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1 INPUT VARIABLES FOR SLEMSA

1.1 Provisional values of rainfall energy based on mean annual rainfall; Rhodesian data (Elwell and Stocking, 1973 as quoted by Department of Agricultural Technical Services, 1976)

Mean annual rainfall mm	E $\text{Jm}^{-2}\text{yr}^{-1}$
400 – 500	10400
500 – 600	12200
600 – 700	14000
700 – 800	15800
800 – 900	17600
900 – 1000	19000
1000 – 1100	21000
1100 – 1200	23000
1200 - 1500	28000
Greater than 1500	30000

1.2 Mean annual rainfall at the research sites and their energy estimated based on the ratings in given Appendix 1.1

Site	Mean annual RF	Rainfall Energy $\text{Jm}^{-2}\text{yr}^{-1}$	Years of rainfall
Alemaya AU Alluvial AU Regosol AU Vertisol	845.7	17600	1979-93, 1995-2001
Chiro Hirna	795.3	15800	1985-89,95,96
Babile	652	14000	1969-1980
Bedessa	981.1	19000	1984-87,1996-97
Dire Dawa	650	14000	1980-2000
Gelemso	1146	23000	1981-1989
Jijiga Amadle Dugda Hidi Karamara	562.9	12200	1952-89, 1996-2001
Kersa/Lange	898.9	17600	1989-1994
Hamaresa	845.7	17600	See Alemaya
Adele	845.7	17600	See Alemaya

1.3 Estimated topographic factors for SLEMSA at the different research sites

Study sites	Slope gradient, S (%)	Slope length L (m)	Topographic Factor X Value
Adele	10	200	7.53
Amadle	5	80	1.85
AU Alluvial	1	300	0.92
AU Regosol	10	100	5.33
AU Vertisol	1	200	0.75
Babile	12	100	7.04
Bedessa	8	60	2.98
Chiro	25	20	10.72
Dire Dawa	2	300	1.43
Dugda Hidi	4	300	2.77
Gelemso	15	50	7.12
Hamaresa	25	20	10.72
Hirna	15	40	6.36
Karamara	12	100	7.04
Kersa/Lange	10	120	5.83

1.4A Criteria for assigning the basic input values for soil erodibility (F_b) for use in the SLEMSA (Elwell, 1978 cited by Morgan, 1995)

Soil texture	Soil type	F value
Light	Sands	4
	Loamy sands	
	Sandy loams	
Medium	Sandy clay loams	5
	Clay loams	
	Sandy clay	
Heavy	Clay	6
	Heavy clay	

The following adjustments were made to the basic F values based on the soil characteristics.

Soil Condition	Add
For light textured soils consisting mainly of sands and silts	(-1)
For restricted vertical permeability within one metre of the surface or for severe soil crusting	(-1)
For ridging up and down the slope	(-1)
For deterioration in soil structure due to excessive soil loss in the previous year (>20t/ha) or for poor management	(-1)
For slight to moderate surface crusting or for soil losses of 10- 20t/ha in the previous year	(-0.5)
High swell –shrink potential/ self mulching (Vertic A)	(-0.5)
For deep (>2m) well drained, light textured soils	2
For tillage techniques which encourage maximum retention of water on the surface, e.g. ridging on the contour	1
For first season of no tillage	1
For subsequent seasons of no tillage	2
For tillage techniques which encourage high surface infiltration and maximum water storage in the profile, e.g. ripping, wheel- track planting	1

1.4B Estimation of soil erodibility index (F values) for selected Harerghe soils based on appendix 1.4A

Research sites	% Clay in B Horizon	Textural class	Basic value, †Fb	Description	‡Fm
Adele	45.22	Sandy clay	5	(+1) Ridging on contour; Slightly restricted B horizon (-0.5)	5.5
AU Alluvial	13.9	Sandy loam	4	(-1) Consists of mainly sands and silts; (+2) Deep well drained light textured soil;	5
AU Regosol	27.42	Sandy clay loam	5		5
AU Vertisol	58.22	Clay	6	Self mulching (-0.5)	5.5
Asebe Teferi/Chiro	NA	Clay	6	Self mulching (-0.5); (+1) Ridging on contour; (-0.5) Previous erosion damage	6
Babile	8.36	Sandy Loam	4	(-0.5) Previous erosion damage; (-1) Mainly of sand and silts; Good tillage technique (+1)	3.5
Bedessa	63.8	Clay	6	Self mulching (-0.5); slightly restricted B horizon (-0.5); Ridging on contour (+1)	6
Dire Dawa	22.84	Loam	5	(+2) deep well drained light textured soil; (-1) mainly of sands and silts	6
Gelemso	41.12	Sandy clay	5	(+1) Ridging on contour; Slightly restricted vertical drainage (-0.5); -0.5 previous erosion damage	5
Amadle	58	Silt clay	5	Slight surface crusting -(0.5), High swell- shrink potential -0.5), slightly restricted B horizon (High clay content in B horizon)-0.5	3.5
Dugda Hidi/Chinaksen	51.86	Silt clay	5	Slight surface crusting -(0.5), High swell- shrink potential -0.5), slightly restricted B horizon (High clay content in B horizon)-0.5	3.5
Karamara	29.26	Clay loam	5	Surface crusting -(0.5); calcareous soil (-0.5); (-1) Excessive soil loss in previous year;	3
Kersa/Lange	29.14	Sandy clay loam	5	Contour ploughing, and application of house refuse +1, Erosion evidence (-0.5)	5.5
Hamaresa	56.9	Clay	6	Previous erosion damage (-1), Ridges for moisture retention, (+1)	6
Hirna	60.32	Clay	6	High swell-shrink potential -0.5), slightly restricted B Horizon -0.5; Rock fragments +1, Erosion evidence (-0.5), Moisture retention practice (+1)	6.5

†Fb = Basic soil erodibility value estimated based mainly on the textural classes of the soils

‡Fm = Adjusted soil erodibility value after taking management factors into consideration

1.5 Calculated C values for SLEMSA at the study sites

1.5.1 AU Regosol

Months	Rainfall	Fraction of RF	Crop/Veg	Percent land use	% Cover per landuse	% Cover of total area	I (%Energy intercption)
Jan-Mar	123.38	0.15	Grasses	0.5	25	12.5	1.856
	123.38	0.15	Weeds	0.5	20	10	1.485
							<u>3.341</u>
A-J	273.25	0.33	Maize/sorghum	0.6	40	24.00	7.893
	273.25	0.33	Grasses	0.2	50	10.00	3.289
	273.25	0.33	Beans/weeds	0.2	30	6.00	1.973
							13.154
J-S	347.33	0.42	Maize/Sorghum	0.6	60.00	36.00	15.048
	347.33	0.42	Beans	0.2	70.00	14.00	5.852
	347.33	0.42	Grasses	0.2	70.00	14.00	5.852
							26.753
O-D	86.94	0.10	Maize/Sorghum	0.6	30.00	18.00	1.883
	86.94	0.10	Beans	0.2	15.00	3.00	0.314
	86.94	0.10	Grasses	0.2	40.00	8.00	0.837
							3.034
						Sum I	46.283
						C	0.062

1.5.2 AU Alluvial soils

Months	Rainfall	Fraction of RF	Crop/Veg	Percent land use	% cover per landuse	% cover of total area	I (%Energy intercption)
Jan-Mar	123.38	0.15	Grasses &weeds	1	10	10.00	1.485
							<u>1.485</u>
A-J	273.25	0.33	Sorghum/maize	0.5	40	20.00	6.577
	273.25	0.33	Grasses &weeds	0.5	50	25.00	8.222
							14.799
J-S	347.33	0.42	Sorghum/maize	0.5	60	30.00	12.540
	347.33	0.42	Beans	0.1	70	7.00	2.926
	347.33	0.42	Wheat	0.2	70	14.00	5.852
	347.33	0.42	potato	0.2	40	8.00	3.360
							24.679
O-D	86.94	0.10	Sorghum/maize	0.5	30	15.00	1.570
			Grasses &weeds	0.5	40	20.00	2.093
							3.662
						Sum I	<u>44.625</u>
						C	0.069

1.5.3 AU Vertisols

Months	Rainfall	Fraction of RF	Crop/Veg	Percent land use	% cover per landuse	% cover of total area	I (%Energy intercption)
Jan-Mar	123.38	0.15	Grasses &weeds	1	15	15.00	2.227 2.227
A-J	273.25	0.33	Maize/sorghum	0.5	40	20.00	6.577
	273.25	0.33	Grasses &weeds	0.5	50	25.00	8.222 14.799
J-S	347.33	0.42	Maize/sorghum wheat	0.5 0.5	60 70	30.00 35.00	12.540 14.630 27.171
O-D	86.94	0.10	Maize/sorghum	0.5	30	15.00	1.570
			Wheat Grasses and weeds	0.5	50	25.00	2.616 4.185
						Sum I	48.382
						C	0.055

1.5.4 Hamaressa soils

Months	Rainfall	Fraction of RF	Crop/Veg	Percent land use	% cover per landuse	% cover of total area	I (%Energy intercption)
Jan-Mar	123.38	0.15	Chat	0.6	25	15	2.227
		0.15	Trees/grass	0.4	35	14	2.079
						Mean I	<u>4.306</u>
A-J	273.25	0.33	Chat	0.6	30	18	5.919
		0.33	Sorghum	0.2	30	6	1.973
		0.33	Trees/grasses	0.2	50	10	3.289
						Mean I	<u>11.181</u>
J-S	347.33	0.42	Chat	0.6	40	24	10.032
		0.42	Sorghum	0.2	60	12	5.016
		0.42	Trees/grasses	0.2	60	12	5.016
						Mean I	<u>20.065</u>
O-D	86.94	0.10	Chat	0.6	25	15	1.570
		0.10	Sorghum	0.2	20	4	0.419
		0.10	Trees/grasss	0.2	35	7	0.732
						Mean I	<u>2.721</u>
						Sum I	38.273
						C	0.101

1.5.5 Babile Soils

Months	Rainfall	Fraction of RF	Crop/Veg	Percent land use	% cover per landuse	% cover of total area	I (%Energy intercption)
Jan-Mar	89.32	0.13	Chat	0.2	25	5	0.649
			Trees/Grasses	0.8	5	4	0.519
			Mean I				<u>1.168</u>
A-J	253.22	0.37	Chat	0.2	35	7	2.576
			Sorghum/maize/Groundnut	0.7	40	28	10.303
			Trees	0.1	20	2	0.736
Mean I				<u>13.615</u>			
J-S	287.48	0.42	Chat	0.2	35	7	2.924
			Sorghum/maize/Groundnut	0.7	55	38.5	16.084
			Trees	0.1	30	3	1.253
Mean I				<u>20.261</u>			
O-D	58.15	0.08	Chat	0.2	25	5	0.422
			Sorghum/maize/Groundnut	0.7	30	21	1.774
			Trees	0.1	10	1	0.084
Total	688.15	1.00					Mean I <u>2.281</u>
							Sum I 37.325
							C 0.107

1.5.6 Amadle Soils

Months	Rainfall	Fraction of RF	Crop/Veg	Percent land use	% cover per landuse	% cover of total area	I (%Energy intercption)
Jan-Mar	61.44	0.11	Maize/sorghum/Weeds	0.7	15	10.5	1.142
			Grass	0.3	25	7.5	0.816
						<u>18</u>	<u>1.958</u>
A-J	196.04	0.35	Maize/sorghum/Weeds	0.7	40	28	9.720
			Grass	0.3	50	15	5.207
						<u>43</u>	<u>14.927</u>
J-S	242.78	0.43	Maize/sorghum/Weeds	0.7	60	42	18.056
			Grass	0.3	80	24	10.318
						<u>66</u>	<u>28.374</u>
O-D	64.47	0.11	Maize/sorghum/Weeds	0.7	25	17.5	1.998
			Grass	0.3	50	15	1.712
						<u>32.5</u>	<u>3.710</u>
Total	564.72	1.00					Sum I 48.969
							C 0.053

1.5.7 Dugda Hidi Soils

Months	Rainfall	Fraction of RF	Crop/Veg	Percent land use	% cover per landuse	% cover of total area	I (%Energy intercption)
Jan-Mar	61.44	0.11	Grass	0.5	30	15	1.632
		0.11	Weeds	0.5	30	15	1.632
						<u>30</u>	<u>3.264</u>
A-J	196.04	0.35	maize/Sorghum	0.5	40	20	6.943
		0.35	Grass	0.5	60	30	10.414
						<u>50</u>	<u>17.357</u>
J-S	242.78	0.43	maize/Sorghum	0.5	60	30	12.897
		0.43	Grass	0.5	80	40	17.196
						<u>70</u>	<u>30.093</u>
O-D	64.47	0.11	maize/Sorghum	0.5	40	20	2.283
		0.11	Grass	0.5	60	30	3.425
						<u>50</u>	<u>5.708</u>
Total	564.72	1.00				Sum I	56.422
						C	0.058

1.5.8 Lange soils

Months	Rainfall	Fraction of RF	Crop/Veg	Percent land use	% cover per landuse	% cover of total area	I (%Energy intercption)
Jan-Mar	86.50	0.10	Sorghum/weeds	0.6	10	6	0.573
	87.50	0.10	Maize/weeds	0.3	5	1.5	0.145
	88.50	0.10	Potato/Onion	0.1	5	0.5	0.049
						8	0.766
A-J	248.34	0.27	Sorghum/weeds	0.6	40	24	6.575
	249.34	0.28	Maize/weeds	0.3	40	12	3.301
	250.34	0.28	Potato/Onion	0.1	10	1	0.276
						37	10.152
J-S	474.70	0.52	Sorghum/weeds	0.6	60	36	18.852
	475.70	0.52	Maize/weeds	0.3	60	18	9.446
	476.70	0.53	Potato/Onion	0.1	40	4	2.104
						58	30.402
O-D	96.93	0.11	Sorghum/weeds	0.6	40	24	2.566
	97.93	0.11	Maize/weeds	0.3	40	12	1.296
	98.93	0.11	Potato/Onion	0.1	20	2	0.218
Total	906.48	1.00				38	4.081
						Sum	45.401
						C	0.066

1.5.9 Hirna Soils

University of Pretoria etd – Bobe, B W (2004)

Months	Rainfall	Fraction of RF	Crop/Veg	Percent land use	% cover per landuse	% cover of total area	I (%Energy intercption)
Jan-Mar	106.48	0.13	Weeds	0.8	10	8	1.022
	106.48	0.13	Grass	0.2	20	4	0.511
						12	1.533
A-J	289.71	0.35	Sorghum/weeds	0.8	40	32	11.122
	289.71	0.35	Grass	0.2	50	10	3.476
						42	14.598
J-S	364.55	0.44	Sorghum/weeds	0.8	60	48	20.993
	364.55	0.44	Grass	0.2	70	14	6.123
						62	27.116
O-D	72.81	0.09	Sorghum/weeds	0.8	30	24	2.096
	72.81	0.09	Grass	0.2	50	10	0.873
						34	2.970
Total	833.54	1.00				Sum	46.216
						C	0.062

1.5.10 Chiro

Months	Rainfall	Fraction of RF	Crop/Veg	Percent land use	% cover per landuse	% cover of total area	I (%Energy intercption)
Jan-Mar	106.48	0.13	Weeds/Sorghum	0.7	15	10.5	1.341
	106.48	0.13	Grass/trees	0.1	20	2	0.255
	106.48	0.13	Chat	0.2	40	8	1.022
						20.5	2.619
A-J	289.71	0.35	Weeds/Sorghum	0.7	40	28	9.732
	289.71	0.35	Grass/trees	0.1	50	5	1.738
		0.35	Chat	0.2	50	10	3.476
						43	14.945
J-S	364.55	0.44	Weeds/Sorghum	0.7	60	42	18.369
	364.55	0.44	Grass/trees	0.1	80	8	3.499
		0.44	Chat	0.2	50	10	4.373
						60	26.241
O-D	72.81	0.09	Weeds/Sorghum	0.7	30	21	1.834
	72.81	0.09	Grass/trees	0.1	50	5	0.437
		0.09	Chat	0.2	40	8	0.699
Total	833.54	1.00				34	2.970
						Sum	46.775
						C	0.060

1.5.11 Bedessa Soils

Months	Rainfall	Fraction of RF	Crop/Veg	Percent land use	% cover per landuse	% cover of total area	I (%Energy intercption)
Jan-Mar	108.61	0.10	Sorghum/weeds	0.4	20	8	0.818
	108.61	0.10	Tef/weeds	0.3	30	9	0.920
	108.61	0.10	Chat/trees	0.3	50	15	1.533
						32	3.270
A-J	391.30	0.37	Sorghum/weeds	0.4	40	16	5.891
	391.30	0.37	Tef/weeds	0.3	30	9	3.314
	391.30	0.37	Chat/trees	0.3	55	16.5	6.075
						41.5	15.280
J-S	477.33	0.45	Sorghum/weeds	0.4	60	24	10.779
	477.33	0.45	Tef/weeds	0.3	70	21	9.432
	477.33	0.45	Chat/trees	0.3	60	18	8.085
						63	28.296
O-D	85.51	0.08	Sorghum/weeds	0.4	40	16	1.287
	85.51	0.08	Tef/weeds	0.3	30	9	0.724
	85.51	0.08	Chat/trees	0.3	50	15	1.207
Total	1062.75	1.00				40	3.218
						Sum	50.065
						C	0.060

1.5.12 Gelemso Soils

Months	Rainfall	Fraction of RF	Crop/Veg	Percent land use	% cover per landuse	% cover of total area	I (%Energy intercption)
Jan-Mar	112.18	0.10	Chat	0.5	50	25	2.441
	112.18	0.10	Maize/sorghum	0.4	20	8	0.781
	112.18	0.10	Others	0.1	50	5	0.488
						38	3.711
A-J	409.77	0.36	Chat	0.5	60	30	10.702
	409.77	0.36	Maize/sorghum	0.4	40	16	5.708
	409.77	0.36	Others	0.1	55	5.5	1.962
						51.5	18.372
J-S	467.23	0.41	Chat	0.5	70	35	14.237
	467.23	0.41	Maize/sorghum	0.4	60	24	9.762
	467.23	0.41	Others	0.1	60	6	2.441
						65	26.439
O-D	159.49	0.14	Chat	0.5	50	25	3.471
	159.49	0.14	Maize/sorghum	0.4	30	12	1.666
	159.49	0.14	Others	0.1	50	5	0.694
Total	1148.67	1.00				42	5.832
						Sum	54.354
						C	0.059

1.5.13 Diredawa Soils

Months	Rainfall	Fraction of RF	Crop/Veg	Percent land use	% cover per landuse	% cover of total area	I (%Energy intercption)
Jan-Mar	145.04	0.22	Orchards	0.5	50	25	5.562
	145.04	0.22	Papaya	0.3	30	9	2.002
	145.04	0.22	Vegetables&others	0.2	60	12	2.670
						46	10.235
A-J	204.69	0.31	Orchards	0.5	50	25	7.850
	204.69	0.31	Papaya	0.3	30	9	2.826
	204.69	0.31	Vegetables&others	0.2	60	12	3.768
						46	14.444
J-S	247.94	0.38	Orchards	0.5	60	30	11.411
	247.94	0.38	Papaya	0.3	50	15	5.705
	247.94	0.38	Vegetables&others	0.2	70	14	5.325
						59	22.441
O-D	54.21	0.08	Orchards	0.5	50	25	2.079
	54.21	0.08	Papaya	0.3	30	9	0.748
	54.21	0.08	Vegetables&others	0.2	60	12	0.998
Total	651.88	1.00				46	3.825
						Sum	50.944
						C	0.060

1.5.14 Karamara Soils

Months	Rainfall	Fraction of RF	Crop/Veg	Percent land use	% cover per landuse	% cover of total area	I (%Energy intercption)
Jan-Mar	61.44	0.11	Acatia Shrubs & Grasses	0.8	15	12	1.305
			Chat	0.2	20	4	0.435
			Total				<u>1.741</u>
A-J	196.04	0.35	Acatia Shrubs & Grasses	0.6	40	24	8.331
			Chat	0.2	25	5	1.736
			Sorghum	0.2	35	7	2.430
						Total	<u>12.497</u>
J-S	242.78	0.43	Acatia Shrubs & Grasses	0.6	60	36	15.477
			Chat	0.2	30	6	2.579
			Sorghum	0.2	55	11	4.729
						Total	<u>22.785</u>
O-D	64.47	0.11	Acatia Shrubs & Grasses	0.6	30	18	2.055
			Chat	0.2	20	4	0.457
			Sorghum	0.2	5	1	0.114
Total	564.72	1.00					<u>2.626</u>
						Sum I	39.648
						C	0.093

1.5.15 Adele soils

Months	Rainfall	Fraction of RF	Crop/Veg	Percent land use	% Cover per landuse	% Cover of total area	I (%Energy intercption)
Jan-Mar	123.38	0.15	Chat	0.6	30.00	18.00	2.673
	123.38	0.15	Grass	0.4	15	6.00	0.891
A-J	273.25	0.33	Maize/sorghum	0.4	40.00	40.00	13.154
		0.33	Chat	0.6	40	40.00	13.154
J-S	347.33	0.42	Maize/sorghum	0.4	60	24	10.032
		0.42	chat	0.6	50	30	12.540
O-D	86.94	0.10	Maize/sorghum	0.4	30	12	1.256
		0.10	Chat	0.6	30	18	1.883
							3.139
							<u>55.584</u>
						C	0.058

2. INPUT VARIABLES FOR USLE

2.1 Estimated mean annual rainfall erosivity R of the USLE for some sites in Harerge, eastern Ethiopia

Weather station	Annual rainfall mm	Rainfall erosivity factor, R [†]	(Study sites to which the same data was used)
Alemaya	830.9	459	AU Alluvial, AU Regosol, AU Vertisol, Adele and Hamaressa
Asebe Teferi	833.54	460	Chiro; Hirna
Babile	688.15	378	
Bedessa	1062.75	589	
Dire Dawa	651.88	358	
Gelemso	1148.67	637	
Jijiga	564.72	309	Amadle, Karamara, Dugda Hidi
Kersa/Lange	906.48	501	

[†]R is computed based on the adaptation of the erosivity factor of Wischmeier and Smith (1978) to Ethiopian conditions by Hurni (1985).

2.2 Permeability information for the major soil textural classes (Renard et al., 1991)

for use in estimating K value in USLE Wischmeier and Smith Nomograph.

Texture class	Permeability Class	Saturated Hydraulic conductivity mm/hr	[†] Permeability rating
Clay, Silty clay	6	<1	Very slow
Silty clay Loam, Sandy clay	5	1-2	Slow
Sandy Clay loam, Clay loam	4	2-5	Slow to moderate
Loam, Silty loam, silt	3	5-20	Moderate
Loamy sand, Sandy loam	2	20-60	Moderate to rapid
Sand	1	>60	Rapid

[†]Wischmeier, et al., 1971.

2.3 Soil structure codes for use in estimation of K value in USLE Wischmeier and Smith Nomograph

Structure codes†	Description
1	Very fine granular
2	Fine granular
3	Medium of course granular
4	Blocky, Platy or massive

†Wischmeier, et al., 1971.

2.4 Estimation of K value of USLE for selected sites in Harerghe, eastern Ethiopia

Study Site	% Silt and very fine sand	% Sand	Textural Class	%OM	Soil permeability index (b)	Soil structure index (a)	K Nomograph‡	§K Calc.
Adele	20.24	36.56	Sandy Clay	1.47	5	3	0.24	0.20
Amadle	37.02	7.80	Silt Clay	2.78	6	2	0.26	0.22
AU Alluvial	12.75	74.60	Sandy Loam	1.17	2	2	0.11	0.06
AU Regosol	19.52	53.05	Sandy Clay Loam	2.78	4	3	0.22	0.18
AU Vertisol	32.60	9.59	Clay	2.16	6	2	0.23	0.20
Babile	14.40	76.65	Sandy Loam	0.84	2	4	0.20	0.16
Bedessa	28.47	5.43	Clay	2.56	6	1	0.20	0.12
Chiro	†ND	ND	Clay	ND	6	2	0.23	0.10
Dire Dawa	40.49	34.85	Loam	0.88	3	2	0.30	0.29
Dugda Hidi	42.00	10.88	Silt Clay	2.51	6	2	0.28	0.27
Gelemso	11.29	48.9	Sandy Clay	1.18	5	4	0.23	0.20
Hamaresa	22.95	23.34	Clay	1.68	6	2	0.21	0.18
Hirna	39.81	6.5	Clay	2.90	6	2	0.24	0.22
Karamara	20.37	49.34	Clay Loam	1.72	4	4	0.25	0.23
Lange	25.50	47.38	Sandy clay Loam	2.03	4	3	0.23	0.22

‡ K Nomograph = K value estimated from Soil erodibility Nomograph (Wischmeier, et. al., 1971)

§K Calc. = K value calculated using equations of Wischmeier and Smith (1978)

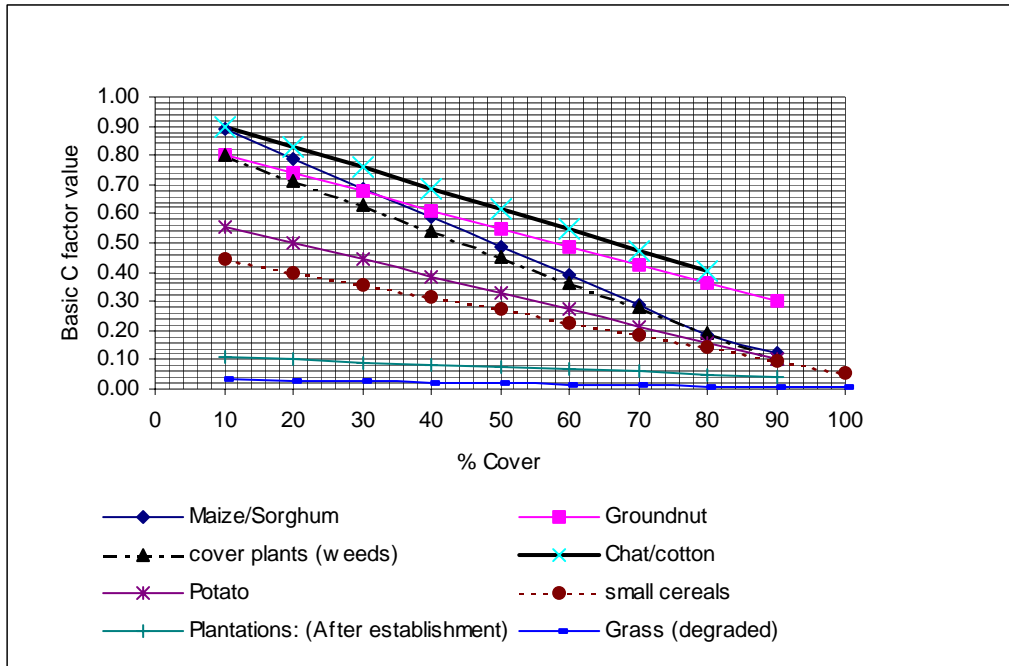
†ND= Not determined

2.5 Cover and management factor C for the USLE

2.5.1 Basic C factor values for the USLE

Practice	Average annual C factor	Remark
Bare soil	1.00	
Forest or dense shrub, high mulch crops	0.001	
Savanna or Prairie grass in good condition	0.01	
Overgrazed savanna or prairie grass	0.1	
Maize, sorghum or millet: High productivity, conventional tillage	0.20-0.55	
Maize, sorghum or millet: low productivity, conventional tillage	0.50-0.90	
Meadow grass	0.01-0.025	
Wheat	0.1-0.40	
Groundnuts	0.30-0.80	
Ethiopian tef	0.25	
Mungbean	0.04	
Coffee after first harvest	0.05	
Plantations: after establishment	0.05-0.1	
Papaya	0.21	
Cotton	0.40-0.70	
Potatoes: rows down slope	0.20-0.50	
Potatoes: rows across slope	0.10-0.40	

Sources: Rooth (1977); Wischmeier and Smith (1978); Hurni (1985); Morgan (1995)



2.5.2 Estimation of the basic USLE -C factor values for some crops from their percent cover based on the range of values presented in Appendix 2.5.1.

2.5.3 Calculation procedures of the weighted C factor values (indicated in Appendix 2.6) for USLE model

The weighted C value for a given crop i during a certain season of the year j is calculated as:

$$C_{wij} = R_{ij}U_{ij}C_{ij}$$

Where

C_{wi} = weighted C value of crop i during season j

R_{ij} = the ratio of season j rainfall to the mean annual rainfall

U_{ij} = ratio of land use for crop i to total land use during season j

C_{ij} = C value for a certain percent cover of crop i during season j

The weighted C value for the total land use during the jth season is

$$C_{ws} = \sum C_{w_{ij}}$$

Then, the annual weighted C value for each study site is computed as

$$C = \sum C_{ws} = \sum \sum R_{ij}U_{ij}C_{ij}$$

2.6 Calculated C value for USLE Model for the research sites

2.6.1 AU Regosol

Months	Rainfall	Fraction of RF	Crop/Veg	Percent land use	% cover per landuse	C value per crop/Ve gt	Weighted C
Jan-Mar	123.38	0.15	Grasses	0.5	25	0.03	0.002
	123.38	0.15	Weeds	0.5	20	0.70	0.052
							<u>0.054</u>
A-J	273.25	0.33	Maize/sorghum	0.6	40	0.59	0.116
	273.25	0.33	Grasses	0.2	50	0.03	0.002
	273.25	0.33	Beans/weeds	0.2	30	0.63	0.041
							0.159
J-S	347.33	0.42	Maize/Sorghum	0.6	60.00	0.39	0.098
	347.33	0.42	Beans	0.2	70.00	0.28	0.023
	347.33	0.42	Grasses	0.2	70.00	0.01	0.001
							0.122
O-D	86.94	0.10	Maize/Sorghum	0.6	30.00	0.69	0.043
	86.94	0.10	Beans	0.2	15.00	0.75	0.016
	86.94	0.10	Grasses	0.2	40.00	0.02	0.000
							0.059
						Sum C	0.395

2.6.2 AU Alluvial soils

Months	Rainfall	Fraction of RF	Crop/Veg	Percent land use by crop a	% cover per landuse	C value per crop/Ve gt	Weighted C
Jan-Mar	123.38	0.15	Grasses &weeds	1	10	0.45	0.067
							<u>0.004</u>
A-J	273.25	0.33	Sorghum/maize	0.5	40	0.59	0.097
	273.25	0.33	Grasses &weeds	0.5	50	0.45	0.074
							0.171
J-S	347.33	0.42	Sorghum/maize	0.5	60	0.39	0.082
	347.33	0.42	Beans	0.1	70	0.28	0.012
	347.33	0.42	Wheat	0.2	70	0.19	0.016
	347.33	0.42	potato	0.2	40	0.39	0.033
							0.142
O-D	86.94	0.10	Sorghum/maize	0.5	30	0.69	0.036
		0.10	Grasses &weeds	0.5	40	0.54	0.027
							0.063
					45.56	Sum	0.380

2.6.3 AU Vertisols

Months	Rainfall	Fraction of RF	Crop/Veg	%		C value per crop/VegtC	Weighted
				land use	per landuse		
Jan-Mar	123.38	0.15	Grasses &weeds	1	15	0.75	0.111 0.111
A-J	273.25	0.33	Maize/sorghum	0.5	40	0.59	0.097
	273.25	0.33	Grasses &weeds	0.5	50	0.45	0.074 0.171
J-S	347.33	0.42	Maize/sorghum	0.5	60	0.39	0.082
		0.42	wheat	0.5	70	0.19	0.040 0.121
O-D	86.94	0.10	Maize/sorghum	0.5	30	0.69	0.036
		0.10	Wheat Grasses and weeds	0.5	50	0.45	0.023 0.059
						Sum	0.462

2.6.4 Hamaressa soils

Months	Rainfall	Fraction of RF	crop/Veg	%		C value per crop/VegtC	Weighted
				land use	per landuse		
Jan-Mar	123.38	0.15	Chat	0.6	40	0.69	0.061
		0.15	Trees/grass	0.4	35	0.03	0.002 <u>0.063</u>
A-J	273.25	0.33	Chat	0.6	40	0.69	0.136
		0.33	Sorghum	0.2	40	0.59	0.039
		0.33	Trees/grasses	0.2	50	0.02	0.001 <u>0.176</u>
J-S	347.33	0.42	Chat	0.6	40	0.69	0.173
		0.42	Sorghum	0.2	60	0.39	0.033
		0.42	Trees/grasses	0.2	60	0.02	0.002 <u>0.207</u>
O-D	86.94	0.10	Chat	0.6	35	0.73	0.046
		0.10	Sorghum	0.2	20	0.79	0.017
		0.10	Trees/grasses	0.2	40	0.02	0.000 <u>0.063</u>
						Sum I	0.510

2.6.5 Babile Soils

Months	Rainfall	Fraction of RF	Crop/Veg	Percent land use	% cover per landuse	C value per crop/Veg	Weighted C
Jan-Mar	89.32	0.13	Chat	0.2	25	0.47	0.012
		0.13	Trees/Grasses	0.8	5	0.05	0.005
							<u>0.017</u>
A-J	253.22	0.37	Chat	0.2	35	0.72	0.053
		0.37	Sorghum/maize/Groundnut	0.7	40	0.59	0.152
		0.37	Trees	0.1	20	0.1	0.004
							<u>0.209</u>
J-S	287.48	0.42	Chat	0.2	35	0.72	0.060
		0.42	Sorghum/maize/Groundnut	0.7	55	0.44	0.129
		0.42	Trees	0.1	30	0.09	0.004
							<u>0.193</u>
O-D	58.15	0.08	Chat	0.2	25	0.8	0.014
		0.08	Sorghum/maize/Groundnut	0.7	30	0.69	0.041
		0.08	Trees	0.1	10	0.11	0.001
Total	688.15	1.00					<u>0.055</u>
						Sum	0.474

2.6.6 Amadle Soils

Months	Rainfall	Fraction of RF	Crop/Veg	Percent land use	% cover per landuse	C value per crop/Veg	Weighted C
Jan-Mar	61.44	0.11	Maize/sorghum/Weeds	0.7	15	0.84	0.064
		0.11	Grass	0.3	20	0.03	0.001
							<u>0.065</u>
A-J	196.04	0.35	Maize/sorghum/Weeds	0.7	30	0.69	0.168
		0.35	Grass	0.3	40	0.02	0.002
							<u>0.170</u>
J-S	242.78	0.43	Maize/sorghum/Weeds	0.7	50	0.49	0.147
		0.43	Grass	0.3	65	0.01	0.001
							<u>0.149</u>
O-D	64.47	0.11	Maize/sorghum/Weeds	0.7	25	0.74	0.059
		0.11	Grass	0.3	50	0.02	0.001
							<u>0.060</u>
Total	564.72	1.00				Sum	0.443

2.6.7 Dugda Hidi Soils

Months	Rainfall	Fraction of RF	crop/Veg	Percent land use	% cover per landuse	C value per crop/Veg	Weighted C
Jan-Mar	61.44	0.11	Grass	0.5	20	0.03	0.002
		0.11	Weeds	0.5	20	0.71	0.039
							<u>0.040</u>
A-J	196.04	0.35	maize/Sorghum	0.5	30	0.69	0.120
		0.35	Grass	0.5	40	0.02	0.003
							<u>0.123</u>
J-S	242.78	0.43	maize/Sorghum	0.5	50	0.49	0.105
		0.43	Grass	0.5	70	0.01	0.002
							0.107
O-D	64.47	0.11	maize/Sorghum	0.5	25	0.74	0.042
		0.11	Grass	0.5	40	0.02	0.001
							<u>0.043</u>
Total	564.72	1.00					0.314

2.6.8 Lange Soils

Months	Rainfall	Fraction of RF	crop/Veg	Percent land use	% cover per landuse	C value per crop/Veg	Weighted C
Jan-Mar	86.50	0.10	Sorghum/weeds	0.6	10	0.89	0.051
		0.10	Maize/weeds	0.3	5	0.95	0.028
		0.10	Potato/Onion	0.1	5	0.75	0.007
							0.086
A-J	248.34	0.27	Sorghum/weeds	0.6	40	0.59	0.097
		0.28	Maize/weeds	0.3	40	0.59	0.049
		0.28	Potato/Onion	0.1	10	0.56	0.015
							0.161
J-S	474.70	0.52	Sorghum/weeds	0.6	60	0.39	0.123
		0.52	Maize/weeds	0.3	60	0.39	0.061
		0.53	Potato/Onion	0.1	40	0.39	0.021
							0.204
O-D	96.93	0.11	Sorghum/weeds	0.6	40	0.59	0.038
		0.11	Maize/weeds	0.3	40	0.59	0.019
		0.11	Potato/Onion	0.1	20	0.5	0.005
Total	906.48	1.00					0.062
							0.514

2.6.9 Hirna Soils

Months	Rainfall	Fraction of RF	Crop/Veg	Percent land use	% cover per landuse	C value per crop/Veg	Weighted C
Jan-Mar	106.48	0.13	Weeds	0.8	10	0.8	0.082
	106.48	0.13	Grass	0.2	20	0.03	0.001
							0.083
A-J	289.71	0.35	Sorghum/weeds	0.8	40	0.59	0.164
	289.71	0.35	Grass	0.2	50	0.02	0.001
							0.165
J-S	364.55	0.44	Sorghum/weeds	0.8	60	0.39	0.136
	364.55	0.44	Grass	0.2	70	0.01	0.001
							0.137
O-D	72.81	0.09	Sorghum/weeds	0.8	30	0.69	0.048
	72.81	0.09	Grass	0.2	50	0.02	0.000
							0.049
Total	833.54	1.00					0.434

2.6.10 Chiro

Months	Rainfall	Fraction of RF	Crop/Veg	Percent land use	% cover per landuse	C value per crop/Veg	Weighted C
Jan-Mar	106.48	0.13	Weeds/Sorghum	0.7	15	0.84	0.075
	106.48	0.13	Grass/trees	0.1	20	0.1	0.001
	106.48	0.13	Chat	0.2	40	0.69	0.018
							0.094
A-J	289.71	0.35	Weeds/Sorghum	0.7	40	0.59	0.144
	289.71	0.35	Grass/trees	0.1	50	0.08	0.003
		0.35	Chat	0.2	50	0.62	0.043
							0.189
J-S	364.55	0.44	Weeds/Sorghum	0.7	60	0.39	0.119
	364.55	0.44	Grass/trees	0.1	80	0.05	0.002
		0.44	Chat	0.2	50	0.62	0.054
							0.176
O-D	72.81	0.09	Weeds/Sorghum	0.7	30	0.69	0.042
	72.81	0.09	Grass/trees	0.1	50	0.08	0.001
		0.09	Chat	0.2	40	0.69	0.012
							0.055
Total	833.54	1.00					0.514

2.6.11 Bedessa Soils

Months	Rainfall	Fraction of RF	Crop/Veg	Percent land use	% cover per land use	C value per crop/Veg	Weighted C
Jan-Mar	108.61	0.10	Sorghum/weeds	0.4	20	0.79	0.032
	108.61	0.10	Tef/weeds	0.3	30	0.44	0.013
	108.61	0.10	Chat/trees	0.3	50	0.35	0.011
							0.057
A-J	391.30	0.37	sorghum/weeds	0.4	40	0.59	0.087
	391.30	0.37	Tef/weeds	0.3	30	0.44	0.049
	391.30	0.37	Chat/trees	0.3	55	0.33	0.036
							0.171
J-S	477.33	0.45	sorghum/weeds	0.4	60	0.39	0.070
	477.33	0.45	Tef/weeds	0.3	70	0.27	0.036
	477.33	0.45	Chat/trees	0.3	60	0.31	0.042
							0.148
O-D	85.51	0.08	sorghum/weeds	0.4	40	0.59	0.019
	85.51	0.08	Tef/weeds	0.3	30	0.44	0.011
	85.51	0.08	Chat/trees	0.3	50	0.35	0.008
Total	1062.75	1.00					0.038
							0.414

2.6.12 Gelemso Soils

Months	Rainfall	Fraction of RF	crop/Veg	Percent land use	% cover per land use	C value per crop/Veg	Weighted C
Jan-Mar	112.18	0.10	Chat	0.5	50	0.62	0.030
	112.18	0.10	Maize/sorghum	0.4	20	0.79	0.031
	112.18	0.10	Others	0.1	50	0.5	0.005
							0.066
A-J	409.77	0.36	Chat	0.5	60	0.55	0.098
	409.77	0.36	Maize/sorghum	0.4	40	0.59	0.084
	409.77	0.36	Others	0.1	55	0.45	0.016
							0.198
J-S	467.23	0.41	Chat	0.5	70	0.47	0.096
	467.23	0.41	Maize/sorghum	0.4	60	0.39	0.063
	467.23	0.41	Others	0.1	60	0.4	0.016
							0.175
O-D	159.49	0.14	Chat	0.5	50	0.62	0.043
	159.49	0.14	Maize/sorghum	0.4	30	0.69	0.038
	159.49	0.14	Others	0.1	50	0.5	0.007
Total	1148.67	1.00					0.088
							0.528

2.6.13 Diredawa Soils

Months	Rainfall	Fraction of RF	crop/Veg	Percent land use	% cover per landuse	C value per crop/Veg	Weighted C
Jan-Mar	145.04	0.22	Orchards	0.5	50	0.08	0.009
	145.04	0.22	Papaya	0.3	30	0.21	0.014
	145.04	0.22	Vegetables&others	0.2	60	0.4	0.018
							0.041
A-J	204.69	0.31	Orchards	0.5	50	0.08	0.013
	204.69	0.31	Papaya	0.3	30	0.21	0.020
	204.69	0.31	Vegetables&others	0.2	60	0.4	0.025
							0.057
J-S	247.94	0.38	Orchards	0.5	60	0.07	0.013
	247.94	0.38	Papaya	0.3	50	0.21	0.024
	247.94	0.38	Vegetables&others	0.2	70	0.3	0.023
							0.060
O-D	54.21	0.08	Orchards	0.5	50	0.08	0.003
	54.21	0.08	Papaya	0.3	30	0.21	0.005
	54.21	0.08	Vegetables&others	0.2	60	0.4	0.007
Total	651.88	1.00					0.015
							0.173

2.6.14 Karamara Soils

Months	Rainfall	Fraction of RF	crop/Veg	Percent land use	% Cover per landuse	C value per crop/Veg	Weighted C
Jan-Mar	61.44	0.11	Acatia Shrubs & Grasses	0.8	25	0.75	0.065
		0.11	Chat	0.2	20	0.83	0.018
							<u>0.083</u>
A-J	196.04	0.35	Acatia Shrubs & Grasses	0.6	40	0.6	0.125
		0.35	Chat	0.2	40	0.69	0.048
		0.35	Sorghum	0.2	35	0.6	0.042
							<u>0.215</u>
J-S	242.78	0.43	Acatia Shrubs & Grasses	0.6	60	0.4	0.103
		0.43	Chat	0.2	50	0.62	0.053
		0.43	Sorghum	0.2	55	0.4	0.034
							<u>0.191</u>
O-D	64.47	0.11	Acatia Shrubs & Grasses	0.6	35	0.65	0.045
		0.11	Chat	0.2	35	0.73	0.017
		0.11	Sorghum	0.2	5	0.95	0.022
Total	564.72	1.00					<u>0.083</u>
							0.572

2.6.15 Adele soils

Months	Monthly Rainfall	Fraction of RF	crop/Veg	Percent land use	% cover per landuse	C value per crop/Veg	Weighted C
Jan-Mar	123.38	0.15	Chat	0.6	30	0.76	0.068
	123.38	0.15	Grass	0.4	15	0.03	0.002
A-J	273.25	0.33	Maize/sorghum	0.4	40	0.59	0.078
		0.33	Chat	0.6	40	0.69	0.136
J-S	347.33	0.42	Maize/sorghum	0.4	60	0.39	0.065
		0.42	chat	0.6	50	0.62	0.156
O-D	86.94	0.10	Maize/sorghum	0.4	30	0.69	0.029
		0.10	Chat	0.6	30	0.76	0.048
							0.077
							0.581

2.7 Basic P-factor values for the Universal Soil Loss Equation

Erosion control practice	P-factor value
Contouring 0-1° slope	0.60†
Contouring 2-5° slope	0.50†
Contouring 6-7° slope	0.60†
Contouring 8-9° slope	0.70†
Contouring 10-11° slope	0.80†
Contouring 12-14° slope	0.90†
Level bench terrace	0.14
Reverse slope bench terrace	0.05
Outward-sloping bench terrace	0.35
Level retention bench terrace	0.01
Tied ridging	0.1-0.20

†Use 50% of the value for contour bunds or if contour strip cropping is practiced.

After Wischmeier and Smith (1978); Roose, (1977); Chan, (1981) (Quoted by Morgan, 1995)

2.8 Estimation of slope factors and P values for the research sites for use

in USLE model

Study sites	Slope gradient (S) %	Slope length L	LS factor	Remark	P factor (USLE)
Adele	10	200	3.50		0.5
Amadle	5	80	0.86		0.5
AU Alluvial	1	300	0.25		0.6
AU Regosol	10	100	2.48		0.6
AU Vertisol	1	200	0.23		0.6
Babile	12	100	3.28	Bunds at 100m interval	0.6
Bedessa	8	60	1.38	Soil Bunds at 60m interval	0.3
Chiro	25	20	4.99	Stone terraces 20m interval	0.14
Dire Dawa	2	300	0.40		0.5
Dugda Hidi	4	300	0.99		0.5
Gelemso	15	50	3.31		0.6
Hamaresa	25	20	4.99	Bunds at 20m interval	0.4
Hirna	15	40	2.96	Stone terraces 50 m interval	0.14
Karamara	12	100	3.28		0.7
Lange	10	120	2.71	Soil Bunds at 20m apart	0.3

2.9 Input variables for the Universal Soil Loss Equation (USLE) adapted for Ethiopia (Hurni, 1985; Nyssen, et al, 2003).

R. Rainfall erosivity

Mean annual rainfall (mm)	100	200	400	800	1200	1600	2000	2400
Annual factor R [†]	48	104	217	441	666	890	1115	1340

K. Soil erodibility

Soil color	Black	Brown	Red	Yellow
Factor K	0.15	0.20	0.25	0.30

L. Slope length

Length m	5	10	20	40	80	160	240	320
Factor L	0.5	0.7	1.0	1.4	1.9	2.7	3.2	3.8

S. Slope gradient

Slope, %	5	10	15	20	30	40	50	60
Factor S	0.4	1.0	1.6	2.2	3.0	3.8	4.3	4.8

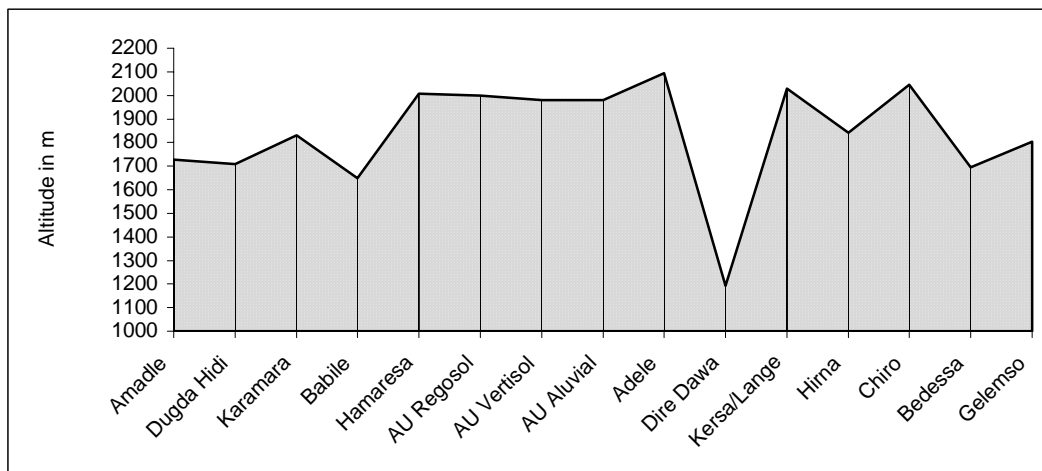
C. Land cover factor

Dense forest	0.001	Dense grass	0.01
Other forests	0.01-0.05	Degraded grass	0.05
Badland hard	0.05	Fallow hard	0.05
Badland soft	0.40	Fallow ploughed	0.60
Sorghum, Maize	0.10	Ethiopian teff	0.25
Cereals, Pulses	0.15	Continuous fallow	1.00

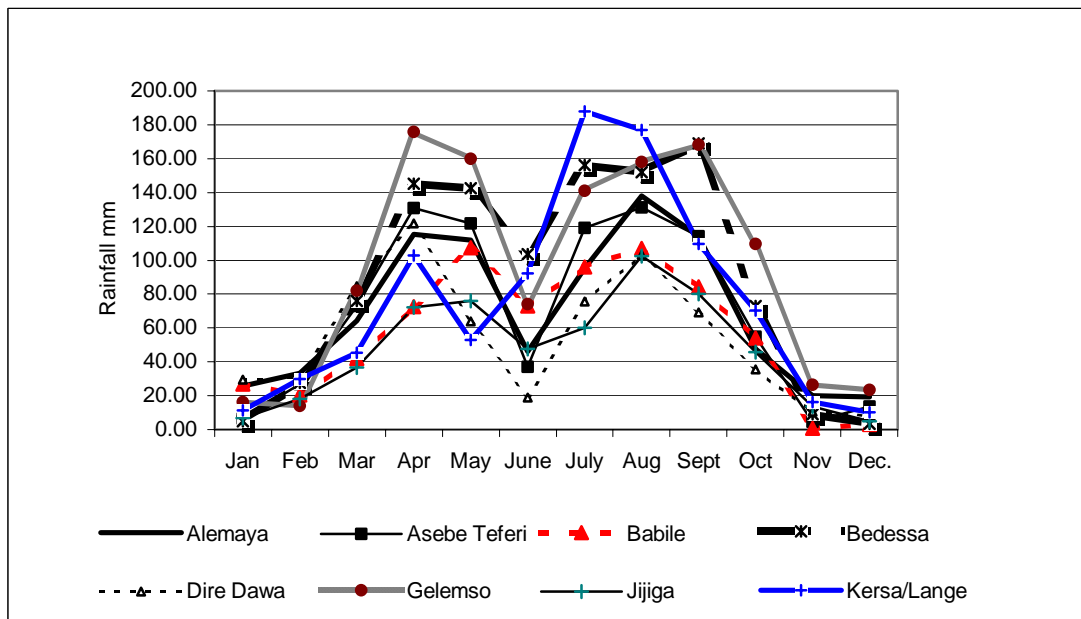
P. Management factor

Ploughing up and down	1.0	Ploughing on contour	0.9
Strip cropping	0.8	Intercropping	0.8
Applying mulch	0.6	Dense intercropping	0.7
Stone cover 80%	0.5	Stone cover 40%	0.8

[†]R in J cm m⁻²h⁻¹ year⁻¹(Nyssen, et al. 2003); K is also in SI units following Wischmeier and Smith's (1978) conversion coefficient



3. AVERAGE ALTITUDES OF THE STUDY SITES IN HARERGE, EASTERN ETHIOPIA



4. MEAN MONTHLY RAINFALL AT THE STUDY SITES IN HARERGE, EASTERN ETHIOPIA

Altitude in metres above sea level	More than 3700		HIGH WURCH	
	3700 to 3200		MOIST WURCH WET WURCH	
	3200 to 2300		MOIST DEGA WET DEGA	
	2300 to 1500	DRY WEYNA DEGA <i>Adele, Alemaya (AU Alluvial, Regosol, Vertisol,)</i> , <i>Babile, Chiro Jijiga (Amadle, Dugda Hidi, Karamara) Hamaressa, Hirna, Lange</i>	MOIST WEYNA DEGA <i>Bedessa Gelemso</i>	WET WEYNA DEGA
	1500 to 500	DRY KOLLA Diredawa	MOIST KOLLA	
	Below 500	BERHA		

Less than 900	900 to 1400	More than 1400
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Annual Rainfall (mm)

5. AGROCLIMATIC ZONES OF THE STUDY SITES (shaded area) WITH REFERENCE TO THAT DESCRIBED FOR ETHIOPIA BY HURNI, 1986)