Part VI

Bibliography and Appendices

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Chapter 22

List of Symbols and Formulas

22.1 Symbols

The following list gives a short description of the symbols used throughout this book with their units.

Symbol	Description and unit
A	Available energy for partitioning over H and λE [W m^{-2}]
A_f	Forest age [years]
API	Antecedent precipitation index [mm]
α	Albedo for short-wave radiation
α_{par}	Albedo for photosynthetic active radiation
β	Bowen ratio
c_p	Specific heat of air at constant pressure [J kg^{-1} K^{-1}]
Γ	Adiabatic temperature lapse rate [K m^{-1}]
γ	Psychrometric constant [mbar K^{-1}]
d	Zero plane displacement length [m]
D	Drainage [mm]
D_a	Horizontal flux divergence [W m^{-2}]
D_{lf}	Drainage from litter layer [mm]
$Dbhob$	Diameter at breast height over bark [m]
Dob	Diameter over bark [m]
Dub	Diameter under bark [m]
Δ	Change of the saturation vapour pressure with temperature [mbar K^{-1}]
$\bar{E}$	Average evaporation from a wet canopy [mm h^{-1}]
ET	Evapotranspiration [mm t^{-1}]
E_i	Interception loss from canopy [mm]
E_l	Evaporation rate from litter layer [mm h^{-1}]
E_{il}	Interception loss from litter layer [mm]
E_{it}	Interception loss from trunks [mm]
E_0	Penman open water evaporation [mm]
E_t	Transpiration rate [mm day^{-1}, mm year^{-1}
ET_{sm}	Evapotranspiration obtained from soil moisture depletion [mm]
ET_{pm}	Evapotranspiration rate obtained for Penman-Monteith mode [mm]

e	Water vapour pressure in air [mbar]
e_s	Saturation vapour pressure of air [mbar]
G	Flux density of heat into the soil [W m^{-2}]
ΔG	Change in groundwater storage [mm]
g	Gravitational acceleration [m s−2]
Γ	Adiabatic lapse rate [K m^{-1}]
γ	Psychrometric constant [mbar K^{-1}]
H	Sensible heat flux [W m^{-2}]
H	Water level or pressure [cm H_2O]
h	Mean vegetation height [m]
J_h	Sensible heat storage within the forest [W m^{-2}]
J_w	Latent heat storage within the forest [W m^{-2}]
J_{veg}	Energy storage in the biomass [W m^{-2}]
K_H	Eddy diffusivity for heat [m^2 s^{-1}]
K_M	Eddy diffusivity for momentum [m^2 s^{-1}]
K_E	Eddy diffusivity for water vapour [m^2 s^{-1}]
K_L	Litter turnover rate [$year^{-1}$]
k	Von Karman's constant, set to 0.4
κ	Light extinction coefficient
L	Leakage losses from catchment [mm]
LAI	Leaf area index [m^2 m^{-2}]
λ	Latent heat of vapourization of water [J kg^{-1}]
λE	Latent heat flux [W m^{-2}]
MC_l	Moisture content of the litter layer [mm]
M_l	Litter layer mass [kg ha^{-1}]
M_{veg}	Fresh forest biomass [kg m^{-2}]
n	Sample size
N	Maximum daily sunshine duration [h]
n	Actual daily sunshine duration [h]
P	Rainfall total [mm]
P_a	Mean areal precipitation [mm]
P_g	Above canopy rainfall [mm]
P'_g	Amount of rainfall necessary to fill the canopy storage [mm]
P_{veg}	Energy flux into biochemical storage [W m^{-2}]
p	Free throughfall coefficient
p_t	Fraction of rainfall diverted to tree trunks
Q	Below canopy photosynthetic active radiation [μmol m^{-2} s^{-1}]
Q_s	Incoming photosynthetic active radiation [μmol m^{-2} s^{-1}]
Q	Streamflow output [mm; l s^{-1}; mm h^{-1}]
Q_b	Baseflow [mm; l s^{-1}; mm h^{-1}]
Q_p	Peak discharge [mm; l s^{-1}; mm h^{-1}]
Q_s	Stormflow [mm; l s^{-1}; mm h^{-1}]
q	Specific humidity of air [kg m^{-3}]
$R_s \downarrow$	Incoming short-wave radiation [W m^{-2}]
$R_s \uparrow$	Reflected short-wave radiation [W m^{-2}]
$\bar{R}$	Average rainfall rate on a wet canopy
R_{ET}	Incoming short-wave radiation at the top of the atmosphere [W m^{-2}]
RH	Relative humidity [%]
R_n	Net radiation [W m^{-2}]
R_{lw}	Reflected shortwave radiation [W m^{-2}]
r_a	Aerodynamic resistance [s m^{-1}]
r_s	Surface or canopy resistance [s m^{-1}]
r_{st}	Stomatal resistance [s m^{-1}]
ρ	Density of air [kg m^{-3}]
S	Canopy storage capacity [mm]
Sf	Stemflow [mm]
S_l	Litter layer moisture storage capacity [mm]

S_t	Storage capacity of tree trunks [mm]
SMD	Soil moisture deficit [mm]
SV	Stormflow volume [mm]
ΔS	Change in soil moisture storage [mm]
T	Temperature [°C; K]
Tf	Throughfall [mm]
t	Time [s; h; day; year]
θ	Volumetric soil moisture content [m^3 m^{-3}]
$u(z)$	Wind speed at height z above the soil surface [m s^{-1}]
u_*	Friction velocity [m s^{-1}]
VPD	Vapour pressure deficit [mbar]
z	Height above the surface [m]
z_0	Aerodynamic roughness length [m]

22.2 Micrometeorological Formulas

22.2.1 Formulas for general use

In this section the formulas used for the calculation of micrometeorological 'constants', as well as those used to calculate parameters dependent on temperature and relative humidity will be presented. The following formula (WMO, 1984a) was used to calculate the saturated vapour pressure (e_{sat}, in mbar) from the temperature (T, in K):

$$e_{sat} = 10^{10.79574\left(1-\frac{T_0}{T}\right)-5.028\log\left(\frac{T}{T_0}\right)+1.50475\cdot10^{-4}\left(1-10^{-8.2969\left(\frac{T}{T_0}-1\right)}\right)} * 10^{0.42873\cdot10^{-3}\left(10^{4.76955\left(1-\frac{T_0}{T}\right)}-1\right)+0.78614}$$

where T_0 is 273.15 K.

The actual vapour pressure e can be obtained from e_{sat} and the relative humidity (RH, in %):

$$e = \frac{RH}{100}\cdot e_{sat}$$

The specific humidity of the air (q, in kg m^{-3}) can be approximated by:

$$q = 0.622\cdot\frac{e}{p-0.378e}$$

where p was set at 998 mbar.

The slope of the saturated vapour pressure curve (Δ, in mbar K^{-1}) is obtained by differentating the equation used to calculate e_{sat} with respect to T (WMO, 1984a):

$$\begin{aligned}\Delta &= \frac{de_{sat}}{dT}\\ &= e_{sat}\cdot[\frac{10.79574T_0}{0.4343T^2} - 5.028\frac{1}{T}\\ &\quad + 1.50475\cdot10^{-4}\frac{8.2969}{0.4343^2T_0}\cdot10^{8.2969\left(1-\frac{T}{T_0}\right)}\\ &\quad +0.42873\cdot10^{-3}\frac{4.76955T_0}{0.4343^2T^2}\cdot10^{4.76955\left(1-\frac{T_0}{T}\right)}]\end{aligned}$$

The latent heat of vapourization (λ, in J kg^{-1}) is dependent on the temperature (T, in K) and was calculated as follows (Bringfelt, 1986):

$$\lambda = 4185.5\cdot(751.78-0.5655T)$$

The specific heat of air (c_p, in J kg^{-1} K^{-1}) from e, where the atmospheric pressure p was assumed constant at 998 mbar:

$$c_p = 0.24 \cdot 4185.5 \left(1 + 0.8\frac{0.622e}{p-e}\right)$$

The density of the air (ρ, in kg m^{-3}) fluctuates with the temperature (T, in K), vapour pressure (e, in mbar) and pressure (p, set at 998 mbar) of the air and can be calculated from the following expression:

$$\rho = 1.201\frac{290 \cdot (p - 0.378e)}{1000T}$$

The psychrometric constant was calculated as (Bringfelt, 1986):

$$\gamma = \frac{c_p \cdot p}{0.622 \cdot \lambda}$$

22.2.2 Penman Open Water Evaporation

The Penman open water evaporation (E_0, in mm day^{-1}) may be written as (Penman, 1956, 1963):

$$E_0 = \frac{\Delta \cdot R_n + \gamma \cdot E_a}{\Delta + \gamma} \tag{22.1}$$

where R_n represents the net radiation for an open water surface and E_a represents the aerodynamic evaporation. The daily input of net radiation (mm day^{-1}) for an open water surface is given by:

$$R_n = R_s \downarrow (1-\alpha) - R_{ln} \tag{22.2}$$

where R_g is the incoming short-wave radiation (mm day^{-1}), α the albedo of open water (0.05) and R_{ln} the net-longwave radiation (mm day^{-1}), which can be obtained as follows:

$$R_{ln} = \frac{86400\sigma T^4(0.56 - 0.248\sqrt{e}) \cdot (0.1 + 0.9n/N)}{\lambda} \tag{22.3}$$

where σ is the Stefan-Boltzmann constant ($5.670 \cdot 10^{-8}$ W m^{-2} K^{-4}), T is the daily average air temperature (K), e is the average daily water vapour pressure of the air (kPa), n is the duration of bright sunshine (h), N is the maximum possible sunshine duration (h). The aerodynamic term (mm day^{-1}) is a function of the wind speed and vapour pressure deficit (Calder, 1990):

$$E_a = 2.6(1 + 0.537u) \cdot (e_{sat} - e) \tag{22.4}$$

where u is the wind speed (m s^{-1}). Conventionally, all micrometeorological parameters should be measured at a height of 2 m above ground level.

Chapter 23

Oleolega Rock Sample Mineralogy

Seven rock samples were collected at various locations in the Oleolega catchment, and the mineralogy was optically determined from thin slides by Mr. H. Helmers at the Institute of Earth Sciences from the Free University of Amsterdam. The number of each of the rock samples described below corresponds with the sample location as shown in Figure 15.3. Most of the rock outcrops on the ridges in the catchment were strongly weathered and crumbled under pressure. Relatively fresh samples could only be collected in the stream valleys (boulders in the creek). However, the exact origin from these samples could not be traced.

Rock sample (1) collected *in situ* at the catchment outlet The rock consisted of fine grained plagioclase (microphanerite), clino-pyroxene ortho-pyroxene (augite) and and evenly distributed ore mineral (ilmenite or titanite). The pyroxene seemed to be transformed to olivine. Small amounts of calcite and chlorite of secundary origin were present. Some of the chlorite was of late magmatic origin, whereas some was formed by transformation of primary minerals. Flow structure were not present. The sample could be classified as a basalt (diabase).

Rock sample (2) collected *in situ* at the catchment outlet The rock consisted of fine grained plagioclase (Anorthite 38) with hornblende, hyperstene, magnetite and pyrite as accessory minerals. The ore was not regularly distributed. The rock showed signs of metamorphosis with some of the hyperstene being transformed to anthophyllite. The mineral association indicated high temperature transformation. The rock may have been part of a lava flow and was classified as an andesite. The chemical composition of the rock has been given in Table 4.5 (Rock1).

Rock sample 4 The rock consisted of plagioclase phenocrists, clay minerals and some secundary quartz, which were well distributed indicating a magmatic origin. There were many signs of hydrothermal secundary recrystallization, with most of the quartz being recristallized. The rock showed pseudomorphosis, with amphiboles and pyroxenes being replaced by clay minerals, possibly in a Mg rich solution, indicated by the presence of chlorite. Some opaque ore was present in the rock (Iron, pyrite). Features concentrated around air inclusions, and the matrix showed some of the original flow structures. The presence of secundary minerals made it difficult to classify the rock, but it may have been part of a trachite or dacite lava flow.

Rock sample 33 This rock sample was very similar in mineral content as rock sample 4. However, there were fewer phenocrists, and the plagioclase crystals were stretched. The flow structure was very vague. The sample could be classified as part of a dacite lava flow.

Rock sample 11, collected *in situ* This rock was similar to sample 4 and 33, but more weathered and transformed. Euhedric plagioclase and quartz formed clusters, which are indicative for flow conditions. Since the flow structures were less evident than in sample 4, the flow may have stopped during matrix cristallization. Spherolite of late magmatic origin was present, and some ore was observed surrounded by spherolite. The rock was classified as a dacite.

Rock sample 14a This rock, and sample 14b, were collected in the creek, and the exact origin (upstream of sample point 14) is therefore unknown. The matrix consisted of orthophyric plagioclase, and contained a large number of plagioclase phenokrists (40%), as well as some high temperature quartz (<5%), pyroxene, and some opaque ore minerals (pyrite). The rock had undergone low temperature metamorphosis and the pyroxene had been altered to carbonate and chlorite. The presence of phrenite indicated that the temperature had been lower than 400 °C, whereas the presence of a zeolite vein suggested transformation at a temperature below 200 °C. Some of the ore had been weathered to limonite. The rock was classified as a quartz-andesite lava and the chemical composition has been given in Table 4.5 (Rock2).

Rock sample 14b The matrix consisted of spherulites of felsophyric plagioclase, some quartz and traces of K-feldspar. The structure of the matrix suggested that the rock had cooled down rapidly after formation, preventing the forming of phenocrists, although some plagioclase phenocrists had formed. However, initial cooling had been slow as indicated by the presence of antiperthites (demixing of K-feldspar and plagioclase). Accessory minerals were cericite (fine grained muscovite), chlorite (altered pyroxene), titanite, and some ore minerals (pyrite). The rock was classified as a leuco-andesite (light colored) or dacite lava and the chemical composition has been given in Table 4.5 (Rock3).

On the basis of these samples two rock types could be identified in the catchment. Dacite lavas were found in the northern and middle part of the catchment, and these were grading into andesite and basalt lava flows in the southernmost part of the catchment.

Chapter 24

Capacitance Soil Moisture Probe

24.1 Use and Calibration Procedures

A capacitance soil moisture probe (type IH1, Didcot Instruments Company Ltd., Oxford, UK) was used to measure profiles of the volumetric soil moisture content (θ) at the grassland and forest sites.

The dielectric constant (ε) of a composite material is determined by the dielectric constants and proportions of its constituents. As ε of dry soil at frequencies below 1000 MHz is typically about 4 and that of water is about 80 (Dean *et al.* 1987) small changes in θ result in relatively large changes of ε. As such estimates of θ can be obtained from measured ε values using appropriate calibration curves.

The design and performance of a prototype of the capacitance probe have been discussed in detail by Dean *et al.* (1987) . The probe consists of a sensor linked to a hand held frequency reader by a fibre optic cable. The sensor measures ε of the soil with a temperature compensated, highly stable, electronic oscillator and the output is displayed by the frequency reader. A series of extension handles are used to lower the sensor into PVC access tubes. An access tube extension piece is placed on the access tube and a pin on top of this extension tube, which fits into holes placed at a 2 cm interval over the length of the extension handles, ensures that measurements are always made on the same depths in the access tubes and that the orientation of the sensor is always the same.

The probe is sensitive over a total vertical extent of 34 cm, independent of the medium, with 90% of the response coming from a region 8.5 cm above and below the centre of sensitivity (Dean *et al.* 1987). Bell *et al.* (1987) observed that the bulk of the response was derived from a 4–8 cm thick soil layer and that the influence of the surface–air interface extended down to a depth of about 20 cm. The penetration in the horizontal direction is rather small with 90% of the response comming from the soil within a radius of 13 cm of the centre of sensitivity of the probe (Dean *et al.*, 1987).

The frequency output of the probe is influenced by variations in temperature and these can therefore not be used directly for the calculation of θ. As such a universal frequency (UF) is calculated (Equation 24.1) from frequency readings taken in the soil (F_s) using the frequency measured in the access tube extension, which is read at the start and end of each measurement and represents the frequency measured in air (F_a), and that measured in an access tube fully submerged in water (F_w).

$$UF = \frac{F_a^{7.692} - F_s^{7.692}}{F_a^{7.692} - F_w^{7.692}} \tag{24.1}$$

For the probe sensor used in the present study F_a ranged from 17610–17640 kHz during the warm wet season and from 17640–17670 kHz during the cool dry season. F_w was measured on four occassions during both seasons and was 4430±4 kHz lower than the corresponding F_a (range 17618–17653 kHz).

The probe has a nonlinear response to changes in θ and is most sensitive at moisture volume fractions below 0.35 m^3 m^{-3} as shown in Figures 24.1 and 24.2 where plots of UF against θ are shown for all access tubes. The porosity of the soils in the Nabou Estate

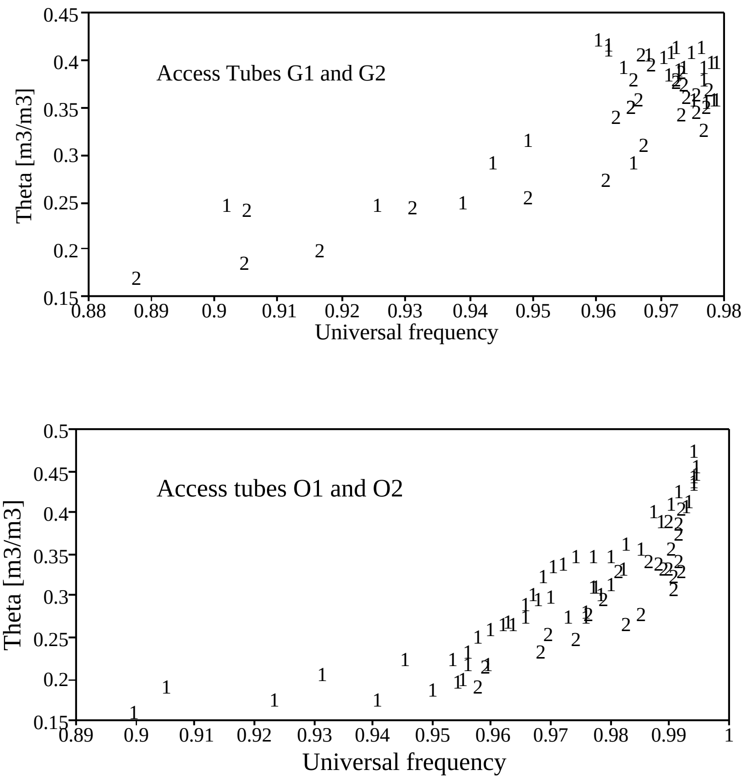

Figure 24.1: *Plots of θ (m^3 m^{-3}) against UF for access tubes in grassland (G1 and G2) and Oleolega drainage basin (O1 and O2). The data labels represent access tube numbers, samples collected above a depth of 10 cm were excluded as the UF was strongly influenced by the soil–air interface.*

was generally high (40–65%) due to the large proportions of fine grained weathering products (clay and silt), resulting in observed θ values up to 0.60 m^3 m^{-3} (Access tubes A3, B5). Furthermore the spatial variation in soil depth, stucture, texture and bulk density between and within the research sites was considerable and separate calibration curves were therefore needed for each access tube. The bulk density often increased considerable with depth in a soil profile and separate calibrations had to be made for the various soil layers. As the soil moisture probe is very sensitive to small variations in soil properties and θ it was not possible to calibrate the probe using samples collected in the vicinity of the access tube as is the normal procedure for the calibration of the neutron probe (Bell *et al.*, 1987). The capacitance probe was therefore calibrated on θ values obtained from soil samples removed during installation of the access tube. Soil samples were collected at 4 cm depth intervals over the length of each

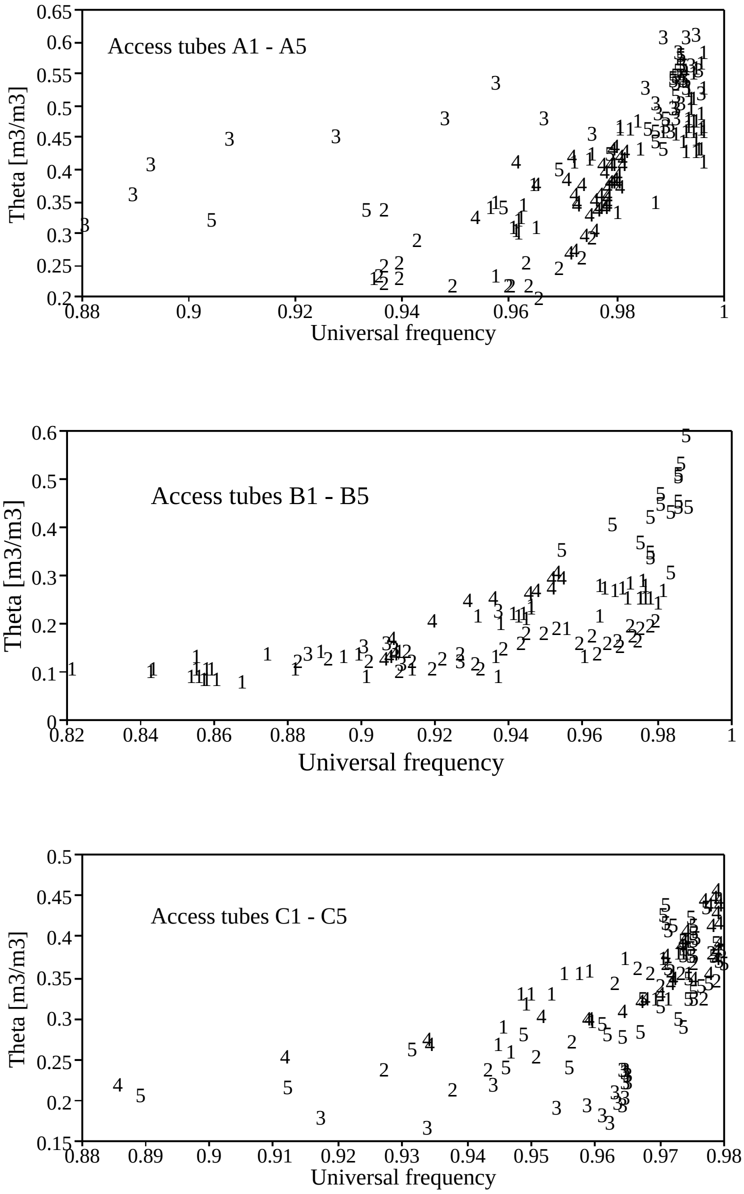

Figure 24.2: *Plots of θ (m^3 m^{-3}) against UF for access tubes in Tulasewa (A1–A5), Korokula (B1–B5) and Koromani forests (C1–C5). The data labels represent access tube numbers, samples collected above a depth of 10 cm were excluded as the UF was strongly influenced by the soil–air interface.*

access tube. As the volume of the soil removed at each interval was known (78.5 cm^3) θ and the bulk density could be calculated from the measured field and dry weights (105°C). Frequency readings corresponding with the observed θ values were obtained by lowering the probe sensor into the access tube immediately after installation. Readings were always taken over the length of the tube at 2 cm depth intervals. Instrumental drift during the measurements was determined by taking readings of F_a before and after measuring the profile. The instrumental drift was usually negligible as the measurement of a profile was usually completed within 3–5 minutes.

The calibration procedure given above is based on the assumption that the frequency output of the sensor responds mainly to the moisture status of the soil and that effects of variations in soil structure, texture and bulk density are negligible. Calibration becomes troublesome when either the variation of θ is small throughout the profile or when large contrasts exist between the characteristics (*e.g.* bulk density) of the soil layers. In the former case the relatively large scatter in the calibration data, caused by the small range of UF and θ, results in a poor fit of the regression line, whereas in the latter case the regression lines for the various horizons are based on few calibration points which may also limit the range of UF and *theta*. In both cases large uncertainties exist in the regression constants (*e.g.* slope of the regression line) as indicated by low coefficients of determination. However, there are several ways in which the calibrations may be improved. One way is to combine the data from several access tubes with soil layers having similar characteristics to extend the range of UF and θ. An alternative is to obtain additional calibration data by collecting soil samples within 10 cm of the access tubes immediately after frequency readings have been taken. This should be done at the end of the study as the access tubes cannot be used afterwards. When the foregoing is not possible the calibration of dry soil sections, of which the θ at saturation (porosity) is well known can be improved by the inclusion of a fictional calibration point assuming that $UF = 1.00$ at saturation.

During the present study additional calibration data were obtained for several access tubes using an auger to collect soil samples within 8 cm of the tubes at 10 cm depth intervals. The gravimetric moisture contents obtained from these samples were multiplied with the bulk densities corresponding with the sample depths as obtained from the samples collected at installation of the tubes.

Linear regression analysis was used to obtain expressions for the calculation of θ from UF. The regression models used for the calibrations were the linear model (Equation 24.2), the exponential model (Equation 24.3) and the reciprocal model (Equation 24.4).

$$\theta = a \cdot UF + b \tag{24.2}$$

$$\theta = \exp^{a \cdot UF + b} \tag{24.3}$$

$$\theta = \frac{1}{a \cdot UF + b} \tag{24.4}$$

An impression of the expected range of θ was provided by moisture retention curves (Appendix 25) obtained from samples collected within 10 cm from the access tubes at the end of the study. During the wet season θ can be expected to be at or just below field capacity (pF=1.7–2) whereas it may approach wilting point (pF=4.2) after several dry weeks during the dry season. This range was compared to that calculated from extremes of the UF for each soil layer and more realistic regression lines were calculated when the two ranges differed much from eachother.

The air–soil interface strongly influenced the frequency measurements taken at depths above 10 cm. As such samples collected above a depth of 8 cm were excluded from the calibrations for deeper soil layers and when necessary separate calibrations were made for the 0–10 cm soil layer by combining the data of several access tubes.

24.2 Calibrations for Grassland

Regression equations for the two access tubes installed at the grassland site are given in Table 24.1, whereas plots of the predicted and the observed θ profiles against depth are shown in Figure 24.3. Both tubes were installed with their lower ends in the massive lower C-horizon.

Table 24.1: *Regression constants (a, b), standard errors (SE) and coefficients of determination (CD) for the calibrations of access tubes G1 and G2 in grassland. The sample size is represented by n.*

Tube	Depth (cm)	Model	a	SE	b	SE	CD	n	Samples used (Tube: Depths in cm)
G1	0-10	Reciprocal	-15.8611	1.5582	18.3781	1.4691	0.90	13	G1: 0-46
	10-46	Exponential	5.5638	0.9355	-6.4926	0.0736	0.81	10	G1: 10-46
	50-66	Linear	3.0054	0.3142	-2.5394	0.3044	0.95	7	G1: 22-26,50-66
	70-98	Linear	3.7210	0.3582	-3.2147	0.3463	0.93	10	G1: 22-26,70-98
	102-11	Linear	6.4096	1.1125	-5.7566	1.0645	0.89	6	G1: 22-26,102-114
G2	0-58	Reciprocal	-30.7804	2.3621	32.9560	2.2227	0.93	14	G2: 6-58
	62-82	Reciprocal	-55.6328	6.7779	56.8743	6.5668	0.91	9	G2: 30-38,62-82
	86-110	Reciprocal	-83.2930	27.8593	83.1707	26.9112	0.64	7	G2: 86-110

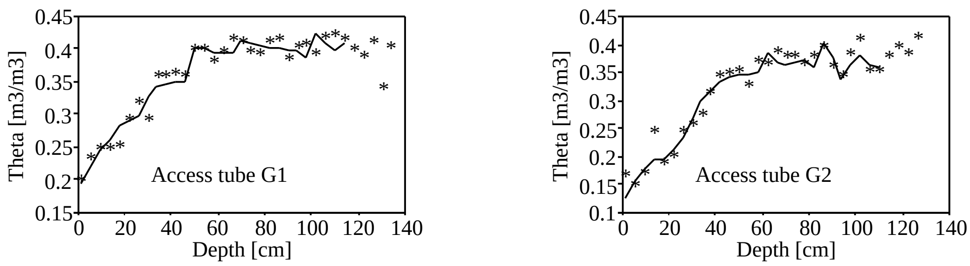

Figure 24.3: *Profiles of observed and predicted θ values for access tubes G1 and G2.*

Although the distance between the access tubes was only 5 m the calibration data could not be combined as observed θ values at a given UF differed by more than 0.05 m^3 m^{-3} between tubes G1 and G2 (Figure 24.1), illustrating the sensitivity of the probe to small variations in the properties of the soil.

24.3 Calibrations for Oleolega Drainage Basin

Regression equations for the two access tubes installed in the Oleolega drainage basin are given in Table 24.2, whereas plots of the predicted and the observed θ profiles against depth are shown in Figure 24.4. Access tube O1 was installed in undisturbed 16 year old forest whereas tube O2 was installed some 30 m to the East in an area logged in January and burned in August 1990 (bare soil). Both access tubes were installed with their lower ends in bedrock which was reached at 110 cm and 54 cm for access tubes O1 and O2 respectively. The tubes were installed in soils having similar aspects and slopes. Additional calibration data were

Table 24.2: *Regression constants (a, b), standard errors (SE) and coefficients of determination (CD) for the calibrations of access tubes O1 and O2 in the Oleolega drainage basin. The sample size is represented by n.*

Tube	Depth (cm)	Model	a	SE	b	SE	CD	n	Samples used (Tube: Depths in cm)
O1	0-10	Exponential	8.6019	2.4625	-9.3809	0.1607	0.67	8	O1: 2-10, O2: 2-6
	14-18	Exponential	14.6879	1.4191	-15.4523	0.1006	0.80	28	O1: 10-66
	22-66	Exponential	21.6394	1.5655	-22.1716	0.0658	0.90	24	O1: 22-66
	70-118	Exponential	23.5529	0.9933	-24.2214	0.0342	0.97	21	O1: 70-114
O2	0-10	Exponential	8.6019	2.4625	-9.3809	0.1607	0.67	8	O1: 2-10, O2: 2-6
	10-22	Exponential	19.3963	2.2180	-20.1997	0.0525	0.92	8	O2: 10-22
	26-30	Exponential	53.9976	10.7354	-54.3964	0.0588	0.89	5	O2: 26-30,54
	34-50	Exponential	48.4107	28.6284	-49.0202	0.0792	0.26	10	O2: 34-50

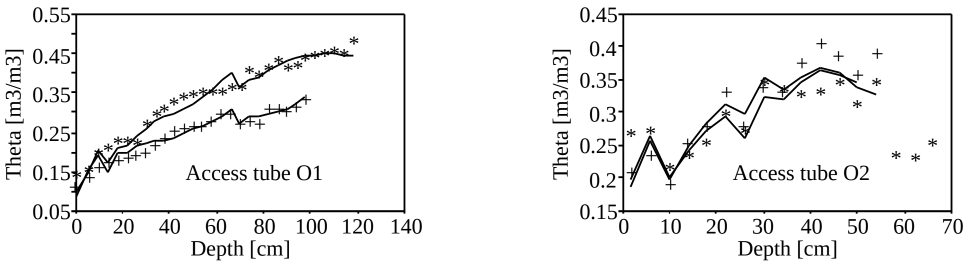

Figure 24.4: *Profiles of observed and predicted θ values for access tubes O1 and O2 in the Oleolega drainage basin*

obtained for both access tubes at the end of the study.

24.4 Calibrations for Tulasewa Forest

Regression equations for the five access tubes installed in Tulasewa forest are given in Table 24.3. Profiles of the predicted and the observed θ *versus* depth are shown in Figure 24.5 for each of the access tubes. Access tube A2 was installed with its lower end in bedrock (75 cm) whereas the other tubes were installed in the lower C-horizon or rotten rock. Dark brown A-horizons were present at tubes A1 and A2 but these had been removed by erosion at the other tubes exposing the B- or C-horizon.

Table 24.3: *Regression constants (a, b), standard errors (SE) and coefficients of determination (CD) for the calibration of access tubes A1–A5 in Tulasewa forest. The sample size is represented by n.*

Tube	Depth (cm)	Model	a	SE	b	SE	CD	n	Samples used (Tube: Depths in cm)
A1	2-6	Exponential	7.3992	4.8335	-8.3165	0.2465	0.37	6	A1-A2: 2-6
	10-38	Exponential	10.1689	1.2144	-10.9691	0.0865	0.83	16	A1: 0-38
	42-78	Exponential	8.2452	0.8521	-8.9056	0.0496	0.84	20	A1: 42-78
	82-118	Exponential	17.5237	8.1086	-18.1187	0.0921	0.26	15	A1: 82-118
A2	2-6	Exponential	7.3992	4.8335	-8.3165	0.2465	0.37	6	A1-A2: 2-6
	10-38	Exponential	10.0971	0.8510	-10.8902	0.1158	0.85	26	A1: 10-38, A2: 2-38
	42-70	Exponential	21.0294	2.8665	-21.7726	0.1287	0.86	11	A1: 110-118, A2: 42-70
A3	2-6	Exponential	2.5984	0.5972	-3.4789	0.0649	0.76	8	A3-A5: 1-6
	10-38	Exponential	4.5958	1.0010	-5.0744	0.0881	0.78	8	A3: 10-38
	42-70	Exponential	10.8990	1.1291	-11.3765	0.0795	0.90	12	A4: 6-10, A3: 42-70
	74-106	Exponential	9.5349	2.4968	-10.1331	0.0465	0.57	13	A1: 66-78, A3: 74-106
A4	2-6	Exponential	2.5984	0.5972	-3.4789	0.0649	0.76	8	A3-A5: 1-6
	10-34	Exponential	9.7456	1.1846	-10.3904	0.0680	0.72	28	A1: 54-78, A4: 10-34
	38-74	Exponential	31.9333	5.0322	-32.2289	0.0408	0.69	20	A4: 38-74
	78-98	Linear	10.8744	0.2944	-10.2856	0.0088	0.99	13	A3: 90-106, A4: 78-98
A5	2-6	Exponential	2.5984	0.5972	-3.4789	0.0649	0.76	8	A3-A5: 1-6
	0-18	Exponential	8.0433	2.2813	-8.6647	0.0953	0.76	6	A3: 42-46, A5: 6-18
	22-106	Exponential	15.2363	1.7346	-15.7284	0.0552	0.74	29	A1: 54-78, A5: 22-106

24.5 Calibrations for Korokula Forest

Regression equations for the five access tubes installed in Korokula forest are given in Table 24.6. Profiles of the predicted and the observed θ *versus* depth are shown in Figure 24.6. All access tubes were placed with their lower ends in bedrock of which the depth varied from 40 cm for access tube B3 to 80 cm for access tubes B1, B2 and B5. A sandy A-horizon was present at access tubes B1, B2, B3 and B4 but this horizon had locally been removed by erosion at tube B5. The sandy soil extended down to bedrock at tube B3 whereas a clayey B-horizon was observed at tubes B1, B2 and B5. Data from comparable soil layers of access tubes B1, B4 and B5 were combined to improve calibrations. Additional calibration data were obtained for access tubes B1 and B2 following the procedure given in Section 24.1 whereas a third set was obtained for access tube B1 from soil samples collected some 50 cm downslope from the tube. Fictional calibration points where used to improve the calibrations for the dry sandy topsoils of access tube B2 and B3 (10-38 cm) using values of θ at saturation ($UF = 1$) of 0.40 and 0.45 respectively.

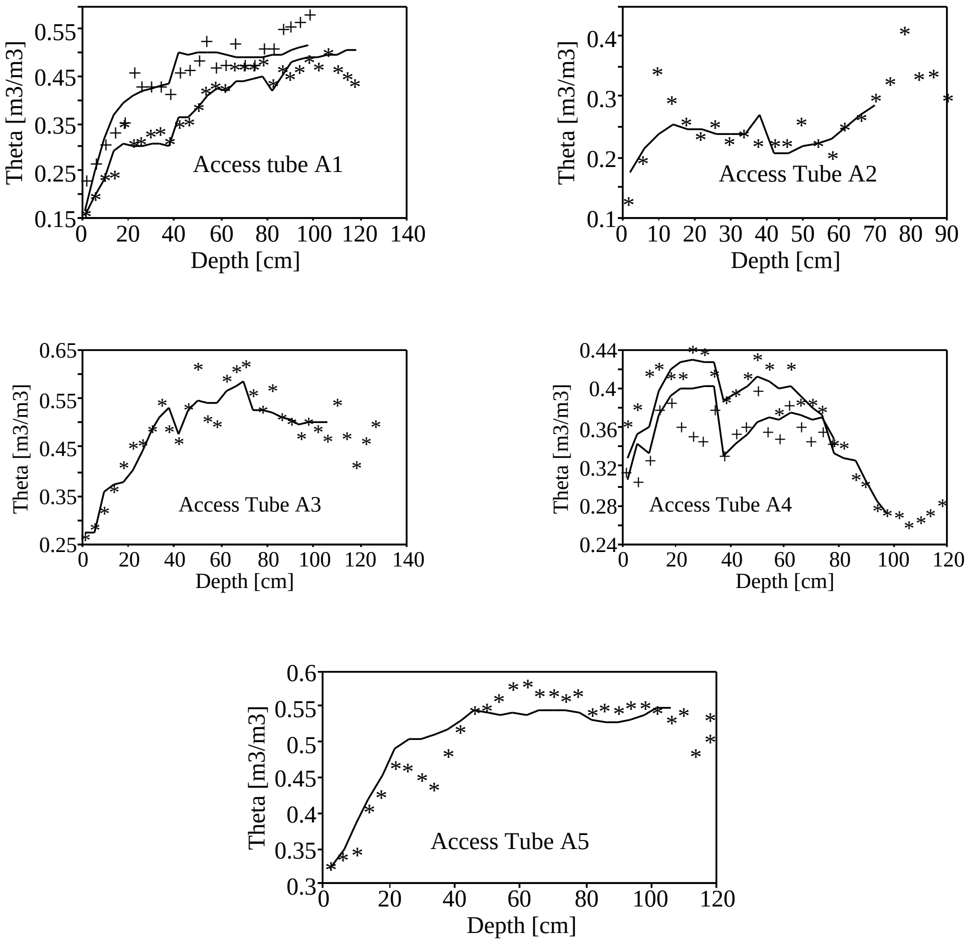

Figure 24.5: *Plot of observed and predicted θ values* versus *depth for access tubes A1–A5.*

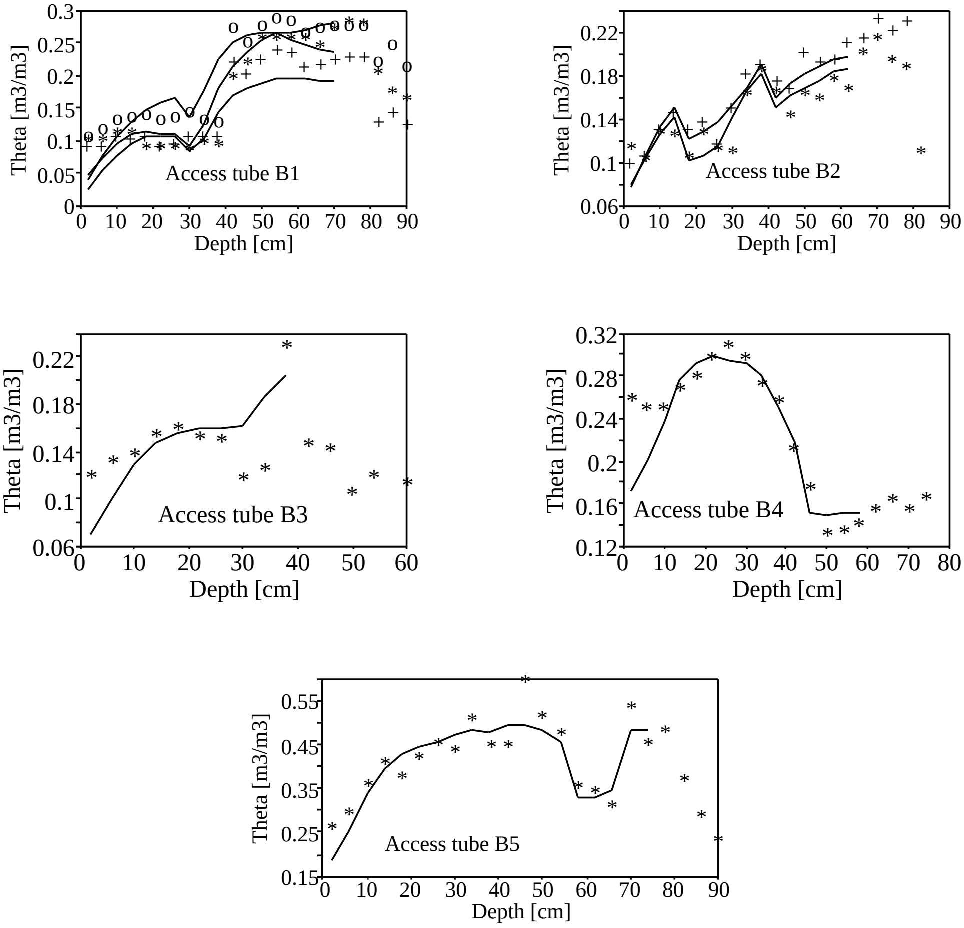

Figure 24.6: *Plot of observed and predicted θ values* versus *depth for access tubes B1–B5.*

Table 24.4: *Regression constants (a, b), standard errors (SE) and coefficients of determination (CD) for the calibration of access tubes B1–B5 in Korokula forest. The sample size is represented by n.*

Tube	Depth (cm)	Model	a	SE	b	SE	CD	n	Samples used (Tube: Depths in cm)
B1	0-26	Exponential	9.7592	0.8786	-10.5756	0.1611	0.87	20	B1: 10-26, B4: 10-26
	30-70	Exponential	9.9361	1.1357	-11.0215	0.2103	0.71	33	B1: 30-70
B2	0-14	Exponential	9.6126	1.4319	-10.8366	0.1866	0.68	17	B2: 10-38
	18-38	Exponential	14.6873	1.4319	-15.6497	0.1153	0.91	13	B2: 18-38
	42-62	Linear	2.1986	0.7106	-1.9562	0.0153	0.49	12	B2: 42-62
B3	0-38	Exponential	8.9146	2.0222	-9.9413	0.2263	0.71	10	B3: 10-38
B4	0-42	Exponential	8.9500	1.0750	-9.7501	0.0375	0.91	9	B4: 10-42
	46-58	Exponential	8.8734	0.9158	-9.9458	0.1006	0.87	16	B1: 46-58, B4: 46-58
B5	0-54	Exponential	11.0017	2.7207	-11.5720	0.0925	0.58	14	B5: 10-54,70-74
	58-66	Linear	2.9083	0.3351	-2.5173	0.0182	0.90	10	B5: 58-66, B1: 50-70
	70-74	Exponential	11.0017	2.7207	-11.5720	0.0925	0.58	14	B5: 10-54,70-74

24.6 Calibrations for Koromani Forest

Regression equations for the five access tubes installed in Koromani forest are given in Table 24.5. Profiles of the predicted and the observed θ *versus* depth are shown in Figures 24.7. Access tube C1 (ridge) and C3 (valley) were installed with their lower ends in bedrock whereas the lower ends of the other tubes were placed in a massive part of the C-horizon. The soil at access tube 3 was more sandy than those at the other tubes which explained the lower moisture content.

Table 24.5: *Regression constants (a, b), standard errors (SE) and coefficients of determination (CD) for the calibration of access tubes C1–C5 in Koromani forest. The sample size is represented by n.*

Tube	Depth (cm)	Model	a	SE	b	SE	CD	n	Samples used (Tube: Depths in cm)
C1	0-42	Exponential	10.7958	0.7060	-11.5199	0.0548	0.95	14	C1: 2-42,78-86
	46-74	Linear	3.1780	0.4622	-2.6881	0.0069	0.89	8	C1: 46-74
	78-86	Exponential	10.7958	0.7060	-11.5199	0.0548	0.95	14	C1: 2-42,78-86
C2	0-10	Exponential	4.4933	1.1883	-5.5845	0.1630	0.47	18	C1,C2,C3,C4,C5: 0-10
	10-30	Exponential	12.1463	3.0695	-12.8365	0.1061	0.76	7	C2: 10-34
	30-54	Exponential	15.6159	1.6588	-16.1760	0.0502	0.92	10	C2: 18-54
	58-70	Exponential	12.0767	3.9753	-12.8373	0.0747	0.75	5	C2: 26,58-70
C3	0-26	Exponential	5.0747	2.1916	-6.5158	0.0606	0.43	9	C3: 14,22-50
	30-50	Exponential	33.6583	23.5970	-34.0530	0.0659	0.34	6	C3: 30-50
	54-74	Exponential	16.9402	68.6840	-17.7903	0.0295	0.02	5	C3: 54-66,74
C4	0-10	Exponential	4.4933	1.1883	-5.5845	0.1630	0.47	18	C1,C2,C3,C4,C5: 0-10
	14-34	Exponential	7.3446	1.0438	-8.2058	0.0438	0.83	12	C4: 10-38
	38-50	Exponential	16.0979	4.8543	-16.6575	0.0535	0.65	8	C4: 38-50
	54-78	Exponential	20.5657	4.4372	-20.9392	0.0304	0.73	10	C4: 14-22,54-78
C5	0-34	Exponential	5.6962	0.9579	-6.6932	0.0889	0.73	15	C5: 10-34
	38-62	Exponential	17.0979	3.5363	-17.7251	0.0737	0.59	18	C5: 34-62
	66-90	Linear	10.4134	2.0792	-9.7471	0.0140	0.68	14	C4: 62-78, C5: 66-90
	94-110	Linear	3.7719	0.3591	-3.2458	0.0224	0.94	9	C4,C5: 10-15, C5: 94-110

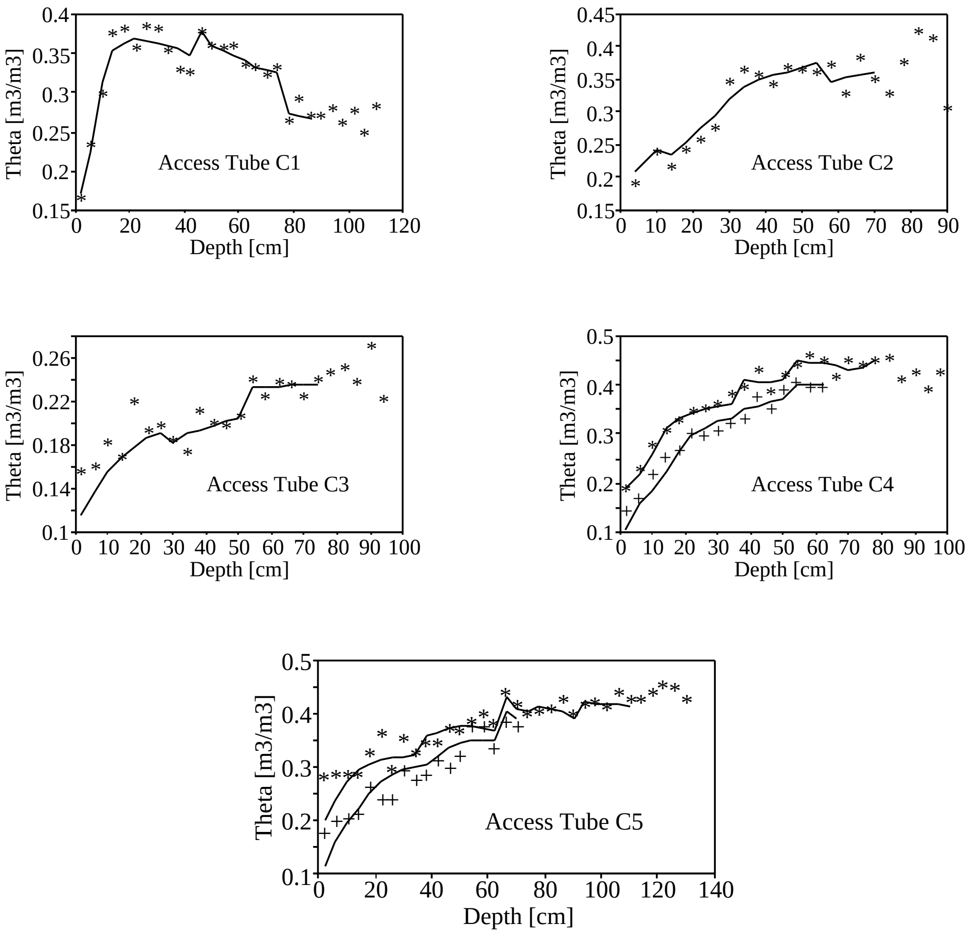

Figure 24.7: *Plot of observed and predicted θ values* versus *depth for access tubes C1–C5.*

Chapter 25

Soil Physical Data

Data on the bulk density, soil moisture retention characteristics (pF=0.4–pF=5.5) and saturated and unsaturated hydraulic conductivity for soils in Nabou forest are presented in this appendix. The data were obtained from 141 soil cores collected at several depths in Nabou grassland, Tulasewa, Korokula and Koromani forests and in the Oleolega catchment.

The 'van Genuchten' model (van Genuchten, 1980) was used to provide estimations of θ and of the unsaturated hydraulic conductivity from measured pF–θ pairs and saturated hydraulic conductivities.

The equations in the model of 'van Genuchten' are largely based on the method of Mualem (1976). The model is based on Equation 25.1 which describes the relationship between the volumetric moisture content (θ) and the pressure head (h).

$$\theta = \theta_r + \frac{\theta_s - \theta_r}{[1 + (\alpha h)^n]^m} \tag{25.1}$$

In this equation θ_r and θ_s represent the residual and saturated soil moisture contents, respectively, whereas α and n are fitting constants determining the shape of the curve. The parameter m is related to n as shown in Equation 25.2.

$$m = 1 - \frac{1}{n} \tag{25.2}$$

Estimates of θ_r and θ_s were obtained from measurements of θ on airdry (pF=5.5–6.5) and moist (pF=0.4) samples respectively, and a computer program was used to fit a curve on the experimental data by adjusting α and n using a non-linear regression technique (Marquardt, 1963). When a good fit is obtained α and n can be inserted in Equation 25.3 to obtain estimates of the unsaturated hydraulic conductivity (K_u) from the measured saturated hydraulic conductivity (K_s.

$$K_u = K_s \frac{\{1 - (\alpha h)^{n-1}[1 + (\alpha h)^n]^{-m}\}^2}{[1 + (\alpha h)^n]^{m/2}} \tag{25.3}$$

The bulk density, soil moisture retention data and available moisture for plants for eight samples in Nabou grassland are presented in Table 25.1 whereas the saturated and modelled unsaturated hydraulic conductivity data are shown in Table 25.2. Samples coded as GSMP1 were collected within 30 cm of the capacitance probe access tube 1, whereas those coded as G1 were collected in a soil pit.

The bulk density, soil moisture retention data and available moisture for plants for 30 samples collected in Tulasewa forest are presented in Table 25.3 whereas the saturated and modelled unsaturated hydraulic conductivity data are shown in Table 25.4. Samples coded as ASMP were collected within 30 cm of the capacitance probe access tubes, whereas those coded as A close to the soil pit.

The bulk density, soil moisture retention data and available moisture for plants for 22 samples collected in Korokula forest are presented in Table 25.5 whereas the saturated and

Table 25.1: *Bulk density (g cm^{-3}) and soil moisture retention data (θ in m^3 m^{-3}) for soil samples collected in Nabou grassland. Modelled θ values are shown in italics.*

Sample Code	Depth cm	Bd g/cm3	Theta at various soil moisture tensions (pF) **0.4**	**1.0**	**1.4**	**1.7**	**2.0**	**2.4**	**2.7**	**3.5**	**4.2**	**Air**	A.M.P. m3/m3
GSMP1	4.5	1.16	0.440	0.398	0.376	0.358	0.344	0.313	0.297	0.258	0.199	0.022	0.145
GSMP1	12.5	1.20	0.421	0.412	0.372	0.340	0.316	0.278	0.263	0.249	0.191	0.021	0.125
GSMP1	19.0	1.15	0.438	0.420	0.371	0.333	0.309	0.274	0.259	0.217	0.169	0.017	0.140
G1	3.5	1.17	0.465	0.427	0.391	0.352	0.309	*0.261*	*0.228*	*0.160*	*0.119*	*0.072*	0.190
G1	13.5	1.05	0.503	0.432	0.377	0.352	0.335	0.300	0.282	0.239	0.174	0.022	0.161
G1	24.5	1.31	0.372	0.364	0.336	0.302	0.277	0.242	0.230	*0.170*	*0.136*	0.019	0.141
G1	38.5	1.28	0.392	0.379	0.351	0.318	0.296	0.271	0.263	*0.208*	*0.174*	0.02	0.122
G1	61.5	1.33	0.359	0.336	0.313	0.291	0.272	0.249	0.242	*0.199*	*0.171*	0.021	0.101

Bd: Bulk density, Air: Theta of air dry soil (pF between 5 and 6)
A.M.P.: Available moisture for plants (Field capacity (pF=2) minus capacity at wilting point (pF=4.2))

Table 25.2: *Measured saturated hydraulic conductivities (mm day^{-1}), model parameters and correlation coefficients (r), and modelled unsaturated hydraulic conductivities (mm day^{-1}) for soil samples collected in Nabou grassland.*

Sample Code	Depth cm	K-sat mm/d	Model parameters Tsat* m3/m3	Tres* m3/m3	Alpha	n	r	Modelled K-unsat pF=1 mm/d	pF=2 mm/d	pF=3 mm/d	pF=4.2 mm/d
GSMP1	4.5	22400	0.45	0.02	0.1916	1.1032	0.96	28.34	0.24	0.00	0.00
GSMP1	12.5	950	0.45	0.02	0.2586	1.1094	0.95	0.67	0.01	0.00	0.00
GSMP1	19.0	6400	0.47	0.02	0.2475	1.1320	0.98	7.29	0.05	0.00	0.00
G1	3.5	12800	0.47	0.02	0.0717	1.2149	0.99	273.20	2.41	0.00	0.00
G1	13.5	160500	0.58	0.02	1.1766	1.1234	0.98	6.10	0.03	0.00	0.00
G1	24.5	2800	0.38	0.02	0.6530	1.1637	0.98	44.22	0.53	0.00	0.00
G1	38.5	430	0.40	0.02	0.1080	1.1209	0.97	1.90	0.00	0.00	0.00
G1	61.5	71	0.37	0.02	0.2003	1.1042	0.99	0.08	0.00	0.00	0.00

*: Tsat, Tres are theta at saturation and residual theta respectively

Table 25.3: *Bulk density (g cm^{-3}) and soil moisture retention data (θ in m^3 m^{-3}) for soil samples collected in Tulasewa forest. Modelled θ values are shown in italics.*

Sample Code	Depth cm	Bd g/cm3	Theta at various soil moisture tensions (pF) **0.4**	**1.0**	**1.4**	**1.7**	**2.0**	**2.4**	**2.7**	**3.5**	**4.2**	**Air**	A.M.P. m3/m3
ASMP1	3.5	1.17	0.597	0.587	0.582	0.567	0.550	0.521	0.500	0.504	0.422	0.092	0.128
ASMP1	40.0	0.94	0.652	0.650	0.649	0.648	0.642	0.621	0.603	0.527	0.431	0.092	0.211
ASMP1	65.0	1.03	0.679	0.672	0.670	0.669	0.665	0.651	0.641	0.580	0.561	0.140	0.104
ASMP2	3.5	0.88	0.637	0.579	0.551	0.539	0.514	0.477	0.459	0.344	0.265	0.068	0.249
ASMP3	3.5	1.13	0.589	0.573	0.535	0.504	0.478	0.433	0.412	*0.340*	*0.290*		0.188
ASMP3	29.0	0.91	0.695	0.671	0.660	0.650	0.641	0.627	0.620	*0.594*	*0.573*		0.068
ASMP3	72.0	1.06	0.738	0.739	0.735	0.730	0.721	0.704	0.693	*0.651*	*0.615*	0.048	0.106
ASMP4	3.5	1.29	0.566	0.556	0.552	0.532	0.507	0.462	0.435	0.388	0.313	0.058	0.194
ASMP4	40.5	1.34	0.562	0.553	0.552	0.550	0.545	0.512	0.487	0.381	0.239	0.052	0.306
ASMP4	65.5	1.26	0.597	0.580	0.566	0.545	0.524	0.478	0.454	0.289	0.161	0.056	0.363
ASMP5	3.5	1.13	0.582	0.541	0.499	0.482	0.457	0.417	0.397	0.308	0.220	0.055	0.238
ASMP5	17.5	1.22	0.575	0.561	0.530	0.516	0.499	0.462	0.439	0.390	0.317	0.082	0.181
ASMP5	24.5	1.30	0.585	0.584	0.587	0.585	0.572	0.553	0.540	0.428	0.367	0.091	0.204
ASMP5	60.5	1.00	0.644	0.637	0.631	0.625	0.615	0.597	0.587	*0.555*	*0.528*		0.087
A1	2.5	0.91	0.633	0.603	0.570	0.539	0.525	*0.435*	*0.390*	0.284	0.230	0.085	0.295
A2	14.5	1.16	0.564	0.535	0.506	0.478	0.471	*0.368*	*0.314*	0.436	0.326	0.088	0.145
A3	14.0	1.08	0.553	0.527	0.495	0.469	0.460	*0.405*	*0.372*	0.436	0.326		0.134
A4	30.5	0.98	0.599	0.580	0.545	0.517	0.506	*0.411*	*0.361*	*0.254*	*0.190*	0.113	0.316
A5	37.5	0.89	0.617	0.588	0.551	0.525	0.515	*0.463*	*0.428*	0.413	0.325	0.112	0.190
A6	42.5	0.81	0.637	0.620	0.582	0.555	0.537	*0.479*	*0.436*	0.382	0.292	0.105	0.245
A7	48.5	0.79	0.653	0.622	0.579	0.548	0.532	*0.464*	*0.423*	0.377	0.289	0.104	0.243
A8	57.5	0.73	0.651	0.604	0.557	0.527	0.506	*0.434*	*0.395*	0.345	0.270	0.098	0.236
A9	62.5	0.78	0.626	0.574	0.528	0.501	0.487	*0.42*	*0.386*	0.362	0.281	0.096	0.206
A10	68.5	0.92	0.664	0.642	0.594	0.566	0.552	*0.478*	*0.437*	0.360	0.297	0.141	0.255
A11	74.5	0.91	0.623	0.600	0.561	0.538	0.528	*0.487*	*0.456*	0.450	0.371	0.145	0.157
A12	97.5	1.04	0.662	0.652	0.628	0.606	0.596	*0.622*	*0.601*	0.473	0.334	0.153	0.262
A13	110.5	1.09	0.660	0.658	0.645	0.619	0.607	*0.623*	*0.593*	0.429	0.310	0.108	0.297
A14	126.5	1.01	0.666	0.660	0.624	0.589	0.567	*0.505*	*0.456*	0.379	0.274	0.124	0.293
A15	137.5	1.04	0.633	0.627	0.588	0.557	0.533	*0.479*	*0.435*	0.375	0.267	0.120	0.266
A16	148.5	1.30	0.516	0.494	0.485	0.476	0.473	*0.494*	*0.492*	0.435	0.371	0.137	0.102

Bd: Bulk density, Air: Theta of air dry soil (pF between 5 and 6)
A.M.P.: Available moisture for plants (Field capacity (pF=2) minus capacity at wilting point (pF=4.2))

Table 25.4: *Measured saturated hydraulic conductivities (mm day^{-1}), model parameters and correlation coefficients (r), and modelled unsaturated hydraulic conductivities (K-unsat, mm day^{-1}) for soil samples collected in Tulasewa forest.*

Sample Code	Depth	K-sat	Model parameters					Modelled K-unsat			
			Tsat*	Tres*	Alpha	n	r	pF=1	pF=2	pF=3	pF=4.2
	cm	mm/d	m3/m3	m3/m3				mm/d	mm/d	mm/d	mm/d
ASMP1	3.5	18	0.60	0.07	0.0411	1.0650	0.99	0.100	0.003	0.000	0.000
ASMP1	40.0	0.09	0.65	0.01	0.0019	1.1197	0.99	0.013	0.003	0.000	0.000
ASMP1	65.0	0.01	0.68	0.12	0.0079	1.0517	0.96	0.000	0.000	0.000	0.000
ASMP2	3.5	101000	0.67	0.01	0.1530	1.1050	0.92	192	1.82	0.010	0.000
ASMP3	3.5	1840	0.59	0.10	0.0607	1.1359	0.99	23.5	0.340	0.000	0.000
ASMP3	29.0	0.60	0.72	0.01	1.3662	1.0226	0.99	0.000	0.000	0.000	0.000
ASMP3	72.0	0.01	0.74	0.15	0.0108	1.0463	0.99	0.000	0.000	0.000	0.000
ASMP4	3.5	7.7	0.57	0.01	0.0269	1.0979	0.99	0.143	0.005	0.000	0.000
ASMP4	40.5	1.12	0.56	0.01	0.0021	1.2319	0.98	0.391	0.113	0.004	0.000
ASMP4	65.5	31	0.60	0.01	0.0071	1.2533	0.96	7.5	0.858	0.006	0.000
ASMP5	3.5	32000	0.60	0.01	0.0986	1.1214	0.96	165	1.76	0.009	0.000
ASMP5	17.5	2200	0.58	0.01	0.0614	1.0838	0.98	11.8	0.206	0.001	0.000
ASMP5	24.5	0.28	0.59	0.01	0.0030	1.1294	0.99	0.037	0.008	0.000	0.000
ASMP5	60.5	6.7	0.65	0.15	0.0381	1.0420	0.99	0.018	0.000	0.000	0.000
A1	2.5	19200	0.64	0.08	0.0306	1.2114	0.99	1176	25.7	0.100	0.000
A2	14.5	27100	0.56	0.07	0.0170	1.3189	0.98	5271	202.6	0.547	0.000
A3	14.0	1010	0.56	0.01	0.4890	1.1287	0.83	15.2	0.264	0.001	0.000
A4	30.5	490	0.60	0.05	0.0219	1.2335	0.99	48.7	1.5	0.006	0.000
A5	37.5	20200	0.63	0.01	0.0478	1.1206	0.85	286	0.053	0.031	0.000
A6	42.5	220	0.64	0.01	0.0255	1.1508	0.93	9.2	0.286	0.002	0.000
A7	48.5	1200	0.66	0.01	0.4640	1.1428	0.93	23.7	0.415	0.002	0.000
A8	57.5	29800	0.67	0.01	0.0823	1.1425	0.94	265.5	2.9	0.014	0.000
A9	62.5	7700	0.65	0.01	0.1339	1.1259	0.90	25.4	0.223	0.001	0.000
A10	68.5	4900	0.67	0.01	0.0451	1.1400	0.97	96.8	1.76	0.009	0.000
A11	74.5	1600	0.63	0.01	0.0467	1.1038	0.80	17.9	0.358	0.002	0.000
A12	97.5	2.7	0.64	0.01	0.0009	1.2544	0.97	1.3	0.578	0.052	0.000
A13	110.5	1.4	0.65	0.01	0.0012	1.2816	0.98	0.710	0.290	0.018	0.000
A14	126.5	84	0.67	0.01	0.0204	1.1646	0.97	5.0	0.192	0.001	0.000
A15	137.5	12	0.64	0.01	0.0221	1.1568	0.96	0.615	0.022	0.000	0.000
A16	148.5	2.5	0.50	0.00	0.0001	1.3479	0.96	2.0	1.52	0.665	0.014

*: Tsat, Tres are theta at saturation and residual theta respectively

Table 25.5: *Bulk density (g cm^{-3}) and soil moisture retention data (θ in m^3 m^{-3}) for soil samples collected in Korokula forest. Modelled θ values are shown in italics.*

Sample Code	Depth cm	Bd g/cm3	Theta at various soil moisture tensions (pF) 0.4	1.0	1.4	1.7	2.0	2.4	2.7	3.5	4.2	Air	A.M.P. m3/m3
BSMP1	22.5	1.30	0.437	0.417	0.405	0.383	0.365	0.297	0.258	*0.181*	*0.133*		0.232
BSMP1	70.5	1.61	0.517	0.514	0.513	0.512	0.509	0.496	0.486	0.469	0.445	0.039	0.064
BSMP2	53.5	1.78	0.405	0.402	0.399	0.383	0.363	0.333	0.320	0.297	0.263	0.033	0.099
BSMP3	3.5	1.36	0.475	0.467	0.419	0.395	0.377	0.343	0.324	*0.271*	*0.233*		0.144
BSMP3	12.5	1.35	0.469	0.454	0.392	0.361	0.343	0.304	0.282	*0.222*	*0.183*		0.160
BSMP4	3.5	1.23	0.481	0.459	0.423	0.391	0.369	0.322	0.292	*0.230*	*0.187*		0.182
BSMP4	12.5	1.37	0.449	0.437	0.378	0.340	0.315	0.270	0.247	*0.180*	*0.141*		0.174
BSMP4	18.5	1.22	0.449	0.422	0.363	0.327	0.302	0.249	0.228	*0.164*	*0.127*		0.175
BSMP5	4.5	1.40	0.438	0.424	0.405	0.369	0.342	0.298	0.275	*0.208*	*0.166*		0.176
BSMP5	12.5	1.28	0.568	0.554	0.526	0.501	0.481	0.445	0.425	*0.365*	*0.320*		0.161
BSMP5	51	1.57	0.494	0.478	0.468	0.447	0.431	0.405	0.393	*0.349*	*0.319*		0.112
B1	3.5	1.14	0.522	0.480	0.422	0.377	0.359	*0.260*	*0.218*	*0.136*	*0.093*	0.022	0.266
B1	11.5	1.32	0.477	0.444	0.395	0.353	0.338	*0.254*	*0.216*	*0.141*	*0.100*	0.026	0.238
B2	3.5	1.07	0.452	0.384	0.313	0.276	0.259	*0.196*	*0.169*	*0.115*	*0.084*	0.021	0.175
B2	11.5	1.21	0.500	0.430	0.349	0.300	0.281	*0.212*	*0.180*	*0.118*	*0.082*	0.024	0.199
B3	3.5	1.16	0.555	0.489	0.425	0.389	0.370	*0.272*	*0.232*	*0.152*	*0.106*	0.023	0.264
B3	11.5	1.15	0.498	0.429	0.370	0.332	0.315	*0.238*	*0.207*	*0.143*	*0.105*	0.020	0.210
soilpit	3.5	1.15	0.465	0.419	0.367	0.346	0.320	*0.249*	*0.216*	0.142	0.117	0.027	0.203
soilpit	28	1.36	0.390	0.376	0.329	0.294	0.267	*0.233*	*0.207*	0.190	0.112	0.020	0.155
soilpit	53	1.40	0.528	0.533	0.525	0.492	0.485	*0.454*	*0.432*	0.378	0.332	0.115	0.153
soilpit	72	1.38	0.520	0.520	0.494	0.468	0.459	*0.425*	*0.404*	*0.354*	0.316	0.110	0.143
soilpit	87	1.44	0.510	0.514	0.503	0.473	0.464	*0.422*	*0.391*	*0.318*	0.268	0.102	0.196

Bd: Bulk density, Air: Theta of air dry soil (pF between 5 and 6)
A.M.P.: Available moisture for plants (Field capacity (pF=2) minus capacity at wilting point (pF=4.2))

modelled unsaturated hydraulic conductivity data are shown in Table 25.6. Samples coded as BSMP were collected within 30 cm of the capacitance probe acces tubes.

The bulk density, soil moisture retention data and available moisture for plants for 22 samples collected in Koromani forest are presented in Table 25.7 whereas the saturated and modelled unsaturated hydraulic conductivity data are shown in Table 25.8. Samples coded as CSMP were collected within 30 cm of the capacitance probe acces tubes.

The bulk density, soil moisture retention data and available moisture for plants for 25 samples, collected within the forested Oleolega drainage basin before logging started, are presented in Table 25.9 whereas the saturated and modelled unsaturated hydraulic conductivity data are shown in Table 25.10. Samples coded as OSMP were collected within 30 cm of the capacitance probe acces tubes. Samples were collected at the same locations after logging and burning of the catchment and the results are presented in Tables 25.11 and 25.12 respectively. Additional samples were collected on skidder tracks, roads and landings in the vicinity of the previous sample points to study the effect of compression and removal of the top soil on the moisture retention characteristics, permeability and bulk density. The results for the samples collected on the skidder tracks, roads and landings are given in Tables 25.13 and 25.14.

Table 25.6: *Measured saturated hydraulic conductivities (mm day^{-1}), model parameters and correlation coefficients (r), and modelled unsaturated hydraulic conductivities (mm day^{-1}) for soil samples collected in Korokula forest.*

Sample Code	Depth cm	K-sat mm/d	Model parameters Tsat* m3/m3	Tres* m3/m3	Alpha	n	r	Modelled K-unsat pF=1 mm/d	pF=2 mm/d	pF=3 mm/d	pF=4.2 mm/d
BSMP1	22.5	220	0.44	0.03	0.0216	1.2358	0.97	22.0	0.710	0.003	0.000
BSMP1	70.5	0.04	0.52	0.04	0.0138	1.0302	0.98	0.000	0.000	0.000	0.000
BSMP2	53.5	7.5	0.41	0.03	0.0485	1.0751	0.96	0.045	0.001	0.000	0.000
BSMP3	3.5	5880	0.50	0.03	0.1831	1.1050	0.97	8.0	0.070	0.000	0.000
BSMP3	12.5	1960	0.49	0.03	0.1568	1.1409	0.97	5.8	0.044	0.000	0.000
BSMP4	3.5	1140	0.49	0.03	0.0790	1.1506	1.00	11.8	0.129	0.001	0.000
BSMP4	12.5	920	0.46	0.03	0.0849	1.1880	0.98	12.3	0.106	0.000	0.000
BSMP4	18.5	1490	0.46	0.03	0.1009	1.2024	0.99	16.8	0.119	0.000	0.000
BSMP5	4.5	220	0.45	0.03	0.0479	1.1683	0.99	5.5	0.086	0.000	0.000
BSMP5	12.5	2100	0.58	0.03	0.0811	1.0879	1.00	8.3	0.118	0.001	0.000
BSMP5	51	0.95	0.50	0.15	0.0643	1.1034	0.99	0.007	0.000	0.000	0.000
B1	3.5	6600	0.53	0.02	0.0524	1.2890	0.97	349	3.1	0.007	0.000
B1	11.5	249500	0.49	0.02	0.5270	1.2624	0.98	11296	112	0.284	0.000
B2	3.5	34400	0.49	0.02	0.2218	1.2439	0.98	109	0.395	0.001	0.000
B2	11.5	34500	0.53	0.01	0.1772	1.2487	0.99	180	0.704	0.002	0.000
B3	3.5	52000	0.57	0.01	0.0888	1.2438	0.96	959	6.2	0.016	0.000
B3	11.5	47700	0.53	0.02	0.1651	1.2275	0.97	256	1.2	0.003	0.000
soilpit	3.5	32100	0.48	0.01	0.0827	1.2179	0.98	561	4.3	0.013	0.000
soilpit	28	10500	0.40	0.01	0.0808	1.1838	0.94	146	1.3	0.005	0.000
soilpit	53	9.2	0.54	0.12	0.0260	1.1087	0.99	0.214	0.007	0.000	0.000
soilpit	72	410	0.53	0.11	0.0599	1.1038	0.99	3.3	0.055	0.000	0.000
soilpit	87	36	0.52	0.10	0.0162	1.1642	0.99	2.6	0.128	0.001	0.000

*: Tsat, Tres are theta at saturation and residual theta respectively

Table 25.7: *Bulk density (g cm^{-3}) and soil moisture retention data (θ in m^3 m^{-3}) for soil samples collected in Koromani forest. Modelled θ values are shown in italics.*

Sample Code	Depth cm	Bd g/cm3	Theta at various soil moisture tensions (pF) **0.4**	**1.0**	**1.4**	**1.7**	**2.0**	**2.4**	**2.7**	**3.5**	**4.2**	**Air**	A.M.P. m3/m3
CSMP4	3.5	1.16	0.581	0.510	0.441	0.419	0.404	0.372	0.356	0.297	0.255	0.029	0.149
CSMP4	31.5	1.36	0.517	0.500	0.464	0.445	0.432	0.411	0.403	0.432	0.356	0.027	0.076
CSMP4	53.5	1.45	0.518	0.514	0.509	0.497	0.488	0.471	0.463	0.531	0.465	0.035	0.023
CSMP5	3.5	1.22	0.558	0.496	0.454	0.433	0.419	0.388	0.372	0.350	0.287	0.031	0.131
CSMP5	33.5	1.49	0.477	0.461	0.429	0.411	0.399	0.376	0.353	0.381	0.310	0.028	0.089
CSMP5	57.5	1.37	0.525	0.514	0.502	0.486	0.474	0.451	0.440	0.459	0.394	0.032	0.079
C1	3.5	1.08	0.492	0.460	0.434	0.423	0.419	*0.393*	*0.379*	*0.345*	*0.318*	0.046	0.101
C1	10.5	1.18	0.476	0.454	0.422	0.401	0.397	*0.389*	*0.354*	*0.316*	*0.287*	0.038	0.110
C1	16.5	1.16	0.462	0.445	0.412	0.394	0.387	*0.365*	*0.351*	*0.317*	*0.290*		0.097
C1	37.5	1.38	0.511	0.513	0.498	0.480	0.475	*0.451*	*0.434*	*0.392*	*0.358*	0.047	0.117
C1	43.5	1.37	0.501	0.498	0.483	0.469	0.461	*0.385*	*0.325*	*0.192*	*0.120*		0.341
Soil pit	3.5	1.12	0.511	0.442	0.419	0.406	0.395	*0.355*	*0.336*	0.308	0.237	0.049	0.158
Soil pit	9.5	1.19	0.518	0.443	0.406	0.378	0.362	*0.322*	*0.300*	*0.249*	*0.213*		0.149
Soil pit	15.5	1.42	0.515	0.474	0.443	0.410	0.393	*0.358*	*0.336*	*0.284*	*0.246*	0.053	0.147
Soil pit	23.5	1.43	0.512	0.493	0.455	0.425	0.405	*0.361*	*0.334*	*0.272*	0.228		0.177
Soil pit	30.5	1.29	0.508	0.459	0.417	0.392	0.379	*0.343*	*0.322*	*0.274*	*0.239*		0.140
Soil pit	57.5	1.31	0.583	0.559	0.544	0.528	0.516	*0.497*	*0.484*	*0.450*	*0.423*	0.053	0.093
Soil pit	63.5	1.32	0.544	0.535	0.512	0.492	0.479	*0.450*	*0.431*	*0.382*	*0.345*	0.050	0.134
C3	3.5	1.03	0.546	0.459	0.425	0.399	0.386	*0.342*	*0.319*	*0.267*	*0.230*	0.050	0.156
C3	21.5	1.33	0.536	0.477	0.428	0.397	0.383	*0.338*	*0.314*	*0.258*	*0.219*	0.040	0.164
C3	27.5	1.39	0.537	0.488	0.440	0.407	0.388	*0.346*	*0.321*	*0.264*	*0.224*	0.040	0.164
C3	36.5	1.36	0.517	0.473	0.420	0.387	0.375	*0.349*	*0.304*	*0.247*	*0.207*	0.040	0.168

Bd: Bulk density, Air: Theta of air dry soil (pF between 5 and 6)
A.M.P.: Available moisture for plants (Field capacity (pF=2) minus capacity at wilting point (pF=4.2))

Table 25.8: *Measured saturated hydraulic conductivities (mm day^{-1}), model parameters and correlation coefficients (r), and modelled unsaturated hydraulic conductivities (mm day^{-1}) for soil samples collected in Koromani forest.*

Sample	Depth	K-sat	Model parameters					Modelled K-unsat			
Code			Tsat*	Tres*	Alpha	n	r	pF=1	pF=2	pF=3	pF=4.2
	cm	mm/d	m3/m3	m3/m3				mm/d	mm/d	mm/d	mm/d
CSMP4	3.5	12	0.63	0.03	0.9143	1.1038	0.97	0.001	0.000	0.000	0.000
CSMP4	31.5	300	0.54	0.10	0.7092	1.0624	0.96	0.013	0.000	0.000	0.000
CSMP4	53.5	4	0.52	0.04	0.0404	1.0428	0.99	0.010	0.000	0.000	0.000
CSMP5	3.5	680	0.60	0.03	1.2333	1.0784	0.96	0.013	0.000	0.000	0.000
CSMP5	33.5	180	0.49	0.03	0.3394	1.0620	0.96	0.034	0.000	0.000	0.000
CSMP5	57.5	7	0.54	0.03	0.3033	1.0411	0.98	0.001	0.000	0.000	0.000
C1	3.5	150	0.50	0.05	0.3762	1.0597	0.89	0.022	0.000	0.000	0.000
C1	10.5	3180	0.50	0.05	0.4632	1.0719	0.95	0.416	0.003	0.000	0.000
C1	16.5	66	0.50	0.05	0.9596	1.0652	0.94	0.002	0.000	0.000	0.000
C1	37.5	110	0.52	0.05	0.0357	1.0645	0.85	0.704	0.020	0.000	0.000
C1	43.5	210	0.51	0.01	0.0078	1.3157	0.99	64.9	7.0	0.036	0.000
Soil pit	3.5	50500	0.54	0.05	0.6374	1.0936	0.95	5.1	0.034	0.000	0.000
Soil pit	9.5	7800	0.57	0.05	0.7627	1.1235	0.97	0.771	0.004	0.000	0.000
Soil pit	15.5	15500	0.54	0.05	0.2556	1.1091	0.99	12.5	0.092	0.001	0.000
Soil pit	23.5	2300	0.52	0.05	0.0820	1.1351	1.00	18.9	0.214	0.001	0.000
Soil pit	30.5	47600	0.55	0.05	0.6235	1.1058	0.98	6.0	0.037	0.000	0.000
Soil pit	57.5	250	0.60	0.03	0.4226	1.0418	1.00	0.016	0.000	0.000	0.000
Soil pit	63.5	230	0.55	0.05	0.0767	1.0744	0.97	0.729	0.011	0.000	0.000
C3	3.5	65600	0.60	0.05	0.8944	1.1171	0.94	4.3	0.024	0.000	0.000
C3	21.5	5700	0.57	0.04	0.4060	1.1240	0.98	2.2	0.013	0.000	0.000
C3	27.5	2200	0.57	0.04	0.3376	1.1233	0.99	1.22	0.008	0.000	0.000
C3	36.5	750	0.54	0.04	0.2497	1.1322	0.96	0.84	0.005	0.000	0.000

*: Tsat, Tres are theta at saturation and residual theta respectively

Table 25.9: *Bulk density (g cm^{-3}) and soil moisture retention data (θ in m^3 m^{-3}) for soil samples collected in the undisturbed Oleolega drainage basin. Modelled θ values are shown in italics.*

Sample Code	Depth cm	Bd g/cm3	Theta at various soil moisture tensions (pF)										A.M.P. m3/m3
			0.4	**1.0**	**1.4**	**1.7**	**2.0**	**2.4**	**2.7**	**3.0**	**4.2**	**Air**	
OSMP1	3.5	1.15	0.479	0.441	0.403	0.378	0.355	0.308	0.280	0.193	0.127	0.022	0.228
OSMP1	32.5	1.39	0.481	0.477	0.461	0.420	0.387	0.328	0.303	0.298	0.200	0.027	0.187
OSMP1	68.5	1.43	0.487	0.476	0.457	0.438	0.422	0.387	0.370	0.321	0.216	0.026	0.206
O4	3.5	1.13	0.489	0.470	0.423	0.400	0.384	*0.345*	*0.321*	*0.299*	*0.228*	0.047	0.156
O4	27.5	1.08	0.530	0.437	0.381	0.352	0.331	*0.280*	*0.254*	*0.231*	*0.162*		0.169
O5	3.5	0.99	0.571	0.490	0.437	0.412	0.398	*0.281*	*0.255*	*0.232*	*0.160*	0.029	0.238
O5	29.5	1.15	0.553	0.512	0.473	0.434	0.404	*0.361*	*0.332*	*0.305*	*0.222*		0.182
O11	3.5	0.99	0.567	0.483	0.413	0.376	0.352	*0.298*	*0.268*	*0.242*	*0.163*	0.032	0.189
O11	31.5	1.31	0.525	0.507	0.439	0.388	0.360	*0.296*	*0.259*	*0.228*	*0.143*		0.217
O13	3.5	1.14	0.538	0.534	0.486	0.446	0.414	*0.354*	*0.315*	*0.280*	*0.177*	0.022	0.237
O13	33.5	1.25	0.538	0.522	0.470	0.426	0.401	*0.344*	*0.310*	*0.280*	*0.189*		0.212
O18	3.5	1.05	0.551	0.486	0.463	0.435	0.424	*0.388*	*0.369*	*0.350*	*0.285*	0.044	0.139
O18	28.5	1.18	0.531	0.519	0.453	0.416	0.392	*0.337*	*0.305*	*0.276*	*0.189*		0.203
O19	3.5	1.06	0.601	0.511	0.466	0.438	0.416	*0.368*	*0.341*	*0.316*	*0.236*	0.030	0.180
O19	31.5	1.11	0.533	0.493	0.424	0.374	0.344	*0.284*	*0.250*	*0.221*	*0.141*		0.203
O27	3.5	1.00	0.511	0.443	0.405	0.379	0.357	*0.321*	*0.299*	*0.278*	*0.211*	0.034	0.146
O27	31.5	1.28	0.469	0.438	0.374	0.336	0.311	*0.261*	*0.233*	*0.209*	*0.139*		0.172
O42	3.5	1.05	0.610	0.588	0.539	0.513	0.504	*0.464*	*0.441*	*0.419*	*0.343*	0.054	0.161
O42	31.5	1.11	0.603	0.548	0.491	0.457	0.440	*0.392*	*0.365*	*0.340*	*0.258*		0.182
O47	3.5	1.02	0.591	0.562	0.478	0.451	0.432	*0.373*	*0.341*	*0.312*	*0.221*	0.039	0.211
O47	27.5	1.16	0.557	0.518	0.466	0.422	0.391	*0.337*	*0.304*	*0.275*	*0.187*		0.204
O61	3.5	1.00	0.638	0.531	0.498	0.466	0.446	*0.396*	*0.369*	*0.344*	*0.260*	0.018	0.186
O61	21.5	1.21	0.522	0.434	0.380	0.350	0.332	*0.285*	*0.261*	*0.239*	*0.172*		0.160
O64	3.5	1.22	0.513	0.502	0.437	0.410	0.394	*0.345*	*0.318*	*0.292*	*0.212*	0.042	0.182
O64	34.5	1.29	0.550	0.522	0.477	0.434	0.421	*0.374*	*0.347*	*0.322*	*0.241*		0.180

Bd: Bulk density, Air: Theta of air dry soil (pF between 5 and 6)
A.M.P.: Available moisture for plants (Field capacity (pF=2) minus capacity at wilting point (pF=4.2))

Table 25.10: *Measured saturated hydraulic conductivities (mm day^{-1}), model parameters and correlation coefficients (r), and modelled unsaturated hydraulic conductivities (mm day^{-1}) for soil samples collected within the forested Oleolega drainage basin.*

Sample Code	Depth cm	K-sat mm/d	Model parameters Tsat* m3/m3	Tres* m3/m3	Alpha	n	r	Modelled K-unsat pF=1 mm/d	pF=2 mm/d	pF=3 mm/d	pF=4.2 mm/d
OSMP1	3.5	101	0.48	0.02	0.0483	1.2094	0.95	3.6	0.048	0.000	0.000
OSMP1	32.5	56	0.49	0.03	0.0426	1.1557	0.98	1.4	0.026	0.000	0.000
OSMP1	68.5	8.8	0.49	0.03	0.0217	1.1444	0.98	0.398	0.015	0.000	0.000
O4	3.5	30600	0.50	0.05	0.1259	1.1210	0.95	105	0.977	0.005	0.000
O4	27.5	19300	0.57	0.05	0.4252	1.1742	0.96	10.2	0.045	0.000	0.000
O5	3.5	82800	0.59	0.03	0.6151	1.1585	0.97	17.3	0.079	0.000	0.000
O5	29.5	580	0.57	0.05	0.1467	1.1424	1.00	2.0	0.015	0.000	0.000
O11	3.5	27400	0.62	0.03	0.4155	1.1708	0.98	14.9	0.068	0.000	0.000
O11	31.5	1660	0.54	0.05	0.0735	1.2350	0.96	39.2	0.310	0.001	0.000
O13	3.5	8100	0.55	0.02	0.0460	1.1862	0.96	253	3.8	0.016	0.000
O13	33.5	2140	0.55	0.05	0.0704	1.1827	0.97	36.2	0.375	0.001	0.000
O18	3.5	175000	0.59	0.04	0.8227	1.0863	0.95	9.3	0.062	0.000	0.000
O18	28.5	4860	0.55	0.05	0.0927	1.1751	0.94	50.3	0.434	0.002	0.000
O19	3.5	83000	0.65	0.03	0.6285	1.1199	0.96	12.1	0.069	0.000	0.000
O19	31.5	1920	0.55	0.05	0.1088	1.2287	0.98	22.8	0.134	0.000	0.000
O27	3.5	224900	0.57	0.03	0.8685	1.1157	0.99	15.5	0.087	0.000	0.000
O27	31.5	4610	0.49	0.05	0.1318	1.2087	0.98	33.9	0.195	0.001	0.000
O42	3.5	73200	0.63	0.05	0.2213	1.0846	0.93	51.3	0.454	0.003	0.000
O42	31.5	580	0.64	0.05	0.3641	1.1206	0.98	0.268	0.002	0.000	0.000
O47	3.5	19100	0.61	0.039	0.1509	1.1467	0.91	65.0	0.481	0.002	0.000
O47	27.5	770	0.57	0.05	0.1077	1.1789	0.99	6.4	0.049	0.000	0.000
O61	3.5	142000	0.71	0.02	1.1078	1.1079	0.94	5.6	0.033	0.000	0.000
O61	21.5	580	0.60	0.05	0.8479	1.1583	0.98	0.059	0.000	0.000	0.000
O64	3.5	11200	0.53	0.04	0.1153	1.1404	0.90	56.8	0.503	0.002	0.000
O64	34.5	320	0.57	0.05	0.1557	1.1218	0.96	0.834	0.007	0.000	0.000

*: Tsat, Tres are theta at saturation and residual theta respectively

Table 25.11: *Bulk density (g cm^{-3}) and soil moisture retention data (θ in m^3 m^{-3}) for soil samples collected within the Oleolega drainage basin after logging and burning. Modelled θ values are shown in italics.*

Sample Code	Depth cm	Bd g/cm3	Theta at various soil moisture tensions (pF) **0.4**	**1.0**	**1.4**	**1.7**	**2.0**	**2.4**	**2.7**	**3.0**	**4.2**	**Air**	A.M.P. m3/m3
OSMP2	3.5	1.06	0.575	0.504	0.460	0.439	0.422	0.384	0.365	0.311	0.257	0.043	0.165
OSMP2	70.5	1.29	0.535	0.524	0.513	0.501	0.489	0.465	0.451	*0.431*	0.370	0.086	0.119
O4A	3.5	0.87	0.503	0.426	0.391	0.373	0.356	0.322	0.304	0.200	0.100	0.022	0.257
O4B	3.5	1.06	0.545	0.446	0.396	0.379	0.366	0.342	0.323	0.252	0.127	0.031	0.239
O4	41.5	1.29	0.461	0.460	0.433	0.410	0.394	0.361	0.346	0.258	0.128	0.022	0.266
O5	3.5	1.15	0.528	0.443	0.413	0.400	0.388	0.358	0.341	0.292	0.143	0.027	0.245
O5	68.5	1.48	0.464	0.459	0.457	0.452	0.437	0.408	0.390	0.322	0.100	0.024	0.338
O11	3.5	0.99	0.539	0.425	0.380	0.362	0.347	0.316	0.301	0.260	0.185	0.027	0.162
O11	46.5	1.37	0.528	0.477	0.444	0.426	0.414	0.398	0.388	0.372	0.259	0.038	0.156
O13	3.5	1.14	0.564	0.540	0.512	0.455	0.376	0.262	0.239	0.127	0.050	0.015	0.325
O13	69.5	1.26	0.530	0.510	0.452	0.414	0.382	0.321	0.294	0.189	0.093	0.021	0.289
O18	3.5	1.06	0.463	0.452	0.430	0.425	0.413	0.381	0.364	0.280	0.190	0.027	0.223
O18	44.5	1.32	0.518	0.516	0.513	0.511	0.504	0.492	0.484	0.412	0.307	0.037	0.197
O19	3.5	1.19	0.563	0.488	0.445	0.429	0.413	0.380	0.361	0.326	0.242	0.022	0.171
O19	43.5	1.33	0.461	0.459	0.435	0.419	0.403	0.375	0.361	0.344	0.258	0.021	0.145
O27	10.5	1.24	0.487	0.396	0.339	0.313	0.290	0.243	0.223	0.157	0.073	0.017	0.217
O27	60.5	1.61	0.390	0.382	0.381	0.376	0.366	0.343	0.328	0.265	0.089	0.025	0.277
O42	3.5	1.08	0.562	0.493	0.460	0.445	0.432	0.399	0.382	0.318	0.091	0.030	0.341
O42	57.5	1.46	0.515	0.512	0.512	0.503	0.488	0.467	0.454	0.422	0.287	0.032	0.201
O47	3.5	1.22	0.555	0.546	0.541	0.533	0.520	0.477	0.446	0.378	0.204	0.031	0.315
O47	45.5	1.15	0.622	0.623	0.621	0.618	0.607	0.579	0.564	0.523	0.325	0.031	0.283
O61	3.5	1.21	0.555	0.438	0.392	0.376	0.358	0.326	0.310	0.204	0.072	0.015	0.286
O61	65.5	1.76	0.316	0.308	0.302	0.295	0.284	0.264	0.253	*0.198*	0.087	0.021	0.197
O64	3.5	1.18	0.522	0.428	0.395	0.383	0.365	0.333	0.317	0.260	0.101	0.033	0.263
O64	65.5	1.59	0.435	0.433	0.430	0.428	0.419	0.404	0.394	0.333	0.157	0.031	0.261
O36A	3.5	1.25											

Bd: Bulk density, Air: Theta of air dry soil (pF between 5 and 6)
A.M.P.: Available moisture for plants (Field capacity (pF=2) minus capacity at wilting point (pF=4.2))

Table 25.12: *Measured saturated hydraulic conductivities (mm day^{-1}), model parameters and correlation coefficients (r), and modelled unsaturated hydraulic conductivities (mm day^{-1}) for soil samples collected within the Oleolega drainage basin after logging and burning.*

Sample Code	Depth cm	K-sat mm/d	Model parameters Tsat* m3/m3	Tres* m3/m3	Alpha	n	r	Modelled K-unsat pF=1 mm/d	pF=2 mm/d	pF=3 mm/d	pF=4.2 mm/d
OSMP2	3.5	2810	0.63	0.04	0.7648	1.1074	0.98	0.233	0.001	0.000	0.000
OSMP2	70.5	0.84	0.54	0.09	0.0546	1.0681	1.00	0.004	0.000	0.000	0.000
O4A	3.5	1473	0.58	0.05	1.5888	1.1127	0.96	0.541	0.003	0.000	0.000
O4B	3.5	153000	0.60	0.03	0.5575	1.4450	0.87	36.0	0.181	0.001	0.000
O4	41.5	41	0.47	0.02	0.1146	1.2449	0.93	3.7	0.250	0.001	0.000
O5	3.5	188	0.62	0.03	2.8854	1.0943	0.89	0.001	0.000	0.000	0.000
O5	68.5	5	0.47	0.02	0.0035	1.2585	0.95	1.7	0.360	0.005	0.000
O11	3.5	11945	0.68	0.03	2.5592	1.1399	0.92	0.086	0.000	0.000	0.000
O11	46.5	215	0.57	0.01	0.9159	1.0723	0.91	0.007	0.000	0.000	0.000
O13	3.5	1060	0.57	0.02	0.0249	1.3954	0.99	206	3.9	0.006	0.000
O13	69.5	240	0.53	0.02	0.0314	1.2764	0.96	21.9	0.391	0.001	0.000
O18	3.5	720	0.53	0.04	21.546	1.0353	0.93	0.000	0.000	0.000	0.000
O18	44.5	0.44	0.52	0.15	0.0025	1.2375	0.96	0.149	0.039	0.001	0.000
O19	3.5	1600	0.69	0.03	4.0791	1.0947	0.96	0.003	0.000	0.000	0.000
O19	43.5	110	0.47	0.05	0.0486	1.0996	0.98	1.09	0.021	0.000	0.000
O27	10.5	133	0.57	0.03	0.8500	1.1730	0.98	0.014	0.000	0.000	0.000
O27	60.5	2	0.39	0.03	0.0330	1.2854	0.93	0.775	0.181	0.003	0.000
O42	3.5	29500	0.64	0.05	2.3057	1.0851	0.94	0.169	0.001	0.000	0.000
O42	57.5	8.2	0.52	0.03	0.0052	1.1422	0.99	0.984	0.140	0.002	0.000
O47	3.5	213	0.60	0.04	33.673	1.0177	0.86	0.000	0.000	0.000	0.000
O47	45.5	20.3	0.63	0.03	0.0020	1.2008	0.99	6.0	1.7	0.064	0.000
O61	3.5	4430	0.64	0.02	1.2275	1.1364	0.90	0.168	0.001	0.000	0.000
O61	65.5	18	0.32	0.02	0.0046	1.3205	0.94	7.1	1.32	0.012	0.000
O64	3.5	4533	0.61	0.04	1.9979	1.1133	0.90	0.048	0.000	0.000	0.000
O64	65.5	0.91	0.44	0.03	0.0017	1.3514	0.98	0.526	0.202	0.007	0.000
O36A	3.5	0.01									

*: Tsat, Tres are theta at saturation and residual theta respectively

Table 25.13: *Bulk density (g cm^{-3}) and soil moisture retention data (θ in m^3 m^{-3}) for soil samples collected on skidder tracks, roads and landings in Oleolega drainage basin. Modelled θ values are shown in italics.*

Sample Code	Depth cm	Bd g/cm3	Theta at various soil moisture tensions (pF) **0.4**	**1.0**	**1.4**	**1.7**	**2.0**	**2.4**	**2.7**	**3.0**	**4.2**	**Air**	A.M.P. m3/m3
O5	3.5	1.05	0.572	0.566	0.556	0.550	0.538	0.490	0.461	0.263	0.163	0.022	0.375
O11	3.5	1.10	0.508	0.482	0.443	0.415	0.392	0.357	0.339	0.308	0.207	0.029	0.185
O13	3.5	1.16	0.548	0.461	0.430	0.416	0.399	0.364	0.351	0.288	0.206	0.026	0.193
O18	3.5	1.26	0.546	0.534	0.527	0.514	0.497	0.435	0.371	0.254	0.137	0.025	0.360
O19	3.5	1.15	0.564	0.472	0.423	0.405	0.387	0.347	0.327	0.252	0.135	0.023	0.251
O27	3.5	1.40	0.491	0.475	0.465	0.459	0.450	0.422	0.405	0.359	0.258	0.038	0.192
O36B	3.5	1.15											
O42	3.5	1.27	0.580	0.541	0.484	0.458	0.439	0.405	0.387	0.333	0.2	0.027	0.240
O61	3.5	1.20	0.602	0.592	0.560	0.535	0.516	0.472	0.448	0.358	0.204	0.035	0.312
O64	3.5	0.99	0.634	0.628	0.604	0.586	0.557	0.506	0.483	0.338	0.184	0.031	0.373
O73B	3.5	1.28											

Bd: Bulk density, Air: Theta of air dry soil (pF between 5 and 6)
A.M.P.: Available moisture for plants (Field capacity (pF=2) minus capacity at wilting point (pF=4.2))

Table 25.14: *Measured saturated hydraulic conductivities (mm day^{-1}), model parameters and correlation coefficients (r), and modelled unsaturated hydraulic conductivities (mm day^{-1}) for soil samples collected on skidder tracks, roads and landings in Oleolega catchment.*

Sample Code	Depth cm	K-sat mm/d	Model parameters Tsat* m3/m3	Tres* m3/m3	Alpha	n	r	Modelled K-unsat pF=1 mm/d	pF=2 mm/d	pF=3 mm/d	pF=4.2 mm/d
O5	3.5	1.6	0.57	0.02	0.0037	1.3893	0.90	0.834	0.201	0.002	0.000
O11	3.5	140	0.52	0.03	0.1045	1.1267	0.99	0.705	0.007	0.000	0.000
O13	3.5	690	0.60	0.03	0.7032	1.1128	0.94	0.073	0.000	0.000	0.000
O18	3.5	177	0.55	0.03	0.0062	1.3676	0.97	10.5	0.056	0.000	0.000
O19	3.5	43	0.61	0.02	0.3611	1.1502	0.91	0.027	0.000	0.000	0.000
O27	3.5	1.3	0.49	0.04	0.0110	1.1357	0.97	0.092	0.007	0.000	0.000
O36B	3.5	49									
O42	3.5	351	0.60	0.03	0.1321	1.1319	0.94	1.3	0.011	0.000	0.000
O61	3.5	413	0.60	0.04	0.0118	1.2138	0.96	57.5	3.8	0.023	0.000
O64	3.5	0.164	0.63	0.03	0.0063	1.2970	0.96	0.052	0.007	0.000	0.000
O73B	3.5	0.1									

*: Tsat, Tres are theta at saturation and residual theta respectively

Chapter 26

Soil Chemical Data

All data on the soil pH, pH_{KCl}, %N, %C, LOI, exchangeable cations (Na, K, Ca, Mg, NH_4), extractable P and soluble NO_3 are presented in this appendix. The analytical data for 31 bulked and single soil samples collected in Tulasewa forest are presented in Table 26.1. Analytical data on 30 bulked and single samples collected in Korokula forest and 29 samples collected in Koromani forest are given in Tables 26.2 and 26.3 respectively.

Data on the soil pH, pH_{KCl}, %N, %C, LOI, exchangeable cations (Na, K, Ca, Mg, NH_4), extractable P and soluble NO_3 for depths of 0–10 cm, 10–20 cm and 30–50 cm collected at 25 sample points in the forested Oleolega catchment in December 1990 are presented in Tables 26.4, 26.5 and 26.6 respectively. The locations of the sample points are shown by the points with corresponding numbers as shown in Figure 15.3.

The forest in the Oleolega catchment was logged and burned between December 1990 and August 15, 1991 and soil samples were collected in August–September 1991 at the same locations and depths as those collected when the catchment was still under forest. When landings or tracks were constructed at a sample point location soil samples were collected at the sample point as well as in an area near the sample point where the soil had not been disturbed by earth moving machinery or skidders. The analytical data for the relatively undisturbed samples collected at depths of 0–10 cm, 10-20 cm, 30–40 cm and 50–60 cm are shown in Tables 26.7, 26.8, 26.9 and 26.10 respectively. Exchangeable cations, soluble NO_3 and extractable PO_4 were not analysed for the samples collected at a depth of 30–40 cm. samples collected at a depth of 30–40 cm.

Analytical data obtained from samples collected at depths of 0–10 cm, 10–20 cm and between 30–60 cm on landings, roads and skidder tracks at or near 14 of the 25 sample points are given in Tables 26.11, 26.12 and 26.13 respectively. Exchangeable cations and NO_3 and extractable PO_4 were not analysed for samples collected between depths of 30–60 cm.

Table 26.1: *Analytical data obtained from soil samples collected in Tulasewa forest. The number of sample points is given by n, the LOI is in percentage of oven dry material and the exchangeable cations (Na, K, Ca, Mg and NH_4), soluble NO_3 and extractable PO_4 are given in meq 100 g^{-1} dry soil.*

Sample	Depth	n	pH	pH*	%N	%C	LOI	Na	K	Ca	Mg	NH4	NO3	PO4
AA1	0-10 cm	3	4.84	3.95	0.156	2.53	8.5	0.142	0.057	3.256	4.356	0.078	0.003	0.009
AB1		4	4.90	3.81	0.130	2.20	11.0	0.137	0.191	2.414	7.840	0.037	0.004	0.002
A32		1	5.22	4.11	0.284	3.74	5.4	0.263	0.171	2.549	9.092	0.069	0.023	0.014
A47		1	5.22	3.93	0.141	1.74	11.6	0.091	0.101	1.249	7.707	0.025	0.006	0.001
A126		1	5.16	3.94	0.144	2.26	11.0	0.146	0.160	2.695	9.167	0.053	0.001	0.006
A141		1	5.23	4.06	0.143	1.57	7.0	0.104	0.150	2.535	7.145	0.071	0.003	0.003
A221		1	5.13	4.21	0.242	3.51	11.2	0.198	0.133	3.342	5.974	0.078	0.018	0.005
Soil pit	0-8 cm	1	5.51	4.24	0.277	3.98	13.0	0.280	0.080	2.390	6.620			
Weighted Average			**5.05**	**3.97**	**0.171**	**2.55**	**9.9**	**0.158**	**0.133**	**2.630**	**6.933**	**0.057**	**0.006**	**0.005**
SD			*0.20*	*0.14*	*0.055*	*0.71*	*2.1*	*0.054*	*0.053*	*0.544*	*1.630*	*0.020*	*0.007*	*0.004*
AA2	10-20 cm	3	5.02	4.03	0.124	1.86	8.2	0.139	0.045	2.951	4.485	0.027	0.009	0.004
AB2		4	4.91	3.78	0.105	1.55	10.7	0.134	0.089	1.852	7.022	0.040	0.004	0.008
A32		1	5.42	4.14	0.177	2.00	14.4	0.200	0.092	2.509	10.677	0.041	0.008	0.001
A47		1	5.33	3.94	0.114	0.80	9.0	0.083	0.043	0.583	5.161	0.015	0.008	0.001
A126		1	5.28	3.93	0.102	1.05	10.6	0.130	0.143	2.582	10.277	0.024	0.000	0.001
A141		1	5.60	4.18	0.098	0.87	6.7	0.140	0.084	2.451	9.428	0.026	0.001	0.001
A221		1	5.30	4.19	0.150	1.76	8.7	0.189	0.102	3.201	6.713	0.036	0.021	0.001
Weighted Average			**5.14**	**3.97**	**0.119**	**1.52**	**9.7**	**0.141**	**0.080**	**2.299**	**6.983**	**0.032**	**0.007**	**0.004**
SD			*0.23*	*0.15*	*0.022*	*0.39*	*1.9*	*0.028*	*0.029*	*0.706*	*2.093*	*0.008*	*0.005*	*0.003*
AA3	20-30 cm	3	5.14	4.05	0.098	1.39	8.0	0.215	0.036	3.060	6.556	0.028	0.014	0.002
AB3		4	4.90	3.75	0.087	1.18	9.7	0.173	0.089	2.080	7.201	0.022	0.018	0.011
ABMS3		5	5.10	3.65	0.058	0.73	7.4	0.156	0.065	1.833	6.747	0.008	0.004	0.002
Soil pit	19-26 cm	1	5.22	4.16	0.188	2.37	12.1	0.290	0.060	2.240	7.750			
Weighted Average			**5.06**	**3.81**	**0.086**	**1.15**	**8.6**	**0.185**	**0.065**	**2.223**	**6.920**	**0.018**	**0.011**	**0.005**
SD			*0.11*	*0.18*	*0.034*	*0.44*	*1.4*	*0.038*	*0.019*	*0.476*	*0.346*	*0.008*	*0.006*	*0.004*
AA5	40-50 cm	3	5.39	4.02	0.045	0.54	6.2	0.306	0.059	1.748	7.702	0.009	0.004	0.001
AB5		4	5.12	3.80	0.049	0.64	8.5	0.122	0.073	0.686	5.062	0.012	0.011	0.004
ABMS5		5	5.04	3.74	0.026	0.31	6.2	0.225	0.068	1.227	7.453	0.005	0.006	0.001
Soil pit	35-40 cm	1	5.28	4.13	0.052	0.55	10.2	0.300	0.080	2.360	10.980			
Weighted Average			**5.16**	**3.85**	**0.039**	**0.48**	**7.2**	**0.218**	**0.068**	**1.268**	**7.046**	**0.008**	**0.007**	**0.002**
SD			*0.14*	*0.13*	*0.011*	*0.14*	*1.4*	*0.072*	*0.006*	*0.500*	*1.601*	*0.003*	*0.003*	*0.001*
AA7	60-70 cm	3	5.54	4.12	0.022	0.28	5.7	0.350	0.054	1.685	8.238	0.001	0.003	0.001
AB7		4	5.23	3.83	0.031	0.32	7.8	0.166	0.091	0.764	7.470	0.008	0.006	0.002
ABMS7		5	5.21	3.78	0.020	0.19	6.4	0.303	0.091	0.770	8.756	0.003	0.005	0.002
Soil pit	50-63 cm	1	5.67	4.16	0.029	0.23	9.4	0.380	0.080	2.010	10.740			
Weighted Average			**5.33**	**3.90**	**0.025**	**0.25**	**6.9**	**0.278**	**0.082**	**1.075**	**8.393**	**0.004**	**0.005**	**0.002**
SD			*0.17*	*0.15*	*0.005*	*0.06*	*1.1*	*0.078*	*0.015*	*0.468*	*0.861*	*0.003*	*0.001*	*0.000*
AA10	90-100 cm	3	5.71	4.11	0.012	0.09	5.4	0.429	0.063	1.397	10.190	0.001	0.005	0.002
AB10		4	5.20	3.55	0.020	0.17	7.5	0.243	0.110	1.304	8.836	0.009	0.005	0.002
Soil pit	75-80 cm	1	5.45	4.22	0.023	0.20		0.420	0.080	1.830	10.690			
Weighted Average			**5.42**	**4.39**	**0.017**	**0.14**	**6.6**	**0.335**	**0.089**	**1.405**	**9.576**	**0.006**	**0.005**	**0.002**
SD			*0.24*	*0.30*	*0.004*	*0.04*	*1.0*	*0.092*	*0.022*	*0.166*	*0.755*	*0.004*	*0.000*	*0.000*
Soil pit	115-130 cm	1	5.58	4.13		0.01		0.360	0.110	2.060	11.960			

pH*: pH of soil in KCl solution

Table 26.2: *Analytical data obtained from soil samples collected in Korokula forest. The number of sample points is given by n, the LOI is in percentage of oven dry material and the exchangeable cations (Na, K, Ca, Mg and NH_4), soluble NO_3 and extractable PO_4 are given in meq 100 g^{-1} dry soil.*

Sample	Depth	n	pH	pH*	%N	%C	LOI	Na	K	Ca	Mg	NH4	NO3	PO4
BA1	0-10 cm	4	5.36	4.23	0.117	1.86	6.6	0.168	0.042	2.263	2.813	0.050	0.006	0.007
BB1		3	5.45	4.44	0.171	2.66	6.8	0.220	0.063	1.999	4.582	0.071	0.036	0.016
B17		1	5.54	4.42	0.106	1.51	7.1	0.210	0.097	3.019	3.797	0.069	0.104	0.009
B32		1	5.34	4.46	0.157	2.30	7.3	0.234	0.084	2.789	3.823	0.076	0.014	0.007
B59		1	5.39	4.49	0.234	3.76	6.2	0.339	0.082	2.939	4.663	0.052	0.046	0.011
B80		1	5.41	4.45	0.169	2.58	7.5	0.339	0.084	2.953	4.047	0.040	0.035	0.016
B92		1	5.63	4.31	0.077	0.88	5.2	0.262	0.059	1.942	3.080	0.026	0.008	0.003
Soil pit	0-10 cm	1	5.67	4.36	0.127	2.09	5.6	0.034	0.030	1.370	1.230			
Weighted Average			**5.44**	**4.36**	**0.142**	**2.20**	**6.6**	**0.212**	**0.061**	**2.312**	**3.511**	**0.056**	**0.028**	**0.010**
SD			*0.10*	*0.10*	*0.039*	*0.67*	*0.6*	*0.076*	*0.020*	*0.469*	*0.983*	*0.015*	*0.027*	*0.004*
BA2	10-20 cm	4	5.38	4.15	0.104	1.71	5.7	0.197	0.025	2.230	3.546	0.025	0.006	0.003
BB2		3	5.35	4.40	0.147	2.20	6.0	0.220	0.063	1.999	4.582	0.071	0.036	0.010
B17		1	5.83	4.37	0.085	1.04	5.2	0.240	0.035	2.792	3.607	0.040	0.035	0.003
B32		1	5.55	4.45	0.137	1.82	6.3	0.181	0.050	2.251	3.333	0.051	0.049	0.002
B59		1	5.59	4.34	0.130	1.73	9.1	0.332	0.035	2.496	4.711	0.030	0.020	0.001
B80		1	5.71	4.51	0.102	1.26	7.0	0.233	0.034	2.645	3.553	0.025	0.006	0.002
B92		1	5.83	4.38	0.100	1.34	5.5	0.271	0.056	1.939	3.515	0.024	0.015	0.001
Weighted Average			**5.51**	**4.32**	**0.118**	**1.72**	**6.2**	**0.225**	**0.042**	**2.253**	**3.887**	**0.040**	**0.021**	**0.004**
SD			*0.18*	*0.13*	*0.021*	*0.36*	*1.0*	*0.040*	*0.016*	*0.258*	*0.519*	*0.019*	*0.015*	*0.003*
BA3	20-30 cm	4	5.50	4.15	0.074	1.17	5.6	0.195	0.019	1.735	4.076	0.022	0.003	0.005
BB3		3	5.45	4.32	0.100	1.61	4.9	0.145	0.020	1.070	2.563	0.023	0.005	0.005
Soil pit	18-35 cm	1	6.01	4.35	0.033	0.46	3.2	0.350	0.020	0.980	1.130			
Weighted Average			**5.55**	**4.24**	**0.079**	**1.25**	**5.0**	**0.196**	**0.020**	**1.391**	**3.140**	**0.022**	**0.004**	**0.005**
SD			*0.18*	*0.09*	*0.021*	*0.36*	*0.8*	*0.063*	*0.001*	*0.345*	*1.033*	*0.006*	*0.010*	*0.001*
BA5	40-50 cm	4	5.66	4.08	0.029	0.41	4.4	0.217	0.025	0.831	7.117	0.002	0.003	0.005
BB5		3	5.63	4.38	0.034	0.45	3.6	0.165	0.024	0.661	3.539	0.003	0.005	0.001
BBMS5		5	5.40	4.00	0.054	0.80	5.2	0.244	0.036	1.400	5.161	0.007	0.011	0.002
Soil pit		1	5.92	4.66	0.039	0.36	7.0	0.420	0.070	1.180	8.220			
Weighted Average			**5.57**	**4.16**	**0.041**	**0.57**	**4.7**	**0.231**	**0.032**	**1.037**	**5.624**	**0.004**	**0.007**	**0.003**
SD			*0.15*	*0.21*	*0.011*	*0.19*	*0.9*	*0.062*	*0.012*	*0.313*	*1.513*	*0.002*	*0.004*	*0.002*
BA7	60-70 cm	4	5.79	4.00	0.019	0.36	4.4	0.336	0.024	0.017	9.506	0.001	0.005	0.002
BB7		3	5.70	4.44	0.028	0.33	4.4	0.317	0.026	0.443	3.964	0.001	0.005	0.002
BBMS7		5	5.66	4.18	0.022	0.28	4.9	0.327	0.030	0.917	7.744	0.001	0.009	0.001
Soil pit		1	6.65	4.47	0.020	0.20	7.4	0.510	0.060	1.360	15.170			
Weighted Average			**5.79**	**4.21**	**0.022**	**0.31**	**4.8**	**0.342**	**0.030**	**0.565**	**7.985**	**0.001**	**0.007**	**0.002**
SD			*0.26*	*0.18*	*0.003*	*0.05*	*0.8*	*0.049*	*0.009*	*0.438*	*2.905*	*0.000*	*0.002*	*0.000*
BA9	80-90 cm	2	5.95	4.09	0.015	0.17	4.4	0.228	0.027	0.051	7.731	0.001	0.006	0.001
BB9		2	5.95	4.65	0.030	0.34	5.2	0.424	0.017	0.312	7.170	0.001	0.004	0.005
Soil pit		1	6.54	4.12		0.06	7.4	0.530	0.040	1.160	16.640			
Weighted Average			**6.07**	**4.32**	**0.023**	**0.22**	**5.3**	**0.339**	**0.025**	**0.288**	**8.634**	**0.001**	**0.005**	**0.003**
SD			*0.24*	*0.27*	*0.008*	*0.11*	*1.1*	*0.120*	*0.008*	*0.408*	*3.684*	*0.000*	*0.001*	*0.002*
BB11	100-110 cm	1	5.92	4.68	0.042	0.59	7.0	0.593	0.011	0.322	10.032	0.001	0.003	0.002

pH*: pH of soil in KCl solution

Table 26.3: *Analytical data obtained from soil samples collected in Koromani forest. The number of sample points is given by n, the LOI is in percentage of oven dry material and the exchangeable cations (Na, K, Ca, Mg and NH_4), soluble NO_3 and extractable PO_4 are given in meq 100 g^{-1} dry soil.*

Sample	Depth	n	pH	pH*	%N	%C	LOI	Na	K	Ca	Mg	NH4	NO3	PO4
CR1	0-10 cm	3	4.83	3.78	0.160	3.43	13.0	0.145	0.054	2.023	2.187	0.045	0.006	0.012
CM1		3	4.35	3.85	0.191	3.57	14.0	0.152	0.039	2.043	2.253	0.058	0.008	0.014
CV1		3	4.52	3.98	0.217	3.58	14.3	0.281	0.064	2.608	2.459	0.069	0.023	0.016
C20		1	5.10	4.29	0.178	3.64	14.3	0.177	0.062	3.178	2.045	0.052	0.010	0.008
C88		1	5.17	4.36	0.232	4.05	15.3	0.220	0.076	3.568	2.806	0.107	0.089	0.008
C98		1	5.17	4.40	0.138	2.58	14.0	0.172	0.049	1.950	1.402	0.051	0.011	0.001
Soil pit		1	4.99	4.33	0.191	3.07	15.1	0.200	0.030	1.580	1.470			
Weighted Average			**4.73**	**4.02**	**0.188**	**3.47**	**14.0**	**0.193**	**0.053**	**2.331**	**2.186**	**0.061**	**0.018**	**0.012**
SD			*0.30*	*0.23*	*0.027*	*0.33*	*0.7*	*0.053*	*0.013*	*0.535*	*0.369*	*0.017*	*0.022*	*0.004*
CR2	10-20 cm	3	5.02	3.72	0.082	1.49	10.1	0.060	0.020	0.688	0.941	0.014	0.004	0.005
CM2		3	4.45	3.84	0.124	2.31	12.1	0.088	0.019	1.129	1.417	0.031	0.008	0.005
CV2		3	4.57	3.94	0.142	2.23	12.2	0.115	0.022	1.296	1.420	0.037	0.010	0.003
C20		1	5.10	4.00	0.073	1.00	10.4	0.144	0.027	1.502	1.250	0.016	0.009	0.003
C88		1	5.14	4.18	0.169	2.74	12.8	0.116	0.038	1.833	1.723	0.042	0.031	0.001
C98		1	5.17	4.40	0.065	0.82	14.0	0.106	0.029	1.159	1.128	0.024	0.010	0.001
SoilPit	14-20 cm	1	5.21	4.24	0.091	1.62	11.3	0.270	0.020	1.190	1.190			
Weighted Average			**4.83**	**3.95**	**0.111**	**1.87**	**11.7**	**0.110**	**0.023**	**1.156**	**1.279**	**0.027**	**0.010**	**0.004**
SD			*0.30*	*0.20*	*0.032*	*0.56*	*1.2*	*0.053*	*0.005*	*0.316*	*0.230*	*0.010*	*0.007*	*0.001*
CR3	20-30 cm	3	4.90	3.71	0.061	1.13	9.6	0.061	0.018	0.431	0.718	0.009	0.004	0.003
CM3		3	4.43	3.84	0.093	1.67	11.1	0.077	0.013	0.857	1.269	0.020	0.006	0.003
CV3		3	4.52	3.91	0.093	1.46	7.4	0.069	0.011	0.969	1.007	0.017	0.013	0.002
CBMS3		3	5.48	4.00	0.074	1.22	10.2	0.075	0.019	0.810	0.774	0.011	0.007	0.002
Weighted Average			**4.83**	**3.87**	**0.080**	**1.37**	**9.6**	**0.071**	**0.015**	**0.767**	**0.942**	**0.014**	**0.008**	**0.003**
SD			*0.41*	*0.11*	*0.014*	*0.21*	*1.4*	*0.006*	*0.003*	*0.202*	*0.218*	*0.004*	*0.003*	*0.001*
CR5	40-50 cm	3	4.95	3.59	0.034	0.47	8.7	0.035	0.017	0.023	0.138	0.006	0.004	0.003
CM5		3	4.70	3.85	0.065	0.84	10.0	0.070	0.007	0.327	0.753	0.009	0.010	0.002
CV5		3	4.40	3.93	0.068	0.73	9.5	0.055	0.006	0.270	0.511	0.009	0.013	0.005
CBMS5		3	5.05	3.80	0.038	0.55	8.7	0.080	0.019	0.170	0.209	0.007	0.004	0.003
SoilPit	43-53 cm	1	4.98	4.17	0.059	0.64	11.7	0.290	0.020	0.650	0.730			
Weighted Average			**4.79**	**3.82**	**0.052**	**0.65**	**9.4**	**0.078**	**0.013**	**0.232**	**0.428**	**0.008**	**0.008**	**0.003**
SD			*0.25*	*0.16*	*0.015*	*0.14*	*0.8*	*0.063*	*0.006*	*0.164*	*0.252*	*0.001*	*0.004*	*0.001*
CR7	60-70 cm	3	4.56	3.66	0.026	0.41	8.1	0.031	0.025	0.017	0.094	0.004	0.003	0.002
CM7		3	4.62	3.82	0.052	0.60	10.5	0.064	0.006	0.086	0.281	0.007	0.009	0.002
CV7		3	4.40	3.94	0.049	0.56	9.5	0.072	0.010	0.245	0.498	0.007	0.012	0.002
CBMS7		3						0.042	0.018	0.191	0.338	0.007	0.003	0.001
SoilPit	73-93 cm	1	5.21	4.09	0.030	0.33	10.8	0.320	0.020	0.600	0.800			
Weighted Average			**4.60**	**3.84**	**0.041**	**0.50**	**9.5**	**0.076**	**0.014**	**0.153**	**0.330**	**0.006**	**0.008**	**0.002**
SD			*0.22*	*0.14*	*0.012*	*0.10*	*1.0*	*0.073*	*0.007*	*0.151*	*0.192*	*0.001*	*0.004*	*0.000*
Soil pit	97-105 cm	1	4.68	4.05		0.19		0.290	0.020	0.600	0.630			
Soil pit	152-162 cm	1	4.46	4.01		0.11		0.310	0.020	0.560	0.540			

pH*: pH of soil in KCl solution

Table 26.4: *Analytical data obtained from 25 soil samples collected at a depth of 0–10 cm in the forested Oleolega catchment. The LOI is in percentage of oven dry material and the exchangeable cations (Na, K, Ca, Mg and NH_4), soluble NO_3 and extractable PO_4 are given in meq 100 g^{-1} dry soil.*

Sample pt.	pH	pH*	%N	%C	LOI	Na	K	Ca	Mg	NH4	NO3	PO4
4	4.04	3.53	0.242	3.369	9.1	0.159	0.046	0.771	0.823	0.120	0.049	0.038
5	3.97	3.54	0.091	1.312	6.7	0.105	0.099	0.550	0.904	0.066	0.007	0.002
8	4.34	3.90	0.078	1.558	7.0	0.106	0.150	0.094	0.493	0.091	0.012	0.001
9	4.29	4.01	0.286	3.829	10.0	0.151	0.148	1.683	2.030	0.121	0.746	0.040
11	4.12	3.73	0.110	2.379	7.2	0.107	0.038	0.066	0.429	0.130	0.045	0.005
13	5.04	4.40	0.067	0.948	4.0	0.176	0.105	0.735	1.614	0.059	0.091	0.007
14	5.34	5.11	0.460	5.584	12.6	0.337	0.213	4.834	3.366	0.152	0.132	0.112
18	4.83	4.41	0.096	1.539	9.7	0.180	0.062	1.698	1.031	0.080	0.084	0.001
19	4.74	4.21	0.141	1.953	8.1	0.231	0.116	1.558	1.129	0.101	0.122	0.014
22	4.51	3.68	0.077	1.794	7.4	0.340	0.027	0.212	2.050	0.056	0.056	0.012
24	4.06	3.48	0.081	1.585	8.1	0.134	0.076	0.492	0.775	0.106	0.010	0.001
27	4.36	3.67	0.078	2.216	6.0	0.203	0.046	0.785	0.964	0.066	0.013	0.014
34	4.32	3.78	0.123	2.255	8.3	0.130	0.055	1.025	1.332	0.101	0.053	0.007
36	4.69	4.07	0.115	2.020	7.3	0.183	0.033	0.985	2.735	0.107	0.088	0.011
33	5.01	3.60	0.235	3.201	10.4	0.162	0.306	2.890	2.696	0.155	0.525	0.026
42	5.04	4.61	0.169	2.826	12.6	0.129	0.082	2.299	1.700	0.142	0.137	0.002
45	4.73	3.89	0.085	1.527	7.5	0.170	0.162	0.740	4.936	0.199	0.129	0.002
47	4.55	3.98	0.084	1.676	9.5	0.217	0.255	0.398	1.736	0.335	0.008	0.002
54	4.02	3.14	0.076	1.348	8.1	0.116	0.122	0.893	0.689	0.281	0.032	0.002
59	4.35	3.61	0.192	3.002	10.1	0.154	0.206	1.573	3.846	0.438	0.060	0.006
60	4.70	3.90	0.069	1.913	8.3	0.095	0.109	0.593	0.818	0.175	0.002	0.003
61	4.73	4.01	0.055	1.280	6.2	0.096	0.161	0.954	1.137	0.306	0.191	0.006
64	5.15	4.34	0.118	2.039	6.0	0.206	0.076	3.414	6.585	0.287	0.143	0.008
67	4.82	4.12	0.161	2.446	12.0	0.205	0.078	1.876	1.709	0.340	0.152	0.002
73	5.33	4.65	0.113	1.930	6.0	0.147	0.085	0.895	2.653	0.246	0.341	0.004
Average	**4.60**	**3.97**	**0.136**	**2.221**	**8.3**	**0.170**	**0.114**	**1.280**	**1.927**	**0.170**	**0.129**	**0.013**
SD	**0.40**	**0.43**	**0.089**	**0.978**	**2.1**	**0.063**	**0.070**	**1.091**	**1.450**	**0.103**	**0.170**	**0.023**

* pH measured in KCl solution

Table 26.5: *Analytical data obtained from 25 soil samples collected at a depth of 10–20 cm in the forested Oleolega catchment. The LOI is in percentage of oven dry material and the exchangeable cations (Na, K, Ca, Mg and NH_4), soluble NO_3 and extractable PO_4 are given in meq 100 g^{-1} dry soil.*

Sample pt.	pH	pH*	%N	%C	LOI	Na	K	Ca	Mg	NH4	NO3	PO4
4	4.30	3.81	0.169	2.154	7.5	0.136	0.025	0.443	0.500	0.062	0.042	0.016
5	4.01	3.57	0.051	0.703	6.2	0.082	0.134	0.191	0.454	0.102	0.005	0.001
8	4.16	3.77	0.028	0.313	4.3	0.062	0.082	0.017	0.088	0.092	0.020	0.001
9	4.07	3.69	0.149	1.569	7.7	0.115	0.127	0.321	1.296	0.082	0.251	0.010
11	4.19	3.78	0.093	2.029	6.5	0.192	0.030	0.034	0.450	0.115	0.039	0.006
13	4.98	4.22	0.062	0.765	3.7	0.101	0.093	0.768	1.803	0.069	0.110	0.004
14	5.06	4.48	0.162	1.637	6.9	0.131	0.065	1.403	1.561	0.067	0.145	0.011
18	4.66	4.12	0.077	1.053	9.7	0.087	0.046	1.499	0.932	0.060	0.047	0.001
19	4.78	4.15	0.105	1.308	7.5	0.165	0.079	1.049	0.737	0.066	0.075	0.008
22	4.80	3.60	0.034	0.543	4.8	0.290	0.014	0.023	1.694	0.049	0.016	0.001
24	3.92	3.37	0.052	1.063	6.2	0.099	0.059	0.147	0.502	0.087	0.013	0.001
27	4.43	3.72	0.052	1.102	4.9	0.118	0.024	0.383	0.550	0.077	0.045	0.002
34	4.24	3.70	0.097	1.591	7.5	0.092	0.040	0.903	1.167	0.109	0.050	0.004
36	4.77	4.21	0.134	2.315	7.8	0.114	0.036	1.024	2.764	0.108	0.205	0.014
33	4.46	3.94	0.131	1.613	8.5	0.069	0.190	0.610	1.936	0.139	0.134	0.004
42	5.01	4.57	0.131	2.082	12.0	0.052	0.048	2.242	1.450	0.324	0.238	0.001
45	4.95	3.91	0.058	0.929	7.5	0.204	0.166	0.370	6.883	0.174	0.057	0.001
47	4.56	3.71	0.058	1.250	8.1	0.150	0.108	0.157	1.598	0.170	0.006	0.002
54	4.14	3.11	0.040	0.581	7.0	0.060	0.089	0.496	0.324	0.214	0.014	0.001
59	3.91	3.15	0.062	0.734	7.7	0.084	0.108	0.212	1.934	0.175	0.002	0.001
60	4.64	3.73	0.038	0.940	7.7	0.061	0.065	0.256	0.586	0.106	0.001	0.001
61	4.55	3.70	0.012	0.261	4.3	0.060	0.185	0.476	0.622	0.085	0.042	0.001
64	5.17	4.19	0.117	1.840	6.4	0.199	0.074	3.198	6.544	0.179	0.046	0.005
67	4.79	4.09	0.136	1.955	12.0	0.150	0.055	2.070	2.212	0.411	0.039	0.001
73	5.38	4.41	0.064	0.941	5.0	0.088	0.085	0.521	3.247	0.194	0.051	0.001
Average	**4.56**	**3.87**	**0.084**	**1.251**	**7.1**	**0.118**	**0.081**	**0.752**	**1.673**	**0.133**	**0.068**	**0.004**
SD	**0.40**	**0.37**	**0.044**	**0.586**	**2.0**	**0.056**	**0.048**	**0.776**	**1.679**	**0.084**	**0.071**	**0.004**

* pH measured in KCl solution

Table 26.6: *Analytical data obtained from soil samples (30–60 cm) collected in the forested Oleolega catchment. LOI in % of oven dry material, exchangeable Na, K, Ca, Mg, NH_4, NO_3 and Ca-Lactate extractable P in meq 100 g^{-1} dry soil.*

Sample pt.	pH	pH*	%N	%C	LOI	Na	K	Ca	Mg	NH4	NO3	PO4
4	4.84	4.08	0.049	0.258	4.8	0.161	0.017	0.017	0.541	0.035	0.012	0.005
5	4.20	3.67	0.017	0.101	5.0	0.080	0.061	0.016	0.103	0.022	0.010	0.001
8	4.43	3.95	0.012	0.049	4.3	0.034	0.075	0.018	0.029	0.023	0.004	0.001
9	4.70	3.76	0.040	0.270	4.5	0.076	0.154	0.017	3.193	0.063	0.091	0.001
11	4.63	3.89	0.038	0.408	5.0	0.114	0.013	0.017	0.265	0.039	0.011	0.001
13	4.68	3.84	0.064	0.704	4.6	0.181	0.068	0.495	1.809	0.106	0.057	0.001
14	4.95	4.03	0.077	0.712	5.3	0.157	0.043	0.977	1.817	0.110	0.057	0.002
18	4.54	3.98	0.028	0.202	10.8	0.060	0.025	0.249	0.203	0.039	0.042	0.001
19	4.90	4.87	0.018	0.224	4.8	0.132	0.062	0.883	1.241	0.067	0.022	0.001
22	4.91	3.56	0.024	0.284	4.8	0.342	0.020	0.016	2.242	0.041	0.012	0.001
24	4.20	3.71	0.025	0.430	6.9	0.072	0.044	0.016	0.079	0.067	0.015	0.001
27	4.98	3.44	0.020	0.198	4.0	0.257	0.041	0.017	2.876	0.028	0.009	0.001
34	4.20	3.67	0.049	0.788	6.8	0.084	0.020	0.035	0.167	0.061	0.011	0.001
36	4.79	3.91	0.050	0.961	5.8	0.112	0.012	0.715	2.501	0.140	0.025	0.001
33	4.47	3.87	0.042	0.418	7.6	0.054	0.026	0.212	0.645	0.144	0.030	0.001
42	4.54	3.93	0.061	1.200	10.3	0.050	0.012	1.074	0.612	0.204	0.087	0.001
45	5.66	4.04	0.024	0.087	7.1	0.289	0.202	0.029	14.336	0.012	0.016	0.001
47	4.53	3.47	0.008	0.089	6.1	0.082	0.093	0.016	1.231	0.043	0.003	0.001
54	4.68	3.62	0.011	0.123	3.8	0.037	0.068	0.118	0.028	0.031	0.006	0.001
59	4.30	3.36	0.024	0.219	5.6	0.078	0.089	0.016	0.885	0.108	0.001	0.001
60	4.77	3.80	0.020	0.260	8.5	0.076	0.064	0.016	0.737	0.083	0.018	0.001
61	4.53	3.56	0.004	0.115	4.5	0.063	0.165	0.072	0.133	0.022	0.015	0.002
64	5.34	3.96	0.036	0.522	4.2	0.198	0.092	1.696	6.144	0.093	0.016	0.001
67	4.72	3.77	0.045	0.414	10.8	0.149	0.022	0.414	0.932	0.119	0.038	0.001
73	5.49	3.96	0.033	0.256	8.3	0.229	0.060	0.038	8.809	0.044	0.029	0.001
Average	**4.72**	**3.83**	**0.033**	**0.372**	**6.2**	**0.127**	**0.062**	**0.288**	**2.062**	**0.070**	**0.025**	**0.001**
SD	**0.37**	**0.29**	**0.018**	**0.289**	**2.1**	**0.081**	**0.049**	**0.436**	**3.209**	**0.047**	**0.024**	**0.001**

* pH measured in KCl solution

Table 26.7: *Analytical data obtained from soil samples (0–10 cm) collected in the logged and burned Oleolega catchment. LOI in % of oven dry material, exchangeable Na, K, Ca, Mg and NH_4, NO_3 and Ca-Lactate extractable P in meq 100 g^{-1} dry soil.*

Sample pt.	pH	pH*	%N	%C	LOI	Na	K	Ca	Mg	NH4	NO3	PO4
4	5.07	4.03	0.132	2.918	8.5	0.128	0.094	1.645	1.297	0.096	0.016	0.024
5	5.15	4.21	0.094	1.862	7.7	0.095	0.188	1.030	1.083	0.123	0.008	0.005
8	4.90	3.93	0.070	1.341	6.7	0.121	0.181	0.523	0.863	0.209	0.040	0.002
9	5.07	4.43	0.308	3.534	11.0	0.093	0.278	2.747	3.548	0.180	0.312	0.036
11	5.44	4.23	0.084	1.554	7.9	0.127	0.192	1.798	2.904	0.066	0.059	0.010
13	5.54	4.84	0.070	0.975	3.9	0.077	0.253	1.512	2.852	0.031	0.079	0.004
14	5.73	4.99	0.338	4.444	10.9	0.142	0.254	4.790	4.313	0.142	0.058	0.027
18	5.36	4.45	0.163	2.651	11.0	0.097	0.126	2.651	1.912	0.094	0.063	0.007
19	5.14	4.09	0.139	1.915	8.8	0.081	0.138	1.449	1.533	0.090	0.062	0.007
22	5.37	3.96	0.079	1.867	6.3	0.108	0.084	0.810	3.173	0.050	0.015	0.010
24	5.23	4.08	0.080	1.746	7.4	0.112	0.131	0.935	1.140	0.113	0.009	0.005
27	5.21	3.98	0.068	1.574	5.9	0.099	0.059	0.752	1.013	0.085	0.019	0.016
34	5.11	4.03	0.171	3.074	9.8	0.117	0.198	1.826	2.062	0.127	0.050	0.027
36	5.39	4.60	0.206	3.157	10.0	0.067	0.319	3.064	4.166	0.151	0.011	0.021
33	5.43	4.53	0.191	2.721	10.3	0.080	0.267	2.244	2.602	0.182	0.049	0.018
42	5.35	4.55	0.167	2.655	12.8	0.084	0.069	2.754	2.395	0.105	0.034	0.005
45	5.44	4.24	0.092	2.049	8.8	0.154	0.273	1.350	5.081	0.094	0.042	0.015
47	4.87	3.73	0.012	1.184	10.3	0.097	0.049	0.041	0.503	0.027	0.004	0.001
54	4.90	3.79	0.055	0.546	8.3	0.083	0.149	0.843	0.682	0.068	0.021	0.004
59	4.91	3.92	0.155	2.074	9.2	0.133	0.193	1.019	3.097	0.082	0.004	0.009
60	5.13	3.93	0.082	1.626	8.5	0.119	0.299	0.951	1.543	0.104	0.004	0.009
61	5.22	4.15	0.060	0.990	6.3	0.059	0.249	1.400	1.599	0.065	0.050	0.014
64	5.59	4.57	0.131	2.242	6.7	0.226	0.077	2.612	6.050	0.051	0.008	0.009
67	5.35	4.65	0.216	3.297	13.6	0.141	0.270	3.545	3.308	0.140	0.022	0.004
73	5.29	4.57	0.074	2.146	7.0	0.125	0.096	1.017	2.126	0.106	0.005	0.002
Average	**5.25**	**4.26**	**0.130**	**2.166**	**8.7**	**0.111**	**0.179**	**1.732**	**2.434**	**0.103**	**0.042**	**0.012**
SD	**0.22**	**0.33**	**0.077**	**0.895**	**2.2**	**0.034**	**0.083**	**1.067**	**1.399**	**0.045**	**0.060**	**0.009**

* pH measured in KCl solution

Table 26.8: *Analytical data obtained from soil samples (10–20 cm) collected in the logged and burned Oleolega catchment. LOI in % of oven dry material, exchangeable Na, K, Ca, Mg, NH_4, NO_3 and Ca-Lactate extractable P given in meq 100 g^{-1} dry soil.*

Sample pt.	pH	pH*	%N	%C	LOI	Na	K	Ca	Mg	NH4	NO3	PO4
4	5.13	3.96	0.095	1.908	6.7	0.123	0.068	1.255	1.098	0.118	0.008	0.007
5	4.81	4.14	0.063	1.238	7.5	0.129	0.168	0.975	1.277	0.109	0.035	0.002
8	4.91	3.87	0.040	0.771	5.7	0.115	0.154	0.314	0.542	0.150	0.028	0.001
9	4.88	3.95	0.165	1.745	8.2	0.073	0.191	1.233	2.707	0.060	0.137	0.003
11	5.30	4.13	0.076	1.316	7.6	0.094	0.106	1.296	2.488	0.042	0.032	0.002
13	5.72	4.55	0.057	0.867	3.6	0.077	0.160	1.137	2.297	0.024	0.048	0.001
14	5.69	4.70	0.161	1.708	7.2	0.130	0.115	2.723	3.407	0.079	0.034	0.003
18	5.24	4.26	0.115	1.567	9.8	0.086	0.128	2.431	2.102	0.064	0.044	0.001
19	5.04	4.00	0.088	1.235	7.9	0.058	0.099	0.974	1.090	0.056	0.040	0.001
22	5.69	3.96	0.036	0.712	4.6	0.129	0.030	0.264	3.430	0.024	0.013	0.001
24	4.00	3.87	0.049	0.771	6.3	0.058	0.086	0.176	0.614	0.052	0.004	0.001
27	5.12	4.04	0.041	0.901	4.7	0.093	0.046	0.484	0.873	0.034	0.018	0.005
34	4.90	3.92	0.101	1.995	8.2	0.107	0.131	1.341	1.683	0.081	0.045	0.009
36	5.40	4.33	0.123	1.983	10.3	0.076	0.105	2.173	2.906	0.087	0.002	0.006
33	4.86	3.90	0.106	1.431	8.5	0.072	0.119	0.589	1.770	0.077	0.025	0.003
42	5.44	4.58	0.113	2.029	11.9	0.073	0.042	2.493	1.920	0.067	0.018	0.002
45	5.53	4.06	0.061	1.075	7.8	0.168	0.205	0.553	6.745	0.054	0.023	0.006
47	4.71	3.76	0.002	0.123	10.2	0.073	0.033	0.016	0.201	0.022	0.004	0.001
54	4.96	3.83	0.034	0.497	8.1	0.064	0.130	0.457	0.429	0.040	0.012	0.001
59	4.96	3.82	0.090	1.067	8.2	0.135	0.175	0.623	3.140	0.068	0.004	0.002
60	5.17	3.95	0.049	0.992	8.0	0.088	0.228	0.491	1.153	0.050	0.003	0.002
61	5.22	4.04	0.006	0.424	4.7	0.042	0.193	0.795	1.051	0.058	0.019	0.002
64	5.76	4.44	0.119	1.830	6.5	0.249	0.075	3.048	7.240	0.033	0.002	0.003
67	5.25	4.40	0.098	1.941	11.5	0.122	0.149	2.532	2.634	0.121	0.014	0.002
73	5.37	4.57	0.050	1.251	5.3	0.092	0.068	0.682	2.293	0.054	0.006	0.001
Average	**5.16**	**4.12**	**0.077**	**1.255**	**7.6**	**0.101**	**0.120**	**1.162**	**2.204**	**0.065**	**0.025**	**0.003**
SD	**0.38**	**0.27**	**0.042**	**0.537**	**2.1**	**0.042**	**0.055**	**0.871**	**1.690**	**0.032**	**0.027**	**0.002**

* pH measured in KCl solution

Table 26.9: *Analytical data obtained from soil samples (30–40 cm) collected in the logged and burned Oleolega catchment. LOI in % of oven dry material.*

Sample pt.	pH	pH*	%N	%C	LOI
4	4.55	3.92	0.032	0.450	4.9
5	4.40	3.97	0.024	0.280	5.8
8	4.15	3.97	0.010	0.150	5.0
9	4.56	3.99	0.080	0.830	6.7
11	5.17	4.08	0.033	0.271	7.6
13	4.83	4.00	0.061	0.720	4.6
14	5.03	3.05	0.092	0.920	5.6
18	4.69	3.94	0.041	0.350	9.4
19	4.70	3.95	0.047	0.580	6.3
22	5.40	3.90	0.011	0.130	3.4
24	5.13	3.97	0.034	0.650	6.3
27	5.20	3.89	0.019	0.290	3.7
34	4.32	3.88	0.080	1.200	7.2
36	4.90	3.92	0.064	0.840	9.0
33	4.40	3.86	0.067	0.800	8.0
42	4.59	4.00	0.068	1.240	10.6
45	5.04	3.95	0.021	0.340	6.7
47	4.67	3.92	0.000	0.050	9.8
54	4.40	3.89	0.013	0.240	6.2
59	4.50	3.94	0.029	0.320	5.1
60	4.87	3.90	0.022	0.410	8.1
61	4.40	3.87	0.005	0.090	3.8
64	5.09	4.07	0.055	0.960	4.2
67	4.55	3.97	0.060	0.700	11.4
73	5.01	4.27	0.046	0.810	4.9
Average	**4.74**	**3.92**	**0.041**	**0.545**	**6.6**
SD	**0.32**	**0.20**	**0.025**	**0.337**	**2.2**

* pH measured in KCl solution

Table 26.10: *Analytical data obtained from soil samples (50–60 cm) collected in the logged and burned Oleolega catchment. LOI in % of oven dry material, exchangeable Na, K, Ca, Mg NH_4, NO_3 and Ca-Lactate extractable P in meq 100 g^{-1} dry soil.*

Sample pt.	pH	pH*	%N	%C	LOI	Na	K	Ca	Mg	NH4	NO3	PO4
4	5.29	4.01	0.016	0.187	4.7	0.143	0.058	0.555	1.142	0.018	0.037	0.001
5	4.87	4.07	0.014	0.098	5.3	0.040	0.041	0.016	0.164	0.012	0.011	0.001
8	4.86	3.95	0.009	0.093	4.7	0.046	0.066	0.017	0.028	0.007	0.010	0.001
9	5.28	4.16	0.047	0.473	5.9	0.059	0.225	0.043	4.365	0.011	0.082	0.001
11	5.17	4.08	0.033	0.271	7.6	0.099	0.019	0.145	2.024	0.007	0.045	0.002
13	5.55	5.28	0.056	0.600	4.6	0.127	0.137	0.661	3.667	0.032	0.088	0.002
14	6.16	4.53	0.043	0.448	4.8	0.119	0.051	1.654	3.575	0.049	0.034	0.001
18	5.17	4.10	0.035	0.275	9.5	0.077	0.040	0.869	1.090	0.013	0.055	0.001
19	4.85	3.95	0.036	0.393	7.7	0.073	0.019	0.505	0.733	0.013	0.023	0.001
22	6.25	4.07	0.015	0.101	4.1	0.252	0.025	0.018	9.530	0.000	0.007	0.001
24	5.01	3.97	0.012	0.079	5.2	0.071	0.046	0.016	1.258	0.008	0.006	0.001
27	6.01	3.91	0.011	0.159	4.2	0.277	0.022	0.017	4.781	0.003	0.013	0.001
34	4.87	3.97	0.044	0.812	7.1	0.093	0.020	0.068	0.221	0.009	0.025	0.004
36	5.40	4.06	0.040	0.622	8.0	0.063	0.031	0.795	1.962	0.010	0.009	0.003
33	4.69	3.94	0.045	0.598	7.5	0.065	0.052	0.235	0.962	0.025	0.036	0.008
42	5.15	4.18	0.041	0.909	10.4	0.050	0.013	0.742	0.455	0.012	0.018	0.001
45	5.07	3.79	0.029	0.142	6.8	0.269	0.072	0.017	13.083	0.000	0.012	0.001
47	4.69	3.75	0.001	0.129	10.5	0.074	0.031	0.016	0.272	0.006	0.004	0.005
54	5.03	3.87	0.007	0.125	5.6	0.059	0.039	0.128	0.061	0.015	0.009	0.001
59	5.00	3.80	0.028	0.192	4.7	0.069	0.072	0.017	1.027	0.003	0.004	0.001
60	5.24	3.96	0.016	0.148	8.8	0.057	0.032	0.015	0.624	0.010	0.011	0.001
61	4.91	3.97	0.033	0.062	4.3	0.020	0.094	0.038	0.136	0.005	0.014	0.001
64	6.28	4.36	0.033	0.387	4.5	0.208	0.051	1.184	6.027	0.002	0.008	0.001
67	5.11	4.01	0.028	0.289	10.7	0.128	0.020	0.217	0.632	0.008	0.023	0.001
73	5.81	4.71	0.025	0.264	4.3	0.091	0.025	0.018	3.690	0.006	0.011	0.002
Average	**5.27**	**4.10**	**0.028**	**0.314**	**6.5**	**0.105**	**0.052**	**0.320**	**2.460**	**0.011**	**0.024**	**0.002**
SD	**0.47**	**0.32**	**0.014**	**0.233**	**2.1**	**0.071**	**0.045**	**0.432**	**3.127**	**0.010**	**0.022**	**0.002**

* pH measured in KCl solution

Table 26.11: *Analytical data obtained from soil samples (0–10 cm) collected on landings, roads and skidder tracks in the Oleolega catchment. LOI in % of oven dry material, exchangeable Na, K, Ca, Mg, NH_4, NO_3 and Ca-Lactate extractable P in meq 100 g^{-1} dry soil.*

Sample pt.	pH	pH*	%N	%C	LOI	Na	K	Ca	Mg	NH4	NO3	PO4
4	5.36	4.10	0.137	4.898	11.9	0.113	0.118	1.375	1.071	0.214	0.041	0.012
5	5.12	4.29	0.080	2.716	12.2	0.153	0.214	1.700	2.233	0.069	0.009	0.006
11	5.29	4.36	0.086	2.538	9.5	0.123	0.129	0.905	3.486	0.057	0.069	0.003
18	5.13	3.90	0.027	0.700	6.4	0.136	0.087	0.417	1.556	0.027	0.010	0.001
19	5.54	4.84	0.093	2.082	8.3	0.123	0.247	1.763	1.573	0.141	0.069	0.039
22	5.59	4.20	0.024	0.921	4.8	0.245	0.064	0.391	8.430	0.023	0.031	0.003
24	4.70	3.85	0.055	1.520	7.8	0.219	0.085	0.195	1.205	0.146	0.047	0.009
27	4.75	3.83	0.070	1.979	11.2	0.174	0.138	1.329	1.384	0.078	0.027	0.009
42	4.89	4.32	0.095	2.161	11.2	0.072	0.081	1.954	1.829	0.094	0.081	0.005
45	5.21	4.05	0.064	1.345	5.2	0.200	0.155	0.899	4.047	0.046	0.027	0.009
54	4.88	3.92	0.015	0.363	7.4	0.074	0.054	0.158	0.396	0.024	0.003	0.001
61	5.21	4.38	0.098	3.071	11.7	0.152	0.314	2.131	4.140	0.142	0.096	0.008
64	5.11	4.36	0.099	2.954	15.0	0.162	0.251	3.046	2.444	0.151	0.010	0.004
67	5.22	4.29	0.169	2.943	12.0	0.112	0.280	2.271	3.287	0.141	0.018	0.002
Average	**5.14**	**4.19**	**0.079**	**2.156**	**9.6**	**0.147**	**0.158**	**1.324**	**2.649**	**0.097**	**0.039**	**0.008**
SD	**0.26**	**0.27**	**0.041**	**1.135**	**2.9**	**0.049**	**0.084**	**0.842**	**1.949**	**0.057**	**0.029**	**0.009**

* pH measured in KCl solution

Table 26.12: *Analytical data obtained from soil samples (10–20 cm) collected on landings, roads and skidder tracks in Oleolega catchment. LOI in % of oven dry material, exchangeable Na, K, Ca, Mg, NH_4, NO_3 and Ca-Lactate extractable P in meq 100 g^{-1} dry soil.*

Sample pt.	pH	pH*	%N	%C	LOI	Na	K	Ca	Mg	NH4	NO3	PO4
4	5.28	4.09	0.081	2.633	8.4	0.079	0.063	0.478	0.516	0.053	0.015	0.010
5	5.20	4.18	0.058	1.694	10.5	0.087	0.225	0.890	1.300	0.104	0.008	0.003
11	5.37	4.17	0.042	1.141	8.5	0.136	0.069	0.578	3.103	0.042	0.050	0.001
18	5.17	3.97	0.021	0.505	7.0	0.119	0.080	0.318	2.277	0.019	0.018	0.001
19	5.28	4.03	0.071	1.519	8.3	0.136	0.264	1.521	1.563	0.111	0.074	0.032
22	5.58	4.20	0.045	1.697	5.8	0.195	0.057	0.869	4.185	0.068	0.015	0.008
24	4.65	3.89	0.030	0.851	6.7	0.107	0.047	0.085	0.824	0.069	0.054	0.002
27	4.89	3.84	0.040	0.959	9.5	0.093	0.043	0.490	0.709	0.033	0.010	0.001
42	5.54	4.31	0.052	1.139	9.4	0.054	0.057	1.184	1.125	0.076	0.046	0.005
45	5.07	4.10	0.206	4.162	15.3	0.205	0.233	1.656	4.722	0.122	0.028	0.031
54	4.86	3.93	0.012	0.234	7.0	0.054	0.049	0.093	0.323	0.024	0.004	0.001
61	5.36	4.38	0.073	2.147	9.7	0.123	0.229	1.876	3.960	0.102	0.052	0.005
64	4.90	4.14	0.058	1.387	10.8	0.068	0.083	0.592	0.792	0.047	0.043	0.001
67	5.19	4.18	0.120	1.846	10.2	0.097	0.161	1.414	2.524	0.066	0.003	0.002
Average	**5.17**	**4.10**	**0.065**	**1.565**	**9.1**	**0.111**	**0.119**	**0.860**	**1.995**	**0.067**	**0.030**	**0.007**
SD	**0.26**	**0.15**	**0.047**	**0.945**	**2.3**	**0.045**	**0.081**	**0.563**	**1.428**	**0.032**	**0.022**	**0.010**

* pH measured in KCl solution

Table 26.13: *Analytical data obtained from soil samples (30–60 cm) collected on landings, roads and skidder tracks in Oleolega catchment. LOI in % of oven dry material.*

Sample pt.	pH	pH*	%N	%C	LOI
4	5.46	4.13	0.021	0.336	4.7
5	5.09	3.95	0.028	0.468	13.1
11	5.50	4.08	0.019	0.245	7.1
18	5.62	4.01	0.048	0.055	7.4
19	5.16	4.37	0.012	0.163	4.6
22	6.50	3.64	0.008	0.111	3.1
24	4.77	3.88	0.003	0.064	4.9
27	4.99	3.83	0.017	0.268	8.5
42	5.14	4.21	0.038	0.807	8.6
45	6.34	4.02	0.019	0.108	7.7
54	4.81	3.96	0.007	0.091	6.4
61	5.36	4.12	0.036	0.861	9.1
64	5.06	4.10	0.031	0.130	10.2
67	5.23	4.16	0.038	0.293	6.8
Average	**5.36**	**4.03**	**0.023**	**0.286**	**7.3**
SD	**0.49**	**0.17**	**0.013**	**0.251**	**2.5**

* pH measured in KCl solution

Chapter 27

Analytical Data of the Vegetation

The concentrations of nutrients in mission grass and in pine components sampled during the biomass study are given in this appendix. Nutrient concentrations in mission grass, sampled in February 1991, are given in Table 27.1.

Table 27.1: *Nutrient concentrations in mission grass (Pennisetum polystachyon) sampled in the grassland plot adjacent to the Nabou Forest Estate headquarters. Macronutrients are in % of dry weight, micronutrients in ppm.*

Code	N	P	K	Ca	Mg	Zn	Mn	B
GRS1	0.471	0.036	1.127	0.178	0.202			
GRS2	0.466	0.049	1.529	0.267	0.279	15	284	3.9

The macronutrient (N, P, K, Ca and Mg) concentrations observed in pine components are shown in Tables 27.2, 27.3, 27.4, 27.5 and Table 27.6 respectively. Separate foliage samples were collected from the lower 2–3 m of the crown (low), the middle 2–3 m of the crown (mid) and the upper 2–3 m of the crown (high). Concentrations of Zn, Mn and B in the foliage are given in Table 27.8.

Concentrations of nutrients in tree stems sampled in the Oleolega catchment in December 1990 (O1–O12) and in march 1991 (O13, O14) are given in Table 27.7. Samples coded O1, O2 and O3 were collected at sample point A (see Figure 15.3, Chapter 4), samples O4, O5, and O6 at sample point B, samples O7, O8, and O9 at sample point C, O10, O11 and O12 at sample point D and samples O13 and O14 were collected at sample point E.

Table 27.2: *Nitrogen concentrations (% of dry weight) in components of Pinus caribaea in Nabou Forest Estate.*

Tree Code	Stem Wood	Stem Bark	Dead Branches	Dead Twigs	Live Branches	Live Twigs	Dead Needles	Live Needles Low	Live Needles Mid	Live Needles High
A32	0.068	0.158	0.090	0.124	0.173	0.384	0.325	0.994	0.985	1.154
A47	0.088	0.167	0.072	0.101	0.204	0.330		0.624	0.818	0.792
A126	0.068	0.109	0.056	0.121	0.136	0.415	0.320	0.845	0.869	0.896
A141	0.129	0.287	0.100	0.182	0.196	0.296		0.873	0.891	1.051
A221	0.121	0.185	0.094	0.161	0.179	0.438	0.272	0.824	0.920	1.082
B17	0.103	0.162	0.089	0.148	0.174	0.455	0.564	0.873	0.981	1.006
B32	0.048	0.139	0.073	0.134	0.091	0.454	0.440	0.890	0.988	1.030
B59	0.072	0.207	0.087	0.161	0.140	0.892	0.475	0.986	1.112	1.318
B80	0.063	0.130	0.104	0.188	0.136	0.382	0.534	0.896	0.954	1.025
B92	0.076	0.141	0.076	0.149	0.162	0.359	0.444	0.765	0.865	0.892
C20	0.061	0.106	0.089	0.153	0.157	0.404	0.491	0.953	1.014	1.071
C88	0.089	0.199	0.150	0.157	0.130	0.460	0.378	0.925	0.913	1.071
C98	0.052	0.161	0.096	0.130	0.108	0.433	0.364	1.017	1.029	1.051
O13	0.092	0.215	0.100	0.167	0.137	0.492		1.226	1.205	1.308
O14	0.073	0.174	0.083	0.144	0.138	0.388		0.966	0.974	0.965

A=Tulasewa forest; B=Korokula forest; C=Koromani forest; O=Oleolega catchment

Table 27.3: *Phosphorus concentrations (% of dry weight) in components of Pinus caribaea in Nabou Forest Estate.*

Tree Code	Stem Wood	Stem Bark	Dead Branches	Dead Twigs	Live Branches	Live Twigs	Dead Needles	Live Needles Low	Live Needles Mid	Live Needles High
A32	0.013	0.020	0.005	0.010	0.029	0.070	0.016	0.077	0.077	0.095
A47	0.014	0.010	0.009	0.009	0.023	0.109		0.072	0.095	0.134
A126	0.015	0.021	0.008	0.016	0.034	0.118	0.032	0.095	0.123	0.135
A141	0.015	0.029	0.007	0.009	0.022	0.037		0.067	0.071	0.080
A221	0.016	0.020	0.008	0.012	0.029	0.111	0.023	0.081	0.095	0.116
B17	0.008	0.102	0.050	0.052	0.013	0.065	0.031	0.066	0.068	0.063
B32	0.007	0.011	0.005	0.005	0.027	0.059	0.026	0.056	0.070	0.081
B59	0.031	0.035	0.007	0.010	0.018	0.163	0.025	0.079	0.074	0.079
B80	0.012	0.166	0.010	0.015	0.018	0.061	0.043	0.067	0.066	0.070
B92	0.023	0.032	0.006	0.018	0.019	0.054	0.028	0.057	0.068	0.071
C20	0.006	0.004	0.003	0.008	0.021	0.061	0.027	0.075	0.069	0.074
C88	0.010	0.013	0.015	0.009	0.018	0.066	0.016	0.065	0.061	0.064
C98	0.006	0.018	0.006	0.008	0.011	0.063	0.044	0.069	0.082	0.103
O13	0.012	0.018	0.007	0.010	0.012	0.052		0.069	0.071	0.085
O14	0.014	0.019	0.007	0.009	0.014	0.047		0.054	0.053	0.060

A=Tulasewa forest; B=Korokula forest; C=Koromani forest; O=Oleolega catchment

Table 27.4: *Potassium concentrations (% of dry weight) in components of Pinus caribaea in Nabou Forest Estate.*

Tree Code	Stem Wood	Stem Bark	Dead Branches	Dead Twigs	Live Branches	Live Twigs	Dead Needles	Live Needles Low	Live Needles Mid	Live Needles High
A32	0.050	0.099	0.018	0.015	0.142	0.375	0.113	0.467	0.478	0.570
A47	0.065	0.079	0.025	0.020	0.148	0.383		0.272	0.323	0.465
A126	0.061	0.092	0.022	0.042	0.126	0.396	0.125	0.417	0.526	0.794
A141	0.064	0.139	0.022	0.018	0.132	0.219		0.339	0.376	0.479
A221	0.097	0.081	0.050	0.066	0.182	0.461	0.085	0.425	0.421	0.660
B17	0.040	0.048	0.025	0.020	0.078	0.320	0.078	0.421	0.393	0.452
B32	0.031	0.052	0.023	0.026	0.054	0.232	0.056	0.210	0.209	0.230
B59	0.046	0.055	0.015	0.023	0.085	0.504	0.070	0.324	0.349	0.543
B80	0.033	0.028	0.028	0.031	0.073	0.258	0.123	0.368	0.327	0.279
B92	0.047	0.072	0.020	0.025	0.093	0.276	0.081	0.378	0.338	0.328
C20	0.042	0.040	0.033	0.025	0.085	0.300	0.088	0.380	0.309	0.499
C88	0.046	0.039	0.041	0.021	0.073	0.235	0.082	0.341	0.348	0.398
C98	0.045	0.109	0.048	0.061	0.111	0.416	0.116	0.457	0.529	1.075
O13	0.052	0.123	0.036	0.027	0.085	0.350		0.362	0.370	0.573
O14	0.062	0.130	0.036	0.057	0.132	0.434		0.484	0.503	0.792

A=Tulasewa forest; B=Korokula forest; C=Koromani forest; O=Oleolega catchment

Table 27.5: *Calcium concentrations (% of dry weight) in components of Pinus caribaea in Nabou Forest Estate.*

Tree Code	Stem Wood	Stem Bark	Dead Branches	Dead Twigs	Live Branches	Live Twigs	Dead Needles	Live Needles Low	Live Needles Mid	Live Needles High
A32	0.046	0.042	0.128	0.153	0.109	0.180	0.966	0.701	0.473	0.318
A47	0.047	0.041	0.131	0.168	0.108	0.143		0.825	0.517	0.294
A126	0.054	0.059	0.166	0.213	0.111	0.185	0.544	0.502	0.314	0.130
A141	0.042	0.065	0.151	0.198	0.139	0.198		0.769	0.716	0.438
A221	0.049	0.052	0.143	0.196	0.100	0.186	0.686	0.699	0.569	0.282
B17	0.044	0.038	0.089	0.141	0.079	0.123	0.490	0.353	0.304	0.220
B32	0.064	0.068	0.122	0.256	0.115	0.233	0.952	1.009	0.662	0.361
B59	0.046	0.067	0.145	0.233	0.104	0.373	0.626	0.665	0.460	0.264
B80	0.050	0.056	0.134	0.275	0.134	0.197	0.514	0.347	0.353	0.297
B92	0.055	0.137	0.199	0.275	0.167	0.231	0.630	0.391	0.334	0.229
C20	0.062	0.058	0.159	0.271	0.166	0.281	0.757	0.572	0.533	0.345
C88	0.074	0.125	0.141	0.286	0.144	0.298	0.713	0.598	0.471	0.300
C98	0.069	0.206	0.239	0.392	0.205	0.495	0.813	0.929	0.711	0.319
O13	0.044	0.064	0.135	0.266	0.118	0.281		0.789	0.732	0.482
O14	0.058	0.116	0.124	0.239	0.139	0.243		0.562	0.443	0.209

A=Tulasewa forest; B=Korokula forest; C=Koromani forest; O=Oleolega catchment

Table 27.6: *Magnesium concentrations (% of dry weight) in components of Pinus caribaea in Nabou Forest Estate.*

Tree Code	Stem Wood	Stem Bark	Dead Branches	Dead Twigs	Live Branches	Live Twigs	Dead Needles	Live Needles Low	Live Needles Mid	Live Needles High
A32	0.019	0.041	0.055	0.082	0.070	0.118	0.277	0.269	0.227	0.206
A47	0.027	0.037	0.061	0.103	0.094	0.142		0.275	0.218	0.209
A126	0.024	0.032	0.045	0.075	0.061	0.124	0.149	0.146	0.152	0.145
A141	0.018	0.045	0.040	0.083	0.062	0.111		0.226	0.226	0.200
A221	0.021	0.043	0.038	0.073	0.050	0.105	0.229	0.250	0.227	0.164
B17	0.026	0.042	0.047	0.074	0.061	0.126	0.295	0.230	0.246	0.268
B32	0.022	0.045	0.036	0.073	0.046	0.130	0.202	0.363	0.251	0.195
B59	0.025	0.068	0.060	0.113	0.075	0.365	0.402	0.424	0.416	0.381
B80	0.026	0.040	0.050	0.091	0.068	0.140	0.371	0.268	0.288	0.295
B92	0.020	0.040	0.041	0.075	0.059	0.117	0.255	0.195	0.214	0.231
C20	0.022	0.023	0.029	0.045	0.039	0.078	0.210	0.161	0.175	0.181
C88	0.024	0.029	0.039	0.069	0.052	0.121	0.195	0.185	0.145	0.136
C98	0.019	0.058	0.038	0.062	0.043	0.142	0.128	0.184	0.151	0.163
O13	0.016	0.047	0.033	0.061	0.052	0.156		0.213	0.231	0.220
O14	0.020	0.031	0.028	0.055	0.043	0.119		0.124	0.110	0.107

A=Tulasewa forest; B=Korokula forest; C=Koromani forest; O=Oleolega catchment

Table 27.7: *Nutrient concentrations in Pinus caribaea stems (wood and bark) sampled at several locations in the Oleolega catchment.*

Code	N	P	K	Ca	Mg	Zn	Mn	B	Dbhob	h
O1	0.072	0.018	0.053	0.041	0.021	5	36	2.1	0.352	20.1
O2	0.066	0.009	0.041	0.043	0.024	6	60	1.0	0.253	18.7
O3	0.092	0.012	0.056	0.037	0.019	28	45	1.1	0.250	19.4
O4	0.072	0.008	0.046	0.033	0.021	18	30	1.1	0.240	18.8
O5	0.082	0.008	0.054	0.033	0.020	8	70	1.3	0.256	19.0
O6	0.071	0.006	0.050	0.027	0.021	13	17	1.0	0.243	18.0
O7	0.078	0.007	0.046	0.061	0.024	13	79	1.4	0.282	17.1
O8	0.079	0.006	0.045	0.062	0.018	9	35	0.9	0.252	19.3
O9	0.075	0.006	0.042	0.041	0.021	12	32	1.1	0.230	19.3
O10	0.085	0.009	0.049	0.039	0.018	3	101	0.7	0.324	17.7
O11	0.109	0.013	0.080	0.033	0.024	8	84	1.1	0.299	20.3
O12	0.079	0.007	0.046	0.041	0.016	5	91	1.2	0.256	19.6
O13	0.107	0.013	0.061	0.046	0.020				0.260	18.7
O14	0.082	0.014	0.068	0.063	0.021				0.264	20.3

Table 27.8: *Concentrations of Zn, Mn and B (ppm) in foliage of Pinus caribaea in Nabou Forest Estate.*

Tree Code	Dead Needles	Live Needles Low	Live Needles Mid	Live Needles High	Dead Needles	Live Needles Low	Live Needles Mid	Live Needles High
	Zn	**Zn**	**Zn**	**Zn**	**B**	**B**	**B**	**B**
A32	31	29	29	26	12.5	10.7	7.9	7.3
A47		35	31	33		9.0	7.0	8.0
A126	23	25	25	15	9.1	7.9	6.5	4.9
A141		42	50	57		14.0	10.0	11.0
A221	36	34	35	28	10.5	10.9	10.7	9.1
B17	12	14	19	24	10.2	10.2	9.8	10.3
B32	35	38	35	32	16.6	15.7	13.1	10.4
B59	23	28	36	49	15.7	15.5	13.9	20.3
B80	28	30	33	35	12.2	9.7	10.0	9.3
B92	18	14	22	29	14.3	11.8	11.0	10.2
C20	26	22	28	33	13.4	12.8	11.8	16.2
C88	22	24	23	24	14.9	13.1	10.6	8.3
C98	29	35	37	39	15.9	21.1	16.2	14.3
O13		32	40	49		15.8	14.5	15.8
O14		34	32	31		17.2	14.9	20.0
	Mn	**Mn**	**Mn**	**Mn**				
A32	1249	987	643	442				
A47		432	743	579				
A126	620	632	405	201				
A141		229	651	573				
A221	533	649	513	254				
B17	274	268	252	194				
B32	414	470	313	219				
B59	368	474	310	187				
B80	328	274	289	234				
B92	399	304	283	220				
C20	273	240	208	160				
C88	516	361	335	228				
C98	670	787	682	296				
O13		2013	2175	1574				
O14		961	734	152				

A=Tulasewa forest; B=Korokula forest; C=Koromani forest; O=Oleolega catchment

Chapter 28

Litter and Litter Fall Data

28.1 Needle fall

Monthly concentrations and amounts of needle fall in Tulasewa, Korokula and Koromani forests are presented in Tables 28.1, 28.2 and 28.3 respectively.

28.2 Needle and Undergrowth Litter

Concentrations of nutrients in needle litter on the forest floor are presented in Table 28.4 for the Tulasewa, Korokula and Koromani forest plots. As the undergrowth litter mass (mainly mission grass) accounted for a large proportion of the total litter layer mass in Tulasewa forest concentrations for this component were determined at a similar frequency as for those of needle litter on the forest floor. To reduce the number of samples in the Tulasewa forest plot, bulk samples were analysed for the periods January–March and April–June 1990.

Table 28.1: *Nutrient concentrations and amounts of needle fall as observed in Tulasewa forest.*

Field Code	Month	N %	P %	K %	Ca %	Mg %	B ppm	Mn ppm	Zn ppm	Amount kg/ha
ALF1	Dec'90	0.364	0.018	0.152	0.922	0.228	12	486	27	366.8
ALF2	Jan'90	0.401	0.015	0.095	0.863	0.203	10	490	28	525.8
ALF3	Feb'90	0.380	0.017	0.082	0.840	0.188	9	608	30	163.7
ALF4	Mar'90	0.395	0.013	0.074	0.862	0.195	9	498	26	773.0
ALF5	Apr'90	0.467	0.024	0.099	0.923	0.198	9	697	32	250.7
ALF6	May'90	0.431	0.019	0.125	0.855	0.193	9	647	26	264.0
ALF7	Jun'90	0.389	0.020	0.092	1.029	0.187	9	634	28	678.4
ALF8	Jul'90	0.391	0.014	0.096	0.928	0.190	9	602	25	271.7
ALF9	Aug'90	0.381	0.011	0.075	0.811	0.204	9	512	24	614.1
ALF10	Sep'90	0.357	0.010	0.061	0.833	0.199	9	605	23	343.5
ALF11	Oct'90	0.305	0.018	0.101	0.796	0.219	10.1	614	23	189.7
ALF12	Nov'90*	0.672	0.071	0.323	0.625	0.196	8.0	498	24	6219.8
ALF13	Dec'90*	0.652	0.055	0.230	0.467	0.168	8.0	382	27	655.1
ALF14	Jan'91	0.663	0.055	0.181	0.737	0.201	8.7	509	37	352.7
ALF15	Feb'91	0.591	0.047	0.155	0.748	0.212	8.8	515	31	177.7
ALF16	Mar'91	0.477	0.041	0.105	0.885	0.235	10.2	618	31	211.4
ALF17	Apr'91	0.402	0.030	0.082	0.974	0.239	11.1	650	30	226.7
ALF18	May'91	0.409	0.027	0.110	0.803	0.234	9.9	699	30	345.3
ALF19	Jun'91	0.390	0.025	0.083	0.832	0.214	10.1	642	27	281.8
ALF20	Jul'91	0.319	0.024	0.084	0.866	0.251	11.0	696	29	257.4
ALF21	Aug'91	0.366	0.027	0.087	0.830	0.220	10.5	721	29	527.4
ALF22	Sep'91	0.375	0.043	0.075	0.777	0.214	10.4	678	27	296.3

*: Litter fall resulting from cyclone Sina

Table 28.2: *Nutrient concentrations and amounts of needle fall as observed in Korokula forest.*

Field Code	Month	N %	P %	K %	Ca %	Mg %	B ppm	Mn ppm	Zn ppm	Amount kg/ha
BLF1	Jan'90	0.290	0.012	0.033	0.894	0.330	13.2	433	12	663.3
BLF2	Feb'90	0.313	0.012	0.100	0.734	0.311	12.2	374	14	132.5
BLF3	Mar'90	0.422	0.021	0.115	0.678	0.295	13.4	300	12	859.2
BLF4	Apr'90	0.323	0.013	0.080	0.756	0.348	12.1	366	11	395.2
BLF5	May'90	0.264	0.006	0.077	0.786	0.357	13.9	358	17	1746.4
BLF6	Jun'90	0.285	0.008	0.057	0.785	0.313	13.6	444	12	448.7
BLF7	Jul'90	0.300	0.010	0.069	0.762	0.317	13.2	388	12	457.1
BLF8	Aug'90	0.314	0.009	0.060	0.878	0.308	14.9	455	13	343.8
BLF9	Sep'90	0.362	0.013	0.069	0.859	0.300	17.9	392	16	181.4
BLF10	Oct'90	0.341	0.027	0.063	0.707	0.288	13.2	409	18	328.2
BLF11	Nov'90*	0.764	0.049	0.233	0.561	0.311	15.1	382	15	9187.5
BLF21	Dec'90*	0.885	0.045	0.119	0.571	0.279	12.4	355	23	634.2
BLF12	Jan'91	0.725	0.092	0.092	0.606	0.325	14.9	399	27	430.4
BLF13	Feb'91	0.594	0.104	0.101	0.679	0.321	14.6	428	25	244.0
BLF14	Mar'91	0.595	0.054	0.082	0.712	0.340	14.9	446	22	240.4
BLF15	Apr'91	0.441	0.044	0.065	0.733	0.338	14.0	226	20	281.3
BLF16	May'91	0.485	0.112	0.108	0.711	0.367	13.9	220	18	524.2
BLF17	Jun'91	0.337	0.132	0.080	0.762	0.346	14.1	508	19	291.3
BLF18	Jul'91	0.375	0.137	0.074	0.696	0.356	15.1	493	19	237.1
BLF19	Aug'91	0.337	0.124	0.070	0.658	0.330	15.0	413	20	396.4
BLF20	Sep'91	0.353	0.020	0.063	0.693	0.323	13.4	464	20	190.7

*: Litter fall resulting from cyclone Sina

Table 28.3: *Nutrient concentrations and amounts of needle fall as observed in Koromani forest.*

Field Code	Month	N %	P %	K %	Ca %	Mg %	B ppm	Mn ppm	Zn ppm	Amount kg/ha
CLF1	Feb'90	0.273	0.014	0.070	0.788	0.214	12	707	18	124.6
CLF2	Mar'90	0.404	0.013	0.106	0.699	0.206	11	565	15	864.7
CLF3	Apr'90	0.379	0.009	0.111	0.724	0.238	11	712	16	381.7
CLF4	May'90	0.282	0.010	0.107	0.672	0.219	9	655	15	732.4
CLF5	Jun'90	0.320	0.009	0.073	0.678	0.215	10	533	13	379.2
CLF6	Jul'90	0.299	0.007	0.106	0.678	0.185	10	626	14	212.3
CLF7	Aug'90	0.336	0.010	0.093	0.652	0.181	8	524	16	455.1
CLF8	Sep'90	0.378	0.013	0.093	0.655	0.176	15	659	45	155.5
CLF9	Oct'90	0.335	0.012	0.098	0.597	0.173	10	637	16	130.1
CLF10	Nov'90*	0.831	0.050	0.288	0.522	0.188	11	590	21	6018.3
CLF11	Dec'90*	0.664	0.034	0.150	0.491	0.161	10	744	23	994.0
CLF12	Jan'91	0.624	0.027	0.147	0.667	0.186	9.2	590	22	530.9
CLF13	Feb'91	0.673	0.032	0.127	0.605	0.185	11.9	721	42	234.1
CLF14	Mar'91	0.691	0.033	0.117	0.583	0.193	10.8	703	21	293.7
CLF15	Apr'91	0.514	0.019	0.101	0.677	0.187	11.5	778	23	297.5
CLF16	May'91	0.474	0.020	0.106	0.676	0.187	12.2	824	22	362.3
CLF17	Jun'91	0.418	0.018	0.097	0.698	0.192	13.6	789	23	233.4
CLF18	Jul'91	0.397	0.011	0.090	0.688	0.172	11.8	781	25	247.3
CLF19	Aug'91	0.365	0.010	0.078	0.663	0.179	11.8	792	26	311.8
CLF20	Sep'91	0.398	0.013	0.083	0.646	0.173	11.2	756	24	167.8

*: Litter fall resulting from cyclone Sina

Table 28.4: *Nutrient concentrations and amounts of needle and undergrowth litter on the forest floors in the Tulasewa, Korokula and Koromani forest plots.*

Date	**N** %	**P** %	**K** %	**Ca** %	**Mg** %	**B** ppm	**Mn** ppm	**Zn** ppm	**Amount** kg/ha
TULASEWA FOREST, Planted 1984									
Needle Litter									
14-Jan-90				Bulked					3057.5
15-Feb-90				Bulked					1250.2
15-Mar-90	0.415	0.020	0.056	0.868	0.210	10.0	541	28.5	2302.5
15-Apr-90				Bulked					2100.9
16-May-90				Bulked					3002.1
19-Jun-90	0.393	0.018	0.076	0.940	0.203	8.5	639	33.5	5450.8
18-Sep-90	0.442	0.022	0.083	0.888	0.248	10.5	730	33.5	3496.0
08-Jan-91	0.829	0.057	0.184	0.792	0.205	9.4	643	31.5	9090.7
02-Apr-91	0.864	0.051	0.068	0.795	0.212	8.5	657	32.1	6981.4
30-Jul-91	0.937	0.061	0.170	0.794	0.222	9.7	739	32.7	6238.0
Undergrowth Litter									
14-Jan-90			Bulked						6660.0
15-Feb-90			Bulked						6445.4
15-Mar-90	0.526	0.024	0.110	0.193	0.148				7877.8
15-Apr-90			Bulked						5199.7
16-May-90			Bulked						6738.3
19-Jun-90	0.528	0.027	0.109	0.271	0.158				5546.3
18-Sep-90	0.535	0.026	0.126	0.250	0.183				7438.9
08-Jan-91	0.711	0.040	0.099	0.412	0.198				8172.2
02-Apr-91	0.959	0.054	0.110	0.618	0.244				5051.2
30-Jul-91	0.901	0.058	0.185	0.710	0.267				4591.3
KOROKULA FOREST, Planted 1979									
Needle Litter									
15-Jan-90	0.540	0.027	0.050	0.766	0.295	13.5	410	16	8888.2
14-Feb-90	0.450	0.025	0.044	0.677	0.282	11.1	427	16	9929.5
16-Mar-90	0.466	0.023	0.043	0.732	0.295	10.1	421	16	8806.0
16-Apr-90	0.496	0.019	0.056	0.770	0.282	13.5	454	12	7510.4
16-May-90	0.453	0.015	0.049	0.799	0.298	13.6	455	13	9906.7
18-Jun-90	0.512	0.020	0.053	0.749	0.298	15.2	487	15	11033.4
18-Sep-90	0.431	0.018	0.046	0.849	0.335	10.5	444	11.5	7138.8
09-Jan-91	0.666	0.034	0.104	0.707	0.304	11.9	414	17.7	14855.6
08-Apr-91	0.815	0.038	0.078	0.748	0.236	10.9	448	20.9	9473.1
02-Aug-91	0.868	0.038	0.081	0.739	0.315	11.3	473	23.0	10288.5
KOROMANI FOREST, Planted 1975									
Needle Litter									
15-Jan-90	0.415	0.014	0.070	0.788	0.214	12	707	18	8231.9
14-Feb-90	0.370	0.013	0.106	0.699	0.206	11	565	15	7515.5
15-Mar-90	0.459	0.009	0.111	0.724	0.238	11	712	16	7217.0
16-Apr-90	0.506	0.010	0.107	0.672	0.219	9	655	15	7959.1
16-May-90	0.369	0.009	0.073	0.678	0.215	10	533	13	10678.9
18-Jun-90	0.428	0.007	0.106	0.678	0.185	10	626	14	9130.8
17-Sep-90	0.490	0.014	0.073	0.722	0.191	8.3	626	18.1	8307.2
07-Jan-91	0.717	0.042	0.149	0.706	0.208	12.6	758	21.0	13464.3
01-Apr-91	0.840	0.047	0.072	0.694	0.210	10.3	807	22.4	10441.0
02-Aug-91	0.848	0.049	0.086	0.716	0.228	11.7	727	22.5	8706.2