Annotated Bibliography on Reclamation and Improvement of Saline and Sodic Soils (1966-1960)

Updated version of Bibliography No. 4
on Reclamation and Improvement of Saline and Alkali Soils (1957-1964)

ANNOTATED BIBLIOGRAPHY ON RECLAMATION AND IMPROVEMENT OF SALINE AND SODIC SOILS (1966-1960)

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CONTENTS

PREFACE

This bibliography contains selected references to the literature on the reclamation and improvement of saline and sodic soils, mostly published in the period from 1960 through 1966. References of earlier date, when considered of much importance have been included. Literature issued before 1960 can be found in the bibliographies enumerated on page 42 and 43.

In general only literature published in English, French and German as well as English translations have been mentioned. Capital letter symbols, placed in brackets, indicate the language in which the paper has been published; summaries are designated with small letter symbols. Journals are abbreviated according to the following principle:
Soil Sci. Soc. Amer. Proc. 29(1965)5 : 597-601.
Soil Science Society of America Proceedings, volume 29, year 1965, number 5, pages 597-601.

Topics included, according to which references have been listed, are: general aspects; leaching and drainage; application of chemical and organic amendments; tillage; influence of crops, crop rotation; costs and bibliographies.

GENERAL ASPECTS

ANTIPOV-KARATAEV, A. and KERZUM, P.A. / The system of reclamation methods for exploiting saline and swamped soils and against secondary salinization of irrigated soils in Tadzhiskistan.
Salinity Problems in the Arid Zones; Proc. Teheran Symp., 1961: 281-284
Arid Zone Research 14, Unesco.

Reclamation methods were developed in order to exploit saline and swamped lands. The Vakhsh Valley irrigation project is taken as an example of these methods. They include: drainage by a network of collectors, deep ploughing, and removal of salts by leaching. Salinization after leaching is prevented by a complex of agronomical methods.

AYERS, A.D. / The improvement of saline and sodic soils.
Potassium Symp., Athens, (1962) 259-270, 38 refs. (E, f, g, sp.).

Special management practices can be helpful in improving salt-affected soils and in increasing crop production. These include the concept of "leaching requirement", use of tolerant crops, special planting techniques, and the application of amendments and fertilizers (From auth. summ.).

BERNSTEIN, L. / Salt affected soils and plants.
The problems of the Arid Zone; Proc. Paris Symp. Arid Zone Research 18, Unesco, 1962 : 139-174, 274 refs.

With chapters on "Soil amendments and reclamation" and Management and preparation of salt-affected soils".

BONNET, J.A. / Edafologia de los suelos salinos y sodicos. (The soil science of saline and sodic soils).
Estacion Experimental Agricola, Universidad de Puerto Rico, Rio Piedras, 1962. Pp. 337, 225 refs. (Sp.).

Following the introduction, the next eight chapters cover the nature of the soluble salts, cation exchange in the clay components, classification of saline and sodic soils, water relationships, drainage problems, effects on plants, and desalinization. The tenth chapter deals with the polders of Holland and the eleventh with the specific saline soils of the Valle de Lajas In Puerto Rico. The final chapter presents methods of analysis of saline and alkaline soils and waters.

BOWER, C.A. and FIREMAN, M. / Saline and alkali soils.
In: Soil. The Yearbook of agriculture 1957. U.S. Dept. of Agriculture, Washington. Pp. 282-290.

The second part of this article gives some practical methods for improving and reclaiming saline and alkali soils.

BRADSHAW, G.B. and DONNAN, W.W. / Leaching studies in connection with drainage of saline soils in the Imperial Valley California.
USDA Soils Cons. Serv. Research, May, 1953.

Data on leaching experiments as well as costs of reclamation have been given.

BREBURDA, J. / Salz- und Alkaliboden in Trockengebieten der Sovjetunion und ihre Verbesserung.
Zeitschrift für Kulturtechnik und Flurbereinigung 7 (1966). 2: 81-90. (G.e.)

The different opinions on the formation of saline and sodic soils in the Soviet Union and the methods for improving salt affected soils have been briefly reviewed.

BURINGH, P. / Soils and soil conditions in Iraq.
Ministry of Agriculture, Baghdad, 1960. Pp. 322. 344 refs.

A part of chapter 3 is dealing with the reclamation of saline and alkali soils, especially in Iraq (p. 105-114).

CHAPMAN, V.J. / Salt marshes and salt deserts of the world.
Leonard Hill, London, 1960. Pp. 392. 343 refs.

With brief chapters on "Reclamation of maritime marshes", and "Reclamation of inland salt deserts and alkali soils".

DIELEMAN, P.J. (ed.) / Reclamation of salt affected soils in Iraq.
Wageningen, 1963, Pp. 175. 50 refs. Int. Inst. for Land Reclamation and Improvement, publ. no. 11.

This paper is the result of the combined efforts of four authors, who, during the period 1953-1959, worked several years as "foreign experts" at the Ministry of Development and Development Board of Iraq, First Technical Section (subsequently in the Fourth Technical Section). It was their task among other things to report on the possibilities and methods of reclamation of salt-affected areas of Iraq. Experimental fields were laid out in order to obtain a clear insight into the water and salt movement of the soil. In this paper the experiments conducted on these fields are described and the results obtained set forth.

FIREMAN, M. and KRAUS, Y. / Salinity control in irrigated agriculture. Published by Tahal. Water planning for Israel. Ltd. Tel Aviv. 1965.

The bulletin gives a brief introduction to the more technical literature and is intended for agriculturists, irrigation and drainage engineers and technicians. The material included in the bulletin is mainly based on USDA Hdb. 60.

FIREMAN, M. / Comments on the reclamation of saline and alkali soils. Report on the Seminar on waterlogging in relation to irrigation and salinity problems, Lahore Pakistan. 1964: 150-156; Rep. Exp. Progr. of Techn. Assist. FAO no. 1932.

The depth, permanence and costs and the methods of saline (and sodic) soil reclamation are briefly reviewed.

GARLAND, K. R. / Reclamation of waterlogged saline land in N. Victoria, Australia, a review of recent experiments.
6th Congr. Int. Comm. Irr. Drain., New Delhi, 1966. Q 19, R 12.

In North-West Pakistan saline soils are common in irrigation areas. Groundwater, often present within a depth of $1\frac{1}{2}$ meter below soil surface, contains 10-40 grams of salt / liter. The results of different reclamation experiments are briefly reviewed.

GRANDE COVIAN, R. / Las Marismas del Guadalquivir y su rescate (The Guadalquivir marshes and their reclamation).
Estudios Vol V, no. 29 (1967), Instituto Nacional de Colonizacion, Madrid, Pp 64 (Sp.).

HOON, R. C. / Reclamation of saline lands under irrigation.
6th Congr. Int. Comm. Irr. Drain. 1966. Q 19, R 20.

An outline is given on the waterlogged, saline and sodic soils in several States of India. Adequate surface and subsurface drainage is a prerequisite for reclamation. Suitable and economically feasible amendments can be used. Other measures are land preparation and the cultivation of salt and alkali resistant crops like paddy. To introduce organic matter in the soil green manures are cultivated. Sesbania acculeata is an excellent green manure for improving sodic soils. Normally reclamation of alkali lands will take 4-5 years.

HUSZ, G. VON / Einiges zur Theorie und Praxis der Salzbodenmelioration mit besonderer Berücksichtigung der Verhältnisse im Seewinkel, Oesterreich. II Teil.
Die Bodenkultur, 17 (1966) 1:33 (G, e.).

The salt-affected soils in Seewinkel, eastern Austria, have been described.

An outline on their reclamation is given.

JANITZKY, P. / Salz- und Alkaliböden und Wege zu ihrer Verbesserung; ein Vergleich russischer und amerikanischer Forschungsergebnisse. (Saline and sodic soils and means of their reclamation; a comparison of results of Russian and American research).
Giessen, 1957. Pp. 196. 114 refs. Giessener Abhandlungen zur Agrar- und Wirtschaftsforschung des Europäischen Ostens. Bd. 2. (G.).

JOHNSGARD, G. A. / Salt affected problem soils in North Dakota; their proporties, use, suitability and management.
Bull. no. 453 of the Agric. Exp. Stat. North Dakota.

The management, improvement of saline and sodic soils in North-Dakota is briefly discussed.

JORDAN, H. D. / Development of mangrove swamp areas in Sierra Leone.
Publ. Comm. Techn. Co-oper. Africa S. Sahara, Rice (63) 6 (1963). 20th Mch, 1-3.

The mangrove swamp areas in Sierra Leone cover an area of some 100,000 ha. Their reclamation is briefly described. By 1940 some 20,000 ha had been brought under cultivation, all of it easily reclaimed land along the edges of the major tidal rivers with an abundance of fresh tidewater in the rainy season. After that the reclamation of the adjacent stagnant swamps inland was started by digging channels large enough to enable the fresh tidal water to flood the land and be drained off freely. By far the largest areas of mangrove land, situated along the coast, are flooded by saline tidal water. To reclaim these areas saline water has to be excluded; only fresh rain-water is to be used. This system is practised in Guinea, but failed in Sierra Leone. Brief description of the chemical and biological studies on mangrove soils made by the West African Rice Research Station at Rokupr (Trop. Abstr. 1963: k. 1740).

KELLEY, W. P. / Alkali soils, their formation, properties and reclamation.
Reinhold, New York, 1951. Pp. 176. 152 refs.

Important handbook on all aspects of alkali soils. Chapter 7: "Reclamation of alkali soils" covers the following subjects: replacement of sodium by calcium; soils containing sodium carbonate; soils high in salts but low in exchangeable sodium; non-calcarous soils high in exchangeable sodium; reclamation of soils inundated with sea water; saline irrigation water in relation to reclamation; soil management in relation to reclamation; feasibility and permanence of reclamation; drainage; and importance of calcium in alkali soils.

KOVDA, V. A. / Principles of the theory and practice of the reclamation and utilization of saline soils in the arid zones.
Salinity Problems in the Arid Zones, Proc. Teheran Symp., 1961: 201-213. Arid Zone Research 14, Unesco. 32 refs.

The processes responsible for soil salinization. Classification of the saline soils in Eurasia. Reclamation of solonchak-like soils and of solonchaks.

KOVDA, V. A. / Review of principles of salinization and reclamation of irrigated soils.
Report on the Seminar on waterlogging in relation to irrigation and salinity problems. Lahore, Pakistan. 1964: 158-164, Rep. Exp. Progr. of Techn. Assist. FAO no. 1932.

A brief outline is given on the Soviet experience in the reclamation and utilization of saline soils.

MOLEN, W. H. VAN DER / The inundations of 1944-1945 in the Netherlands and their effect on agriculture. Part 9. The exchangeable cations in soils flooded with sea water.
The Hague, 1957. Pp. 167. Versl. Landb. Onderz. 63.17

The change in the chemical properties of soils brought about by sea inundation and the reclamation of sea-inundated soils have been discussed extensively.

PLYUSNIN, I. I. / Reclamative soil science.
Foreign Languages Publ. House, Moscow, 1962. Pp. 398. Translated from Russian. Chapter XX deals with "Reclamation of salined soils" (p. 371-391).

RAYCHAUDHURI, S. P. / Classification of saline and alkali soils of India.
Proc. of the Symp. on Sodic Soils, Budapest 1964. Agrokémia és Talajtan 14 (1965) supplementum: 83-89 (E, r).

In India approximately 6 million hectares of land are salt affected. The paper gives a brief review of the techniques applied in India to reclaim saline and sodic soils.

RICHARDS, L. A. (Ed.) / Diagnosis and improvement of saline and alkali soils.
U.S.D.A., Washington 1954. Pp. 160. Agriculture Handbook no. 60. 215 refs.

One of the best books on improvement of saline soils composed by the staff of the United States Salinity Laboratory in Riverside.

RICHARDS, L. A. (Ed.) / Diagnostico y rehabilitacion de suelos salinos y sodicos.
Instituto Nacional de Investigaciones Agricolas, Mexico 1962. Pp. 172.
Translation of: Diagnosis and improvement of saline and alkali soils. U.S.D.A. Agriculture Handbook no. 60.

RUSSELL, J.S., BROOKER, M.I.H. / Preliminary experiments on the reclamation of a saline-sodic soil in the Jervois area.
Exp. Rec. Dep. Agric. S. Austr. 1 (1963): 5-20.
An experiment started in 1958 on the reclamation of a very saline alkali soil in the lower reaches of the Murray river. Up to 20 tons/acre of gypsum were applied and various drainage patterns were tried.

SHANIN, M. and ARNOUT, Z. / Reclamation of the northern part of the Nile delta area.
6th. Congr. Int. Comm. Irr. Drain., New Delhi, 1966. Q 19, R 15: 187-218.
A description is given of the procedure followed in reclaiming a vast area in the northern part of the Nile delta. This includes the data on physical and chemical properties of the soil, depth to groundwater, data on irrigation and drainage water, alignment of irrigation and drainage systems and crop rotation (From authr. summ.).

Study on wastelands including saline, alkali and waterlogged lands and their reclamation measures.
Committee on Natural Resources Planning Commission, New Delhi, 1963.
This book gives a extensive review on the distribution of saline and alkaline soils in India and the results of reclamation experiments carried out in the different provinces of the Indian Union.

SZABOLCS, S. / Salt affected soils in Hungary.
Proc. Symp. on Sodic Soils, Budapest, 1964. Agrokémia és Talajtan 14 (1965) supplementum: 275-306 (E.R.).
The difference in origin, properties and methods of improvement and reclamation of salt affected soils in Hungary are briefly reviewed. In the past the methods of "digózas" and liming salt affected soils were recommended. With the "digózas" method the surface of salt affected soils was covered with a 5-12 cm thick layer of soil of good quality. With the liming method 30-40 tons per ha of calcium carbonate containing materials, ground limestone, peat containing lime and sugar factory sludge, were applied. Since the last decade reclamation experiments have been directed towards the application of small amounts, viz. 500-800 kg/ha of calcium nitrate.

The importance of controlling the groundwater table and irrigation is delineated. Limits are set up for the quality of irrigation water depending on soil type and properties, method of irrigation and crop rotation.

SZABOLCS, S.; KOVACS, Gy.; BUDAVARI, K and HARMATI, S
6th Congr. Int. Comm. Irr. Drain. New Delhi, 1966, Q 19, R 14.
Shallow and saline groundwater causes salinity and alkalinity in the Hungarian lowlands. Often saline and alkaline soils have a fine textured and impervious topsoil. The following measures are proposed: When the impervious topsoil is more than 1.5 m thick, the construction of fishponds or storage reservoirs for excess water is the only reclamation measure possible. With an impervious topsoil of 1 - 1.5 meter the soil can be improved by a fairly closely spaced drainsystem, irrigation, and a native grass cover. When the impervious topsoil is less than 1 meter thick the soil can be reclaimed by 3 year rice cultivation plus addition of 700 kg gypsum or 2000 kg lignite/ha.

TALSMA, T. / The control of saline groundwater.
Veenman, Wageningen, 1963. Thesis Agric. Univ. Wageningen.
Contents: Drainage requirements to control the salinity factor. The Murrumbridge irrigations areas (Australia). Assessment of the salinity hazard.

UPPAL, H.L. / Reclamation of saline and alkali soils.
6th Congr. Int. Comm. Irr. Drain. New Delhi, 1966. Q 19, R 25: 381-440.
The reclamative measures of saline and alkali soils in India have been discussed in 8 chapters e.g. formation of saline and alkali soils; magnitude of menace caused by saline and alkali soils in India; diagnosis of saline and alkali soils, a study of methods for the reclamation of saline and alkali soils; management of saline and alkali soils before reclamation; land reclamation work carried out in the state of Punjab; management of saline and alkali soils after reclamation; future programme. Many data on crop yields and costs of reclamation are included.

VIETS, F.G. jr. and MUCKEL, D.C. / Reclamation of tidal soils.
4th Congr. Int. Comm. Irr. Drain., Madrid, 1960, Q 11: 1-16.
Levees are usually required to prevent inundation during high tides. Main and lateral drain ditches are required for the removal of excess surface and subsoil water, and outlets are required for the disposal of excess water. The chemical and fertility problems involved in reclamation after drainage and water control have been established are: removal of salts, replacement of exchangeable sodium, correction of acidity, and adequate supplies of plant nutrients. Removal of salts by leaching and the displacement of exchangeable

sodium by leaching, using gypsum when needed, do not present any problem. But careful evaluation of the problem of excess sulfides may lead to extreme acidity when the soil becomes aerated, must be made.

Waterlogging and salinity in West Pakistan.
Report on the Seminar on waterlogging in relation to irrigation and salinity problems, Lahore, Pakistan 1964: 19-68. Rep. Exp. Progr. of Tech. Assist. FAO no. 1932

A basic report on waterlogging and salinity in West Pakistan.

LEACHING AND DRAINAGE

AHMAD, N. / Soil salinity in West Pakistan and means to deal with it.
Salinity problems in arid zones. Proc. Teheran Symp. 1961: 117-125. Arid Zone Research 14, Unesco.

Subsoil watertable conditions; causes of the rapid rise of the water table in the canal regions; salts in subsoil water; salts in river waters; removal of salts by leaching; difficulties of successful leaching in West Pakistan; open drains; tile drains; drainage by pumping; hydraulics of tube wells.

AMEMIYA, M. and ROBINSON, C.W. / The use of undisturbed soil cores to investigate the reclamation of saline and alkali soil.
Soil Sci. Soc. Amer. Proc. 22 (1958) 1 : 76-78.

Concurrent with a field leaching experiment a laboratory leaching study was made to determine the relationship between results obtained from undisturbed cores in the laboratory and those obtained from field plots. Changes in infiltration rate, soluble salts and exchangeable-sodium-percentage due to leaching, with and without gypsum, were compared. In view of the similarity of results obtained from undisturbed cores in the laboratory and field plots, it appears that soil cores, properly encased, can be used to predict with reasonable accuracy the reclaimability of saline and alkali soils (From auth. summ.).

ANTIPOV-KARATAEV, A. and KERZUM, P.A. / The system of reclamation methods for exploiting saline and swamped soils and against secondary salinization of irrigated soils in Tadzhikistan.
Salinity problems in the Arid Zones, Proc. Teheran Symp. 1961: 281-284. Arid Zone Research 14, Unesco.

Reclamation methods were developed in order to exploit saline and swamped lands. The Vakhsh Valley irrigation project is taken as an example of these methods. They include: drainage by a network of collectors, deep ploughing, and removal of salts by leaching. Continued desalinization after leaching is secured by a complex of agronomical methods.

ARISTOV, S.G. / Leaching soils salinized with sodium sulphate.
Sov. Soil Sci. (1962): 699-702 (E).

Soils of the sodium sulphate type of salinity are widespread in Azerbaydzhan. Such soils are usually leached in winter because of the more ample water supply. This frequently proves inadequate, which is ascribed to the low

solubility of sodium sulphate during the cold period. Summer leachings under rice could be more profitable. (From Sov. Soil Sci.).

BIGGAR, J.W. and NIELSEN, D.R. / Miscible displacement, 2, Behaviour of tracers.
Soil Sci. Soc. Am. proc., 26 (1962): 125-128.

Tritium and chloride ion were used as tracers for water flowing under stationary conditions in laboratory soil columns. The distribution of the tracers measured in the effluent is explained on the basis of the relative effects of pore geometry, diffusion rates, adsorption and exchange (Auth. summ.).

BIGGAR, J.W.; NIELSEN, D.R. and TANJI, K.K. / Comparison of computed and experimentally measured ion concentrations in soil column effluents.
Trans. of the ASAE Vol. 9 (1966) no. 6 (Gen. Ed.): 784-787

An attempt is made to predict effluent concentration in leaching studies in which Mg-Ca exchange reactions are involved. A discontinuous flow model computer program was found to be useful to predict the nature of the column effluent. To predict the cation and anion distributions more accurately the concept of hold back was introduced. A reasonable estimate of the hold back should be made. Moreover an exchange parameter as a function of the concentrations was included in the computations (From auth. summ.).

BOUMANS, J.H. and MOLEN, W.H. van der / Drainage requirements of irrigated soils in relation to their salinity.
Landbk. Tijdschrift 76 (1964) 880-887 (D.e).

The method of calculating salt balances for irrigated soils is discussed briefly. For cases in which the irrigation waters have a noticeable salt content, a correction is proposed. Moreover, a method is given for dealing with cases in which certain salts (mainly gypsum) are precipitated in the soil. From such balances the drainage requirements of irrigated soils can be derived. An important factor determining these requirements is seepage, which is a wide spread phenomenon in irrigated areas (From auth. summ.).

BOUWER, H. / Developing design requirements for parallel drains.
Proc. Drainage for efficient crop production conference, 1965: 62-65.

BOWER, C.A. / Salinity control in irrigation agriculture.
Report on the Seminar on waterlogging in relation to irrigation and salinity problems. Lahore, Pakistan, 1964: 140-148. Rep. Exp. Progr. of Tech. Assist. FAO

no. 1932.

An outline is given on some of the principles, requirements and practices that are essential to control salinity in irrigation agriculture.

BROOKS, D.R. / Leaching agricultural soils.
Trans. of the ASAE 9 (1966), Gen. Ed. no. 6: 826-827, 833.

A leaching experiment in the Tulare Lake basin in southern San Joaquin Valley, California is described.

BRYSSINE, G.; GUILLARDO, J. et GROENEMAN, A. / La dynamique du lessivage des sels d'un sol brun-rouge steppique.
Al Awamia 14 (1965): 47-71 (F, e, a, sp).

The soil studied is characterized by a high amount of soluble salts in alkaline horizons at some depth below soil surface. The removal of Cl and Na by leaching follows an exponential curve, whereas the removal of SO_4, HCO_3, Ca and Mg gives straight lines. Leaching of the salts does not cause a dispersion of the colloids in the alkaline horizons.

DHANAK, G.G. and SHALIGRAM, V.K. / Reclamation of saline lands, special problems of low areas along the sea coast.
6th Congr. Int. Comm. Irr. Drain., New Delhi, 1966, Q 19, R 16.

Some reclamation measures of saline coastal lands of the Gujarat State (India), have been described.

DOERING, E.J. and REEVE, R.C. / Engineering aspects of the reclamation of sodic soils with high-sakt waters.
Journ. of the Irr. and Drain. Div.; Proc. Am. Soc. Civil Eng. 1965: 59-72.

A soil column experiment was designed to provide information concerning the engineering aspects of the reclamation of sodic soil that is needed to evaluate the high salt-water dilution method for field use. (From auth. introduction).

EL ABEDINE, A.Z.; ABDEL BARR, A. and EL AKYABI, A.M. Effect of reclamation system and cultivation on the distribution of salinity and alkalinity in soil profiles in an area in the northern part of the Nile Delta.
J. Soil Sci. Un. Arab. Rep. 5 (1965) : 89-109.

Cultivation, following reclamation by drainage and irrigation reduced salt content of the surface soil. Salinity of the groundwater was reduced.

FLANNERY, R.D. / Field reclamation testing procedures and results in the Middle East.

Trans. 7th Int. Congr. Soil Sci, 1 (1960): 553-559.

Field reclamation tests simulating field reclamation practice, on circular plots of 10 m diameter, provided opportunities to determine how much leaching water was required. The tests demonstrated that soil amendments were not needed where certain amounts of soluble calcium and magnesium salts existed. The excessive accumulations of salts in the upper meter could be reduced to a safe level with about one meter of leaching water. The amount of leaching water required to remove the excessive alkalinity was a variable quantity and dependent upon the availability of the soluble salts of calcium and magnesium. It was less than one meter at two tests and almost three meter at a third test.

GARLAND, K.R. and JONES, G.O. / Reclamation of saline soils at Kerang, Victoria, by ponding and pumping from an aquifer.
Aust. J.Exp. Agr. Animal Husbandry 3 (1963) 10 : 177-179.

Unproductive saline soils cover 12,000-24,000 ha of the Torrumbarry irrigation area in North-Western Victoria, Australia. Trials were conducted in which one tests area was flooded while at the same time water was pumped from an aquifer; the other test area was flooded only. In both instances it was found that the salt content of the soil was rapidly reduced and was maintained at a tolerable level for at least 14 months, and that the pH rose after reclamation. Application of gypsum did not increase the efficiency of the treatment. The trials did not indicate whether pumping is justified or not (Trop. Abstr. 1963 : K 2781).

GIBBS, H.J. / Research on electroreclamation of saline-alkali soils.
Transactions of the A.S.A.E. 9 (1966) 2 Spec.Ed.: 164-169.

It was found that electricity encouraged movements and promoted desirable reactions, viz. an increased amount of Ca cations were released from precipitated carbonates. However, leaching and drainage are considered major factors in carrying the undesirable materials away.

GRANDE COVIAN, R. and BELLAS RIVERA, R. / The evolution of marshland vegetation in consequence of decreased salinity.
4th Congr. Int. Comm. Irr. Drain., Madrid, 1960, 211, R 38 : 741-754.

Saline marshlands in the Guadalquivir delta which were provided with a artificial drainage system, have been desalinized by the action of natural precipitation alone. After one year the natural halophytic vegetation started to disappear and cultivated plants and non-halophytic wild grasses and herbs envaded the area.

GRANDE COVIAN, R. / Reclaiming the Guadalquivir marshes.
Fatis Review 12 (1965) 3 : 73-76 .

The marshes of the Guadalquivir are leached by excess winter rain which subsequently is drained. Field drains have a spacing of 16 meter and are 0,7-0,9 meter deep. Within a 3-years period the salinity was strongly decreased down to a depth of 2 meter.

HALKIAS, N.A. / Experimental work on the reclamation of saline and alkali soils in the Thessaloniki plain, Greece.
Greek Nat. Committee on Irrigation and Drainage, Athens, 1965.

The area of salt affected soils in the Thessaloniki plain amounts to about 60,000 acres. Field experiments were conducted to delineate proper reclamation measures.

HART, M.G.R.; CARPENTIER, A.J. and JEFFERY, J.W.O. / Problems in reclaiming saline mangrove soils in Sierra Leone.
Agron. Trop. 18 (1963)8 : 800-2.

Mangrove soils become very acid when subjected to heavy drainage. The acid formation is the result of oxidation of elemental sulphur by the bacterium Thiobacillus thio-oxidans. Most of the oxidizable sulphur is present in the form of pyrites; it was observed that the rate of oxidation depends on the size of the particles Field trials conducted in Sierra Leone have shown that the following reclamation scheme may be recommended: (1) impoldering, (2) drying as thoroughly as possible, (3) reintroducing tidal wash, (4) permanent impoldering, (5) liming and (6) leaching with rain water until the salt content is sufficiently low (Trop. Abstr. 1964: m 265).

HULSBOS, W.C. and BOUMANS, J.H. / Leaching of saline soils in Iraq.
Neth. J. Agr. Sci. 8 (1960) 1: 1-10.

A large proportion of the soils of the Lower Mesopotamian Plain contains excessive amounts of salts. Data are presented on salinity in a few project areas, on salt movement in the top-soil and on the overall discharge of salt from the area. A leaching curve has been constructed on the basis of certain field experiments and its use is discussed. It is pointed out that to obtain a general leaching plan for the reclamation of a given area the information on the amount of water required for leaching has to be considered and used in conjunction with agricultural information on the salt-tolerance of field crops and need for fertilizers (Trop. Abstr. 1960: h 1754).

JANITZKY, P. and WHITTIG, L.D / Natural leaching processes in some salt-affected soils of California

Proc. Symp. on Sodic Soils, Budapest 1964. Agrokémia és Talajtan 14 (1965) supplementum: 251-260 (E).

The effects of natural leaching of saline-sodic soils containing precipitated carbonates in two sequences were studied. Soluble and exchangeable sodium are removed early in the leaching cycle. Data indicated that Mg and Ca cations enter the soil solution by solubilization of precipitated carbonates. No Na_2CO_3 is accumulated in the soil because CO_3 anions are removed at a faster rate than SO_4 and Cl anions. The hydrolysis of Na-clay appeared to be of small significance and leaching did not result into a high alkalinity.

JONES, L.D. / Measuring the effects of irrigation and drainage on salt content.

6th Congr. Int. Comm. Irr. Drain., New Delhi, 1966, Q 19, R 13: 159-169.

The paper reports the following new ideas and techniques: (1) the influence of method of irrigation on leaching and reclamation (2) the field use of soil resistivity and the 4-electrode probe technique for measuring changes in soil salinity (3) the use of a salt balance to measure leaching and reclamation rates (From auth. summ.).

KELLER, J. and ALFARO, J.F. / Effect of water application rate on leaching.

Soil Sci. 102 (1966) 2: 107-114.

The effect of water application rate on leaching efficiency has been studied using a single soil and salt and several salt and initial soil moisture levels. The shapes of the effluent conc. curves suggest that leaching efficiency is improved by decreasing application rate (From auth. summ.).

KIZILOVA, A.A. / The movement of Na and SO_4 ions during winter leachings.

Sov. Soil Sci. (1959): 597-605 (E).

The purpose of this experiment was to investigate the laws governing the solution and movement of Na and SO_4 ions during winter leachings of sodium sulphate solonchaks. Field experiments in the Bukhara Oasis showed that during winter leachings (under drainage conditions) a very intensive migration of Na and SO_4 ions takes place from the upper to lower soil layers. The investigations confirm the effectiveness and soundness of winter leaching of solonchak soils, including solonchaks of the sulfate magnesium-sodium type (From Sov. Soil Sci.).

KOVDA, V.A.: EGOROV, V.V.(Ed.) / The application of drainage in the reclamation of salinized soils.
The Academy of Sciences of the U.S.S.R., Moscow, 1958. Pp. 228. Translated from Russian. Publ. for the National Foundation, Washington, D.C., and the Department of Agriculture, U.S.A., by the Israel Program for Scientific Translations, 1960. P.S.T. Cat. no. 102.

The papers in this collection deal with the problems of applying drainage as a measure against the salinization of irrigated soils. Most of the papers published were delivered as reports at working conferences on the application of drainage for the purpose of soil melioration organized by the Soil Institute im. V.V. Dokuchaev of the U.S.S.R. Academy of Sciences.

LEVEN, J.A. VAN 'T / Waterlogging and water balance.
Report on the seminar on waterlogging in relation to irrigation and salinity problems. Lahore, Pakistan. 1964 : 166-173 Rep. Exp. Progr. of Tech. Assist. FAO no. 1932.

In arid and semi-arid areas often a close relation exists between salinity and waterlogging. To study problems of waterlogging and salinity the water and salt balance methods are very useful. This paper gives an outline of the water balance method.

MILLER, R.J.; BIGGAR, J.W. and NIELSEN, D.R. / Chloride displacement in Panoche clay loam in relation to water movement and distribution.
Water Resources Research 1 (1965) 1 : 63-73.

The way in which chloride, applied to the soil surface as KCl, moves through a Panoche clay loam was investigated under field conditions. The experiment revealed that chloride movement results from a dynamic process that may be altered or controlled with the method of water application. (From auth. abstr.).

MINASHINA, N.G. / Salinization and required melioration of ancient irrigated soils in the Kara-Kum canal zone.
Soviet Soil Sci. (1964) 2 : 111-120.

In the area studied about 75% of the soils are more or less salt-affected. To reclaim these soils a drainage system should be constructed as soon as possible.

MOLEN, W.H. VAN DER and BOUMANS, J.H. / Drainage requirements of irrigated soils in relation to salinity.
Trans. 8th Int. Congr. Soil Sci. 1964, (2) : 847-854.

The method of calculating salt balances for irrigated soils is briefly discussed. From such balances the drainage requirements of irrigated soils can be derived.

An important factor determining these requirements is seepage, which is a widespread phenomenon in irrigated areas. (Auth. summ.).

NIELSEN, D.R. and BIGGAR, J.W. / Miscible displacement in soils: 1 Experimental information.
Soil Sci. Soc. Amer. Proc. 25 (1961): 1-5.

Miscible displacement in several porous materials under saturated and unsaturated conditions resulted in the appearance of tracers at the end of the soil column well in advance of that expected had no mixing occurred at the boundary of the tracers and tracers free water. The shapes of the tracers concentration curves for the various media were dependent upon microscopic flow, velocity distribution and tracers diffusion (Auth. summ.).

NIELSEN, D.R.; BIGGAR, J.W. and LUTHIN, J.N. / Desalinization of soils under controlled unsaturated flow conditions.
6th Congr. Int. Comm. Irr. Drain., New Delhi, 1966, Q 19, R 2.

It is shown in laboratory studies and field experiments that the efficiency of leaching of salts depends upon the water saturation and rate of water movement through the soil profile. In areas where drainage conditions are restricted or where water supply is limited, leaching slowly under unsaturated conditions is more efficient than under saturated conditions.

OZTAN, B.; DINGER, D. / Rice growing for reclamation of salt- and sodium affected soils in the Çukurova plain.
Salinity problems in the arid zones, Proc. Teheran Symp., 1961 : 291-294. Arid Zone Research 14, Unesco.

A discussion of experiments carried out in southern Turkey for the reclamation of highly saline soils. The treatments consisted of continuous leaching with and without gypsum and leaching by rice cultivation. Continuous leaching (without gypsum) greatly decreased the salt concentration salt content all over the root layer (Trop. Abstr. 1961 : i 2138).

PANIN, P.S. / Salt discharge from soils and determination of leaching norms.
Soviet Soil Sci. (1962) 7 : 703-709.

Leaching norms could be determined, using the method of leaching soil monoliths.

PANIN, P.S. / Salt release by chloride-salinized soils with leaching.
Soviet Soil Sci. (1963)11 : 1083-1089.

Leaching studies revealed that simultaneous with soluble salt removal cation

exchange reactions take place.

PENMAN, F. / Slow reclamation by tile drainage of sodic soils containing boron.
6th Congr. Int. Comm. Irr. Drain. New Delhi, 1966, Q 19, R 10.

It has been found that the chlorine content of the soil rapidly decreases by the construction of a tile drainage system and a 20-30% deep percolation of the applied quantity of irrigation water. Boron toxicity symptoms, however, may persist for some years. Care should be taken in re-using drainage water, blended with fresh river water, on boron-sensitive crops.

PILLSBURY, A. F. / Water table control in arid and semi-arid regions.
4th Congr. Int. Comm. Irr. Drain., Madrid (1960), Q 11, R 5 : 65-84.

Prime objective of water table control in arid and semi-arid regions is to provide a soil environment for plant roots reasonable low in salts. Control requires proper irrigation management and properly designed and installed drainage facilities. Useful techniques and practices are discussed (From auth. abstr.).

PILLSBURY, A. F.; JOHNSTON, W. R.; ITTIHADIEK, F. and DAUM, R. M. / Salinity of tile drainage effluent.
Water Resources Research 1 (1965) 4 : 531-535.

A four-year study of drainage effluent obtained from 15 tile drainage systems located in the arid San Joaquin Valley of California showed that the concentration of salts and the various ions discharged in the tile effluent decreased, logarithmically, from the time that the tile systems were installed. The relationships presented could change with more intensive drainage and more liberal use of irrigation water, providing a more rapid trend toward equilibrium (From auth. summ.).

REEVE, R. C.; BOWER, C. A. / Use of high-salt waters as a flocculant and source of divalent cations for reclaiming sodic soils.
Soil Sci. 90 (1960)2 : 139-144.

Use is made of the flocculating effect that high electrolyte concentration has on soil permeability, and of the valence-dilution effect of the exchange of divalent cations from the water for absorbed sodium in the soil. Experimental data are presented for the reclamation of a sodic soil in laboratory columns. Four treatments, consisting of successive dilutions of Salton Sea water with Colorado River water, were used. In all cases for all treatments, the exchangeable sodium percentage was reduced from an initial value of 39 to a final value of 5. Where 3 successive dilution steps were used followed with

river water as the final equilibrating water, complete equilibration of the soil column was accomplished in 12 days; in comparison 120 days were required for the column leached with river water only. Where 3 successive dilution steps were used, followed by river water complete equilibration of the soil column was accomplished with 0.4 ft of sea water combined with 6 ft of river water (From auth. summ.).

REEVE, R.C. and DOERING, E.J. / The high salt-water dilution method for reclaiming sodic soils.
Soil Sci. Soc. Amer. Proc. 30 (1966) : 498-504. 13 refs.

Sodic soils can be reclaimed by leaching with successive dilutions of a divalent cation-containing high salt water. Equations are given for determining the suitability of waters and for calculating the depth of water required for reclamation in terms of measurable properties of the soil and chemical characteristics of the water (Auth. summ.).

REEVE, R.C. and DOERING, R.J. / Field comparisons of the high salt water dilution method and conventional methods for reclaiming sodic soils.
6th Congr. Int. Comm. Irr. Drain. New Delhi, 1966, Q 19, R 1.

The high salt-water dilution method proved to be very successful in the reclamation of a sodic soil. The high salt-water dilution method was effective in maintaining a high permeability. The feasibility of the method, depends on the ratio of divalent calcium content over the total cation content of the water. This ratio should be equal to or more than 0,3.

ROBINSON, C.W.; KEMPER, W.D. et al / Requirements for achieving and maintaining uniformly low salt in a saline soil.
Soil Sci. Soc. Amer. Proc. 29 (1965) 5 : 597-601.

The amount of irrigation necessary to limit salinity in the plant root zone was computed from consumptive use, rainfall and salinity of the irrigation water assuming completely homogeneous plots. Heterogenity of infiltration rates within plots required that the amount of water applied be 10 to 20% higher than in the theoretical homogeneous case in order to maintain adequate salt removal (From auth. abstr.).

RUSSEL, J.S.; BROOKER, M.I.H. / Preliminary experiments on the reclamation of a saline-sodic soil in the Jervois area.
Exp. Rec. Dep. Agric. S. Austr. 1 (1963) : 5-20.

An experiment started in 1958 on the reclamation of a very saline alkali soil in the lower reaches of the Murray river. Up to 20 tons/acre of gypsum were applied and various drainage patterns were tried.

SA'ADAT ALI, M. / Lowering the water table for combating waterlogging and salinity.
Report on the Seminar on Waterlogging in relation to irrigation and salinity problems. Lahore, Pakistan, 1964 : 97-98; Rep. Exp. Progr. of Techn. Assist. FAO no. 1932.

SADLER LLOYD, D.M.; TAYLOR, S.A. et al / Miscible displacement of soluble salts in reclaiming a salted soil.
Soil Sci. 100 (1965) : 348-355.

Fresh water was supplied to the surface of a salted soil and the effluent from the tile drain was collected. The change in concentration of several ionic species was measured and plotted. If proper account is taken of the two-dimensional nature of the field-leaching studies, miscible displacement theory gives a qualitative explanation of several observed results. It is apparent that both hydrodynamic dispersion and ionic diffusion actively contribute salt to the effluent. The salt in the soil immediately over the line of the drain is removed largely by velocity flow and dispersion. Diffusion was of increasing importance in removing salt from soil more distant from the drains (From auth. summ.).

SANDOVAL, F.M. et al / Effects of run-off prevention and leaching water on a saline soil.
Canad. J. of Soil Sci. 41 (1961) : 207-217.

A 4-year study was conducted on the effects of precipitation management on salt movement and springwheat yields on an imperfectly drained saline silt loam. Partial leaching by artificially applied water at the beginning of the experiment was compared to leaching benefits by impounded precipitation. Impounded precipitation was found effective in partially desalinizing the soil (From auth. abstr.).

SCHAIK, J.C. VAN and MILNE, R.A. / Reclamation of a saline sodic soil with shallow tile drainage
Canad. J. of Soil Sci. 42 (1962) 43-48.

Leaching studies showed that shallow glacial soils that have become saline-sodic can be reclaimed with tile drains installed at a depth of 30 inches (75 cm) with a 30-feet (9 meter) spacing. The glacial soil at the experimental site occurres at a depth of 2 to 3 feet (60-90 cm) below the surface and was slowly permeable. Only after the application of 71 inches (178 cm) of water was the saline sodic soil sufficiently reclaimed to allow normal plant growth (From auth. abstr.).

Soil salinity and irrigation in the Soviet Union; report of a technical study group. Agr. Res. Serv. U.S.D.A., Washington, 1962. Pp. 41.

A chapter on field observations and practices (p. 4-22) gives information on leaching and drainage methods for reclaiming saline soils.

TALSMA, T. / The control of saline groundwater.
Veenman, Wageningen, 1963. Thesis Agric. Univ. Wageningen.

Contents: Drainage requirements to control the salinity factor. The Murrumbridge irrigations areas (Australia). Assessment of the salinity hazard.

TALSMA, T. / The effect of soil physical conditions on reclamation of saline land.
6th Congr. Int. Comm. Irr. Drain., New Delhi, 1966, Q 19, R 7.

The steady state diffusion mechanism, describing evaporation from the water table as dependent on the meteorological conditions, soil properties and water-table depth, was found to be suitable in understanding and predicting chloride salinization from saline groundwater. The main soil property, involved in the steady state transfer of moisture and salt to the soil surface is the capillary conductivity-moisture suction relationship. Two of such relationships, for a loam and a clay soil respectively, are shown. For prevention of serious salinization or re-salinization after reclamation, it is argued that the water table should be at or below that depth where evaporation is reduced to about 1 mm/day (From auth. summ.).

USSERY, L.R. / Salinity control through tile drains in Hildago clay loam.
J. Rio Grande Valley Hort. Soc. 14 (1960) : 200-204.

A leaching test is described. The drainage system (6-inch concrete tile; 6.5-7.5 ft below the surface; 200 ft apart) removed in the first year 29.5 ton salts per acre from the top 6 feet. Soil salinity was reduced in the top 3 feet to a level permitting the growth of crops of low salt tolerance. A fluctuating, highly saline water table, previously high enough to restrict plant root development, was lowered to permit leaching of salts from the soil profile by irrigation and high intensity rainfall (From auth. summ.)

VOLOBUYEV, V.R. / General pattern of changes in the salt content of irrigated and meliorated soils.
Soviet Soil Sci. (1964) 5 : 483-489.

Due to irrigation and melioration practices soil salinity decreases. The decrease in soil salinity could be described by an exponential relationship:
$S_1 = S_H e^{\pm \beta t}$ in which
S_1 = final salt content

S_H = initial salt content

t = time passed to reduce salt content

β = a constant for certain conditions of leaching

Salt removal is characterized by a negative value for β, salinization by a positive value for β.

WILCOX, L.V. and RESH, W.F. / Salt balance and leaching requirement in irrigated lands.

U.S.D.A. Agric. Res. Serv. Techn. Bull. no. 1290 (1963) pp. 23.

Salt balance and leaching requirement were studied in the Rio Grande project in New Mexico and Texas. The finding supports the conclusions that:

1. Salt balance is a reliable and useful indicator of year-to-year trends in salinity conditions on irrigation projects. Salt balance data can be interpreted in terms of the average increment of salt added to the soil extracts.
2. Leaching requirement is a reliable criterion for anticipating the leaching that would be necessary in order to prevent the salinity in the soil from exceeding a specified level (From auth. summ.).

WILSON, L.G.; LUTHIN, J.N.; BIGGAR, J.V. / Drainage-salinity investigations of the Tulelake lease lands.

Calif. Agric. Exp. Sta. Bull. no. 779 (1961). pp. 56.

APPLICATION OF CHEMICAL AND ORGANIC AMENDMENTS

ABRAHAM, L. / The application of small amounts of ameliorating materials to alkali soils.
Proc. Symp. on Sodic Soils, Budapest 1964. Agrokémia és Talajtan 14 (1965) *supplementum*: 329-332. (R, e)

An application of 700-2000 kg/ha of lime sludge from sugar factories or gypsum resulted into an effective reclamation of solonetzlike meadow soils.

ABRAHAM, L. and SZABOLCS, I. / Improving of alkali soils with small doses of reclamation materials.
Trans. 8th Int. Congr. Soil Sci. 1964 (2) : 875-880.

Several reclamation trials were done on solonetz soils using only 10-15% of the conventional doses of reclamation materials.

The reclamation material was sometimes applied in granulated form together with the seed, in other cases it was incorporated in rows or spread on the surface of the soil. It was found that low doses of amendments were as or even more effective than high ones (From auth. summ.).

BOWER, C.A. and GOERTZEN, J.O. / Replacement of adsorbed sodium in soils by hydrolysis of calcium carbonate.
Soil Sci. Soc. of Amer. Proc. 22 (1958) 1 : 33-35.

The replacement of adsorbed Na in calcareous soils subjected to leaching by rainfall has been studied.

CARTER, D.L.; FLAMING, C.D. / Combining surface mulches and periodic water applications for reclaming saline soils.
Soil Sci. Soc. Amer. Proc. 28 (1964) 4 : 564-567.

Water applied by periodic sprinkling of surface-mulched soil resulted in greater salt removal and higher leaching efficiency than did either flooding or periodic sprinkling of bare soil. Flooding and sprinkling bare soil decreased salt concentration in the surface 2 feet of the soil profile, but salt accumulated below a depth of 3 feet when compared with check soil that received only rainfall. Similarly, salts were removed from all depths to 5 feet where surface mulches were present. The higher leaching efficiency for mulched soil was attributed to the probably reduced evaporation under mulches that reduced upward movement of water (From auth. abstr.).

DAVIDSON, J. L.; QUIRK, J. P. / The influence of dissolved gypsum on pasture establishment on irrigated sodic clays.
Austr. J. Agr. Res. 12 (1961) : 100-110.

On heavy grey and brown soils of the Riverine plain, a series of experiments has indicated that satisfactory pasture establishment can be achieved by the application of gypsum. The most efficient method of applying gypsum was to dissolve it in the first irrigation water. The treatment with gypsum leads to a more friable soil surface, increases the rate of water entry, and results in increased yields per plant (From auth. summ.).

EL-GIBALY, H. / Gypsum fineness in relation to reclamation of alkali soil.
Trans. 7th. Int. Congr. Soil Sci. 1 (1960) : 528-534.

Finer gypsum particles are more efficient in reclaiming alkali soils than coarse particles. A logarithmic relationship between concentration of replaced sodium in the leachate and the volume of leachate is found. The logarithmic equation is helpful on predicting the degree of improvement of reclamation of alkali soil with a certain type of gypsum. A chemical method for calibrating the efficiency of gypsum samples of different fineness and quality is proposed (From auth. summ.).

EL SHABASY, A. S. et al / Gypsum requirement estimation and its agreement with the actual gypsum needs of soils in the UAR.
J. Soils Sci. Un. Arab. Rep. 2 (1962) : 271-303.

The three methods compared were: (1) Schoonover's technique using Ca determination with EDTA titration. (2) Calculating the amount of $CaSO_4$ needed for neutralizing soluble carbonates + bicarbonates in the soil solution. (3) Calculating the amount of $CaSO_4$ needed to reduce exch. Na to 15% of the cation-exch. cap., and deducting from the result the amount of soluble Ca in the soil solution. None of the methods proved reliable in estimating $CaSO_4$ requirements for reclamation of alkali soils (From auth. summ.).

ESCOLAR, R. P. / Reclamation of a saline-sodic soil by use of molasses and distillery slops.
J. Agric. Univ. Puerto Rico 50 (1966) 3 209-217 6 refs.

Laboratory studies revealed that blackstrap molasses and rum distillery slops could be used successfully for the reclamation of highly saline-alkaline heavy clay soils of Southwestern Puerto-Rico. It is suggested that organic acids are being produced upon decomposition of the slops and molasses. The divalent cation content of the soil solution increases when the organic acids react with the soil $CaCO_3$ and $MgCO_3$.

FANNING, C.D. and CARTER, D.L. / The effectiveness of a cotton bur mulch and a ridge-furrow system in reclaiming saline soils by rainfall.
Soil Sci. Soc. Amer. Proc. 27 (1963) 6 : 703-706.

A cotton bur mulch facilitated leaching of soluble salts by rainfall. Salt concentration was reduced in the surface 30 inches of soil to a level below that considered detrimental to growth of field crops. The high efficiency of salt removal by rainfall was attributed to flushing of salts from conducting pores when rains occurred combined with diffusion of salts from non-conducting to conducting pores between rains. Exchangeable Na percentage was also reduced to a low level. A ridge-furrow system facilitated leaching of salts below the furrows, but less effectively than the mulch system. Salts returned to the leached zones beneath the furrows, whereas no appreciable return was evident under the mulch (Auth. abstr.).

GODUNOV, S.B. / Increasing the productivity of meadow sodium sulfate carbonate-solonetzes.
Soviet Soil Sci. (1965) 3 : 285-286.

To improve crop production on meadow sodium sulfate carbonate solonetzes, having ground water at a depth of 1 meter, salt-tolerant and solonetz-resistant grasses and forage crops are cultivated. Without the construction of a drainage system the application of chemical amendments proved to be of no use.

HART, M.G.R. et al / Problems of reclaiming saline mangrove soils of Sierra Leone.
Afr. Soils 10 (1965) 71-82 (E, F).

Large tracks of mangrove soils are at present uncultivable owing to their high salinity and acidity. The reclamation of saline coastal areas in Sierra Leone is very difficult because of the formation of catclays immediately after the construction of a drainage system. Locally no source of liming material to neutralize the acid soils is present.

HERKE, A. and HARMATI, S. / Amelioration and utilization of alkali soils of the solontchak and solontchak-solonetz types in the region between the rivers Danube and Tisza.
Proc. Symp. on Sodic Soils, Budapest 1964. Agrokémia és Talajtan 14 (1965) supplementum: 313-322 (E, r)

The results of some field experiments of reclaiming solonchak and solonchak solonetz soils with gypsum and lignite dust have been given. The importance of the use of the proper chemical amendments in combination with irrigation, subsoiling and manuring is stressed in order to obtain an efficient crop production.

LI, P. and CALDWELL, A.C. / The oxidation of sulfur in the soil.
Soil Sci. Soc. Amer. Proc. 30 (1966) 3: 370-372.

Incubation studies were conducted to measure the rate of elemental S oxidation in a Dorset sandy loam soil. The rate of S oxidation was significantly affected by particle size and temperature. Greatest oxidation occured with particle sizes of less than 100 mesh, and at temperatures of 30 °C and 40 °C. The oxidation was accelerated by inoculation with Thiobacillus thiooxidans (From auth. abstr.).

MARGULIS, V. Yu. / Calculation of gypsum rates in meliorating solonetzes.
Soviet Soil Sci. (1965) 2: 190-192.

Based on a maximal allowable percentage of exchangeable sodium of 10, a nomogram to calculate gypsum applications is given.

PADHI, U.C.; ODELL, R.T. and FEHRENBACHER, J.B. / Effect of gypsum and starch on water movement and sodium removal from solonetzic soils in Illinois.
Soil Sci. Soc. Amer. Proc. 29 (1965). 2:227-229.

Results indicate that soil disturbance plus appropriate treatment especially with gypsum, increased percolation of water and sodium removal from solonetzic soils. Starch was not effective.

PRETTENHOFFER, S. / Amelioration of sodic solonetz soils in the region east of the river Tisza.
Proc. Symp. on Sodic Soils, Budapest 1964. Agrokémia es Talajtan 14 (1965) supplementum: 323-328 (E, r).

The paper deals with reclamation experiments carried out on different types of solonetz soils.

SAMBUR, G.N. / Mobility of exchangeable sodium and the establishment of rates for gypsum in melioration of solonetzes.
Soviet Soil Sci. (1963) 11: 1040-1049.

In laboratory research it was found that the fraction of exchangeable sodium adsorbed on soil particles smaller than 0,25 micron in diameter was highly toxic for plant growth, highly mobile and easily replaceable by calcium. The exchangeable sodium adsorbed by particles of 0,25-2 micron had only a limited toxicity for plant growth, was not very mobile and was not easily replaceable by calcium. On the basis of theoretical considerations as to the difference in mobility and possible effect on plant growth together with the results of a large number of field experiments, recommendations on standard rates of gypsum application were drawn up for the different regions of the Ukraine.

SZABOLCS, S. and DARAB, K. / Examination of the improving effect of $CaCO_3$ on alkali ("szik") soils by radioactive indication.
Acta Agronomica 13 (1964) 93-100 (R, e, g).

It was found, by applying Ca^{45} labelled $CaCO_3$ that liming sodic ("szik") soils generally resulted only in a very slow improvement.

UPPAL, H. L. and SINGH, M. / Use of kankar lime in reclamation of alkaline soils and soils irrigated by slightly saline waters.
6th Congr. Int. Comm. Irr. Drain., New Delhi, 1966 Q 19, R 19.

In the province of the Punjab no lime or powdered gypsum for reclamation of alkaline soils is present. However at shallow depth below soil surface kankar, an unpure form of argillaceous limestone, can be found. A description is given how kankar can be calcined and powdered by the local farmers.

VASIL'CHIKOVA, S.J. / A comparison of the meliorative effects of chemical agents on sodium carbonate solonetzes.
Soviet Soil Sci. (1965) 6: 650-653.

The ameliorating effect of different chemical amendments was compared. The chemical amendments tested were gypsum, calcium chloride and ferrous sulfate.

VERHOEVEN, B. / Leaching of sodic soils as influenced by application of gypsum.
Proc. Symp. on Sodic Soils, Budapest, 1964. Agrokémia és Talajtan 14 (1965) supplementum: 263-268 (E, r).

The improvement of structure of sea-inundated soils of low lying areas in the Netherlands, is brought about by large dressings of gypsum. About twenty years ago it was recommended to apply gypsum only after the bulk of the salt had been leached. However, experimental fields showed that a decline of structure was prevented easier by application of gypsum on fully salinized soils than on partly leached soils. Moreover leaching efficiency of the precipitation proved to be larger on the early treated plots than on plots which got a late dressing of gypsum (From auth. summ.).

TILLAGE

ANTIPOV-KARATAYEV, J.N. and PAK, K.P. / Melioration of solonetzes under irrigated and dry-land conditions.
Soviet Soil Sci. (1965) 10: 1127-1131.

Neutral solonetzes of the Chestnut and brown semi-desert zones are reclaimed by the agrobiological method. This method includes the utilization of the lime and gypsum of the soil itself by deep ploughing. A light application of irrigation water (4000-4500 m^3/ha) increased the rate of improvement. More water could be stored in the soil by means of shelterbelts and windbreaks of tall-stubble crops.

CAIRNS, R.R. / Some chemical characteristics of a solonetzic soil sequence at Vegreville, Alberta, with regard to possible amelioration.
Canad. J. of Soil Sci. 41 (1961): 24-34.

A study of the chemical chracteristics of a Solonetzic soil sequence at Vegreville, Alberta, reveals that the deep ploughing method of amelioration holds more promise than methods based on the application of commonly suggested amendments, e.g. gypsum and sulphur (Auth. abstr.).

CAIRNS, R.R. / Some effects of deep working on solonetz soil.
Canad. J. of Soil Sci. 42 (1962) : 273-275.

A 6-year study was conducted to determine the effect of working to a depth of 24 inches (60 cm) on the productivity and chemical and physical condition of a solonetz soil. Productivity was generally increased during the second rotation by deep working (From auth. summ.).

COBOS, L.P. de los / Sanding in saline soils; Dalias project, Almeria, Spain.
4th Congr. Int. Comm. Irr. Drain., Madrid, 1960. Q 13, R 5 : 57-64.

The author describes experiments carried out on saline soils covered with a 10 cm layer of washed beach sand. This practice makes possible the growth of plants with a low tolerance to salinity, such as beans.

DAVIS, S. and PUGH, W.J. / Inexpensive land preparation for leaching.
J. Soil and Water Conservation 18 (1963) 6 : 246-247.

The paper describes an inexpensive method of preparing sloping lands for leaching operations.

FILIPPOVA, V.N. / Reclamation and increase in the fertility of solonetz soils.
Soviet Soil Sci. (1963). 10 : 996-998.

Some basic methods applied in the Soviet Union to reclaim solonetz soils under dry farming or irrigated conditions by tillage operations are briefly discussed.

HAMDI, H. et al / The effect of sanding on the leaching and distribution of salts in the soils of Kharga oasis.
Journ. Soil Sci. U.A.R. 3 (1963) 1 : 31-58.

The effects of sanding and leaching on the improvement of saline clay soils of the Kharga Oasis were studied. The quantities of sand applied were 60, 90, 120 and 150 m^3/feddan mixed to a depth of 15 cm (From auth. abstr.).

HAMDI, H. et al / The effect of sand application on the physical properties and plant root development in Kharga Oasis soils.
Journ. Soil Sci. U.A.R. 3 (1963) 1 : 117-142.

The effect of sanding and leaching on the yield of rice was studied.

KURKIN, K.A. / Surface cultivation as a method of conserving soil moisture in the saline meadows of Baraba.
Soviet Soil Sci. (1964) 3 : 287-297.

Moldboard ploughing combined with a complete turn-over of the topsoil increased the storage of moisture in saline meadow soils.

LYLES, L. and ALLEN, R.R. / Landforming for leaching of saline soils in a non irrigated area.
J. of Soil and Water Conservation 21 (1966) 2 : 57-60.

A great portion of non-irrigated land in Texas is salt affected.
The saline areas occur as islands or salt spots randomly distributed among non saline soils. The salt content of the 6-feet profile was effectively reduced by lowering the soil surface of the saline islands. By lowering the soil surface more rainfall water was retained and more runoff collected from surrounding leveled non-saline areas. The surface lowering method is not suited for use in all areas. Its suitability depends on rainfall and groundwater conditions as well as on the complexity of the salt spot pattern.

PRETTENHOFFER, I. / Die Weiterentwicklung der Melioration der Karbonatfreien Alkaliböden (Wiesen-Solonetz-böden) durch Untergrundlockerung. (Subsoiling as an additional development in the amelioration of non-carbonatic alkali solonetz soils).

Agrokém. io es Talajtan 13 (1964) suppl. : 227-235. (G, e, f, r.)

Experiments conducted for 4 years have shown that the effect of subsoiling is larger and lasts longer on noncarbonatic slightly basic alkali soils than on variants with fairly neutral reaction. On the former ones subsoiling is equivalent to chemical amelioration and ought to be applied parallel to the latter. At author's suggestion a subsoil cultivator with three blades able to cope with the hard resistance of alkali soils was constructed.

PRETTENHOFER, S. / New results on the reclamation of noncalcareous alkali soils (meadow solonetz soils) through deep subsoil loosening.
Trans. 8th Int. Congr. Soil Sci. 1964 (2) : 881-889 (G e f)

Several subsoiling experiments were conducted for 4 years. The depth of subsoiling was 30, 40, 50 and 60 cm.

The best results obtained were those with root crops, next came fodder crops and cereals were the last (From auth. summ.).

RODE, A.A. / The most important results of ten years study by the Dzhanybek station, Academy of Sciences, USSR.
Soviet Soil Sci. (1961) 4 : 375-386.

Solonetz soils occur on the flat land between depressions in the north-west Caspian lowland. The solonetz soils are reclaimed by deep ploughing and snow retention. By deep ploughing to a depth of 50 cm subsoil gypsum is brought in the topsoil. Deep ploughing is followed by normal ploughing to a depth of 20-22 cm and harrowing. Reclamation resulted in good crops of wheat and perennial herbage.

INFLUENCE OF CROPS, CROP ROTATION

ASGHAR, A.G. and HAFEEZ, M.A. / Feasibility of cropping patterns for permanent reclamation and soil protection from salinity in the Indus Valley. Research Publ. II (1961) no. 5 of the Directorate of Land Reclamation, West Pakistan.

The feasibility of crop rotations and cropping pattern recommended for salinity control has been examined from the point of view of (1) labour requirements, (2) the farmers balance sheet and financial resources, (3) water allowance.

CHANDRI, S.S., SHAH, B.H. et al / Investigations on the role of Suaeda fructicosa in the reclamation of saline and alkaline soils in W. Pakistan plains.
Plant and Soil 21 (1964) 1 : 1-7.

Investigations on Suaeda fructicosa shows that it can bring about reclamation of saline and alkali soils in certain parts of W. Pakistan plains by collecting non-saline blown soil of sandy loam type and by absorbing large quantities of salts from the top soil. An estimate shows that more than 2400 lbs of salts can be removed from one acre by a single harvest of the aerial parts in the fall each year. The dunes help in reclamation by diluting the salt conc. and decreasing the salt-holding capacity of the topsoil by changing the texture. It is estimated that by this method saline soils can be reclaimed within three years in S. and Central parts of W. Pakistan plains which are frequented by dust storms (From auth. summ.).

CHEN LU-FENG et al / The soda solontchak in the north-east part of China and the experiences in growing rice for the amelioration of soils.
Trans. 8th Int. Congr. Soil Sci. 1964(2): 897-902.

Soda solontchaks are gradually reclaimed by growing rice with proper irrigation and applying farm manure in the growing season (From auth. summ.).

GOERTZEN, J.O., BOWER, C.A. / Carbon dioxide from plant roots as a factor in the replacement of adsorbed sodium in calcareous soils.
Soil Sci. Soc. Am. Proc. 22 (1958) : 36-37.

It was found that the effect of CO_2 on the replacement of adsorbed Na was measurable but small.

GRATZL, D. ; HARMATI, J. and ABRAHAM, L. / Increasing the yields of natural grasses on Hungary's salt affected soils.
Proc. Symp. on Sodic Soils, Budapest, 1964. Agrokémia és Talajtan 14 (1965) supplementum : 385-388 (R, e).

Methods to increase the yield of fodder of natural pastures on salt-affected soils in Hungary have been summarized. The reclamation methods include irrigation, and the application of nitrogen-phosphorus fertilizers.

HUSSAIN, Ch. M. / Irrigation and agricultural practices for salinity control and increased crop production.
Report on the seminar on waterlogging in relation to irrigation and salinity problems, Lahore, Pakistan, 1964 : 99-103. Rep. Exp. Progr. Tech. Ass. FAO no. 1932.

The paper gives a brief account on irrigation and agriculture practices applied in W. Pakistan to overcome salinity and prevention of salinization.

JEN YU-min et al / Studies on the plantation of Sesbania aegyptica and its effect on amelioration of saline soils of the coastal areas of Pan-Chin, Liaoning province.
Acta Pedol. Sinica 13 (1965) 4 : 365-376 (Ch, e).

It has been found that Sesbania aegyptica can be cultivated succesfully on saline and poorly drained soils. Soil physical properties are improved by its deep root system.

MOLINA, J.S. and SAUBERAN, C. / Reclamation of sodic soils by biological methods.
Proc. Symp. on Sodic Soils, Budapest 1964. Agrokémia és Talajtan 14 (1965) supplementum: 411-414 (E, r).

A biological method has been tested to improve sodic soils. In the first stage of improvement broom corn is sawn. Cattle is allowed to consume 60-70% of the crop by intensive grazing. The remainder part is incorporated into the soil leaving a thick stubble mulch. In the second stage of the improvement a mixture of plants, well adapted to alkaline conditions is sawn viz. tall wheat grass, white sweet clover, yellow sweet clover and high fescue.

Mc. NEAL, B.L., PEARSON, G.A. et al / Effect of rice culture on the reclamation of sodic soils.
Agronomy Journal 58 (1966) p. 238-240. 9 refs.

Greenhouse and laboratory studies were undertaken to examine the effect of rice culture on the reclamation of sodic soils. Rice culture hastened the reclamation of coarse-textured sodic soils but did not improve the reclamation

efficiency per unit of water leached through the soil. The beneficial effects on coarse-textured soils were traced to a more rapid removal of entrapped air from the larger conducting pores of the soils during rice culture. After several weeks of rice growth on a medium textured soil, the reclamation efficiency per unit of water leached did begin to increase. However, the simultaneous increase in soil hydraulic conductivity suggested that the effect was caused by an increase in the percentage of the cross-sectional area of the soil that was serviced by conducting pores, rather than by any enhanced solubility of $CaCO_3$ in the presence of CO_2 given off by the rice roots (From auth. summ.).

OZTAN, B. and DINGER, D. / Rice growing for reclamation of salt- and sodium affected soils in the Çukurova plain.
Salinity problems in the Arid Zones;
Proc. Teheran Symp., 1961 : 291-294. Arid Zone Research 14, Unesco.
A discussion of experiments carried out in southern Turkey for the reclamation of highly saline soils. The treatment consisted of continuous leaching with and without gypsum and leaching by rice cultivation. Continuous leaching (without gypsum) greatly decreased the salt concentration at a depth of 60 cm. The use of gypsum and rice greatly reduced the salt content all over the root layer (Trop. Abstr. 1961 : i 2138).

PAK, K. P. et al / Solonetz melioration methods in different zones of the USSR.
Trans. 8th Int. Congr. Soil Sci. 1964 (2) : 891-896.
Various methods for the reclamation of solonetz soils in the different zones of the USSR are discussed. The amelioration includes the application of chemical amendments, tillage practices, water conservation, special crop rotation. Under irrigation lucerne is recommended for solonetz reclamation, under dry farming sorghum and Melilotus Rudbeckia horta are advocated for solonetz reclamation. Under irrigation the reclamation will take 3-4 years, under dry farming 5-7 years.

PEARSON, G. A. and AYRES, A. D. / Rice as a crop for salt-affected soil in process of reclamation.
U.S. Ag. Production Res. Rep. no. 43 (1960) : 1-13.

REPP, G. / The importance of biological factors in the improvement of saline soils.
Salinity problems in the arid zones; Proc. Teheran Symp. 1961 : 295-298. Arid Zone Research 14, Unesco.

The effect of rice culture is described.

SMITH, S. T. / Reclaiming salt land with bluebush.
J. Agr. W. Australia 1, 1, 4th ser. (1960): 57-59.

Approximately half a million hectares of land in Western Australia is affected by salt encroachment. This is most extensive in the Eastern wheat belt, where the salt has come from the subsoil to the surface through clearing and farming. For reclamation of such lands the author recommends to maintain a roughened "cloddy" surface and careful grazing and protection on slightly affected lands. On several affected lands he advocates bluebush (Kochia brevifolia), a salt-tolerant extremely drought-resistant re-seeding perennial bush of 2-3 feet high, with succulent leaves of high nutritive value containing more protein than does sub-clover. The method of establishment and grazing management is described (Trop. Abstr. 1960: h 1209).

SZABOLCS, I and DARAB, K. / Chemical properties of solonetz soils as affected by alfalfa production under irrigation.
Agrokémia és Talajtan 14 (1965) 3, 4: 191-202 (Hu, e, g).

The upper horizons of solonetz soils were improved considerably by the cultivation of irrigated alfalfa.

COSTS

BURAS, N., SPENCER, I.R.; PILLSBURY, A.F. / Cost of reclamation and development of some saline lands.
Trans. A.S.A.E. 4 (1961) 1 : 105-107.

A study was made of the costs involved in reclaiming and developing virgin saline land in the Coachella Valley of California.

NAYLOR, P.E. / Control of waterlogging and salinity in West Pakistan.
Int. J. of Agrarian Affairs (London) 4 (1963) : 1-12.

Economical considerations about costs and profits of measures for the reclamation and prevention of waterlogging and salinity in the Indus basin.

Programme for waterlogging and salinity control in the irrigated areas of West Pakistan.
West Pakistan Water and Power Development Authority, Lahore, 1961. Each chapter paged separately.

This report presents the history of the salinity and waterlogging problem; the extent of the problem and the accelerating rate at which it is developing, the history of measures taken and being taken to evaluate and solve the problem. It presents a programme of project development, by areas, to be undertaken in the next ten years to solve the problem, and the costs of the works.

Salinity control and reclamation project; project number one : salinity control in West Pakistan; investigations and background information, reclamation and construction programmes, and construction estimates.
Pakistan Water and Power Development Authority, Lahore, 1959. Vol. I: 103 pp.; Vol. II: maps.

UPPAL, H.L. / Reclamation of saline and alkali soils.
6th Congr. Int. Comm. Irr. Drain. New Delhi, 1966. Q 19, R 25 : 381-440.

The costs of various measures to reclaim or improve saline and sodic soils in India have been given.

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Commonwealth Bureau of Soils, Harpenden, 1962. Bibl. no. 520. 113 refs.

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Commonwealth Bureau of Soils, Harpenden, 1960. Bibl. no. 309. 33 refs.

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Commonwealth Bureau of Soils, Harpenden, 1960. Bibl. no. 358. 28 refs.

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Commonwealth Bureau of Soils, Harpenden, 1961. Bibl. no. 377. 65 refs.

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Commonwealth Bureau of Soils, Harpenden, 1963. Bibl. no. 616. 87 refs.

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Commonwealth Bureau of Soils, Harpenden, 1966. Bibl. no. 905.

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Commonwealth Bureau of Soils, Harpenden, 1962. Bibl. no. 475. 101 refs.

ABELL, L. F. and GELDERMAN, W. J. / Annotated Bibliography on reclamation and improvement of saline and alkali soils (1957-1964).
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U.S.D.A., ARS 41-80, 1962. Pp. 47.

SHERWANI, A. K. / Water and salt balances in the soil; preliminary draft of regional annotated bibliography on Pakistan.
Pakistan Meteorological Service, Karachi, 1961. Ca. 180 refs.

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Soils and Fert. 14 (1951) : 185-190.
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