Chapter 8: APPLICATION OF GEO-INFORMATICS

8.1 Introduction

The geospatial data available with the Government departments at the district/block level at present bristle with inherent problems like non-availability and obsolescence and they are inaccessible to many of the potential users. The major disadvantage is that they fail to furnish the spatial information required by the officials or the elected representatives (PRIs). Therefore, the departments like District rural development agency (DRDA), Lead banks, Agriculture department, Animal resources development, Agri-irrigation, Horticulture, I & W department, Pollution control board and SWID etc., which take area/location specific decisions based on the information available in the maps, are forced to use these maps with several inadequacies and obsolescence (Batty, M. 1995; P. Densham, 1991; Harris, B, 1989; Rana, S., 2008; Sarkar, S & A. Subbiah, 2006; Sprague, R. H., and E. D. Carlson, 1982; Sprague, R. H. and H. J. Watson, 1996). These departments do not have facilities for preparation of maps of their own with updated information.

The enactment of the 73rd and the 74th Constitutional amendments in 1996 induced decentralized planning and made the district to village pancheyet as three tier planning for the implementation of rural development programmes. Both the planners and politicians have realized the stern reality that decentralized planning has no substitute for a vast and a heterogeneous country like India. The amendment listed 29 subjects as sectors of planning under the new pancheyeti raj dispensation. That is, since 1996, the decision-making in the area of rural development has been decentralized and thereby made a permanent imprint on the national scene (Batty, M., and Y. Xie, 1994; Densham, P.J. and M.P. Armstrong, 1993 & 1994).

The 73rd and 74th Amendments have paved the way for establishment of District Planning Committee at the District level, gram sabha at the village level and ward Committees within the municipalities as the structural means for devolution of decision making power from the centre to the grassroots level together with other constitutional provisions give new meaning and content to multi-level decision making process in which pancheyets, Municipalities and District Planning Committees become institutions of self

governance throughout the country (Rana, S & Sarkar S, 2009). The elected representatives often take area/location specific decisions. They are in need of geo-spatial data on a large scale, particularly at the gram pancheyets and gram samsad levels. Thus, there is a vast scope for the use of geo-informatics facilitating the decision making process at various levels of decentralized planning.

8.2 Spatial Decision Support System (SDSS) for Development Planning

Decision Support System (DSS) is an interactive, computer-based system designed to support a decision maker or a group of decision makers in achieving higher effectiveness of decision making while solving a semi-structured spatial problem. It is designed to assist the spatial planner with guidance in making land use decisions. For example, when deciding where to build a new Sishu Shiksha Kendra (SSK) many contrasting criteria, such as areas not covered by SSK, volume/number of potential school goers, number of school drop-out as well as desire and zeal of decision makers which make the decision difficult. A system which models decisions could be used to help identify the most effective as well as deserving decision. In recent years, Spatial Decision Support Systems (SDSS) developed in parallel with the concept of Decision Support Systems (DSS). Spatial Decision Support Systems is sometimes referred to as a Policy Support System (PSS).

While a Spatial Decision Support Systems (SDSS) usually exists in the form of a computer model or collection of interlinked computer models, including a land use model. A spatial decision support system typically consists of the following components:

i) A database management system: system holds and handles the geographical data.
ii) A stand-alone system for this is called a Geographical Information System (GIS).
iii) A library of potential models to be used for forecast the possible outcome of decision.
iv) An interface to aid the user interaction and to assist in analysis of outcomes.

SDSS typically uses a variety of spatial and non-spatial information, like data on land use, transportation, water management, demographics, agriculture, climate or employment. By using two (or, better, more) known points in history the models can be calibrated and then projections into the future can be made to analyze different spatial policy options. Using these techniques spatial planners can investigate the effects of different

scenarios, and provide information to make informed decisions. To allow the user to easily adapt the system to deal with possible intervention possibilities an interface allows for simple modification to be made.

In a backward block like Dhupguri where vast majority of people lives in rural area and dominated by ST and SC population facing perpetual hunger and inadequacy in basic life sustaining processes need a very structured planning procedure such that the development activities and infrastructure facilities are available at both urban and rural area. However, in such a condition where majority of people leave in rural area and are provided with the least infrastructure facilities, creates a regional imbalance in development, causing shift in population from rural to urban areas. Hence decision-makers require an efficient GIS based tool which will assist them to get the updated scenario of the region.

Dhupguri block faces a number of challenges in the path of development. One of the main causes is absence of accurate digital data in the form of maps. The data generated by various state government departments such as Education, Health, PWD etc. are enormous but poorly maintained; particularly the spatial data shows the maximum inaccuracy. The present study emphasizes the power of GIS technology which will help the PRIs and other decision makers to better understand and evaluate spatial data by creating graphic displays using information stored in the database hosting the maps and/or Internet in such a way clients can view the information query.

It is concluded that a block like Dhupguri which has immense potential of development and has maximum ST and ST population residing in rural area urgently needs a GIS based e-governance system such that it will help the PRIs and decision makers in planning, implementation and monitoring of various projects for development in different fields at much faster rate which in turn will usher a new era of informed planning processes for sustainable development planning.

- To provide the development planners and PRIs an accurate spatial view of the CD block at different levels such as gram samsad, gram pancheyet as well as land use, infrastructure allocation, road and rail network, drainage etc.

- To provide the planners detailed demographic data and education & health related data on desktop in a GIS environment.
- To assists the planners in finding out the possible locations for the schools and health centers depending on several parameters such as for health; population density, number of health centers required and its optimum location, number of disease infected persons etc. and
- As GIS does more than just display the data; it enables the user to dynamically analyze and update the information linked to those locations spatially and can further strengthen the e-governance.

Dhupguri block in Jalpaiguri district has been taken as a case study covering all the gram pancheyets and gram samsad. All the spatial and non-spatial data as mentioned earlier is attached under ArcGIS platform. An interface has been customized where the user can query on the data-sets to retrieve tabular and spatial information. Provision is made for background of the hierarchical system approach and valuable experiences of spatial data handling a consistent spatial information database can be created. Despite problems with data accuracy, logical consistency and completeness of data, a powerful tool for local level planning can be developed which can serve as a framework for a variety of planning purposes at the gram pancheyet and gram samsad levels, as well as the transfer of know-how between the PRIs and institutions using an interactive approach.

The investigator has undertaken the task of geo-referencing of gram samsad and Gram Pancheyet maps of Dhupguri block at a scale of 1: 3960 which were prepared and compiled under the DST Govt. of India sponsored NRDMS project in Jalpaiguri district and the restructuring and compilation of CCA data (gram samsad level) of Dhupguri block for attachment in Dhupguri map under ArcGIS 9.1 platform. The following achievements have been made in this regard with logistic support provided by the District authority and the NRDMS centre, Jalpaiguri:

i) Digitization of the upgraded and delineated mauza sheets (270 nos.) of Dhupguri block along with infrastructure allocation, rivers, roads etc.
ii) Field verification of 247 gram samsad and 16 gram pancheyet boundaries of Dhupguri block in consultation with the concern authority and pancheyet members.

iii) Field verification of 81 infrastructures allocation in the mauza maps of Dhupguri block.

iv) Compilation and tabulation of CCA data from Village Registrar at gram samsad level in Dhupguri block in MS Excel format.

v) Restructuring of database of 16 Gram Pancheyet and 247 gram samsad of Dhupguri block.

vi) Geo-referring of delineated and upgraded mauza maps of Dhupguri block at a scale of 1:3960 under ArcGIS 9.1 Platform.

vii) The development of GIS for Dhupguri block with gram samsad level geo-spatial database attachment with SQL facilities.

viii) Development of thematic maps (samsad level) on various socio-economic and resource based aspects is possible in Dhupguri block for planning purpose on decentralized planning.

8.3 Decentralized Planning at PRIs Level

With the enactment of 73rd and 74th Constitution the PRIs and ULBs emerge the key player in development planning processes in both rural and urban areas. It is observed that the planning, plan implementation, monitoring, evaluation and monitoring processes in Pancheyeti Raj Institutions are still in rudimentary form. Lack of information on ground reality and relevant database often help the decision making at clutch of the whims of the key players. Such an act not only deprives the neediest section of our society but also allow wastage of invaluable resource.

An attempt has been made to demonstrate the integration of village-level spatial and non-spatial data in GIS environment into a useful informatics tool for decentralized planning. A simple and robust tool, called 'VLIS' (Village-Level Information Systems) will assist the decision-makers to generate various eco-socio-economic views/scenarios for identifying GP/GS/Mauza for rural watershed management schemes. This also envisages future development and usefulness of this community GIS tool for grass-root level planning.

The implementation of GIS in planning processes raised a variety of conceptual questions for both the ecological and the socio-economic sectors. In addition to these basic units of research, spatial links between the two sectors and levels of data abstraction for the

spatial database had to be defined. Using the theoretical model generated in the present study integrating the spatial village maps with non-spatial or tabular information can be demonstrated for its potential for grass-root level development planning taking into consideration the local needs and constraints. It has also established its usefulness to the decision-makers in the district to generate views/scenarios for decision-making at local-level. The prototype community GIS tool thus developed would served as a first step towards the development of Spatial Decision Support System for decentralized planning at hierarchical stages from gram samsad onwards.

8.3.1 Present Scenario

In the present scenario the project planning in the block has been carried out in the conventional manner, i.e., both maps and the database for planning and the development, and the planning process itself are conducted on paper. With GIS methodology not only small-scale but the large scale planning of a system is to create a base for development of the society, implementation and evaluation of the socio-economic status for easy operation and execution. The editing functions such as appending, edge-matching, etc. in GIS package. Each gram samsad in this map was assigned unique ids (user-defined) in a regular sequence. Thus, block map with gram pancheyet and gram samsad boundaries with in-built table having aerial extent, ids etc.

8.3.2 Integration of Spatial and Non-spatial Database

The MS Excel file was converted into text format to enable & open. The tables of both spatial gram samsad map and non-spatial samsad level information were opened and joined together, with the help of user-defined ids, using table-join function. Thus, an information system has been generated for the block showing the samsad map with its boundaries and the relevant information containing eco-socio-economic dimensions. The general objectives include:

- Identification of resources for generating self employment and stronger village based rural economy.
- To identify opportunities and constraints to rural development
- To empirically validate the benefits of self-governance in fostering rural development.

Specific Strategy & Objectives

- Estimation of Location specific Resource analysis
- Monitoring and trend analysis for various factors
- Identification of risk factors
- Planning model on poverty eradication programm
- Allocation of resources
- Frame work for monitoring & control of administrative factors.
- The system can be implemented in macro level as well as in micro level DSS.
- Information can be updated easily and analysed quickly.

There will be a scope of further data enhancement in database, the effect of which will be directly reflected on the GIS map. It is needless to say that the proposed system is equipped with the solution required by the Local Govt. for implementing the development program effectively. GIS has the potential to link data visually on a common denominator, analyze it and make predictions, which is essential in rural planning. The proposed GIS based system offers the flexibility and excludes the problem of traditional procedure and database created in the registers cannot be used conveniently either for first decision making or for implementation of policy in operation or for evaluation of the efficiency of the schemes.

8.3.3 Monitoring & Evaluation

A GIS based rural surveillance system may also be implemented based on the developed GIS model in Dhupguri block. With the intensity, distribution and its trends is proposed for better monitoring, control and decision making as well as instant management information. GIS application can capture, describe the problem areas and distribution features. GIS allows spatial data handling, manipulation and analysis with new dimension and unparalleled flexibility. This system provides more accurate base maps and re-defines several methods of data capturing within accepted level of accuracy.

Strategy:

- To provide greater access to simple, low-cost data management and mapping systems to Panchayet administrators at sub-district levels.

- To expand the network of logistics support and data distribution channels.
- To stimulate partnerships at all levels in an effort to synergies approaches to GIS and mapping for rural development.

Objective

- Support and strengthen surveillance, monitoring and management of Panchayet areas.
- Support and strengthen planning capacities of sub-district level for more rationalized use of resources.
- Develop and strengthen local level capacities in surveillance information management and analysis.
- This system compliments the fully functional database that can be updated regularly.
- It not only benefits the planning for rural development but also help to make proper decision by the policy makers in the appropriate direction and in right time.
- The GIS acts as a powerful tool by proper interpretation of a huge database with maps for all kinds of planning & implementation in the fields of Economy, Agriculture, Drinking Water Supply, Irrigation, Drainage, Sanitation, Land Use and effective use of Rural Resources.
- The proposed system has been designed in a comprehensive manner so that it becomes beneficial and will facilitate PRIs, line departments and other decision makers.

8.3.4 Linkage of Spatial and Non-Spatial Data

GIS allows the linkage of spatial and non-spatial data based upon a defined relationship. A one to one relationship can be defined for each of the spatial entity with the non-spatial data. For performing the linkage operation the following steps were done:

- Identification of relation between spatial and non-spatial data such as one-to-one relationship between each of the village entity with non- spatial data for them.
- Selection of key field as linkage item which may be Census-code, polygon – id obtained after topology creation.
- Linkage has been done in a environment of the GIS coverage's, as they are easily accessible and performing Join operation.

In a GIS based system any analysis can be done and its output can be shown in a much better way only by integrating non-spatial data with spatial data. The core of all analysis involves i) a combination of different parameter whether spatial or non-spatial; and ii) derivation of mathematical indices from non-spatial data and representing them spatially. In present case main emphasis was to derive such indices which reflects the level of infrastructure development of each village, identifies the gaps so as to be taken up for development considering two basic amenities education and health. The following main objectives would be achieved by the proposed system;

- Perform regional economic analyses/quantifying the community-agriculture linkages.
- Non-market valuation of the benefits of agriculture, self employment schemes in fostering rural development.
- Identifying constraints to increased agriculture/community economic expansion Study of basic services: education, health, drinking water, transport, roads etc. for identifying the rural standard of living.
- Rural community development - social structure, cultural heritage, tribal history etc.

8.3.5 Case Studies

The purpose of the case study is to demonstrate the PRIs and line department personnel who are entrusted to take the crucial decision making at ground level on various development and income generating and/or enhancing schemes mostly sponsored by Centre and the State Governments. An all out efforts have been made to make the processes as simple and understandable to the stakeholders normally not acquainted with the Geo-informatics. In fact, during the processes of handholding/capacity buildings many stakeholders raised the issue of technical barriers in implementing geo-spatial database in real world planning processes. Keeping in mind all the above facts and understanding the ground reality an effort has been made to develop a few simple cases to demonstrate the utility and usability of developed geo-database in the processes of development planning.

8.3.5.1 Case Study I: Locating Sites for new SSKs (Sishu Shiksha Kendra).

Although, Dhupguri block has quite a large number of Primary Schools and Sishu Siksha Kendra (SSK) yet their spatial distribution have been found failed to cater the need of

many rural habitations. Large number of drop-out especially of girl children has been noticed and also reported the daily travelling distance from their residence to nearby schools is too far for the children specially girls to continue their school education.

Geo-data based decision support in location suitable sites for new SSKs has demonstrated simply with the help of following four maps (figure 8.1, 8.2, 8.3 and 8.4) prepared out of Dhupguri block geo-database created by the North Bengal University under the current DST sponsored project and already handed over to the NRDMS centre, Jalpaiguri for further dissemination.

Figure 8.1 demonstrates the current (as it is updated under the present project) geographical perspective of Dhupguri block including her territorial boundary that includes Gram Panchayet, Gram Samsad (*Sava*) and revenue village (mauza); its resources base including rivers, wetlands, ponds, forests, tea gardens, arable lands, grasslands etc.; transport networks including NH, SH, Railways, District roads, other metal roads, cart roads, footpaths, forest and tea garden section roads, bridge, culvert and ferry services including the location of existing SSKs and Primary Schools. Thus, the map itself shall provide a true geographic perspective of the block as a whole to the prospective stakeholders.

Figure 8.2 demonstrate the coverage area of the existing SSKs and Primary schools at 500 meter (ideal distance to be travelled by very young children to attend school) least distance circle (created through buffer). This has been superimposed over the existing habitation areas (settlements) to visualize the prevailing scenario of best attended area. As already mention that the block under consideration is backward and less privileged naturally large uncovered area has been noticed in figure 8.2.

Figure 8.3 demonstrate the coverage area of the existing SSKs and Primary schools at 1 km least distance circle (created through buffer). This has been superimposed over the existing habitation areas (settlements) to visualize the prevailing scenario of extended covered area. In spite of extending coverage area it has been found that a number of un-covered area exist (figure 8.4). This will assist the stakeholders (decision makers at PRIs/line department) instantaneous identification of exact ground location including gram Panchayet, gram samsad and mauza level and a very quick decision would be taken followed by scheme preparation, implementation and monitoring cum evaluation.

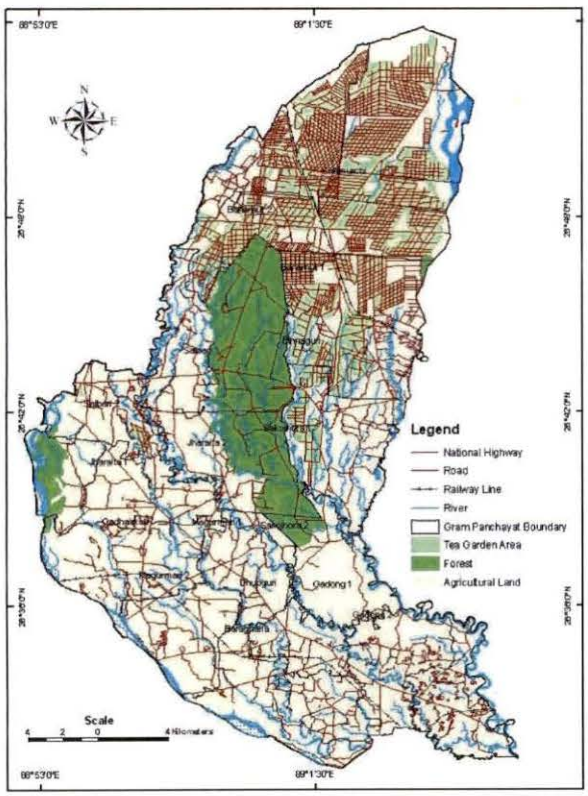

Figure 8.1 Resource map of Dhupguri block

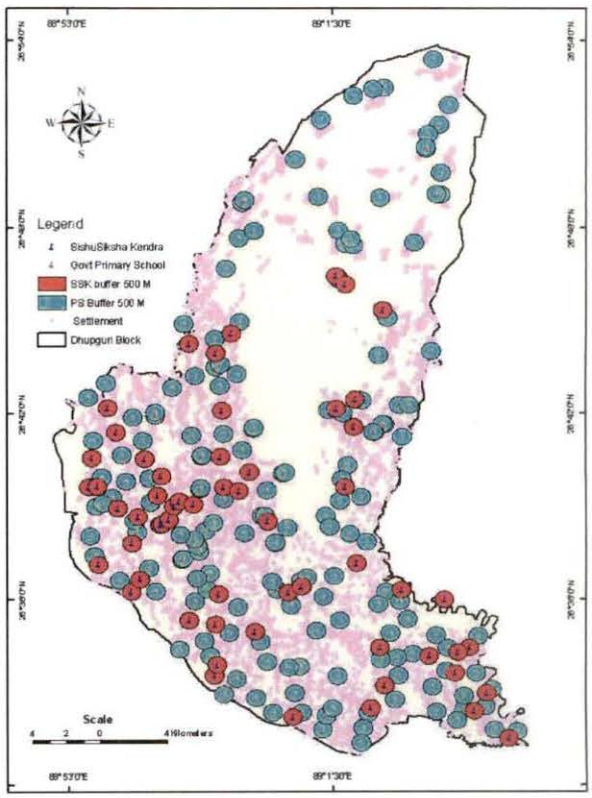

Figure 8.2 Coverage of SSK/ Primary Schools

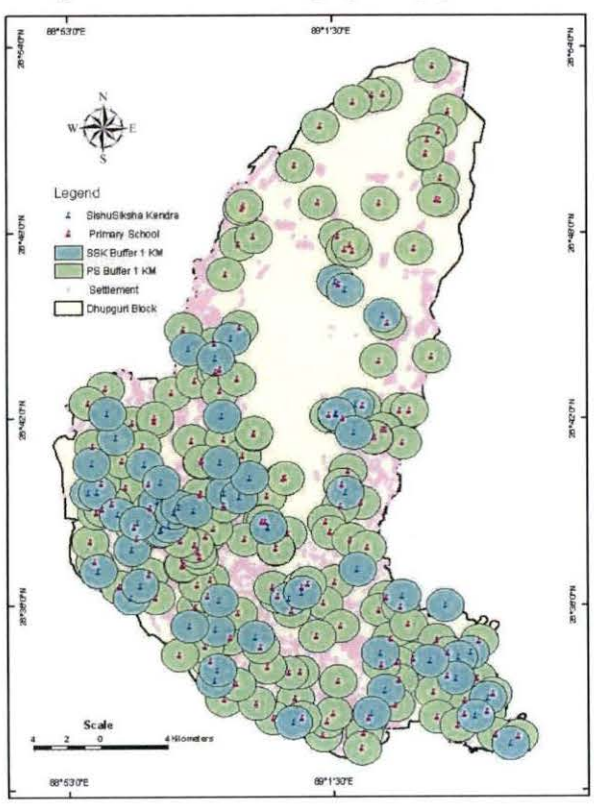

Figure 8.3 Coverage of SSK/Primary Schools

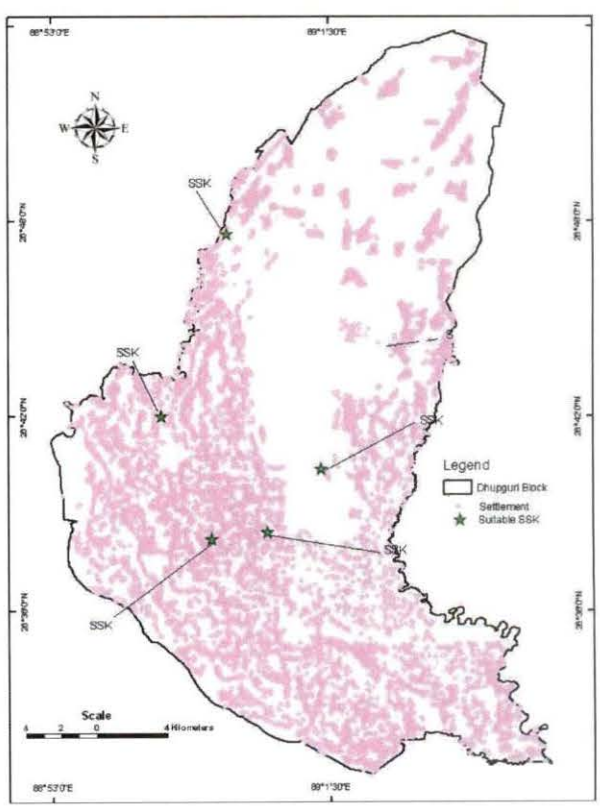

Figure 8.4 Best Location for New SSKs

8.3.5.2 Case Study II: Locating sites for new SSKs in Sakojhora II G.P.

The geo-database of Dhupguri block may also be equally useful at gram pancheyet level of decision making for development planning. Particularly after the 73rd Constitution amendment the overall responsibility of grass-root level development planning has been vested to the PRIs at GP level. The present case will demonstrate how the decisions of locating best suitable sites for establishing new SSKs at GP level would be supported by the geo-informatics. Sakojhora II is one of the most backward GP in Dhupguri block presently has 2 SSKs and 10 Primary schools. The spatial distribution of the schools has been found not well distributed and failed to cater the need of many rural habitations. Large number of drop-out especially of girl children has been noticed and also reported the daily travelling distance from their residence to nearby schools is too far for the children specially girls to continue their school education.

Geo-data based decision support in location suitable sites for new SSKs has demonstrated simply with the help of following four maps (figure 8.5, 8.6, 8.7 and 8.8) prepared out of Dhupguri block geo-database created by the North Bengal University under the current DST sponsored project and already handed over to the NRDMS centre, Jalpaiguri for further dissemination.

Figure 8.5 demonstrates the geographic location of Sakojhora II GP in the perspective of other gram pancheyets of the block. While the figure 8.6 demonstrates the current (as it is updated under the present project) geographical perspective of Sakojhora II GP including her territorial boundary that includes gram samsad and revenue village (mauza); its resources base including rivers, wetlands, ponds, forests, tea gardens, arable lands, grasslands etc.; transport networks including NH, SH, Railways, District roads, other metal roads, cart roads, footpaths, forest and tea garden section roads, bridge, culvert and ferry services including the location of existing SSKs and Primary Schools. Thus, the map itself shall provide a true geographic perspective of the block as a whole to the prospective stakeholders.

Figure 8.7 demonstrate the coverage area of the existing SSKs and Primary schools at 500 meter (ideal distance to be travelled by very young children to attend school) least distance circle (created through buffer). This has been superimposed over the existing

habitation areas (settlements) to visualize the prevailing scenario of best attended area. As already mention that the GP under consideration is backward and less privileged naturally large uncovered area has been noticed in figure 8.7.

Figure 8.5 Gram Pancheyets in Dhupguri block

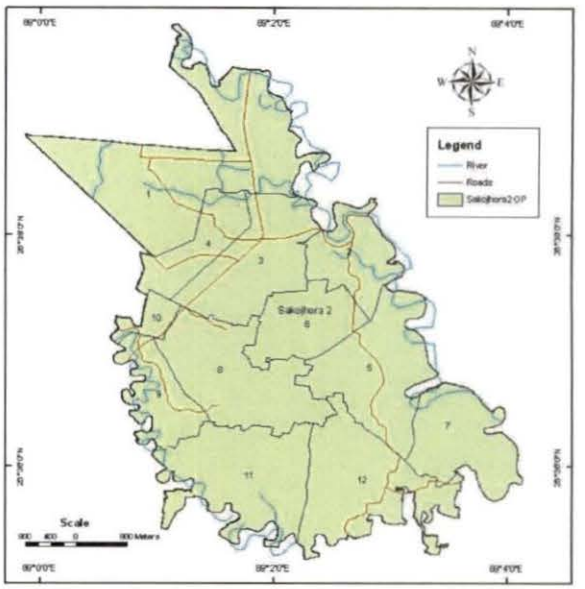

Figure 8.6 Gram Samsads in Sakojhora GP

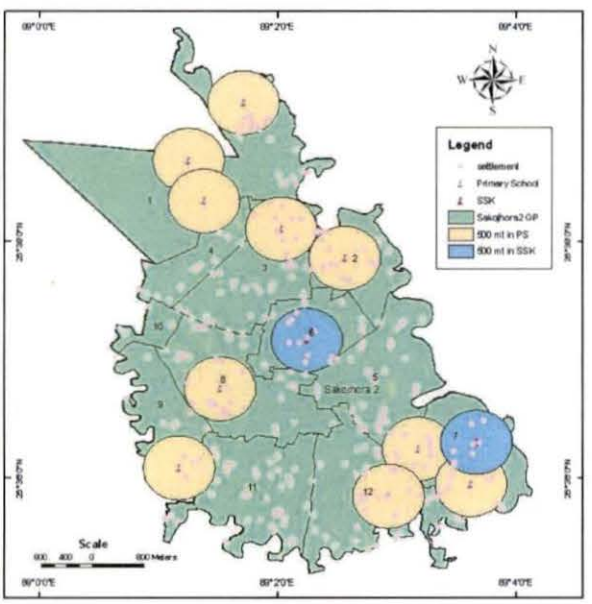

Figure 8.7 Coverage of SSK & Primary Schools

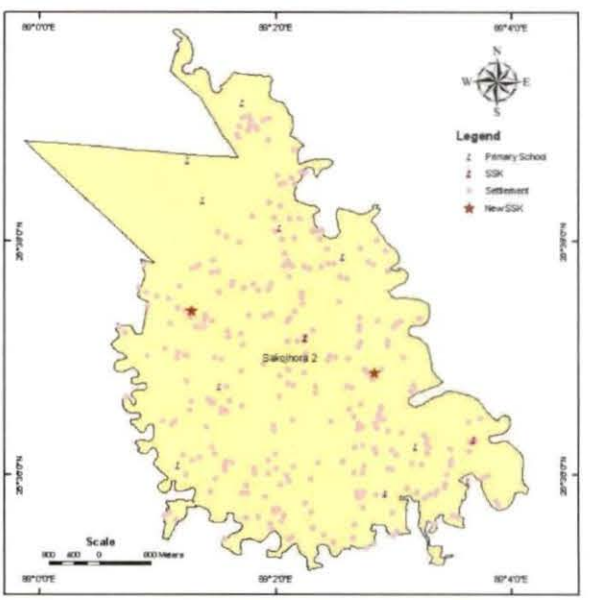

Figure 8.8 Best locations of new SSKs

Figure 8.8 demonstrates a few cases of ideal location sites for establishing new SSKs in Sakojhora II GP. This will assist the stakeholders (decision makers at PRIs/line department) instantaneous identification of exact ground location including gram pancheyet,

gram samsad and mauza level and a very quick decision would be taken followed by scheme preparation, implementation and monitoring cum evaluation.

8.3.5.3 Case Study III: Locating best suitable sites for new SSKs in Salbari I GP

The geo-database of Dhupguri block may also be equally useful at gram pancheyet level of decision making for development planning. Particularly after the 73rd Constitution amendment the overall responsibility of grass-root level development planning has been vested to the PRIs at GP level. The present case will demonstrate how the decisions of locating best suitable sites for establishing new SSKs at GP level would be supported by the geo-informatics. Salbari I is typical by its location i.e., it covers major portion of Moraghat RF to the east and river Jaldhaka to the west has 4 SSKs and 9 Primary schools. The spatial distribution of the schools has been found not well distributed and failed to cater the need of many rural habitations. Large number of drop-out especially of girl children has been noticed and also reported the daily travelling distance from their residence to nearby schools is too far for the children specially girls to continue their school education.

Geo-data based decision support in location suitable sites for new SSKs has demonstrated simply with the help of following four maps (figure 8.9, 8.10, 8.11 and 8.12) prepared out of Dhupguri block geo-database created by the North Bengal University under the current DST sponsored project and already handed over to the NRDMS centre, Jalpaiguri for further dissemination.

Figure 8.9 demonstrates the geographic location of Salbari I in the perspective of other gram pancheyets of the block. Figure 8.6 demonstrates the current geographical perspective of Salbari I gram pancheyet including her territorial boundary that includes gram samsad and revenue village (mauza); its resources base including rivers, wetlands, ponds, forests, tea gardens, arable lands, grasslands etc.; transport networks including NH, SH, Railways, District roads, other metal roads, cart roads, footpaths, forest and tea garden section roads, bridge, culvert and ferry services including the location of existing SSKs and Primary Schools. Thus, the map itself shall provide a true geographic perspective of the block as a whole to the prospective stakeholders. Figure 8.7 demonstrate the coverage area of the existing SSKs and Primary schools at 500 meter (ideal distance to be travelled by very young children to attend school) least distance circle (created through buffer). This has been

superimposed over the existing habitation areas (settlements) to visualize the prevailing scenario of best attended area. Figure 8.8 demonstrates a few cases of ideal location sites for establishing new SSKs. This will assist the decision makers at PRIs/line department instantaneous identification of exact ground location including gram pancheyet, gram samsad and mauza level and a very quick decision would be taken followed by scheme preparation, implementation and monitoring cum evaluation.

Figure 8.9 Gram Pancheyets in Dhupguri block

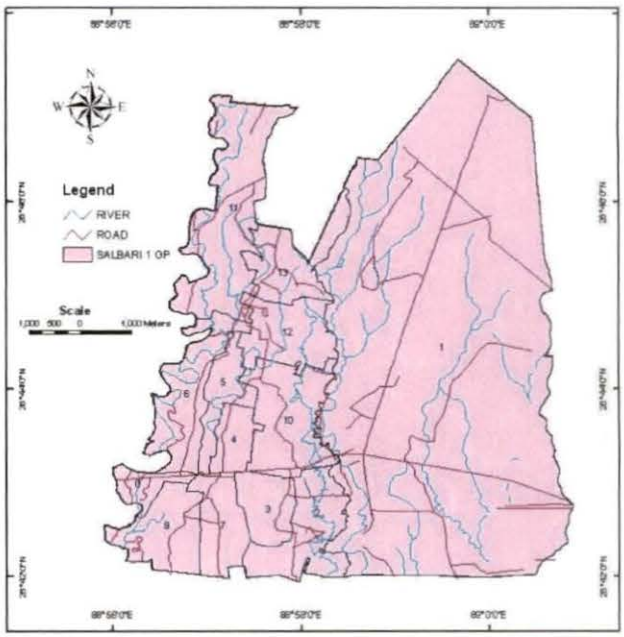

Figure 8.10 Gram Samsads in Salbari 1 GP

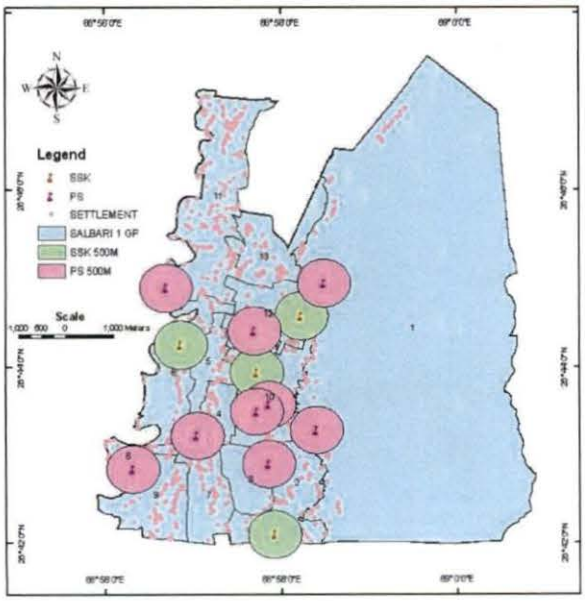

Figure 8.11 Coverage of SSK/Primary Schools

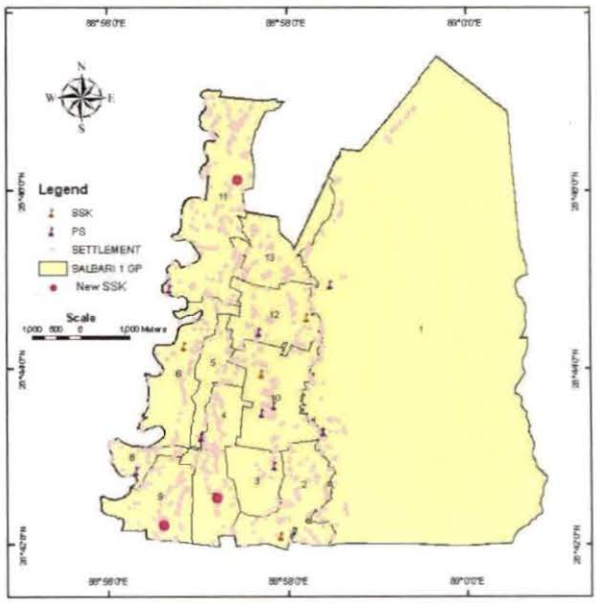

Figure 8.12 Best Location for New SSKs/PS

8.4 Spatial Decision Support for ULBs

8.4.1 Introduction

As mentioned earlier that Dhupguri one of the youngest municipality of the state of West Bengal has tremendous growth potential at one end and embedded multifaceted problems at the other. Location advantage of Dhupguri town on major transport node further accelerates its rapid linear growth. Unscientific, unplanned and myopic expansion of the town has already exerted tremendous stress to the urban environment. Inadequate infrastructure aggravates the problem further. The drainage problems become acute in the monsoon months due to heavy rainfall and the low-lying area become precariously water logged. Traffic congestion also becomes a serious problem as the town is situated along the major transport route between the northeast and the rest of the country. The situation is thus, highly complicated and perhaps, can only be tackled through comprehensive planning exercises based on GIS based SDSS (Rana S., 2008; Rana, S. & S. Sarkar, 2009).

8.4.2 Spatial Technologies for Design and Decision Support

Planning and management are based on a generic problem solving process which begins with problem definition and description, involves various forms of analysis which might include simulation and modeling, moves to prediction and thence to prescription or design which often involves the evaluation of alternative solutions to the problem. Decision characterises every stage of this process while the process of implementation of the chosen plan or policy involves this sequence once again. Processes may be nested within one another while the extent to which different professionals, managers and other decision-making interests are involved through the various stages, depends upon the nature of specific applications and their context. In practice, the process is often partial and much diluted from this more formal characterisation.

Before we are able to demonstrate these ideas, we must briefly review the development of spatial technologies of which GIS are central. Spatial technologies involve any kind of software which is essentially descriptive of data with an explicit spatial or geographical dimension. Mapping software is not explicitly spatial for often data is not geo-referenced in a form that can be manipulated, and thus not strictly part of those technologies

we define as being spatial. The conventional definition of spatial technologies are those which have integrated and explicit functions for storing, manipulating and displaying spatial data where the spatial dimension is the key to each of these functions.

Geographic information systems are the main spatial technologies to date although increasingly other systems dealing with spatial data are acquiring spatial database and display capabilities. For example, the remote sensing package Imagine from ERDAS can be used as a GIS while GIS packages such as ArcGIS provide very clear and well-defined links to other mapping and remote sensing software. Even the growing desktop GIS packages such as MapInfo, Global mapper contain formal links and macro languages which enable their functionality to be extended directly through new programming or indirectly through links to other software. There are many examples of extended functionalities which link GIS to analysis and modeling and we will illustrate two varieties here.

The advantage of using GIS to structure simulation modeling is in the way this software is neutral to its sources of data. Once generic data analysis functions are set up, these can be applied to observed data, model results, forecasts and designs. Data functions thus dominate the system. In short, although the GIS acts as the framework, most of its relational functions are never actually used, yet the structure of its software forms the essential organisation of the application. In the ArcPlot frame which is shown, the popup-pull down menu window at the top shows the sequence of modeling operations, each element of which is accessed through the Arc Macro Language link to other program modules, while the display of results of these operations is the GIS itself. In the screen which is shown, the model has already been calibrated and thematic maps of observed data, model predictions and residuals are shown. There are many other graphics features such as 3-d surfaces, scatter plots, and dynamically-linked or `hot' windows in the system, all accessible through a hierarchy of menu items (Batty and Xie, 1994).

8.4.3 Digital Environments for Decision Support

Our last foray into developments in computing and GIS likely to affect urban planning involves the ways integration between spatial representation, modeling and optimisation-design will be implemented in the coming years. Increasingly these will take place in a digital environment which itself will be integrated through networking. As an

example of this, much of the data in the examples which we have shown in Figures 2 to 4 has been retrieved and manipulated over networks and over different platforms. But this has usually been by individuals or small groups and as yet the more general user has not been involved interactively with such applications. The next decade will see the development of whole groups of non-technical users in planning being directly involved in the use of this kind of information technology across distributed networks. The current growth of the Internet and the World Wide Web is clear evidence of the potential for this kind of integration and more and more data and applications software are available in this medium.

Computing environments for collaborative, distributed spatial decision making have been explored by Densham and Armstrong (1994). Heterogeneous processing environments such as this can support both individual and group use of spatial decision support systems (SDSS). Similarly, the processing requirements of different kinds of software vary greatly and dictate their suitability for different computing platforms. SDSSs tend to have large computational burdens and diverse ranges of processing requirements that make it difficult for any single computer architecture to accommodate them effectively. Consequently, SDSS designers are turning to suites of computers with heterogeneous processing characteristics to support their systems (Densham and Armstrong, 1994). The processing requirements of individual elements of a SDSS are analysed and the best available host architecture is identified. Each user task is shipped to the appropriate computers for processing across very high bandwidth communications channels. Both individual users and groups working together to solve complex spatial problems can be supported in this way.

8.4.4 Case Studies

The purpose of the case study is to demonstrate the ULBs personnel who are entrusted to take the crucial decision making at ground level on various development and income generating and/or enhancing schemes mostly sponsored by Centre and the State Governments. An all out efforts have been made to make the processes as simple and understandable to the stakeholders normally not acquainted with the Geo-informatics. In fact, during the processes of handholding/capacity buildings many stakeholders raised the issue of technical barriers in implementing geo-spatial database in real world planning processes. Keeping in mind all the above facts and understanding the ground reality in its proper perspective an effort has been made to develop a few simple cases with an aim to

demonstrate the utility and usability of developed geo-database in Dhupguri municipality in the processes of development planning.

8.4.4.1 Case Study I: Locating sites for new Crematorium in Dhupguri Municipality

Although, Dhupguri municipality has a number of Crematorium yet their spatial distribution have been found failed to cater the need of all citizen of the municipality. Many inhabitants faced problems of travelling long distance to perform last ritual for the departed soul. Geo-data based decision support in location suitable sites for new Crematorium has demonstrated simply with the help of following four maps (figure 8.13, 8.14, 8.15 and 8.16) prepared out of Dhupguri municipal geo-database created by the North Bengal University under the current DST sponsored project and already handed over to the NRDMS centre, Jalpaiguri for further dissemination.

Figure 8.13 demonstrates the current (as it is updated under the present project) geographical perspective of Dhupguri municipality including ward boundary and the location of crematoriums. Thus, the map itself shall provide a true geographic perspective of the municipality as a whole to the prospective stakeholders.

Figure 8.14 demonstrate the coverage area of the existing crematorium at 1000 meter (ideal distance to be travelled for last ritual) least distance circle (created through buffer). This has been superimposed over the existing habitation areas (settlements) to visualize the prevailing scenario of best attended area.

Figure 8.15 demonstrate the habitation area along with the existing road networks and other infrastructures of Dhupguri municipality. This has been superimposed over the the existing habitation areas (settlements) to visualized the prevailing scenario of the municipality.

Figure 8.16 shows the best suitable location for new Crematorium to cater hitherto uncovered dwellers of the municipality. This will assist the stakeholders instantaneous identification of exact ground location including ward and a very quick decision would be taken followed by scheme preparation, implementation and monitoring cum evaluation.

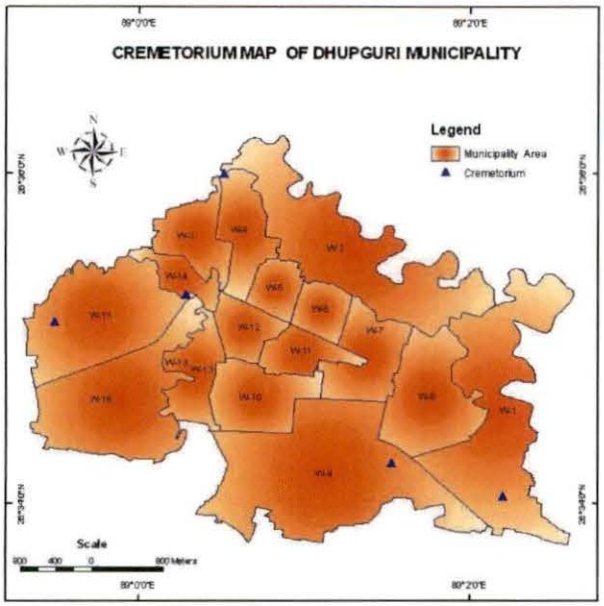

Fig. 8.13 Crematorium in Dhupguri Municipality

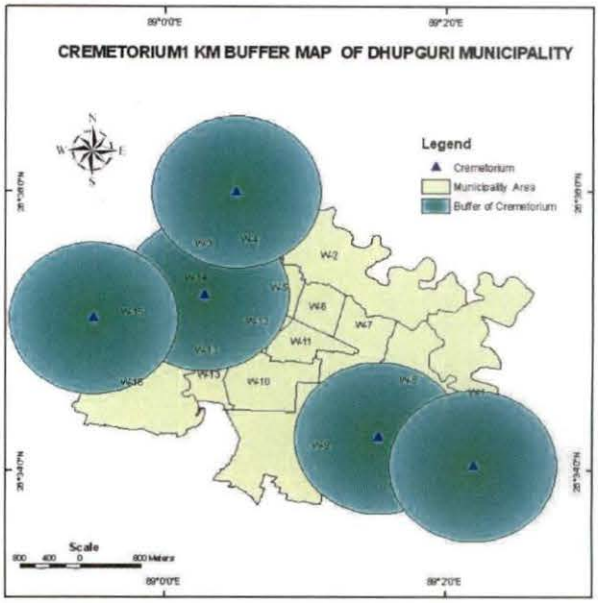

Figure 8.14 Service covered area (1 Km)

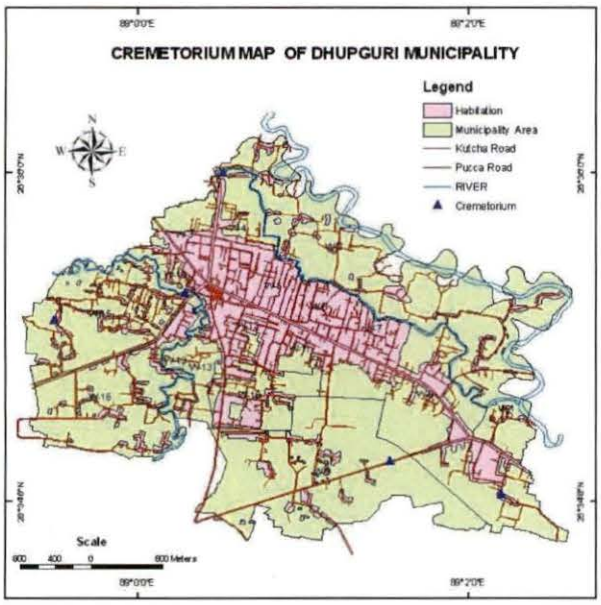

Figure 8.15 Habitation and Infrastructure

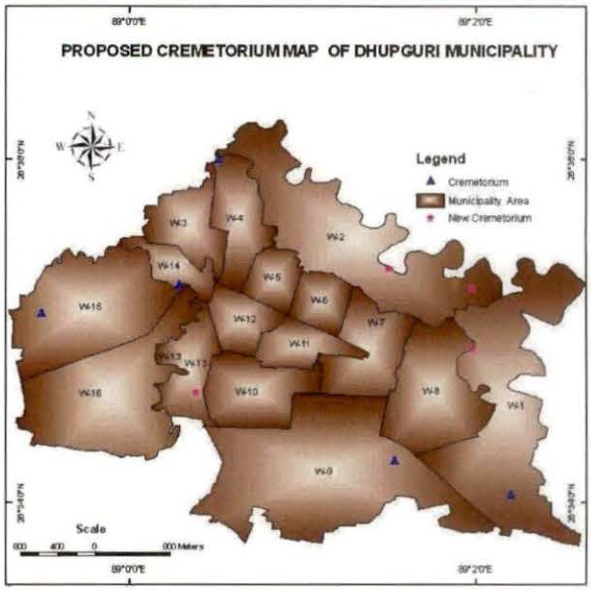

Figure 8.16 Ideal sites for new Crematorium

8.4.4.2 Case Study II: Locating suitable sites for new SSKs in Dhupguri Municipality

The geo-database of Dhupguri municipality may also be equally useful at ULB level of decision making for development planning. Particularly after the 74th Constitution amendment the overall responsibility of grass-root level development planning has been vested to the elected body of the respective ULBs. The present case will demonstrate how the decisions of locating best suitable sites for establishing new SSKs at ward level would be supported by the geo-informatics. The spatial distribution of the schools has been found not

well distributed and failed to cater the need of many habitations. Large number of drop-out especially of girl children has been noticed and also reported the daily travelling distance from their residence to nearby schools is too far for the children specially girls to continue their school education.

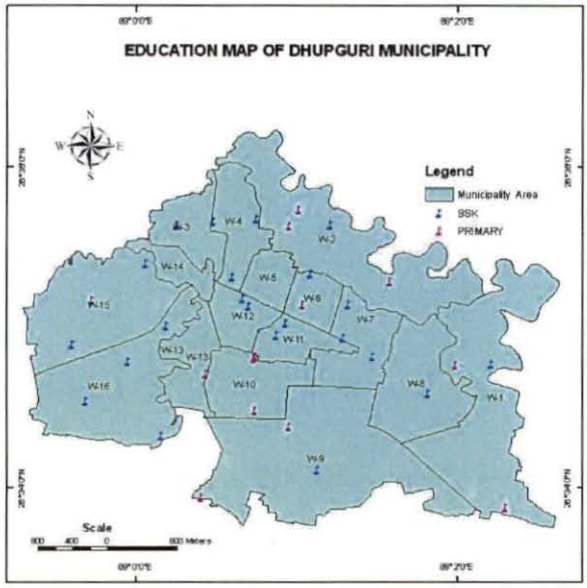

Figure 8.17 Existing SSK/Primary Schools

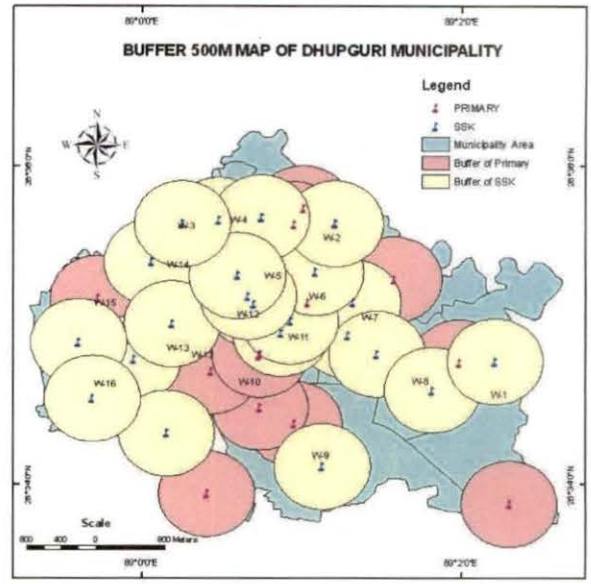

Figure 8.18 Covered area (500 m) of Schools

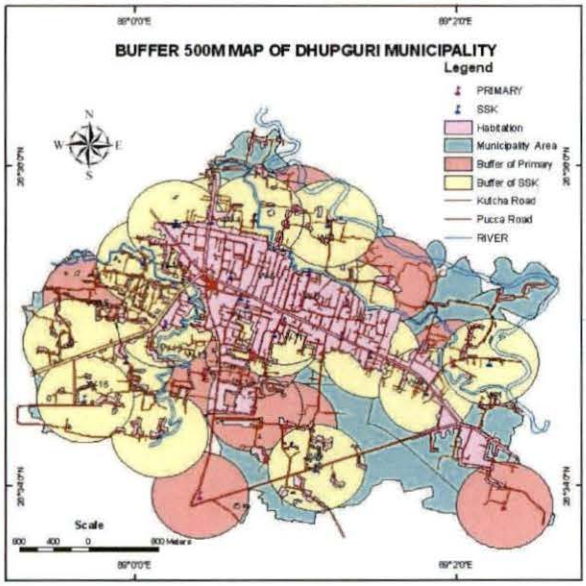

Figure 8.19 Habitation and Infrastructure

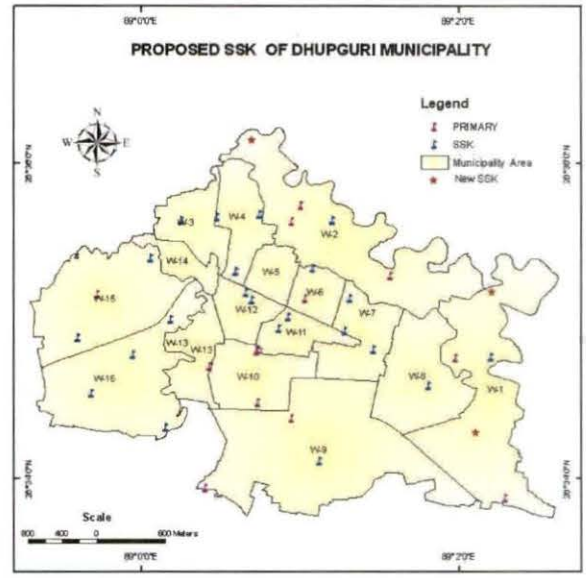

Figure 8.20 Ideal sites for new Crematorium

Geo-data based decision support in location of suitable sites for new SSKs has demonstrated simply with the help of following four maps (figure 8.17, 8.18, 8.19 and 8.20) prepared out of Dhupguri municipality geo-database created by the investigator. Figure 8.18 demonstrate the coverage area of the existing SSKs and Primary schools at 500 meter (ideal

distance to be travelled by very young children to attend school) least distance circle. This has been superimposed over the existing habitation areas to visualize the prevailing scenario of best attended area.

Figure 8.17 demonstrates the geographic location of wards and SSKs and Primary Schools and figure 8.19 demonstrates the geographical perspective of Dhupguri municipality including its territorial boundary that includes ward boundary; its resources base including rivers, wetlands, ponds; transport networks and the location of existing SSKs and Primary Schools. The figure 8.20 demonstrates a few cases of ideal location sites for establishing new SSKs in Dhupguri municipality. This will assist the stakeholders (decision makers at ULB) instantaneous identification of exact ground location including wards and a very quick decision would be taken followed by scheme preparation, implementation and monitoring cum evaluation.

8.4 Conclusions

The study emphasizes the power of GIS technology which will help the PRIs and other decision makers to better understand and evaluate spatial data by creating graphic displays using information stored in the database hosting the maps in such a way clients can view the information query. It has demonstrated that a block like Dhupguri which has immense potential of development and has maximum ST and ST population residing in rural area urgently needs a GIS based e-governance system such that it will help the PRIs and decision makers in planning, implementation and monitoring of various projects for development in different fields at much faster rate which in turn will usher a new era of informed planning processes for sustainable development planning.

- To provide the development planners and PRIs an accurate spatial view of the CD block at different levels such as gram samsad, gram pancheyet as well as land use, infrastructure allocation, road and rail network, drainage etc.
- To provide the planners detailed demographic data and education & health related data on desktop in a GIS environment.
- To assists the planners in finding out the possible locations for the schools and health centers depending on several parameters such as for health; population density,

number of health centers required and its optimum location, number of disease infected persons etc. and

- As GIS does more than just display the data; it enables the user to dynamically analyze and update the information linked to those locations spatially and can further strengthen the e-governance.

A number of case studies has also been attempted to demonstrate the PRIs and line department personnel who are entrusted to take the crucial decision making at ground level on various development and income generating and/or enhancing schemes mostly sponsored by Centre and the State Governments. Keeping in mind the ground reality in its proper perspective an effort has been made to develop a few simple cases with an aim to demonstrate the utility and usability of developed geo-database in Dhupguri block in the processes of development planning i.e., locating sites for new SSKs (Sishu Shiksha Kendra) and crematorium in. Geographical information systems will be open and will continue to evolve to harmonize with our ever changing needs. The main challenge will continue to be in our ability to understand spatial processes, and to translate them into computer algorithms and computer environments for use by different kind of people, including decision makers.

8.6 References

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