EVALUATION AND SUITABILITY RATING OF TEN MAJOR SOIL SERIES OF THE COMMAND AREA OF KALLADA IRRIGATION PROJECT

By

P. N. PREMACHANDRAN

THESIS

Submitted in Partial fulfilment of
the requirement for the degree

Master of Science in Agriculture

Faculty of Agriculture
Kerala Agricultural University

Department of Soil Science and Agricultural Chemistry

COLLEGE OF AGRICULTURE

VELLAYANI, THIRUVANANTHAPURAM

JULY—1992.

DECLARATION

I hereby declare that this thesis entitled "Evaluation and Suitability Rating of ten major soil series of the Command Area of Kallada Irrigation Project" is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

Vellayani,

24,July 1992.

24/7/92.

P.N. PREMACHANDRAN.

CERTIFICATE

Certified that this thesis entitled "Evaluation and Suitability Rating of ten major soil series of the Command Area of Kallada Irrigation Project" is a record of research work done independently by Sri. P.N. Premachandran, under my guidance and supervision and that it has not previously formed the basis for the award of any degree fellowship or associateship.

Vellayani,
24 -7-1992.

Dr. R.S. Aiyer,
Chairman,
Advisory Committee,
Professor and Head (Rtd),
Department of soil science
and Agricultural Chemistry.

CERTIFICATE

We, the undersigned, members of the Advisory Committee of Sri. Premachandran.P.N., a candidate for the degree of Master of science in Agriculture with major in Soil Science and Agricultural Chemistry, agree that the thesis entitled "Evaluation and Suitability rating of ten major soil series of the Command Area of Kallada Irrigation Project." may be submitted by Sri.Premachandran,P.N., in partial fulfilment of the requirement for the degree.

Chairman:

Dr. R.S.Aiyer.

Members:

Dr. P. R. Ramasubramonian.

Dr. V.Muraleedharan Nair.

Dr. N. Saifudeen.

External Examiner

29.02.93,

Dr. K. Velayudhan

ACKNOWLEDGEMENT

I am extremely happy to record my sincere thanks to Dr.R.S. Aiyer, Professor and Head,(Retd), Department of Soil Science and Agricultural Chemistry, College of Agriculture, Vellayani and Chairman of my advisory committee for the expert guidance and constant encouragement extended to me during the course of this research work. Diction is not enough to express my indebtedness to him for selecting this topic of study related to the application of soil survey data for research, for his untiring interest, learned counsel, constructive criticism and sustained guidance throughout the course of this investigaton.

I am extremely grateful to Dr. P.R.Ramasubramonian, Professor of Soil Science, Dr.V. Muraleedharan Nair, Professor of Agronomy and Dr. N. Saifudeen, Associate professor of Soil Science for their valuable suggestions and help as members of the advisory committee.

It will be a great omission, if I fail to express my sincere thanks to Sri. P.T.Mathew,Deputy Director, Soil Survey for the keen interest envinced by him for the succesful completion of this research work.

I also wish to express my sincere gratitude to Sri. V.M.M.Chandra Das, Sri.George Varghese (Former Additional Directors of Soil Survey), Sri.A.Raveendranathan, Additional Director, Soil Survey and Sri.L.Prabhakaran, Deputy Director,Soil Survey, Thiruvananthapuram for their sincere help and suggestions.

Sincere thanks are due to Sri.Joseph George, Sri.K.S.Sivanandan and Sri.Thomas Cherian, my colleagues for their immense help for the successful completion of this research work. The valuable services rendered by Sri.T.N.Vidyadharan,Draftsman, in the compilation of the maps is gratefully acknowledged.

The services and co-operation rendered by all other soil survey personnel of the Department of Agriculture and staff of the Department of Agricultural Chemistry,College of Agriculture,Vellayani for the conduct of the study is gratefully acknowledged.

I am also indebted to the Government of Kerala for deputing me for this research programme. My sincere thanks are also due to M/S N.C.Computers, Thycaud,for the prompt service rendered by them during the computerised typing and printing of this thesis.

Last but not the least, my heart felt thanks are also due to the members of my family for their forbearance and encouragement for the succesful completion of this endeavour.

P.N. PREMACHANDRAN.

24/7/92.

CONTENTS

		Page
INTRODUCTION	..	1
REVIEW OF LITERATURE	..	5
MATERIALS AND METHODS	..	28
RESULTS AND DISCUSSION	..	58
SUMMARY	..	119
REFERENCES	..	1-V1
APPENDIX		

LIST OF TABLES

1. Name of soil series with area in hectares.

2. Rating of productivity parameters for paddy.

3. Rating of productivity parameters for coconut.

4. Rating of productivity parameters for tapioca.

5. Rating of productivity parameters for banana.

6. Rating for Organic Carbon, Available P and Available.K.

7. Rating of nutrient status.

8. Classification based on Soil Taxonomy (USDA)

9. Brief description of the occurance of the land Capability class and sub-class.

10. Area in hectares under different land capability class and sub-class.

11. Area in hectares under different land Irrigability class and sub-class.

12. Productivity index code for the soil series under study.

13. Rating of productivity classes.

14. Productivity rating of soil properties for paddy.

15. Productivity rating of soil properties for coconut.

16. Productivity rating of soil properties for tapioca.

17 Productivity rating of soil properties for banana.

18 Crop ranking based on productivity rating.

LIST OF FIGURES

1. Location map of the command area of Kallada Irrigation Project.

2. Soil map of the command area of the Kallada Irrigation Project.

3. Land capability map of the command area of the Kallada Irrigation Project.

4. Land Irrigability map of the command area of the Kallada Irrigation Project.

5. Proposed land use map of the command area of the Kallada Irrigation Project.

INTRODUCTION

INTRODUCTION

Agricultural prosperity of any country is, to a great extent dependent on judicious use of soils and rational application of soil data. Evaluation of land for land use planning is a consequent step following soil survey and mapping process. In the recent past,it has gained high popularity in almost every land development programme.

The need for a scientific approach in inventorying and utilizing land resources most economically and efficiently is now universally appreciated. Generally the agronomist or soil scientist would generate this kind of information after conducting field experiments on individual soil mapping units. But the land users have no time to wait that long and need to plan their development work on the basis of the information given in the soil survey reports.

The soil survey reports prepared till recently emphasized the characterizations (morphology and physicochemical) of different soils recognized in an area without making interpretative maps for optimum land use planning. As such their utility has been limited. In some cases,the user agencies undertook land development programme without giving any consideration to soil suitability. For instance, some areas were shaped using heavy machines without giving any attention to soil depth, gravelly and/or calcareous soil leading to more difficult and complex management problems, consequent to such ill conceived land development programme.

The soils also behave differently. For example, the fine textured soils are more susceptible to water-logging, sodicity and nutrient imbalances, whereas coarse textured soils are poor holders of both water as well as nutrients and may show deficiency of plant nutrients. A crop which requires a clayey soil for favorable growth may not thrive well in a sandy soil. Similarly a crop which requires deep or well drained soil will not grow well in a shallow or poorly drained soil.

Productivity of soils varies with the type of crop grown, some plants being able to withstand soil drainage or soil fertility conditions which others cannot, and to give economically satisfactory yields where other plant cannot grow at all. (Riquier, et al 1970). Further, a soil which qualified for a high productivity index for one crop, may have only a low index for another crop.

The criteria for evaluation of a soil on the major agricultural resources have been subjected to revisions by different workers. The extent to which soil and site characteristics can influence actual productivity is to be precisely defined. The socioeconomic factors which affect crop productivity also need to be studied.

Agricultural productivity of the land will be influenced by the physical environment of the site in the same way as the profile development has been. The genesis of a soil cannot be used directly as a measure of its agricultural value. (Cruickshank,1977). Crop production is affected particularly by certain physical properties such as structure,texture, stoniness and drainage. These physical properties are so expensive to modify that they are regarded as semipermanent limitations on crop productivity. A proper soil survey interpretation provides information on soil potential,productivity and limitations in their sustained use. (Pofali,1980).

The unique combination of climate, physiography and vegetation of Kerala provides a wide diversity in the soils. The fertility problems of Kerala are so complex and diverse that it is not possible to copy the result obtained by research in one soil type to another satisfactorily. It is, therefore desirable that the soils should be interpreted in terms of their suitability for optimum land use planning especially in respect of their land capability, suitability for irrigation and different crops. This will, not only help the farmers, but also the administrators and policy-makers to make best use of the soil survey data for making optimum land use recommendations.

With the above goal in mind, the present study was undertaken covering the ten identified important soil series of the command area of kallada irrigation project, with the following objectives.

1. To evaluate the ten soil series based on their morphological and physico-chemical characteristics.

2. To produce a land capability map based on soil/crop suitability rating.

3. To produce an irrigability map based on the above data.

4. To suggest modifications if any required on the present land use and to prepare revised landuse plan.

It is hoped that the present study would open up avenues for further investigations on soil and crop suitability and other management aspects for sustained use of soil resource data to the best advantage.

REVIEW OF LITERATURE

REVIEW OF LITERATURE.

Not much work has been done in Kerala in evolving a system of soil classification on the basis of productivity parameters. Identification of productivity parameters for various crops and the interpretation of the soil survey data for the sustained use of cultivation of these crops, will definitely open up new areas of research application. In this chapter an attempt is made to review in a systematic manner the work carried out till recently in india and else where on land evaluation and system of classification.

Storie(1933) evolved a system of classification of soils based on productivity index. The storie index expresses numerically the relative degree of suitability or value of soils for general intensive agricultural land use. The rating is based on soil characteristics and is obtained by evaluating only four factors viz. depth,texture-slope and drainage. The index rating is obtained by multiplying the above four factors.

Riquier et al (1970) developed a system to evaluate productivity and potentiality, which is an improvement over earlier methods. They considered nine factors for determining soil productivity, moisture, drainage, effective soil depth, texture/structure, base saturation, soluble salt concentration organic matter content, mineral exchange capacity/ nature of clay and mineral reserves. Riquier considered productivity as a function of the intrinsic properties of the soil, firstly as involved in the process of describing the soil profile in situ, and secondly by laboratory analysis. Productivity is measured as a product of the above factors. Each factor is rated on a scale from zero to 100, the actual percentages being multiplied by each other to obtain the productivity rating. The resultant index of productivity also lying between 0 and 100 is set against a scale placing the soil in one or other of the productivity classes. Grist(1975) reported that soil structure has little or no significance for swamp paddy.

The FAO panel for land evaluation (1976) defined the concept of land utilization types and suggested the classification of land for specific use. The classification itself is presented in different categories: orders,classes, subclasses and units. There are two orders (`S' for suitable and 'N' for unsuitable) which reflect kinds of suitability. There are three classes (S1-3) under the orders `S' and 2 classes (N1-2) under the order N reflecting the degree of suitability within the order. The appraisal of the classes, with in the order is done according to evaluation of land limitations or the main kinds of improvement measures required within classes. The limitations are `c' climatic limitations, `t'-topographic, limitations,`w' wetness limitations. `n'-salinity limitations, `f'soil fertility limitations and `s' physical soil limitations. They are indicated by the symbol using lower case letters following the arabic numeral used for classes.

Chan(1978) made soil survey interpretation for improved rubber production in Peninsular Malaysia. He evaluated the pedological properties as soil texture,soil depth,effective depth slope and drainage.

In the criteria for classifying soils in to paddy grouping,Bali and Karale(1978) list out seven soil properities-texture, depth,salinity,ESP,puddling qualities, permeability and slope percentage. According to them purposeful and practical interpretation are most important in the utilization of soil survey data.

The soil properties important for rice crop have been enumerated by Rich and Protz(1981) as slope, effective soil depth, soil texture, structure, drainage, water release, salinity,pH etc.

Bishnoi(1981) in his studies examined in detail the influence of ecological factors,temperature moisture,light,edaphic and biotic factors on distribution of plants.

Austin Joseph (1982) conducted study on crop suitability in Trivandrum district with a view to identify the areas suitable for the different crops and to delineate the areas in village maps. The 9 soil parameters have been taken in to consideration for evolving major criteria for crop suitability. Land capability classification has been evolved based on soil survey data. Land capability classification has been further subclassified into soil performance groups based on soil texture, pH, T.S.S, wetness and workability of land. Then each crop group has been fitted to the soil performance group according to merits. The areas coming under each crop group so identified has been marked in the village maps.

Anilán (1983) classified the rice lands in Trivandrum district based on productivity parameters. He observed that the productivity of the six rice soil series decreased in the order of Amaravila, Kuttichal, Kunnathukal, Vembayam, Marukil and Poovar series. The productivity parameters studied are soil texture,nutrient status,soil reaction,total nitrogen percentage and drainage.

Chan et al (1984) evolved a land evaluation system for rubber cultivation in peninsular Malaysia. The early system was non-parametric and based on number and type of soil limitations. Later systems were parametric and included the influence climate. On the basis of current evidence a land suitability system for rubber cultivation is recommended. To facilitate use of this system, modern soil classification system have been used to describe the local soil units, so that this technology can be transferred at a global level.

Harnandez Silva (1985) used a parametric for the evaluation of land suitability for sugar cane cultivation in Mexixco. Geological, topographical, vegetational, morphological, physical and chemical properties were determined at specific intervals through out the study area and analysed by principal component analysis, cononical correlation analysis and cluster analysis. Four classes and ten subclasses of land suitability were established . The method was compared with the USDA classification of land capability into eight classes, in the Palya Vicente region of Veracruz and gave satisfactory results.

Natarajan, et al (1985) studied the soil and land use planning of Rameswaram Island. The P^H, electrical conductivity and composition of water collected from shallow open wells at six sites were studied. The suggested land use were shown on a small map (1: 25,000).

Sys (1985) described the stages in rural land use planning, land use resources, land utilization type, land characteristics and land qualities, evaluation of land characteristics and land qualities and guidelines for the interpretations of land use requirements.

Vidacek and Vancine (1985) prepared land suitability maps for physical planning and land protection and reclamation in Croatia, adopting FAO land evaluation criteria.

Altmann (1986) estimated the production potential of agricultural land by a classification process. This method of land evaluation examines a number of parameters, including soil, physical and chemical properties, texture and stoniness, agroclimatic data, slop and erosion hazard. Each is subdivided and the resulting categories given a designation, rank and numerical value, An algorithm is used to compute a final score.

Harding *et al* (1986) derived a methodology for qualitatively evaluating the current land suitability for rainfed arabic/coffee production in Papua New Guinea. The methodology is modified to enable evaluation of individual (uniform) sites and also large area of variable land, such as provinces,at two levels of management inputs.

Ornig (1986) made land evaluation in Austria. Land evaluation of all agricultural land in Austria, over 3 million hectares was completed. Sample areas are chosen for each different land scape; the remainder is evaluated in relations to the samples and its grading expressed as a value between 0 (unproductive land) and 100 (the best locations in Austria). Assessment frame has been developed for both arable and grass land.

Sys(1986) formulated suggestions for soil survey interpretations for rice cultivation. Four main types of rice cultivations are considered; rainfed upland rice,bunded rice, cultivation under natural flood and irrigated rice. The following parameters are quantified to determine FAO land classes; rainfall, temperature, relative air humidity, sunshine. Land forms requirements and wetness conditions are discussed. Soil conditions considered include ; surface and/subsurface texture, coarse fragments, soil depth, lime and gypsum content. Quantification of these parameters as related to FAO land classes were made.

Vettorazzi and Angulo Filho (1986) made characterization of soil of the Riberia de Iguage valleys in the states of Sp Paulo by means of topographic indexes. Five soil units from latosols, red yellow podzolic soils and cambisols were characterized according to three topographic indexes expressing gradient, altitude and slop characteristic. The relative efficiency of the indexes were discussed.

Weigel (1986) studied the potential and constraints of the soils of the Maybar/Wollow area for agricultural development. Distribution pattern of soils are described, their crop suitability assessed and an agroecological development plan proposed. Present trends are extrapolated to the year 2010 and comparison made with other part of Ethiopian highlands.

Abdulkadir (1987) put forward some methological arguments in interrelationship among land evaluation, soil survey and land use planning. There are several approaches to land evaluation, giving rise to alternative system based on different principle. In this system,apart from the physical land conditions, other parameters used in the assessment exercise include social, economic and environmental considerations, so that land can be used on a sustained basis. Land evaluation has thus developed as a system distinct from survey and planning. It is suggested that a clear definition and integration of the roles of each discipline need to be undertaken so that they can work for the betterment of land use practise.

Alaily (1987) conducted evaluation of agriculturally useful land in South West Egypt. A soil and land capability map has been prepared for part of the sahara in South West Egypt at a scale of 1: 1000000. Capability classes and subclasses are listed and important physical and chemical properties of representatives soils tabulated.

Aosunade (1987) evolved a viaible method of land capability classification for small farmers. According to him modern method of land capability classification are of limited value to small farmers in the humid tropics, because of the complexity of the environment and a new method is needed. Millions of small farmers relate to their environment, on the basis of experience accumulated over many years. Slope units can be recorganized by farmers & are interpretable from air photos. Names can be assigned which are in common usage locally. Equally important is the localized interpretation of soil,with regard to complex nature of the environment. Survey results should reach the small farmers who constitute the largest individual land users. Community education progranmmes and inclusion of environment studies in the school curiculam should be integral aspects of ány land capability classification project.

Bleeker and Lant (1987) described the result of a survey of Lockhant River Valley, Cape York, Queensland. The area which is isolated and of limited accessibility was being considered for possible oil palm development and cashew cultivation. The study concludes that the study area is less than satisfactory for commercial cultivation of oil palm and that only about 30% of the survey area may be suitable for cashew cultivation.

Calvo et al (1987) made land evaluation studies in a mountainous area of Galicia (NWSpain). They have discussed land capability based on physiographic, climatic and soil characteristics data. Land use suitability maps are presented.

Eckelmann and Raissi (1987) suggested soil evaluation maps as a frame work for land consolidation programs. The new terms of reference involve the integration and harmonization of economic and ecological interest, especially where natural and intensive farmed areas are adjacent. Soils with high productive potential which should remain in food production,need to be identified and mapped according to an evaluation model.

Embrechts et al (1987) made physical land evaluation, using a parametric method for application to oil palm plantation in North Sumatra. Climatic records, site and profile description and oil palm yields of 36 plantation with comparable management were collected and conducted studies. Six land qualities were used to estimate land suitability for oil palm, and land index calculated using ratings attributed to each land quality. Highly significant relationships were found between yield and selected land qualities and between the yield and the land index. A land suitability classification based on yield is proposed. They observed that standard climatic data and site and profile descriptions can be used to predict oil palm yield very accurately.

The seventh meeting of the East and Southern African subcommittee for soil correlation and evaluation (1987) considered the application of the FAO Guidelines on land evaluation for rained agriculture. Comparison between the FAO system of land Evaluation and national system of land evaluation were made.

Farshad and Wijnhond (1987) made land evaluation studies of the wetupland areas in Sri Lnaka. Two representative areas in Kandy district and the main land use type to the wet uplands and wet midlands regions of Sri Lanka are studied. The factors for rating crops requirements includes climate, topography, wetnes, physical soil condition and soil fertility. The requirements of the main crops: rubber, cocount,tea,coffee, cardamom, cinnamon and cloves were tabulated.

Gbadegesin (1987) made soil rating for crop production in the savanna belt of South Western Nigeria. A method for grouping soils for specific purposes is presented, using as example maize cultivation in the savanna zone of Nigeria. This technique has two stages. The first is the identification of those soil properties influencing maize production in the study area, while the second is the rating of the soils based on the properties identified.

Using an index of soil variable contribution to the growth and yield of maize in the area, only two of the twenty soil parameters analysed, organic matter and available moisture content contribute significantly. (58.4% and 13.1% respectively to the growth and yield of the crop).

In the second stage six soil productivity classes ranging from A (Excellent) to E (Poor) were established for maize production in the area. The assignment of scores to the two soil properties used in rating the soils was based on their relative contribution to the growth and yield of the crop. However comparison of the rating scheme with 29 local soil series previously assessed for rainfed maize production indicates that, after carrying out the special purpose soil classification, there is still a need for land capability assessment using other environmental parameters than soil attributes.

Gil et al (1) (1987) conducted soil survey and land evaluation studies in the Marmolejo Menjibar (Jaen) regions of the Guadalquivir valley. The soils are divided into 3 units according to morphology and parent materials. Soils of unit 1 are fairly level and have developed in Holocene and Pleistocene sediments. Soils of unit 2 have a more undulating relief and have developed on argillaceous tertiary sediments. Unit 3 include mainly hilly soils subjected to selective erosion and developed on heterogeneous parent materials. Soil of the three units includes Entisols, Alfisols, Mollisols, Inceptisols and Aridisols.

Gil et al (2) 1987) made land evaluation of soils in the Guadalgmirir valley, Spain using the variables of effective depth,erosion extent,slope and climate as primary characteristics and presence of stones, texture,exchange capacity and sodium saturation as secondary characteristics. Four capability classes were identified using 24 model profiles, each class being mapped using geomorphologocal and edaphic properties.

Keulen. et al (1987) made quantitative land evaluation for agro-ecological characterization. This method is presented for estimating the potential yields of crops using knowledge of crop characteristics and the environment in which they are grown.This method can identify the limiting factors and estimate the change in crop yield if these factors are removed or reduced. The technique is a hierarchal analysis in which limiting factors are eliminated at the highest level and then subsequently accounted for at lower levels.

Kanyanda (1987) made field application of the FAO Guidelines for Land Evaluation for Rainfed Agriculture in comparison with the national guidelines. The land capability system used in Zimbabwe consists of eight land capability classes, based on the classification developed by the U.S.Department of Agriculture. Its advantage and disadvantage were discussed and compared with the FAO guidelines.

Kintukwonka (1987) evolved land evaluation for rainfed agriculture in Uganda. The Uganda method of land capability classification is closely related to the FAO and US. Department of Agriculture systems, with modification to suit local condition. Eight classes are defined. The method consists of assessment of climate,(mainly rainfall) seven soil and three site factors; land quality rating were made.

Kalima and Veldkamp (1987) made application of FAO guidelines, on land evaluation for rainfed agriculture in Zambia. The importance of climate in land evaluation has been emphasized. The Zambian system uses sub-qualities with rating options, crop type (single crops) and agro ecological zone. The suitability classes consists of four suitable and three unsuitable classes.

Lekholoane (1987) formulated suitability classification of soils and climate for specific land use in Lesotho. The results of land evaluation in Lesotho are based on study of eight key agricultural soils. The land qualities used in the Lesotho system include; water availability, oxygen availability, nutrient availability, P^H; P availability; temperature and rainfall. The climate and soil requirement of maize, sorghum and wheat are discussed and a suitability classification of soil series for each crop is prepared.

Nortcliff (1987) briefly reviewed the procedures and development of land evaluation . The limitation of existing land evaluation teachniques are illustrated by reference to recent examples of their use, and alternatives such as the concept of soil potential ratings are appraised.

Rhebergen (1987) conducted land suitability evaluation studies in Botswana. According to him moisture availability, soil drainage, salinity and alkalinity affect land quality ratings most strongly.

Verheye (1987) conducted land suitability evaluation in major agro-ecological zones of the European community, and its application in land use planning and nature protection. The system provides a basis for assessing nonagricultural use and environmental protection.

Elbersen et al (1988) conducted small scale soil survey and studied the automated land evaluation. Soil information for the ISWIS date base was derived from new and existing surveys. The land evaluation computer system (LECS) was tested for incopration in the integrated Land and Watershed Management Information systems (ILWIS) rules base. Comparison of LEGS- predicted yields and yields observed in the field indicated that modifications are required in the LECS programme to accommodate Local conditions.

Food and Agricultural Organization (1988) evolved guidelines for land evaluation for rainfed agriculture. In this system, practical indications are provided for the planning and execution of the different stages involved in land evaluation for rainfed agriculture. The procedures proposed are applicable at the local, regional, national,or continental levels.

Gatahi and D'costa (1988) conducted land suitability evaluation of red soils in the Kilifikwale coastal, area Kenya. A land suitability evaluation of the soils was made for coconut,cashew nut and maize based on availability of moisture, nutrients and oxygen, susceptibility to soil erosion, availability of foothold for plants and the possibility of mechanization. Each land quality was studied, quantified and rated. Subsequently the suitability of each unit was obtained by matching the land qualities with the crop requirements through conversion tables.

Gavrilyuk (1988) observed that agricultural planning requires a system of land evaluation, where the productivity of soil can be expressed qualitatively. According to him soils are evaluated according to their natural properties and the use of mathematical models to aid this is currently increasing.

Koreleski (1988) studied the effect on the adaptation of the Storie Index for land evaluation in Poland. He observed that the koreleski's Habital Fertility Index give results which agree better with farmers experience and soil productivity measurements than the Stories Index, which over estimates the adverse effect of any limiting factor.

Noitcliff (1) (1988) mentioned the purpose of soil survey and classification, leading to the development of soil Taxonomy. He has further discussed soil survey and land evaluation, land capability classification,productivity and parametric indices, land suitability and agrotechnology transfer.

Nortcliff (2) (1988) suggested that change in land use requires sound evaluation of the land's suitability for particular use. He discussed in detail land suitability and land capability classification,specific purpose evaluation and data requirements for land evaluation,with particular reference to the FAO's frame work for land evaluation.

Sharma and Bhargava (1988) made evaluation studies of the alkali soil in Haryana, using satellite imagery. They observed that reclaimed soil had significantly improved properties and gave good yields of rice and wheat after reclamation.

Bedrna (1989) suggested three levels of suitability rating for land productivity evaluation for various plant communities under specific soil and climate factors.

Burrough (1989) proposed Fuzzy Reasoning, a new quantitative aid for soil survey and land evaluation.

According to Burrough, the rigid data model consisting of discrete, sharpely bounded internally uniform entities that is used in hierarchal and relational data bases of soil profile, chloropleth soilmap and land evaluation classifications ignores aspects of reality caused by internal inhomogenicity,short-range spatial variation, measurement error,complexity and imprecision.

Fuzzy set theory, which is a generation of Boolean algebra to situations where data are modelled by entities whose attributes have zones of gradual transitions,rather than sharp boundaries, offers a useful alternative to existing methodology. In the Fuzzy set theory mutually exclusive classes are known in mathematical terms as crisp sets. The use of fuzzy reasoning is illustrated by a land evaluation exercise for suitability for apple growing in the Dalian Wafangdian area of the Liaotung peninsula of Northeast china.

Challa <u>et al</u> (1989) conducted a case study of land evaluation for irrigation in Kanedi village,Dadra & Nagar Haveli, Maharastra. Based on land features and soil characteristics,the soil unit were evaluated by qualitative and parametric method. According to the former method about 98% of the area was moderately suitable for irrigation, with limitations of topography, erosion and compactness in subsurface soil layers. About 1.3% of the area was marginal land with shallow soils and erosions. Based on the parametric method, 3.5% of the area was not suitable for irrigation where as 45% and 51.5% of th area were moderately and marginally suitable, respectively.

Lal (1989) made productivity evaluation of sixty four bench mark soil of India, using the modified Storie Index soil rating. Moderately deep soils occurring on steep slopes with erosion hazards and salt-affected soils were grouped in the non-agricultural category(Grade-6) Most of the arid soils, poorly drained soils,soils of low fertility status (Ultisols, Oxisols and oxic sub groups) clayey soil (Vertisols and vertic subgroups) and sandy soils were placed in grade 3 and 4. Soils with good productivity were graded 2 or 1.

Paez and Rodriguez (1989) used water erosion potential, as a criterion for land evaluation Land use and management requirements are given for a range pf cp values. Lands with values greater than 0.1 are considered to have a low risk of erosion and few or more agricultural limitation. Value lower than 0.01 indicate a high risk of erosion and severe restrictions to agricultural use.

170375

Perssons (1989) considered the use of biological parameters, in soil mapping and evaluation. They influence the nutrient supply and physical properties of the soil, and are important in fertilizer recommendations. The parameters examined include the soil organic matter content, humus quality,nitrogen pool, nitrogen fixation capacity,biomass, phosphorus pool, ammonium fixation and the rhizosphere effect.

Smit and Kristjanson (1989) developed a parametric approach to rating the importance of lands for agriculture, based on their significance or value in meeting broad societal needs for food. Land quality, land security and demands for the product of the land are three criteria, up on which the importance of lands for agriculture are evaluated. Parametric system are employed to evaluate land types on each criterion for an agricultural use separately, then to derive rating of importance for each use and ultimately to rate each land type for agriculture.

Zonneveld (1989) discussed landscape, ecology, survey and evaluation. According to him soil survey may lead to land evaluation, which serves as basis for land use planing and management. The scientific data can be suitably used by planners and managers and is able to generate, generalize and extrapolate and estimate complex data,with a reasonably low risk in a reasonably short time.

Rossiter (1990) described the Automated Land Evaluation system (ALES) as a frame work for land evaluation. Automated Land Evaluation system is a micro computer programe that allow land evaluators to build their own knowledge-based system with which they can compute, the physical and economic suitability of land map units, in accordance with the FAO's frame work for land evaluation. The economic suitability of a land mapping unit for land utilization type is determined from the predicated annual gross margin per unit area. Evaluation build decision trees, to express inferences from land characteristics to land qualities,from land qualities to predicated yields and from land qualities to over all physical suitability was formulated.

MATERIALS AND METHODS

MATERIALS AND METHODS

The present study relates mainly to the ten identified important soil series of the command Area of Kallada Irrigation project, using soil maps prepared by the soil Survey Unit of the Department of Agriculture, Kerala. The location of the Command Area of Kallada Irrigation Project is given in the Figure 1. The names of the soil series under study and their extent are given in Table 1.

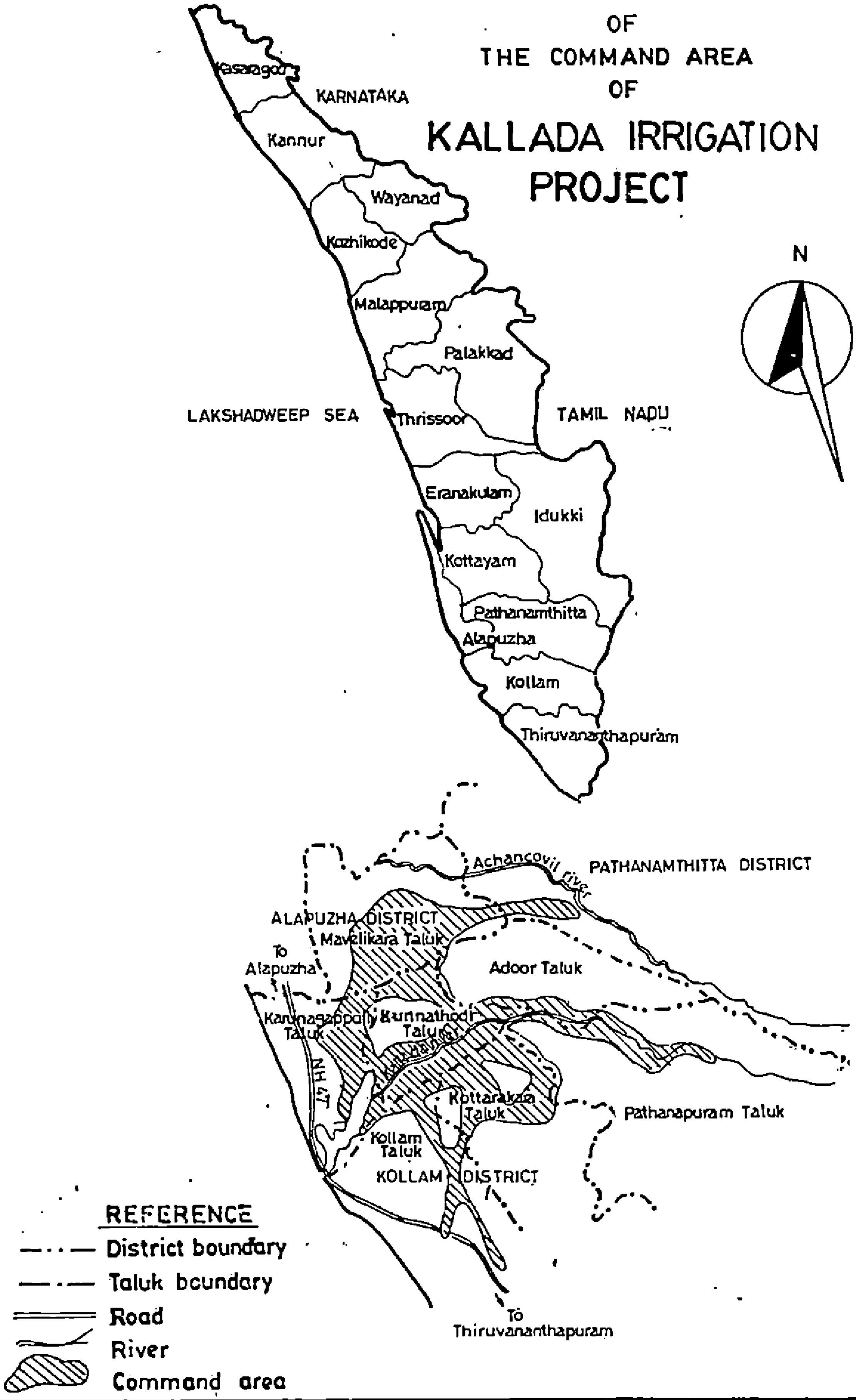
1.Field Studies.

Profile pits were dug in the typical areas identified and the morphological features were observed and recorded as per soil Survey Manual (1970). The salient features of the areas in respect of locations, physiography, drainage, vegetation and land use were also recorded.

Sample collection

After morphological examinations of the profiles, soil samples representing the different horizons of each profile were collected for laboratory examinations.

LOCATION MAP OF THE COMMAND AREA OF KALLADA IRRIGATION PROJECT



2. Laboratory Studies

The physical and chemical properties of the soil samples collected representing the soil series were determined by standard analytical procedures for comparing against a productivity scale.

3. Productivity Parameters and productivity Index.

The productivity parameters considered in the present study include soil texture, depth, soil reaction, nutrient status, drainage, cation exchange capacity, base saturation percentage, TSS, coarse fragments and slope. For each parameter a range of scale is prepared, and numerical values assigned for paddy, coconut, banana and tapioca based on the principles of land evaluation. The importance of each factor fixed for productivity parameter is discussed in detail hereunder. The rating of productivity parameters for paddy, coconut, Tapioca and banana are given in Table 2 to 5. Table 6 gives rating for organic carbon, available P and available K. The rating for nutrient status are given in table 7.

3.1 Soil Texture.

The interplay of factors dependent upon the relative proportions of various mechanical fractions in the soil influences the physical properties of the soil, the availability and movement of soil, water and air and the supply of nutrients to the plants, besides emphasizing the dominance of soil texture in crop production. The plant growth is related to the particle size composition of soils and has been recognized to be important for many years. Factors such as water holding capacity, pore space, percolation capacity, total surface of soil particles, and a number of others are directly attributable to texture (John Durairaj 1961). The productivity ratings for soil texture have been prepared after consideration of the degree of importance of each textural class. Sandy clay loam or finer textured soils are good for rice crop (Protz, 1981) and coarse textured soils are well recognized to be poor to unsuitable (Bali and Karale, 1978).

3.2 Soil depth.

Insufficient soil depth,which often modifies the root system of plants ultimately reflecting on crop growth and yield is, perhaps an obvious soil limitation very often ignored. The proper root development of a crop is considered to be very important for better anchorage and nutrient uptake. Moisture retention and infiltration resulting in run off and soil loss, depends on the depth of soil. Depth of the soil has a direct relation to rooting habits and yield of a crop. Depending on the rooting habit of crops, minimum soil depth required for each crop has to be fixed.

3.3 Soil Reaction.

Tropical crop plants differ widely in their ability to tolerate acid soil conditions, which is to a large extent tolerance to toxicity of Al, Mn and Fe and deficiency of Ca and Mg. Coffee, rubber, tea, pineapple and certain legumes are very tolerant to high levels of acidity. Several essential elements tend to become less available as pH is raised form 5.0 to 7.5 or 8(pH) levels to a large extent determines the levels of available phosphorus.

In general, it is recognized that changes in soil pH affect type and amount of plant nutrient in soil solution and the microbial activity which connected with nitrification and nitrogen fixation. Slightly or strongly acid soils are considered to be good for rice crop by many authorities. A pH ranging from 5.0 to 6.5 has been stated to be optimum for rice (Grist, 1975).

3.4 Nutrient Status.

The relative levels of various nutrients in the soil are very important in soil productivity. It determines the overall soil performance. The usefulness of one nutrient element is determined by the presence of other nutrient elements. Their availability and utilization are decided by the interactions of the nutrients in the soil.

3.5Drainage.

Better drainage of land provides favorable soil moisture and aeration, for the growth, and satisfactory cultivation of crops. The drainage helps to develop sufficiently deep, effective and extensive rooting zone. Good drainage conditions promote granulation of the soil. The greatest contribution of drainage is towards better aeration of the soil,allowing ready diffusion of oxygen to, and carbondioxide from the plant root zone. The activity of aerobic soil microorganisms is dependent upon soil aeration, which in turn influence the availability of nutrients such as nitrogen, phosphorus,sulphur etc.

In a nutshell,removal of excess water from soil is as important as watering of crops,when soil moisture is low to promote better growth and production of crops. The ratings are low for water logged soils, where dewatering operations and good water management practices are required, and high for moderately drained soils.

3.6 Slope.

Slope , which varies according to topography and relief of the land in turn determines the drainage conditions and patterns of land features. In a sloppy land a considerable amount of precipitation received is lost by run off. This loss has two consequences. First, crop plants are deprived of this water which might other wise have entered the soil, second, the run off water carries with it some of the valuable top soil. This means not only a loss of natural fertility by both soil and nutrient loss but also of the added nutrients through fertilizers. Hence when cultivation is carried out in a sloppy land a better package of management practices will have to be adopted. This in turn affects the cost of production and profit. So it is of great importance to select crops in such a way that we choose those which can be grown under minimum management levels in such sloppy lands.

3.7.T.S.S.

T.S.S. is a parameter directly related with the concentration of neutral soluble salts present in soil solution. High T.S.S. interfere with the growth and productivity of many crops. Hence saline conditions of soil will have to be seriously looked into before accommodating crops in saline areas.

3.8. Coarse fragments.

Soil texture and coarse fragments such as gravel, stones etc. determine the workability of soil. The ease with which cultivation operations can be carried out is denoted by workability. Light textured soils are more easy to work, than heavy textured soil. Seasonal and annual crops require intensive cultural operations and fine tilth. Hence, presence of coarse materials such as gravel, stone and boulders which hinder the workability of soil is not desirable in the field, where such crops are to be grown. Workability is not that important in the case of perennial and plantations crops, which do not require frequent cultivation operation. In fact, these crops require zero tillage or minimum tillage, with the inter spaces either covered with a cover crop, or allowed to mulch with the litter fall and recycle nutrients. Workability determines the cost of cultivation operations, and hence coarse fragments will have to be considered to determine crop suitability of an area.

3.9. Cation exchange capacity

The exchange property of a soil mainly determines the availability of plant nutrients. The capacity to retain and release the nutrient elements is expressed in terms of the cation exchange capacity. A soil with high CEC will retain the plant nutrient elements more efficiently against leaching loss and will release them to plants. This soil property is taken as one of the parameter for accessing the productivity rating.

3.10. Base saturation

The degree to which the cation exchange capacity is saturated with exchangeable bases is meant by its base saturation. A soil with high base exchange capacity is more productive than one with low base saturation. This factor is also taken as a parameter in the productivity rating system.

A. Productivity Calculation.

If favorable conditions extraneous to the soil are present (good varieties, sound husbandry, freedom from pest and diseases etc.) the productivity can be expressed by reference to the intrinsic soil characteristics (depth, moisture, base status, organic matter content, texture etc.) Productivity is a function of the intrinsic properties of a soil, firstly as described in the soil profile *in situ* in the field, and secondly by laboratory analysis.

From among the number of factors that influence soil productivity, the most commonly accepted and most easily measurable factors of productivity alone are selected.

A soil is considered more fertile if more volume of it is at the disposal of plants,(depth) richer it is in bases (base saturation) and it contains more water, more nutrients and facilitates more root penetration (Texture and structure). Certain additional factors such as organic matter content, nature of clay, drainage, mineral resource etc. are also considered.

Since more organic matter is there, the more the nutrients are available and more stable is the structure. The greater the cation exchange capacity, the more nutrients are retained in the soil with less leaching of fertilizer elements and the greater the mineral reserves the more will be the nutrient replacement.

The productivity of the soil is calculated by multiplying the ratings of the individual parameters and expressed as percentage. The resultant index of productivity is set against a scale placing the soil in one or other of the six productivity classes viz. excellent, very good, good, average, poor or extremely poor to nil.

Table 1. NAME OF SOIL SERIES WITH EXTENT IN HECTARES CONSIDERED FOR THE PRESENT STUDY

SL. No.	Name of soil series	Area in ha.
1	Mannar	8461.44
2	Adoor	4550.31
3.	Sooranad	4298.65
4.	Palamel	4089.50
5.	Mylom	3780.63
6.	Erath	3590.28
7.	Bharanikavu	2819.75
8.	Kallada	2440.74
9.	Pooyappally	1365.42
10.	Kunnamkara	1063.76

Table 2. RATING OF PRODUCTIVITY PARAMETERS FOR PADDY

Soil Texture (T)

		Rating.
T1	Sand	40
T2	Loamy sand	45
T3	Sandy loam	50
T4	Loam	75
T5	Silty loam	70
T6	Silt	65
T7	Sandy clay loam	100
T8	clay loam	95
T9	Silty clay loam	90
T10	Sandy clay	70
T11	Silty clay	75
T12	Clay	70

Depth (R)

		Rating.
R1	Less than 50cm	20
R2	50 - 75	40
R3	76 - 100	50
R4	101 - 150	75
R5	More than 150	100

Soil Reaction (H)

	pH	Rating.
H1	Extremly acid (<4.5)	60
H2	Very strongly acid (4.5 - 5.0)	70
H3	Strongly acid (5.1 - 5.5)	90
H4	Medium acid (5.6 - 6.0)	100
H5	Slightly acid (6.1 - 6.5)	100
H6	Neutral (6.6 - 7.3)	90

Drainage (D)

		Rating.
D0	Water loged	60
D1	Very Poorly drained	70
D2	Poorly drained	80
D3	Moderately well drained	100
D4	Well drained	80
D5	Excessively drained	60

Cation Exchange Capacity (C)

	Cmol kg^{-1}	Rating.
C1	Low (less than 16)	50
C2	Marginal (16 - 24)	80
C3	Medium (24 - 32)	85
C4	Moderate (32 - 60)	90
C5	High (>60)	100

Base Saturation (B)

	Percentage	Rating.
B1	Low (< 35)	50
B2	Marginal (35 - 50)	80
B3	Medium (50 - 60)	85
B4	Moderate (60 - 90)	90
B5	High (>90)	100

T.S.S (E)

E1	High >4	50
E2	Moderate 2 - 4	60
E3	Medium 1 - 2	70
E4	Marginal 0.5 - 1	90
E5	Low <0.5	100

Coarse Fragements (G)
(Percentage of gravels)

		Rating.
G1	Extremely gravelly (>60)	50
G2	Very gravelly (50 - 60)	60
G3	Gravelly(skeletal) (35-50)	70
G4	Slightly gravelly (15 - 35)	80
G5	Non gravelly (less than 15)	100

Slope (S)

			Rating.
S1	Flat or almost flat	(0 - 3)	100
S2	Gently sloping	(3 - 5)	90
S3	Sloping	(5 - 10)	80
S4	Moderately steep	(10 -15)	70
S5	Steep	(15 - 25)	50

Table 3. Rating of Productivity parameters for coconut

Soil Texture (T)

			Rating
T1	Sand	-	60
T2	Loamy sand	-	65
T3	Sandy loam	-	90
T4	Loam	-	100
T5	Silty loam	-	75
T6	Silt	-	60
T7	Sandy clay loam	-	80
T8	Clay loam	-	80
T9	Silty clay loam	-	75
T10	Sandy clay	-	75
T11	Silty clay	-	60
T12	Clay	-	60

DEPTH (R)

R1	>50 cm	50
R2	50 - 75	60
R3	76 - 100	80
R4	101 - 150	90
R5	>150	100

SOIL REACTION (H)

	pH	Rating
H1	Extremely acid (<4.5)	60
H2	Very strongly acid (4.5-5.1)	70
H3	Strongly acid (5.1-5.5)	90
H4	Medium acid (5.6-6)	100
H5	Slightly acid (6.1-6.5)	100
H6	Neutral (6.6-7.3)	90

Drainage (D)

D0	Waterloged	50
D1	Very poorly drained	60
D2	Poorly drained	75
D3	Moderately well drained	90
D4	Well drained	100
D5	Excessively drained	60

CATION EXCHANGE CAPACITY (C)

	Cmol kg^{-1}	Rating
C1	Low (< 16)	50
C2	Marginal (16-24)	80
C3	Medium (24-32)	85
C4	Moderate (32-60)	90
C5	High (>60)	100

PERCENTAGE BASE SATURATION (B)

B1	Low	(< 35)	50
B2	Marginal	(35-50)	80
B3	Medium	(50-60)	85
B4	Moderate	(60-90)	90
B5	High	(>90)	100

T.S.S. (E.)

E1	High	> 4	50
E2	Moderate	2-4	60
E3	Medium	1-2	70
E4	Marginal	0.5-1	90
E5	Low	(0.5	100

COARSE FRAGMENTS (G)

G1	Extremely gravelly	(>60)	70
G2	Very gravelly	(50-60)	75
G3	Gravelly (skeletal)	(35-50)	80
G4	Slightly gravelly	(15-35)	90
G5	Non gravelly	(<15)	100

SLOPE (S)

S1	Flat or almost flat	(0-3)	100
S2	Gently sloping	(3-5)	90
S3	Sloping	(5-10)	80
S4	Moderately steep	(10-15)	70
S5	Steep	(15-25)	50

Table 4. Rating of Productivity parameters for Tapioca.

Soil Texture (T)

			Rating
T1	Sand	-	50
T2	Loamy sand	-	50
T3	Sandy loam	-	55
T4	Loam	-	100
T5	Silty loam	-	80
T6	Silt	-	75
T7	Sandy clay loam	-	90
T8	Clay loam	-	80
T9	Silty clay loam	-	85
T10	Sandy clay	-	80
T11	Silty clay	-	70
T12	Clay	-	60

DEPTH (R)

R1	< 50 cm	50
R2	50 - 75	60
R3	76 - 100	80
R4	101 - 150	90
R5	> 150	100

SOIL REACTION (H)

	pH	Rating
H1	Extremely acid (<4.5)	60
H2	Very strongly acid (4.5-5.1)	70
H3	Strongly acid (5.1-5.5)	80
H4	Medium acid (5.6-6)	100
H5	Slightly acid (6.1-6.5)	100
H6	Neutral (6.6-7.3)	100

DRAINAGE (D)

D0	Waterloged	50
D1	Very poorly drained	55
D2	Poorly drained	60
D3	Moderately well drained	90
D4	Well drained	100
D5	Excessively drained	70

CATION EXCHANGE CAPACITY (C) $Cmol\ kg^{-1}$

C1	Low (< 16)	50
C2	Marginal (16-24)	80
C3	Medium (24-32)	85
C4	Moderate (32-60)	90
C5	High (>60)	100

PERCENTAGE BASE SATURATION (B)

		Rating
B1	Low (< 35)	50
B2	Marginal (35-50)	80
B3	Medium (50-60)	85
B4	Moderate (60-90)	90
B5	High (>90)	100

T.S.S. (E.)

E1	High	> 4	50
E2	Moderate	2-4	60
E3	Medium	1-2	70
E4	Marginal	0.5-1	90
E5	Low	< 0.5	100

COARSE GRAGEMENTS (G)

G1	Extremely gravelly	(>60)	50
G2	Very gravelly	(50-60)	60
G3	Gravelly (skeletal)	(35-50)	70
G4	Slightly gravelly	(15-35)	90
G5	Non gravelly	(<15)	100

SLOPE (S)

			Rating
S1	Flat or almost flat	(0-3)	100
S2	Gently sloping	(3-5)	90
S3	Sloping	(5-10)	80
S4	Moderately steep	(10-15)	70
S5	Steep	(15-25)	50

Table 5. Rating of Productivity parameters for Banana.

Soil Texture (T)

			Rating
T1	Sand	-	50
T2	Loamy sand	-	50
T3	Sandy loam	-	55
T4	Loam	-	70
T5	Silty loam	-	80
T6	Silt	-	60
T7	Sandy clay loam	-	100
T8	Clay loam	-	90
T9	Silty clay loam	-	85
T10	Sandy clay	-	80
T11	Silty clay	-	70
T12	Clay	-	65

DEPTH (R)

R1	<50 cm	50
R2	50 - 75	60
R3	76 - 100	80
R4	101 - 150	90
R5	> 150	100

SOIL REACTION (H)

	pH	Rating
H1	Extremely acid (<4.5)	60
H2	Very strongly acid (4.5-5.1)	70
H3	Strongly acid (5.1-5.5)	90
H4	Medium acid (5.6-6)	100
H5	Slightly acid (6.1-6.5)	100
H6	Neutral (6.6-7.3)	90

DRAINAGE (D)

D0	Waterloged	50
D1	Very poorly drained	60
D2	Poorly drained	70
D3	Moderately well drained	100
D4	Well drained	100
D5	Excessively drained	70

CATION EXCHANGE CAPACITY (C) Cmol kg^{-1}

C1	Low (< 16)	50
C2	Marginal (16-24)	80
C3	Medium (24-32)	85
C4	Moderate (32- 60)	90
C5	High (>60)	100

BASE SATURATION (B)		Rating
B1	Low (< 35)	50
B2	Marginal (35-50)	80
B3	Medium (50-60)	85
B4	Moderate (60-90)	90
B5	High (>90)	100

T.S.S.(E.)			
E1	High	(> 4)	50
E2	Moderate	(2-4)	60
E3	Medium	(1-2)	70
E4	Marginal	(0.5-1)	90
E5	Low	(< 0.5)	100

COARSE FRAGMENTS (G)			
G1	Extremely gravelly	(>60)	50
G2	Very gravelly	(50-60)	60
G3	Cravelly (skeletal)	(35-50)	70
G4	Slightly gravelly	(15-35)	90
G5	Now gravelly	(<15)	100

SLOPE (S)

			Rating
S1	Flater almost flat	(0-3)	100
S2	Gently sloping	(3-5)	90
S3	Sloping	(5-10)	80
S4	Moderately steep	(10-15)	70
S5	Steep	(15-25)	50

Table 6. Rating for Organic Carbon, Available P and Available.K.

Sl. No.	Organic carbon %	Rating	Available P Kg/Ha	Ratings	Available K Kg/ Ha	Ratings
1.	0.00-0.16	L	0.00-3.0	L	0-35	L
2.	0.17-0.33	L	3.1-6.5	L	36-75	L
3.	0.34-0.50	L	6.6-10.0	L	76-115	L
4.	0.51-0.75	M	10.1-13.5	M	116-155	M
5.	0.76-1.00	M	13.6-17.0	M	156-195	M
6.	1.01-1.25	M	17.1-20.5	M	196-235	M
7.	1.26-1.50	M	20.6-24.0	M	236-275	M
8.	1.51-1.83	H	24.1-27.5	H	276-315	H
9.	1.84-2.16	H	27.6-31.0	H	316-355	H
10.	2.17-2.50	H	31.1-31.5	H	356-395	H

Source : Soil Testing Laboratory, Thiruvananthapuram.

Table 7. RATING OF NUTRIENT STATUS

	Nutrient combinations	Rating
N_1	Org C - low Av P - Medium Av K - high	70
N_2	Org C - low Av P - Med Av K - Med	65
N_3	Org C - low Av P - Med Av K - low	55
N_4	Org C - low Av P - high Av K - high	75
N_5	Org C - low Av P - high Av K - med	65
N_6	Org C - low Av P - high Av K - low	60
N_7	Org C - low Av P - low Av K - high	60
N_8	Org C - low Av P - low Av K - Med	55
N_9	Org C - low Av P - low Av K - low	50
N_{10}	Org C - med Av P - med Av K - high	80
N_{11}	Org C - med Av P - med Av K - med	75

Contd..

	Nutrient combinations	Rating
N_{12}	Org C - med Av P - med Av K - low	70
N_{13}	Org C - med Av P - high Av K - high	85
N_{14}	Org C - med Av P - high Av K - high	80
N_{15}	Org C - med Av P - high Av K - low	75
N_{16}	Org C - med Av P - low Av K - high	75
N_{17}	Org C - med Av P - low Av K - med	70
N_{18}	Org C - med Av P - low Av K - low	65
N_{19}	Org C - high Av P - med Av K - high	85
N_{20}	Org C - high Av P - med Av K - med	90
N_{21}	Org C - high Av P - med Av K - low	85
N_{22}	Org C - high Av P - high Av K - high	100

Contd..

	Nutrient combinations	Rating
N_{z3}	Org C - high Av P - high Av K - med	95
N_{z4}	Org C - high Av P - high Av K - low	85
N_{z5}	Org C - high Av P - low Av K - high	85
N_{z6}	Org C - high Av P - low Av K - med	80
N_{z7}	Org C - high Av P - low Av K - low	70

RESULTS AND DISCUSSION

RESULTS AND DISCUSSION

1. Soil Characteristics

The present study was undertaken covering the ten identified important soil series of the Command Area of Kallada Irrigation Project. They are Kallada Series (Kld), Bharanikavu series (BkY), Mannar series (Mnr), Adoor Series (Adr), Palamel series(Pml) Mylom Series(Mlm), Erath Series(Eh), Pooyappally Series(Pyp), Sooranad Series(Snd) and Kunnamkara series(Knk).

The results of the study are discussed on the basis of the morphological,physical and chemical studies on the profile each from the ten identified major soil series. The result of the studies are discussed in detail under the following captions.

1.1. Soil Classification

1.2. Land Capability Classification and

1.3. Land Irrigability classification.

Detailed examination of the profiles were carried out in the field and described in the profile sheets. The profile characteristics of the above ten soil series are described below.

Soil Series Description

Kallada Series(Kld)

Classification:- Typic Ustifluvents. Fine loamy mixed isohyperthermic.

Kallada series represents the fluventile sediments located in the lower topographic situations adjoining Kallada river and its tributaries. They are very deep, moderately well drained, dark brown soils having slope range from 3 to 5%. The original land form have been considerably modified by levelling and bunding for agricultural purposes. These soils are developed under warm humid tropical climate with high rainfall.

Typifying Pedon:

Horizon	Depth(incm)	Description
Ap	0-14	Dark brown (7.5 YR 4/4M) clay loam; weak, medium, granular; very friable, slightly sticky and slightly plastic; abundant fine&coarse roots; moderate permeability; many micro pores; clear, smooth boundary; pH 5.1.
AC1	14-75	Dark reddish brown(5YR 3/4M); clay loam; weak medium subangular blocky; firm sticky and plastic, root plenty; few coarse and many micro pores; moderately slow permeability; clear, smooth boundary; pH 5.0.

AC2	75-130	Reddish brown(5YR.4/4M); Moderate, medium, subangular blocky;firm sticky and plastic; few coarse and micro pores; few roots; slow permeability pH 5.1.
AC3	130-200	Reddish brown (5YR 4/4M); sandy clay loam; medium, weak, subangular breaking into granular,, very friable; slightly sticky and slightly plastic; few coarse roots, few coarse and many micro pores; moderately slow permeability; pH 5.1.

Range in Characteristics:-

The thickness of the soil column ranges from 130 to 200 cm. The clay content increases with depth. Sand streak are noticed in the lower layers.

The colour of the Ap horizon ranges from dark brown to dark yellowish brown in hue 7.5 YR to 10 YR, values 4 and chroma 4. The texture ranges from loam toclay loam. These soils have granular structure.

The colour of the second layer ranges between dark reddish brown to dark brown in hues 5 YR 7.5 YR, values 3 and chroma 4. The texture of the layer is found to vary from clay loam to clay. The structure is always subangular blocky, which may be either coarse or moderate.

The colour of the third layer ranges from reddish brown to dark brown in hue 5 YR with value 4 and chroma 4. The structure varies from sub-angular blocky to massive.

The colour of the last layer varies from reddish brown to dark brown in hue 5 YR with value 4 and chroma 4. The structure is medium weak sub-angular breaking into granular.

Type location:- Sy. No. 714 in Kunnathur village, Kunnathur Taluk.

Bharanikavu Series(Bky)

Classification:- Fluventic Dystropepts. Fine loamy mixed isohyperthermic.

Bharanikavu series represents the very deep, moderately well drained, brownish soils with a very thick `B' horizon. Increase in sand content with depth is a common faature observed in the profile. The laterite layer associated with these soils is often observed at great depths. These soils are usually found to occur in nearly level to moderately sloping lands, and have been formed under a humid, tropical climate.

Typifying Pedon:

Horizon	Depth in cm	Description
Ap	0-26	Brown(10YR 5/3 M); clay loam with few gravels; weak,moderate, sub-angular blocky structure; slightly sticky and slightly plastic; few, very fine and medium pores; abundant roots; moderately rapid permeability; clear, smooth, boundary;pH 5.4.
B1	26-76	Dark yellowish brown(10YR 4/4M); sandy clay loam; weak, medium sub-angular blocky structure; friable; slightly sticky and slightly plastic; abundant roots, common, fine and medium pores; gradual, wavy boundary; moderately rapid permeabilty; pH5.5.
B2	76-130	Dark yellowish brown (10YR 4/4M); sandy clay loam; medium,weak sub-angular; very friable, slightly sticky and slightly plastic; few, very fine medium pores; roots few;rapid permeability; pH 4.6.
B3	130-180	Dark brown (7.5YR 4/4M); sandy clay loam; medium, weak, sub-angular blocky; friable; slightly sticky and slightly plastic; few very fine medium pores; root nil; moderate permeability;pH 4.6

Range in Characteristics:-

Thickness of solum usually ranges from 150 to 200 cm. Content of coarse fragements comes to below 5% in the profile, but in some areas gravel is found in the surface layer. The colour of the A horizon is typically brown to dark brown in hues 10 YR, values 4 and 5 and chroma 2 and 3. The textural range observed in this horizon is sandy loam to clay loam.

The 'B' horizon is very thick, usually more than 110 cm and shows an increase in sand content with depth. The colour is mostly yellowish brown. The texture ranges from sandy loam to sandy clay loam.

Type Location:- Sy.No.501 in Sasthamkotta Village of Kunnathur Taluk.

Mannar Series(Mnr)

Classification:- Typic Ustipsamments; mixed isohyperthermic

Mannar series represents very deep, coarse textured, coastal alluvial soils of recent origin, having grey colour, with more or less identical characteristics through out the profile. The surface layer is mostly loamy sand in texture. These soils are young and horizon differentiation is indistinct. They occur on flat to very gently sloping lands having slopes up to 3%. They have developed under warm humid tropical. climate.

Typifying pedon:-

Horizon	Depth in cm	Description
Ap	0-17	Dark grey(5YR 4/1 M); loamy sand; single grain; moist loose; non-sticky and non-plastic; abundant roots; rapid permeability; clear smooth boundary; pH 6.2.
AC1	17-99	Brown(10YR 5/3 M); loamy sand; single grain; moist loose; nonsticky and non plastic; roots plenty; moderately rapid permeability; gradual smooth boundary. pH 6.3.
AC2	99-150	Light grey (10yr 6/1); loamy sand; single grain; moist loose, non sticky and non plastic; roots absent; rapid permeability pH 7.0.

Range in Characteristics:-

The depth of the soil is always more than 120 cm. The texture, and structure are strikingly uniform throughout the profile, clearly revealing the immature condition. Few yellow and brown mottling are observed in the lower layers in areas with high water table. The colour and distribution vary with degree of hydration.

Type location : Sy. No. 9424 in Perunadu village in Karunagapally Taluk.

Adoor Series :- (Adr)

Classification: Typic Plinthustults. Clayey skeltal mixed isohyperthermic.

Adoor series represents the very deep, well drained, yellowish brown to strong brown heavy textured soils. The entire profile is embedded with laterite gravels mixed with varying amounts of quartz. Few iron concretions are also observed in the surface layer. The laterite is of quarriable type and occurs very deep in the profile. These soils occur on gently sloping to moderately sloping lands and are formed under warm humid tropical climate.

Typifying pedon

Horizon	Depth in cm	Description
Ap	0-23	Yellowish brown (5Y R4/3M) ; gravelly clay loam ;moderate, medium, granular, slightly sticky and slightly plastic; common, very fine and medium interstetial pores; moderate permeability ; clear, smooth boundary ph 6.3.
B 21	23-58	Yellowish red (5YR 5/6 M); gravelly clay; coarse, moderate sub angular blocky; firm; sticky and plastic; few coarse roots; moderate permeability; gradual, smooth boundary pH 6.1.

B 2-2	58–158	Strong brown (7.5YR 5/6M); gravelly clay; coarse, moderate,sub-angular block. firm, sticky and plastic, few roots; few fine micropores; moderately slow permeability; diffused smooth boundary pH 5.7.
C	158 +	Plinthite

Range in Characterstics

Thickness of the solum varies with relief and ranges from 120 to 160 cm. The underlying laterite layer is quarriable and the thickness extends up to 4 M or more.

The surface texture ranges from gravelly sandy to gravelly clay loam. In some areas gravels are absent on the surface. Colour of Ap horizon ranges from yellowish red to reddish yellow in hue 7.5.YR, value 4 to 6 and chroma 3 to 8. Structure is mostly granular.

Texture of the B horizon is predominantly gravelly clay with colour ranging from yellowish red to strong brown in hue 5 YR and 7.5 YR, values 4 and 5 chroma 6 to 8.

Type location : Sy : No. 244/11 in Pattazhi village,
Pathanapuram Taluk.

Palamel series :- (pml)

Classification: Fluventic Dystropepts. Fine mixed isohyperthermic.

Palamel series consists of well drained, very deep, dark brown, heavy textured soils occurring in the garden land tract of the command area. The surface layer shows the presence of gravels. The surface texture varies from gravelly sandy loam to gravelly clay. These soils occur on gently sloping lands and are developed from charnockite rocks under a warm humid tropical climate.

Typifying Pedon

Horizon	Depth in cm	Description
Ap	0-16	Dark brown (7.5 YR 4/4M) ; gravelly sandy loam; weak, medium, granular; moist friable; wet slightly sticky and slightly plastic; roots plenty; common fine and medium pores; moderately rapid permeability; pH 5.5.
B 1	16-38	Strong brown (7.5 YR 5/6 M); sandy clay; medium, coarse sub angular blocky; moist friable; wet sticky and plastic; roots plenty; few fine micro pores; moderately slow permeability; clear smooth boundary, pH 5.3.
B 2-1	38-107	Yellowish red (5 YR 4/8M); sandy clay; medium, coarse, subangular blocky; moist friable; wet sticky and plastic; roots few; few fine

		micro pores; modertely slow permeability; gradual, irregular boundary; pH 6.3.
B 2-2	107-137	Yellowish red (5 YR 5/8 M); gravelly clay; medium, coarse, subangular blocky; moist friable, wet,sticky and plastic; few fine micropores, moderately slow permeability; clear smooth boundary. pH 6.1.
C	137	Soft laterite.

Range in Characterstics :-

The depth of solum ranges from 110 to 150 cm. The coarse fragments occur mostly in the surface just above the laterite layer. The water table during summer is around 15m and rises up to a level of 6m duing rainy season. The surface texture ranges from gravelly sandy loam to gravelly clay, and colour varies from reddish brown to dark brown in hues 5 YR and 7.5 YR, value 4, and chroma 3 & 4.

The B 1 and B 2.1 horizon are predominantly sandy clay in texture but ranges fom sandy clay loam to sandy clay. The colour varies from strong brown to yellowish red.

The B 2.2 horizon is mostly gravelly clay in texture and the colour ranges from reddish yellow to yellowish red in hue 5 YR, values 5 and 6 and chroma 8. This horizon contains relatively higher proportion of laterite gravels.

The structure is sub-angular blocky. The 'C' horizon is mostly soft laterite.

Type location :- Sy. No. 627/3/C of Erath Village, Kunnathoor Taluk.

Mylom series (Mlm)

Classification : Aeric Tropaquepts Fine loamy mixed isohyperthermic.

The soils of Mylom series are very deep, imperfectly drained, light brownish to dark greyish brown that are found to occur on nearly level to very gently sloping flood plains. Sub soil texture ranges from loam to clay. An increase in sand content is noticed down towards the lower layers of the profile. These soils are developed from alluvial deposits under warm humid tropical climate.

Typifying pedon :-

Horizon	Depth in cm	Descriptions
Ap	0-16	Yellowish brown (10 YR 5/4M); silty clay loam; weak, medium sub angular blocky; firm; sticky and plastic; abrupt smooth boundary; many fine roots; common micro and macropores; moderate permeability pH 5.8.

B 2.1	16-33	Brownish Yellow (10 YR 6/8M); clay loam; weak, medium subangular blocky; friable sticky and slightly plastic; clear wavy boundary; few fine roots; few micro and macro pores; moderately slow permeability. pH 5.2.
B 2.2	33-100	Light brownish grey (10 YR 6/2M); clay; moderate coarse sub angular blocky; firm; sticky and plastic; gradual wavy boundary; few micro and macropores; medium prominent brownish yellow (10 YR 6/6) and dark brown (7.5 YR 4/2) mottlings.; moderately slow permeability. pH 6.8.
B 3	100-155 +	Light yellowish brown (2.57 YR 6/4) sandy clay loam; massive, friable; sticky and slightly plastic; many dark brown (7.5 YR 4/2)mootlings; abundant fine manganeese concretions; moderately slow permeability. pH 6.3.

Range in characterstics :-

The thickness of solum ranges from 120-160 cm and the texture from loam to clay. An increase in sand content is noticed in lower horizons.

Ap horizon is yellowish brown to brownish yellow. Colour of the Ap horizons ranges from light brownish grey to dark greyish brown in hue 2.5 YR and 10 YR; value 4 to 6 and chromas 2 to 4. Structure is either granular or sub-angular blocky.

Colour of `B' horizon varies from grey to dark yellowish brown in hue 2.5 YR with values of 4 to 6 and chroma 1 to 8. Texture ranges from loam to clay. Structure is either massive or sub-angular blocky.

Type location :- Mylom village, Sy. No. 524,
Kottarakara Taluk.

Erath Series (Erh)

Classification: Typic Ustifluvents. Fine mixed isohyperthermic.

Erath series include very deep, brownish, poorly drained, heavy textured soils with a fair amount of gravel. These soils occur on very gently sloping lands lying between undulating terrain. They are formed from colluvial deposits under a warm humid tropical climate.

Typifying pedon :-

Horizon	Depth in cm	Description
Ap	0-10	Dark yellowish brown (10 YR 4/4 M); gravelly clay; weak, medium granular structure; friable; slightly

		sticky, and plastic;abundant roots; few fine;interstitial pores; moderate permeabity; clear smooth boundary. pH 6.2.
AC 1	10-40	Dark brown (10 YR 4/3); gravelly clay; weak, medium sub-angular blocky; firm, sticky and plstic; few roots; few fine micro and macroores; moderately slow permeability; clear wavy boundary pH 6.0.
AC 2	40-65	Brown (7.5 YR 5/4);gravelly clay; medium moderate sub-angular blocky; firm, sticky and plastic; roots absent few micro pores; gradual, wavy boundary; slow permeability. pH 6.2
AC 3	65-130+	Reddish yellow (7.5 YR 6/8); clay; massive; wet sticky and plastic; roots nil, slow permeability. pH 6.9.

Range in characteristics :-

The thickness of soil column is always more than 120 cm. The surface texture ranges from loam to clay. The colour variations observed is from yellowish brown to dark brown in hue 10 YR, value 3 and 4 and chromas 3 and 4. The structure is predominently granular.

The sub surface texture varies from clay loam to clay. The colour range observed is dark brown to reddish yellow in hue, (7.5 YR, and 10 YR) value 4 to 6 and chroma 3, 4 & 8. Accumulation of clay is observed in lower layers.

Type location :- Sy. No. 624 in Earth Village,
Kunnathoor Taluk.

Pooyappally series (Pyp)

Classification : Typic Ustifluvents, Fine loamy mixed isohyperthermic.

Pooyappally series represents the imperfectly drained, very deep soils formed mainly from colluvial deposits. The surface soils have olive brown to very dark greyish brown colour and are mostly encountered in flat to very gently sloping valley fills. Sand content shows an increase down the profile with varying amounts of quartz and laterite debris embedded in the subsoils. Climate is warm humid tropical.

Typifying pedons

Horizons	Depth in cm	Description
Ap	0-12	Very dark greyish brown (10 YR 3/2M);clay loam; medium, moderate granular; friable; slightly sticky and slightly plastic; fine roots; common fine micro and macro pores; few, fine quartz gravels; abrupt smooth boundary. pH 5.7

AC 1	12-65	Yellowish brown (10 YR 5/8M), clay loam; medium moderate subangular blocky; firm; sticky and slightly plastic; few, fine roots; few fine micropores; gradual wavy boundary. pH 5.8.
AC 2	65-119	Yellowish brown (10 YR 5/9 M); sandy loam; massive; friable; slightly sticky; few laterite gravels of varying size and shape; common micro and macro pores; clear, wavy boundary; moderate permeability. pH-6.0.
AC 3	119-130 +	Light grey (2.5 Y 7/0); loamy sand; single grain; non sticky and non plastic, many quartz gravels; Rapid permeability; pH 6.0

Range in characteristics

The thickness of soil column exceeds 120 cm. Colour ranges from light olive brown to dark greyish brown and texture from sandy loam to clay. An increase in sand content with depth and presence of quartz gravels mixed with laterite in the sub soil are characterstic features.

Colour of Ap horizon varies from light olive brown to very dark greyish brown in hues 10 YR and 2.5 Y with value 3 to 5 and chromas 2 to 4. Texture ranges from sandy loam to clay.

Sub-surface colour ranges from yellowish brown to dark brown in hue 10 YR, values 4 to 5 and chroma 3 to 8. Loamy sand to sand clay are the textural grades noticed. Structure is either massive or sub massive or sub angular blocky.

<u>Type location</u> : Sy.No 426 in Pooyappally village Kottarakara Taluk.

Sooranad Series (Snd)

<u>Classification</u> : Plinthic Tropaquepts. Fine mixed isohyperthermic.

Sooranad series represents the deep dark greyish brown, poorly drained, loamy soils occurring on deposits over laterite. The depth of laterite layer varies. The sub soil contains more gravel. They ususally occur on level to very gently sloping wet lands and have been developed from colluvial deposits under conditions of warm humid tropical climate.

<u>Typifying pedon :-</u>

Horizon	Depth in cm	Description
Ap	0-18	Dark greyish brown (10 YR 4/2); sandy loam; structure less; loose; non sticky and non plastic, many roots, clear smooth boundary; rapid permeability pH 5.9.

B 1	18-37	Yellowish brown (10 YR 5/4 M), Clay loam; weak, medium, sub-angular blocky; slightly sticky and slightly plastic; few roots; common fine micro and macro pores; clear, wavy, boundary; moderately slow permeability. pH 5.9.
B 2	37-120	Yellowish red (5 YR 5/6 M) gravelly sandy clay loam; medium, weak, sub-angular blocky structure; firm; sticky and plastic; roots absent; common fine micro and macro pores; Dark brown (7.5 YR 4/2) mootlings; gradual, wavy boundary; moderately slow permeability. pH 6.0.
C	120-130 +	Laterite.

Range in characterstics :-

The depth of soil column ranges from 100 to 150 cm. The colour of Ap horizon ranges from grey to dark greyish brown in hues 10 YR, values 4 and 5 and chroma 1 and 2.

The B 1 horizon has mostly clay loam texture. The colour ranges from yellowish brown to brownish yellow in hue 10 YR, values 5 and 8 and chroma 6 and 8. Structure is mostly sub-angular blocky.

The B 2 horizon has clay texture but content of laterite gravel is high which ranges from 30 to 45 %. Clay accumulation is also observed in this layer. Colour varies from reddish yellow to yelloowish red in hue 5 YR, value 5 and 6 and chroma 4 and 6.

Type location :- Sy: No. 613, Adoor vilage,
Kunnathoor Taluk.

Kunnamkara series :- (Kuk)

Classification :- Tropic Fluvaquents. Fine mixed isohyperthermic.

Kunnamkara series include the very deep, imperfectly drained, light olive brown to dark brown soils with clayey textural grades. An increase in clay content is noticed down the profile. Sub soil texture is mostly clay. These soils occurr on nearly flat to very gently sloping valley fills and other lower topographical sites. They are formed from residual products of weathering by alluvial and colluvial actions.

Typifying pedon :-

Horizon	Depth in cm	Description
Ap	0-12	Pale olive (5 YR 6/3 M); clay loam moderate, fine granular; friable; slightly sticky and plastic; abundant fine roots; common micro and macro pores; . . . quartz gravels; abrupt smooth boundary. pH 6.2.
AC 1	12-32	Strong brown (7.5 YR 5/6M); silty clay loam; moderate medium subangular blocky; friable; slightly sticky and plastic; many fine roots; common micro and macro pores; .... quartz gravels; gradual, wavy boundary. pH 6.7.
AC 2	32-107	Yellowish brown (10YR 5/8M); clay; massive, moist firm; wet sticky and plastic; medium distinct grey mottlings; few fine micro pores; few Fe concretions; gradual wavy boundary. pH 7.0.
AC 3	107-169 +	Olive (5YR 4/4 M) ; clay; massive; firm; sticky and plastic; medium distinct grey mottlings, accumulation of clay streaks. pH 7.1

Range in characteristics

Thickness of soil column is more than 120 cm. Texture ranges from clay loam to clay. Colour of the soil varies from light olive brown to dark brown.

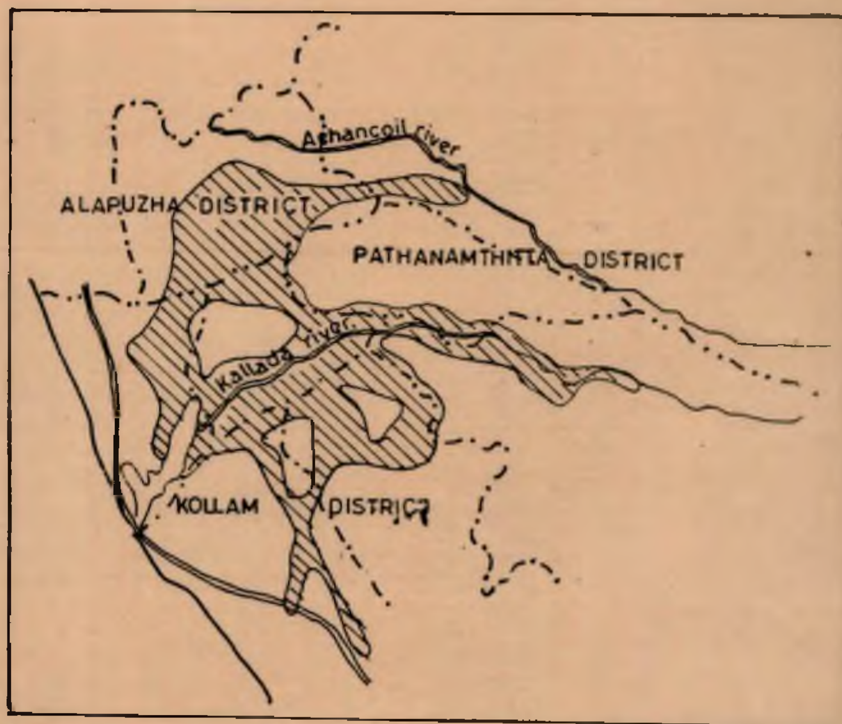
Colour of Ap horizons ranges from light olive brown to dark brown in hue. 5 YR with values 4 to 6 and chroma 3 to 6. Surface texture ranges from loam to clay. Structure is mostly granular. Sub surface colour ranges from light olive brown to drk greyish brown. Texture is mostly clay; but ranges from clay loam to clay.

Type location : SY.No. 565 of Mylom village, Kottarakara Taluk.

1.1 Soil Classification

The soils of the Command area of Kallada Irrigation project have been classified as per the comprehensive soil classification system - Soil Taxonomy (U.S.Soil Survey Staff 1975). The primary basis for identifying different classes in the system are the properties of the soil, properties that can be measured quantitatively either in the field or in the laboratory. All of the physical, chemical and biological properties of the soils are used in this system. Among the most significant of the properties used as a basis for classification is the presence or absence of certain diagnostic soil horizons,which may help to determine the placement of a soil in the classification system. Based on the studies,the soil map showing the distribution of these soil series in the command area has been prepared.

SOIL MAP
OF
THE COMMAND AREA
OF
KALLADA IRRIGATION PROJECT



SOIL SERIES

- Adoor - Kottarakara
- Mannar
- Sooranadu
- Palamel
- Mylom
- Erath
- Bharanikavu
- Kallada
- Pooyappally
- Kunnamkara

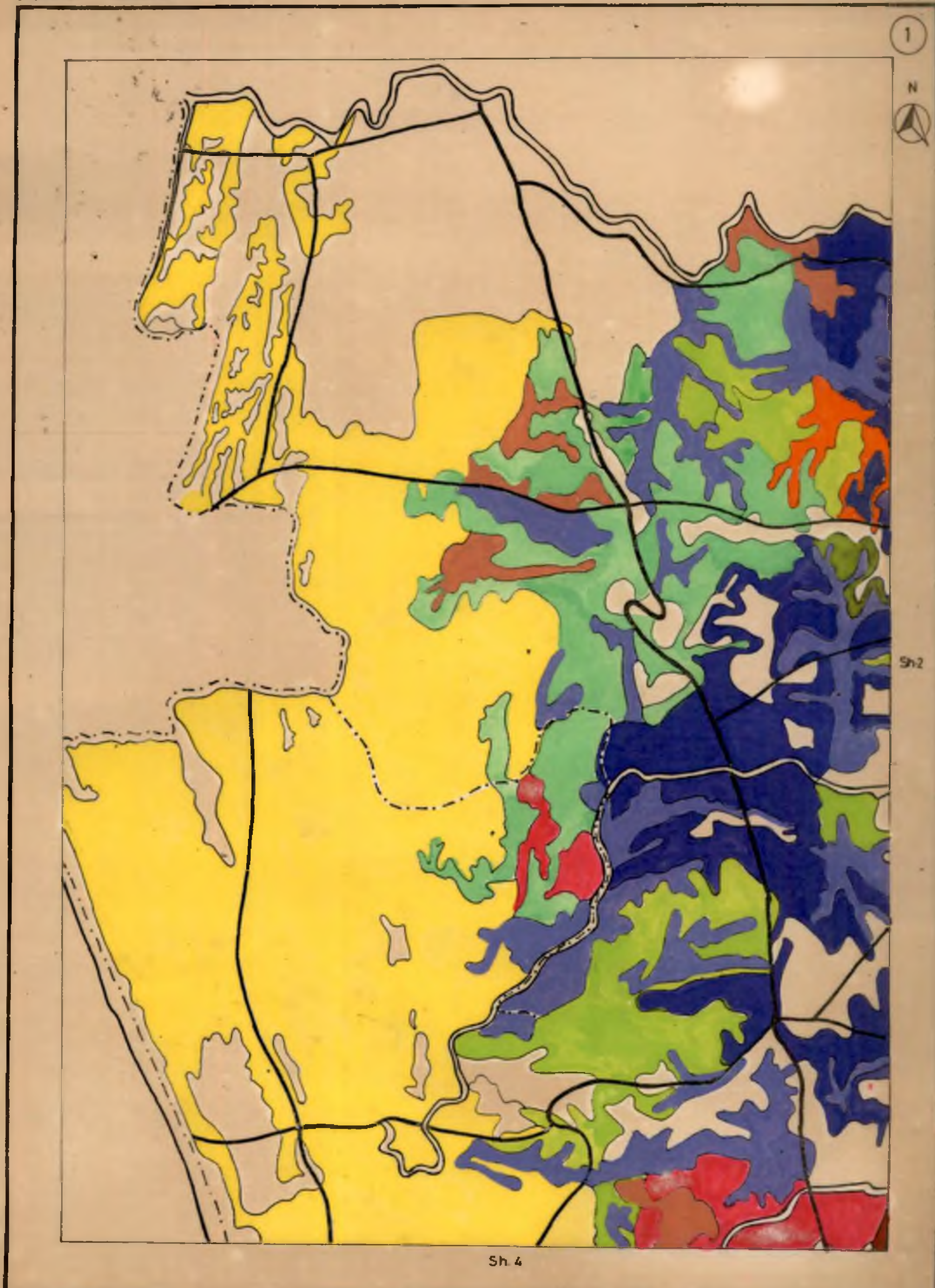
INDEX TO MAP SHEETS

1	2	3
4	5	6

KALLADA IRRIGATION PROJECT

SCALE 1:63360

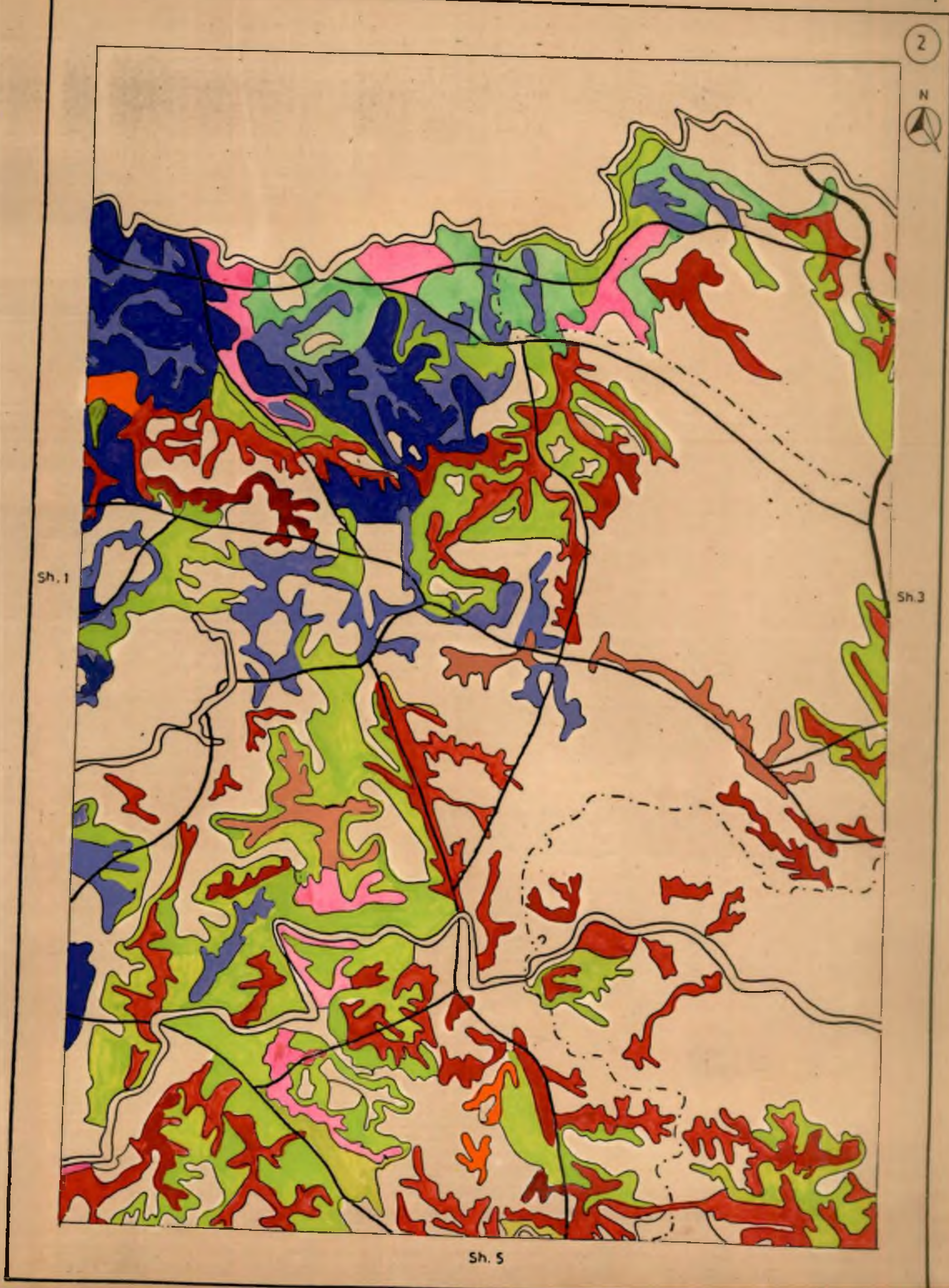
Soil Map



KALLADA IRRIGATION PROJECT

SCALE 1:63360

Soil Map



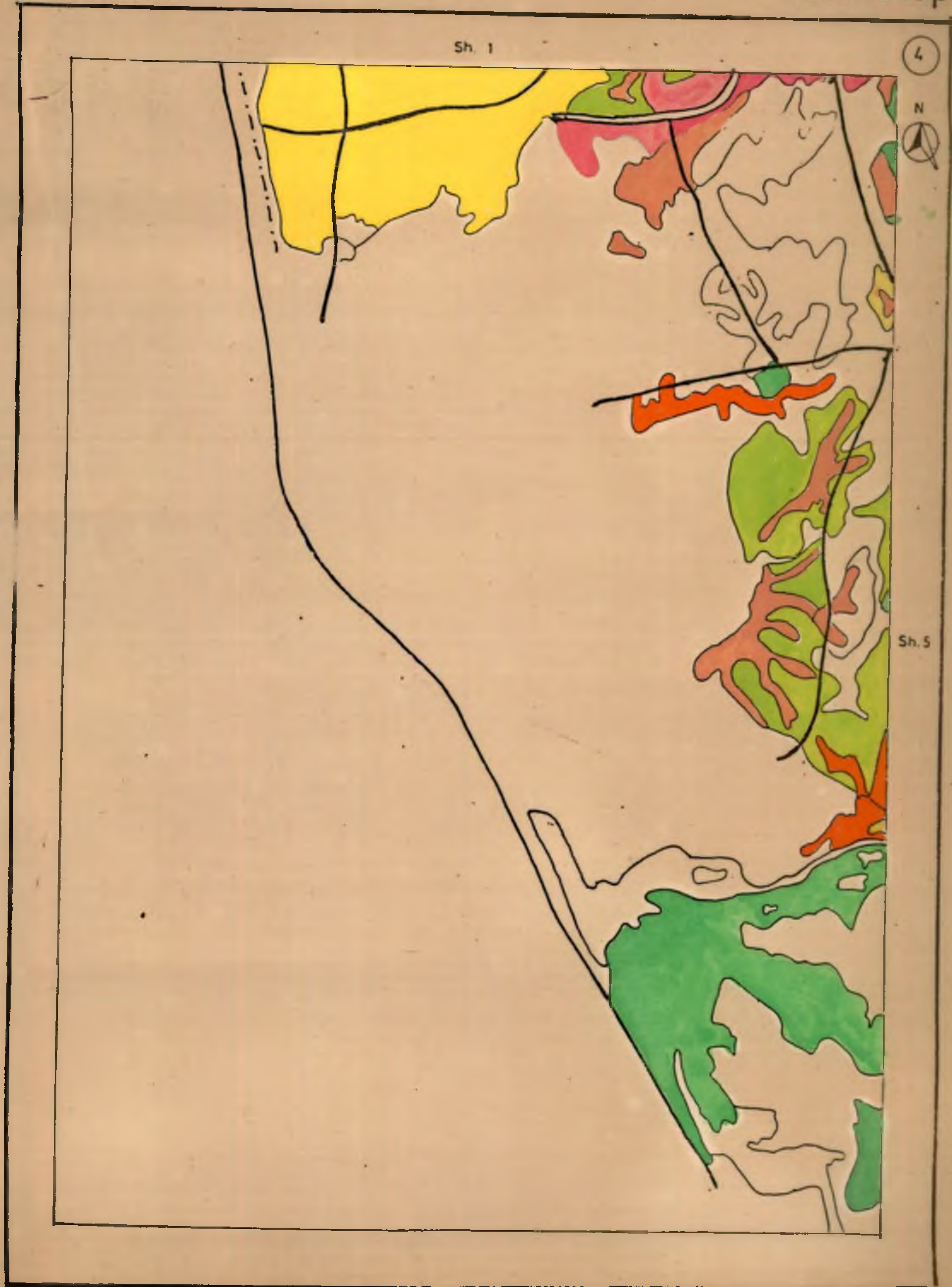
KALLADA IRRIGATION PROJECT
SCALE 1:63360

Soil Map

KALLADA IRRIGATION PROJECT

SCALE 1:63360

Soil Map



KALLADA IRRIGATION PROJECT

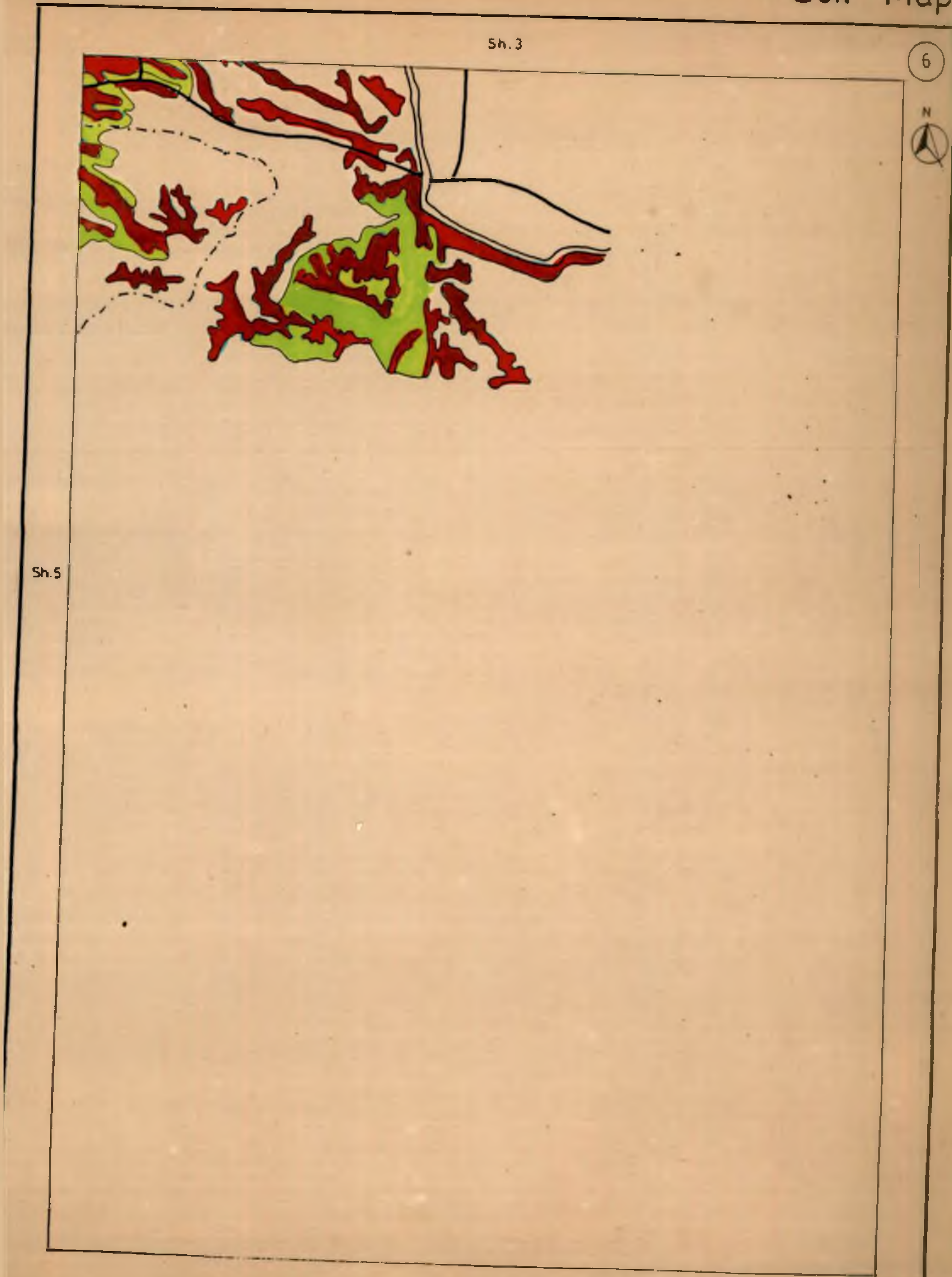
SCALE 1:63360

Soil Ma

KALLADA IRRIGATION PROJECT

SCALE 1:63360

Soil Map



The command area enjoys a warm humid tropical climate. The mean annual soil temperature is 27°C. ie more than 22°C. The mean summer and winter temperature differ by 1.7°C. Hence the area possess an isohyperthermic temperature regime.

The command area is having a Ustic moisture regime in the garden land and an aquic moisture regime in the lower topographical sites. The moisture control section of the soils of the garden land will be dry for more than 90 cumulative days in a year but will remain moist for more than 180 days in a year. Hence the Ustic moisture regime of the soils of the area is considered to possess a Typic Tropustic moisture regime in the subdivision.

Out of the ten soil series selected for the study, five series namely Kallada, Mannar, Erath, Pooyappally and Kunnamkara were grouped under Entisols, four series namely Bharanikavu, Palamel, Mylom and Sooranad under Inciptisols and Adoor series under Ultisols. Table 8 gives classification of these soils based on Soil Taxonomy.

Kallada series are located on level to gently sloping lands developed from alluvial deposits which are flooded periodically, receiving large quantity of sediments.

The organic carbon content decreases irregularly and the area possess a Ustic moisture regime. The soil is placed as fluvents at suborder level,Ustifluvents at great group level and Typic Ustifluvents at sub group level. The clay percentage of the control section is in between 18 to 35 percent and the minerology is mixed. Hence the soil is placed under the family fine loamy mixed,isohyperthermic.

Bharanikavu series are developed over laterite with very deep loamy soils. They have an ochric epipedon followed by a cambic subsurface horizon. A Slight increase in clay content is observed down the profile. But evidence of translocated clay is absent. The soils are developed under isohyperthermic temperature regime and hence the soil is placed under sub-order Tropepts. The base saturation is less than 50 percent. The slopes are less than 25% and the organic carbon content remains above the level of 0.2 at a depth of 125 cm. Hence the soil is placed under Fluventic Dystropepts at subgroup level. The clay content of the control section is within the range of 18 to 35percent having a mixed minerology. The soil is placed under Fine loamy, mixed isohyperthermic Fluventic Dystropepts.

Mannar series are coastal alluvium located near the coastal region of the command area. Mannar soils are sandy; Coarse sand, dominates the textural grade. No diagnostic horizon is seen in the profile. Clay content is less than 10 percent in the control section. Coarse fragment content is less than 1 percent and have loamy fine sand or coarser textural grades in all sub horizons. The moisture regime is ustic. The soil is placed at the subgroup level under Typic Ustipsamments.

Adoor series represents the laterite soils of the command area. They are gravelly with less base saturation. The CEC is below 16 Cmol(+) and the soils are characterized with an ochric epipedon and a Kandic subsurface diagnostic horizon. Due to low base saturation these soils are placed under order Ultisols. Since the moisture regime is Ustic the soils are placed under suborder Ustults.

A continuous layer of plinthite is observed at a depth of 120 to 140 cm. Hence the soil is placed under Plinthustults. Sub groups are not developed. The control section contains more than 35 percent by volume of gravel and more than 35percent of clay with mixed minerology. The soil is placed under clayey skeletal, mixed, isophyperthermic family.

Palamel series have also been grouped under the sub group Fluventic Dystropepts. But at the family level they differ from Bharanikavu series in having more clay in the control section. The clay content in the control section is always more than 35percent. Hence they are grouped into fine,mixed isopyperthermic family.

Soils under Mylom are placed under Inceptisoils. These soils are located on lower topographic sites and the soil is saturated with water during monsoon period. Reduced mottling with chroma 2 are also observed. Hence the soil is grouped in suborder Aquepts. The variation in winter and summer temperature is less than 5°C and hence great group is Tropaquepts. The mottle colour satisfies the sub group requirement and hence the soil is placed under Aeric Tropaquepts.

Erath and Pooyappally series are also grouped under Typic Ustifluvevnts. These soils are located in the paddy fields with very gentle slope. Even though the organic carbon content decreases regularly with depth it remains above 0.2percent at a depth of 125cm.

At the family level the Erath soils differ from Pooyappally series in having more than 35percent clay in the control section, whereas its range in Pooyappally remains in between 18 to 35 percent. Erath soils are placed in Fine mixed isohypertermic and Pooyappally in Fine loamy mixed isohyperthermic families. The gravels found in the Erath soil do not interfere with cultivation and the total quantity of gravel present in the control section is less than 35percent by volume.

Sooranad soils are colluvial soils resting on a layer of plinthite at a depth of 130cm. Eventhough young in age these soils exhibit an ochric epipedon and a cambic subsurface horizon. Due to high water table during monsoon period reduced mottlings are observed in the lower layers. Soils are placed under Tropaquepts in the great group level and linthic Tropaquepts at sub group level. Control section is having more than 35percent clay with mixed minerology. Hence the soil is placed under Fine mixed isohyperthermic family.

Kunnamkara series represent the low land soils with aquic moisture regime. These soils are developed from colluvio alluvial deposits. These soils show an ochric epipedon but no diagnostic sub surface horizons. They are saturated with water during monsoon period and reduction mottles of Chroma less than 2 are observed in the subsurface

Table:8.Classification based on Soil Taxonomy. (USDA)

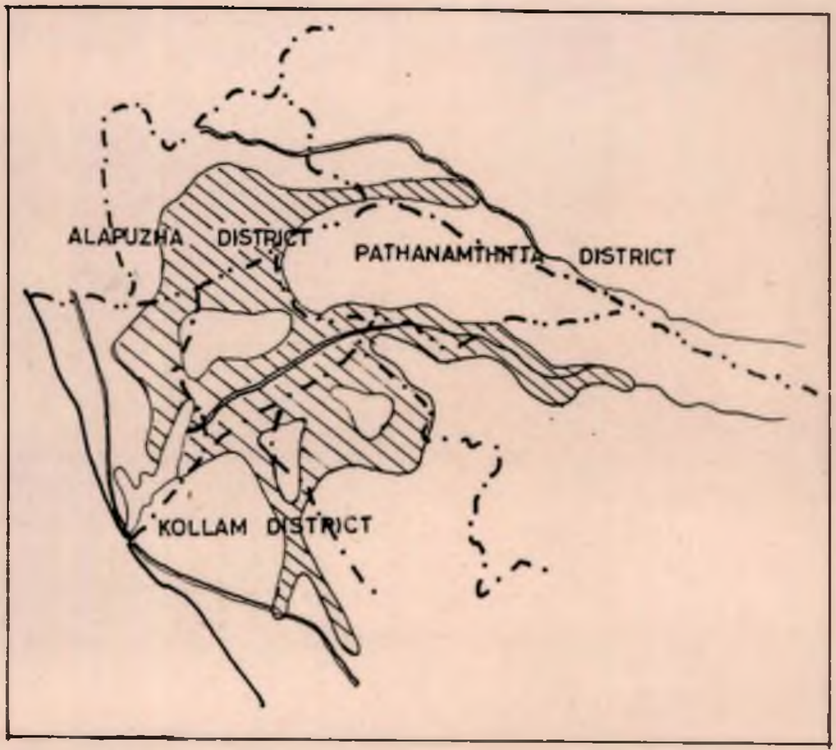
No. Name of Series	Family	Subgroup	Great group	Suborder	Order
1. Kallada	Fine loamy mixed isohyperthermic	Typic Ustifluvents	Ustifluvents	Fluvents	Entisol
2. Bharanikavu	Fine loamy mixed isohyperthermic	Fluventic Dystropepts	Dystropepts	Tropepts	Inceptisol
3. Mannar	Mixed isohyperthermic	Typic Ustipsamments	Ustipsamments	Psamments	Entisol.
4. Adoor	Clayey skeletal mixed isohyperthermic	Typic Plinthustults	Plinthustults	Ustults	Ultisol
5. Palamel	Fine mixed isohyper- thermic	FluventicDystropepts	Dystropepts	Tropepts	Inceptisol
6. Mylom	Fine loamy mixed isohyperthermic	Aeric Tropaquepts	Tropaquepts	Aquepts	Inceptisol
7. Erath	Fine mixed isohy- perthermic	Typic Ustifluvents	Ustifluvents	Fluvents	Entisol
8. Pooyappally	Fine loamy mixed isohyperthermic	Typic Ustifluvents	Ustifluvents	Fluvents	Entisol
9. Sooranad	Fine mixed isohyp- erthermic	Plinthic Tropaquepts	Tropaqueuts	Aquepts	Inceptisol
10. Kunnamkara	Fine mixed isohyp- ermic	Tropic Fluvaquents	Fluvaquents	Aquents	Entisol.

horizon. The soil is placed under Aquents at suborder level. Irregular decrease in organic carbob content is noticed and the soil goes under Fluvaquents at great group level. Since the summer and winter soil temperature do not differ by 5°C, the soil is placed under Tropic Fluvaquents at suborder level. The particle size control section is having more than 35percent clay having a mixed minerology. Hence the soil is placed under fine mixed isohyperthermic family.

1.2 Land Capability Classification

Land capability classification shows in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretation designed to show suitability and limitations of groups of soils for woodland and for engineering purposes.

LAND CAPABILITY MAP
OF
THE COMMAND AREA
OF
KALLADA IRRIGATION PROJECT



LAND CAPABILITY CLASS

- Class IIe
- Class IIw
- Class IIIe
- Class IIIsc
- Class IVe

INDEX TO MAP SHEETS

1	2	3
4	5	6

KALLADA IRRIGATION PROJECT

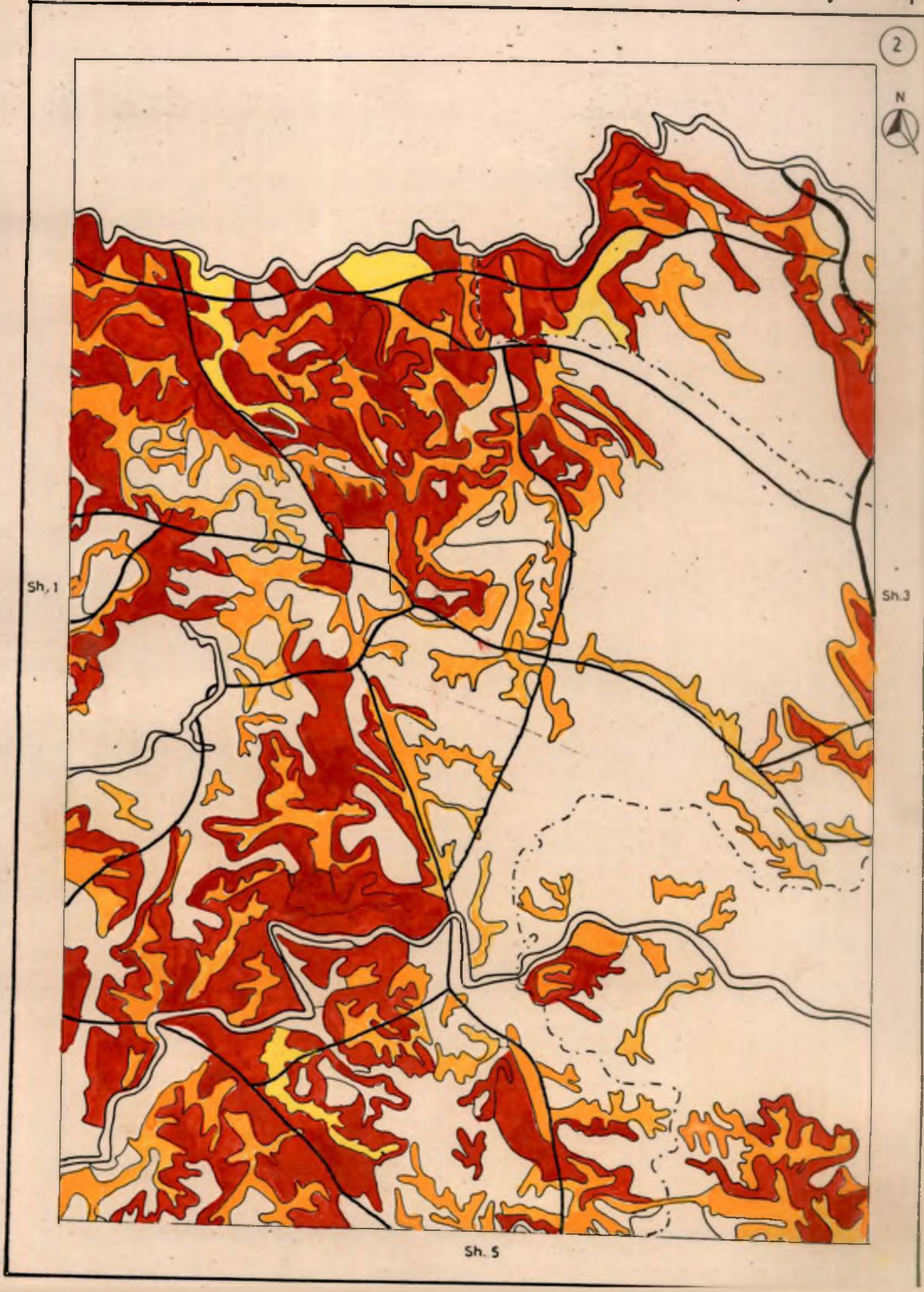
SCALE 1:63360

Land Capability Map

KALLADA IRRIGATION PROJECT

SCALE 1:63360

Land Capability Map



KALLADA IRRIGATION PROJECT

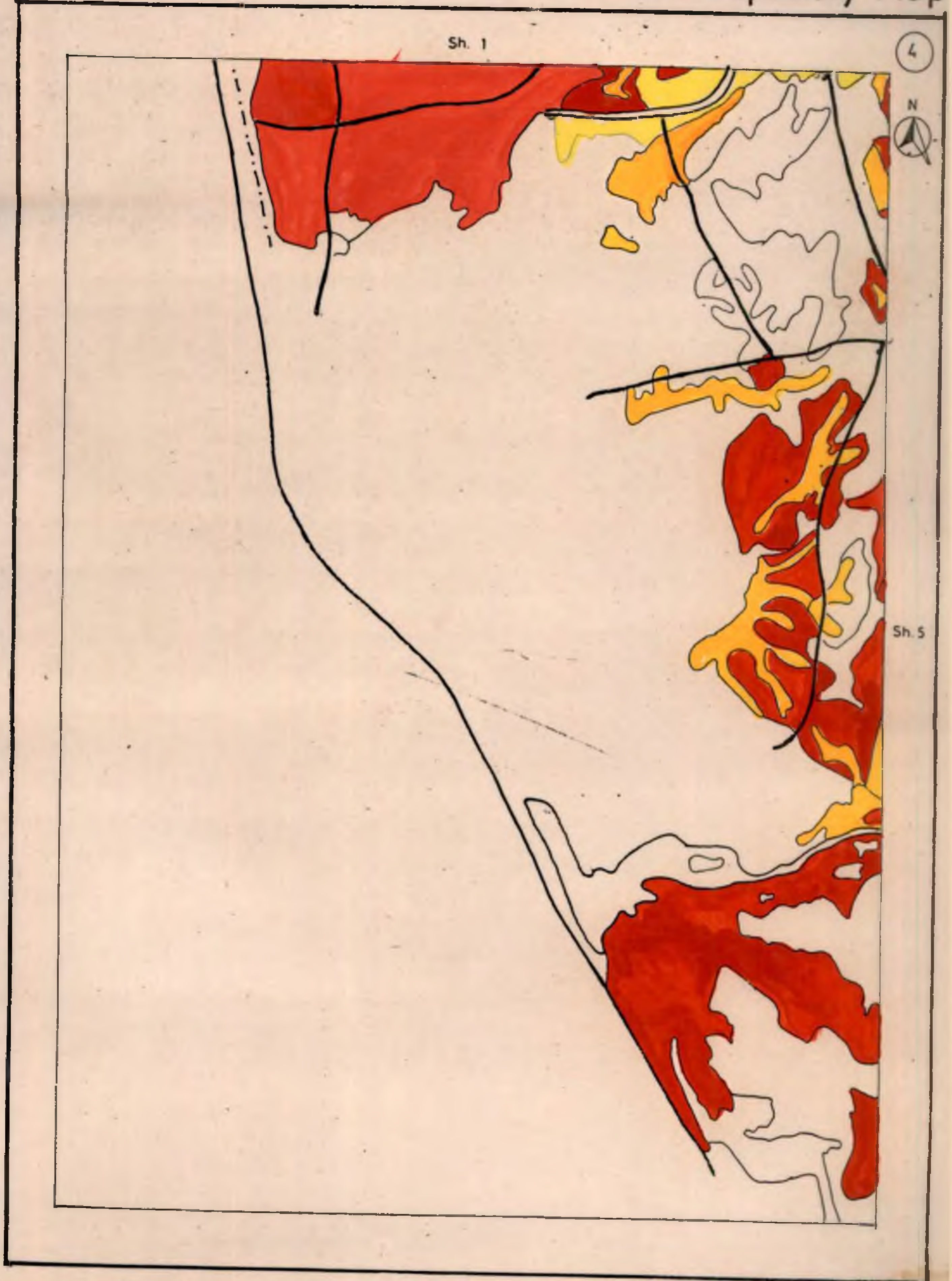
SCALE 1:63360

Land Capability Map

KALLADA IRRIGATION PROJECT

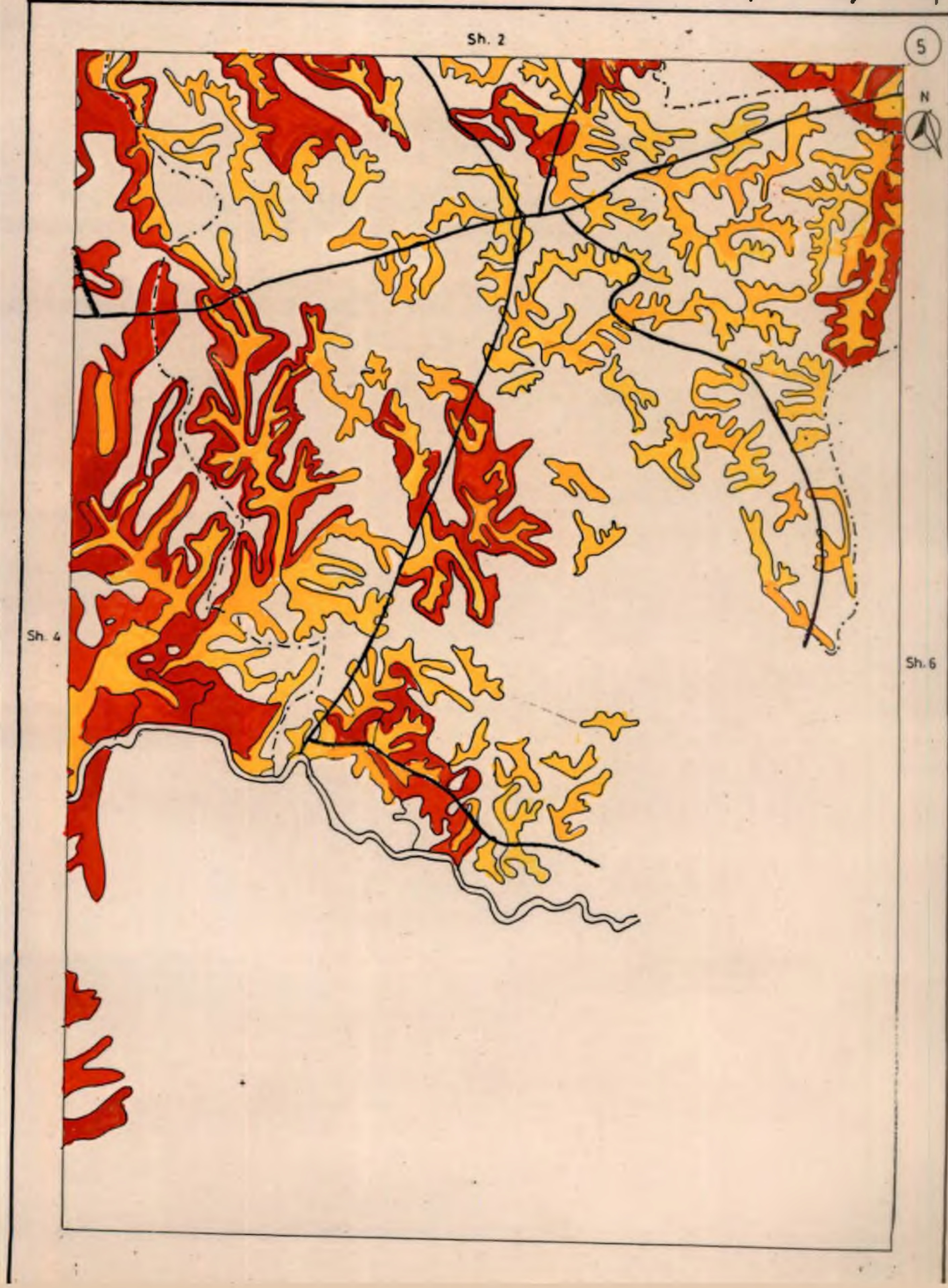
SCALE 1:63360

Land Capability Map



KALLADA IRRIGATION PROJECT
SCALE 1:63360

Land Capability Map



KALLADA IRRIGATION PROJECT

SCALE 1:63360

Land Capability Map

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this study.

Capability classes, the broadest groups, are designated by Roman numerals 1 to VIII. Soil Survey Manual (1970). The numerals indicate progressively greater limitations and narrower choice for practical use. The classes are defined as follows.

Class I soils have few limitations or hazards that restrict their use.

Class II soils have moderate limitations or hazards that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations or hazards that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations or hazards that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability sub classes are soil groups within one class. They are designated by adding a small letter, e, w, s, or c to the class number, for example, II e. The letter e shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; w shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage) ; and s shows soil limitation & `c' climatic limitation.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by w or s because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, woodland , wildlife habitat, or recreation.

Based on the characteristics of the soils encountered in the command area, land capability classification has been made. Soils of the command area taken for study have been grouped into three land capability classes, Class II, III & IV. Based on the studies map showing the distribution of different land capability classes of the command area has been prepared.

Land Capability Class and Subclass:-

The soil series taken for study will fall under the following land capability class and sub class. Table 9 and 10 gives brief description of the different land capability classes with its extent.

Class II e.

The Kallada Soil Series with an extent of 2113.04 Ha. will fall under this class. These are good arable lands having very deep moderately well drained, medium to loamy textured soils occurring on very gently sloping to gently sloping lands located near the river banks.

Slight erosion, slightly to strongly acidic conditions, poor fertility status etc. are the problems encountered in these soils.

By adopting contour cultivation, the soil erosion can be checked. Similarly river bank erosion can be prevented by the protection of river banks. Addition of lime to correct acidity and application of fertilizer in optimum quantity to improve the fertility status are the other management practices recommended for these soils.

Class II w

The Soornad, Mylom, Erath, Pooyappally and Kunnamkara soil series will come under this class covering an area of 14098.74 ha. of the Command Area.

These are good arable lands having very deep, moderately drained, to imperfectly drained medium to fine textured soils occurring on the concave alluvial toe slopes, gently sloping valley fills and other topographical position. The fields are bunded and hence soil erosion is not a problem.

Excessive moisture due to impeded drainage and water logging during monsoon period are the major problems of these soils. Low fertility status, and slightly to strongly acidic conditions are other problems encountered in these soils.

Deepening of the existing drainage channels and construction of permanent drainage channels to drain the excess water collected from the adjoining slopes during monsoons, addition of lime to check the acidity, addition of heavy dose of organic manure and optimum quantity of fertilizers are some of the management recommendations made.

Class III e

Palamel, Bharanikavu, major part of Adoor and a portion of Kallada will fall under this class covering an area of 11232.06 ha. Erosion is the problem.

These are moderately good cultivable lands having very deep, moderately well drained, medium to heavy textured soils with good physical properties, having varying amounts of gravels. These soils are located on the lower foot-slopes having a slope gradient ranging from 3-10 percent. Soils are low in CEC and base saturation.

Contour cultivation and contour bunding at 2 m vertical interval to check the hazards of soil erosion, addition of lime, organic manure and fertilizer in optimum quantity are some of the management recommendation.

Class III sc

Mannar soil series, covering an area of 8641.44 ha. come under this land capability class. Soil and climate are the main limitations of these soils.

These soils are very deep, moderately well drained, coarse textured soils occurring adjoining the coastal belt. Due to the sandy textural grades of soils and poor water holding capacity, the soils get depleted of moisture during summer seasons. Soils are deficient in all major plant nutrients.

Coarse textural grades, very poor fertility status, unfavorable soil structure and very rapid permeability are some of the problems associated with these soils.

Application of heavy doses of organic manure will improve the soil structure, water holding capacity and nutrient status of these soils. Controlled irrigation to improve the moisture status, application of optimum quantity of fertilizers and prevention of moisture loss through evaporation are some of the other management practices.

Class IV e

A portion of Adoor series covering an area of 525.20 ha. will fall under this class. These are deep to very deep, moderately well drained, slightly acidic to medium acid, strongly sloping soils found on the side slopes of low laterite mounds.

Moderate to severe erosion hazards, depletion of plant nutrient, low fertility status and medium acidity are some of the major problems encountered in these soils.

Contour bunding at suitable vertical intervals, cultivation of perennial crops, addition of lime, organic manures and fertilizers are the recommended management practices.

Table 9. Brief description of the occurance of the land capability class and sub class

Land capability class and sub-class	Series Mapped	Area (ha.)	Total (ha.)	Soil characterstics and associated problems	Management Requirements
1	2	3	4	5	6
II e	Kallada	2113.04	2113.04	Good arable lands having very deep, modertaely well drained, medium to heavy textured soils occurring on very gently sloping to gently sloping lands located near the river banks. <u>Problems:-</u> Slight erosion. Slightly to strongly acidic conditions, poor fertility status.	Contour cultivation to check soil erosion. Protection of river banks to prevent river bank erosion. Addition of lime to correct acidity. Application of fertilizers in optimum quantity to improve the fertility status.
II w	1. Sooranad 2. Mylom 3. Erath	4298.65 3780.63 3690.28		Good arable lands having deep, moderately drained	1. Deepening of the existing drainage channels and construction

	4. Pooyapally 5. Kunnamkara	1365.42 1063.76	 14098.74	to imperfectly drained medium to fine textured soils occurring on the concave alluvial foot slopes, gently sloping valley fills and other lower topographical position. Fields are bunded and hence soil erosion is not a problem. Problems :- (1) Excessive moisture as a result of impeded drainage and water logging during monsoon periods. (2) Low fertility status (3) Slightly to strongly acidic.	of permanaent drainage channels to drain the excess water collected from the adjoining slopes during monsoon. 2. Addition of lime to check the acidity. 3. Addition of heavy dose of organic manures and optimum quantity of fertilizer.
III e.	1. Adoor 2. Palamel 3. Bharanikavu 4. Kallada	4025.11 4059.50 2819.75 327.70	 11232.06	Moderately good cultiviable lands having very deep, moderately well drained, medium	1. Contour cultivation and contour bounding at 2m vertical interval to check the hazards of soil erosion. 2.Addition of lime to check the soil acidity.

				soils with good physical properties having varying amounts of gravels are included in this group. Soils are located on the lower foot slops. slope gradiant ranges from 3-10 precent. Soils are low in CEC & Base saturation. Problems: 1. Susceptibility to moderate erosion 2. Low fertility status. 3.Slightly acidic to strongly acidic	3. Addition of organic manure & fertilizers at optimum quantity.
III sc	Mannar	8461.44	8461.44	Very deep,moderately well drained coarse textured soils occu-rring adjoining the coastal belt is inc-luded in this group. Due to the sandy textural grades of soils & poor water holding capacity sois get depleted of moisture during	1.Application of heavy dose of organic manures to improve the soil structure, water holding capacity & nutrient status. 2.Application of optimum quantity of fertiliser. 3. Controlled irrigation to improve the moisture status. 4.Mulching to prevent moisture loss

				summer seasons. soils are deficient in all major plant nutrients. Problems : 1. Coarse textured textural grades. 2.Very poor fertility status 3. Unfavourable soil structure. 4.Very rapid permeability	through evaparation.
IV e	Adoor	525.20	525.20	Deep to very deep, moderately well drained, slightly acidic to medium acid, strongly sloping soils found on the side slopes of low laterite monds Problems :- 1.Moderate to severe erosion hazards. 2.Depletion of plant nutrients. 3. Low fertility. 4. Medium acidity.	1.Contour bunding at suitable vertical intervals. 2. Cultivation of perennial crops. 3. Addition of lime to check the acidity. 4. Addition of organic manures & fertilizers.

Table 10. **Area in ha. under different land capability class & sub class.**

Name of the soil series	IIe	IIw	IIIe	IIIsc	Ive
1.Kallada	2113.04	-	327.70	-	-
2.Bharanikavu	-	-	2819.75	-	-
3.Mannar	-	-	-	8461.44	
4.Adoor	-	-	4025.11		525.20
5.Palamel	-	-	4059.50		
6.Mylom	-	3780.63	-	-	-
7.Erath	-	3590.28	-	-	-
8.Pooyappally	-	1365.42	-	-	-
9.Sooranad	-	4298.65	-	-	-
10.Kunnamkara	-	1063.76	-	-	-
Total	2113.04	14098.74	11232.06	8461.44	525.20.

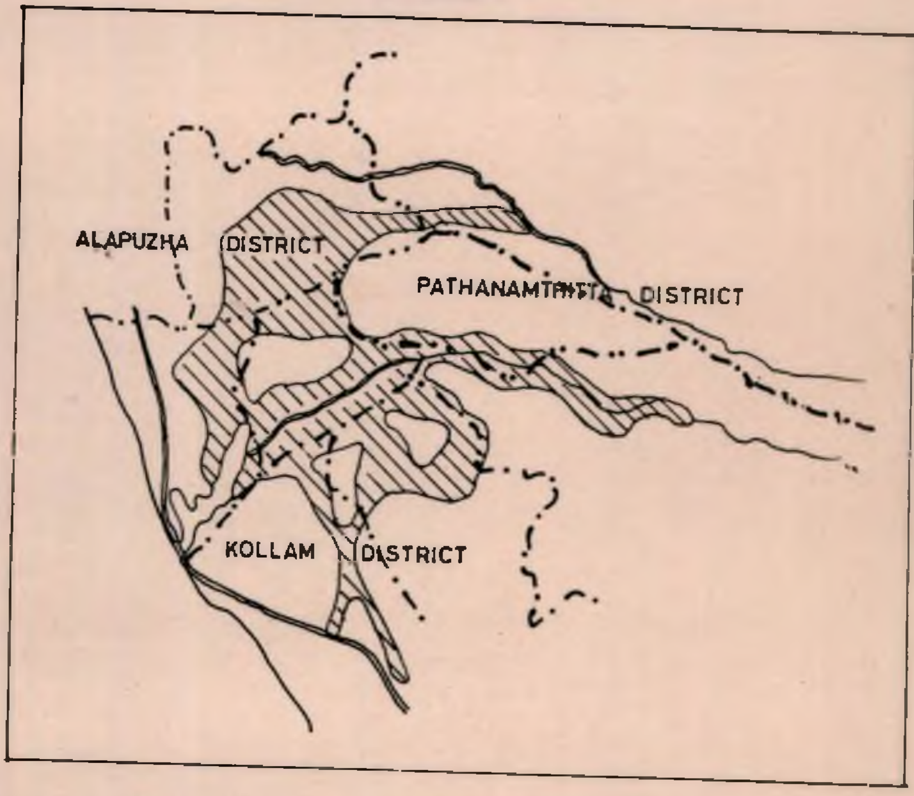
1.3 Land Irrigability Classification

The physical and chemical properties of the soils of the command area show vide variation. Depending on their characters like clay content, solum thickness, nature of cations, permeability and depth of water table, different soils will have limitations of different degree and kind for sustained use under irrigated agriculture. The limitations of the soils are discussed in this chapter.

In general the soil limitations are moderate. In addition to soil limitations, the land irrigability depends upon features like slope, terrain conditions, land development costs, economic considerations, drainage requirement etc. Taking into consideration all the above factors, the land irrigability classifications are made. Lands are grouped into six classes from 1 to 6. Class 1lands have practically no limitations and can be irrigated without any difficulty. As the class number increases, limitations also increase. Class 4 lands are marginal for sustained use under irrigation due to very severe limitation. Class 5 lands are provisionally not suitable for sustained irrigation and Class 6 unsuitable for irrigation. The land irrigability class are further subdivided into sub classes to indicate the nature of limitation requiring attention by

LAND IRRIGABILITY MAP
OF
THE COMMAND AREA
OF

KALLADA IRRIGATION PROJECT



IRRIGABILITY CLASS

2

3

4

Hilly & Misc. land

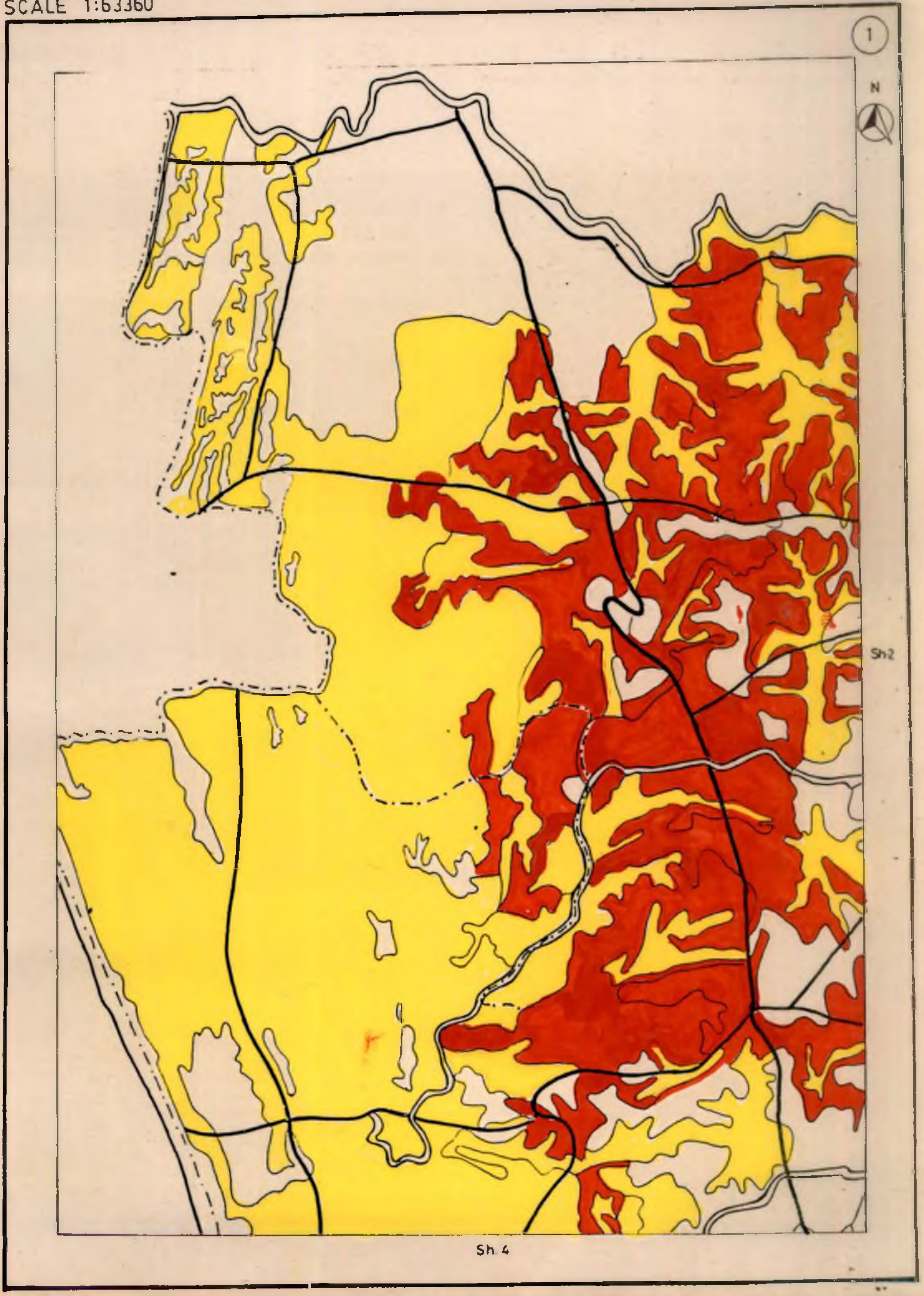
INDEX TO MAP SHEETS

1	2	3
4	5	6

KALLADA IRRIGATION PROJECT

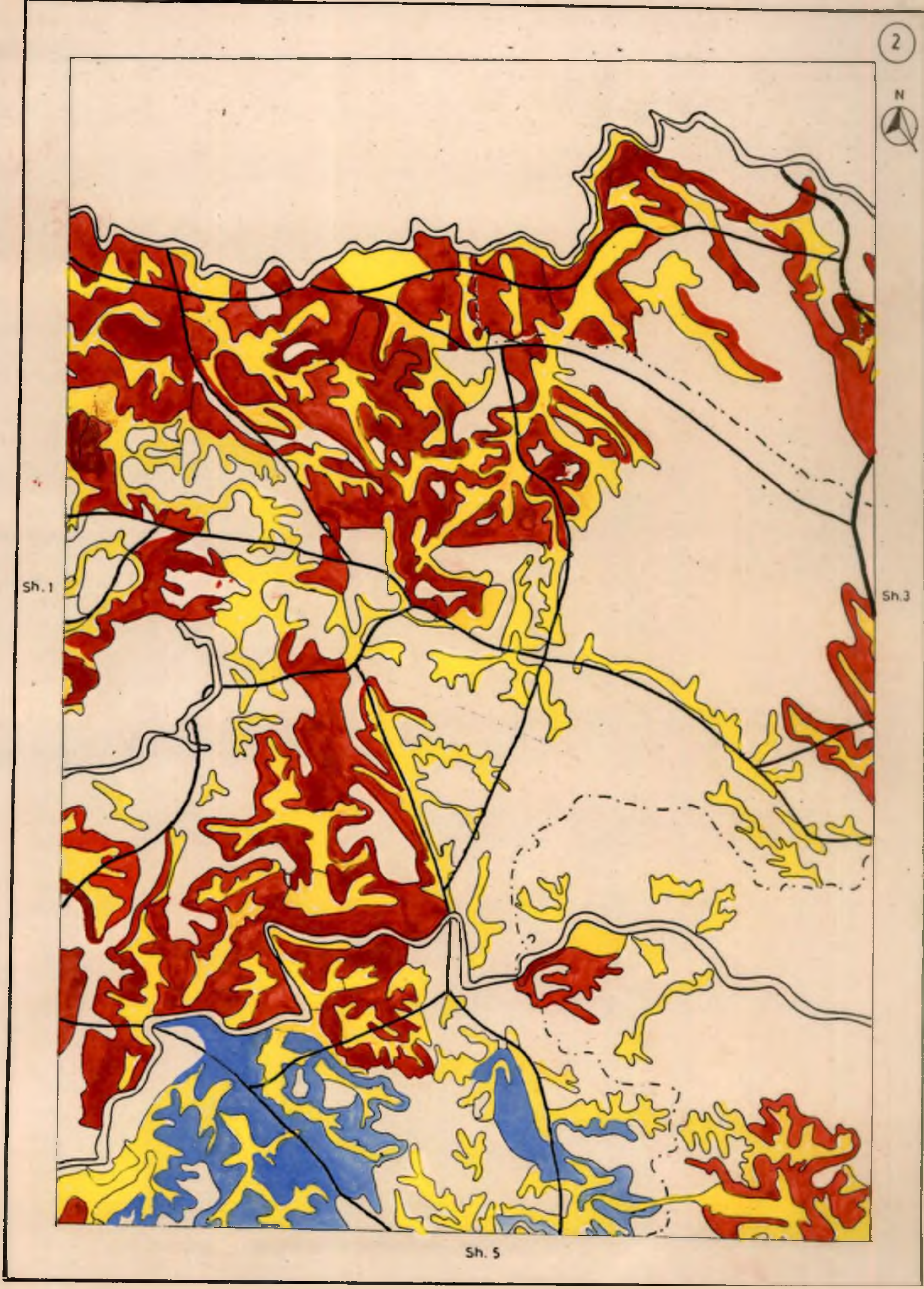
Land Irrigability Map

SCALE 1:63360



KALLADA IRRIGATION PROJECT
SCALE 1:63360

Land Irrigability Map



KALLADA IRRIGATION PROJECT

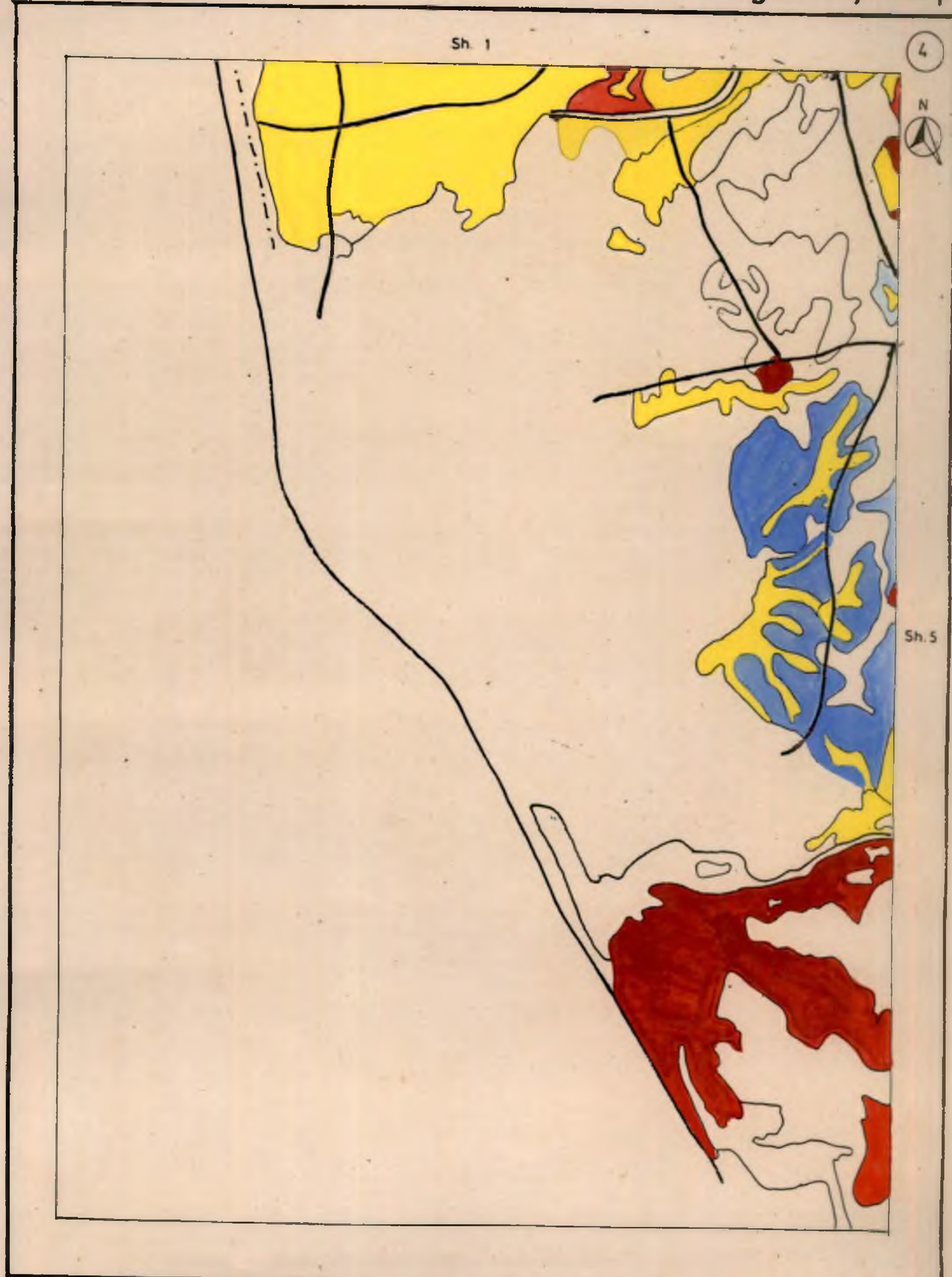
SCALE 1:63360

Land Irrigability Map

KALLADA IRRIGATION PROJECT

SCALE 1:63360

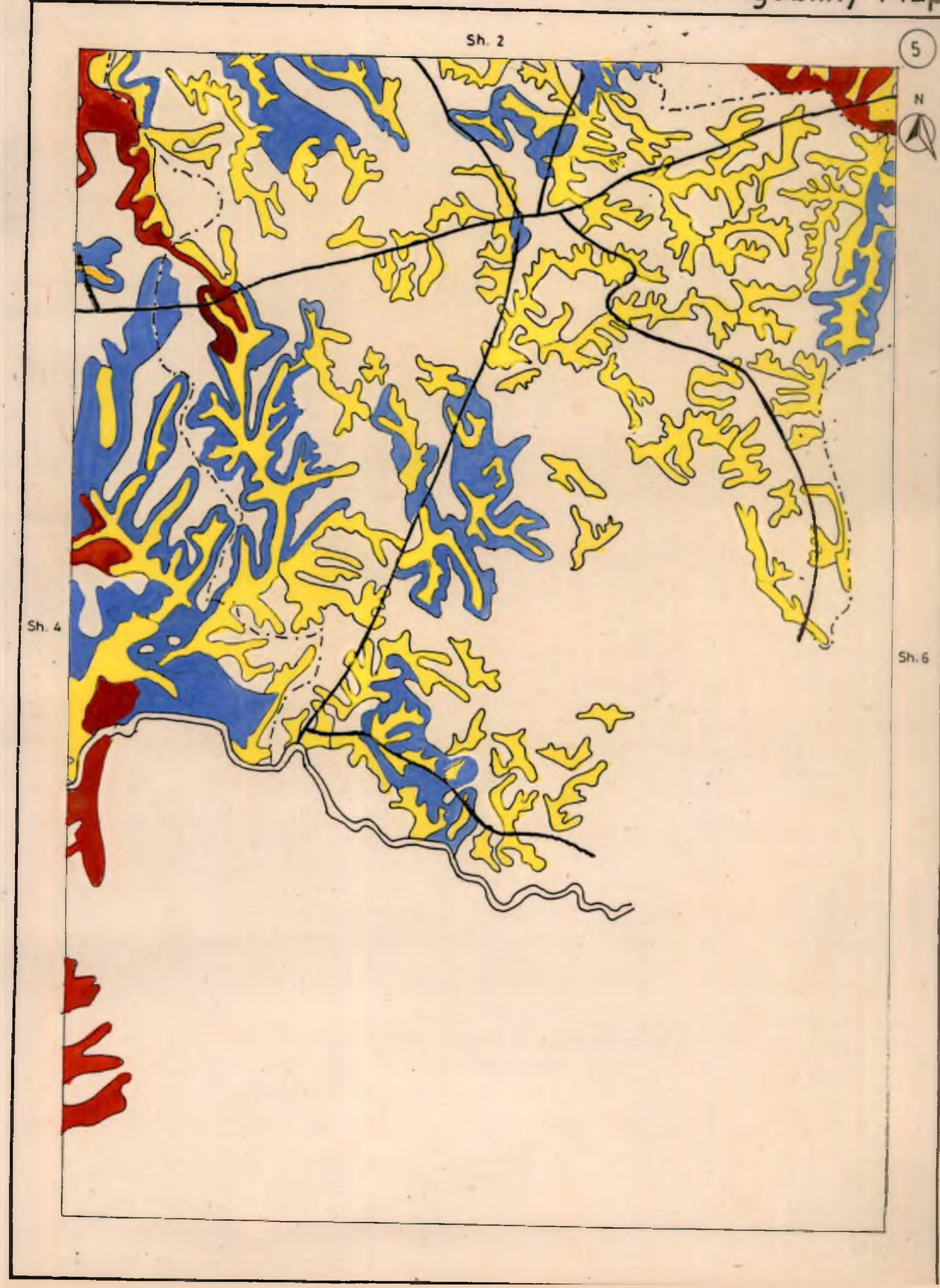
Land Irrigability Map



KALLADA IRRIGATION PROJECT

SCALE 1:63360

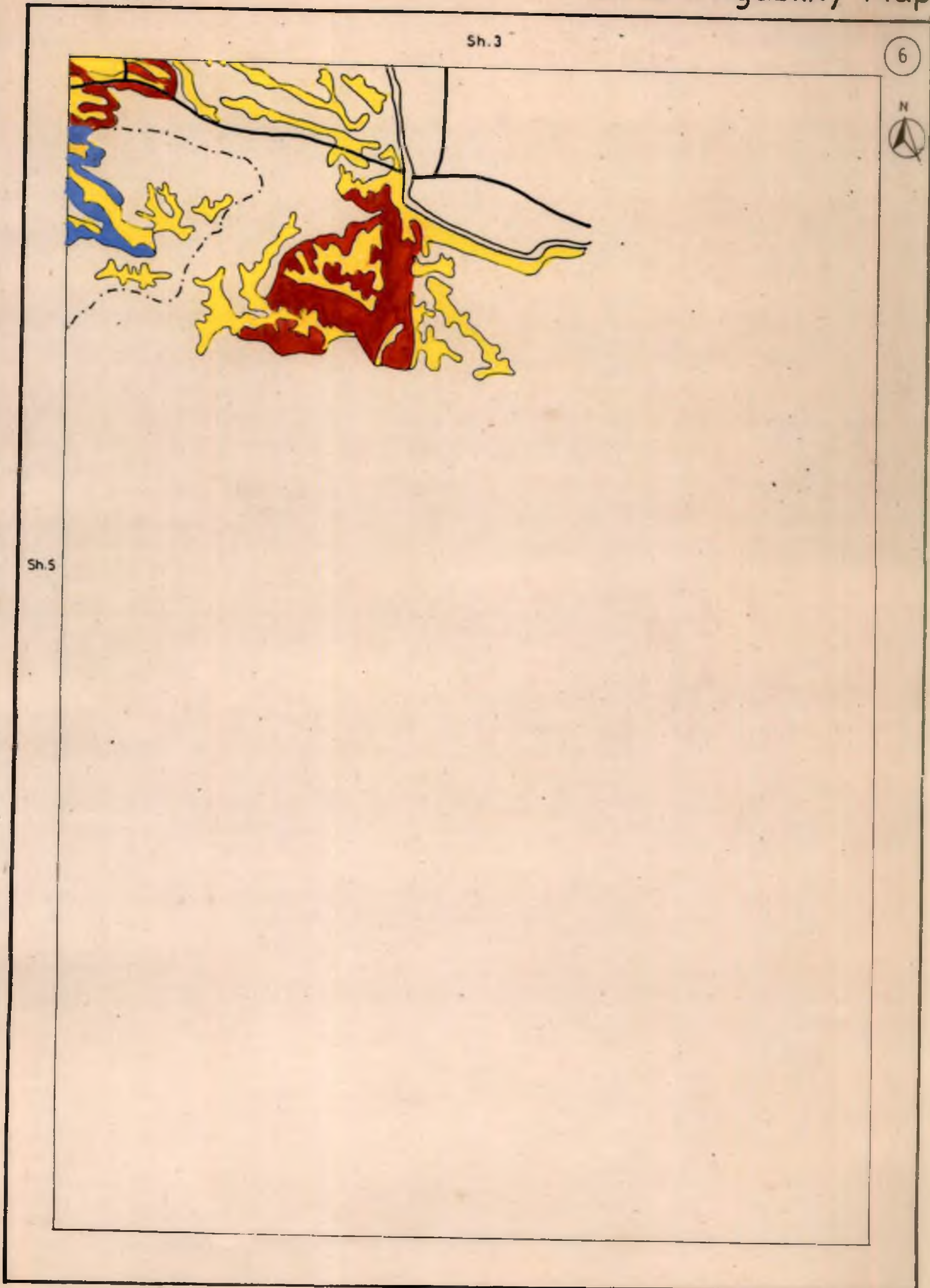
Land Irrigability Map



KALLADA IRRIGATION PROJECT

SCALE 1:63360

Land Irrigability Map



adding a suitable lower case letter for the concerned limitation such as 's' for soil factor, 't' for topography or terrain and 'd' for drainage requirement.

The land coming in the command area are grouped into three land irrigability classes namely class 2, class 3 and class 4. Table 11 gives area in hectares under different land irrigability class and sub classes. Based on the studies, map showing the distribution of land irrigability classes in the command area has been prepared.

Irrigability Class and Subclasses

Class-2

Lands have moderate limitations for sustained use under irrigation. An area of 24673.22 ha. of command area will fall under this Class. Lands coming under this class are located in lower topographical sites with very deep, coarse to medium textured soils, having low to medium waterholding capacity. These soils are depicted in the land irrigability map in yellow colour. The major limitations observed are impeded drainage in Sooranad, Mylom, Erath, Pooyapally and Kunnamkara series, soil limitations in mannar series and slight topographical limitations in kallada series. Hence the land irrigability class 2 is further subdivided into subclasses 2d, 2s, and 2t.

Class 2d

An area of 14098.74 ha of land coming under Sooranad, Mylom, Erath, Pooyappally and Kunnamkara series are grouped under this class. They are located on lower topographical sites with medium to heavy textured soils with medium to high water holding capacity and moderate infiltration. The major limiting factor is the impeded drainage during monsoon season. Water table reaches near the surface and excess water from the adjoining slopes are drained into these areas, creating an anaerobic condition. Providing proper drainage facilities is one of the important management requirement of these soils.

A partial drought conditions is experienced from January to May. Annuals grown in these soils need irrigation for a period of five months. These lands can be put under intensive agriculture round the year, if assured irrigation facilities are made available during the dry spell.

Class 2s

Lands have moderate limitation for sustained use under irrigation. An area of 8461.44 ha coming under Mannar series are grouped under this class. These soils are located on flat to gently sloping lands adjoining the coastal belts. The major limiting factor for irrigation is the sandy textural grade of the soil with very low water holding capacity. Eventhough water table is high in these localities, the soil cloum dries up immediately after the recession of monsoon due to its sandy textural nature and severe drought conditions prevails during the summer months. Eventhough the soil is poor in all major plant nutrients, the soils will respond to scientific management practices. A variety of crops both annuals & peranials can be grown successfully in these soils, if assured irrigation facilities are made available from the middle of December to June.

Class 2t:

Lands have moderate limitations for sustained use under irrigation. An area of 2113.04 ha coming under Kallada series are grouped under this class. They are located on very gently sloping to gently lands, adjoining the river banks and subjected to occasional flooding. Soils are medium to heavy textured with medium water holding and infiltration capacity. The limiting factor noticed in these soils are the slight gradient of the terrain.

All climatically adapted crops can be successfully grown in these soils, provided irrigation is made available during the dry spell prevalent in the area from the middle of January to middle of May.

Class 3t

Lands have severe limitation for sustained use under irrigation. An area of 11232.06 ha. coming under Adoor, Palamel, Bharanikavu and a portion of Kallada series are grouped under this class. These soils are moderately well drained, medium to heavy textured, having good physical properties, with varying amount of coarse fragments in the textural grade. The major limiting factor is the unfavorable topography. Gradient upto 10 percent are observed in these soils and hence flood irrigation is not practicable. The water table is low and partial drought period is experienced during January to the end of May. Irrigation is needed for all the crops grown in the area during the drought period.

Table 11 Area in ha. under diffeent land irrigability class & sub class

Sl. No.	land Irrigability class & sub-class	Area in ha	Major Limitation	Soil Series
1.	2d	14098.74	Drainage	Sooranad, Mylom Erath, Pooyappally, Kunnamkara.
2.	2s	8461.44	Sandy textural grade of the soil with very low water holding capacity	Mannar
3.	2t	2113.04	sight gradiant of the terrain	Kallada
4.	3t	11232.06	Topography	Adoor, Palamel Bharanikavu & portion of Kallada
5.	4t	525.20	Moderate slope	Adoor series

Class 4t

Lands that are marginal for sustained use under irrigation because of severe limitations. An area of 525.20 ha coming under Adoor series are grouped under this class. Soils are very deep,medium to heavy textured with medium infiltration and waterholding capacity. Major limitations for irrigation is the moderate slope of the land. Flood irrigation is not possible.

2.Productivity Rating

The four important crops namely paddy,coconut tapioca and banana are considered for suitabilty rating. The ratings of the soil properties against the productivity index showed the following features. The productivity index for the soil series are given in table.12.The rating of prductivity classes are given in table.13.

2.1. Productivity Rating of Soil Properties for Paddy

The productivity rating shows that Kunnamkara series having a rating of 38.7 percent ranks first in the very good rating class among the five rice soil series and the Erath series ranks last with only 8.2 percent in

Table No.12. Productivity Index code For The Soil Series Under Study

Name of soil series	Texture	Depth	pH	CEC	BS	EC	Nutrient Combination class	Coarse fragm-ents	Slope	Drainage
Kallada (Kld)	T8	R5	H3	C2	B2	E5	N11	G5	S1	D3
Bharanikavu (Bky)	T8	R5	H3	C2	B2	E5	N18	G5	S2	D3
Mannar (Mnr)	T2	R5	H5	C4	B4	E5	N9	G5	S1	D5
Adoor (Adr)	T8	R5	H5	C2	B2	E5	N18	G3	S3	D4
Palamel (Pml)	T3	R5	H3	C2	B2	E5	N11	G4	S2	D4
Mylom (Mlm)	T9	R5	H4	C2	B3	E5	N17	G5	S1	D2
Erath (Erh)	T12	R5	H4	C1	B2	E4	N18	G3	S2	D2
Pooyappally (Pyp)	T8	R5	H4	C2	B3	E5	N18	G4	S2	D2
Sooranad (Snd)	T3	R5	H4	C2	B3	E5	N8	G5	S2	D2
Kunnamkara (Knk)	T8	R5	H5	C2	B3	E5	N11	G5	S1	D2

Table-13 RATING OF PRODUCTIVITY CLASSES

SL.NO.	Productivity Class	Rating
1	Excellent	65-100
2	Very Good	35-64
3	Good	25-34
4	Average	20-24
5	Poor	8-19
6	Extremely Poor	0- 7

Table 14. Productivity rating of soil properties for paddy

Name of Series	Productivity Index Code	Productivity Calculation	Rating %
Mylom	T9,R5,H4,C2,B3,E5,N17,G5,S1,D2	(90/100)*(100/100)*(100/100)*(80/100)*(85/100)*(100/100)*(70/100)*(100/100)*(100/100)*(80/100)=0.342	34.2
Erath	T2,R5,H4,C1,B2,E4,N18,G3,S2,D2	(70/100)*(100/100)*(100/100)*(50/100)*(80/100)*(90/100)*(65/100)*(70/100)*(90/100)*(80/100) =0.082	8.2
Pooyappally	T8,R5,H4,C2,B3,E5,N18,G4,S2,D2	(95/100)*(100/100)*(100/100)*(80/100)*(85/100)*(100/100)*(65/100)*(80/100)*(90/100)*(80/100) =0.241	24.1
Sooranad	T3,R5,H4,C2,B3,E5,N8,G4,S2,D2	(50/100)*(100/100)*(100/100)*(80/100)*(85/100)*(100/100)*(55/100)*(100/100)*(90/100)*(80/100) =0.134	13.4
Kunnamkara	T8,R5,H5,C2,B3,E5,N11,G5,S1,D2	(95/100)*(100/100)*(100/100)*(80/100)*(85/100)*(100/100)*(75/100)*(100/100)*(100/100)*(80/100)=0.387	38.7

the poor rating class. Mylom series ranks second with a rating of 34.2 percent and included in the productivity class, 'Good'.The Pooyappally series is placed in the average rating class with a rating of 24.1 and Sooranad in the poor rating class with the rating of 13.4. Table 14 gives the rating of soils for paddy.

2.2. Productivity Rating for Coconut

Palamel series having a rating of 31.4 percent ranks first among the ten soils and Erath series ranks last with only 8.5 percent rating. Out of the ten soil series, Palemel,Kallada, Mylom and Kunnakkara are placed under the productivity rating of class 'Good'.

Bharanikavu, Pooyappally and Sooranad are placed under the productivity rating class 'Average'.Adoor and Mannar series come under the poor productivity class. Productivity ratings are given in table 15.

2.3. Productivity Rating for Tapioca:-

Kallada series having a rating of 27.6 percent ranks first for tapioca and come under the good productivity class and Erath series ranks last with

Table 15. Productivity Rating of soil properties for coconut

Name of Series	Productivity Index Code	Productivity Calculation		Rating %
Kallada	T8,R5,H3,C2,B2,E5,N11,G5,S1,D3	(80/100)*(100/100)*(90/100)*(80/100)*(80/100)*(100/100)*(75/100)*(100/100)*(100/100)*(90/100)	= 0.311	31.1
Bharanikavu	T8,R5,H3,C2,B2,E5,N18,G5,S2,D3	(80/100)*(100/100)*(90/100)*(80/100)*(80/100)*(100/100)*(65/100)*(100/100)*(90/100)*(90/100)	= 0.242	24.2
Mannar	T2,R5,H5,C4,B4,E5,N9,G5,S1,D5	(65/100)*(100/100)*(100/100)*(90/100)*(90/100)*(100/100)*(50/100)*(100/100)*(100/100)*(60/100)	= 0.157	15.7
Adoor	T8,R5,H5,C2,B2,E5,N18,G3,S3,D4	(80/100)*(100/100)*(100/100)*(80/100)*(80/100)*(100/100)*(65/100)*(80/100)*(80/100)*(90/100)	= 0.191	19.1
Palamel	T3,R5,H3,C2,B2,E5,N11,G4,S2,D4	(90/100)*(100/100)*(90/100)*(80/100)*(80/100)*(100/100)*(75/100)*(90/100)*(90/100)*(100/100)	= 0.314	31.4
Mylom	T9,R5,H4,C2,B3,E5,N17,G5,S1,D2	(75/100)*(100/100)*(100/100)*(80/100)*(85/100)*(100/100)*(70/100)*(100/100)*(100/100)*(75/100)	= 0.267	26.7
Erath	T12,R5,H4,C1,B2,E4,N18,G4,S2,D2	(60/100)*(100/100)*(100/100)*(50/100)*(80/100)*(90/100)*(65/100)*(90/100)*(90/100)*(75/100)	= 0.085	8.5
Pooyappally	T8,R5,H4,C2,B3,E5,N18,G4,S2,D2	(80/100)*(100/100)*(100/100)*(80/100)*(85/100)*(100/100)*(65/100)*(90/100)*(90/100)*(75/100)	= 0.214	21.4
Sooranad	T3,R5,H4,C2,B3,E5,N8,G5,S2,D2	(90/100)*(100/100)*(100/100)*(80/100)*(85/100)*(100/100)*(55/100)*(100/100)*(90/100)*(75/100)	= 0.227	22.7
Kunnamkara	T8,R5,H5,C2,B3,E5,N11,G5,S1,D2	(80/100)*(100/100)*(100/100)*(80/100)*(85/100)*(100/100)*(75/100)*(100/100)*(100/100)*(75/100)	= 0.306	30.6

Table 16. Productivity rating of soil properties for tapioca

Name of Series	Productivity Index Code	Productivity Calculation	Rating %
Kallada	T8,R5,H3,C2,B2,E5,N11,G5,S1,D3	(80/100)*(100/100)*(80/100)*(80/100)*(80/100)*(100/100)*(75/100)*(100/100)*(100/100)*(90/100) = 0.276	27.6
Bharanikavu	T8,R5,H3,C2,B2,E5,N18,G5,S2,D3	(80/100)*(100/100)*(80/100)*(80/100)*(80/100)*(100/100)*(65/100)*(100/100)*(90/100)*(90/100) = 0.215	21.5
Mannar	T2,R5,H5,C4,B4,E5,N9,G5,S1,D5	(50/100)*(100/100)*(100/100)*(90/100)*(90/100)*(100/100)*(50/100)*(100/100)*(100/100)*(70/100)= 0.141	14.1
Adoor	T8,R5,H5,C2,B2,E5,N18,G3,S3,D4	(80/100)*(100/100)*(100/100)*(80/100)*(80/100)*(100/100)*(65/100)*(70/100)*(80/100)*(100/100) = 0.186	18.6
Palamel	T3,R5,H3,C2,B2,E5,N11,G4,S2,D4	(55/100)*(100/100)*(80/100)*(80/100)*(80/100)*(100/100)*(75/100)*(90/100)*(90/100)*(100/100) = 0.171	17.1
Mylom	T9,R5,H4,C2,B3,E5,N17,G5,S1,D2	(85/100)*(100/100)*(100/100)*(80/100)*(85/100)*(100/100)*(70/100)*(100/100)*(100/100)*(60/100)= 0.242	24.2
Erath	T12,R5,H4,C1,B2,E4,N18,G4,S2,D2	(60/100)*(100/100)*(100/100)*(50/100)*(80/100)*(90/100)*(65/100)*(90/100)*(90/100)*(60/100) = 0.068	6.8
Pooyappally	T8,R5,H4,C2,B3,E5,N18,G4,S2,D2	(80/100)*(100/100)*(100/100)*(80/100)*(80/100)*(100/100)*(65/100)*(90/100)*(90/100)*(60/100) = 0.161	16.1
Sooranad	T3,R5,H4,C2,B3,E5,N8,G5,S2,D2	(55/100)*(100/100)*(100/100)*(80/100)*(80/100)*(100/100)*(55/100)*(100/100)*(90/100)*(60/100)= 0.104	10.4
Kunnamkara	T8,R5,H5,C2,B3,E5,N11,G5,S1,D2	(80/100)*(100/100)*(100/100)*(80/100)*(80/100)*(100/100)*(75/100)*(100/100)*(100/100)*(60/100)= 0.230	23.0

only 6.8 percent rating. Bharanikavu, Mylom and Kunnamkara series are placed under the average productivity class. Mannar, Adoor, Palamel, Pooyappally and sooranad series are grouped under the poor rating class. The ratings are given in table 16.

2.4. **Productivity Rating for Banana:-**

The Kallada series having a rating of 38.8 percent ranks top for banana which will come under the very good productivity class and Erath series occupies the last position with a rating of 9.1 percent. Bharanikavu, Mylom and Kunnamakara series are grouped under good productivity class. Adoor and Pooyappally series are placed in the average productivity class. Mannar, Palamel and Soornad series are grouped under the poor productivity class. The productivity rating for banana are given in table 17.

3. PROPOSED LAND USE

The command area is predominantly an agricultural tract with 75 per cent of the population depending on agriculture, for their liveli-hood. The holdings are fragmented and small. Holdings are especially smaller in the western portion, compared to the bigger sized holdings, in the east. Different kinds of crops like paddy, coconut,

Table 17. Productivity rating of soil properties for banana

Name of Series	Productivity Index Code	Productivity Calculation	Rating %
Kallada	T8,R5,H3,C2,B2,E5,N11,G5,S1,D3	(90/100)*(100/100)*(90/100)*(80/100)*(80/100)*(100/100)*(75/100)*(100/100)*(100/100)*(100/100) = 0.388	38.8
Bharanikavu	T8,R5,H3,C2,B2,E5,N18,G5,S2,D3	(90/100)*(100/100)*(90/100)*(80/100)*(80/100)*(100/100)*(65/100)*(100/100)*(90/100)*(100/100) = 0.303	30.3
Mannar	T2,R5,H5,C4,B4,E5,N9,G5,S1,D5	(50/100)*(100/100)*(100/100)*(90/100)*(90/100)*(100/100)*(50/100)*(100/100)*(100/100)*(70/100) = 0.141	14.1
Adoor	T8,R5,H5,C2,B2,E5,N18,G3,S3,D4	(90/100)*(100/100)*(100/100)*(80/100)*(80/100)*(100/100)*(65/100)*(70/100)*(80/100)*(100/100) = 0.209	20.9
Palamel	T3,R5,H3,C2,B2,E5,N11,G4,S2,D4	(55/100)*(100/100)*(90/100)*(80/100)*(80/100)*(100/100)*(75/100)*(90/100)*(90/100)*(100/100) = 0.192	19.2
Mylom	T9,R5,H4,C2,B3,E5,N17,G5,S1,D2	(85/100)*(100/100)*(100/100)*(80/100)*(85/100)*(100/100)*(70/100)*(100/100)*(100/100)*(70/100) = 0.283	28.3
Erath	T12,R5,H4,C1,B2,E4,N18,G3,S2,D2	(65/100)*(100/100)*(100/100)*(50/100)*(80/100)*(90/100)*(65/100)*(70/100)*(90/100)*(70/100) = 0.091	9.1
Pooyappally	T8,R5,H4,C2,B3,E5,N18,G4,S2,D2	(90/100)*(100/100)*(100/100)*(80/100)*(85/100)*(100/100)*(65/100)*(90/100)*(90/100)*(70/100) = 0.225	22.5
Sooranad	T3,R5,H4,C2,B3,E5,N8,G5,S2,D2	(55/100)*(100/100)*(100/100)*(80/100)*(85/100)*(100/100)*(55/100)*(100/100)*(100/100)*(70/100) = 0.143	14.3
Kunnamkara	T8,R5,H5,C2,B3,E5,N11,G5,S1,D2	(90/100)*(100/100)*(100/100)*(80/100)*(85/100)*(100/100)*(75/100)*(100/100)*(100/100)*(70/100) = 0.321	32.1

tapioca, banana, arecanut, vegetables, pulses, oil seeds and pepper are grown in the area. Only four important crops namely paddy, coconut, banana and tapioca are taken into consideration for this present study.

The detailed study of the major soils of the command area was undertaken. The soil limitations observed are low fertility status, slight erosion, slightly to strongly acidic condition and in some cases coarse textural grades and excessive moisture as a resut of impeded drainage. In general the soils of the command area exhibit good physical properties which can be beneficially utilised for irrigated agriculture. A certain degree of changes in the physical and chemical properties of the soils can be expected in the altered regime brought about by the introduction of irrigation.

After studying in detail the various soil characteristics, its capabilities, fertility status and socio-economic conditions of the farmers the follwing land use is proposed for the ten major soil series of the command area. The table 18 shows the crop ranking for the ten soil series based on productivity rating.

Table 18. Crop ranking based on productivity rating

Sl. No.	Name of Soil Series	Crop ranked in the order
1.	Kallada	Banana-Coconut-Tapioca
2.	Bharanikkavu	Banana-Coconut-Tapioca
3.	Mannar	Coconut-Banana-Tapioca
4.	Adoor	Banana-Coconut-Tapioca
5.	Palamel	Coconut-Banana-Tapioca
6.	Mylom	Paddy-Banana-Coconut-Tapioca
7.	Erath	Banana-Coconut-Paddy-Tapioca
8.	Pooyapally	Paddy-Banana-Coconut-Tapioca
9.	Sooranad	Coconut-Banana-Paddy-Tapioca
10.	Kunnamkara	Paddy-Banana-Coconut-Tapioca

PROPOSED LAND USE MAP
OF
THE COMMAND AREA
OF

KALLADA IRRIGATION PROJECT

CROP RANKING

(red)	Kallada, Bharanikavu, Adoor	Banana-Coconut-Tapioca
(yellow)	Mannar, Palamel	Coconut-Banana-Tapioca
(green)	Mylom, Pooyappally, Kunnamkara	Paddy-Banana-Coconut-Tapioca
(dark brown)	Erath	Banana-Coconut-Paddy-Tapioca
(orange)	Sooranad	Coconut-Banana-Paddy-Tapioca

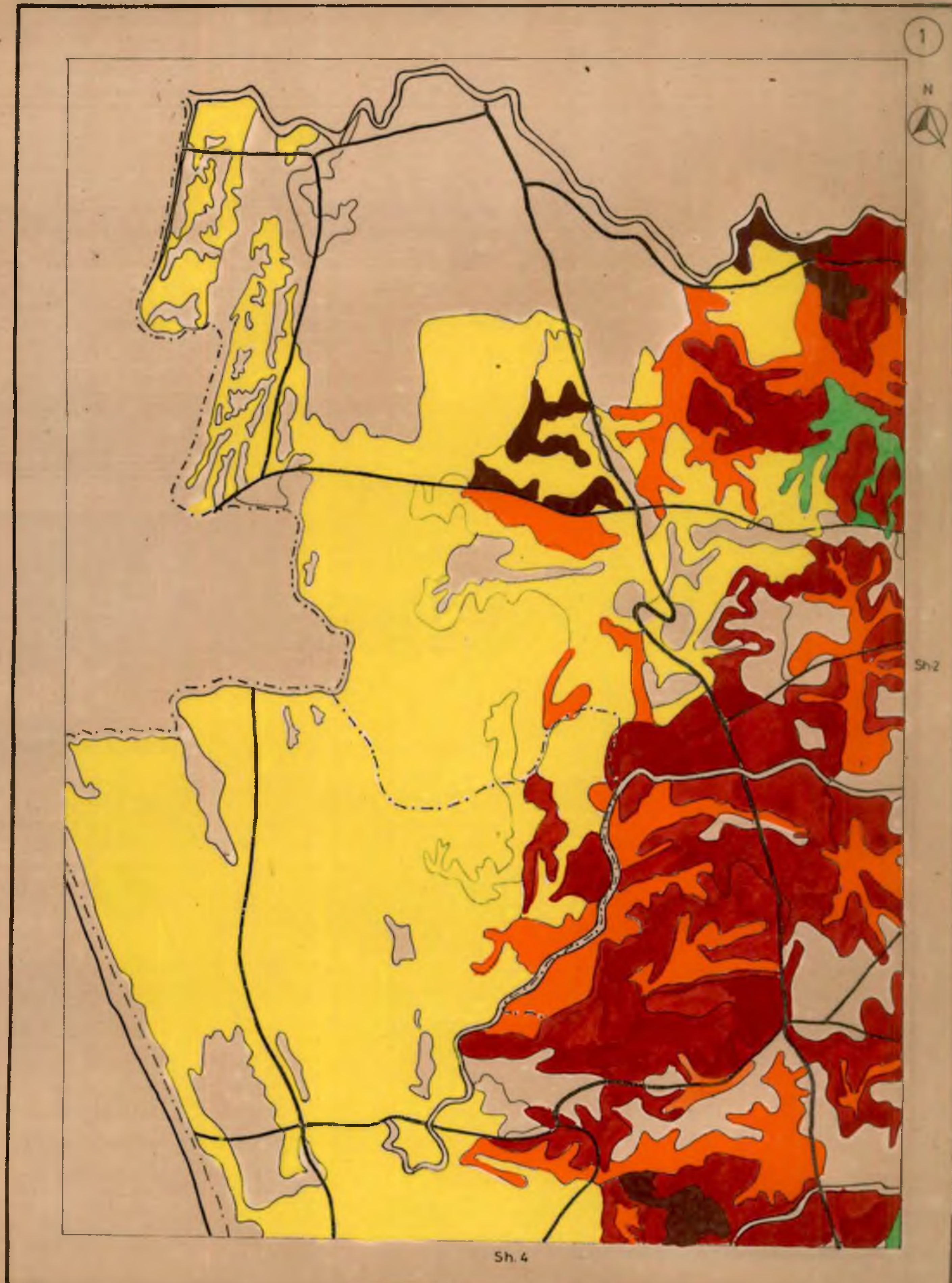
INDEX TO MAP SHEETS

1	2	3
4	5	6

KALLADA IRRIGATION PROJECT

SCALE 1:63360

Land Use Map



KALLADA IRRIGATION PROJECT

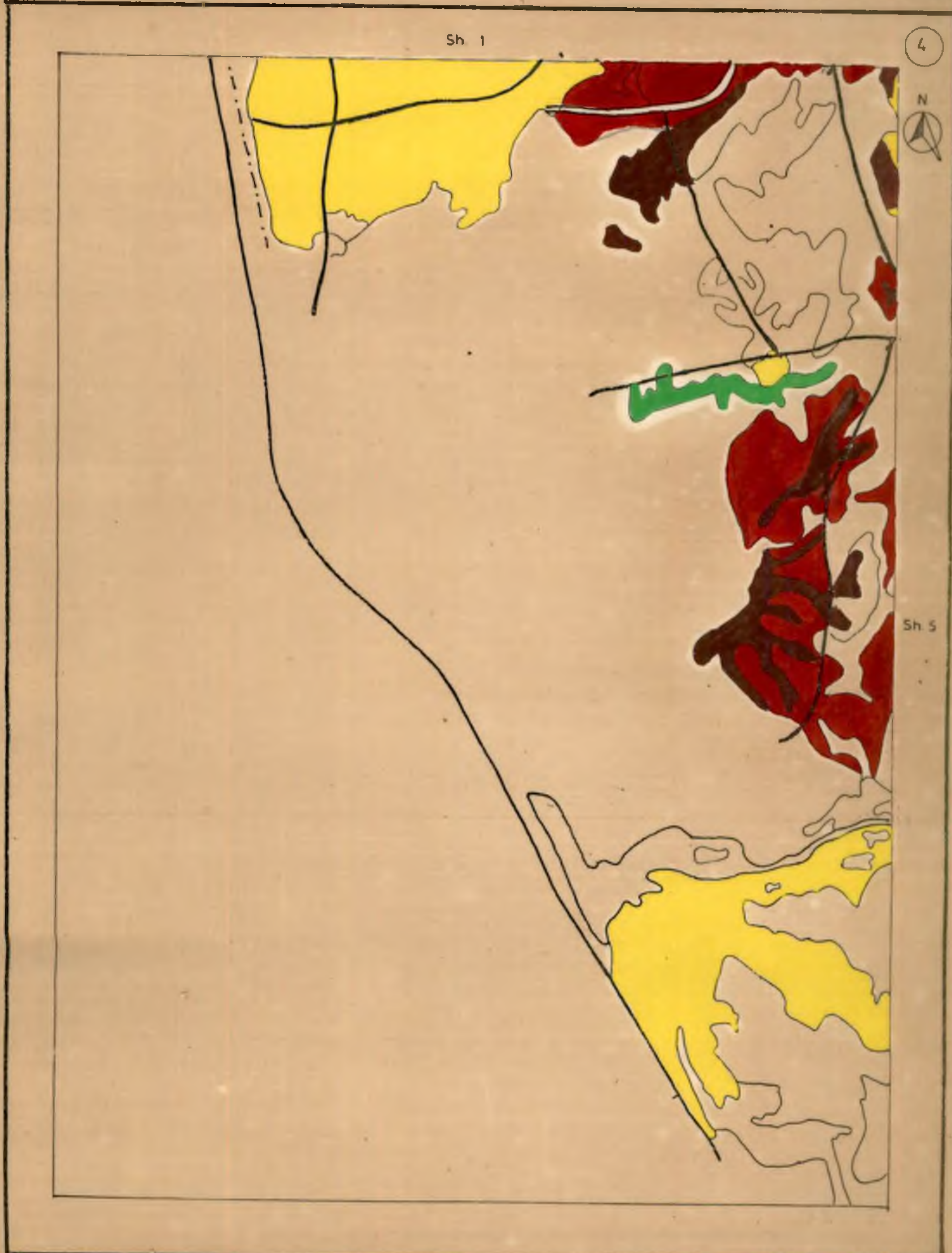
SCALE 1:63360

Land Use Map

KALLADA IRRIGATION PROJECT

SCALE 1:63360

Land Use Map



KALLADA IRRIGATION PROJECT

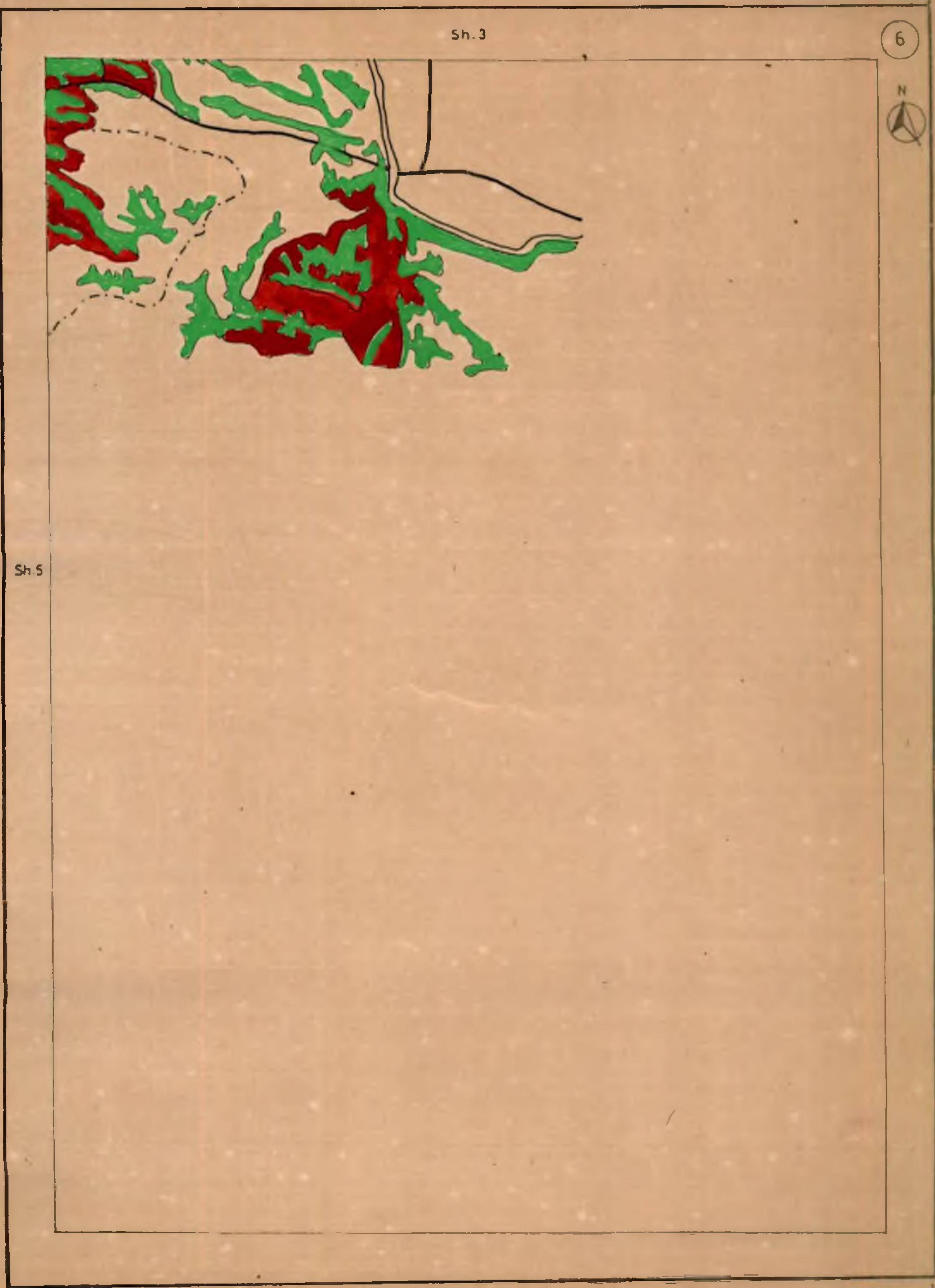
SCALE 1:63360

Land Use Map

KALLADA IRRIGATION PROJECT

SCALE 1:63360

Land Use Map



3.1. Kallada soil series

As per the productivity ranking, this soil is best suited for banana followed by coconut and tapioca. Since a mixed cropping system prevails in the locality it is advisable to continue a coconut dominated cropping system, with coconut as the perennial crop and banana or tapioca as annual intercrop.

3.2 Bharanikavu Soil Series

The ranking shows that banana, coconut and tapioca are the crops suited for this soil series. Since the productivity rating is similar to that of Kallada, the land use suggested for Kallada can be followed for Bharanikavu also.

3.3 Mannar Soil Series

As per the productivity rating, the soil is best suited for coconut followed by banana and tapioca. Since coarse textural grade dominate the soil, a coconut dominated cropping system with banana as intercrop is suggested. Tapioca, though equally suited as intercrop, requires more management inputs.

3.4 Adoor Soil Series

The soil is best suited for banana, coconut and tapioca. The area is mainly inhabited and holdings are fragmented and homstead farming is being practised . Hence the cropping system suggested is coconut as the perennial crop and banana or tapioca as intercrop .

3.5 Palamel soil series

This soil series is best suited for coconut , followed by banana and tapioca. A coconut dominated cropping system with banana or tapioca as intercrop is suggested.

3.6 Mylom soil series

As per the ranking, the soil is best suited for paddy followed by banana, coconut and tapioca. Paddy as the major crop and banana and tapioca in rotation can be grown. Eventhough the soil is suited for coconut cultivation, it is not suggested, since conversion of paddy field to coconut is against the policy of the State Government.

3.7 Erath soil series

The ranking shows that the soil is suited for banana, followed by coconut, paddy and tapioca. Major crop grown at present is paddy. The paddy can be rotated with banana or tapioca. Coconut is not suggested for reasons stated above.

3.8 Pooyapally soil series

As per productivity rating, the crops in order are paddy, banana, coconut and tapioca. The area is cultivated to paddy at present. Paddy can be rotated with banana or tapioca. Coconut is not suggested for reasons mentioned in Mylom.

3.9 Sooranad soil series

The crops ranked are coconut, banana, paddy and tapioca. Eventhough the soil is suited for coconut cultivation, it is not recommended due to the existing land use policy of the state. Paddy can be rotated with banana or tapioca.

3.10 Kunnamkara soil series

This soil is best suited for paddy. However paddy can be rotated with banana or tapioca. Coconut is not suggested.

SUMMARY

The present study was undertaken covering the ten identified important soil series of the command area of Kallada Irrigation Project, with the objective of evaluating the soils based on their morphological and physio chemical characterstics. The soil series selected are Mannar, Adoor, Sooranad, Palamel, Mylom, Erath, Bharanikavu, Kallada, Pooyappally and Kunnamkara.

Profile pits were dug in the typical areas identified and the morphological features observed were recorded as per Soil Survey Manual (1970). The salient features of the area in respect of location, physiography, drainage, vegetation and land use were recorded. The physical and chemical properties of the soil samples collected were determined by standard analytical preocedures. These soil series have been evaluated on the basis of land evaluation and rating of productivity parameters

The productivity parameters considered in the present study include soil texture, depth, soil reaction, drainage, cation exchange capacity, base saturation, electrical conductivity, coarse fragments, slope and

nutrient status. For each parameter, a range of scale is prepared and numerical values assigned, based on principles of land evaluation. Productivity of the soil has been calculated by multiplying the ratings of the individual parameters, and expressed as percentage. The salient findings are summarised below.

The soil series selected have been classified as per the comprehensive soil classification system :- Soil Taxonomy (U.S. Soil Survey Staff, 1975).

1. Out of the ten soil series selected for the study five series namely Kallada, Mannar, Erath, Pooyappally and Kunnamkara are grouped under the order Entisol. Four series namely Bharanikkavu, Palamel, Mylom and Soornad are classified under the order Inceptiol and Adoor series under Ultisol.

2. Based on the characterstics of the soils, land capability classification has been made. Soils of the command area taken for study have been grouped into three land capability classes, namely class II, III and IV. Depending upon the kind of problem or limitations involved, the soil series under study are grouped into class and sub class.

3. The Kallada soil series with an extent of 2113.04 ha falls under the capabiity class IIe. Slight erosion, slightly to strongly acidic conditions and poor fertility status are the problems associated with these soils.

4. The Sooranad, Mylom, Erath, Pooyappally and Kunnamkara soil series are grouped under the capability class IIw covering an area of 14098.74 ha of the command area.Excessive moisture due to impeded drainage and water logging during monsoon period are the major problems.

5. Palamel, Bharanikavu, major part of Adoor and a portion of Kallada soil series falls under the capability class IIIe covering an area of 11232.06 ha.

6. The Mannar soil series, covering an area of 8641.14 ha comes under the land capability class III sc. Soil and climate are the main limitation of these soils.

7. A portion of Adoor series covering an area of 525.20 ha is grouped under class IV e. Moderate to severe erosion hazard depletion of plant nutrients, low fertility status and medium acidity are some of the problems encountered in these soils.

8. The soil series selected for study are grouped into three land irrigability classes namely class2, class3 and class4. Based on the type of limitation, the soil series are subdivided into irrigability classes and sub classes.

9. An area of 14098.74 ha of land coming under Sooranad, Mylom, Erath, Pooyappally and Kunnamkara series are grouped under the irrigability class 2d. The major limiting factor is the impeded drainage during monsoon season.

10. The Mannar soil series with an area of 8461.44 ha is grouped in the irrigability class 2s. The sandy textural grade of the soil with very low waterholding capacity is the major limitation.

11. An area of 2113.04 ha coming under Kallada series is grouped under the irrigability class 2t. The slight gradient of the terrain is the limiting factor.

12. An area of 11232.06 ha coming under Adoor, Palamel, Bharanikavu and a portion of Kallada series are classified in the irrigability class 3t. The major limiting factor is the unfavourable topography.

13. A portion of Adoor series with an extent of 525.20 ha is classified in the irrigability class 4t.

14. The productivity rating of the soil against the productivity index for paddy, coconut, tapioca and banana showed the following results.

15. The productivity ratings for paddy shows that the Kunnamkara series having a rating of 38.7 percent ranks first in the very good rating class among the five rice soil series and the Erath series ranks the last with only 8.2 percent.

16. The study shows that the Erath soil series is the least productive for paddy, coconut, tapioca and banana among the ten soil series.

17. The productive rating for coconut shows that Palamel series having a rating of 31.4 percent ranks first, with good rating class.

18. The Kallada soil series with a rating of 27.6 percent ranks first for tapioca with good productivity rating class.

19. The productivity rating for banana shows that the Kallada soil series with a rating of 38.8 percent ranks top in the very good rating class.

20. After studying in detail the various soil characteristics, its capabilities, fertility status and socio-economic conditions of the farmers a land use is proposed for the ten major soil series of the command area.

REFERENCES

REFERENCES

Abdul Kadir, A. (1987). Some methodological arguments in interrelationships among land evaluation , soil survey and land use planning. Soils and Fertilizers 53 (3): 372pp.

Alaily, F. (1987). Evaluation of agriculturally useful land in South West Egypt. Milteilungm der Deutschen Bodenkundlichan Gesellschaff 55 (ii): 681-686.

Altmann, R. (1986). Estimating the production potential of agricultural land by a classification process. 23 (3): 305-324.

Anilan, R. (1983). Classification of Rice lands in Trivandrum District based on productivity parameters. P.G Diploma Dissertation submitted to K.A.U.

Aosunade, M.A. (1987). A viable method of land capability classification for small farmers. Journal of Environmental Management. 25 (i): 81-94.

Austin Joseph . (1982). Preparation of crop suitability maps for Trivandrum District. P.G. Diploma Dissertation submitted to K.A.U.

Bali,Y.P. and Karale, R.L.(1978). Soil Survey Interpretations of Watershed Development. In: Soil Resource Data for Agricultural Management. ed. Leslie.D.Swindale. Howaii Agricultural Experiment station, College of Tropical Agriculture, University of Howaii.

Bedrna, Z.(1989). Land productivity evaluation. Ekologia cssR. 8 (4) : 369-374.

Bishnol, O.P. (1981). Crops and cropping pattern in Agricultural Geography. 4.ed. Noor Mohammed.

Bleeker, P. and Lant,P.(1987). A soil survey and land evaluation for oil palm and cashewnut of the lockhant. River valley, Cape York, Queensland; In. Divisional Report. Division of water and Land Resources, CSIRD, Australia.

Burrough, P.A. (1989). Fuzzy mathematical methods for soil survey and land evaluation. J .Soil Sci . 40(3): 477-492

Calvo,R., Blazquez,R. and Macias,F. (1987). Land Evaluation in a Mountaineous area of Golicia (NWSpain).Anales de Edafologia.Y. Agrobiologia. 46 (7-8): 897-908.

Challa,O., Kalhande, A.R.,Durge,S.L. and Vadivelu,S. (1989). Land evaluation for irrigation by two systems. J . Ind. Soc . Soil sci. 37(3): 532-538

Chan, H.Y. (1978). Soil Survey Interpretation for improved Rubber Production in peninsular Malayasia. In: Soil Resource Data for Agricultural Management ed. Leslie D. Swindale. Howaii Agricultural Experiment Station , College of Tropicel Agriculture, University of Hawaii.

Chan, H.Y, Vew, F.K. and Pushparajah, E. (1984). Approaches towards land evaluation systems for Hevia brasiliensis cultivation in peninsular Malayasia. Proceeding of the international Rubber conference 75 years of rubber research in Sri Lanka. Vol. 1 Part II:17-19.

Eckelmann, N. and Raissi, F. (1987). Soil evaluation maps as a planning frame work for land consolidation. Mitteilungen der Deutchen Boderkundlichen Cresellschaft. 55 (ii) : 741-744.

Eibirsen, G.W., Ismangun, Sutaatmadja, D.S.and Solihin, A.A. (1988). Small scale soil survey and automated land evaluation. International Institute for Aerial Survey and Earth Sciences. 1 : 51-59.

Embrechts, J. Pocloengan, Z. and Sys,K. (1987). Physical land evaluation using a parametric method. Application to oil palm plantation in North Sumatra, Indonesia. Soil survey and land evaluation. 8 (2): 111-122.

FAO. (1976). A Frame work for land evaluation. FAO Soils Bullettin. No32.

FAO. (1988).. Guidelines: land evaluation for rainfed agriculture. FAO Soils Bullettin No.52. 220 pp

Farshad,A. and Wijinhoud, S. (1987). A contribution to land evaluation of the wet-upland areas in SriLanka. Pedologic. 37 (3): 277-297.

Gatahi, M.M. and D'Costa, V. (1988). Land suitability evaluation of red soils in the killfi- kwale coastal area, Kenya. IRDC Manuscript Reports No:170 :279-295.

Gavrilyuk, F.Y.(1988). The urgent need for soil evaluation Nauchnye Doklady Vysshel Shkorly, Biologicheskie Nauki.No.1, 99-102.

Gbadegesin, A. (1987). Soil rating for crop production in the Savanna belt of south-western Nigeria. Agricultural systems. 23 (i) :27-42.

Gil, J., Corral, L. and Paneque, G.(1) (1987). Soil survey and land evaluation in the Marmolejo Manjibar (Jaen) region of the Guodalquivir valley. I.Soil geomorphology relationships. Anales de Edofalogia. Y. Agrobiologia 46 (Y2) :67-89.

Gil, J., Corral, L. and Panequa, G. (2) (1987). Soil survey and land evaluation in the Guadalquivir valley, Marmolejo Manjibar (jaen) Zone. V. Soil Capability. Anales de Edafologia .Y. Agrobiologia. 46 (5-6); 687-694.

Harding, P.E., Bleeker, P., and Freyne, D.F. (1986). Hand Book for land suitability evaluation for rainfed arabica coffee production in Papua New Guinea. Coffee Research Report. No: 3.134 .
pp

Hernaandez Silva, G. (1985). Application of the parameteric method to the evaluation of land, capability. Anales de Edafologia. Y. Agrobiologia. 44 (11/12): 1701-1716.

Kalima, C. and Vildkamp,W.J. (1987) Application FAO Guidlines on land evaluation for rainfed agriculture in Zambia Criticisms and proposals. FAO World Soil Resources Report. No. 62 : 45-53.

Kanyanda, C.W. (1987). Field application of the FAO guidelines for land evaluations for rainfed agriculture in comparison with the national guidelines: criticisms and proposals, FAO World Soil Resource Reports. No: 62 34-44.

Keulen, H.Van, Berk Hout, J.A.A., Diepen, C.A., Van., Heemst, H.D.J.Van., Janssen, B.H., Rappoldt, C. and Wolf, F. (1987). Quantitative land evaluation for agro-ecological characterisation. In agricultural Environments: characterisation, classification and mapping. ed. Bunting, Wailling ford, Oxnn, U.K. pub: CAB International: 185-197.

Kintukwonka, A.F. (1987). Land evaluation for rainfed agriculture in Uganda. FAO World Soil Resource Reports.No:62:62-68.

Koreleski, K. (1988). Adaptations of the storie Index for land evaluation in Poland. Soil survey and land evaluation. 8(1) : 23-29.

Lal, S. (1989). Productivity evaluation of some bench mark soils of India. J. Ind. Soc. Soil Sci.37(1) : 78-86.

Lekholoane, L. (1987). Suitability classification of soils and climate for specific land use in Lesotho. FAO World Soil Resources Reports. No: 62 : 54-61.

Natarajan, S., Subramanian, T.P. and Sachithanandan, S. (1985). Study on soil and land use planning of Rameswaram island. Madras agric. J. 72 (8): 442-446.

Nortcliff, S.(1987). Developments in soil and land evaluation. Progress in Physical Geography.11 (2) :283-291.

Norcliff, S.(1988). Soil and land evaluaton. Outlook on Agriculture17 (4) :169-174.

Nortcliff, S.(1988). Soil survey, soil classification and land evaluation. Soil conditions and plant growth by Russell. 815-843. ed. Wild, A.

Ornig, F.(1986). Land evaluation in Austria. Milteilungender Deutsehen Bodenkundlichan Gesellschaff. 48 : 173-177.

Paez, M.I. and Rodriguez, O.S (1989). Water erosion potnetial as a criterion for land evaluation. Revista de la Facultated de Agronomia, Universiolad Central de Venezuela. No.37, 9-19.

Perssons, J.(1989) Biological parameters in soil Mapping. Agrokemia es Tolojtan. 38 (3-4) : 739-744.

Rhebergen, G.J. (1987). Land suitability evaluation in Botswana; some problems and solutions. FAO World Soil Resources Reports. No: 62: 22-24.

Richard and Protz. (1981). Soil properties important for various tropical crops ; Pahang Tenggara Master planning study. In: Soil Resource Inventories and Development Planning. Proceeding of workshop at Cornell Univ;, 1977-78, Monograph No: I : U.S.A.

Riequier, J.D., Bramo. and Cornet, J.P. (1970). A new system of soil appraisal in terms of actual and potential productivity. FAO, United Nations, Rome.

Rossiter, D.G. ALES. (1990). A frame work for land evaluation using a micro computer. Soil use and Management. 6 (1) :7-20.

Sharma ,R.C. and Bhargava, G.P. (1988). Assesment and Monitoring of alkali soils in Haryana, India, using satellite imagery. Soil survey and land evaluation. 8 (2) :86-93.

Smit, B. and Kristjanson, J. (1989). Parametric approaches to rating the importance of lands for agriculture. Journal of Environmental Management. 29 (14) : 345-362.

Storie, R.E. (1933). An Index for rating agricultural values of soils. California Agricultural Experiment station Bullettin. 566pp.

Sys, C. (1985). Land evaluation. Brussels, Belgium,; State University of Ghout (iii) : 142pp.

Sys, C. (1986). Approach to soil survey interpretation for rice cultivation. Pedologic. 36 (2) : 199-217.

Verheye, W.H. (1987). Land suitability evaluation in major agro-ecological zones and its applications in land use planning and nature protection. Scientific basis for soil protection in the European Community. ed.Barth, H.L. and Hermite, P. Barkin Essex U.K. pub. Applied science publishers : 377-388.

Veltorazzi, C.A. and Angulo Filho, R. (1986). Characterisation of soils of the Ribeira de lguape valley in the state of Sao Paulo by means of topographic indexes. Anails. de Escola superior de Agricultura "Luiz de Queiroz", Universidade de Sao Paulo XL III (2) :517-536.

Vidacek, Z. and Vancina, F. (1985). Land suitability maps for physical planning and land protection purposes for SR Croatia. Acta Biological lugoslavica. 34 (3):193-207.

Weigel, G. (1986). The soils of the Maybar/Wollo area. Their potential ad constraints for agricultural development. A case study in the Ethiopian highlands. Geographica Bernensis, A (African studies) No:4:174pp.

Zonneveld, I.S. (1989). Land scape survey and evaluation. Journal of arid environments. 17(2): 255-264.

APPENDIX

Soil Analytical Data

Name of soil series	Horizon.	Depth cm	Gravel %	Coarse sand %	Fine sand %	Silt %	Clay %	Organic carbon %	Total N_2 %	Total P_2O %	Available P kg/ha	Total K_2O %	Available K kg/ha	CEC $Cmolkg^{-1}$	Base saturation %	Electrical conductivity dSm^{-1}	pH
	Ap	0-14	13.68	13.60	26.10	29.00	30.50	0.94	0.07	0.03	6.9	0.04	76	6.66	50	0.45	5.1
	AC_1	14-75	19.50	22.30	23.00	19.50	35.00	0.92	0.06	0.13	7.2	0.11	74	9.10	49	0.40	5.1
Kaliada	AC_2	75-130	18.09	37.90	25.30	14.00	32.50	1.12	0.07	0.03	7.1	0.09	75	6.40	53	0.00	5.2
	AC_3	130-200	12.00	35.22	24.22	14.00	26.00	0.90	0.07	0.03	7.1	0.09	72	6.30	52	0.00	5.2
	Ap	0-26	2.02	29.50	22.25	24.35	22.20	0.99	0.07	0.06	6.8	0.09	79	3.98	43	0.00	5.4
	B_1	26-76	1.32	40.00	26.70	5.10	24.70	0.99	0.07	0.06	7.1	0.09	78	3.09	41	0.25	5.5
Bharanikavu	B_2	76-130	0.56	42.10	25.70	7.00	25.50	0.96	0.07	0.05	7.0	0.08	79	3.20	39	0.01	4.6
	B_3	130-180	0.00	45.00	27.60	7.00	21.00	0.67	0.06	0.04	7.1	0.07	74	3.10	36	0.00	4.6

Soil Analytical Data

Name of soil series	Horizon.	Depth cm	Gravel %	Coarse sand %	Fine sand %	Silt %	Clay %	Organic carbon %	Total N_2 %	Total P_2O %	Available P kg/ha	Total K_2O %	Available K kg/ha	CEC $Cmolkg^{-1}$	Base saturation %	Electrical conductivity dSm^{-1}	pH
	Ap	0-17	0.00	60.00	23.10	5.00	10.0	0.40	0.07	0.05	5.0	0.11	44	5.30	65	0.00	6.2
Mannar	AC_1	17-99	0.45	62.30	22.40	5.00	9.01	0.24	0.02	0.05	5.5	0.12	46	4.80	57	0.00	6.3
	AC_2	99-150	0.74	68.30	17.40	4.00	9.01	0.26	0.02	0.02	4.0	0.09	45	4.40	55	0.00	7.0
	Ap	0-23	38.50	39.00	18.20	12.30	30.30	1.32	0.11	0.12	7.1	0.17	86	5.08	42	0.00	6.3
	$B_{2.1}$	23-58	37.86	23.70	12.90	8.00	55.00	0.89	0.07	0.08	7.3	0.09	84	6.14	33	0.00	6.1
Adoor	$B_{2.2}$	58-158	35.92	23.60	11.20	10.00	55.00	0.67	0.06	0.03	7.4	0.08	84	5.34	30	0.00	5.7
	C	158^+	40.90	28.60	15.50	9.00	45.00	0.52	0.04	0.03	6.5	0.06	83	5.11	31	0.00	5.6

Soil Analytical Data

lame of soil series	Horizon.	Depth cm	Gravel %	Coarse sand %	Fine sand %	Silt %	Clay %	Organic carbon %	Total N_2 %	Total P_2O %	Available P kg/ha	Total K_2O %	Available K kg/ha	CEC $Cmolkg^{-1}$	Base saturation %	Electrical conductivity dSm^{-1}	pH
	Ap	0-16	34.69	43.50	29.80	6.00	17.50	1.13	0.10	0.05	11.4	0.12	144	3.73	45	0.00	5.5
	B_1	16-38	1.66	38.00	16.30	5.00	37.00	0.89	0.05	0.03	12.5	0.08	143	4.53	44	0.00	5.3
alamel	$B_{2.1}$	38-107	11.59	33.10	26.00	7.50	38.00	0.74	0.04	0.03	12.0	0.04	144	4.75	46	0.00	6.3
	$B_{2.2}$	107-137	39.30	31.80	13.70	12.00	41.50	0.65	0.05	0.02	11.5	0.04	140	5.10	41	0.00	6.1
	Ap	0-16	5.93	26.00	27.50	20.50	31.00	1.11	0.07	0.12	6.1	0.13	149	6.45	53	0.00	5.80
	$B_{2.1}$	16-33	2.30	19.50	29.50	16.50	33.00	0.99	0.06	0.11	6.4	0.11	151	7.21	56	0.00	5.20
ylom	$B_{2.2}$	33-100	3.86	13.50	34.00	16.00	34.50	0.93	0.05	0.09	6.3	0.10	153	7.53	47	0.00	6.80
	B_3	100-155+	7.54	32.00	42.50	9.50	13.80	0.87	0.05	0.05	6.1	0.10	134	3.22	44	0.00	6.30

Soil Analytical Data

Name of soil series	Horizon.	Depth cm	Gravel %	Coarse sand %	Fine sand %	Silt %	Clay %	Organic carbon %	Total N_2 %	Total P_2O %	Available P kg/ha	Total K_2O %	Available K kg/ha	CEC $Cmolkg^{-1}$	Base saturation %	Electrical conductivity dSm^{-1}	pH
	Ap	0-10	41.50	6.80	21.00	19.50	50.50	1.10	0.08	0.09	6.4	0.09	74	6.97	48	0.60	6.2
	AC_1	10-40	47.50	10.60	13.70	14.50	54.60	1.01	0.07	0.06	6.4	0.08	73	6.69	49	0.40	3.0
Erath	AC_2	40-65	35.00	19.50	17.50	18.50	53.50	0.92	0.06	0.07	6.2	0.07	73	5.30	51	0.00	6.2
	AC_3	65-130+	19.50	19.50	22.50	11.00	40.90	0.81	0.06	0.08	6.1	0.10	70	5.00	49	0.50	6.9
	Ap	0-12	17.49	13.50	29.00	32.00	22.50	1.38	0.12	0.10	6.7	0.12	91	4.48	51	0.00	5.7
	AC_1	12-65	11.52	20.00	29.50	18.00	30.50	0.84	0.08	0.04	6.9	0.11	90	3.13	46	0.00	6.4
Pooyappally	AC_2	65-119	8.53	28.50	45.00	9.50	14.00	0.82	0.06	0.04	6.9	0.08	91	3.52	44	0.00	5.8
	AC_3	119-130	9.80	30.50	47.50	11.50	9.00	0.68	0.05	0.03	6.4	0.05	77	3.32	47	0.00	6.0

Soil Analytical Data

Name of soil series	Horizon.	Depth cm	Gravel %	Coarse sand %	Fine sand %	Silt %	Clay %	Organic carbon %	Total N_2 %	Total P_2O %	Available P kg/ha	Total K_2O %	Available K kg/ha	CEC $Cmolkg^{-1}$	Base saturation %	Electrical conductivity dSm^{-1}	pH
	Ap	0-18	14.83	29.50	15.50	9.50	13.50	0.44	0.05	0.08	6.4	0.21	112	3.85	49	0.00	5.9
Sooranad	B_1	18-37	14.95	26.75	20.50	18.50	31.50	0.45	0.04	0.04	6.7	0.09	110	4.45	47	0.00	4.9
	B_2	37-130	32.50	24.50	14.50	12.50	47.00	0.37	0.04	0.04	6.5	0.03	96	6.60	44	0.00	6.0
	Ap	0-12	0.00	38.20	17.00	10.50	32.20	1.11	0.10	0.12	13.5	0.12	171	6.54	49	0.00	6.2
	B_1	12-32	0.00	15.50	20.50	14.50	28.50	1.01	0.09	0.10	14.2	0.11	174	3.31	51	0.00	6.7
Kunnamkkara	B_2	32-107	0.00	16.50	20.00	12.50	47.50	0.98	0.09	0.10	14.2	0.10	173	11.54	46	0.00	7.0
	$B_{2.2}$	107-169	0.00	20.50	22.50	15.50	41.00	0.87	0.73	0.75	13.0	0.09	169	10.50	54	0.00	6.2

EVALUATION AND SUITABILITY RATING OF TEN MAJOR SOIL SERIES OF THE COMMAND AREA OF KALLADA IRRIGATION PROJECT

By

P. N. PREMACHANDRAN

ABSTRACT OF THE THESIS

Submitted in Partial fulfilment of

the requirement for the degree

Master of Science in Agriculture

Faculty of Agriculture

Kerala Agricultural University

Department of Soil Science and Agricultural Chemistry

COLLEGE OF AGRICULTURE

VELLAYANI, THIRUVANANTHAPURAM

JULY—1992.

ABSTRACT

The present study was undertaken covering the ten identified important soil series of the command area of Kallada Irrigation Project, with the objective of evaluating the soils based on their morphological and physico chemical characterstics. The soil series selected are Mannar, Adoor, Sooranad, Palamel, Mylom, Erath, Bharanikavu Kallada, Pooyappally and Kunnamkara.

Profile pits were dug in the typical areas identified and the morphological features observed were recorded as per Soil Survey Manual (1970). The salient features of the area in respect of location, physiography, drainage, vegetation and land use were also recorded. The physical and chemical properties of the soil samples collected were determined by standard analytical procedures. These soil series have been evaluated on the basis of land evaluation and rating of productivity parameters

The productivity parameters considered in the present study include soil texture, depth, soil reaction, drainage, cation exchange capacity, base saturation, electricl conductivity, coarse fragments, slope and

nutrient status. For each parameter, a range of scale is prepared, and numerical values assigned based on principles of land evaluation. Productivity of the soil has been calculated by multiplying the ratings of the individual parameters and expressed as percentage.

The ten soil series selected for study have been classified as per the comprehensive soil classification system-Soil Taxonomy. Five soil series namely Kallada, Mannar, Erath, Pooyappally and Kunnamkara are grouped under Entisol, four series namely Bharanikavu, Palamel, Mylom and Sooranad under Inceptisol and Adoor series under Ultisol.

The land capability classification of these soils shows that the Kallada soil series comes under class IIe, Sooranad, Mylom, Erath, Pooyappally and Kunnamkara series under class IIw, Palamel, Bharanikavu, major part of Adoor and a portion of Kallada under class IIIe and Mannar series under class IIIsc. A portion of Adoor series is grouped under class IVe.

The irrigability classification of these soils revealed that the Mannar series comes under class 2s, Kallada under class 2t, Sooranad, Mylom, Erath, Pooyappally and Kunnamkara under class 2d, Adoor, Palamel, Bharanikavu and a portion of Kallada series under class 3t. A portion of Adoor series is grouped under the irrigability class 4t.

The productivity rating of these soil series gives the following results. The Kunnamkara soil series with a rating of 38.7 percent ranks first for paddy. The study shows that the Erath soil series is the least productive for paddy, coconut,tapioca and banana. The Palamel series having a rating of 31.4 percent, with good rating class is the most suitable for coconut. The Kallada soil series ranks top both for tapioca and banana with rating of 27.6 and 38.8 percent respectively.