

# **GIS for Rehabilitation and Development of the Northern & Eastern Provinces of SriLanka**

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## **Abstract**

Managing the rehabilitation, reconstruction, development and resources in the North and east Provinces, requires relevant and reliable data as well as simple and effective tools for analysis and display of information. Enormous data are existing with various institutions in the province. However the available data are not location specific, disorganized, unanalyzed and unavailable in a readily usable form to support decision making. Therefore, it was necessary to acquire different sets of data, analyze the data, develop and preferably institutionalize a suitable and appropriate information system within the administration of N&EP.

GIS has become the most powerful tool for managing information with reference to a geographical location. In particular, the uses of relational databases for geographic information management nowadays provide more efficiency in handling of spatial and attribute data. Geo-databases and GIS are very effectively supporting planners and decision makers in assessing and understanding actual situations and trends in various fields of application.

Centre for Information Resources Management (CIRM), a unit of North and east provincial administrations, is functioning with the objective of supporting decision making, planning, monitoring and coordination of the development efforts through a comprehensive Geographic information system (IS). The development of the Geographic Information System has been steadily in progress since the year 2004. The type of information required for the organizations working in the N&E provinces are diverse and enormous and the geographic coverage is also very large. Participation of many organizations and communities is essential to make it a sustainable system. Therefore CIRM has been addressing this endeavour through a set of strategies in long term.

This paper describes the strategies adopted to establish a functional Geographic Information System in the NEP, highlight the achievements and discuss the existing as well the potential uses of the GIS applications in the rehabilitation, reconstruction and development efforts for serving the humanity in the North and Eastern provinces of Sri Lanka.

## **Introduction**

In the war torn Northern and Eastern Provinces (N&EP) of SriLanka, rehabilitation, reconstruction and development efforts are taken by the government institutions, non-government organizations, international agencies and donor-supported projects. This brings a considerable inflow of funding and development resources to the N&EP that has to be allocated in the most efficient way to achieve the highest outcome possible. Managing the rehabilitation, reconstruction, development and resources requires reliable data. For every organization or project that is involved in development works, it is important to have current and reliable data to develop plans/concepts and strategies for

the interventions. Based on the data, the target group and the area of intervention should be decided and the implementation of the project impacts to be assessed.

Many organizations and institutions in the N&EP are weak in the project management i.e. planning, implementing and monitoring their interventions. It is therefore important to have relevant data as well as simple and effective tools for analysis and display of information in order to bring a change in this situation. Relevant, reliable and readily usable form of information is the key for decision making. Access to analyzed data for diverse purposes and effective visualization of the same will enhance the decision making. The grass root level officers need location specific data. The higher level decision makers in the administration and in different sectors of the N&E provinces require to know the trends and patterns. Enormous data are existing with various institutions in the province. However the available data are not location specific, disorganized, unanalyzed and unavailable in a readily usable form to support decision making. Therefore, it was necessary to acquire different sets of data, analyze the data, develop and preferably institutionalize a suitable and appropriate information system within the administration of N&EP (Bunning, 2000).

GIS has become the most powerful tool for managing information with reference to a geographical location. In particular, the uses of relational databases for geographic information management nowadays provide more efficiency in handling of spatial and attribute data (Castle, 1993). Geo-databases and GIS are very effectively supporting planners and decision makers in assessing and understanding actual situations and trends in various fields of application.

**Centre for Information Resources Management (CIRM)**, a unit of North-east provincial administration, is functioning from January 2004 with the objective of supporting decision making, planning, monitoring and coordination of the development efforts of the provincial administration through a comprehensive Geographic information system (IS). CIRM has the following mandates, in relation to GIS:

- harmonise all GIS related practices among the institutions in the Northern and Eastern Provinces,
- develop further applications and practices to promote the use of GIS in the major development sectors
- support efficient decision making, planning and impact monitoring.

CIRM, from its inception, prepared a strategic plan to develop a comprehensive Geographic Information system. The development of the information system according to the plan, has been steadily in progress since the year 2004. The major strategies are:

1. Assessment of the information requirement
2. Development of an appropriate database management structure
3. Data collection, collation, analysis, presentation, retrieval and periodical updating
4. Development of a fundamental spatial data set and geo-database for all N&EP districts and DS divisions
5. Use of the developed geodatabase for various applications

Building of a comprehensive information system demands many resources and it is a continuous process. Few components under each strategy have already been completed and few are being continued.

**This paper describes** the strategies adopted to establish a functional Geographic Information System, highlight the achievements and discuss the existing as well the potential uses of the GIS applications in the rehabilitation, reconstruction and development efforts for serving the humanity in the North and Eastern provinces of Sri Lanka.

## **Strategies adopted in the development of GIS**

The type of information required for the organizations working in the N&E provinces are diverse and enormous and the geographic coverage is also very large. Participation of many organizations and communities is essential to make it a sustainable system. Therefore CIRM has been addressing this endeavour through a set of strategies in long term.

### **1. Assessment on the information requirement in N&E provinces**

Assessment on the type of information that is constantly required by the districts, departments, provincial ministries, provincial planning secretariats, Non Government Organisations and special projects is a continuous process. Data on demography, livelihoods, service provision, basic education and health, conflict effects, tsunami effects, poverty and vulnerability were identified as urgent requirement for the rehabilitation, tsunami recovery and poverty alleviation efforts. These data were collected at the village level, analysed and are available for use. Sector related data important for development efforts are to be identified and collected with the support of the sector departments in near future.

### **2. Development of an appropriate database management structure**

The structure and components/subsystems of a database have to be in conformity with the objective, structure and procedures of the organisation itself. The database developed by CIRM is structured in conformity with the N& EP administrative structures, i.e. 2 Provinces, 8 Districts, 78 DS Divisions, (Pradesha Sabha levels not yet included), 1919 GN divisions and villages. Village is considered as the basic spatial unit. Facilities to add different data sets to the database for future development are in-built. Arrangements are made to provide the information requirement of and for the levels of DS division, district, provinces and sectors through data aggregation. As a relational database structure, all spatial administrative units are given with identity codes.

### **3. Availability of Poverty profiles for all villages in all districts of N&E Provinces.**

In the Northern & Eastern provinces, a large proportion of population is living in poverty. Government and non-government organizations and special supported projects are implementing interventions to alleviate the poverty. The availability of N&E provinces wide poverty data was limited before 2004. The existing national data on poverty does not sufficiently include N&EP wide data. To overcome this situation, CIRM has prepared Poverty Profile that provides detailed information about the poverty status of all villages in the N&E provinces.

The poverty profile captures most of the basic data of poverty. It is a simple and yet effective methodology to identify and monitor/assess poverty interventions. Poverty data is translated into easily understandable and usable information for decision-making in poverty intervention management. It allows selecting the villages for support without arguing along the perceptions of ethnic entitlements, spatial interest or political dominance. Since the data is from the smallest spatial unit, the loss of information due to generalization is also minimized. Totally 4826 villages in the N&EP were surveyed and one page profile showing a panel of poverty information is available for each village.

The Poverty Profile has many advantages that

- enables the comparison of the relative poverty level of villages within a district
- provide an overview of the nature and scope or range of poverty in the NEP
- provide baseline data for monitoring of project interventions
- facilitate planning and decision making on the nature of transition, rehabilitation and development interventions
- facilitate transparent decision making
- enable identification of villages for transition, rehabilitation and development interventions and
- guide reasonable allocation of aid resources.

A village profile is given in Figure 1 as an example provides an insight of the information collected at village level.

The poverty data set enables powerful and various kinds of GIS applications for N&E provinces.

Figure 1: Example of a village profile in Jaffna district

### Vulnerability - Poverty Profile 2005

DS Division	Maruthankerry	<b>VILLAGE STATUS BASED ON VULNERABILITY - POVERTY ANALYSIS</b>	
Other Name	Vadamarachchy East	<b>Poverty Level</b>	<b>79.5</b>
GN Division	Pot Pathy	<b>Poverty Code</b>	<b>5</b>
Village	Pot Pathy		

  

GENERAL VILLAGE INFORMATION			
Total population	533	Families	133
Men	254	Tamil families	133
Women	259	Muslim families	0
Children <14 years	145	Sinhala families	0
Children between 15 and 16 years	21		

  

VULNERABILITY			
Women headed households	17		
War widows	5		
Families directly affected by war	7		
Orphans	5		
Children employed	2		
No. of times displacement occurred	5		
Year of main displacement	1987	1987	1991
	1994	1994	1996
Displaced families	140	140	167
	142	142	127
Year of main resettlement	1987	1988	1991
	1994	1994	1997
Resettled families	140	140	169
	142	142	107
Displaced duration (months)	5	6	5
	4	4	15
IDP Welfare centre	Yes		
Internally displaced families	40		
IDP families within the village	10		
IDP families from outside the village	30		
Families receiving food stamp	89		
Families receiving dry ration	67		
Families having disable members	10		
Families having less than 3 meals / day	22		

  

AGRICULTURE			
Total cultivable paddy area (acre)	0		
Cultivable paddy area accessible (acre)	0		
Cultivated paddy area - Maha (acre)	0		
Cultivated paddy area - Yala (acre)	0		
Presently cultivated paddy area by outsiders (acre)	0		
Total cultivable highland (acre)	0		
Cultivable highland accessible (acre)	0		
Presently cultivated highland (acre)	0		
<b>Perennial crops</b>	<b>Acre</b>	<b>Seasonal</b>	<b>Maha (acre) Yala (acre)</b>

  

EDUCATION FACILITIES	
Primary schools functioning	Yes
if no, nearest distance (km)	0
Time for travelling (min)	0
Nursery schools functioning	Yes
if no, nearest distance (km)	0
Time for travelling (min)	0
School dropouts before grade 5	0
School dropouts between grade 5 and 10	15

  

POVERTY INDICATORS CODE				POVERTY DIMENSIONS CODE	
Food insecurity	5	<b>Vulnerability</b>	5	5	5
Conflicts effects	3				
Social vulnerability	2				
Tsunami affectedness	5				
Infrastructure	6	<b>Economics</b>	5	5	5
Livelihood	3				
Educational service	1	<b>Education</b>	1	1	1
Educational level	5				
Health service	5	<b>Health</b>	5	5	5
Water and sanitation	4				

Ranking is % of poverty level (1 - lowest 20% to 5 - highest 30%)

**Note:** Poverty indicators and dimensions are coded independently; code is relative within each indicator and dimension. Overall value is derived from indicators to determine poverty level; however, profile depicts dimensions in percentile and poverty level in actual value. Poverty code is determined from poverty level.

  

PRIMARY EMPLOYMENT SITUATION (in families)			
Land owned cultivation	0	Abroad employment	20
Tenant cultivation	0	Fishing wage labour	28
Highland farming	0	Seasonal inland fishing	0
Livestock farming	1	Perennial inland fishing	0
Unskilled wage labour	0	Lagoon fishing	0
Skilled wage labour	0	Shallow sea fishing	0
Self employed	0	Deep sea fishing	0
Entrepreneur	0	Dependant families	23
Govt/private employed	1	Distance allowed to deep sea	3

  

HEALTH /HYGIENE SITUATION			
	Drinkable	Saline	Mobile health service available
Private wells	73	0	Yes
Common wells	0	0	if no, nearest distance (km)
Private toilets	20		0
Pipe borne water	0		Time for travelling (min)
Mobile water supply	0		0
Distance to functioning Government dispensary (km)			0
Time for travelling (min)			80
Mode of transport	Walk <input type="checkbox"/> Cycle <input checked="" type="checkbox"/> Bus <input type="checkbox"/>		

  

LIVING CONDITIONS			
Families live in permanent houses	54	Families having own land	109
Families own permanent houses	45	Electricity	No
Families live in temporary houses	79	Families having legal electricity connection	0
Nearest town (km)	10		
Mode of transport	walk <input type="checkbox"/> Bicycle <input checked="" type="checkbox"/> Bus <input type="checkbox"/> Others <input type="checkbox"/>		
Time for travelling (min)	60		
Access road to town	Very good <input type="checkbox"/> Good <input type="checkbox"/> Bad <input type="checkbox"/> Very bad <input checked="" type="checkbox"/>		
Road closed due to security reason (in hour)	0		
Road closed due to natural disaster (in days per year)	0		

  

**Remarks:**

Data collection - July 2005

**CIRM**  
CENTRE FOR INFORMATION  
RESOURCES MANAGEMENT

District Secretariat  
Jaffna

#### **4. Development of a fundamental spatial data set and geo-data base for all N&E districts and DS divisions**

Relational database and GIS are very effective tools supporting planners and decision makers in assessing and understanding actual situations and trends in various fields of application. In particular, the uses of geo-databases for information management nowadays provide more efficiency in handling of spatial and attribute data (Obermeyer, N.J. and Pinto J. F. 1994). CIRM makes use of the digital data of the topographic map series of the Survey Department, Sri Lanka. The entire N&EP is covered by 48 topographic map sheets of 1:50 000. Digital spatial data have been made available by the Survey Department in sheet wise format.

As an initial step, different feature of digital data were separated in different layers and data of different districts as well as DS divisions were also separated. The relevant topographic themes are the administrative boundaries, hydrology, buildings, transport, utility and places. Each theme is subdivided into different feature classes. In total there are about 133 different feature classes. For the generation of a homogeneous and seamless geo database, it was necessary to edit and process these data.

The procedure followed by CIRM is given below.

- the sheet wise themes (administrative boundaries, hydro, buildings, transport, utility, places etc.) were merged to cover the entire N&EP,
- data format (coverage- shape file) converted,
- data edited and cleaned,
- village and GN data updated,
- annotation layers created,
- feature classes from themes created,
- feature classes combined and
- feature datasets created and feature classes into the database were imported.

Few types of digital data sets that were not available with the survey department were generated by CIRM. As example, CIRM has developed all boundaries of the GN Divisions of the Northern and Eastern Provinces. Sector administrative boundaries, e.g. agricultural ranges and local authorities' boundaries are currently in progress.

#### **GIS applications for decision support, planning and monitoring**

With the use of the existing geo-database, CIRM has produced many GIS applications that are useful for the decision makers, planners and implementers in both provinces. Only a small proportion of the total products and outputs of CIRM are presented in this paper.

##### ***i) Administrative boundary maps for planning and management***

Users, especially managers at different level require spatial data for the particular geographic area under their purview. They need it with different topographic features at different scales for specific purposes. As GIS capabilities easily satisfy their

requirements instantly. Provincial, districts, DS divisions and maps with administrative boundaries and important topographic features are available at CIRM. Printed maps of the same are available in A4, A3, A1 sizes.

Examples of simple planning maps to suit the requirements of the users are given in Figures 2 and 3.

Fig. 2 DS division map tailor made for the use of the DS and staff  
(DS Division Map, Town & Gravets, Trincomalee District, see on the website under maps)

Fig. 3. Agricultural Ranges in Mannar District  
(Agricultural instructor Range Map, Mannar District)

### ***ii) Decision support for poverty reduction interventions***

Poverty profile developed by CIRM provides an extensive range of poverty data of a whole district. It allows selecting the villages for support without arguing along the perceptions of ethnic entitlements, spatial interest or political dominance. The poverty data, with the application of GIS, were translated into easily understandable and usable information for decision-making on poverty interventions.

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Different thematic maps can be generated with the poverty data through the application of GIS. The poverty thematic maps guide the decision makers to decide on 'where to support' and 'what type of support' are most needed. The updated poverty data and GIS can also be used to monitor the changes or impacts resulted from the poverty interventions.

The thematic maps showing the poverty and food insecurity situations in Fig. 4 and Fig. 5 give a broader picture to the development actors and allow them to decide on the target groups and proper interventions.

Figure 4: Poverty status in the entire GN Divisions of Jaffna district

Figure 5: Food insecurity conditions in the entire GN Divisions of Vavuniya district

The worst poverty stricken areas are very visible in the Fig 4. Agencies who intend to implement poverty reduction programmes get the initial ideas to identify their focal geographical areas for intervention. The analysed information and raw data in the village poverty profiles will support them to identify the root causes for the poverty. Beyond this point, a detailed assessment on the needs, resources and intervention should continue.

Thematic map depicting the food insecurity condition in different GN divisions in Vavuniya district is given in Figure 5. Food insecurity is considered as one of the indicator for the poverty. Food insecurity condition is very precarious in Olumadu, Semamadu, Kankankulam, Rankethgama, Kallikulam, Kurukkalputhukulam GN divisions. Availability and / or accessibility to food could be the reasons and the relevant can be extracted from the existing geo-database. Further details, use and utilization patterns at the household level can be later found through household assessment to fine-tune the interventions.

### ***iii) GIS for Natural Resource Management***

Agricultural development activities need to be planned on the basis of sound data and an understanding of farming systems, considering resource capability, production efficiency, system sustainability as well as environmental, market and social impacts (Weston, 1992). GIS can be used as an effective tool in agriculture development as it has special capabilities to handle large volumes of spatial data as well as non-spatial data. It is highly flexible and incorporates maps and various other types of data from different sources into a computer system that can provide a multi-layered presentation of the information on agriculture (Environmental System Research Institute, 2007). Limited categories of data related to agriculture sector are available with CIRM. Presently cultivated extent of paddy land and Cultivable paddy land extent in Vavuniya district are overlaid and shown below.

Figure 6. Present paddy cultivation extent and potential paddy cultivation in Vavuniya district

The above maps shows that the untapped potential for expansion of paddy cultivation in Vavuniya district.

<b>GN Division where more than 25 % of paddy lands uncultivated during Maha 2004/2005</b>	<b>% of paddy lands not cultivated</b>
Muthalikkulam	56.18
Kanthasamy Nagar	46.15
Kannaddi	37.50
Cheddikulam	36.61
Mugthankulam	35.34
Chinnachippikulam	27.22

Fig.6 urges the Department of Agriculture to find out the reasons for non-cultivation and launch appropriate extension programmes in the particular GN divisions mentioned in the above table.

## **Conclusion**

The GIS now established at the CIRM is already providing useful facilities to the institutions, decision makers and practitioners in the N&E provinces that are in need to use and manipulate spatial data. The products are on high demand and utilized by many development actors.

The experiences reveal that there is tremendous potential for the applications of GIS in the rehabilitation and development efforts in the North and East provinces.

## **Recommendations:**

Many challenges are ahead of us. The geographic area under purview, i.e. northern and eastern provinces, is very large and the security condition is also not favourable to mobilize personnel to the ground. Integrated approaches are deserved but it is not a culture among the government as well as non government organizations in the area

To make our dream of a comprehensive Geographic Information System for N&E into reality, efforts to be taken in long run in an organised manner are:

- Further collection, compilation and analysis of attribute data on various sectors with the support of relevant organization,
- Generation of specific spatial data with the support of communities and village level officers,
- Periodical update of available attribute and spatial data,
- Sensitization of decision makers on the use of analysed information and facts based decision making and
- Measures on the extent of GIS use, and the improvements in effectiveness resulted through the uses.

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