University of Peradeniya

AI-Based Root Cause Analysis of Chronic Kidney Disease of Unknown Etiology in North East Sri Lanka

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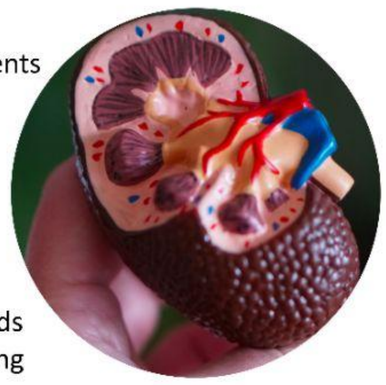
Abstract- Chronic Kidney Disease of Unknown Etiology (CKDu) has emerged as a significant public health concern in North East Sri Lanka, particularly affecting agricultural communities. Despite extensive research, the exact causes of CKDu remain elusive, hindering effective prevention and intervention strategies. This research has utilized Artificial Intelligence (AI) and Machine learning techniques to identify the potential causative factors associated with CKDu.

Impact of the Research

Commercialization Potential

>> Novel diagnostic tools & therapeutic interventions
>> Development of commercial diagnostic tests for CKDu
>> Early detection & intervention of CKDu
>> Potential targeted pharmaceuticals or dietary supplements
>> Growth of biotechnology & healthcare industries



Governance Enhancement

>> Informed evidence-based policy-making
>> Targeted regulations to mitigate CKDu risk
>> Improved agricultural practices & water quality standards
>> Integration of AI-driven analytics for real-time monitoring
>> Proactive governance responses & resource allocation

Economic Development

>> Alleviate economic burden of CKDu on healthcare systems
>> Reduce late-stage CKDu management costs
>> Redirect resources to other healthcare priorities
>> Community engagement & capacity-building initiatives
>> Empower local stakeholders for disease prevention & management
>> Foster resilience & sustainable development in affected regions

Identification of Cases in CKDu Research

National Screening Program
>> Screen population over 30 every three years
>> Assess serum creatinine levels

At-Risk Study Protocol
>> Monitor 600 individuals biannually
>> Collect biological and environmental samples
>> Surveillance Program for Sym-CKDu
>> Participants report intercurrent illness to research assistant
>> Refer symptomatic individuals to renal clinics
>> Home visits for sample collection with consent

Follow-Up and Analysis
>> Refer new cases to renal clinics
>> Conduct home visits for interviews and sample collection
>> Follow up with prospective cohort of KiPP study

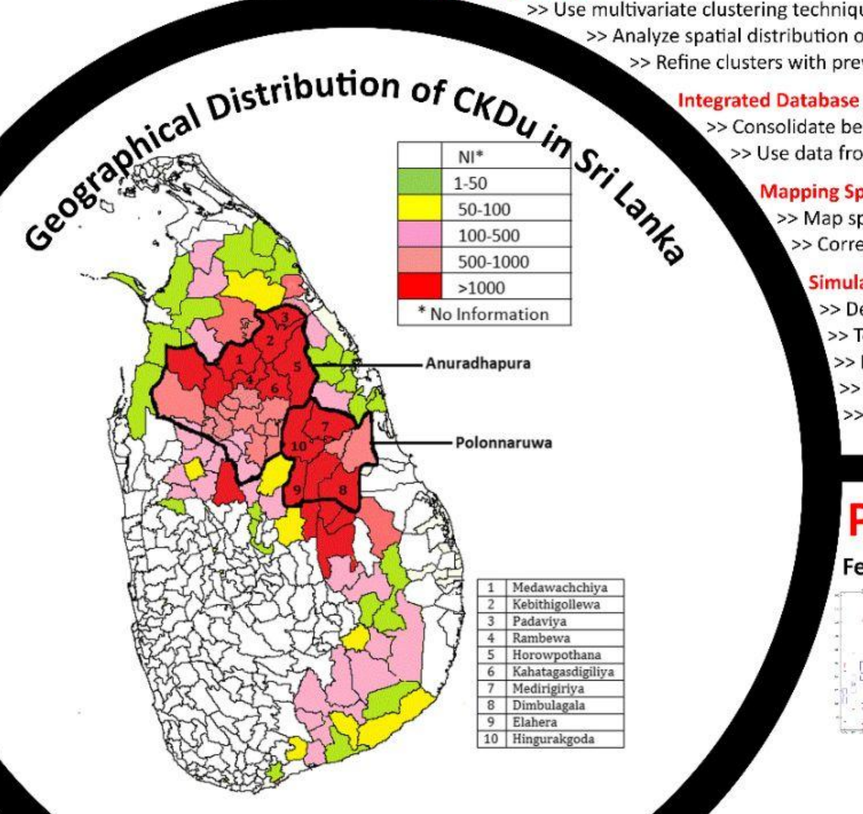
Outcome of Proposed Studies

Clustering Patients
>> Use multivariate clustering techniques
>> Analyze spatial distribution of clusters
>> Refine clusters with previous study data

Integrated Database for CKDu
>> Consolidate behavioral, environmental, and biological data
>> Use data from various study designs

Mapping Spatial Distribution
>> Map spatial distribution in ten GN divisions
>> Correlate health status and microenvironmental risk factors

Simulation Model to Test Hypotheses
>> Develop model using machine learning and AI
>> Test hypotheses on CKDu etiology
>> Identifying Etiology of CKDu
>> Identify critical factors and risk factors
>> Understand pathways from healthy state to CKDu

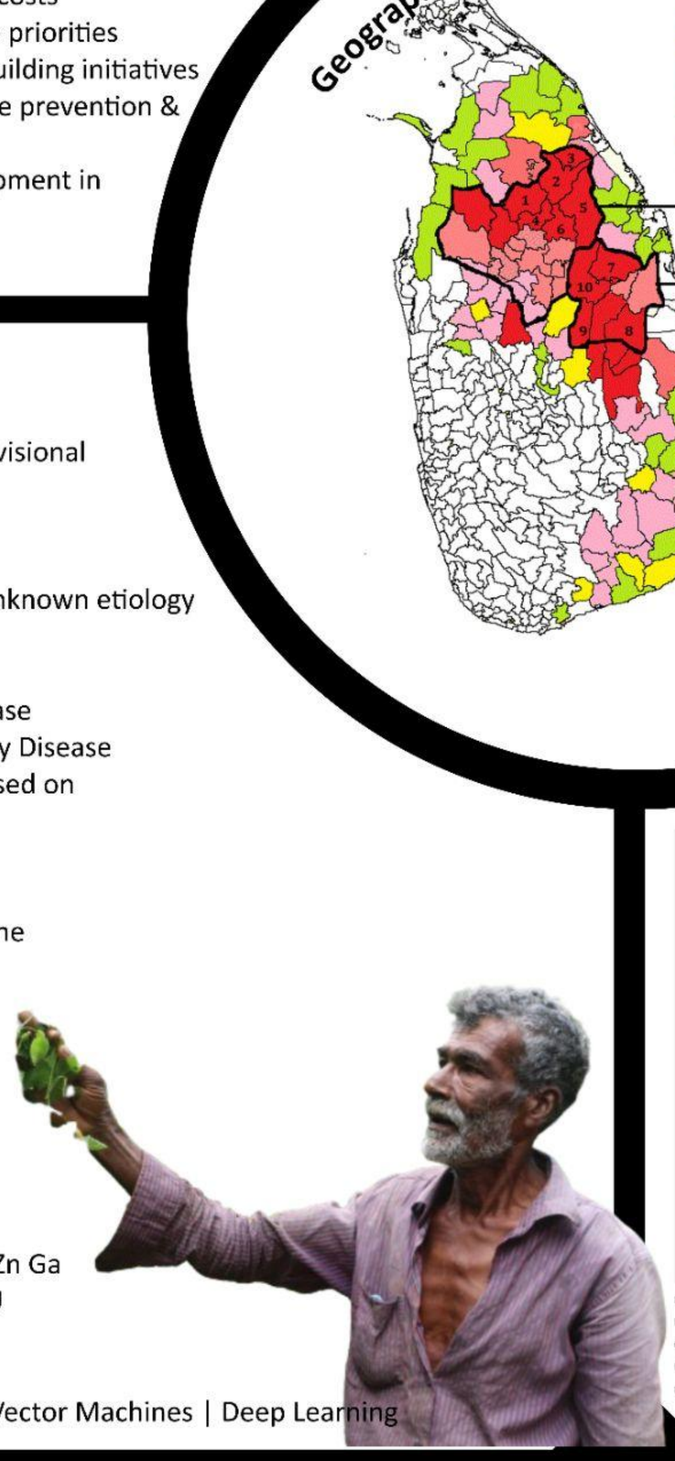


Methodology

Population :: Residents of Wilgamuwa Divisional Secretariat, Matale District
Population Size :: 413
Groups ::
>> CKDu | Chronic Kideney Disease of unknown etiology
>> EC | Endemic Control
>> NEC | Non-Endemic Control
>> ECKD | Endemic Chronic Kidney Disease
>> NECKD | Non-Endemic Chronic Kidney Disease
Analysis :: candidate biological profile based on
>> Biological data for genetic
>> Proteomic
>> Biomarker
>> Trace element in Blood Serum and Urine
>> Single cell sequencing
>> Genetic
>> Nutritional surrey
>> Leptospirosis
>> Hantavirus
>> Behavioral data

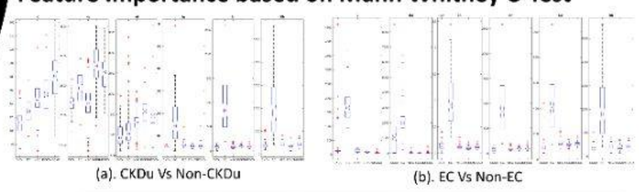
Trace Elements Analysed ::
Na Mg K Ca Li Be Al V Cr Mn Fe Co Ni Cu Zn Ga
As Se Rb Sr Ag Cd In Cs Ba Hg Tl Pb Bi U

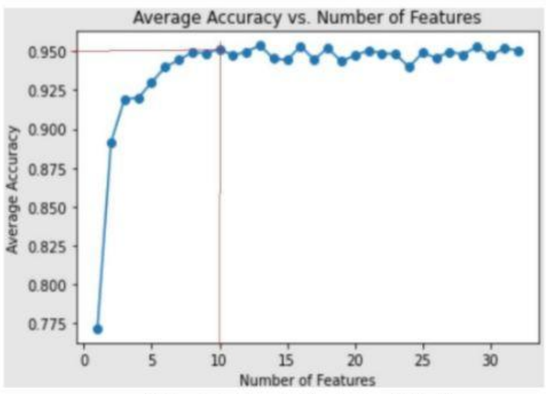
AI and Machine Learning Techniques ::
>> Random Forest Analysis | Support Vector Machines | Deep Learning



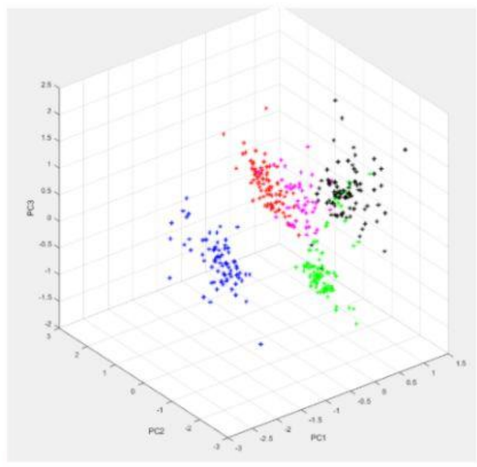
Preliminary Results

Feature Importance based on Mann Whitney U Test

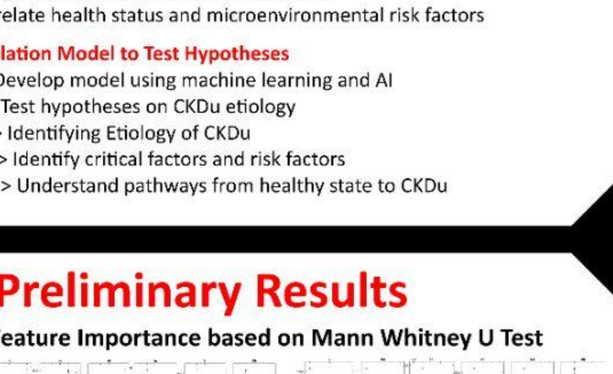

(a). CKDu Vs Non-CKDu (b). EC Vs Non-EC



Feature Reduction using Random Forest Algorithm



Feature Space Using PCA


Classification Using Deep Learning

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