

MTIGT1104: SPATIAL DECISION SUPPORT SYSTEM

UNIT - 5

Designing and Coding of Linking of QUBIS

- 1. Introduction to Spatial Decision Support System:** Definition – Concepts – Multicriterion Approach – Usefulness. **7 Hrs.**
- 2. Designing of Spatial Database:** Identification of Geographic features – attributes & data layer – Defining the storage parameters for each attribute – ensuring of co-ordinate registration – map projection – Transformation. **12 Hrs.**
- 3. Designing of Non spatial Database:** Creation of data table file to hold the attributes – Adding up of description attribute values to table – Different types of sources of data entry – Checking for errors. **12 Hrs.**
- 4. Linking of Spatial Database & with Non spatial Database:** Verifying of common item, availability and joining of attribute table with existing spatial records – spatial display of non spatial data. **15 Hrs.**
- 5. Designing & Coding of QUBIS:** Planning for the user requirement – preparation of spatial & Non spatial relational databases – QUBIS Designing – QUBIS Coding (Testing, Error handling, Monitoring, User interface

5. Designing & Coding of QUBIS: Planning for the user requirement – preparation of spatial & Non spatial relational databases – QUBIS Designing – QUBIS Coding (Testing, Error handling, Monitoring, User interface Development). **18 Hrs.**

5.1 Planning for the User Requirement

- List out the requirement of the users such as,
 - Map display of available facility locations,
 - Tabulated display of these facility locations

For. e.g. Locations of Post Offices, Fire Stations, etc.

 - Map display of existing infrastructures
 - Capacity and facility availability within such infrastructures

For e.g. Schools, Hospitals, Hotels, Lodging, Community Centers, Theaters, Auditoriums, etc.

 - Accessibility details – routes, facilities available to reach, hurdles that may be faced, ...
 - Reachability details – how long need to travel for people residing from various places , time taken to access such facilities.....

5.1 Planning for the User Requirement...contd...

- Specific requirements by the users such as,
 - Information system on existing Natural Resources Exploitation Status
 - Information system depicting the past disaster events that had scrambled the area, how affected, reasons thereby, what to do, what not to do, info for future development, etc.
 - Info. sys. on Forest, birds and animal resources
 - Info. Sys. on tourism development activities by Government

In each case, there may be a variety of information need to be digitized and they may vary from place to place according to the terrain, existing infrastructure, pattern of living and environment, etc., need to be considered carefully.

Types of User Requirements for QUBIS-Query Based Information Retrieval System:

1. Query based map retrieval alone
2. Query based map and chart display
3. Query based map, chart and table display
4. Query based map, chart, table, report generation and display
5. Spatial Decision Support Systems for various Natural Resources Management and Conservation
6. SDSS for Natural Disaster Mitigation and Management
7. SDSS for identification of gap areas for Science and Technology Needs or Requirements
8. SDSS for Physical and Human Resources Sector Development and Management
9. SDSS with modeling capability
10. SDSS with networking capability
11. SDSS with Automated Capabilities such as Interpretation of Recent Satellite Images, Data Manipulation, Data Conversion, Data Classification, Layer Generation, Data Analysis and Action Plan Map Generation, etc.

Basic Ideas for QUBIS / SDSS Development

To be decided before SDSS generation:

1. Basic Display Unit
2. Levels of map display
3. Types of Menus and options
4. Number of Thematic, Action Plan and other Derivative maps to retrieve and display
5. Map handling tools for user interaction
6. Levels of help needed
7. Front page Design - based on the Type of SDSS users.

5.2 Preparation of spatial and Non-spatial relational databases

1. List of **spatial databases** needed for SDSS to be generated first. For e.g.:

a. Base Layers

i. Administrative Boundaries

1. Country
2. State
3. District
4. Taluk / Block
5. Village, etc.

ii. Settlements

1. Major – Cities, Towns, Headquarters, etc.
2. Villages, Habitations, Huts, etc.

iii. Roads

1. Major – Asian Highways, NH, SH, DH
2. Village Roads, Unmetalled, Pack tracks, Cart Tracks, Foot paths, etc.

iv. Railway lines

1. Broad Gauge

2. Meter Gauge

3. Narrow Gauge, etc.

v. Reservoirs, Lakes, Tanks, Rivers, Streams, Canals, Drainages, and other water bodies, etc.

vi. Hill and Reserved / Protected Forest Boundaries.

a. Basic Thematic Maps

- i. Lithology
- ii. Structural Trend lines and fold styles
- iii. Lineaments / Fractures / Faults / Schistosity, Foliation, Shear systems
- iv. Geomorphology
- v. Slope
- vi. Landuse / Land Cover
- vii. Subsurface Lithology
 - 1. Thickness of Top soil
 - 2. Thickness of Weathered Zone
 - 3. Thickness of Fractured Zone
 - 4. Depth to Bed Rock

viii. Aquifer Characteristics

1. Transmissivity
2. Permeability
3. Storage co-efficient
4. Specific yield

ix. Groundwater level

x. Groundwater table

xi. Natural Recharge and discharge

xii. Groundwater Chemistry

1. Electrical Conductivity
2. TDS – Total Dissolved Solids
3. pH – Hydrogen ion concentration
4. Iron
5. Calcium
6. Sodium
7. Potassium
8. Fluoride
9. HCO_3
10. Arsenic
11. Lead, etc.

xiii. Groundwater movement, etc.

b. Specific Thematic Maps

1. Areas prone for Soil Erosion
2. Areas of Groundwater Pollution
3. Areas prone for Landslides, etc.

c. Derivative Maps

4. Soil Erosion due to Geomorphology
5. Groundwater Pollution due to industrial waste disposals
6. Landslides due to sensitive toe removal along hill slopes
7. Landslides due to dyke intrusion, etc

1. Similarly, a List of **non-spatial databases** to be included in SDSS has to be generated as mentioned below:

a. Physical Resources

- i. Agriculture Sectors
- ii. Agricultural Engineering
- iii. Aquaculture
- iv. Animal Husbandry
- v. Banks
- vi. Civil Supplies
- vii. Developmental Sector
- viii. Electrical Sector
- ix. Education
- x. Fisheries
- xi. Horticulture
- xii. Highways

xiii. Industries

xiv. Irrigation

xv. Land Survey

xvi. Mining industries

xvii. Postal offices

xviii. Retired Officers Welfare

xix. Sericulture

xx. Small Industries

xxi. Transport

xxii. Etc.

b. Human Resources

- i. Children – Male, Female
- ii. Middle age People
- iii. Elderly People
- iv. Employed / Unemployed
- v. Habit based classes, etc.

c. Forest Resources...etc.,....

After deciding the number and type of databases need to be generated, the **data structural formats** for **collecting, storing and retrieving** the spatial and non-spatial data in SDSS by the users according to the requirement of the users/planners need to be established.

For example, if the user is interested to see the type of resources available in an area, then, the particular resource locations in terms of points / lines / polygons must have been digitized and the relevant resource details such as its ***areal extent, concentration, volume availability and exploitability***, might have been worked out and entered in the attribute table.

Similarly for the non-spatial database, the planner may be interested in seeing the **locations** of different infrastructure / facilities such as hospitals, schools, postal facility availability in an area. In this case, their exact spatial locations as points or the villages having these facilities can be shown with polygon boundaries.

The **distance to be travelled** by the users / common people can also be shown as the planners are interested to know these details for identifying the grey areas where these facilities can be created and the funds can be allotted and sanctioned based on the priority basis.

Similarly, the database need to be classified or derivative information should be made readily available with attributes so as to retrieve them by the users whenever required.

For example, the distance to be travelled to utilize the existing facility/infrastructure can be simplified based on the distance from various places such as,

0-2 km,

2.1 – 4 km,

4.1 – 6 km,

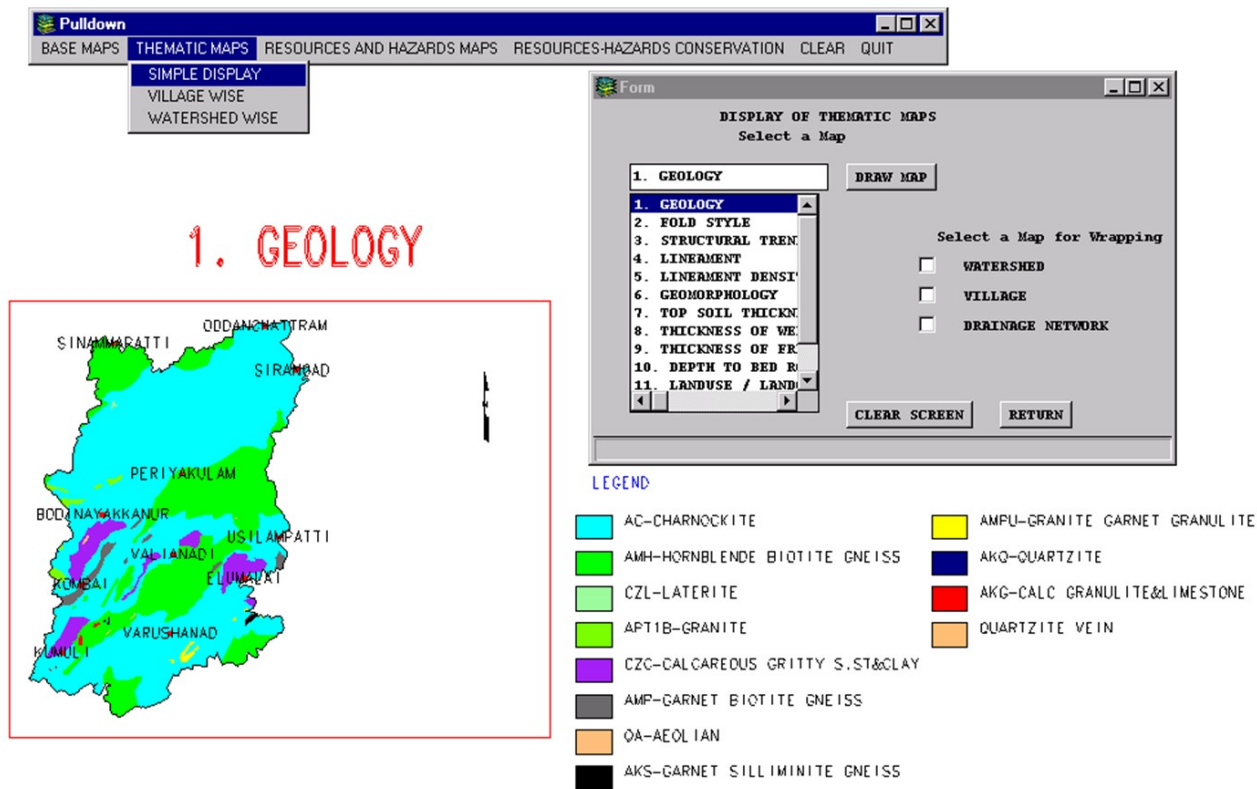
>6 km, etc., and the same should be entered in the attribute tables so as to retrieve them by the planners / users.

5.3 QUBIS Designing

A welcome page can be shown to the user on clicking an icon of SDSS so as to introduce the containment and the use of the present system and the designing agency and contact information.



This can be followed by a Main Menu display. The main menu can contain several options with dropdown and slide down menus containing relevant features.



Pulldown

BASE MAPS

THEMATIC MAPS

RESOURCES AND HAZARDS MAPS

RESOURCES-HAZARDS CONSERVATION

CLEAR

QUIT

MINERAL RESOURCES

SURFACE WATER RESOURCES

GROUND WATER RESOURCES

GEOTHERMAL PROVINCES

SOIL EROSION

LANDSLIDE

SEISMIC CORRIDORS

ROAD METAL

LIME STONE

CLAY

SILICA

WATERSHED WISE

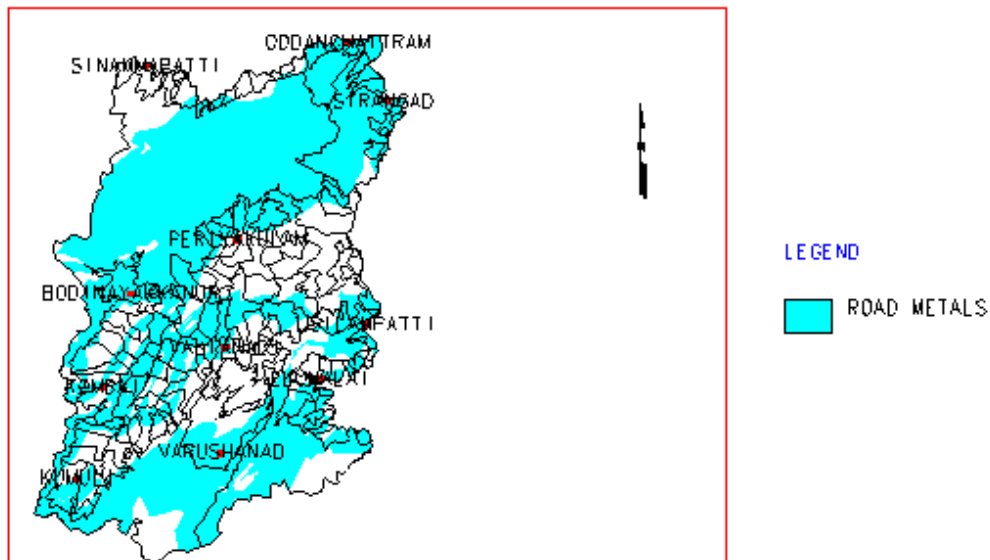
VILLAGE WISE

Clear Screen

☐ Watershed
☒ Village Map
☐ Drainage

Select a Map for Wrapping

Return

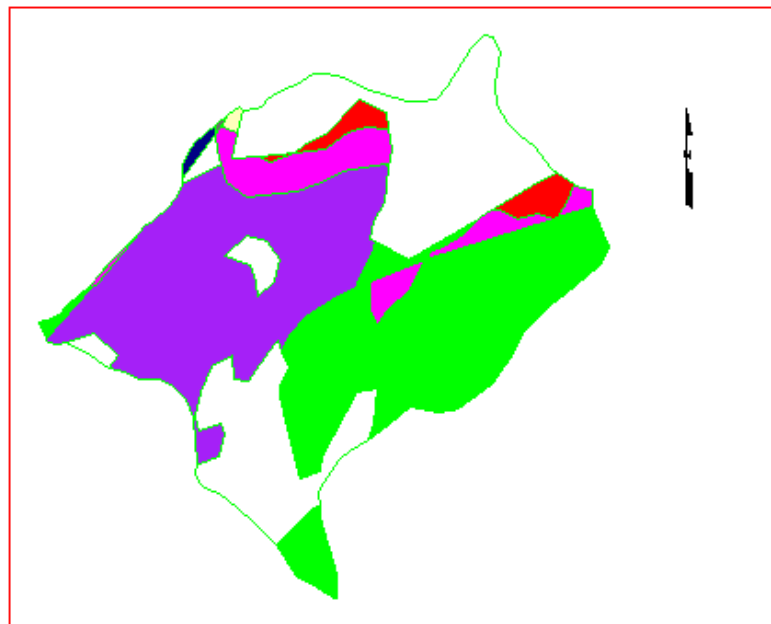


Pulldown _ _ X

BASE MAPS THEMATIC MAPS RESOURCES AND HAZARDS MAPS **RESOURCES-HAZARDS CONSERVATION** CLEAR QUIT

SOIL EROSION ▸ ACTIVE SOIL EROSION
 GROUND WATER RESOURCES ▸ CONSERVATION MEASURE
 LANDSLIDE MANAGEMENT ▸

5-WATERSHED



Form _ _ X

SOIL CONSERVATION - WATERSHEDWISE
SELECT A WATERSHED

0
1
2
3
4
5
6
7
8
9

DRAW MAP

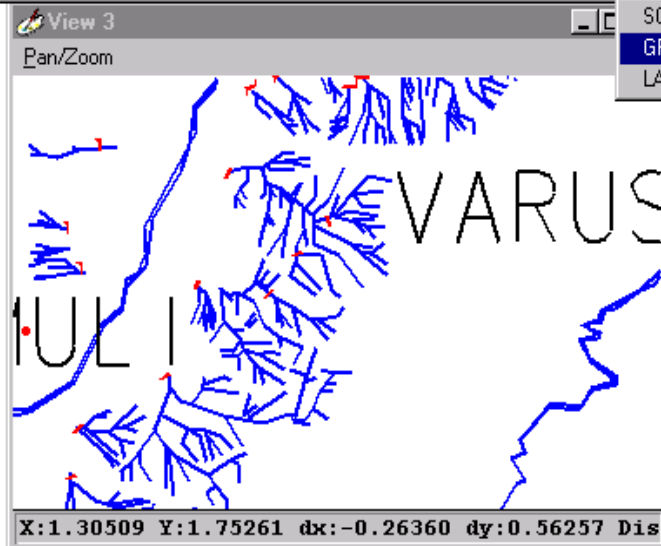
 IDENTIFY

 RETURN

 CLEAR SCREEN

LEGEND

- AFFORESTATION (BARREN LAND)
- SCRUB LAND (LAND WITH OUT SCURB)
- MODERATE HORTICULTURE (ROCKY PEDIMENT)
- CONTOUR BUNDING (SLOPE)
- INTENSIVE AFFORESTATION (BAZADA)
- INTENSIVE AFFORESTATION (OPENSURB)
- CHECK DAMS/SILT TRAPS AND GRASSED WATER WAYS (DRAINAGE DENSITY)



- SOIL EROSION
- GROUND WATER RESOURCES**
 - SHALLOW GROUNDWATER PROVINCES
 - DEEP GROUNDWATER PROVINCES
 - CONSERVATION MEASURES**
- LANDSLIDE MANAGEMENT

CHECK DAM

Form

GROUNDWATER MANAGEMENT AND CONSERVATION MEASURES

OVER ALL WATERSHED WISE

TANKS FOR DESILTATION VILLAGE WISE

PERCOLATION POND

FLOODING AND FURROWING

PITTING

ENECHELAN DAM

CHECK DAM

BATTERIES OF WELL

Select a Map for Wrapping

☐ Watershed

☐ Village Map

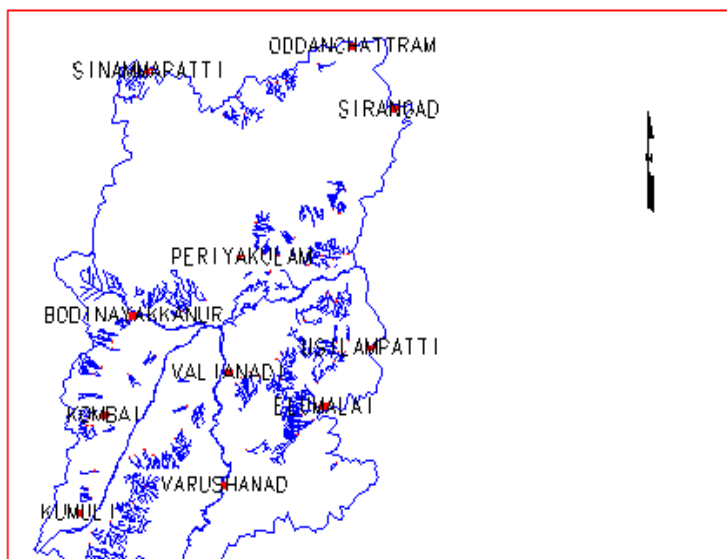
☐ Drainage

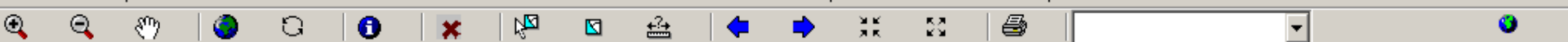
CLEAR SCREEN

RETURN

LEGEND

CHECK DAM





Map Selection

Statistics

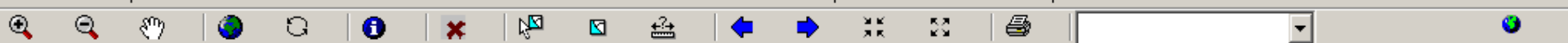
A large rectangular map area with a thin black border. In the center of this area is a smaller rectangle containing the word "Layers".

Layers

- ☒ Entire District
- ☐ Talukwise
- ☐ Blockwise
- ☐ Villagewise
- ☐ Mini Watershedwise
- ☐ Featurewise

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1653.11, 59.81 Decimal Degrees



Map Selection

Statistics

- Thematic Maps
 - Entire District
 - Base Map
 - Taluk Map
 - Block Map
 - Panchayat Village Map
 - Mini Watershed Map
 - IRS Mosaic
 - Road Network
 - Railway Network
 - Rock Types and Lithol
 - Structural Trendlines &
 - Lineaments
 - Geomorphology
 - Drainages, Rivers & C

- ☒ Entire District
- ☐ Talukwise
- ☐ Blockwise
- ☐ Villagewise
- ☐ Mini Watershedwise
- ☐ Featurewise

Layers

Map Selection

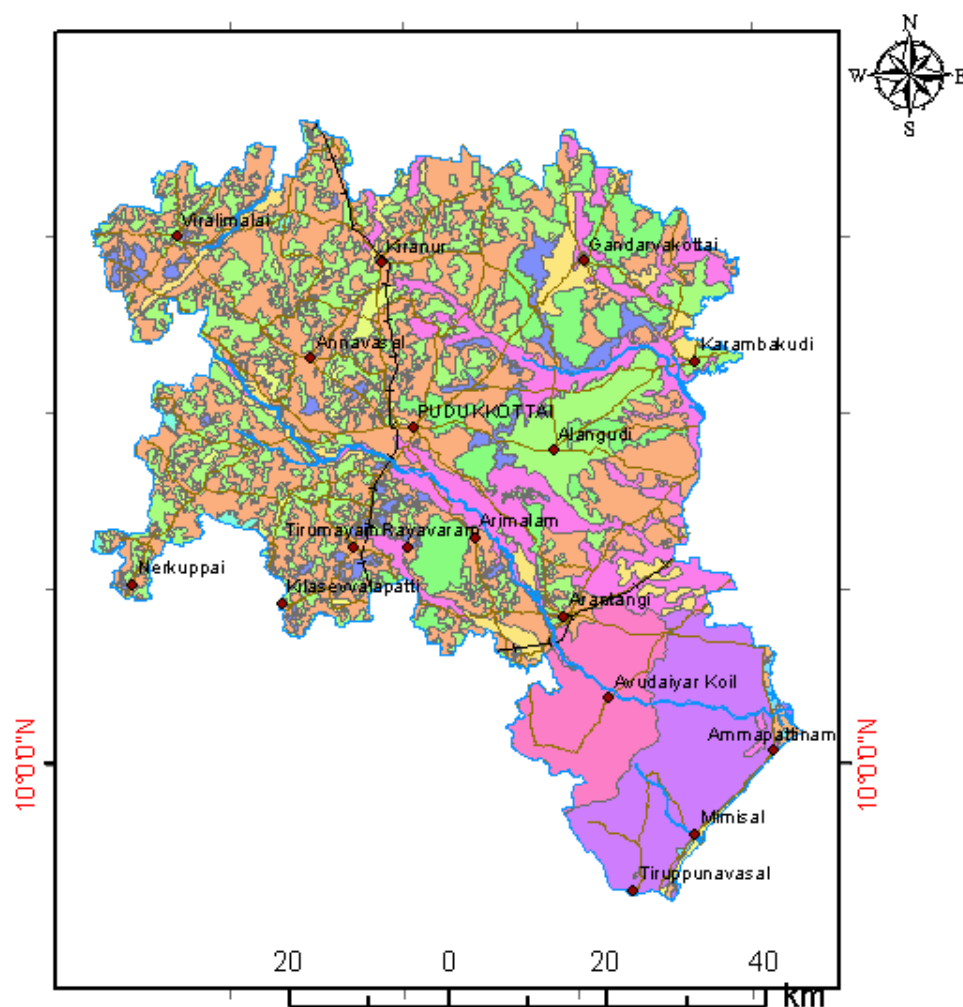
Statistics

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- ☐ Blockwise
- ☐ Villagewise
- ☐ Mini Watershedwise
- ☐ Featurewise

GEOMORPHOLOGY

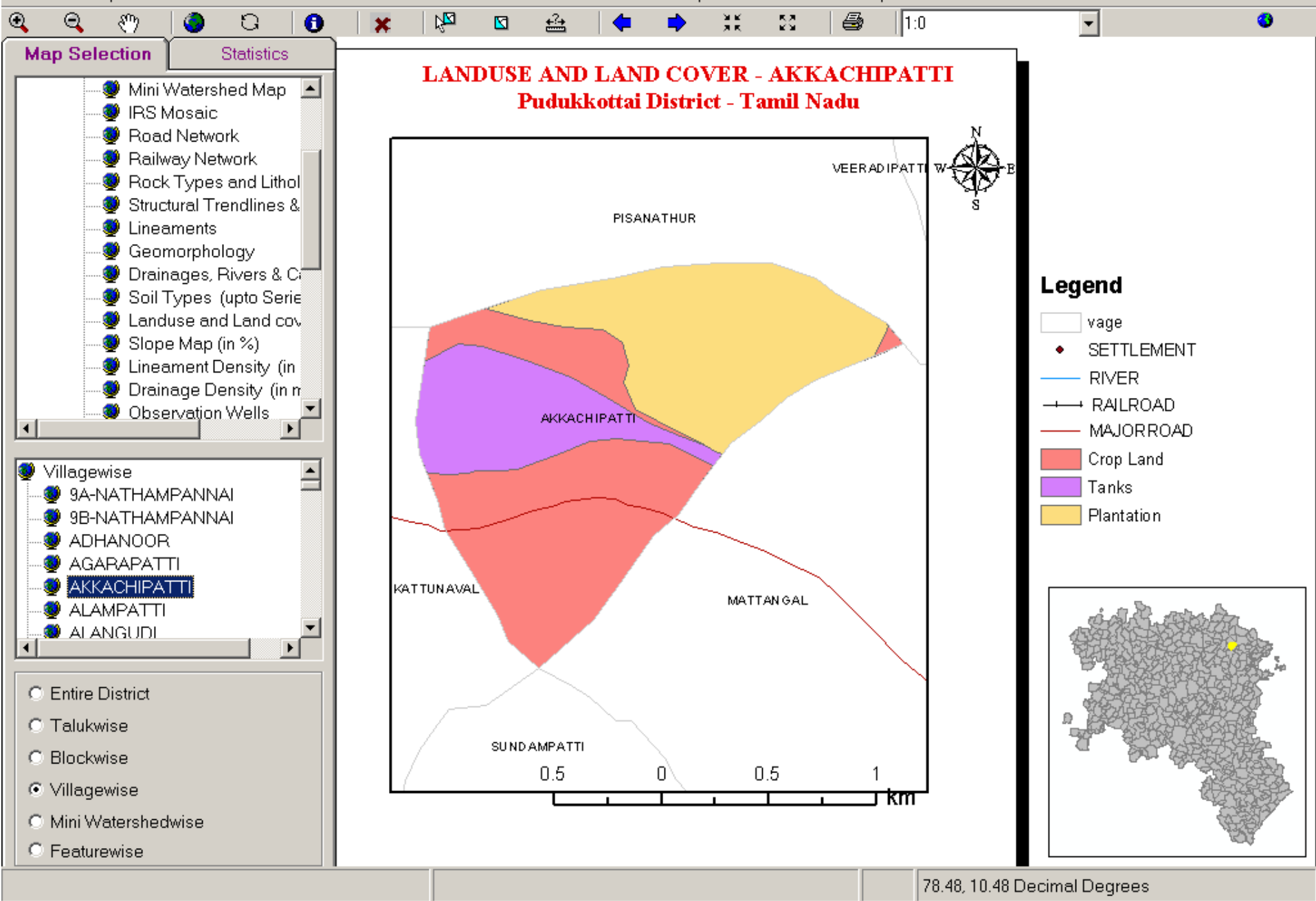
Pudukkottai District - Tamil Nadu



Legend

- SETTLEMENT
- RIVER
- RAILROAD
- MAJORROAD
- Buried pediplain medium
- Buried pediplain shallow
- Alluvial plain younger
- Alluvial plain older
- Lower plateau(lateritic) - dissected
- Pediment
- Buried pediplain deep
- Massive type residual hills
- Linear ridge
- Inselberg
- Deltaic plain upper
- Deltaic plain lower
- Beach ridge (young coastal plain)
- Salt flat
- Mud flat
- Paleo beach ridge (old coastal plain)
- Swale (young coastal plain)
- Young coastal plain
- Creek water

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Map Selection

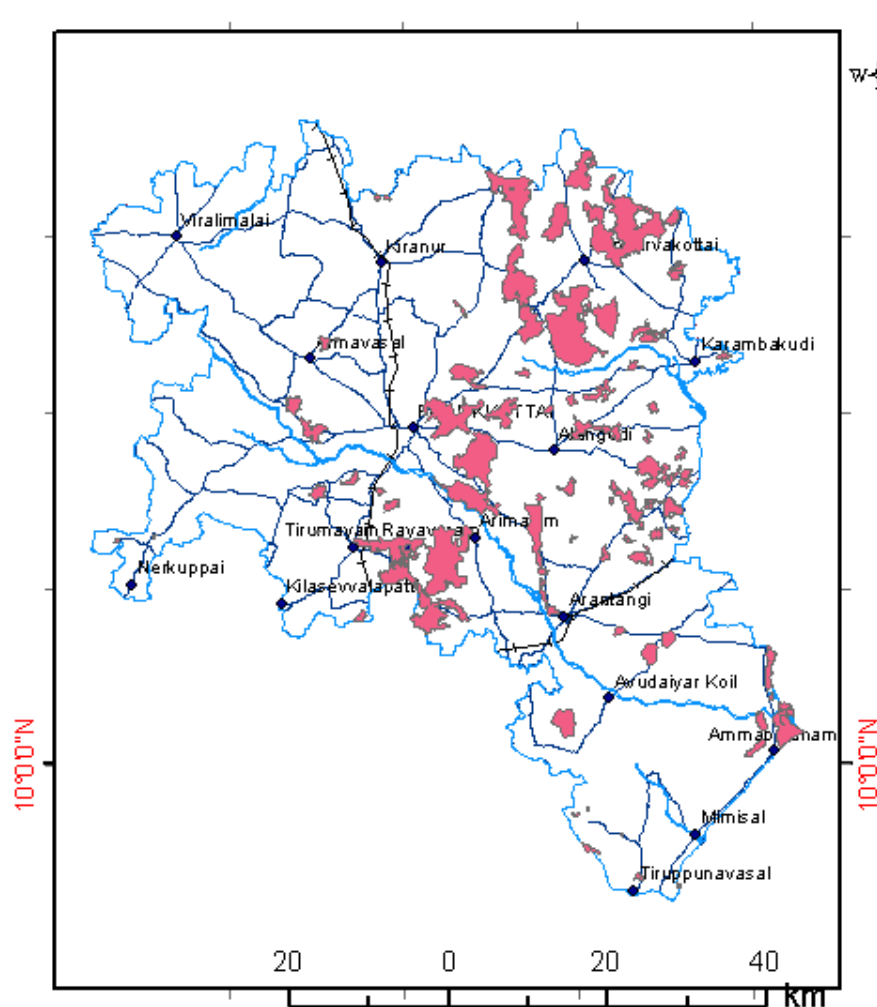
Statistics

- ☒ Drainages, Rivers & Canals
- ☐ Soil Types (upto Series)
- ☐ Landuse and Land cover
- ☐ Slope Map (in %)
- ☐ Lineament Density (in m/km)
- ☐ Drainage Density (in m/km)
- ☐ Observation Wells
- ☐ Rainfall (in mm)
- ☐ Water Level (in meters)
- ☐ Thickness of Top Soil
- ☐ Depth to Bed rock (in m)
- ☐ Transmissivity (in g/c)
- ☐ Permeability (in g/d/ft)
- ☐ Storage Co-efficient
- ☐ Specific Yield (in lps)

- ☐ Land with scrub
- ☐ Land without scrub
- ☐ Mining Area
- ☐ Mud Flat
- ☐ Open Forest
- ☒ Plantation
- ☐ River
- ☐ Salt Pans
- ☐ Sandy Area

- ☐ Entire District
- ☐ Talukwise
- ☐ Blockwise
- ☐ Villagewise
- ☐ Mini Watershedwise
- ☒ Featurewise

LANDUSE AND LAND COVER Pudukkottai District - Tamil Nadu



Legend

- SETTLEMENT
- RIVER
- +— RAILROAD
- MAJORROAD
- vboun
- Plantation

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Map Selection

Statistics

Education Sector

Health Sector

Communication Facilities

Agriculture Sector

Drinking Water

Irrigation Sector

Transport Sector

Electricity Sector

Veterinary Sector

Public Facilities

Revenue / Land Sector

Block Primary Health Centre

Primary Health Centre

Health Sub Centre

Sub Primary Health Centre

Community Health Centre

Government Headquarters Hospitals

Taluk Headquarters Hospitals

Private Hospitals

Panchayat Union Dispensary

Maternity Care Centre

Mother-Child Care Centre

OVERALL HOSPITALS

Layers

☒ Entire District☐ Talukwise☐ Blockwise☐ Villagewise☐ Mini Watershedwise☐ Featurewise

784.69, 1296.65 Decimal Degrees



Map Selection

View

ital Availability - Block Prima

ailable

< 2

2 - 4

> 4

Overall Availability

available

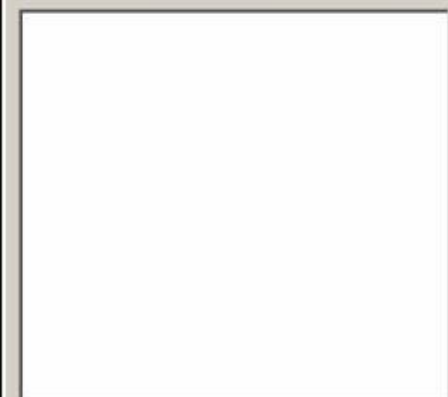
< 3 km

3 - 6 km

> 6 km

Overall Availability and Reachability

rs



☒ Districtwise ☐ Blockwise

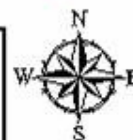
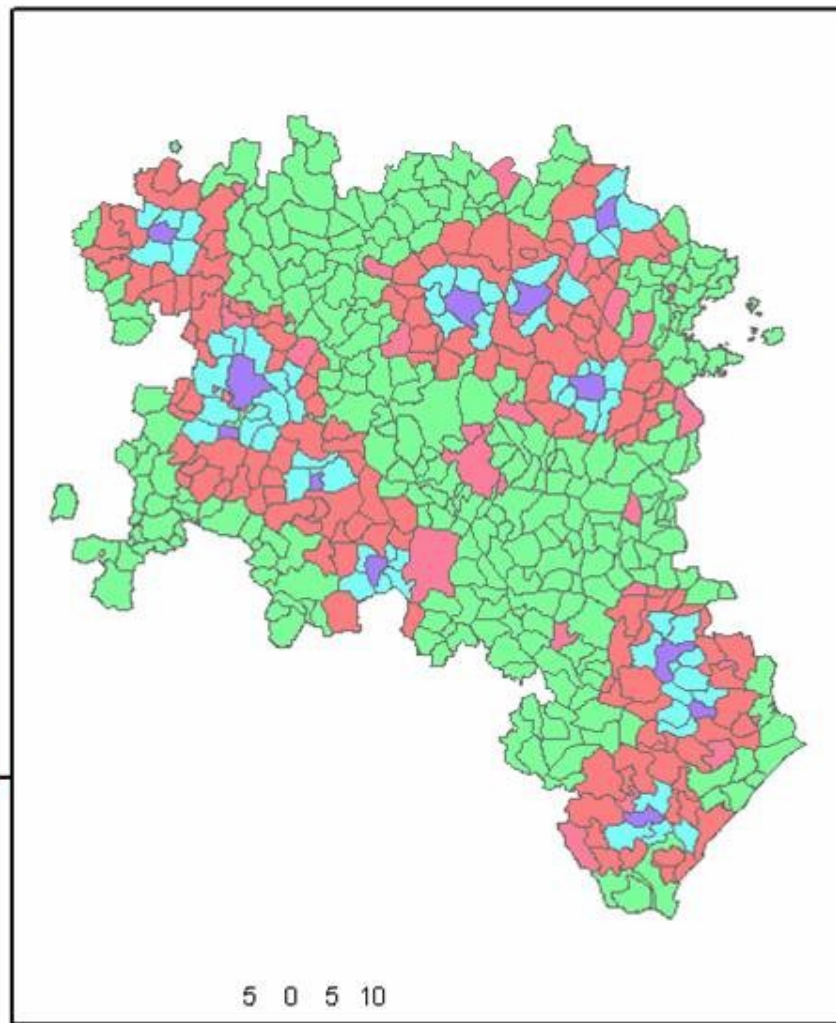
☐ Talukwise ☐ Villagewise

☐ Mini Watershedwise

☐ Featurewise

78.31, 10.34 Decimal Degrees

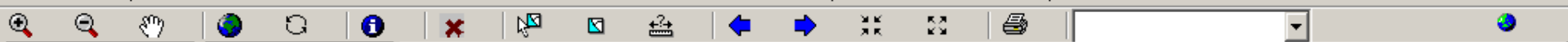
Health Sector - Hospital Availability - Block Primary Health CentreUnavailable - Overall Availability and Reachability



Legend

- < 3 km
- > 6 km
- 3 - 6 km
- 0

5 0 5 10
km



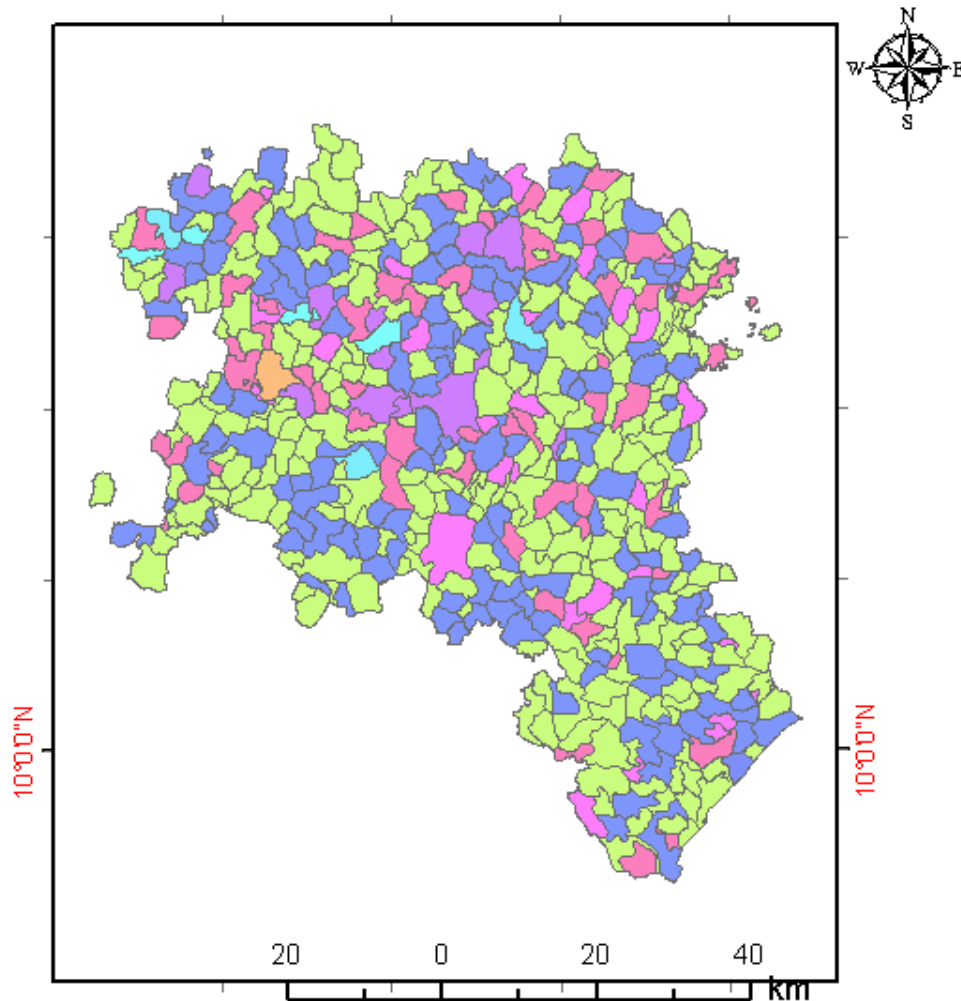
Map Selection

Statistics

- Health Sector
 - Block Primary Health Centre
 - Hospital Availability - Block
 - Doctors
 - Supporting Staff
 - Medical Stores
 - Other Details
 - Patients Details
 - Death Details
 - Infant Deaths
 - Maternal Deaths
 - Diseases

- ☒ Entire District
- ☐ Talukwise
- ☐ Blockwise
- ☐ Villagewise
- ☐ Mini Watershedwise
- ☐ Featurewise

BLOCK PRIMARY HEALTH CENTRE Infant death Details - Infant Deaths



Legend

- 0
- 2
- 1
- 3
- 4
- 6
- 5
- 11

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Data Updation in QUBIS:

A simplified menu is formulated and incorporated with NRDMS-QUBIS design so as to update the existing both kind of databases such as spatial and aspatial data by the authorized users.

A separate option called 'Data Updation' is kept in the main menu. On clicking this option, a dropdown menu showing the two types of databases available in this QUBIS, i.e., Spatial Data and Non-spatial Data will get displayed.

On selecting any of these two, a new login window will lead the users to enter 'User Name' and 'Password'.

On checking the authenticity of these user inputs, the users will be permitted to access the database so as to add a new, delete, change or update the existing databases in QUBIS.

Programming in VBA / .net :

It is necessary for the QUBIS/SDSS developers and GIS programmers to know the available controls in GIS and their applications to execute different actions on the click events of mouse. SML, i.e., Simple Macro Language in Arc/Info DOS versions, AML in NT Arc/Info versions, AVENUE in ArcView, ArcObjects in ArcGIS, ArcSDE in the latest versions of ArcGIS are useful platforms to generate such QUBIS and SDSS for the benefit of the users community.

The GUI based options available for designing the main display page which will provide simplified user interaction by simple click events through mouse. Hence, on compilation of such VBA or .net or Python programs under the backdrop of GIS software, it is possible for the non-GIS users to utilize the fullest capabilities of GIS with simplified menu options for interactions through QUBIS / SDSS.

Coding for QUBIS / SDSS

- Set of sample programs written in VBA can be used in coding QUBIS/SDSS
- After designing the Main / Sub/ dropdown / Menus / Pane, the same can be linked with the variety of mouse clicking events.
 - Declaring the variables and constants and their dimensions followed by the main codes. After completion, the QUBIS/SDSS should undergo
- Testing, Error handling, Monitoring and User interface Development.

Testing

- By running the QUBIS / SDSS codes / programs, the compatibility, suitability, correctness in achieving / displaying the expected results can be checked.
- While the program is on running mode, all the menus, sub-menus, tools, textboxes, check buttons, click options, double click options, help guidance text displays, legends and related map layout aspects need to be checked thoroughly multiple times.

Error handling

- While running the QUBIS / SDSS programs, the errors that are displayed need to be noted and print screen / screenshots need to be saved and to be used to correct the errors.
- Multiple events / clicks by the user at a time, may also lead to error during the execution of program
- Similar errors occur when a task is completed and moved for an another task by the user, and
- Errors raised during several steps in retrieving / modelling for a particular aspect need to be carefully noted and attended.
- Unexpected errors that may rise during the execution of SDSS can also be handled and the related aspects can be saved in a temporary file so as to be attended by the programmers after the event is completed by the user.

Monitoring

- Programs can be written in SDSS such that the number of users benefited out of it
- programmers / source group can monitor the usage of the SDSS / QUBIS for understanding the difficulties faced by the users
- SDSS / QUBIS can be improved then and there, by constant monitoring and
- By viewing the reports automatically generated by these SDSS / QUBIS while used by the user community.

User interface Development

- There are several advanced tools / GUI mechanisms are developed now-a-days for the users to simply use the SDSS effectively.
- Kiosk – touch screen based applications and tools embedded within it improves the speed and simplicity in operating or accessing the program and utilize them effectively.

A photograph of three dolphins leaping from the ocean. The dolphins are captured in mid-air, their bodies arched as they move from left to right. The water below is a deep blue with white foam from the dolphins' jumps. The sky is a vibrant blue, filled with soft, white cumulus clouds. The overall scene is bright and cheerful, conveying a sense of freedom and joy.

Thank You