

THE GREAT SOIL GROUPS OF CHILE (1)

For: RAY C. ROBERTS y
CARLOS DIAZ VIAL (2).

Chile with its long narrow form (4.200 kilometers long by 90 to 500 kilometers wide), is a country of great contrasts, especially in relief features, climate, geology, natural vegetation, soils, and land and water resources. With this wide range of natural features much can be written about this Republic but in this paper the major emphasis are placed on groups of soils and their relationships to natural land resources. Antarctic territory was not included in this study.

Land forms and climate, together with soils and water resources are some of the controlling factors in the economy of most countries and natural vegetation, crops and livestock production, land use soil management are all influenced to a large extent by these factors.

Observation shows that the same kind of soil profiles repeat again and again in Chile within a given region on well drained sites from "normal or intermediate" (3) parent materials. These regions can be called soil zones as they are dominated by one great soil group, which has specific differentiating soil profile characteristics, based primarily on the soil differences related to difference in climate, especially precipitation. Chile can be divided into 11 distinct regions or major kind of soil areas, 2 transition zones and 4 unexplored zones in the high Andes. These many kinds of soil areas or map units consist of single great soil groups, combinations of soil groups, subdivision of a soil group, or unknown soil groups. Each map unit is described in terms of climate, natural vegetation, presently recognized great soil group, map inclusions, land-use, and soil management problems. For many soil groups the concepts and names are those given in the (U.S.D.A.) 1938

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- (1) This paper was presented at the Ninth Pacific Science Congress, held at Bangkok, Thailand, November 1957. It is a part of the regular program of the Chilean soil survey, which it is carried out by the Departamento de Conservación de Recursos Agrícolas y Forestales.
 - (2) FAO Soil Expert and Jefe del Subdepartamento de Agrología, respectively.
 - (3) "Normal or intermediate" parent materials include mixed aluvial sediments, loess, glacial drift, granitic and basaltic materials, most shales and sandstones, whereas "strong" parent materials include limestone, volcanic ash, silicious, materials, serpentine, etc.

Yearbook of Agriculture (Baldwin et al., 1938). The names of other groups are designated by quotation marks.

The soils are characterized in terms of horizon sequence and selected properties of the dominant horizons. In the descriptions, horizons designated with an asterisk are essential for the group. Those with a parenthesis are permissible but not common. Horizon nomenclature and descriptive terms are in accordance with the Soil Survey Manual (Soil Survey Staff, 1951).

RED DESERT (hot desert) ZONE

Map Units RD, RDS, LR-RD

Precipitation (4).— 0 to about 80 mm. all as rain or dew. The largest area receives less than 10 mm. per year and most of these areas if not affected by dew have only C or Dr. horizons.

Mean January Temperature.— 19 to 22° C.

Mean July temperature.— 11 to 16° C.

Natural vegetation (1).— Barren in the fogless areas of low precipitation and low elevation. Some xerophytic shrubs in the areas of 40 to 80 mm. of precipitation and at elevation above 3,000 meters. The main shrubs that occur along the drier (less than 40 mm. of rain per year) fog laden coast are: copao (*Cereus coquimbensis*); tuna (*Opuntia* sp.), chañar (*Lycium chañar*), tipia (*Proustia tipia*), and annuals such as malvilla (*Cristaria* sp.), and llanten (*Plantago* sp.), with palo negro (*Balbisia peduncularis*), lechero (*Euphorbia lectiflua*), monte de burro (*Skytanthus acutus*), churco (*Oxalis gigantea*), and pingo-pingo (*Ephedra americana*), in areas near the coast with higher precipitation (40 to 80 mm. per year). Shrubs begin to appear above 3,000 meters elevation even in areas of low precipitation (15 mm. per year), and increase in density with increasing elevation. The main ones are: jarilla (*Adesmia* sp.), cachiuyo (*atriplex atacamensis*), pingo-pingo (*Ephedra americana*), tola (*Baccharis tola*), and copa (*Artemisea copa*).

Salt grass (*distichlis spiccata*), tamarugo (*Prosopis tamarugo*), and algarrobo (*Prosopis chilensis*), occur on some of the basins where the water table is near or fairly near the surface. These wet saline areas are called salares.

Soils.— The Red Desert soil zone of Chile includes most of the northern onethird of the country or an area approximately 1,200 kilometers long and 150 kilometers wide. This area includes the famous sodium nitrate beds. The Red Desert soil zone be divided into three

(4) Climatic data taken From Geografía Económica de Chile, 1950.

(1) Vegetation taken mostly from: Geografía Económica de Chile, 1950.

parts namely (1) typical Red Desert soils map unit RD, dominating the areas near the coast with 40 to 80 mm. of annual precipitation, (2) Red Desert soils with salt hardpan map unit RDS, dominating the drier areas that are affected by fog and (3) the Lithosolic and Regosolic Red Desert soils map unit LR-RD, or those areas so dry that no B, and in many places no A, has developed. "Calcic Gley" and Solonchak dominate the restricted drained areas. Other soils included are Alluvial soils, "Calcisols", and probably Solonetz.

With increasing precipitation these soils grade on the south into the "Calcic Brown" soils and with increasing elevation and colder temperatures above 4.500 meters they probably grade into Gray Desert soils, however this area, map unit I, has not been adequately studied at this time.

Typical characteristics of Red Desert soils.

AA, Av, B₁, B₂, B₃ca, Bm, Cca, Cm, (D), Dr.

The A is 5 to 10 cm. thick light brown (7,5 YR 6/4) to pink (7,5 YR 7/4) when dry, exceedingly low in organic matter usually calcareous and vesicular. There is a thin crust and usually a desert pavement, with the exposed surfaces of the gravel coated with desert varnish. The B horizon is usually 5 to 40 cm. thick, redder, finer in texture and higher in organic matter, especially virgin areas, than the A horizon. The B is calcareous and may be strongly developed with clay texture and prismatic or blocky structure. This horizon may or may not rest on a cemented lime or lime and silica horizon (C_m) but usually the lower horizons are very calcareous and have a high content of lime with pH values of 8,2 or more.

Principal land use.

Exceedingly sparse grazing for goats or sheep on non irrigated areas, and alfalfa, wheat, corn, citrus, olives, etc., on the irrigated areas, with some irrigated clover and hay pastures for milk stock.

Soil management problems.

May be listed as follows: quality of irrigation water, irrigation practices, leveling, fertility, physical condition of the soil, drainage, salinity and alkalinity, and erosion. Most of the irrigation water is applied by strip borders and basins with some by contour flooding.

Typical characteristics of Red Desert Soil with Salt Hardpan.

A, B₂, Bsa, Csa, Sam or Csm, C, Dr.

The A is 1 to 2,5 cm. Thick, pinkish, coarse textured, little or no organic matter and may or may not be calcareous. The B horizon is redder or pinker, slightly finer in texture than the A and 2,5 to 7

cm. thick. This layer grades into a lighter colored more saline layer usually friable and loose 2,5 to 10 cm. thick. It may or may not be calcareous. This horizon rests abruptly on a cemented salt layer which ranges from 2,5 cm. to 1 m. thick. The salts are probably a mixture of calcium sulphate and sodium chloride or similar salts.

Principal land use.

At the present time these soils are devoid of vegetation and have little or no agricultural future, unless it will become practical to purify sea water and use great quantities for leaching and irrigation.

Typical characteristic of Regosolic - Red Desert soils.

C, Cca.

The profile consists of soil material; the upper 10 cm. is typically pinkish gray (5YR 6/2); reddish gray (5YR 5/2 moist), loose friable single grained slightly calcareous gravelley loamy sand, or sandy loam that does not digest with H_2O_2 at temperature. This material grades into pink slightly calcareous stratified material that may be semi-cemented, in some sites probably with salts. Lime is not visible even on stones or gravels except where the precipitation and elevation (approximately 3.000 m.) is such that there is some desert vegetation.

The soils have desert pavement but very little if any desert varnish and in many areas the surface is some what firm at least sufficient to prevent serious wind erosion.

Principal land use.

Without irrigation these soils have little or no value for agriculture. With irrigation they would be productive for many crops, however in most of the areas, the water requirement would be very high, even if the slope were favorable. The soil is excessively drained and has a low water holding capacity. Some areas of these soils are now irrigated by pumps.

Soil management problems.

Mainly sufficient quantities of good quality water, leveling, fertility, erosion from irrigation and wind erosion when the land is tilled.

Typical characteristics of Lithosolic - Red Desert soil.

C. Dr.

These areas are typical very shallow less than 10 cm. thick, resting or grading into parent rock, rock salt, or sodium nitrate. The surface layer has a pinkish color similar to the Regosolic - Red Desert

soils. These soils may have some visible lime in the seams of the rock, but are lacking organic matter or nitrogen.

Principal land use.

Most areas are devoid of vegetation or animal life and are used, if at all, for mining purposes, such as sodium nitrate.

The A horizon is highly calcareous and usually light colored and grades into a C horizon also highly calcareous and without distinct differentiation characteristics from the horizon above. Usually water table occurs within one of two meters of the surface at some time during the year or during past periods. These soils may have some salt but not sufficient to be classified as Solonchaks. In many places they have a ground water lime hardpan.

Principal land use.

Usually the same as adjacent alluvial soils, corn, pasture, tomatoes, etc.

Soil management problems.

Mainly proper irrigation and drainage and the correct application of fertilizer.

Typical characteristics of Solonchaks.

Asa, or Acs, B, C, (D).

The A horizon is strongly affected with saline salts and has a puffed, fluffy or flocculated condition and is usually light colored, calcareous, low in organic matter and grades without much demarcation into similar colored, usually calcareous C horizon. Generally the salt content and the pH values decrease with depth. These soils usually are wet at a depth less than 2 m.

Principal land use.

The use depends upon the kind, amount and location of the salts, within the profile. Many areas are valueless for cultivated crop without reclamation. Most areas have some forage value such as salt grass pasture.

Soil management problems.

Reclamation, fertilizers and crop adaptation.

Typical characteristics of Alluvial soils of Red Desert zone.

A, C, Cca.

These soils are similar to the Alluvial soils described under, Noncalci Brown zone except they are more pinkish, lower in organic matter and usually more alkaline.

Principal land use.

Alfalfa, corn, some bananas, cotton, citrus, tomatoes and many other crops.

Soil management problems.

Irrigation, quality of water, weed control, fertilizers and salinity.

Typical characteristics of "Calcisols".

A, Cca, Cm, Dr.

The A is thin ranging from 5 to 10 cm. thick and is light brown to very brown, weak medium platy, is usually vesicular and ranges from coarse to medium textured and is highly calcareous. This layer grades into a lighter colored loose friable, similar textured material that is exceedingly high in lime. The high concentration of calcium carbonate has apparently inhibited the formation of a B horizon. The movement of lime and its accumulation has been the principal soil forming process. In places well developed lime hardpans (caliche) are formed, some of which have probably been influenced by ground water of centuries ago.

Principal land use.

If irrigated, alfalfa, barley, wheat, corn and general farm crops.

Soil management problems.

Are many and include difficult to irrigate, subject to saline spots, very low fertility, many lack minor elements, susceptible to water and wind erosion, lime hardpan may be irregular and may be shallow causing spotted growth of crops as well as drainage problems.

COASTAL PRAIRIE ZONE

Map Unit CP

Rainfall.— From 500 mm. in the northern region to 2.500 mm. in the southern one.

Temperature.—The average is 20° C. for January and 5 - 10° C. for July. These temperatures are only approximated because it is impossible to give an accurate range of temperature in such a big area.

Natural vegetation.—The same of the neighbour zones, with the exception of a best growth of grasses.

Typical Characteristics of Coastal Prairies.

A₁^o, A₃, B₁, B₂^o, B₃, C, Dr.

The Coastal Prairie have a characteristic A₁, very rich in humus that seems to be chernozemic.

This zone have the same geological, topographic, climatic and vegetal characteristics of the neighbour zones but are diferent in it greater content of organic matter; also on the better pastures development probably due to the moist from the sea; it is cooler in summer and gently in winter than inland; also it seems to be a salt enrichment specially of sodium.

As a typical Serie, look for the Pucatrihue Serie in the first Revision of Soils of the Osorno and Llanquihue Provinces.

This zone, is all along the coast, from the Santiago to Llanquihue Provinces, extending on a discontinuos line of about 1.000 Km. north to south, and I to 3 Km. east to west.

COASTAL REDDISH BROWN SOIL ZONE

Map Unit RDS

Rainfall.— 16 to 140 mm. per year, with daily fog laden (camanchacas).

January average temperature.— 18 to 22° C.

July average temperature.— 10 to 16° C.

Natural vegetation.— Scanty small shrubs, with short pastures and cacty. Correspond to an intermediate zone in between Non Calcic Brown and Red Deserts Soils.

Typical Characteristics of the Coastal Reddish Brown.

A₁^o, A₃, B₁, B₂^o, B₃ca, Cca, (D), Dr.

One of its principal characteristics is the A₁ horizon, which seems to be chernozemic; it is 15 cm. thick it is deeper, darker and more granular than the A₁ of the Calcic Brown and Red Desert soils; it is rich in organic matter, probably due to the fog laden (camanchaca). The B₂ horizon is reddish brown, sub angular blocky and it has clay flows. It grades gradually into a B₃ca, or a Cca, with no clay flows, and less clay than the above.

It is along a discontinuous line, about 500 Km. From Taltal to Coquimbo, and 1 to 2 Km. east to west. The differences between this and Coastal Prairie Zone are due to the large amount of moist dropped on the last one.

The geological, geographycal and natural vegetation are similar to the surrounding zones; but with more vegetation specially pastures, because it is receives more moist.

"CALCIC BROWN" ZONE

Map Unit PC

Precipitation.— 80 to 140 mm. All as rain with 5 months including summer, December to February nearly rainless.

Mean January temperature.— 17 to 22° C.

Mean July temperature.— 8 to 11° C.

Natural vegetation.— The vegetation in the "Calcic Brown" zone is similar to the drier parts of the Noncalcic Brown zone and in general the shrubs are not so dense nor as tall as in the Noncalcic Brown zone. More grass occurs than in the Red Desert zone but less than in the Noncalcic Brown zone.

Soils.— The "Calcic Brown" soil zone in Chile occur mostly in the west central part of the province of Coquimbo. The well drained soils are dominated by the "Calcic Brown" soils and the wet soils by "Humic Gley" and "Calcic Gley" soils. Other soils probably include some "Grumusols", Alluvial soils and Rendzinas. This area has not been adequately studied to make definite statements about the soils other than "Calcic Brown" soils.

With similar temperature but decreasing precipitation the soils of this zone grades into the Red Desert soils and with increasing precipitation into the "Calcic Brown" Noncalcic Brown transition zone delineated on the map as unit PC-NC.

Typical soils characteristics of "Calcic Brown" soil.

A₁, A₃, B₁, B₂, (Bca), Cca, C, Dr.

The A is 15 to 30 cm. thick neutral or slightly alkaline very low in organic matter with weak subangular blocky to massive structure, which is hard and compact when dry but friable when wet. It is light brown, pale brown or light yellowish brown when dry. The B is richer brown finer textured, stronger structure, and more alkaline than the A. It grades into a more yellow usually calcareous C or Dr horizon. The "Calcic Brown" soils are lighter in color, have thinner horizons, lower in organic matters and more alkaline than the Noncalcic Brown soils for comparable sites.

Principal land use.

Sparse range for sheep, goats and cattle on nonirrigated areas, but a variety of crops on irrigated lands.

Soil management problems.

Low fertility, salinity and workability.

"CALCIC BROWN" — NONCALCIC BROWN TRANSITION ZONE

Map Unit PC-NC

Precipitación: 140 to 300 mm. All as rain with very dry summers.

Mean January temperature.— 17 to 22° C.

Mean July temperature.— 8 to 12° C.

Natural vegetation.— The vegetation in the "Calcic Brown - Noncalcic Brown" transition zone is similar to the Noncalcic Brown area except the shrubs, trees and grass are not so dense, but more dense than on the "Calcic Brown" zone.

Soils.— The soils in this zone are definitely a transition between the "Calcic Brown" soils on the north and the Noncalcic Brown soils in the south. In places, good Noncalcic Brown soils occur on the south slopes and "Calcic Brown" soils occur on the northern drier slopes.

Principal land use.

Nonirrigated areas have less carrying capacity for range stock than the Noncalcic Brown soils. Irrigated areas have about same crops and yields as the irrigated "Calcic Brown" soils.

Soil management problems.

Same as "Calcic Brown" soils.

NONCALCIC BROWN ZONE

Map Unit NC

Precipitation.— 300 to 600 mm. nearly all as rain within 5 months including summer, December to February with less than 10 mm. per month.

Mean January temperature.— 17 to 22° C.

Mean July temperature.— 8 to 12° C.

Natural vegetation.— The vegetation of the Noncalcic Brown zone is dominately mesophytic with many shrubs, some trees and fairly dense cover of grasses. The shrubs and trees include the following: espino

(Acacia cavenia), huanil (*Proustia pungens*), trevillo (*Trevoa trinervis*), yaquil (*Collectia spinosa*), quillay (*Quillaja saponaria*), maitén (*Maytenus boaria*), huingán (*Schinus dependes*), espinillo (*Adesmia arborea*), palqui (*Cestrum parqui*), boldo (*Boldea boldus*), colihuai (*Colliguaya odorífera*), litre (*Lithraea caustica*), molle (*Schinus latifolius*), peumo (*Cryptocarya rubra*), and others. The grasses are typical of the coast of California such as wild oats, wild barley, bromes, alfilaria, bur clover and rye grass.

Soils.—The Noncalcic Brown soil zone includes the so called Central Plain of Chile or that area from Talca to Los Vilos or on areas about 400 kilometers long by 50 kilometers wide.

Noncalcic Brown soils dominate the well drained areas, "Humic Gley" soils dominate the wet areas and Alluvial soils, "Grumosols" and Rendzina include most of the other soils. With increasing elevation and precipitation and decreasing temperature, this soil zone grades into the Brown Forest zone, and with decreasing precipitation into the "Calcic Brown" zone. With increase in summer temperature and increasing precipitation it grades into the Reddish Brown Lateritic zone and along the fog laden cool coast line into the Prairie zone of the coast.

Typical characteristic of Noncalcic Brown soil.

A₁, A₃, B₁, B₂, (B₂m), B₃, (D), C and Dr.

The A is 20 to 40 cm. thick neutral or slightly acid (if unirrigated) very low in organic matter and the upper part (A₁ or Ap horizon) has weak or very weak subangular blocky to massive structure which is hard and compact when dry but friable when moist. There is usually an A₃ which has slightly stronger structure aggregates. This layer may grade through a B₁ to a redder less acid B₂ horizon that has stronger blocky structure, usually more clay and is less permeable. This horizon usually grades into a more alkaline lighter colored and generally coarser textured materials usually B₃, which in turn grades within 1 to 1,1/4 meters into parent material C, or parent rock, Dr, or both.

Soils from normal parent materials, when dry have brown, yellowish brown, or light reddish brown A horizons and the B horizon is commonly brown, yellowish brown, reddish brown or red.

Principal land use.

Includes cattle, sheep and horse range on the nonirrigated steep areas, alfalfa, sugar beets, corn, sunflowers, lentils, beans, truck crops, citrus, deciduous orchards, rice and potatoes on the irrigated lands and grapes, wheat, barley, oats, olives, almonds and figs on both irrigated and dry farmed areas.

Soil management problems.

Includes insufficient summer precipitation; low fertility especially nitrogen and phosphorous; tendency for soils to develop plow pan and water erosion.

In order to increase output over input there is need for conservation irrigation; which is using the soils and the water in such a way as to obtain maximum production with minimum waste of either soil or water. There is also need for better weed and disease control, careful selection of tillage implements for the particular soil type and crop involved and also selecting crops for the degree of slope and kind of soil.

Typical characteristics of "Humic Gley" soils.

A₁, A₃, B₁, B₂, B_{2g}, B_{3g}.

The A is 15 to 76 cm. thick, usually subangular blocky and when moist is very dark grayish brown to black, with pH values ranging from 6,0 to 8,0. The B horizon has either clay accumulation or maximum color intensity or both and is usually mottled. This horizon grades into a C horizon that is usually mottled or has a neutral color. Water table is usually within 1 meter during irrigation season unless the soils have an adequate drainage system.

The "Humic Gley" soils occupy low flat positions often associated with river bottom land and they are usually darker colored and higher in organic matter than adjacent Alluvial and Noncalcic Brown soils.

Soil management problems.

Includes irrigated pastures, for dairy and for beef production, clover, hay, wheat, truck crops, barley, oats and corn.

Soil management problems.

Includes adequate drainage, especially community drainage system, fertilization, weed control and careful selection of crops and tillage implements.

Typical characteristics of "Grumusols".

A₁, AC, C, Cca, (Cm), (Cg), Dr.

The A is 38 to 76 cm. thick neutral to calcareous very plastic and sticky when wet, firm to very firm when moist and hard to very hard when dry, dominately clay with high coefficient of expansion and contraction on wetting and drying. Low chroma (2 or less) but hue may range from 10 YR to and including 5 YR. No B horizon owing to churning or shifting action of the soil during expansion and con-

traction. The C horizon is less weathered lighter colored and higher in pH value and usually calcareous. It as well as A horizon has angular blocky structure, usually strong fine angular blocky in AC portion of the profile and very fine angular blocky no fine granular on the immediate surface which gives the soil self mulching characteristics.

The "Grumusols" occupy basins and nearly level areas on valley fill material and gently sloping to rolling uplands from basic rocks, both sedimentary and basalt. These soils may or may not have a high water table, usually they do not, a few series have a hardpan probably genetic.

Principal land use.

Includes dry farmed and irrigated wheat, irrigated sunflowers, onions, peanuts, tomatoes, corn and pasture with range on most of the dry farmed sloping to rolling lands.

Soil management problems.

Includes developing adequate aeration, fertilizer application, usually nitrogen and phosphorous, and selection of crops and tillage implements. This soil is very difficult to work when wet or when very dry.

Typical characteristics of Alluvial soils.

(A₀₀), (A₀), A₁, C, Cca, (D)

The A horizon is usually 15 to 40 cm. thick and it grades into a loose friable stratified C horizon. These soils do not have a color, texture or distinct structural B horizon and are developed from transported and recently deposited material characterized by a weak modification of the original material by soil forming processes. These soils may be frequently flooded or only rarely flooded and they occur adjacent to streams.

The Alluvial soils in Chile have a distinct genetic thread with the soil zone in which they occur in color, organic matter content, structure, consistence, pH, manganese contents and crops and land use.

Principal land use:

Of the Alluvial soil in the Noncalcic Brown zone is truck crops, pasture, corn, olives, and in places forests.

Soil management problems:

Is dominately one of flood control and fertility.

Typical characteristics of Rendzina soils:

A*, Cca, Dr*ca.

The A horizon is 10 to 30 cm. thick, alkaline and usually calcareous, medium texture and ranging from brown to black depending upon the average annual precipitation and thickness of vegetal cover. The A horizon grades into a highly calcareous much lighter colored C or Dr. horizon or both. These soils are moderately permeable and have good aeration.

The Rendzinas in Chile in the Noncalcic Brown zona occupy hilly to steep relief and are mostly derived from calcareous sedimentary rocks.

Principal land use:

Mostly for range, for sheep and goats; with some areas used as quarries for limestone.

Soil management problems:

Is dominately soil erosion and proper seasons of use.

BROWN FOREST ZONE

Map Unit PF

Precipitation.— 600 to 1.000 mm. considerable snow but with dry summer months, Mediterranean climate.

Mean January temperature.— 10 to 18° C.

Mean July temperature.— 5 to 10° C.

This soil zone has a much shorter growing season than the Noncalcic Brown zone.

Natural vegetation.— The vegetation of the Brown Forest zone is somewhat similar to that of the Noncalcic Brown soils. The dominant trees and shrubs include: yaquil (*Colletia spinosa*), huañil (*Proustia pungens*), tralhuén (*Talguenea costata*), guayacán (*Porlieria chilensis*), peta or pichi (*Fabiana imbricata*), crucero (*Colletia spinosa*), hierba blanca (*Chuquiragua oppositifolia*), bo'do (*Boldea boldus*), peumo (*Cryptocarya rubra*), and others.

Soils.— The Brown Forest soil zone includes the long narrow footslopes of the Andes from about Talca on the south to Illapel on the north.

Brown soils and Lithosolic — Brown Forest soils dominate the well drained sites and "Humic Gley" soils occupy the few wet areas.

With decreasing elevation and precipitation and warmer winters the soils of this zone graded into the Noncalcic Brown soils. With increasing precipitation on the south these soils graded into typical

“Trumao” soils. With increasing elevation, relief and cold temperature the typical Brown Forest soils grade into the Lithosolic - Brown Forest soils.

Typical characteristics of the Brown Forest soils in Chile.

A₀₀, A₀, A₁*, (A₃), B₂*, B₃, C, Dr.

The A₀ is an F layer O to 5 cm. thick usually neutral. The A₁ is 15 to 25 cm. thick dark grayish brown when dry, with moderate granular or subangular blocky structure and pH values from 6,0 to 7,0. The B horizon is usually higher in clay, browner in color and less permeable, than the A horizon and usually has blocky structure. This layer grades into a B₃, C or Dr within 50 to 76 cm.

Principal land use.

Cattle and sheep range with some timber and wood for fuel. The carrying capacity is higher per month of grazing than on the Noncalcic Brown soils with comparable slopes, but the season of use is some what different.

Soil management problems.

Are principally erosion control, revegetation of better grasses and trees for timber production.

Typical characteristics of the Lithosolic - Brown Forest soil.

A₀₀, A₀, A₁*, C, Dr*.

The A₀ and A₁ is similar in color, structure and pH to the comparable horizons of the Brown Forest soils, but the A₁ may be very gravelly or exceedingly steep and many very very rocky.

Some timber is produced but most areas are of little value for agriculture.

“Humic Gley” soils.— Refer to Noncalcic Brown zone.

REDDISH BROWN LATERITIC — NONCALCIC BROWN TRANSITION ZONE
Map Unit NC-LPR

Precipitation.— 600 to about 1.000 mm., with summer months fairly dry.

Mean January temperature.— About 18 to 22° C.

Mean July temperature.— About 8 to 9° C.

Natural vegetation.— The vegetation of this zone includes trees and shrubs of both the Noncalcic Brown zone and the Reddish Brown Lateritic zone.

Soils.—This transition zone occupies the coastal area from Constitución to near Concepción, then inland to near Temuco an area of about 300 kilometers long by 50 kilometers wide. The well drained soils are dominantly a transition between the Reddish Brown Lateritic soils and the Noncalci Brown soils. The restricted drained soils are dominantly Ground Water Laterites and "Humic Gley", other soils include, Alluvial soils, "Grumusols" and Regosols.

Typical characteristics of the soils of this zone.

A_{oo}, A_o, A₁*, A_s, B₁, B₂*, B₃, C, Dr.

Both the A and B horizons have better soil structure than the typical Noncalci Brown soils but weaker structure than the typical Reddish Brown Lateritic soils. The horizons are more distinct than the horizons in the Reddish Brown Lateritic soils. The pH values are more acid with depth, similar to the Reddish Brown Lateritic soils.

Principal land use.

Similar to the Noncalci Brown soil.

Soil management problems.

Mainly soil erosion on the rolling to steep improperly cultivated hills, and soil fertility.

Typical characteristics of Ground Water Lateritics.

A_{oo}, A_o, A₁*, A₂*, B₁, B₂, C_n, B_m, C_m, C.

The A₁ is 15 to 25 cm. thick grayish brown to brown, over a leached A₂ light brownish gray or pale brown, massive to very weak subangular blocky medium textured material which has some iron and manganese concretions, usually quite acid. This layer grades into a finer textured brighter colored, horizon with numerous iron and manganese concretions that may be cemented or semicemented. This horizon grades into a reticulately mottled semicemented C horizon that is usually very acid.

Principal land use.

These soils usually occupy very old nearly level but eroded land surface and in small areas associated with the Noncalci Brown soils or with the Reddish Brown Lateritic soils. They are used principally for pasture or for forestry.

Soil management problems.

Fertility, drainage, and crop adaptation.

"Humic Gley" soils.— Refer to Noncalci Brown zone.

"Grumusols".— Refer to Noncalcic Brown zone.

Regosols.— Refer to Regosol zone.

Alluvial soils.— These soils are similar to those described in Noncalcic Brown soils except they are more acid, higher in organic matter and more leached.

REGOSOL ZONE

Map Unit R

Precipitation.— Approximately 1.000 to 1.300 mm. Dry summers.

Mean January temperature.— 18 to 20,6° C.

Mean July temperature.— 8 to 10° C.

Natural vegetation.— The vegetation of the sandy Regosol zone consists of the followings: huingán (*Schinus dependens*), maitén (*Maytenus boaria*), litre (*Lithraea caustica*), romerillo (*Lomatia ferruginea*), several kinds of grass and other vegetation.

Soils.— The Regosol zone in Chile is dominantly one small area near Los Angeles and is associated with the transition zone of the Reddish Brown Lateritic soils and the Noncalcic Brown soils.

Typical characteristics of Regosols.

Ao, A₁*, C*, (D).

The A is 15 to 30 cm. thick dark grayish brown to brown loose friable single grained and gradually grades into a lighter color similar textured C horizon; which is loose friable and single grained. These soils are darker colored than the Regosolic - Red Desert soils and much higher in organic matter also more productive without irrigation.

Principal land use.

Fruit trees, citrus, olives, alfalfa, wheat, corn and similar crops.

Soil management problems.

Principally wind erosion and fertility.

REDDISH BROWN LATERITIC ZONE

Map Unit LPR

Precipitation.— 1.000 to 3.000 mm. Summers are dry but usually have 16 to 30 mm. per month.

Mean January temperature.— 16 to 22° C.

Mean July temperature.— 7 to 9° C.

Natural vegetation.—The vegetation of the Reddish Brown Lateritic zone is dense and tall. Some of the most common vegetation consists of coigüe (*Nothofagus dombeyi*), tepa (*Laurelia serrata*), raulí (*Nothofagus procera*), laurel (*Laurelia sempervirens*), olivillo (*Aextoxicon punctatum*), ulmo (*Eucryphia cordefolia*), lingue (*Persea lingue*), tineo (*Weinmannia trichosperma*), luma (*Myrtus luma*), mañiu (*Podocarpus salignus*), canela (*Drimys winteri*), and others.

Soils.—The Reddish Brown Lateritic zone occupies the coastal strip in Chile from Concepción on the north to south of Maullín a distance of about 500 km. long and 50 km. wide. The well drained soils are principally Reddish Brown Lateritic and the wet soils are "Humic Gley" soils. With similar climate but ash parent material these soils change to "Trumao" soils. With decrease in precipitation they grade into the Noncalcic Brown soils and are shown on the soil map as Reddish Brown Lateritic - Noncalcic Brown transition.

Typical characteristics of the Reddish Brown Lateritic soils.

A₀₀, A₁*, A₃, B₁, B₂*, B₃, (D), C, Dr.

The A is 15 to 30 cm. thick, dark reddish brown or redder with strong granular structure and spherical concretions usually both iron and manganese, with pH values from 5,5 to 6,5. The B horizon is finer in texture high in iron and aluminum oxide and permeable with red or dark red color and pH values from 4,5 to 5,5. The B horizon is difused with the C horizon which is also high in clay but less friable and usually less red and more yellowish in color than the B horizon.

Principal land use.

Fruits, wheat, potatoes, clovers and timber.

Soil management problems.

Fertility, crop adaptation and erosion.

"Humic Gley" soils.—Refer to Noncalcic Brown soils.

"TRUMAO" ZONE

Map Units T, Tñ

Precipitation.—Ranging from about 1.000 mm. in the North to 3.000 mm. or more in the south. The amount of snow ranges from nil on Chiloé Island to many feet in the Andes.

Mean January temperature.—Ranges from 13 to 20° C.

Mean July temperature.—Ranges from 0 to 9° C.

Freezing and thawing is a characteristic in many areas but absent in others.

Natural Vegetation.—The natural vegetation on the “Trumao” soils is closely correlated with the climate. In areas of high precipitation, the dominant trees are mañío (*Podocarpus salignus*), tepa (*Laurelia serrata*), coigüe (*Nothofagus dombeyi*), canelo (*Drymys winteri*), and similar vegetation as in the Reddish Brown Lateritic zone.

In the areas of lower precipitation, the vegetation is dominately the same as in the Noncalcic Brown zone.

Soils.—The “Trumao” zone extends along the footslopes of the Andes from near Linares to Chiloé Island and beyond to Aysén, an area of about 1.000 kilometers long and 100 kilometers or less wide. The “Trumao” zone can be divided at least into two subdivisions namely (1) the well drained soils Map Unit T, and the wet Soils Map Unit TÑ.

“Trumao” soils Map Unit T dominate the well drained sites and “Ñadi” soil Map Unit TÑ, dominates the wet areas. “Trumao” soils are derived from volcanic ash a “strong” parent material. In areas where the ash is replaced by “normal” or “intermediate” parent materials the soils can be classified as Reddish Brown Lateritic, “Brown Latosol”. Prairie and Brown Forests depending upon the climate, with “Humic Gley” occupying the wet sites within all these soil areas.

Typical characteristics of “Trumao” Soils.

Aoo, Ao, A₁*, A₃, B₁, B₂*, B₃, C, (D).

The Aoo is typically on L and F layer neutral to slightly acid and 2,5 to 10 cm. thick that rest on an A₁ that is 20 to 65 cm. thick, dark brown or darker, with strong granular to subangular blocky structure slightly sticky and slightly plastic when wet, friable when moist, and ranges from soft to hard when dry depending upon the water stability of the aggregates which in turn depends on the content of organic matter which is related to the precipitation. The higher the precipitation and the cooler the summer temperature the higher the organic content and the stabler the soil aggregates. The A horizon grades into a color B horizon which appears to be a horizon of residual iron and aluminium oxides, brown or dark yellowish brown friable and silty with a high water holding capacity but also a high water retaining capacity. The soil peds may appear to be dry or nearly dry but will become moist when squeezed between the fingers. The B horizon gradually grades into a C or may abruptly change to a D of unrelated material.

These soils probably have a high carbon nitrogen ratio, but the ration will probably correlate with organic matter content which is related to the precipitation. The higher the precipitation the higher the carbon nitrogen ratio.

These soils have a low volume weight, most sites probably have less than 1 in all horizons. The pH values range from 6 in the A₁ to

6,8 in the C horizon if the precipitation is less than about 2.000 mm. and from 5 in the A₁ to 6 in the C in areas exceeding 2.400 mm.

Principal land use.

Typically wheat, oats, clovers, pasture grasses and potatoes with forest trees on the steeper slopes and the shallow ash deposited areas.

Soil management problems.

Including heaving, erosión, fertility especially lack of phosphorous, and difficulty for mouldboard plows to scour.

Typical characteristics of the "Ñadi" soil.

Map Unit TÑ

A₁*, A₃, B₁, B₂*, (Bm), C, D.

The A is 25 to 50 cm. thick very dark brown, granular to subangular blocky, slightly plastic exceedingly high in organic matter and strongly acid. The B horizon is yellowish red to reddish yellow, angular blocky usually with some clay accumulation and apparently lots of iron accumulation giving the soil the red color. This horizon may rest on cemented iron silica aluminum hardpan or grade into lighter colored C horizon less acid than the A horizon.

These soils occupy nearly level relief often basin-like areas and the entire profile is saturated some months of the year, partially saturated parts of the year and dry during the summer months.

Evidence of wetness (poor or restricted drainage), is not reflected by mottling, gray or neutral color as in "Humic Gley" soils but by strong croma 5 or 6 in concretions, and veneers on peds and gravel in the lower horizons.

Principal land use.

Dominately pasture in cut over lands and forestry in virgin areas. Very little if any fields are cultivated.

Soils management problems.

Consist of proper moisture supply; usually these soils are too wet in winter and too dry in summer. Many areas are shallow to a hardpan.

PODZOL — ALPINE MEADOW ZONE

Map Unit P-A

Precipitation.— Probably more than 410 mm. evenly distributed with lots of snow.

Mean January temperature.— Approximately 12 to 15° C.

Mean July temperature.— Approximately 1 to 3° C.

Natural vegetation.— Dominately beech. Lenga (*Nothofagus pumilo*), Ñirre (*Nothofagus antarctica*), and roble de Magallanes (*Nothofagus betuloides*), and a few canelo (*Drimys winteri*), with some understory of shrubs. The Podzols and Alpine Meadow soils are so closely associated, especially in southern Chile, that they cannot be unit but described separately.

Soil.— The typical Podzol zone of Chile includes the timber covered areas in the southeast tip of Chile. Some fairly typical Podzols occur on the Western part of Chiloé Island but here the yearly precipitation exceeds 3.000 mm. and it never snows. The vegetation here is dominately ciprés (*Pilgerodendron uviferum*).

In both areas Podzols dominate the well drained soils and Bog soils and Ground Water Podzols occupy most of the wet sites, other soils include "Gray Wooded" soils, Alpine Meadow soils, Lithosols and Brown Podzolic soils. With decreasing precipitation in southern Chile the Podzols change abruptly to the grass covered Prairie soils and with increasing elevation, above timber line about 1.000 meters they change abruptly to the Alpine Meadow soils. On Chiloé Island the Podzols change with changing parent material into the "Trumao" soils which have on this Island profiles similar to "Brown Latosols".

Typical characteristics of Podzols.

A₀₀, A₀*, A₂*, B₂*, B₃, C, Dr, (D).

The A₀ includes F and H layers and ranges from 2 to 8 cm. thick, with pH values from 4,0 to 5,0. The A₂ is 3 to 20 cm. thick, light gray medium fine platy with pH value of about 5. The B₂ is abrupt, 10 to 40 cm. thick, and is yellowish brown with weak fine subangular blockys structure. It is the zone of humus and iron oxide accumulation and it grades into a Dr, C or B₃ that is paler in color and has less noticeable structure and less humus and iron.

Principal land use.

In virgin areas it is used for the production of timber. Cut over areas are used extensively for sheep pasture. A few areas have been cultivated and planted to grass and alfalfa.

Includes fertilizing with nitrogen and phosphorous for grasses and legumes, and wind erosion if repeatedly flowed.

ALPINE MEADOW ZONE

Map Unit P-A

Precipitation.— Probably more than 410 mm. even distribution with lots of snow and wind.

Mean January temperature.— Approximately 10 to 14° C.

Mean July temperature.— Approximately — 2 to 2° C.

Natural vegetation.— Dense thick cover of sedges, festuca and low shrubs with some calafate (*Berberis buxifolia*).

Soil.— The Alpine Meadow zone is closely associated with the Prairie and Podzol zone of the southern tip of Chile. These soils are above timber line and with decreasing elevation they abruptly joint the Podzol zone.

Typical characteristics of the Alpine Meadow soils.

A₁*, A₃, B₁, B₂*, B₃, C, Dr, D.

The A₁ is 15 to 25 cm. thick very dark brown to black, moderate medium granular, exceedingly high in organic matter with pH value of 5 to 5,5 — The B is 20 to 25 cm. thick brighter than the A, finer in texture and subangular blocky with pH value of 5 to 5,5 — This horizon grades into a more yellow coarser textured C or Dr. horizon that is usually also strongly acid.

Principal land use.

Range for sheep during summer months. The carrying capacity is fairly high.

Soils management problems.

Fertility and brush control.

Typical characteristics of the Gray Wooded soils.

A₀₀, A₀*, A₁*, A₂*, B₁, B₂*, B₃, C, (Dr).

The A₀ includes the F and H layer and is 3 to 6 cm. thick with pH value of about 6. The A₁ is thin grayish brown, moderately fine platy usually silty with pH value of about 6. The A₂ is 5 to 20 cm. thick light grayish brown platy and some what firm when dry, pH 5 to 6. The B₂ is a horizon of clay accumulation and has a tendency to be coarse prismatic with gray siliceous material coating the structural units, with pH values of about 5. This horizon is usually fairly thick and grades into a B₃ or C. Usually these horizons are silty or clayey.

Principal land use.

Timber production, pasture, and some alfalfa, oats and potatoes.

Soils management problems.

Include fertilizing wiht nitrogen and phosphorous for grain, grass and potatoes.

*Typical characteristics of the Bog soils.*O₁*, O₂, D.

The O₁ is 20 to 30 cm. thick and consists of partially decomposed and decomposing moss mostly sphagnum, light brown and pH value of 4 to 4,5 — This horizon grades into less decomposed fibrous moss peat O₂ that is redder and more acid than the layer above. Usually this layer rests on unrelated material, (D), at a depth of 1 to 3 meters.

Principal land use.

Dominatedly idle.

*Typical characteristics of Ground Water Podzol.*A₀₀, A₀, A₁*, A₂*, Bh, B₂*, C, (D), Dr.

The A₀ is 2,5 to 5 cm. thick with pH values from 4 to 5. The A₁ is 2,5 to 25 cm. thick dark colored, with weak structure and pH values, ranging from 4 to 5,5 — The A₂ is 7 to 30 cm. thick light gray and usually mottled, with pH values from 4,5 to 5,5 — The B₂ is usually abrupt reddish or blackish and is the zone of humus and iron oxide accumulation. It is commonly cemented into a pan (orstein) with pH values from 4,5 to 5,5.

Principal land use.

Dominatedly forests and pasture.

Soils management problems.

Drainage and fertility.

PRAIRIE — PRAIRIE PLANOSOL ZONE

Map Unit PP

Precipitation.— Probably from 260 to 350 mm. in southern Chile, fairly even distribution with considerable snow and from 700 to 1.000 mm. in the fog laden coast of Central Chile.

Mean January temperature.— Approximately 11 to 16° C. in southern Chile, and 17 to 22° C. in Central Chile.

Mean July temperature.— Approximately 0 to 3° C. in southern Chile and 8 to 12° C. in Central Chile.

Natural vegetation.— In southern Chile very dense stands of tall grasses such as *festuca gracilina*; *Hordeum jubatum*; *Agropyron magallanicum*; and *Poa bonaerensis*, with many areas of Mata Verde bush (*Chiliotrichum diffusum*); and Calafate shrubs (*Berberis buxifolia*); and in Central Chile vegetation similar to the Noncalcic Brown Zone.

Soils.— The Prairie - Prairie Planosol soil zone includes a large part of Tierra del Fuego and adjacent areas on the main land of Chile, and a very narrow strip along the coast of Central Chile. The well drained soils include an intermingling association of Prairie soils and Prairie Planosol, probably the latter soils occupy the largest areas in southern Chile, but a minor area in Central Chile. The wet soils include "Humic Gley" and Solonchak; other soils are Chenozems Regosols, and Alluvial soils in southern Chile, possible some solodized Solonetz in Central Chile. In southern Chile with increasing precipitation the soil zone grades rather sharply into the Podzol zone and with decreasing precipitation into the Chestnut zone. In Central Chile the soils grade into the Noncalcic Brown soils.

Typical characteristics of Prairie soils.

A₁*, A₃, B₁, B₂*, B₃, C, D.

The A₁ is 20 to 30 cm. thick very high in organic matter (nearly muck in the upper few centimeters of the root mat), very dark grayish brown, with weak fine granular structure pH about 6. The B' is usually finer texture similar in color or brown and more alkaline than the A₁ with angular blocky structure. This horizon is 25 to 40 cm. thick and grades into a C or rest on D, unrelated materials.

Principal land use.

Is year long range for sheep with some cattle. The carrying capacity is high approximately two sheep per hectare per year. Some areas are being planted to alfalfa and orchard grass. Production should be somewhat more under irrigation.

Soils management problems.

Include soil fertility especially nitrogen, wind erosion if the land is plowed several times, and brush control.

Typical characteristics of the Prairie soils along the fog ladden coast of Central Chile.

A₁*, A₃, B₁, B₂*, B₃, C, Dr.

The A is thinner and has much less organic matter, also it has weaker structure than the Prairie soils of southern Chile. The B horizon is somewhat similar in the two areas.

Principal land use.

Wheat, oats, barley, pasture and Monterrey pine plantation.

Soils management problems.

Fertility, erosion and crop adaptation.

Typical characteristics of Prairie - Planosols.

A₁*, A₂*, B₂*, B₃, C, D.

The A₁ is thick 20 to 30 cm. very dark grayish brown weak fine granular, very high in organic matter with pH values 6,0 to 6,5. The A₂ is 10 to 20 cm. thick light grayish brown weak fine platy slightly brittle without evidence of manganese, usually less clay than layer above but with similar pH. The B₂ is abrupt 30 to 40 cm. thick somewhat mottled but browner than the A and much higher in clay. It has angular blocky structure and pH values of 6,0 to 7,0. This horizon grades into a C or may rest upon a D. The Prairie - Planosols along the coast of Central Chile have a much thinner A horizon and less organic matter.

Principal land use.

Similar to the associated Prairie soils.

Soils management problems.

Similar to the associated Prairie soils.

Typical characteristics of the Chernozems.

A₁*, A₃, B₁, B₂, B₂ca*, Cca (Dr).

These soils are similar to the Prairie soils except they have a zone of lime accumulation in the lower part of the B or upper part of the C. The land use and management problems are also similar to the Prairie soils.

"Humic Gley" soils.— Refer to Noncalcic Brown Zone.

Solonchak soils.— Refer to Red Desert Zone.

Regosols.— Refer to Regosol Zone.

Alluvial soils.— Refer to Noncalcic Brown Zone.

CHESTNUT SOIL ZONE

Map Unit C

Precipitation.— Probably from 225 to 300 mm. fairly evenly distributed with considerable snow.

Mean January temperature.— Approximately 12 to 16° C.

Mean July temperature.— Approximately 0 to 3° C.

Natural vegetation.— Fairly dense stands of tall grasses mainly *Festuca gracilina*; *Hordeum jubatum*; *Poa bonaerensis*; and *Agropyrum magellanicum*; with patches of Mata Verde brush (*Chiliotricum diffusum*).

Soils.—The Chestnut soil zone in Chile occurs principally in Magallanes Province but probably some in Aysen Province all in southern Chile. The well drained sites are dominated by the Chestnut soils and the wet sites by Solonchak, "Calcic Gley" and "Humic Gley". Other soils include the Alluvial soils and probably solodized - Solonetz and Solonetz.

With increasing precipitation the Chestnut zone grades into the Prairie zone and, with decreasing precipitation into the Brown zone.

Typical characteristics of the Chestnut soils.

A₁*, A₃, B₁, B₂*, B₃, (Cca), C, Dr.

The A is 18 to 24 cm. thick, dark grayish brown when dry, weak platy that breaks into weak granular structure, very high in organic matter and pH value 6.5 to 7.0. The B is usually a horizon of clay accumulation, browner and slightly higher pH than the A with blocky structure, usually prismatic. This layer grades into a C or Dr which may be calcareous.

Principal land use.

Range for sheep and some cattle. The carrying capacity is lower than on the Prairie soils but higher than on the Brown soils. Alfalfa and some planted grass will grow very well on nonirrigated sites, but the summer season is too cold for wheat, corn and most other cereals. Yields of adapted crops would be much higher under irrigation.

Soils management problems.

Include constructing small water reservoirs, brush removal, wind erosion if the land is plowed several times, and fertility. Range grasses respond with nitrogen fertilizers.

Solonchaks.—Refer to Red Desert zone.

"Calcic Gley".—Refer to Red Desert zone, however in this area the use is principally range pasture for sheep.

"Humic Gley".—Refer to Noncalcic Brown zone — however in this area the use is principally range pasture for sheep.

Alluvial soils.—Refer to Noncalcic Brown zone — however in this area the surface soils are dark colored, have fairly good structure and are high in organic matter. They are used for sheep range.

BROWN SOIL ZONE

Map Unit P

Precipitation.—Probably from 150 to 225 mm. fairly evenly distributed with some snow and considerable wind.

Mean January temperature.— Approximately 12 to 16° C.

Mean July temperature.— Approximately 0 to 3° C.

Natural vegetation.— Fairly dense growth of festuca and some Stipa, and Poa with some Mata Negra (Verbena tridens).

Soils.— The typical Brown zone occurs principally on Magallanes province, the big sheep country of southern Chile. The well drained sites are dominated by the Brown Soils and the wet areas by Solonchak and "Calcic Gley" soils. Other soils in this zone include Solonetz and probably solodized Solonetz.

With increasing precipitation these soils grade into the Chestnut soils and with decreasing precipitation into the Sierozem soils.

Typical characteristics of the Brown soils.

A₁*, A₃, B₁, B₂*, B₃, B₃ca, Cca, (Cm), C, Dr.

The A is 14 to 18 cm. thick, grayish brown, strong fine platy that has a tendency to break into weak coarse prisms. It has pH values of 6,5 to 7,0. The B is commonly a horizon of clay accumulation, browner than the A and blocky with pH value of 7,5 to 8. This horizon grades into a Cm., Cca or Dr, that is usually more yellowish and calcareous.

Principal land use.

Range for sheep. The carrying capacity is lower than on the Chestnut soils but higher than on the Sierozem soils. Nonirrigated alfalfa could be grown but the yields would be lower than on the Prairie soils. The area where these soils occur is too cold in the summer for grain production. If irrigated, the crops produced would be the same as on the Prairie soils.

Soils management problems.

Include rate of grabbing, wind and water erosion especially if the land is plowed and replowed and constructing water reservoirs for stock.

Typical characteristics of Solonetz.

A₁*, (A₃), B₂*, B₃, (Bm), (Cm), (D), C.

The A₁ is usually 8 to 12 cm. thick grayish brown moderate fine platy with pH values of 7 to 7,5 The B₂ is browner, thicker and much higher in clay than the A horizon. It has strong colloidal coated prismatic structure with pH values of 7,5 to 8,5. The lower horizons are usually higher in pH values calcareous and lower in clay content.

Principal land use.

Range for sheep, fairly low carrying capacity.

Soils management problems.

Principal reclamation.

UNEXPLORED ZONE

Map Unit I

Precipitation.— Approximately 100 to 1,000 mm. with some rain in summer months and much snow in winter.

Mean January temperature.— 8 to 12° C.

Mean July temperature.— 2 to 6° C.

Natural vegetations.— The vegetation of this zone is probably dominately llareta (*Laretia compacta*); llareta (*Azorella* spp); queñoa (*Polylepis incana*); with some tola (*Baccharis tola*); copa (*Artemisia copa*); and some of the grasses such as *Stipa*, *Poa* and *Festuca*.

Soils.— This zone includes the northern and drier part of the Andes. It probably includes Gray Desert soils, Lithosols, and maybe some Alpine Meadow soils and Sierozems.

UNEXPLORED ZONE

Map Unit II

Precipitation.— Approximately 1,000 to 2,500 mm. with some rain in summer and lots of snow in winter.

Mean January temperature.— Approximately 15 to 25° C.

Mean July temperature.— Approximately 4 to 14° C.

Natural vegetation.— This zone has a dominance of roble (*Nothofagus obliqua*), coigüe (*Nothofagus dombeyi*), belloto (*Bellota nitida*), canela (*Drimys winteri*), lingue (*Persea lingue*), romerillo (*Lomatia ferruginea*), maqui (*Aristotelia chilensis*), and others.

Soils.— This zone includes the central and more moist portion of the Andes. It probably includes Lithosols, Brown Forest soils, Alpine Meadow soils and possibly some Podzols.

UNEXPLORED ZONE

Map Unit III

Precipitation.— Approximately 1,500 to 5,000 mm. with fairly even monthly distribution.

Mean January temperature.— Approximately 10 to 15° C.

Mean July temperature.— Approximately 2 to 6° C.

Natural vegetation.— The dominant vegetation of this area is probably ñirre, roble de Magallanes, ciprés andino or cedro (*Libocedrus chilensis*), etc.

Soils.— This zone includes the wettest areas in Chile or the southern part of the Andes. The soils are probably similar to Brown Podzolic, Podzols and possibly "Brown Latosols" with "Humic Gley" and Bog soils occupying the poorly drained sites.

UNEXPLORED ZONE

Map Unit IV

Precipitation.— Approximately 1.500 to 3.500 mm. mostly as snow.

Mean January temperature.— Approximately 10 to 12° C.

Mean July temperature.— 0° C.

Natural vegetation.— Barren or snow covered.

Soils.— This zone includes the glacier fields of the Andes and probably the soils are Lithosols.
