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Reclamation of Saline Agricultural Land

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Abstract: The sustainability of (irrigated) agriculture in India is threatened by waterlogging, soil salinity, and alkalinity. To reverse declining agricultural productivity, a combination of surface and subsurface drainage, supplemented by improved irrigation management, has been identified as the most appropriate strategy. But subsurface drainage for salinity control is costly. Therefore, its sustained agricultural production benefits must be thoroughly investigated to establish its techno-economic feasibility. The present study attempts to do this by analysing the cost of installing subsurface drainage, the direct on-farm benefits of subsurface drainage, and the financial feasibility of subsurface drainage.

The study site selected for this study is Uran Islampur (Maharashtra State). The results say land use will intensify if drainage is installed because a sizeable area of formerly fallow land was brought under cultivation. It also says that the cropping pattern will be changed in favour of more remunerative crops, and crop yields will increase. These immediate gains from drainage are helping to increase land productivity, gainful employment of the farmers and, hence, farm income. The financial and economic feasibility of drainage in waterlogged and saline areas looks favourable, provided that sufficient water is available for leaching and irrigation and that a sustainable solution for the disposal of the low-quality drainage effluent is found. Concerning the latter, creating ponds to store drainage effluent temporarily is technically possible while not threatening the financial feasibility of the investment in drainage.

Keywords. Waterlogging, salinity, alkalinity, crop yields, leaching, irrigation.

I. INTRODUCTION

Accumulation of excess salts in the root zone resulting in a partial or complete loss of soil productivity is a worldwide phenomenon. The problem of soil salinity is most widespread in arid and semiarid regions. Still, salt-affected soil occurs extensively in sub-humid and humid climates, particularly in coastal areas. Soil Salinity is also a problem in the region where groundwater with high salt content is used for irrigation. Agricultural production in the arid and semiarid areas of the world is limited by insufficient water resources, limited rainfall, and the detrimental effects associated with an excess of soluble salts, constrained to a localised area or sometimes extending over the whole of the basin. To minimise the vagaries of arid weather, bring more land under irrigation, and produce and stabilise greater yields per unit area, numerous water development projects have been commissioned worldwide.

For a definition, saline soils have an electrical conductivity of the saturation soil extract of more than 4 ds/m at 25°C (Richards 1954). This value has generally been used the world over. However, the terminology committee of the Soil Science Society of America has lowered the boundary between saline and non-saline soils to 2 ds/m in the saturation extract. Excess salts keep the clay in saline soils in a flocculated state, so these soils generally have good physical properties. The structure is usually good, and tillage characteristics and permeability to water are even better than those of non-saline soils. However, when leached with low salt water, some saline soils tend to disperse, resulting in low permeability to water and air, mainly when the soils are heavy clays. Leaching may also result in a slight increase in soil pH due to lowering salt concentration. Still, saline soils, as will be shown later, rarely become strongly sodic upon leaching if there is an adequate drainage system. In field conditions, saline soils can be recognised by the spotty growth of crops and often by the presence of white salt crusts on the surface. Growing plants often have a blue-green tinge when the salt problem is only mild. Barren spots and stunted plants may appear in cereal or forage crops growing in saline areas. The extent and frequency of bare spots often indicate the concentration of salts in the soil. If the salinity level is insufficient to cause barren spots, the crop appearance may be irregular in vegetative vigour.

II. LITERATURE SURVEY

Studied the technique for reclamation of saline soil in which reasons for salt accumulation due to natural and manmade causes were studied. Different properties of saline soil are primary considerations to avoid salt accumulation. Remove the salts from Salty soil, and a detailed study of the subsurface method was studied. Books contain different materials required for sub-surface drainage, depending upon the type of surface in terms of slope, other arrangements of pipes and advantages of sub-surface drainage.

The various sources of salts in the soil are mineral weathering without leaching, dissolution of fossil salts, atmospheric deposition, salt movement in the water and upward movement of capillary water. As for the quality of irrigation, water is concerned with the salt content of that irrigated land tends to be similar to the salt content of the water. Electric Conductivity (EC) is measured for the determination salinity of irrigation water, and along with this, sodium hazard is also studied. Salt-affected soil is classified into two types saline soil and sodic soil.

III. RELATED WORK

A. To Study Waterlogging of Soil in Uran Islampur

To conduct a thorough study of waterlogged land in Uran Islampur. This study can involve field visits, analysing satellite data, and collection soil samples, water, and climate data. The study should identify the extent and severity of waterlogging in the district, its contributing factors, and its impact on agriculture and the environment. The objective is to gain a comprehensive understanding of the problem of waterlogging in Uran Islampur.

B. To Study Various Methods of Reducing Waterlogging and Improve Crop Yield

The second objective is to research and analyse various methods for reducing waterlogging in Uran Islampur. This could include drainage systems, soil amendments, and crop rotation techniques. The study should also assess the impact of these techniques on crop yield, soil health, and the environment. The objective is to identify effective and sustainable methods that can be implemented to reduce waterlogging and improve crop productivity in the region.

C. To Decide the Best Methodology for Reducing Waterlogging and Suggest Good Farming Practices for the Farmers

The final objective is to evaluate the different methods for reducing waterlogging and determine the most effective and appropriate approach for Uran Islampur. This decision should be based on the research and analysis conducted in the first two objectives. Once the best methodology is identified, the study should suggest good farming practices that the farmers can adopt to implement the method. These practices could include recommendations for crop selection, soil management, and irrigation techniques that can help reduce waterlogging and improve crop productivity. The objective is to provide actionable advice that farmers can implement to minimise waterlogging and improve their livelihoods.

IV. PROPOSED FRAMEWORK

Methodology for Studying Waterlogging of Soil in Uran Islampur and Identifying Best Methods for Reducing Waterlogging and Improving Crop Yield:

1) *Literature Review:* The first step in the methodology would be to conduct a thorough literature review of existing research and studies on waterlogging in agricultural areas. Studies involve reviewing academic journals, reports, and government publications. This review aims to identify the causes of waterlogging, its impact on agriculture, and the existing methods for mitigating the problem.
2) *Field Visits and Data Collection:* The second step would be to conduct field visits to Uran Islampur to collect primary data on the problem of waterlogging. Field visits would involve selecting representative sites within the district and collecting soil samples, water samples, and weather data. The objective of this data collection is to gain a comprehensive understanding of the factors contributing to waterlogging in Uran Islampur.
3) *Analysis of Data:* The third step would involve analysing the data collected from field visits and secondary sources. This would include using statistical analysis techniques to identify patterns and trends in the data. This analysis aims to determine the extent and severity of waterlogging in the district, the contributing factors, and the impact on agriculture and the environment.
4) *Identification of Methods for Reducing Waterlogging:* The fourth step would involve researching and identifying methods for reducing waterlogging in Uran Islampur. This could include drainage systems, soil amendments, and crop rotation techniques. This research aims to identify effective and sustainable methods that can be implemented to reduce waterlogging and improve crop productivity in the region.
5) *Evaluation of Methods:* The fifth step would involve evaluating the different methods for reducing waterlogging identified in step 4. This evaluation would consider factors such as cost-effectiveness, ease of implementation, and impact on crop yield and the environment. This evaluation aims to identify the most effective and appropriate approach for Uran Islampur.

6) *Recommendations:* The final step would involve providing actionable recommendations based on the research and analysis findings. These recommendations include good farming practices that farmers can adopt to implement the methodology identified in Step 5. These practices could have suggestions for crop selection, soil management, and irrigation techniques that can help reduce waterlogging and improve crop productivity. These recommendations provide practical guidance for farmers and stakeholders in Uran Islampur to minimise waterlogging and improve their livelihoods.

The methodology for studying waterlogging in Uran Islampur and identifying the best methods for reducing waterlogging and improving crop yield involves a multi-step process. This methodology consists of a literature review, field visits, data collection and analysis, identification and evaluation of methods, and finally, providing actionable recommendations for farmers and stakeholders. The methodology aims to provide a comprehensive understanding of the waterlogging problem in Uran Islampur and identify sustainable and practical solutions to address the issue.

V. STUDY AREA

The Selected site is situated in Sangli District in Walwa Taluka at June Khed-Uran Islampur road near Walwa in the Maharashtra State. (Fig. 1).

Most areas suffer from shallow water tables and salinity, leading to low crop productivity. The site is part of the Krishna River zone with clayey, clay and loam soils. The river water is available for all time in 12 months. During this period, rice crop is grown in large areas while some areas are cultivated with sugarcane, turmeric, chillies, and vegetables. During rabi season, black gram, maise green gram and must are under cultivation in normal soils, whereas marginal and salt-affected sods are left barren

Soil samples at different points and depths were collected from the Selected site to analyse a presence of salinity in the soil. In addition to salinity, water logging is also a severe problem in a few parts, with the water table coming to the soil surface during monsoon and receding to about from the ground surface during the pre-monsoon period. This is about 20% of the land area that needs to be treated to reclaim waterlogged salt-affected lands in the command

An area of 1.5 acres was selected for study in Sangli District, Maharashtra, located geographically between 15’ 55” N Latitude and 80’ 28” E Longitude. The project area is bounded by June Khed-Uran Islampur Road in the Walwa area (Fig. 2).

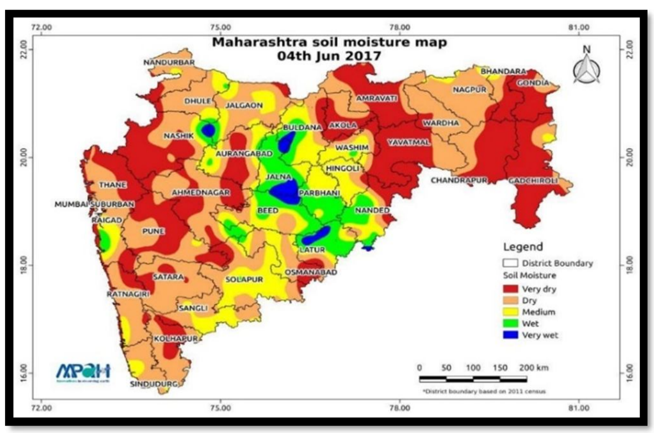

Figure 1 : Irrigation map of Maharashtra State

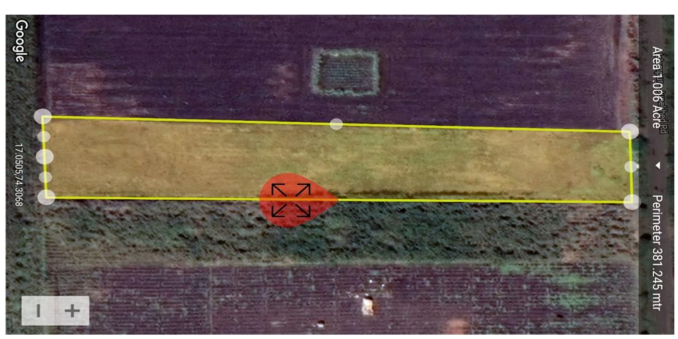

Fig 2: Location of the study area

A. Climate and Rainfall

As rainfall is purely seasonal, we classify the rainfall data according to four seasons, namely winter season (January- February), pre-monsoon (March- May), Monsoon (June- September) and post monsoon (October-December). Most of the rainfall occurs in the monsoon season. During winter season all the stations of Sangli district receives very low rainfall (even much less than 6 mm). During pre- monsoon season maximum rainfall occurs at the Miraj station and it receives 64.48mm (10.98%) on an average whereas Palus station receives only 14.37mm (4.22%) rainfall on an average, which is lowest among all the stations. Most of the rain occurs in the Monsoon season. Shirala station receives 823.75mm rainfall onan average in Monsoon which is 81.97% to the total rainfall. In Monsoon season, Palus station receives on an average only 258.61 mm, which is 76.10% to the total rainfall. In Post-Monsoon season Islampur station receives on an average 142.58mm rainfall which is 19.45%, where as Palus station only 66.70mm rainfall in Post-Monsoon season which is 19.62% to the total rainfall. The following Table 2.4 gives season wise average rainfall with percentage for all the stations of Sangli district.

Table No. 1

Sr.No	station	Winter	Pre-Monsoon	Monsoon	Post-Monsoon	Avg.Rainfall
1	Shirala	3.77 (0.37)	53.45(5.31)	823.759(81.97)	123.96(12.33)	1004.94
2	Kasegoan	0	25.86(3.81)	549.47(80.96)	103.29(15.22)	678.61
3	Islampur	5.40 (0.73)	53.15(7.25)	531.67(72.55)	142.58(19.45)	732.8
4	Tasgaon	4.97(0.83)	59.23(9.89)	421.51(70.39)	113.6(18.88)	598.77
5	Miraj	3.52(0.59)	64.48(10.98)	398.23(67.84)	120.76(20.57)	587
6	Sangali	4.00(0.77)	47.28(9.13)	365.58(70.62)	100.80(19.47)	517.66
7	Jath	2.59(0.45)	49.54(8.70)	385.91(67.82)	130.97(23.01)	569.01
8	K.Mahankal	2.81(0.58)	48.39(10.13)	307.46(64.39)	118.82(24.88)	477.48
9	Palus	0.13(0.03)	14.37(4.22)	258.61(76.10)	66.70(19.62)	339.81
10	Atpadi	3.83(0.91)	36.45(8.68)	286.17(68.19)	93.15(22.20)	415.61

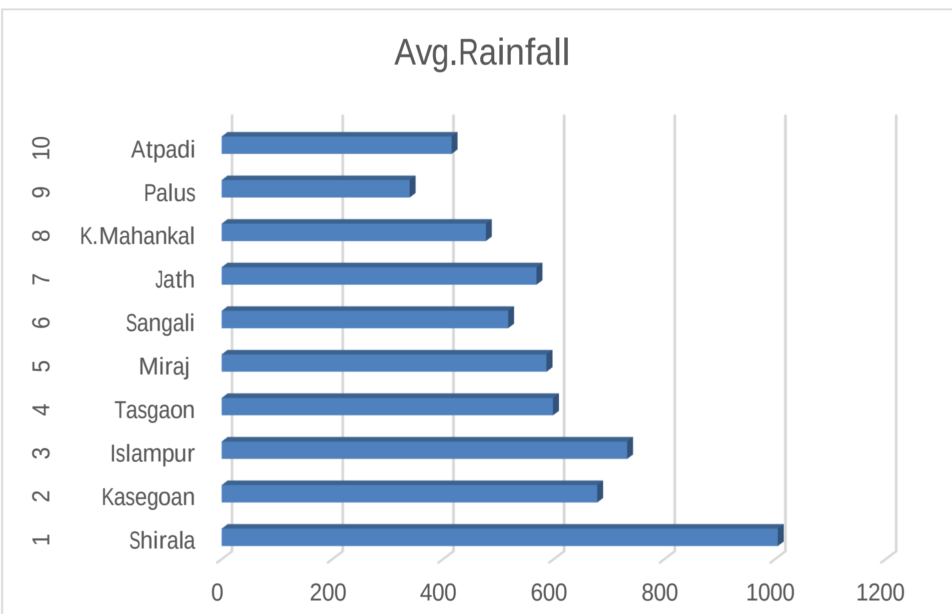

Fig 3: Seasoon wise and annual rainfall

B. Water quality

The Krishna River is the source of irrigation during the kharif season in the project area. The water analysis indicated that it is non-saline with neutral in reaction. It has no problem with SAR or RSC being 1.78 and 0.40 meq/t, respectively.

C. Crop and Cropping pattern

During pre-installation, the project area was mainly mono-cropped with paddy cultivationin the kharif season. The rice crop used to be generally transplanted in the second fortnight ofAugust and harvested during December. Later on, it was left fallow. The average rice productivity in the salt-affected area was 1.81 t/ha against the productivity of normal adjoining lands at 5.8 t/ha. The estimated loss was about 68 % due to water logging and salinity problem.

D. Pre-drainage Investigation

To assess the technical feasibility of the subsurface drainage and to design and construct an efficient and cost-effective system, investigation of the site conditions is an essential pre-requisite Surveys and investigations were carried out to reveal the following information:

1) Inventory of the project site conditions Causes of the excess water.
2) Identification of appropriate solution.
3) Data needed to establish drainage system design parameters.
4) Topographic details
5) Data on soil salinity/alkalinity, soil profile description and depth to impermeable layer etc.
6) Position and fluctuations of the groundwater table, depth to the water table, artisan pressure and groundwater quality.
7) Drainage coefficient.
8) Crops and their tolerance to water logging.
9) Irrigation practices and water requirements.
10) Surface drainage network and outlet conditions.

E. Topography and Outlet Identification

The Walwa subsurface drainage experimental site is low laying saucer-shaped depression having a sufficient natural outlet for surface drainage to the main drain along the southern boundary. The area is gently sloping towards the middle of the field from southern and northern directions with an elevation difference of 0.25 and 0.30 m, respectively. Considering the topography, the main collector line of the subsurface drainage system was fixed in the southwest to northeast direction with a provision of a pumped outlet in the northeast end to pump drainage water into the eastern field channel to carry to the main drain at the southern boundary.

F. Rainfall Analysis for Surface/Subsurface Drainage Coefficient

For drainage system design, the rainfall data of 10 years (2010-2020) was analysed for rainfall depth-duration-frequency to estimate the drainage coefficient. The drainage coefficient was 22.5 mm/day for a 5-year return period. The excess rainfall has to be removed through the surface and subsurface drainage systems since all of it cannot be removed through subsurface drainage, being very high. As per the experience gained with installing a subsurface drainage system at Sangli and other locations, the 2 mm/day drainage coefficient was considered appropriate for a subsurface drainage system, while the remaining must be disposed of through other means.

VI. DESIGN AND ANALYSIS

A. Modified Method of Design

Subsurface drainage describes the process of removal of the water which has infiltrated intothe soil in excess of the amount that can be held by capillary forces against the force of gravity. A primary goal in designing and constructing a subsurface drainage system is toremove. Non-capillary water from another upper layer of the soil profile quickly as possible to ensure adequately aerated and trafficability. As per the traditional design method, the method is costlier and not feasible. In some cases, all the formers cannot afford the expense of the design of the conventional method. So, from the investigation point of view, the new method of design modified method is designed to remove water quickly from the surface and is less expensive than the traditional method.

B. Design Process

The design process for the modified sub-surface drainage method is as follows

1) Step 1: Survey of land

To start the working for drainage of the particular land the survey of whole land is should be need to do, for checking the dimensions of land, to check the slope of ground, type andproperties of soil. it also required to plan and design the pattern of laying the perforated pipes in land.

2) Step 2: Determining the Slope and Dewatering Point

In the modified method the agricultural land should have to be a natural slope to its groundso as to collect the maximum water in the sloped part of land and minimum water logged in lower sloped area.

The slope of the ground should not be more than 1:2000, in only this case the all the methods of sub surface drainage are feasible.

In some cases, to design as per the modified method artificially slope may be provided to ground by the removal of earth or adding the soil on ground.

3) Step 3: Planning for Design

After the completion of pre-work, the next step is to make a proper design plan using AutoCAD or any other of software that will show the appropriate design process and help

4) Step 4: Excavation

According to the plan as per the excavation work for laying of perforated pipes, excavation ground is worked. While excavating the trenches, ensure the excavation is work by providing thedesired slope to the land.

The slope of the excavated trench should be checked by auto level, theodolite or any otherinstrument after every 10m length of each trench.

5) Step 5: Laying of Perforated Pipe

The arrangement of perforated pies starts from the same points connectedwith the open chamber. After the 10m length, the distance between the two perforated pipesis 5m. At the endpoint of the land, the centre-to-centre distance between two perforated pipes is 20m.

In the corner parts of the land, the extra perforated pipe may be used as per site conditions.While placing the pipes, make sure the placement of pipes should be in vain pattern.

6) Step 6: Connection with Open Chamber

In this stage, all the perforated pipes are connected to the open chamber, where the all-perforated pipes assemble and drain off the water in the chamber. The open chamber is made up of pre-cast concrete with a diameter of about 1m. The depth of the chamber depends upon the depth of the water table, the type of crop, the root zoneof plants and the depth of the layer of perforated pipes. The bottom of the chamber should be below the opening of perforated pipes to collect the water and drain it from the main pipes that are non-perforated to the disposal point.

7) Step 7: Connection of Non-perforated Pipes

In sub-surface drainage, the non-perforated pipes work as the main pipes, whereas theperforated pipes are the sub-main or branch line pipes. Non-perforated pips collect the water from the chamber and drain it in the disposalpoint.The main pipes are Double wall corrugated pipes (DWC), which have excellent hydraulic properties, flexible, long-life span and can carry 4Kn/m2 load.

8) Step 8: Dewatering

In this stage, all the water which is collected from the land is dewatered. The endpoint of the main pipe is discharging the water to the dewatering chamber. Sometimes the dewatering points are natural streams, canals, lakes and rivers where all the excessive water is discharged. Dewatering points may also man-made to discharge the water.

C. Estimate of Design

In the following table the estimate for the new modified tableis given.

Table No: 2

SR.	**Material/Equipment**	**Quantity**	**Rate**	**Unit**	**Total Cost**
1.	Perforated Pipe	500 m	150	Per/m	75,000
2.	D.W.C. Pipe	25m	240	Per/m	6,000
3.	Joints	10 nos	145	Nos	1450
4.	End cap	10 nos	50	Nos	500
5.	Excavator	9 hrs.	1000	Per/hr	9000
6.	Labour	4 nos	500	Per/lbr	2000
7.	Other expenses	-	-	-	2000
	Total cost				**95,950**

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Total Estimated cost for construction of sub surface drainage by modified drainage method is Ninety-five thousand nine hundred fifty rupees.

Benefits of modified method-

1) *Fast drainage of Water:* This method is removing the water faster and easier than traditional method.
2) *Economically Convenient:* Modified method is cheaper than regular method which reduces te 30-35% less cost thantraditional method.
3) *Allows More Connections:* Modified method allows to connect more connection for by placing the open chamber to new land with same main (non-perforated) pipe.
4) *Easy for Maintenance:* Due to absence of sub main pipe the checking of working of pipe and maintenanceare easier for e.g., to determine the blockage of perforated pipe is can be found in open chamber where any pipe not discharges the water is considered as a blocked pipe can be easily found. Any unskilled or non-technical person can be easily determining the blocked pipe in modified drainage method.
5) *Close Valve:* The main pipes are connected with the close valve, where it can be closed insummer season to keep water inside the land.

VII. CONCLUSION AND FUTURE SCOPE

The reclamation of saline agricultural land using various amendments in sub- surface drainage method is an effective approach that can help farmers improve soil health, increase crop productivity, and ensure sustainable agricultural practices. This project report provides valuable insights and practical recommendations that can inform policy decisions and guide farmers in managing soil salinity in agricultural areas. With the adoption of these recommended practices, farmers can create a more resilient and sustainable agricultural system that meets the needs of both the present and future generations.

The study also highlights the importance of sub-surface drainage method as an effective approach to manage soil salinity in agricultural land. The use of this method, combined with appropriate amendments, can reduce the adverse impact of salt accumulation on soil structure and crop yield. The study also emphasises the need for a holistic approach that takes into account factors such as soil type, crop selection, irrigation methods, and management practices to ensure sustainable and long-term solutions.

This project report focused on the reclamation of saline agricultural land using various amendments in sub-surface drainage method. The study identified the extent and severity of salinity in the selected agricultural land and evaluated the effectiveness of various amendments including gypsum, farmyard manure, and potassium sulfate in reducing soil salinity. The results showed that the use of these amendments in sub-surface drainage method significantly reduced soil salinity, improved soil structure, and enhanced crop yield.

The introduction of a new method that is better than the traditional method and is also cost- effective is a great development. In this article, we will discuss the advantages of the new method over the traditiona method and how it is cost-effective.

The new method has several advantages over the traditional method. One of the main advantages is that it is more efficient. The new method is designed to perform the same task in less time than the traditional method. This is achieved by using new techniques and technologies that were not available in the traditional method.

Test On Soil Sample

Test	Before Implementation Result	After Implimentation Results
1. Total Dissolved solids (TDS)	786mg/lit	445 mg/lit.
2. Electric Conductivity of Soil	4.07Milesians	2.1 Milesians
3. PH of Soil	8.93	7.42

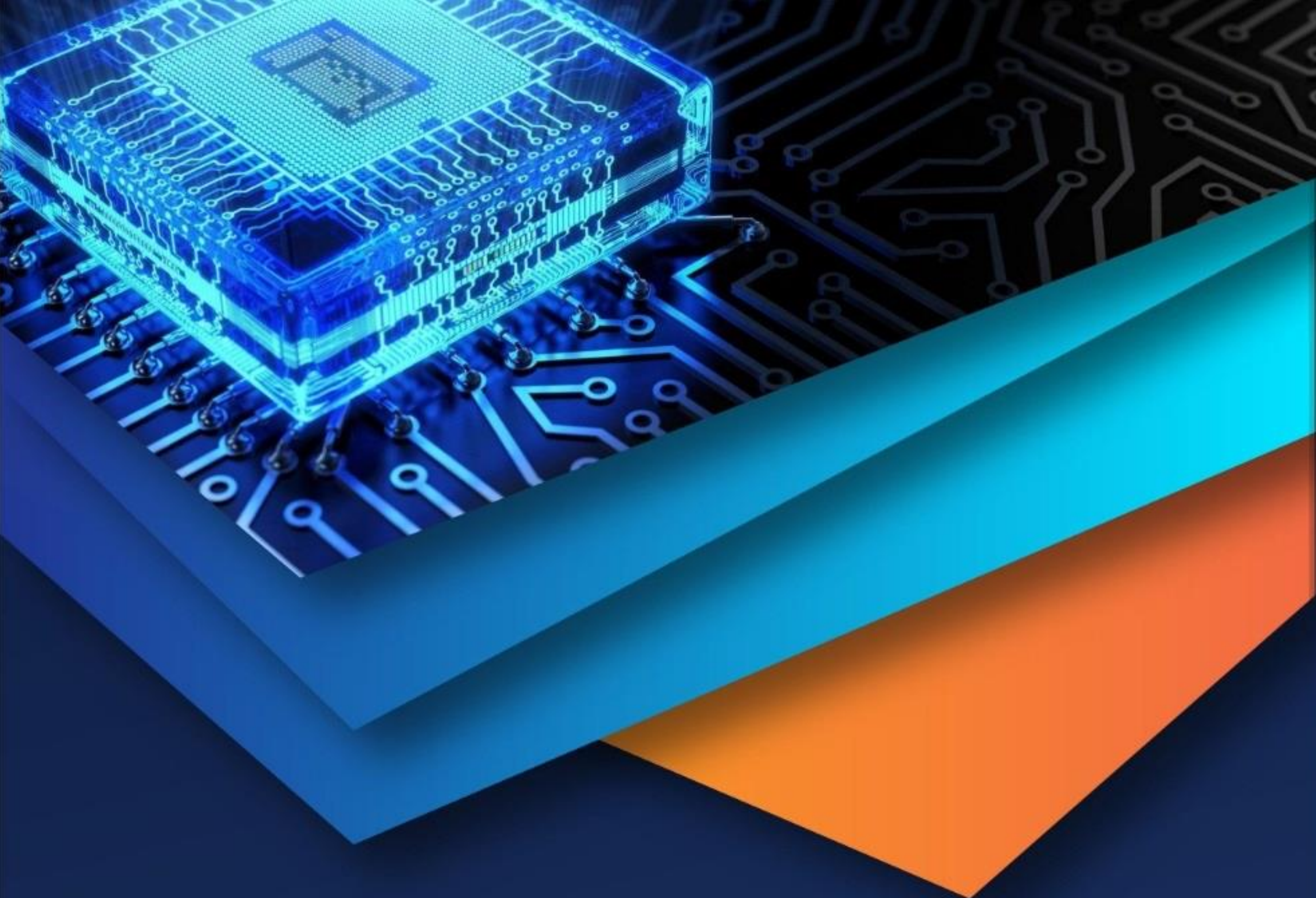
VIII FUTURE SCOPE

1) *Further Research on Amendments:* The study focused on specific amendments such as gypsum, farmyard manure, and potassium sulfate. Future research can explore the effectiveness of other amendments or combinations of amendments in sub-surface drainage methods. This can help identify additional options to reduce soil salinity and improve soil health.

2) *Long-term Monitoring and Evaluation:* Monitoring the long-term effects of the sub-surface drainage method and amendments on soil salinity, crop productivity, and water quality is essential. Future studies can establish monitoring programs to assess the sustained impact of these interventions over multiple cropping seasons.
3) *Cost-Effectiveness Analysis:* Conducting a detailed cost-effectiveness analysis comparing the new method with traditional methods can help in understanding its economic viability. Future studies can explore the cost implications of implementing the sub-surface drainage method with different amendments, including the initial investment, maintenance costs, and long-term benefits in terms of increased crop yield and reduced soil salinity.
4) *Climate Change Resilience:* Considering the potential impact of climate change on soil salinity patterns and water availability, future studies can focus on assessing the resilience of the sub-surface drainage method and amendments under changing climatic conditions. This can involve evaluating the effectiveness of the approach in mitigating the adverse effects of climate change on soil salinity and crop production.
5) *Knowledge Transfer and Collaboration:* Collaboration between researchers, farmers, agricultural institutions, and policymakers is crucial for successful implementation and continuous improvement of land reclamation strategies.

REFERENCES

[1] Abril, I. P. (1992) "Characteristics and Management of Salt Affected Soils”, Kho shoo T. N. and Deeksha Tulu B. L. Ed. 'Land and Soils', Har Anand Publications, New.
[2] Jayasekara D. C. and Shetty Rajasekhara (1993), "Irrigation Agriculture: A Boon or A Curse?" Gupta N. L. & Gurjari R. K. Ed. Integrated Water Use Management, Rawat.
[3] Chopra Kanchan (1989), "Land Degradation - Dimensions and Causalities", Indian Journal of Agricultural Economics, Vol. 44, No. 1, Jan-March.
[4] Datta, K. K. and Ir. C. De Jong (1997), "Economic Consideration Land Drainage for Managing Waterlogged Saline Soils", Indian Journal of Agricultural Economics,
[5] Datta, K. K., C. de Jong and M. T. Rajasekhara (2004), "Implication of Land Degradation on Crop Productivity - Some Evidences from Saline Areas in North West India", Indian Journal of Agricultural Economics, Vol. 59, No. 1, Jan-March,
[6] Jugal, B. V. (1980), "Impact of Lift Irrigation Schemes on General Land Use, Cropping Pattern and Small Farmers - A Case Study of Village Alas, Shivaji University Journal, Kolhapur, p. 97
[7] Patil Prakash B. (1988), "Agricultural Land Use and Land Degradation in the Pachanga Basin: A Geographical Appraisal," Unpublished Ph. D. Thesis, Shivaji University, Kolhapur. Pp. 178-179.
[8] Chatwal, G. R. (1999), "Encyclopedia of Environmental Agriculture Pollution and Its Control", Vol. 1, Amol Publication, New Delhi, pp. 211-212.
[9] Reddy V. Ratna (2003), "Land Degradation in Indian - Extent, Costs and Determinants", Economics and Political Weekly, Vol. XXXVIII, No. 44, Mumbai, p. 4708
[10] Cox George W. and Atkins Michael D. (1979), "Agricultural Ecology - An Analysis of World Food Production System", W. H. Freeman and Co., San Francisco, p.300- 303
[11] Hook Eric E., Frasier Marshall and Schunk Eric (2004) "The Regional Effect of Waterlogging and Soil Salinization on A Rural Country in The Arkansas River Basin of Colorado", Paper Presented at the Western Agricultural Economics Association, Annual Meetings, Honolulu, H. I.



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