Problem Definition

Origin of NPS Pollution : Activities

Agriculture
Habitation
Waste Disposal
Construction

Nature

Diffused in terms of its origin and entry into the water body

Pollutants :

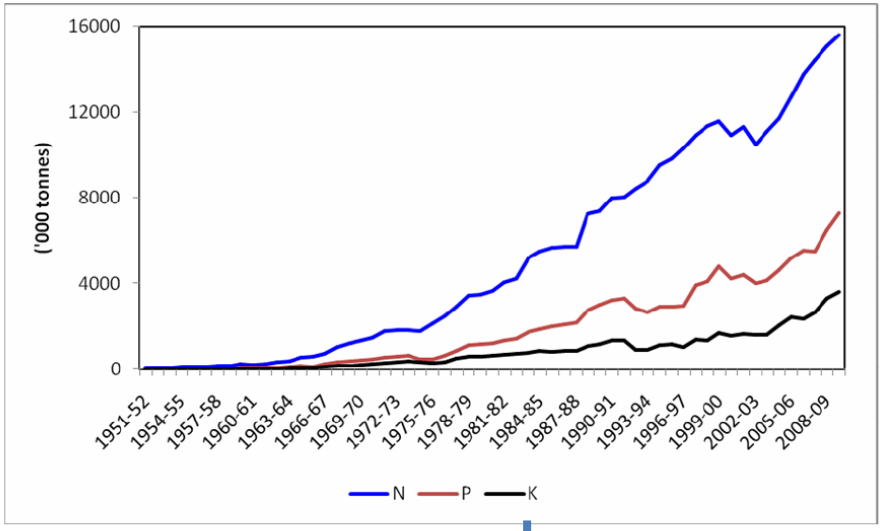
Nutrients (Fertilizers)
Pesticides
Sediments
Organic matter
Salts /Trace elements
Microorganisms

Interlinkage of Hydrologic Cycle and Pollutant Transport

Rainfall
↓
Runoff
↓
Agriculture
Nutrients
Pesticides
↓
Transport from land to receiving water
↓
Violation of Water Quality Standards

Indian Agriculture Scenario

Trends in fertiliser consumption (N, P and K) in India: 1950-51 to 2009-10



Source: Fertiliser Association of India (2010)

Green Revolution in India (1960-70)

High-yielding varieties of seeds

Increased chemical fertilizers use

Irrigation

Genetically modified seeds

One type of crop is grown

- **Large cropped area**
- **High intensity** (use per hectare)

More fertilizer application

Reduced crop variability in Indian soil

- **Water resources: polluted**
- **Soils : infertile**

Important for maintaining soil conditions & its fertility

Out of about 400 districts:
Total fertilizer use-
25% in 27 districts
50% in 76 districts
75% in 151 districts.

Environmental Impact :Soil infertility, less productivity
Health-impacts- acute poisoning, cancer, neurological disorder
Societal impacts – Poor farmer, Labor problem, Loss of wages

Concern : NPS Pollution
No Guidelines :Fertilizer application/ BMP implementation

Need : Methodology for NPS Assessment & Control

Mathematical Models are accepted as Objective Evaluation Tool for Environmental Systems

Data intensive (Input parameters, model coefficients :- Site-specific: Scanty in developing countries)

Not user-friendly (Decision makers/Policy makers)

Visual Mapping : Understanding and Interpretation Easy (GIS-based Models : popular)

Indian Context

- **Applicability of data-intensive models : Not yet well established**
- **Due to varying environmental or agricultural conditions**

No confidence in results

Variability : Soil, climatic conditions, rainfall pattern, geomorphology, Lu-LC
Farm sizes small (few acres)
Less Mechanization (No Precision farming)
No promising rainfall (June-Oct)
Flood irrigation (more runoff generation)
Broadcasting of fertilizers

Models rarely used by decision- makers for pollution control practices

Model for Sub / Micro-watershed Level studies

- **Suitable for Indian scenario**
- **Simple & Easy to understand**
- **User-friendly**
- **Computationally efficient & accurate**
- **Incorporate Sufficient details in site- specific parameters/processes (local soil type, climate, crops, nutrient mobility in the soil and salinity)**

Decision Making for Pollution Control Boards:

- **Selection of BMP**
- **Where to Locate**

Buffer strips

Riparian Zone

Sedimentation Basin/ Trap

NutriL-GIS: A GIS-based Model for Agricultural Watersheds

Development of a NPS Pollution Assessment model for Agricultural watersheds using GIS, Hydrological Modelling Tools

Objective

User-friendly, platform independent S/W with GIS functionalities

ArcGIS Engine Runtime 9.1
VB.Net frame work 3.0
MS-Access/ XLS

Hardware requirement
512 MB RAM
CPU 1.80GHz
Windows XP

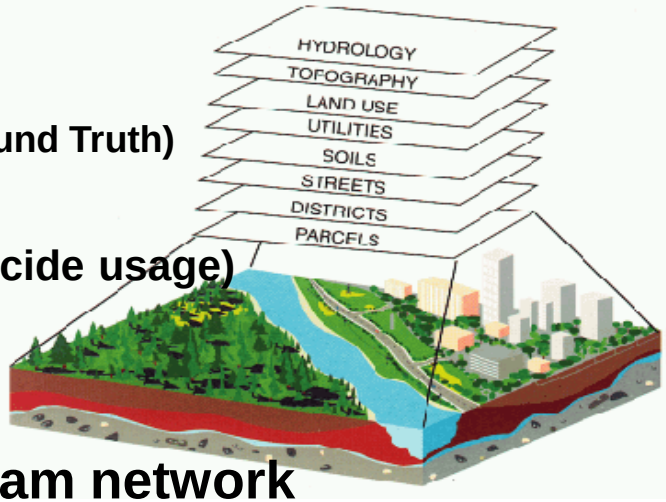
Hardware/ Software Requirement

Methodology

Database Creation

Satellite data/SOI toposheets : Generate Thematic Maps

Spatial Data



Procurement / Loading /preprocessing RS data

(Image,Enhancement, Georeferencing, Visual Interpretation, Ground Truth)

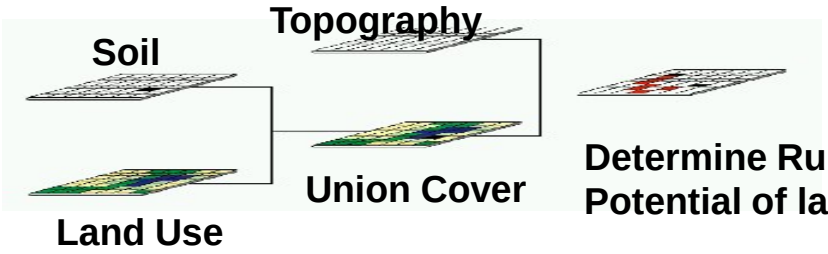
Generation of Base Map and GIS coverages

(Land Use/ Land Cover, Soil, Topography, fertilizer/pesticide usage)

Preprocessing

Creating Digital Elevation Model (DEM) & Stream network

Overlay Analysis using GIS



GriD-Based Modelling

Development of Raster based program for hydrologic modelling

(flow direction, flow accumulation, & watershed delineation)

Development of Pollutant Transport Model in a Watershed

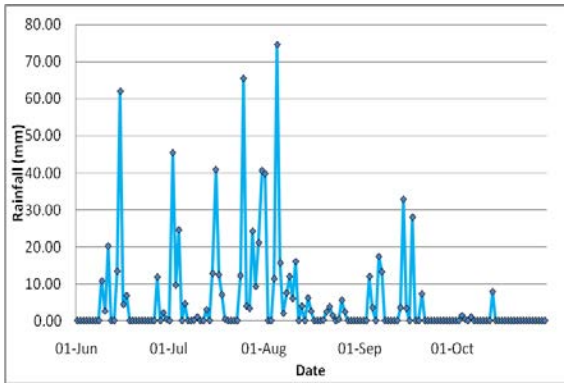
(distributed NP load in watershed)

Inputs for Hydrological Modelling

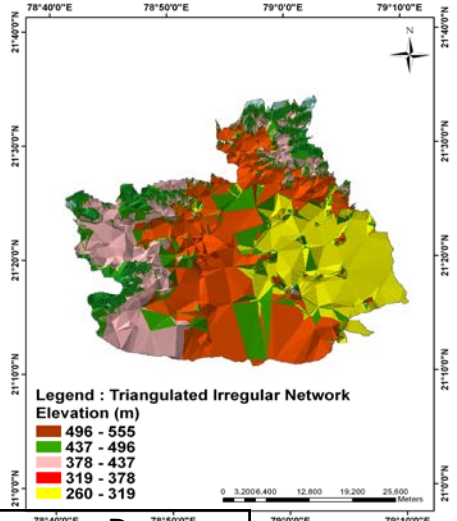
GIS Maps

Boundary

Rainfall



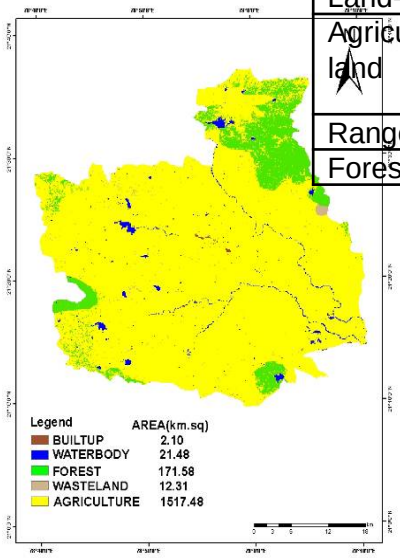
Slope/DEM



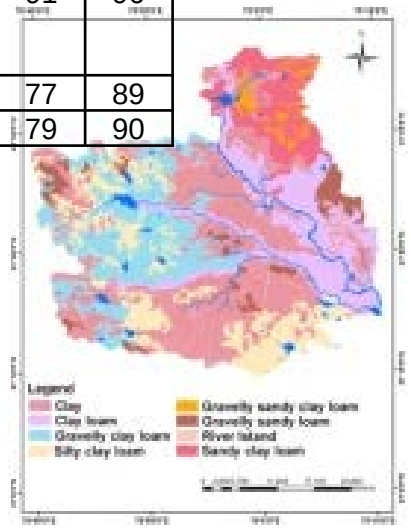
Curve Numbers for SCS-CN Method

HSG[2]	A			B			C			D		
AMC3→ Land-Cover	I	II	III	I	II	III	I	II	III	I	II	III
Agricultural land	52	72	86	64	81	91	75	88	94	81	91	96
Rangeland	18	35	55	35	56	75	49	70	84	58	77	89
Forestland	19	36	56	39	60	78	53	73	86	61	79	90

Landuse



Soil



Main Interface

- RunEstim
- ADAM
- NutriLem

GIS Analysis

- Overlay LU & SOIL
- Assign Model Parameters
- Map to Grid Conversion
- Grid Algebra

↓

Runoff Volume & Accumulated Runoff at Pour Points

Analysis of Agricultural Data

Crop combination
NPK requirement
NPK uptake

↓

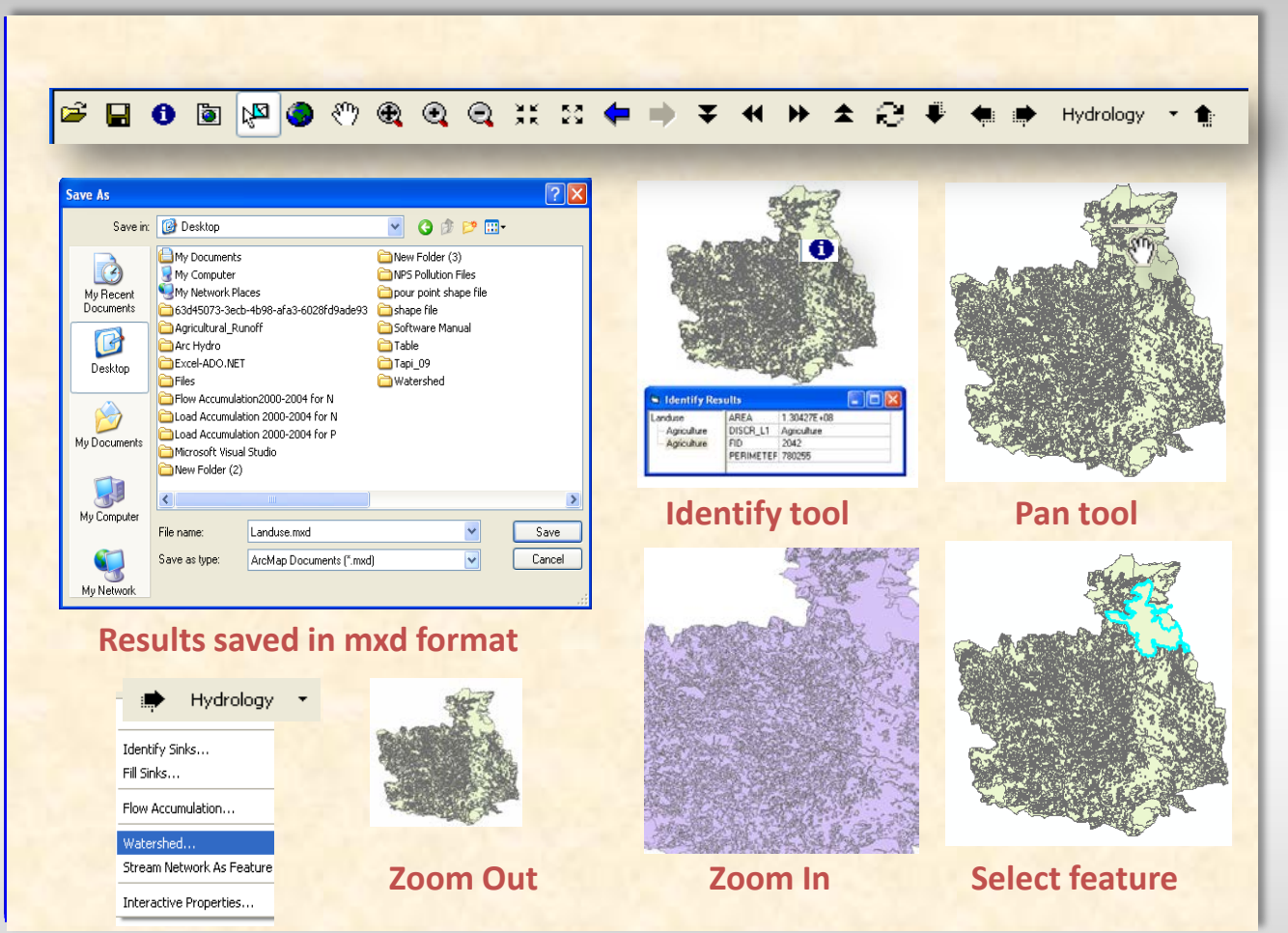
N, P in Runoff

↓

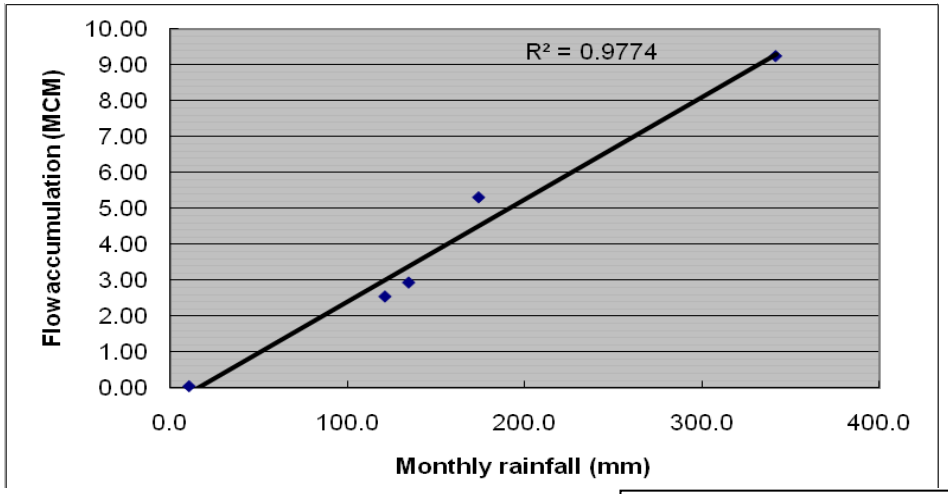
Distributed Load
Accumulated Load

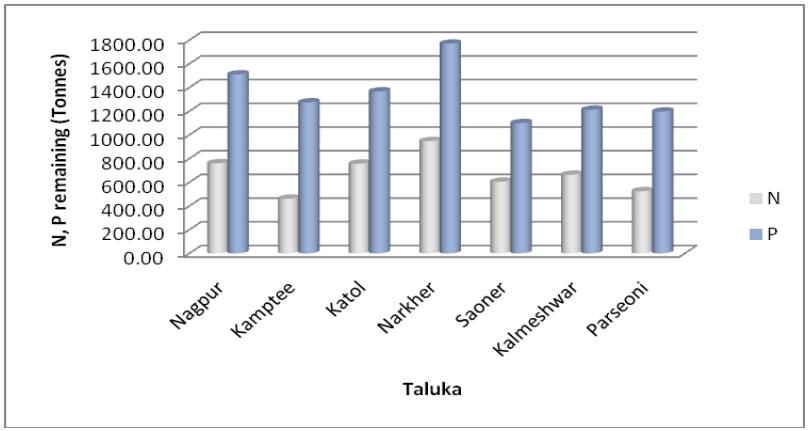
GIS Tools

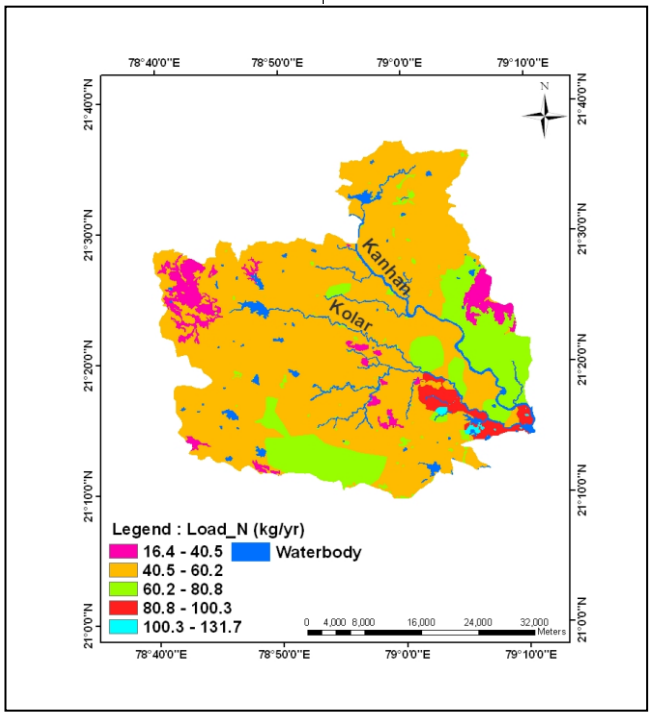
Inbuilt GIS Utilities & Functionalities



Calibration Results







Simulation for distributed N Load

Application of NutriL-GIS for NPS Assessment & Control

In India: Need -NPS pollution control and improve water quality of drinking water in sources

For watershed based planning, distributed pollution load generation and its transport towards the mainstream

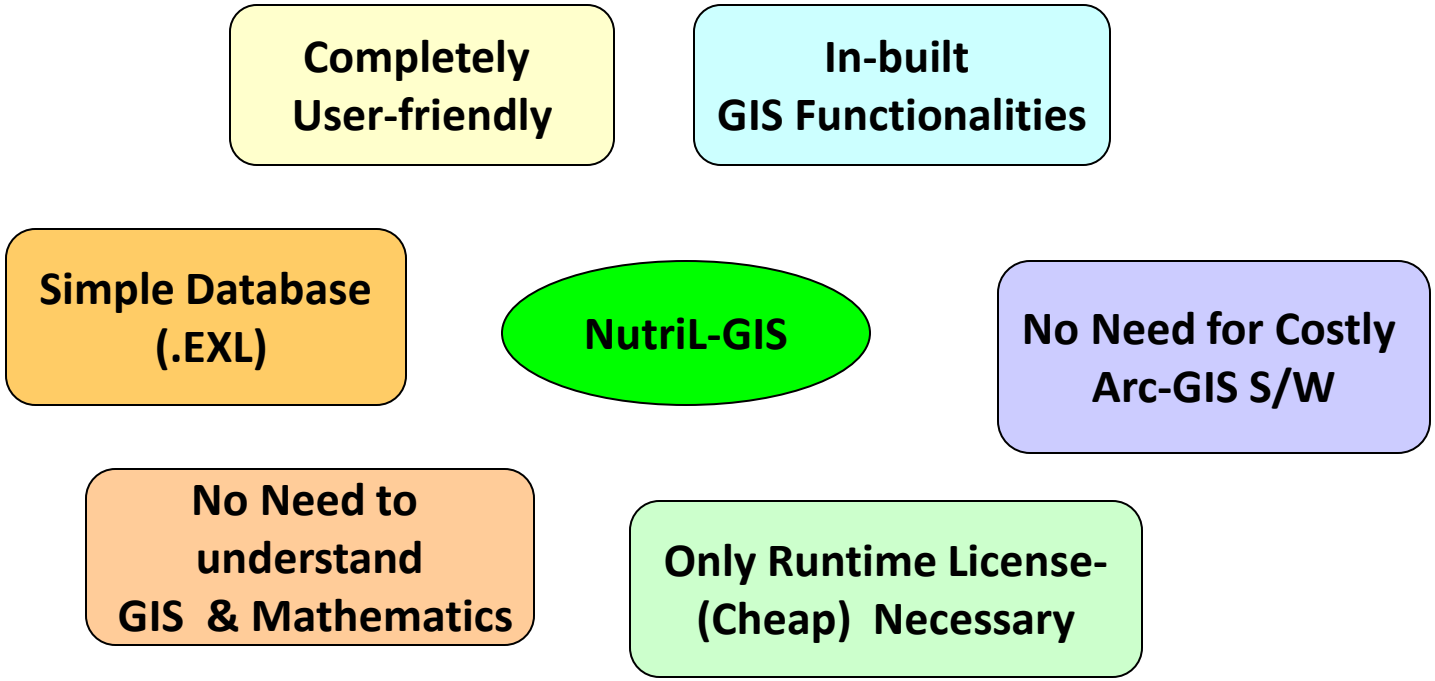
Best Management Practices (BMPs) :

Optimum fertilizer usage, strip intercropping, rotational grazing, riparian buffers, engineered wetlands, and filter strips.

Nutrient pollution control measures implemented : sedimentation basins, ponds, soil erosion control; terracing, ecological farming, reforestation and creation of riparian and buffer zones

EMCs as representative of amount of nutrient carried with the agricultural runoff from a particular taluka. The estimates can be used as guideline for fertilizer application in the next cropping season

Salient Features of NutriL-GIS



Acknowledgement

Department of Science & Technology, India for funding (2006-2008)

Director, CSIR-NEERI for consistent Support

Project Team

Ashish Sharma (Senior Scientist, ESDM, NEERI, Nagpur)

Barkha Rathi (Project Assistant, ESDM, NEERI, Nagpur)
Sanjay Kothe (Project Assistant, ESDM, NEERI, Nagpur)
Sanjay Raut (Project Assistant, ESDM, NEERI, Nagpur)
Anamika (Project Assistant, ESDM, NEERI, Nagpur)
Taj (Project Assistant, ESDM, NEERI, Nagpur)


Thank you