. Some selected chemical properties of soil prior to experiment and in-situ soil after harvesting.

trt	Prior experiment soil				In situ soil after harvesting			
	pH	SOC (%)	TN (%)	AP (ppm)	pH	SOC (%)	TN (%)	AP (ppm)
T1	5.74	1.15	0.15	0.24	5.65	0.85	0.16	3.74
T2	5.79	0.78	0.15	0.25	5.88	0.97	0.18	5.33
T3	5.91	0.76	0.15	0.36	5.63	0.90	0.17	5.32
T4	5.65	0.51	0.16	0.30	5.94	1.23	0.19	19.78
T5	5.75	0.59	0.14	2.32	5.77	0.88	0.16	4.25
T6	5.80	0.32	0.17	0.46	5.78	1.19	0.186	16.04
%CV	1.48	41.4	6.73	24.56	2.05	47.54	7.9	103.51

Source: [3]

Conventional tillage with maize (T1), no tillage with maize (T2), conventional tillage with intercropping (T3), no tillage with intercropping (T4), conventional tillage with soya bean (T5) and no tillage with soya bean (T6), treatment (trt).

No tillage with intercropping (T4) and no tillage with soya bean (T6) retained more soil organic carbon (increased from 0.51 to 1.23%), soil nitrogen (increased from 0.16 to 0.19%) and phosphorus (0.30 to 19.78ppm) as it can be observed from table 9. The retention of nutrients could be because of no tillage conservation decreased both horizontal and vertical movement of nutrients along gradient with erosion in the soil with erosion due to presence of residue and low soil structure disturbance and also soya bean has capacity to fix nitrogen in soil containing nitrogen fixing microorganism.

Soil organic matter content on weight basis at a depth of 0-15 cm was significantly greater under conservation tillage (1.6%) than under conventional tillage (1.2%) and the total nitrogen content on weight basis was increased from low to medium level (0.13%) in conservation tillage, while it remained under low category (0.07%) in conventional tillage [6].

Table 10. The effect of tillage systems on selected soil chemical properties.

Parameters	2000	2004	
	Initial	Conservation1	Conventional5
Soil pH	6.64	6.58	6.34
Soil organic matter	1.02	1.60	1.20
Total nitrogen (%)	0.051	0.130	0.07

Parameters	2000	2004	
	Initial	Conservation1	Conventional5
Available phosphorus (ppm)	9.47	19.44	14.42
Available potassium (ppm)	272	633	597

Source: [6]

T_1: No-tillage (3.0 L/ha glyphosate + 5.0 L/ha LA + 1 time Hand weeding); T_5: conventional Tillage Tilled (four times plowing + two times Hand weeding) where LA is 2-chloro-4-ethylamino-6-isopropylamino-1, 3, 5 triazine); Glyphosate is N-(phosphonomethyl) glycine

Soil pH was slightly decreased under no tillage conservation (T_1) and conservation tillage (T_5) relative to its initial pH in 2000 while soil organic matter and total nitrogen (%) were slightly increased both under no tillage conservation and conservation tillage (T_5) as it is mentioned in table 10. But, available phosphorus and available potassium were increased highly under T_1 and T_5 compared to initial value in 2000 as it can be observed from table 10 and increment of phosphorus could be because of Glyphosate (N-(phosphonomethyl) glycine) and unutilized phosphorus and potassium fertilizer as fertilizers were applied per year.

4. Conclusion

The research conducted on tillage, crops residues and crops management practices on runoff, soil loss and soil properties in Ethiopa were showed that tillage practices with crops residues and crops management practices reduce the impact of runoff on soil loss and soil properties. The investigations showed that reduced tillage reduced runoff and soil loss over conventional tillage, row planting reduced soil loss over broadcast planting, without trampling reduced soil loss over with trampling planting. The three years investigation showed that maximum soil loss was 30t/ha.yr from conventional tillage treatment without crop residue and the lowest was 16.30t/ha.yr from no tilled tillage with 2t/ha.yr crop residue, but the annual soil loss (16 t/ha.yr) was above the tolerable average soil loss rate for the Ethiopian highlands (6 t/ha.yr). The crop intercropped under zero tillage improved organic carbon, available phosphorus and total nitrogen relative to conventionally tilled continuous and the crop intercropped under zero tillage improved capillary porosity and non-capillary porosity relative to conventionally tilled crop. Results of reviewed journals revealed that zero tillage, minimum tillage and conservation tillage with crop residue mulching are preferred to reduce impact of surface runoff erosion on soil loss, soil properties and also crops yield loss. In addition, reviewed article reflected that intercropping and rotation cropping practices under zero tillage and minimum tillage can improve soil physical and chemical properties relative to conventionally tilled tillage. This can be because of tillage with crops residues decreases surface runoff due to its effect in increasing surface roughness. The crops residues increase surface roughness and increment of surface roughness improves soil structure and soil nutrient content. Soil surface roughness increments reduce the surface runoff which detach soil and deplete soil fertility. Even though tillage, crops residues and crops management practices reduce surface runoff erosion impacts on soil loss and soil properties, the improving capacity of the investigated and implemented conservation practices on soil loss and soil properties weren't in similar trend from year to year; consequently, continual research is needed to investigate the long years impacts of tillage, crops residues and crops management practices in Ethiopia.

Abbreviations

AP	Available Phosphorus
AWHC	Available Water Holding Capacity
BD	Bulk Density
CA	Conservation Agriculture
CP	Capillary Pore
CT	Conventional Tillage
CV	Coefficient of Variation
EK	Exchangeable Potassium
FC	Field Capacity
LA	Lasso-Atrazine
LSD	Least Significant Difference
NCP	Non-Capillary Pore
pH	Power of Hydrogen
RP	Row Planting
RT	Reduced Tillage
SOC	Soil Organic Carbon
TN	Total Nitrogen

Author Contributions

Firaol Gemeda is the sole author. The author read and approved the final manuscript.

Conflicts of Interest

The author declares no conflicts of interest.

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Biography

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