

Digital Land Management System : A new initiative for Bangladesh

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Abstract—Being a small country with a huge population Bangladesh is commonly known as an agriculture based nation. Per capita land in comparison to the number of people is very insignificant and hence the management of land system holds a vital role in the economic and social aspects of this country. Eventually the land management system of this country urges to grow into a very efficient system. Unfortunately the reality is lagging behind too far and the land management system of this country has gradually become a burdensome matter which is now entirely impotent to encounter the newly evolving land issues and problems. Majority of the conflicts and quarrels in rural as well as urban areas arise as a result of the inefficient and corrupted land systems which in turns often create a long term problem. Nevertheless, some researchers have tried to come up with a solution but none could make it work. The implement level tasks have remained unexplored in some way or other and consequently the land management system have failed to realize its goals. In a nutshell, the land management system is concerned with two major issue- land surveying and land management. Only eyeing to one issue neglecting to face the other one will not come up with a fruitful upshot. Out of this fact identified, the paper proposes a model land management system which offers both the solutions- GPS based land surveying and online land management encompassing an assortment of web based participatory services. We have also implemented our solution using some real life scenario and data and tried to face the real life complications and hitches.

Index Terms—Per Capita Land, Land Management, Land Surveying, GPS

I. INTRODUCTION

Bangladesh is a country with about 1, 47,570 square km territory. The significant proportion of this territory is cultivatable land mass which is considered as the prime earning source of the people of this country. The country is not yet well prone to large scale industrialization and hence her economy is largely hooked on the land based agronomy. Furthermore, the amount of land per head is very trifling and paramount percentage of its population depend on land property for their livelihood. As a result, land has been always a vital issue in the social and economic traits of this country. Being such an

imperative one, the land sector of this country deserves a well-structured management system but unfortunately the depiction is not the same. The land management system of this country still suffers from outdated methods and technologies and yet too far away from the touch of modernization. Corruption, incompetence and lack of transparency have made the land management system of this country a slow coach. At anyhow, there should be a termination to this obsolete system. We must adopt an efficient system which is free from the above encumbrances which is the core inspiration behind our suggested land management system. In our work, we have tried to find out the bottlenecks and hindrances of the existing land management system and come up with a new system which will free from those troubles as well as serve as a better solution for the people of this country. Our investigation suggests that the core problems behind the inefficiency of current land management system lie with the extensive widespread of corruption and use of obsolete methods to accomplish the huge tasks involved with land management. Eventually we were motivated to design a land management system which is completely contemporary and comes with the concerns of land surveying as well as online land management.

II. EXISTING LAND SYSTEM OF BANGLADESH

The current land system of Bangladesh can be inspected from two major viewpoints. They are-

- Land Surveying
- Land Management

A short summary of the existing land management system can be grasped from the below.

A. *Land Surveying:*

The land surveying system of Bangladesh is conducted totally in a traditional way. The land survey process is denoted by the term land settlement and is managed by the Directorate of Land Records and Surveys (DLRS). A diara settlement officer is in charge to look after oversees surveys in riverine areas and major urban areas where many changes of ownership occur. The land surveying

system comprises of two tasks- land measurement and the map drawing. The whole process is obsolete and old fashioned and there is a little use of modern equipment. The land measurement is done by some people known as Amin or measurer who are responsible for measuring the land and collecting the land data from the owner. At first the land is measured using the measuring tape. The tape is placed along the boundary of the land and the length of the land is calculated. The measured length is then recorded in the paper and the data is submitted to the land office and accordingly the map of the newly measured land is updated. The land surveying process can be described using 10 phases. The first phase is cadastral survey in which Amin and 2 chainmen draw the altered mouza map displaying changes in area, location and characteristics of land followed by demarcation of boundaries. The second phase is Preliminary record writing where Amin fills up the columns of the khatian (record of rights) form giving plot number, khatian number, classification of land, area, crops grown, name of owner, agricultural practices etc. information. At the third stage the draft khatian is handed over to the owner and entries are explained. If it is alright then Tehsildar listens to each owner, attends to any disagreements and, if satisfied, attests the khatian by signing it in red. Otherwise a re-survey is initiated. After completing this phase Senior amin records all details on a draft khatian and presents certified version to owner. After this phase, if any objections arise then cases are heard by ASO and decisions are recorded in violet. There is scope of appeal after this stage and ZSO and ASO hear appeals at Upazilla. Appeals may be forwarded to district where decisions marked in black. After that Entails maps are corrected, amalgamated and splitting up of jamas (interests) by the permanent surveyors takes place. After this stage both khatians and maps were printed. Finally the copies of the ROR are passed to DC, thana and union land offices. The land surveying process is shown in the figure 1

B. Land Management:

The land management system Bangladesh is totally obsolete and outdated. The complete system depends entirely on the manpower efforts. The land management includes maintaining the records of the land, selling and buying of the land, Ownership transfer of the land in various ways, creating the land deeds and their maintenance, Land related disputes management, Updating the land map and information, tax and revenue collection and many other things. There are many land offices throughout the country and every land office has its land staffs for maintaining the land management activities. Each land office has a land officer and many land staffs that collectively perform the management of land.

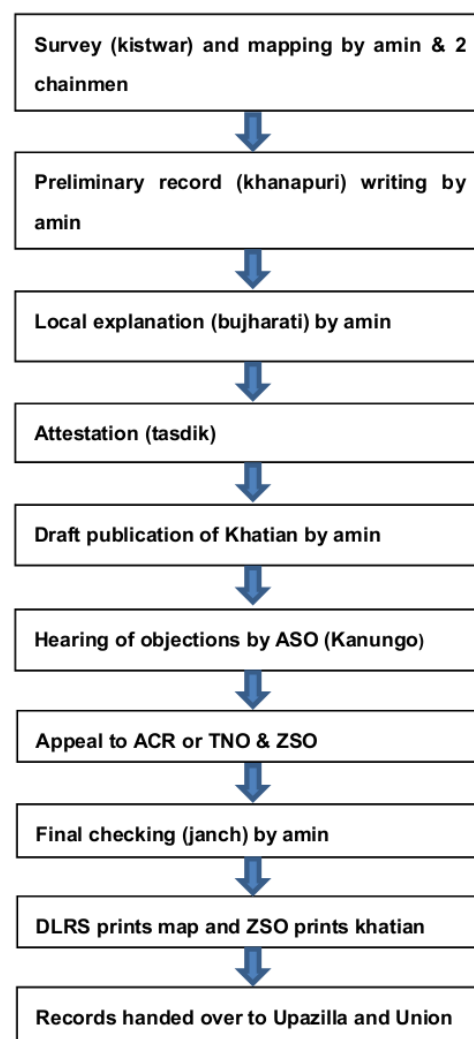


Fig. 1. Steps of Land Surveying in Bangladesh[1]

There are two types of land owner- individual land owner and organization based land owner. All the land owners regardless of their types need to get various services from the land offices. The services include getting the land deeds, land measurement, ownership transfer activities including selling and buying, getting resolution of the land disputes etc. For getting all the services, the land owner is bound to go to land office. For getting the land deeds the land owner has to apply to the land office for the land deed. The request is approved by the land officer and the land deed is prepared accordingly. For selling and buying of the land the land owner has to go to the land office to complete the land ownership transfer. There are a group of people who are known as deed writers. The land owner has to prepare a land ownership transfer deed by the help of deed writers. The deed is approved by the land office and the ownership transfer is complete. The whole process requires a couple of days to complete.

III. BOTTLENECKS OF THE EXISTING SYSTEM

The current land management system of Bangladesh is backdated and error prone. The obsolete procedure and lack of utilization of the technological resources have made the system more accessible to corruption. The whole system is conducted manually without modern concepts, equipment and technology. As a result huge amount of disputes and confusions exist in the management of land. Since the land property is most valuable one to any person, the quarreling and clash for the land remain to exist for decades.

- The error prone obsolete system has made an opportunity for the corrupted people to encounter various types of corruption in the land management. As a result lots of problems like fake land deed, fake ownership, illegal capturing of others land, bribery etc. have been introduced.
- The quarrels and disputes which now arise among the land owners are mostly due to corrupted and obsolete system. About eighty percent of the cases are filed today are only due to land related disputes. This will remain as a big threat and a burning problem until the land system is fully modernized and technologically rich.
- Since the surveying of land is conducted manually without the help of modern technology, there always remains the chance of error in the calculation of area of the land or finding out the boundary of the land.
- The land maps which are drawn contain many errors due to error prone measurement of the land boundary. Besides, since the land map is drawn and updated manually by hand, there remains a possibility of producing erroneous land map which is a major drawback of the current system.
- The land related services take a long time to accomplish since all the tasks are accomplished manually. Besides, due to enormous scope of corruption the land owners face a huge problem in getting their service in due time.
- There are many middle persons who create a lot of problems in performing the land related tasks. They keep liaison with the land staffs and build a strong network that jointly run the corruption based system.

IV. OUR MOTIVATION

Bangladesh is a land based agronomic country. Bunks of the people in this country are directly or indirectly connected to land or land related livelihoods like farming, cultivation, agri-business etc. The extent of agricultural land is being constricted day by day due to the expansion of mills-factories and housing related

constructions. On the other hand the demands for the agricultural land are rising due to the increasing number of population in the country. All the above facts signify that the amounts of land which are available in the country are very much inadequate in contrast to the number of people. As a consequence its becoming a tough challenge to maintain and manage the land system of the country appropriately. Moreover due to the scarcity of land in comparison to number of people, the conflicts and clashes in the society are increasing day by day. About 80% of the conflicts of Bangladesh are triggered due to land related disputes. Since the problem is severe, there should be resolution to this. This situation is no way acceptable in this age of technological progression since most of the developed countries have adopted modern method and technology to cope up with their problems. Our motivation to this model project was to employ the modern technology to resolve the land related problems of Bangladesh.

V. RELATED WORKS

Many researchers have tried to study the land management system of Bangladesh from different perspectives. Many have suggested some reformations in the land management policies but none has come up with a feasible implementation. Barkat et al. have done an extensive work to suggest a feasible land use policy[2]. Choudhury et al. tried to put a model of land management by scanning the current paper based maps and convert the images into scalable vector graphics (svg) format into database[3]. Whereas Nepal et al. have shown the degradation of agro-based land due to inappropriate management of land[4]. Hasibur has done a similar type of work where he has studied the adverse effect of human created causes and pollutions in shrinking of the cropped land[5]. Zulfiqar has worked on the issues and potentials for sustainable land management in Bangladesh[6]. Shoeb has analyzed the corruptions and inefficiencies in different sectors of lands[7].

VI. DLMS AND IT'S KEY FEATURES

Digital Land Management System or in short DLMS is our model system by which the land areas of any country like Bangladesh can be managed digitally with the help of modern technology. The overall range of land system tasks starting from the surveying of the land to the land management is managed in new way. It is a new concept of replacing the existing errors and bottlenecks of the current system with a new technology based system. The key features of DLMS include GPS based land surveying, automatic map drawing and online land management. These key features are described in the following-

A. GPS based Land Surveying:

One of the important features of DLMS is GPS based land surveying. GPS stands for Global Positioning System. GPS device is one of the location tracking devices. This is an electronic device which is commonly used for detecting the position of any place by the help of latitude and longitude value of that place. This device can directly communicate with the artificial satellites to find the latitude and longitude value of any place. Once the latitude and longitude value of any place is known the position of the place can be easily found. The amin or land measurer has to take the GPS device with him and go to the land which has to be measured. All he has to do is to find the coordinates of the corner points of the land with the help of this device and note it down. GPS land surveying can be classified by a range of relative ranging from low-to-moderate, 1 part in 104, through to the ultra-high 1 part in 107 or better accuracies.

- Category A (Scientific) : better than 1 ppm
- Category B (Geodetic) : 1 to 10 ppm
- Category C (General Surveying) : lower than 10 ppm.

Category A surveys principally incorporate those surveys commenced for precise engineering, deformation analysis, and geodynamic applications. Category B surveys embrace geodetic surveys commenced for the establishment, densification and maintenance of control networks to support mapping. Category C surveys mainly incorporate lower accuracy surveys, primarily undertaken for urban, cadastral, geophysical prospecting, GIS and other general purpose mapping applications[8]. We have made the use of this feature of GPS device to find out the boundary lines of any land. Every small piece of land can be imagined as geometrically polygon irrespective of its shape. To find out the boundary lines of any piece of land, we have to find the latitude and longitude of the corner points of the edges of the polygon. After the corner points coordinates are known, we will input the data to our DLMS system and the system will find out the area and boundary of the surveyed land. In calculating the area and boundary of the measured land, we have used the Google map API to process the input data.

• Area Calculation using GPS value

We have to outline the piece of land by taking the corner points coordinates using GPS so that we get a closed figure where all the sides are straight lines. If the area to be calculated contains curves, we have to outline the curves as closely as to make a straight line. Now we can label each corner (x_1, y_1) , (x_2, y_2) , $(x_3,$

$y_3)$ and so on until all corners are taken.

We can now calculate the area by multiplying the coordinates of the corners found previously using the polygon area formula:

$$A = \frac{1}{2} \times \{(x_1y_2) - (x_2y_1) + (x_2y_3) - (x_3y_2) + (x_3y_4) - (x_4y_3) + (x_4y_5) - (x_5y_4) + (x_5y_1) - (x_1y_5)\}$$

B. Automatic Map Drawing:

Another important feature of DLMS is automatically drawing of the map of land which is surveyed without the help of any human effort. In this case we have taken the help of Google Map. Google map has API where there are functions which can draw the line by using the coordinate. We have used the line drawing function to draw the map of the polygonal shaped land which takes as parameter the GPS values of the corner point of the land. The boundary lines are drawn above the Google Map as an overlay image which is our desired land map drawn from the GPS based land surveying. The whole process is completed without any human effort.

C. Online Land Management:

The most important feature of DLMS is online based Land Management system. This feature enables the land owners and others to accomplish their land related tasks online. The online land management includes the entire important tasks related to land management. There are two sides of the land management, one is land owner side and the other is land office side. The owner side online land management includes the following facilities-

- Land Account for every land owner
- See the owned land information online
- See the entire land map online
- Search for any type of land online
- Buy and sell the land online
- Advertise for selling any land online
- Bid to buy any land online
- Get the pdf copy of the land deed online
- Complain against any land dispute online
- Pay the tax or land revenue online
- Ask for any land related query online

Similarly the land office side will have the administrative facility to maintain the land related tasks online and to give the services to the land owner online. Each of the land staff will have a staff account. The official tasks which are accomplished online can be done by logging into the staff account. The land staff account will be divided into some types like grade-1 staff account, grade-2 staff account or officer account. The various staff account will have different administrative facilities with different security level. Any complain or modification in the land map will be finalized by the officer account

that is in charge of the land office. No unauthorized modification of the land information or the land map will be allowed without the consent of the corresponding land owner. Any final change in the land database will be instantly visible in the land map of the country.

VII. HOW OUR MODEL WILL REDUCE ISSUES RAISED IN CURRENT SYSTEM

Digital Land Management System (DLMS) uses an automatic online system for managing the land issues of the country rather than following the traditional system. The instant and easy access to the online services gives the land owners and other stakeholders a well manageable interface through which they can accomplish their land related tasks sitting on their home. Since the online system gives the individual land owner the facility to manage their land properties in home, the chance of inefficiency and longevity to accomplish the land related task diminishes greatly. Moreover, online management of the land properties helps to reduce the chance of corruption magnificently since the tasks are performed by the land owners directly. The surveying of land is done through GPS which reduces the chance of errors in measuring the land. In addition to this, the automatic drawing of land maps ensures the accuracy of mouza maps which is not possible in current system. In a nutshell, by using DLMS a land owner can manage his land properties online at anytime from anywhere of the world.

VIII. IMPLEMENTATION OF OUR SYSTEM AND DLMS WEBSITE

We have implemented our proposed Digital Land Management System (DLMS) and created a website to test the functionality of our implementation. Our Website (<http://www.dreamchasersoft.com/dlms/>) contains almost all the functionality of our proposed system. We have demonstrated the Automatic Map Drawing system by inputting the GPS data in our website. Our system draws the map of the surveyed land as an overlay to the Google Map. We have used Google Map API for this purpose. We have also implemented the Automatic Deed Generation, Searching throughout the drawn map, Sample Land Office Database and various functionalities related to land management. Each land owner can have an account in our system and they can accomplish their land related tasks online without going to land office. They can also advertise for land selling and buying through our system. Some of the screenshots of our website interface are given here.

IX. FEASIBILITY AND PROSPECTS OF OUR MODEL

Given the aforementioned description, it is obvious that implementation of DLMS is not merely the computerization of a land system, but the ability of technology

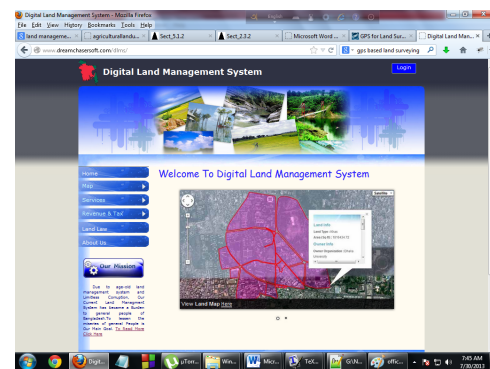


Fig. 2. Homepage of DLMS Website

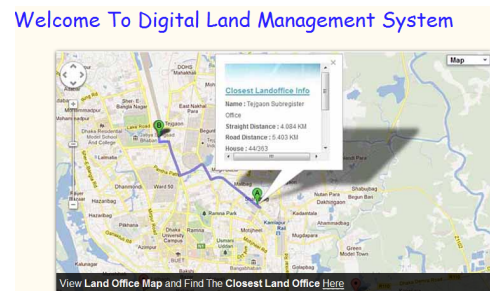


Fig. 3. Informations of Land Offices are Shown in Website

to achieve levels of enhancement in various magnitudes of land management and eliminating the corruption and mismanagement prevailing in Bangladesh. It is apposite at this juncture to establish an approximation of the system drawbacks and possible errors. We can start with the surveying of land with the GPS device. It is not challenging to predict why there rests a possibility of defining the boundary lines and hence to compute the area of any land with this device. For our test case, we measured the area of the lands of our university and its surroundings. For this purpose we used a GPS device having the aptitude of 5 meters preciseness. Consequently, our measured area is not fully precise but contains a small amount of error which is more or less negligible in comparison to the area of the land. From our calculation the error percentage was very negligible in comparison to the size of the lands. Dry air, water vapor,



Fig. 4. Automatically Drawn Map of some Lands as an Overlay in Google Map

TABLE I
APPROXIMATE COST ANALYSIS FOR SETTING UP ONE LAND
OFFICE

Setup Materials	Quantity	Approximate Cost in Taka
Desktop Computer	2	50,000
Modem	2	2,000
Internet Connection	2 PCs	3,000
Training of Staffs	5 Staffs	15,000
GPS Device	2	30,000
Total Cost		1,00,000

hydrometeors, and other particulates in the atmosphere may lead to some precision errors. These errors must be properly considered to achieve the highest precision in surveying using Global Positioning System (GPS) signals. The errors can commonly be categorized into three distinct sets; satellite dependent errors, propagation dependent errors, and receiver dependent errors[9]. All the facts described above can lead to some sort of wrong calculation. Again, there is a possibility that the person involved with taking the GPS reading can do some mistakes and an error prone outcome may be obtained. Moreover, in order to fully implement our project at national level, it is necessary to access the National ID Database of the country. The access to National ID Database can help to ensure the security and authenticity of the system. Currently we have no access to National ID Database which is surely an obstacle to check the authenticity of the land owners. However, in an overall sense our proposed land management system works very well showing a tremendous improvement to the existing land management system. The approximate cost analysis for setting up 1 land office to adopt our system is shown in table I

X. CONCLUSION

The existing land management system of Bangladesh is totally beyond the light of modern technology. Every year a huge amount of money is wasted to resolve the land related disputes. Furthermore, there is the burning problem of corruption in different levels of this sector. All of these problems can be readily checked if the DLMS can be properly adopted in this country. The adoption of DLMS can radically change the land management structure of the country. The use of modern technology will greatly save the time and human effort to accomplish any task. Though the initial set up requires some time, the fastness of service, reduction of cost and eradication of poverty will surely compensate the cost of this adoption.

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