CHAPTER 3

MATERIALS AND METHODS

3.1. MODEL SELECTION

Various erosion models and field assessment methods exist. Not all of them are suitable to be applied for the intended purpose and study area (Appendix 1). According to Morgan (1995), any attempt to use a model for conditions other than those specified should be viewed as a bad practice and, at best, speculative. For that reason, the first objective of this study was to evaluate erosion models and field assessment methods theoretically to select those suitable as soil erosion evaluation tools for use in P&ME in LandCare projects (Section 1.1). Literature on potential models and field assessment methods was studied to evaluate it theoretically to eliminate those unsuitable as soil erosion evaluation tools for use in P&ME in LandCare projects.

3.2. POTENTIAL EROSION MODELS AND FIELD ASSESSMENT METHODS

The requirements for ideal erosion model or field assessment method suitable as a soil erosion evaluation tool for use in P&ME in LandCare projects were that it should be able to:

- Realistically simulate all the important erosion processes occurring on a farmers field or plot;
- Take account of all the dominant erosion factors occurring on a farmer's field or plot;
- Assess the extent to which the various factors will influence erosion;
- Assess the impacts of various land use and management practices;
- Predict erosion for areas of ≈ 1 ha;
- Use available data emanating from a LandCare project;
- Be relatively simple to apply;

Unfortunately, many of the ideal characteristics of erosion models and field assessment methods would conflict with each other.

In order to evaluate different types of erosion models and field assessment methods, a model or assessment method was selected for each type that would serve as an example (Table 3.1). These models were selected because they are widely used and have been evaluated under different conditions.

3.3. EVALUATION OF EROSION MODELS

Different types of erosion models and field assessment methods were evaluated by using a model and assessment method that would serve as an example for each model type (Table 3.1). These models and field assessment method were evaluated according to the following criteria that are summarised in Appendix 1:

- The kind of erosion that is predicted (soil loss, sediment yield or both);
- Type of model (e.g. empirical, conceptual, physically-or process based);
- Purpose for which the model was developed for;
- The size of prediction area for which the model was developed for;
- Type of erosion that are simulated (e.g. interrill, rill, gully, streambank, bedload);
- Erosion processes that are simulated;
- Erosion factors that are accounted for;
- To what extend was the model applied under South African conditions;
- Ease of data file preparation;
- Spatial and temporal distribution of data.

Simple statistical equations are not suitable to be applied as a soil erosion evaluation tools for use in P&ME in LandCare projects. The reason being that, the equations cannot be extrapolated beyond their data range from which it was developed for and must be calibrated if it is to be used in other geographical areas, as model parameters are locations specific. The equations give also no indication of why erosion takes place and could not be applied with confidence to predict the impact of different land management practices scenarios (Morgan, 1995). MUSLE (Appendix 1) can also not be used as a soil erosion evaluation tools for use in P&ME as it was developed to predict sediment yield for basin-sized catchments (> 1000ha) (Williams, 1975).

The mechanistic models (physically- and process-based) simulate the erosion processes more realistically than factor-based models. Erosion processes comprise of soil particle detachment by impacting raindrops and flowing of water, sediment transportation by raindrop splash and flowing water, and sediment deposition. Factor-based models simulate these processes in a lumped manner by using one standard equation. While, mechanistic models simulate the processes in a distributed way by using five main equations. This include particle detachment rate by raindrop impact, particle detachment rate by runoff, transport capacity by rainfall, transport capacity of runoff, and deposition rate in rill flows and channels ((Beasly *et al.,* 1980; Nearing *et al.,* 1994; Morgan, 1995). The detachment process is different from the transport-deposition processes, so they cannot be grouped together into a single equation. Since the equations for simulating the detachment and transport-deposition processes are best considered separately, factor-based models cannot give the best predictions over a broad range of conditions (Foster *et al.,* 1981). The improved simulation of erosion processes by mechanistic models bring about that the fate of detached soil particles in ephemeral gullies and impoundments are predicted in addition to interrill and rill areas. Mechanistic models also take account of runoff and peak discharge in addition to the rainfall erosivity factor. Furthermore, mechanistic models as to factor-based models that predict soil loss only, predict both soil loss and sediment yield. As a result, the application of mechanistic models would have an advantage over factor-based models, because the off-site effects (due to sediment yield) could be predicted in addition to on-site effects (due to soil loss).

The practical value of any model cannot only be evaluated on a scientific basis and with regard to how the erosion processes are simulated, but also on the availability of its required inputs. The accuracy and amount of inputs required and ease of input data file preparation is most often the limiting factor for model application (Morgan, 1986; Morgan, 1995). Appendix 2 summarises the minimum inputs required for USLE, SLEMSA, RUSLE, CREAMS, WEPP and ACED.

Adequate, reliable, spatially distributed data required by mechanistic models was not available for the selected study area (Appendix 2). This imposes a major constraint on model application in LandCare projects. Compared to USLE-based models, most of the mechanistic models, or components thereof, were not tested or researched in southern Africa. Due to unavailability of the required input data for mechanistic models from LandCare projects, factor-based models were to a large extent the only models that could be run with the available data (Smith, 1999). Thus, the use of erosion evaluation tools for

P&ME in LandCare projects were guided mainly by erosion predictions done with the soil loss models USLE, SLEMSA and RUSLE.

Table 3.1. Erosion models and field assessment methods that would serve as an example for each type of erosion model / field assessment method

TYPE OF MODEL		MODEL	ACRONYM	REFERENCE	APPLICABLE TO STUDY
Factor-based models	Statistical equations				
	Empirical soil loss	Universal Soil Loss Equation	USLE	Wischmeier and Smith, 1965	YES
		Soil Loss Estimator of Southern Africa	SLEMSA	Elwell and Stocking, 1982	YES
	Conceptual soil loss	Revised Soil Loss Equation	RUSLE	Renard *et al.*, 1991	YES
	Sediment-runoff	Modified Universal Soil Loss Equation	MUSLE	Williams, 1975	NO
Mechanistic models	Physically-based	Chemicals, Runoff and Erosion from Agricultural Management Systems	CREAMS	Knisel, 1980	YES
	Process-based	Water Erosion Prediction Project	WEPP	Nearing *et al.*, 1989	YES
Field assessment methods		Assessment of Current Erosion Damage	ACED	Herweg, 1996	YES

[a] not yet available for use.

3.4. SELECTED MODELS AND FIELD ASSESSMENT METHOD

The SLEMSA (Soil Loss Estimator for Southern Africa), RUSLE (Revised Universal Soil Loss Equation) erosion models and the ACED (Assessment of Current Erosion Damage) field assessment method were selected to test their suitability as soil erosion evaluation tools for use in P&ME in LandCare projects. SLEMSA is an empirical soil loss model and RUSLE is a conceptual soil loss model.

The RUSLE and SLEMSA models have been applied in South Africa as long-term annual estimates of soil losses from rill and interrill erosion. Therefore, sufficient data is available to run SLEMSA and RUSLE. The flexibility and computerised format of RUSLE makes it possible to evaluate other conditions not possible with SLEMSA. RUSLE retains the same basic structure of USLE, though it incorporates new concepts from process-based erosion modeling and the algorithms used to calculate individual USLE factors, such as climate erosivity, soil's erodibillity and cover management, have been changed significantly (Renard et al., 1994). Attempts have also been made to apply RUSLE to predict sediment yield using a concept similar to that of sediment-runoff models. At present, RUSLE is the state-of the-art soil loss model to predict rill and interill erosion.

The development of SLEMSA was based on southern African conditions (Elliot et al., 1989) and is most widely applied in southern African environments, such as in Zimbabwe and South Africa to predict soil loss by interrill erosion from arable lands and as conservation planning tool (Elwell and Stocking, 1982). However, if SLEMSA is not being applied to the Zimbabwean highveld for where it was developed or in KwaZulu-Natal, the predictions should only be used as ratings such as low or high erosion risk area (Elwell, 1996).

The field assessment method, ACED, is designed for monitoring and assessing soil erosion damage due to rill and gully erosion (Herweg, 1996). It is both a quantitative and qualitative factor-based soil loss assessment tool. Strictly speaking, ACED is neither a universal nor means of predicting soil loss. However, ACED can be applied to make long-term estimates of erosion such as annual soil losses. Although ACED was developed in temperate European zones, it has been modified and adapted for use in subtropical and tropical environments (Herweg, 1996). The method can also be utilised as a support tool for measurements that are lacking between plot and catchment measurements and also to assess on-site and off-site erosion damage.

According to Smith (1999), RUSLE is at present, the most applicable and dynamic factor-based soil loss model and is applicable to a wide range of conditions such as to predict soil loss for plots, on hillslopes and for field-size catchments. SLEMSA requires less input and is relatively easier to apply than RUSLE, but its sensitivity makes it less reliable than RUSLE. Lack of available inputs may also restrict application of RUSLE to a certain degree.

Smith (1999) have investigated the application of the field assessment methods, as described by SARCCUS (1981); Thwaites (1986); Tongway (1994); Tongway and Hindley (1995); Herweg (1996) and Taylor (1998), in Mpumalanga and Gauteng provinces of South Africa. According to his experience the ACED method, although is theoretically less accurate compared to RUSLE and SLEMSA, is the most appropriate practical method for participatory research and a field-training tool. Firstly, ACED allows the user to select the inputs with ease depending on the objective of the erosion damage assessment. Secondly, the complexity of the area can be handled with simplicity by focussing on the damaged area, thereby making it easy to select the inputs. However, the shortcomings of ACED are that it requires an experienced user or the user must have background knowledge of the erosion process and soil and water conservation, hence the design of conservation strategies (Herweg, 1996). Furthermore, handling the inputs of ACED might prove tiresome and difficult; firstly, due to the complexity of the rills or the damaged area; secondly, quick assessment might be complicated depending on the level of experience.

3.5. STUDY AREA

3.5.1. Selection of study area

For this study an area was selected that included several aspects that could be studied in a catchment. The study area was chosen since it,
(1) Lacks sustainable farming systems under the present communal land use;
(2) Experience intense rainfalls;
(3) Shows significant signs of erosion; and
(4) Has low soil fertility.

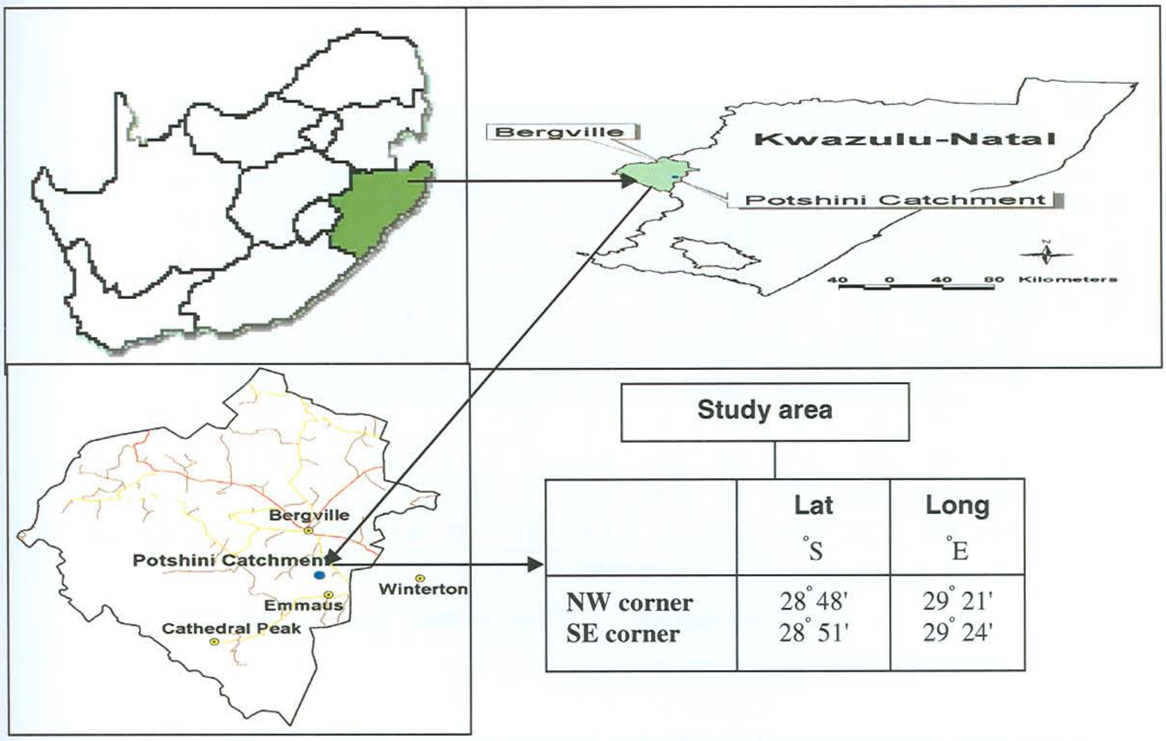
In the study area, some hillslopes showed visible erosion damage that could be used to make field assessments of erosion. The study area is representative of a typical socio-economic and agro-ecological region targeted by a LandCare project, where land degradation and sustainable land management and conservation practices can be applied to improve and maintain soil productivity.

The study area is characterised predominantly as an area used for communal livestock grazing and subsistence-based maize cropping. The cultivation is carried out with low inputs in small fields of approximately 1–5ha. The communal livestock grazing and subsistence cropping practices are the major environmental and agricultural impacting factors that cause erosion damage to the hillslopes of the study area.

3.5.2. General description of study area

3.5.2.1. Location

The selected study area was in the Potshini catchment, which is situated in the Bergville region of KwaZulu-Natal Province. The approximate location of the study area is shown by Figure 3.1 and is bound by the following co-ordinates.

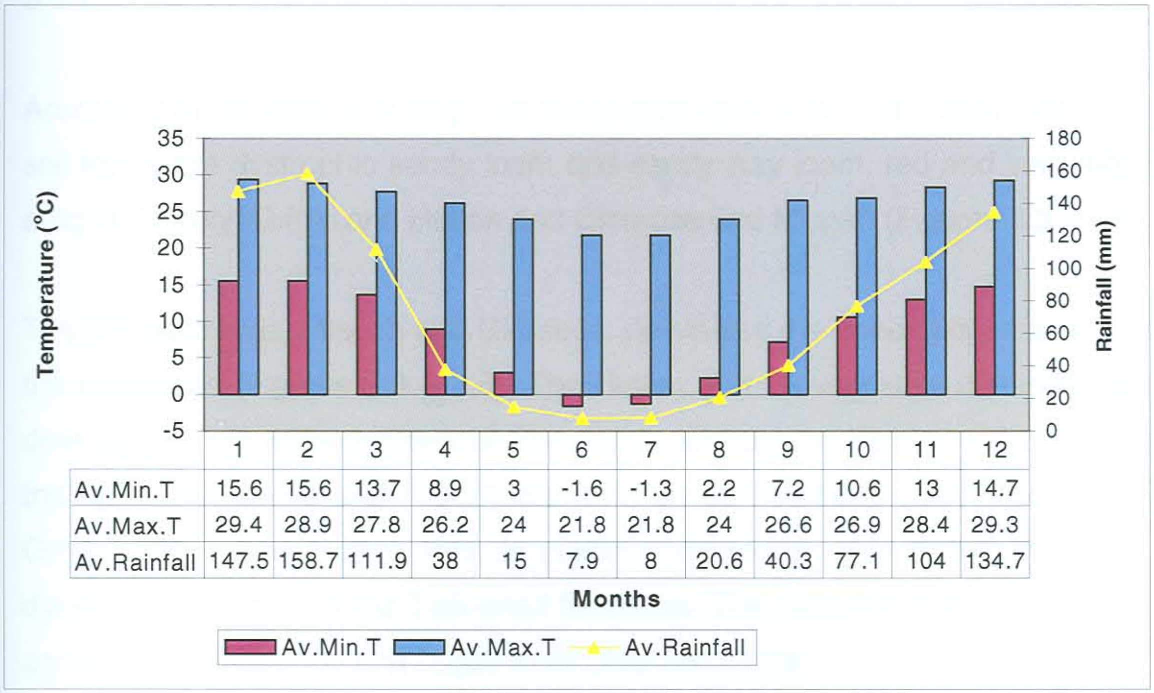


	Lat °S	Long °E
NW corner	28°48'	29°21'
SE corner	28°51'	29°24'

Figure 3.1. Maps and co-ordinates show the location of the study area in the Potshini catchment

3.5.2.2. Climate

The study area falls within the highland sourveld (moist) bio-climatic region of KwaZulu-Natal. Climatic data was obtained from Winterton rainfall station no. 19773 (Agricultural Research Council, 2000). The area receives an average annual rainfall of 864mm that falls mostly in mid-summer rainfall. The average rainfall intensity is approximately 32 mm.day^{-1} and was calculated according to Yu and Neil (1991). According to Elwell and Stocking (1973), the associated rainfall erosivity is approximately 16 700 J/m^2/yr. The mean day temperature ranges between 8 and 26°C. Figure 3.2 illustrates the distribution of long-term mean monthly minimum and maximum temperatures and rainfall.



	1	2	3	4	5	6	7	8	9	10	11	12
Av.Min.T	15.6	15.6	13.7	8.9	3	-1.6	-1.3	2.2	7.2	10.6	13	14.7
Av.Max.T	29.4	28.9	27.8	26.2	24	21.8	21.8	24	26.6	26.9	28.4	29.3
Av.Rainfall	147.5	158.7	111.9	38	15	7.9	8	20.6	40.3	77.1	104	134.7

Figure 3.2. Mean monthly minimum and maximum temperatures and rainfall

3.5.2.3. Topography

The study area is characterised by rock outcrops crests with relatively extensive midslopes and short footslopes. The crests are convex shaped followed by concave-linear topography with steep gradients on the upper areas of the hillslopes (Appendix 3, Table 1, 3, 5 and 7). The effect of extensive slope length and gradient on soil erosion has been investigated by many researchers and found to be generally dependent on locally dominant soil erosion processes (Kirkby, 1969, 1971).

3.5.2.4. Geology and underlying material

The study area is underlain by shale and sandstone of the Estcourt formation, Beaufort group and sandstone and mudstone of the Tarkastad formation. The Estcourt formation is described as comprising of dark-grey shale, siltstone and fine and medium to coarse sandstone (Geological Survey 1981a; Geological Survey 1988b; Geological Survey 1988c; as quoted by Turner, 2000).

3.5.2.5. Soils

According to the land-type map, the study area falls in two main land types. The dominant soil forms are dystrophic sandy loam and sandy clay loam, red and yellow-brown apedal soils of Clovely, Griffin and Hutton and Glenrosa and Mispah (Figures 3.3 – 3.6).

The lithosolic soils, Mispah and Glenrosa, dominates the upper slopes and stretches up to the midslopes (Figures 3.3 – 3.6). The Hutton and Clovely soils dominates the midslope downwards, with little portions of Shortlands and duplex Escourt soil forms occurring on the upper midslopes and Avalon soil form on the footslope (Soil Classification Working Group, 1991). The Hutton form is probably developed due to the influence of dolerite dykes, which is part of the Tarkastad formation. The lithosolic and duplex soils are of less agricultural importance and fragile to erosive conditions.

3.5.2.6. Vegetation

According to Acocks (1953), the vegetation types in the western part of the study area consist largely of north-eastern mountain and moist upland grassland. In the east the vegetation is described as moist cool highland grassland, or as wet cold highland grassland. The veld is sour, but has a good early-season growth and palatability, though deteriorating rapidly after mid-summer and has very little value in winter (Acocks, 1953).

3.5.2.7. Land use

The land use of the study area is divided into two major parts, as cropped area and rangeland. The rangeland is mainly utilised as communal grazing land, whereas the cropped land is utilised mainly for dry-land maize production, although other crops such as *Canibus sativa* are also planted either as intercrops or for crop rotation (Appendix 5, Plate 9).

3.5.3. Experimental layout

3.5.3.1. Field survey

Four representative hillsllopes were identified in the study area and by means of transact walks were selected and characterised according to morphological appearance, vegetation variations and land use on the land facets. The land facets are defined as small segments of the hillslope characterised according vegetation characteristics, topography and soil forms. The four selected hillslopes were classified either as cropland or rangeland or combination of the two. A GPS was used to locate the co-ordinates of the study area and a 1: 50000 aerial-photo as well as land-type maps were used to identify the study area and major land types that occur.

3.5.3.1.1. Hillslope land facet characterization

The criteria used to distinguish different land facets on the selected hillslopes were based on the description of soil erosion factors such as vegetation characteristics, topography and soil forms.

A soil auger and South African soil classification system were used to classify soils and locate their boundaries. Slope gradients, lengths and widths were determined using inclinometer and length-measuring wheel. The sizes of the rills and gullies were measured on each land facet with a 30cm ruler, measuring tape and length-measuring wheel. Plate 8(a) and (b) (Appendix 5) illustrate rill measurements on the land facets with a 30cm ruler. Vegetation was described as percentages canopy (vegetation cover above 5cm) and ground cover (vegetation cover up to 5cm) by applying default files in RUSLE model. The percentage vegetation cover was determined in the field using a square-meter block. Canopy cover includes standing dead and alive vegetation, whereas, ground cover includes basal cover, surface residue such as vegetation litter and rocks.

Appendix 3 summarises the description of the erosion factors and parameters on the various hillslopes used to characterise the land facets. The numbers and symbols in the tables are also explained according to instructions below a table. The hillslopes were divided and characterised as follows.

(i) Hillslope 1

Hillslope 1 is a north-east facing transact divided into 10 land facets. The entire hillslope is under rangeland utilised for communal grazing and is without conservation measures. The upper parts of the crests are covered by rock outcrop, while the lower part consists of Mispah soil forms, which extend on to the midslopes. The Glenrosa, Escourt and Hutton soil formed an association on the midslopes land facets. The hillslope has steep slope gradient and extensive slope length of approximately 351m (Figure 3.3). Also, it has fairly average canopy and poor ground cover (Appendix 3, Table 2).

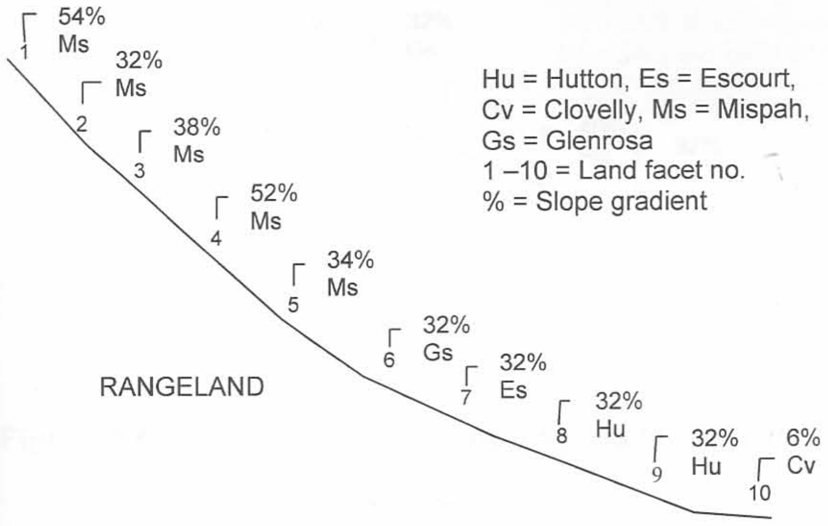


Figure 3.3. Hillslope 1 showing slope gradients and soil forms on the rangeland land facets

(ii) Hillslope 2

Hillslope 2 is a north-east facing transact, divided as rangeland and cropland. The rangeland constitutes the upper land facets (1 – 5), whilst the cropland covers the bottom part of the hillslope land facets (6 – 13). The hillslope has an average steep gradient of 33.9% and slope length of 228.5m.

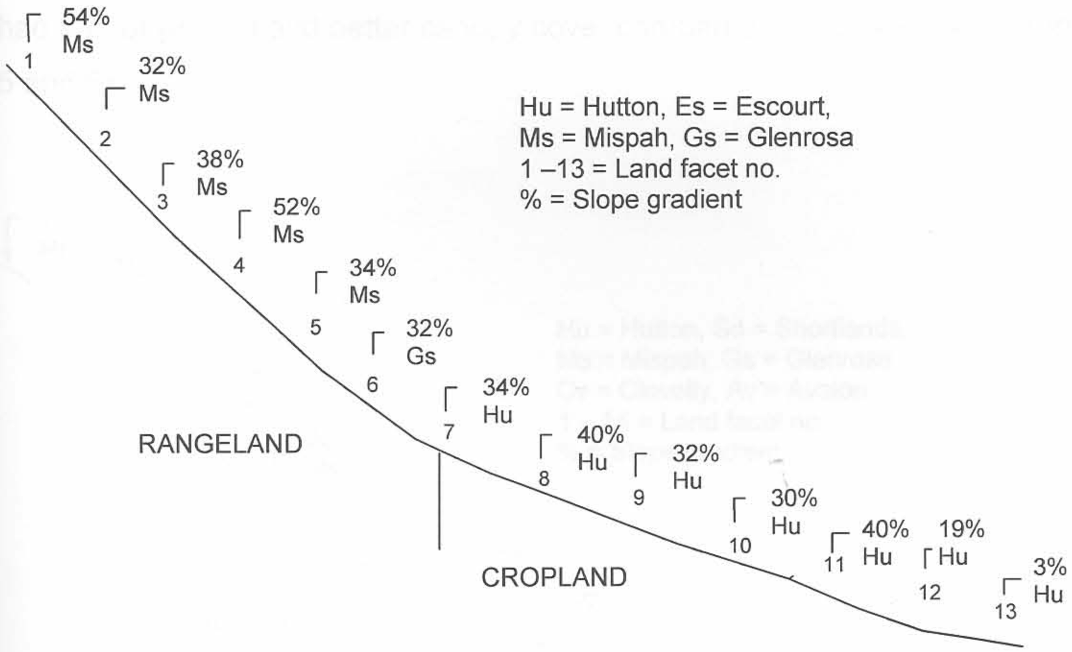


Figure 3.4. Hillslope 2 slope showing gradients and soil forms on the rangeland and cropland land facets

The rangeland part is similar to land facet 1 – 5 of hillslope 1. The crests are occupied by rock outcrop and Mispah and Glenrosa soil forms and has poor ground and canopy cover as compared to the cropland (Appendix 3, Table 4). The cropland was cultivated for maize, which was intercropped with cash crops such as *Canibus sativa* (Appendix 5, Plate 9).

(iii) Hillslope 3

Hillslope 3 is an east facing transact situated next to hillslope 2 and is divided into rangeland (land facet 1 – 7) and cropland (land facet 8 – 14). The average slope gradients and length are 22.1% and 540m respectively.

The rangeland is dominated by heavy-textured Mispah, Glenrosa and Shortlands soil forms. The cropland is dominated by deep medium-textured soils of the Clovelly form and had a poor ground and better canopy cover compared to the rangeland (Appendix 3, Table 5 and 6).

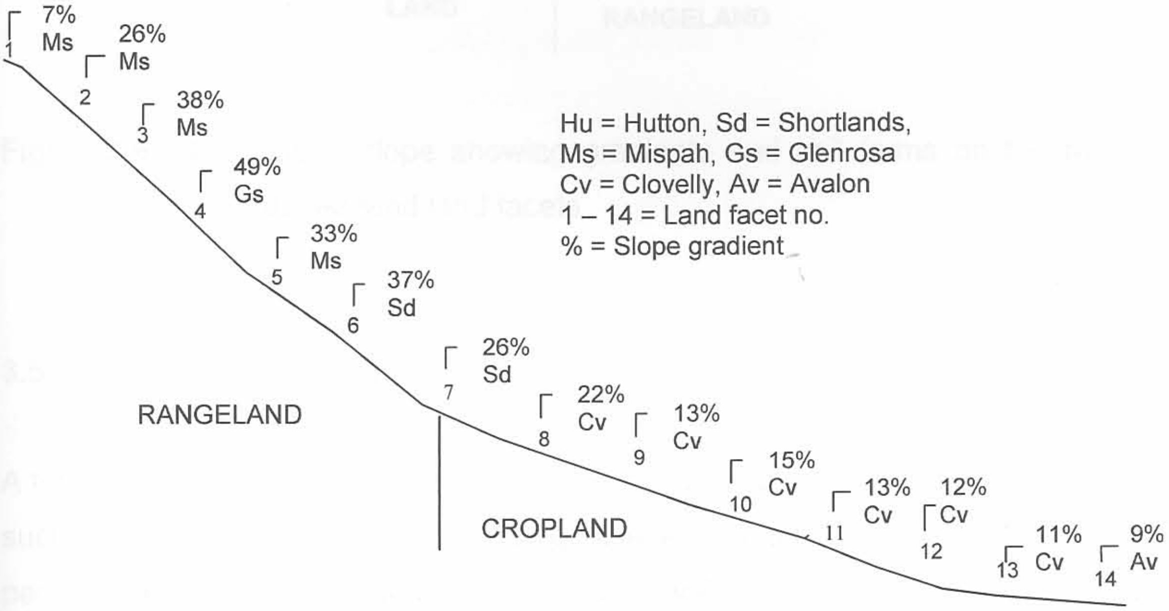


Figure 3.5. Hillslope 3 slope showing gradients and soil forms on the rangeland and cropland land facets

(iv) Hillslope 4

Hillslope 4 is a south facing transact and much flatter and longer than the other hillslopes. The entire hillslope is utilised as a communal rangeland. It has extensive length of 674m and less average slope gradient of 14.2%. Hillslope 4 has average canopy and poor ground cover of 54% and 8% respectively. The heavy-textured Mispah soils dominate the rangeland, whilst medium-textured Griffin soils dominated land facet 5 – 9 (Appendix 3, Table 7 and 8). Previously, land facet 5 and 6 were cultivated and now are abandoned land.

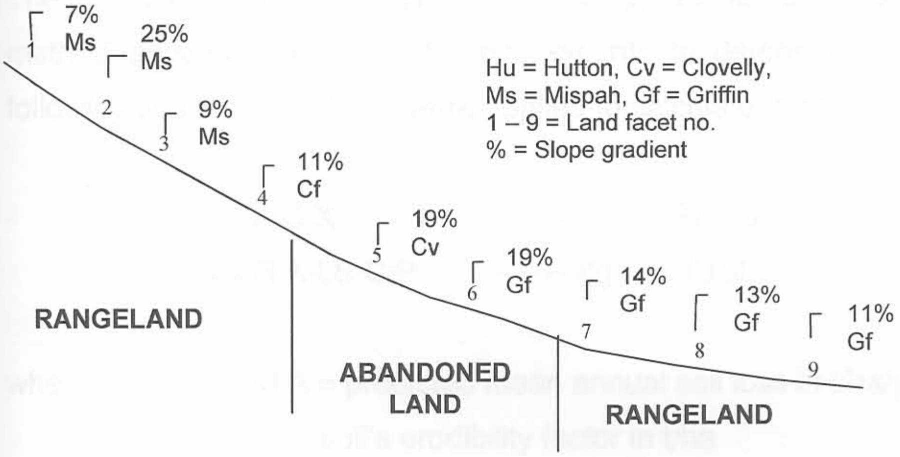


Figure 3.6. Hillslope 4 slope showing gradients and soil forms on the rangeland and abondoned land land facets

3.5.3.2. Laboratory Analysis

A total of 27 representative soil samples were collected for physical and chemical analyses such as particle-size distribution using pipette method (Dewis and Freitas, 1970) and percentage carbon content using Walkley-Black method (Hesse, 1971). The corresponding textural classes were determined by using triangle diagram of texture. The results of the particle-size distribution analyses were used to determine the soil forms and series (Soil Classification Working Group, 1991). The percentage carbon content was converted to soil organic matter using a factor of 1.33 (Hesse, 1971). These results were used to determine the soil's erodibility in SLEMSA and RUSLE.

3.5.3.3. Desktop Study

Soil loss was predicted on a land facet unit. The soil loss for a hillslope was calculated from the sum of the weighted averages of the soil loss for the land facets of that hillslope and are summarised in Appendix 4 (Table 1 – 4 (b) and (c)). The symbols and numbers for permeability, hydrologic and soil structural classes used in Table 1; 3; 5 and 7 of Appendix 3 are defined in Table 9 – 11of Appendix 3.

The collected erosion parameters were applied for the models and field assessment method according to the data requirements to determine and evaluate soil loss. The following soil loss equations were applied to calculate the soil loss,

$Z = K \cdot C \cdot X$ -------- (1) SLEMSA

$A = R \cdot K \cdot LS \cdot C \cdot P$ -------- (2) RUSLE

where, Z and A = predicted mean annual soil loss in t/ha/yr.
K = soil's erodibility factor in t/ha
R = rainfall erosivity in J/m^2/yr.
X, LS = slope factor
C = vegetation factor
P = erosion control/support factor

For ACED, soil loss determination is based on the size and number of erosion features, therefore,

$S_L = n \cdot v$ -------- (3)

where, S_L = predicted soil loss in m^3.
n = of rills and dongas
v = volume of rills and dongas (m^3).

To convert soil loss in m^3 to t/ha, a bulk density, P_b (t/m^3) and field size, F_s (m^2) were applied.

Therefore, soil loss (S_L) is expressed as:

$S_L = m/a$ -------- (4)

where, S_L = soil loss in t/ha
m = mass (t)
a = unit surface area (ha)

Bulk densities of 1.3 and 1.4 t/m^3 were applied respectively for clay and sandy loam soils in the calculation of soil loss by ACED method.

For the ACED method, the number of appearances of soil loss influences in Figure 4.1 – 4.4 indicates the number of times an influence appears on the hillslope. A higher value for the number of appearances of the erosion influences does not imply that soil loss will be higher. However, it highlights the importance of the erosion influence in the conservation planning.

Smithen and Schulze (1982) found that SLEMSA can over predict soil loss due to its sensitivity to rainfall kinetic energy and other factors such as topography. Therefore, two approaches have been followed to calculate soil loss with SLEMSA.

The first approach was described by Elwell and Stocking (1973) and relates to the original version of SLEMSA in Zimbabwe. This version relies on using predetermined annual kinetic energy values in the SLEMSA user's guide to extrapolate the soil erodibility. The second approach was applied by Schulze (1979) and Hudson (1987) and relates to a modified version of SLEMSA and its application in KwaZulu-Natal to suit the local conditions in South Africa. The modified version is based on calculating mean annual kinetic energy value from the mean monthly rainfall data that is applicable to an area using a regression equation. The calculated mean annual kinetic energy is then implemented to extrapolate the soil's erodibility factor value for the study area. The extrapolation errors can be minimised by using the latest data relevant to an area since the use of predetermined data developed somewhere else in an ungauged area can be less accurate and misleading.

The regression equation for calculating kinetic energy, E, at Ntabamhlophe T23 was identified as applicable to the study area. Both Schulze (1979) and Hudson (1987) have used this equation in their studies in key areas in the Drakensburg. The equation represents the lower altitude areas that cover the Potshini catchment as the key areas.

The equation applied at Ntabamhlophe T23 is as follows:

$$E = 15{,}16\ MAP - 1\ 517{,}\ 67 \quad \text{--------} \ (5)$$

where, E = rainfall kinetic energy in Jm^{-2} $annum^{-1}$
MAP = mean annual precipitation in mm.

According to the modified SLEMSA version (Schulze, 1979; Hudson, 1987), the calculated E-value, based on the mean monthly rainfall of the study area, is approximately 11 578 $J/m^2/yr$ (Appendix 5, SLEMSA soil loss tables). The calculated E value from original version of SLEMSA (Elwell and Stocking, 1973) is approximately 16 700 $J/m^2/yr$. This value is extrapolated from the provisional mean annual rainfall of 863,8 mm (Department of Agricultural Technical Services, 1976). There is more than 69% difference in the rainfall kinetic energy between the two versions, suggesting a cautionary approach for local conditions in the use of E-values in SLEMSA.

Furthermore, according to rainfall erosivity maps of South Africa published by (Smithen, 1981), Schulze (1979) estimated average annual kinetic energy values of the study area between 11 000 and 13 000 $J/m^2/yr$ (Figure 3.7). The calculated E-value according to Schulze (1979) and Hudson (1987) approach is closer to that on the kinetic energy map. As a result, the Schulze (1979) and Hudson (1987) approach was chosen and considered more realistic.

3.6. SCENARIO PREDICTION OF LANDCARE MANAGEMENT PRACTICES BY THE SELECTED MODELS AND FIELD ASSESSMENT METHOD

For an erosion evaluation tool to be considered suitable to simulate LandCare management practices it should be able to evaluate and monitor their impacts on land degradation by erosion due to changing conditions of land use and management practices. The LandCare management practices include minimum or no-till practices, mulching, inter-cropping, weeding manually or by herbicides, timing of and harvesting methods and controlled grazing and stocking rates. These are low-cost farming practices which are suitable and available for the community to strike a balance between profitable and conservation farming and at the same time reducing or minimising the risk of erosion. The advantages and disadvantages of the selected field assessment method and models were used to evaluate their suitability to be applied in the prediction scenario.

3.6.1. ACED method

Advantages: The ACED method can identify where on the cropland and/or rangeland does erosion damages occurs and estimate current soil loss. The method focus on the visible damage to quantify soil loss and can be applied to target land facets requiring urgent attention for conservation or evaluate conservation options. Therefore ACED can be utilised with the community on their fields to assess erosion damage, causes and what their effects were.

Disadvantages: However, ACED cannot predict potential erosion by utilising land management practices in LandCare project. According to ACED, "what you see, is what you have". This means that if there is no visible damage, such as rills, there is no soil loss. Furthermore, its soil loss does not include interrill erosion; therefore, it cannot be used to describe the soil loss of the area. ACED is suitable only to evaluate current damage of an area. To evaluate long-term erosion damage and/or soil loss, ACED requires continuous collection of data.