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The indian land records computerization : the dungerpur's pilot project

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Facultés Universitaires Notre Dame de la Paix

**THE INDIAN LAND RECORDS
COMPUTERIZATION :
THE DUNGERPUR'S PILOT PROJECT**

By Denis Latour

**Promoter : J. Berleur
Technical Adviser : F. Bodart**

**A dissertation submitted in
conformity with the requirements
for the degree of
"Licencié et Maître en Informatique"**

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I INTRODUCTION

While information technology has been heralded in the West as a turning-point in human history, it is only recently that attention is being given to its potential impact on socio-economic development in the Third World. Among the Third World countries, India has ever been a precursor in this domain. For several years already, India has developed its own computer policy. Searching constantly to improve the life quality of the population, the Government tries to find out the best ways for using computer in each one of the domains by which a country develops : economy, public services, industry, administration, etc. It is in this philosophy that the pilot project of Dungeerpur's land records computerization has been launched.

Dungeerpur is a district of the State of Rajasthan. As every district of India, the Dungeerpur's district gets its own administration. The main administrative departments are located in or near the town of Dungeerpur, the capital of the district. Among them, there is the Revenue Department where the cadastral system, or land records, is maintained.

The land records have an important role to play in the functioning of the economy. Land is not only the most important economic asset in an agricultural economy, it is an essential resource because without land there can not be any state, neither habitation, nor ground-work for carrying on human activities. Land is a mother resource giving rise to various things of economic value. And in a country like India where more than 70 per cent of the population live from the land produces, these affirmations are ever more significative.

Currently in all parts of the country, the records relating to land are in a very bad shape. The real reason of this bad status of land records is the lack of updating. There is therefore an important disharmony between the records and the reality. Such disharmony misleads any person who has to deal with the land. This is obviously unfortunate because of the importance of land economically, socially and even emotionally. No wonder, this unhappy situation has led to incessant litigation and the clogging of the judicial machinery in the country.

Having well felt the need of reviewing the entirety of its land records, the Central Government of India decided on 27th August 1987 to launch a pilot project of computerization of the Dungeerpur's land records. Approved in October 1988, the project is computerized in charge of the Indian Institute of Management of Ahmedabad (I.I.M.A).

This dissertation aims to present and analyse the land records computerization. In the first part, the complex Indian cadastral system is explained. Similar to ours, it gets however special features concerning the way of updating land records and the way of assessing the lands in order to levy the land taxation.

Next the opportunity study of the Dunderpur's project is made. After a critical study of the existing system, the objectives of the Revenue Department are described in the framework program according to dissatisfaction causes underlined by the staff. These objectives are the decrease of the time spent on tiresome office works, the improvement of work qualities - mainly by reducing the corruption -, and the improvement of land records availability. Undoubtedly, the computer will be able to help to fill these objectives. It remains however to find out how. Some solutions are proposed, one is held and developed.

The held solution is ambitious. It tries to review the heart of the cadastral system: the jamabandi, the Indian cadastral matrix. A new structure of the information presentation is created. It allows to optimize the use of the computer and to improve the land records quality and availability. Moreover, the handling of mutations, that is the changes which occur in the land records, is revised in order to secure legal records-of-rights to landowners. Thus, each landowner will have a judicial proof of his landownership at his disposal.

Because more advantageous, the use of microcomputers, has been chosen to computerize the land records. A decentralized system has advantages and drawbacks. The advantages which have led the officials to choose the microcomputers are their low costs, the possibility to fit out the place where the decisions about the information are taken, and the ease to train the staff.

One of the difficulties in this decentralization approach was to which administration level it would be advisable to introduce computer. The best choice looks to be the tahsil level. However, since the administrative mentality is yet recalcitrant to the use of the computer, we suggest to begin first by fitting out the district office.

The real difficulty in the land records computerization is the lack of documentation. Without any documentation, it is quasi impossible to computerize the complex cadastral system. By constant researches, discussions and readings, the I.I.M. analyst, Mr Bhatt C., has finally succeeded in defining the main land affairs dealt by the land records staff. However, his observations are incomplete; and even if they permit to build the base of an initial information processing, they must still be completed. That situation has led to choose an approach by prototyping. The initial prototype is built on the Bhatt's observation. It will evolve day after day, whenever a new land case will be found out. In order to facilitate the extension of the prototype, the whole application must be built on a very modular architecture.

If the first objective of the use of computers is the improvement of land records and administrative works, the repercussions for the development of the country are not negligible either. The land laws and reforms on the one hand and the development schemes and programmes on the other hand will give henceforth better results. Moreover let us bear in mind that land records have come to the form of the sole proof of asset ownership for seventy per cent of the Indian population. So unless a system is evolved in which information related to land ownership record is secure, accurate and readily accessible, the realization of the concepts of equity and social justice may well remain a distant dream.

In the current century when the scope of scientific enquiry is so broad as to encompass almost any field, it is glaring anomaly to find that the records, on which the crop statistics of a principally agricultural country are based and which form the only authentic proof of ownership, are collected and compiled through erroneous sixteenth century methods.

II GENERAL FRAMEWORK

This chapter is devoted to some general characteristics dealing with the computerization of Dunderpur's land records. The first section gives some general features about India whereas the second describes the administration system. The third section draws the state of the Indian computer science wherein the Dunderpur's project is developed in its main features. Lastly the Indian Institute of Management in Ahmedabad, where the project is computerized and where I have spent more than two months, is briefly described.

II.1. INDIA

II.1.1. SOME BASIC FACTS

India is a vast subcontinent. Its geographical area is gigantic : 3.29 million square kilometers. Its population size is enormous. It stands a 683.81 million, according to the provisional figures of the 1981 census. Today the population is estimated to more than 800,000,000. The density of population is 221 per square kilometre. The population is spread out in twenty-two States and nine Union Territories administered through four hundred districts. The urban population, as a percentage of the total population, is 23.7 per cent. There are 3,245 towns (1981 census) whereas there are nearly 600,000 inhabited villages. 39.3 per cent of the total population is below the age of 14 years. The natural growth rate is 1.9 per cent.

India is a secular country, though it has a preponderance of Hindus (82.7 per cent). Muslims are the second largest group (11.2 per cent), Christians constitute 2.6 per cent of the total population while the Sikhs constitute 1.9 per cent.

The literacy rate (1981 census) is 36.17 per cent; 27.9 per cent of the literate population are living in the rural areas and 60.2 in the urban areas.

Infrastructure facilities are inadequately developed in rural areas. There are only 243,000 villages that are electrified.

II.1.2. RURAL INDIA

Nearly, 70 per cent of the working population reportedly derive its livelihood from agriculture, because land provides not only the raw materials for some of the principal industries - like cotton and jute textiles and sugar -, but it also accounts for nearly half of the total income of the country. Of the total geographical area of 329 million hectares, nearly half of it is mentioned as cultivated area. The estimated total cropped areas stands at 173.3 million hectares [IAB,80].

Apart from the problems of irrigation and scarcity of rainfall in certain parts of the country, another major compulsion on the rural development is the size of landholdings in the villages. A cursory glance at table II.1 indicates that more than 50 per cent of the cultivators are marginal farmers whereas 19 per cent are small farmers. The landholding in different categories varies from 0.4 hectare to 18.1 hectares with an average of 2.3 hectares in all-India basis.

Category	Size of holding	Number of holdings (x 1000) and %age	Total area operated (x 1000) and %age	Average area per holding (hectares)
Marginal	0 - 1	35,682 - 50.6	14,545 - 9.0	0.4
Small	1 - 2	13,432 - 19.1	19,282 - 11.9	1.4
Semi Medium	2 - 4	10,681 - 15.2	29,999 - 18.5	2.8
Medium	4 - 10	7,932 - 11.2	48,234 - 29.8	6.1
Large	10 and above	2,766 - 3.9	50,084 - 30.8	18.1
Total		70,493 - 100.0	162,144 - 100.0	2.3

TABLE II.1 Number of operational holdings and area operated by size classes (1970-1971)

II.1.3. MAIN FEATURES OF RAJASTHAN

The survey about the land records have been set up in Dungepur which is a district of the state of Rajasthan.

The total area of the present State of Rajasthan is 131,943 square miles. According to the area, Rajasthan is the second largest State in India. Rajasthan lies between 23.3° and 30.12° north latitudes and 69.3° and 78.97° east longitudes. It is roughly rhombic in shape. It is bounded on the western and north-western sides by Pakistan. Its northern and north-western frontier matches with the Punjab and Uttar Pradesh until it touches the river Chambal, where it turns south-eastwards. The southern boundary forms a zig zag line across the southern region of India separating Rajasthan from Mattar Pradesh.

Rajasthan is a tropical region consisting mostly of dry sandy desert, but to some extent of fertile plains and equally fertile plateaus as well as forests and clad hills. In the Eastern Rajasthan where Dungepur is located the conditions are better [SIN,64].

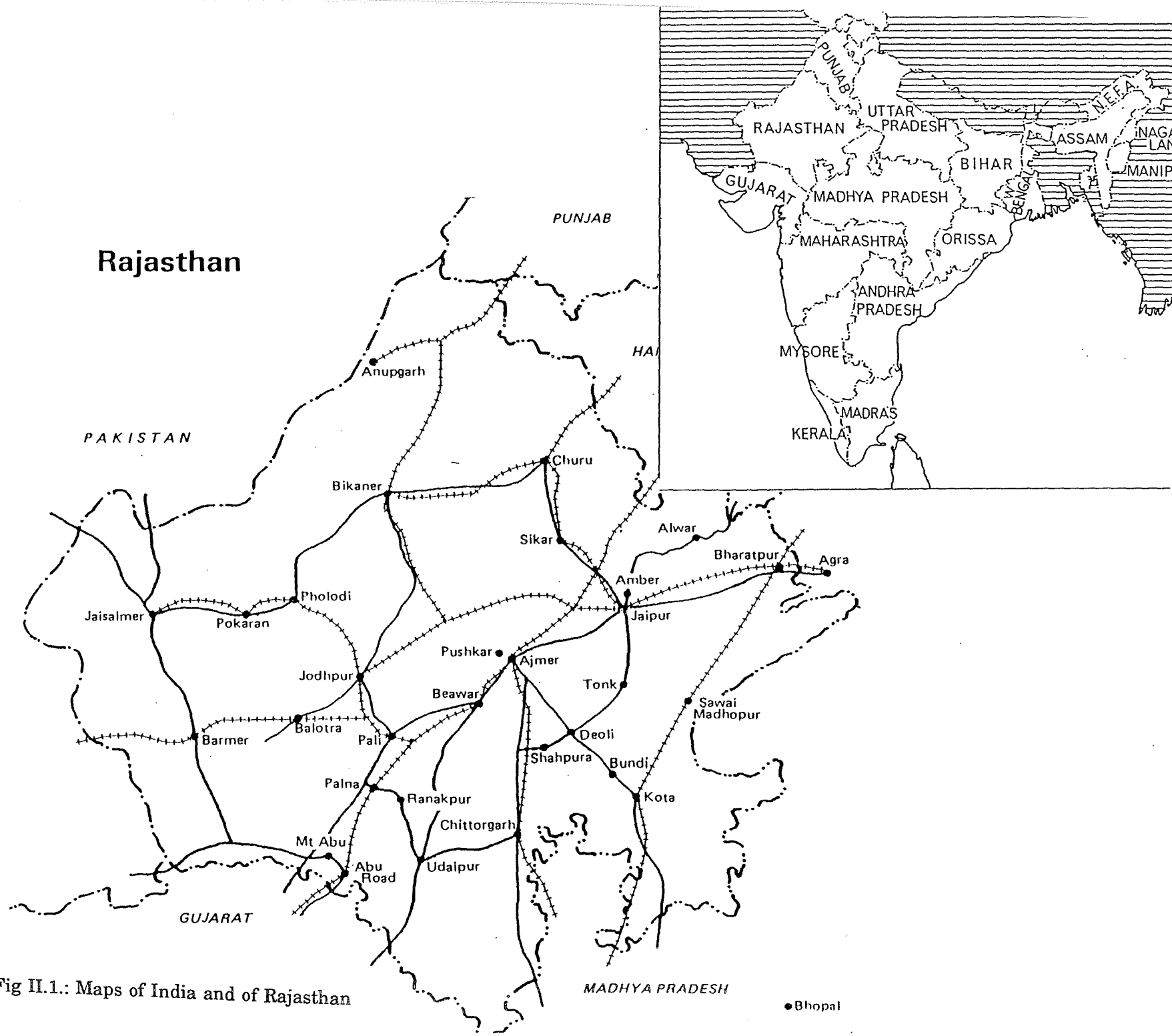


Fig II.1.: Maps of India and of Rajasthan

The rural population of Rajasthan amounts to 27,051,354 [THO,86]. 61.8 per cent of this population own wholly or partly lands.

II. 2 GENERAL ADMINISTRATIVE SETUP

India is composed of twenty-two States and nine Union Territories. Each State is divided into several districts. There are 412 districts in India. They have been created by the State governments for administrative convenience [AVA, 65]. Their boundaries are artificial and accordingly can be, and sometimes are, altered. The broad purposes of district administration are to maintain law and order, to assess and collect the land revenue and other taxes, and to promote welfare of the resident population by development works. To effect this purposes, the district administration is composed of several departments (Revenue, Public Health, Irrigation, etc) and a number of agencies of government (Police, District Judge, etc.). The coordination among these departments and agencies is secured mainly through the *Collector*, the chief government officer in the district.

Most district are divided into two sub-divisions, each of which is the charge of a *Sub-Divisional Officer*, also called Assistant Collector or Sub-Collector.

Each sub-division is divided into two or more administrative areas called tahsils. Each tahsil is in charge of a Tahsildar. In the revenue administration structure, tahsils are usually divided into revenue circle. A tahsil comprises about one hundred villages and a revenue circle on average between 30 and 50 villages. The governmental representative of the circle is the *Circle Inspector*, that of the village is the *Patwari*.

Since their administrative role is important, the Collector, the Tahsildar and the Patwari are briefly presented.

- *the Collector* : he is very powerfull. His duties are numerous and varied. They can be regrouped under the following heads :
 - land revenue
 - law and order
 - development work
 - general administration
 - emergency
 - miscellaneous

As it will be explained in the presentation of the computerized solution (chapter V) his function and his power will play a decisive role in the introduction of computers in the administration. Indeed, if he is convinced of the land records computerization, he will be able to secure the computer success thanks to his power over all the administrative staff.

- *the Tahsildar* : literally, the treasury officer. He and his assistants have jurisdiction over about a hundred villages. It is through the Patwaris that he keeps in close touch with the rural population as regards day-to-day revenue affairs and a wide range of other matters.

Like the Collector and Sub-Divisional Officers, the Tahsildar has magisterial powers. He works closely with the police in the area. He is the appointing authority for inferior village servants.

- *the Patwari* : he is the representative of the government in his charge of one or several villages. His duties are large and varied. But, on no account, he has any kind of authority. His function is only to apply the laws in matters such as land revenue, public health, irrigation, etc.

II.3. THE INDIAN INFORMATION TECHNOLOGY

Until 1984, the Indian policy has been conducted under the cover of important protectionist measures. That has allowed real advances towards a technological autonomy but it has also led to resounding failures such as an accumulated technological tardiness, the lack of dynamism of overprotected manufacturers, the high important taxes, and the non-competitiveness on the mundial market [ZIM,89]. In 1984, all these facts led the government of Rajiv Gandhi to modify significantly the Indian policy. This policy has deeply changed the state of information technology. The main features of this state are presented below [PAT,87].

- *Organizational mechanisms* : overall policy guidelines for computers are laid down by the Department of Electronics (DOE). The National Informatics Centre (NIC) is responsible for developing computer support e.g. data bases and applications software ministries. At state level, there are computer centres coming under either the Department of Planning or the General Administration Department.

The Department of Electronics is the focal point organization for policy-making and controlling of computerization. So the Dunderpur's project has been launched by the Central Government with the agreement of DOE.

- *Availability of computers and major centres* : the NIC has two mainframes in Delhi and five in other cities. These are connected via many super minis and micros to various ministries.

There are four mainframe-based regional computer centres in four regions of India. Many states have either mainframes or supermini computers. Many districts and state agencies use micros.

In 1980, there were 1000 computers, and in 1985, 10,000. There are approximately 120,000 computers in India today.

- *Network communications* : there are some private networks : that of Air India, that of Indian Airlines and the INDONET system. There is a public data communications service provided by the Department of Telecommunications. Another major network is NICNET being implemented by NIC and expected to be completed in the next three years.

- *Training and human resource development* : there are about twenty institutions which have a four year computer science/engineering program and ten other institutions which give a three-year post-graduate system analysis course. There are still some institutions or centres which school students to computer science.
As we can note it, the number of training places is really not sufficient. The lack of competent specialist, and principally in analysis, is undoubtedly one of the major problems for the Indian computer science.
- *Manufacturing and indigenous development* : there are some important computer manufacturing industries in India : ICIM, ECIL, HCL, DCM, WIPRO, ORG, NELCO, UPTRON, HINDITRON, IDM.
Because of the protectionist measures, difficulties and duties to import computers - all agencies need to approach DOE for securing permission for import of computers - these manufacturers share 5/6 of the market between them. The result of this situation is the weak number of compatible computers and adapted softwares.

II.4. THE INDIAN INSTITUTE OF MANAGEMENT

The Indian Institute of Management (I.I.M) where I have made my training periode is located at Ahmedabad in the State of Gujarat.

I.I.M, Ahmedabad, set up by the government of India in collaboration with the government of Gujarat and Indian Industry as an autonomous institution in 1961, provides education, training, consulting, and research facilities in management.

The Institute conducts the following major programmes :

- two-year post graduate programme in Management for graduates from all disciplines which aims to develop professional managers.
- fellow programme in management for those wishing to pursue carrers in teaching and research.
- faculty development programme for those already teaching in universities and colleges.
- management development programmes (MDPs) which cover both general management and functional areas. These MDPs are for industry, business, agricultural and rural sectors, and public systems covering education, health, and population. That is in this framework the Dungerpur's project is integrated.

The Institute has nearly 90 faculty members and 350 students.

- *Set up of the computer facilities* : there are 64 well-furnished air-conditioned double rooms in which 150 microcomputers and terminals are distributed. These material share between the staff, the students and the computer centre.

The computer centre has two major functions :

- Development and maintenance of applications used by the different departments of the Institute: library, accounts department, etc.
- Development and maintenance of research applications. These applications are developed on professor request. So, the Dunderpur's project is led by Mr BATHNAGAR S.C., I.I.M. professor.

Eighteen persons work currently in the computer centre. The Hardware configuration consists of one VAX, one PDP, 20 terminals VT 220 and 7 IBM compatible personal computers.

III THE LAND RECORDS

This chapter aims to present the main characteristics of the Indian land records. After a historical introduction, several features of the present land records are detailed: the organization, the equipment, the general system and the present status of land records.

III.1. HISTORICAL INTRODUCTION

In the sixteenth century, the king Akbhar, finding the revenue administration very unsatisfactory in practice, introduced and developed drastic reforms, which led his country to possess a remarkably complete and effective administrative organization. The detail of this new bureaucratic organization need not detain us. Its main axes were:

- a statistical survey of resources and capacity of the empire, on the basis of which the revenue rates were fixed for a term of years = assessment;
- a survey of the whole land, field by field. To each surveyed field corresponds a record containing the following information: holder's name, area, landtype, and revenue rate;
- an estimation of the average produce of each crop for each class of soil in each province;
- a cohort of employees; some to maintain the records and collect the revenue, others to ensure the good conduct of the administrative works.

About two centuries intervened between the death of Akbhar and the introduction of English rules. During this interval, all the initial organization disintegrated. In fact, instead of the original policy in which the produce of the land was shared between two parties only, the State and the cultivators, we now find three sharers (and sometimes more) : the State, the cultivators and the intermediaries. The latter are persons taking - or claiming the right to take - the revenue from the cultivators, creating consequently an intermediate level between the cultivator and the state.

As soon as they had the power, the English restored the Akbhar organization. However, in spite of some controversies, they did not remove the intermediaries. It is only at the independence that these ones were ejected [MOR, 11].

From this historical approach, one can conclude that the main goal of land recording is the tax collecting. Another interesting point is that the present cadastral system was organized by the king Akbhar three centuries ago; that means a feudal system, well established and hardly modifiable.

III.2. THE PRESENT LAND RECORDS

This section aims to identify the general context of the present land records. At first, the land records are defined. Next, after a presentation of the administrative organization, the patwari and the used material, the general land record system is explained as a lay-out of these ones. In a last part, the actual status of the land records is presented.

III.2.1. A DEFINITION

The land records are legal records, representative of the possession(s) and right(s) of each landholder. Or in other words, the land records are a set of records testifying the links existing between a person and a land. It is on their basis that the Land Revenue Department levies the taxes.

So defined , the problem seems to be easy to deal. But in reality it is more complex.

First, the scope of the land records is very wide. In fact, the land records gather behind their definition many cases of figure : the cadastral system and the associated maps, the tenancy system, the Government properties, the crop estimation, the tax demand/collection/receipt books, the illegal cultivation register,etc [RAO,89]. It is besides hard to understand and link together all these records.

Secondly, in every state, indeed sometimes in the same state, the land records are differently managed. These variations relate as well to the contents of documents than to their handlings or even to the employees who deal with them.

The three next sections are elaborated considering the two previous remarks. In fact, they present only one case of figure : the cadastral system. Moreover only the general characteristics, common to many states, are developed.

In a goal of ease, except if it is explicitly written, the words 'land records' will henceforth be synonymous with cadastral system.

III.2.2. THE ORGANIZATIONAL SET UP OF THE REVENUE DEPARTMENT

The real name of the Revenue Department is the Department of Land Revenue and General Administration. His scope and functions are much wider than its name would imply. In fact, it has to deal in a greater or less degree with every branch of the administration and consequently with every department of the Government, i.e. about forty.

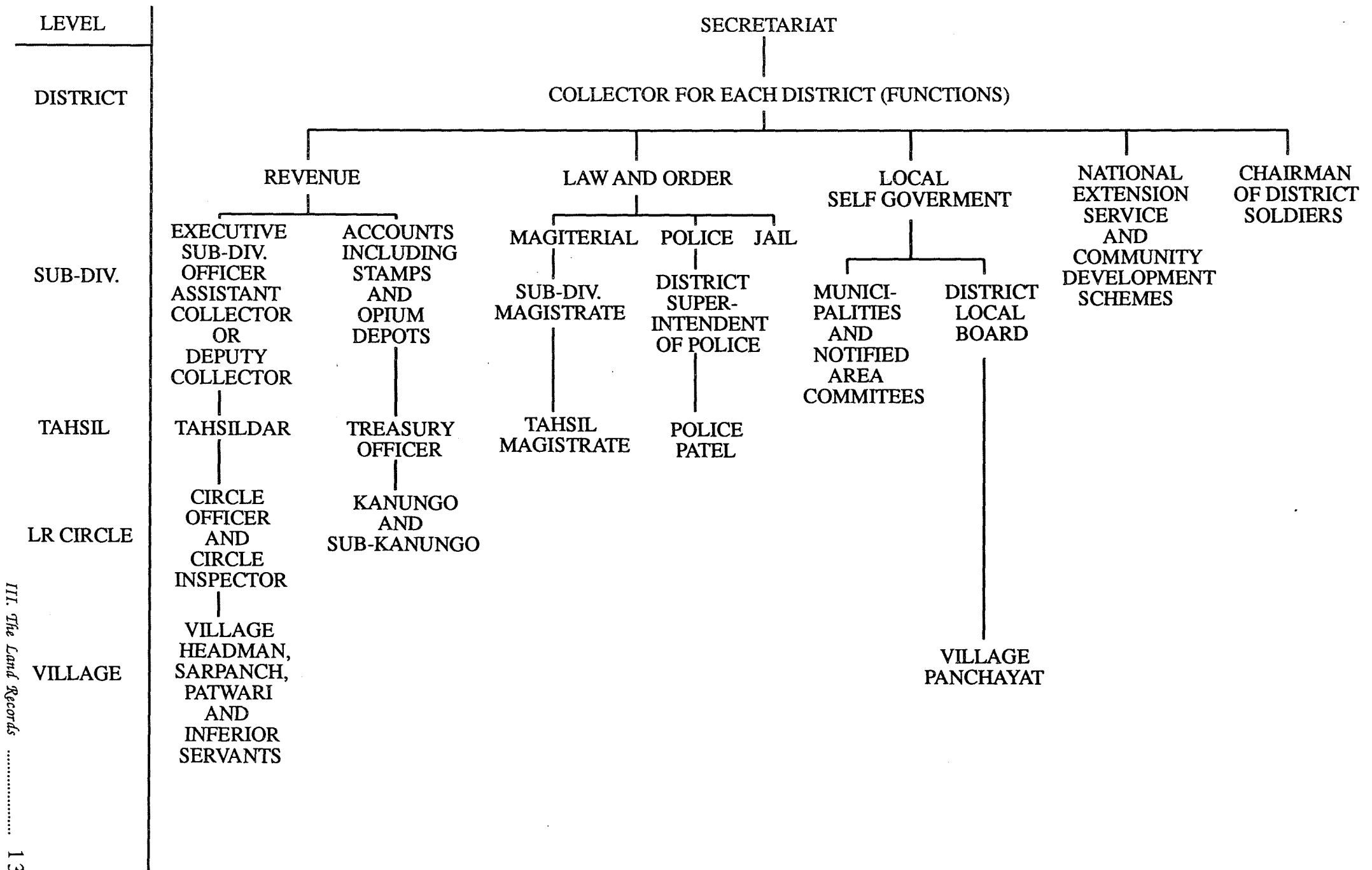


FIGURE III.1. : ORGANIZATION CHART OF THE REVENUE DEPARTMENT

SOURCE: DESAI [1961]

The Revenue Department has an important particularity to underline : it is the only department at the state Government level without a single head. Nobody is hierarchically over the Collector. This one is the only responsible for his district and the Revenue Department that is joined to it. He is the chief controlling authority in all matters connected with the land revenue. This situation may bring about different policies of development and a lack of coordination in the same state.

The figure III.1 shows the general organization of the Revenue Department. We are especially interested by the revenue branch. This branch deals with matters like land revenue, land grants, cash allowances, establishments, dues of cooperatives societies, tenancy, execution of decrees of civil courts and audit of village accounts and inspection.

In the general administrative set up section [II.2], the Revenue Department officers and employees, except the Kanungo, and their power have been briefly presented and can be resumed by the figure III.2. There are the Collector, the Sub-Divisioners, the Tahsildars, the Kanungos, the Circle Officers and Inspectors, and the Patwaris. The Kanungo is the Treasury Officer. He sits at the district level, but has the same rank than the Tahsildar. His duties concern mainly the receipt of the various land revenues. For Dunderpur, there are one Collector (1), Mr Anirudh Krishna, two Sub-Divisional Officers (2), four Tahsildars and Kanungos (4), thirty three Circle Inspectors/Officers (33) and two hundred and ten Patwaris (210).

POPULATION	DIVISION	ADMINISTRATIVE HEAD
800,000,000	INDIA	CENTRAL GOVERNMENT
...	STATE	STATE GOVERNMENT
1,500,000 - 3,000,000	DISTRICT	COLLECTOR
...	SUB-DIVISION	SUB-DIVISIONAL OFFICER
50,000 - 150,000	TAHSIL	TAHSILDAR
...	LAND RECORD CIRCLE	LAND RECORD OFFICER
500 - 3000	VILLAGE	PATWARI

Figure III.2.: General administrative set up

The role of the Collector for the land revenue boils down to village inspections, field inspections, case hearings and audit of land registration. According to Avasthi [AVA,65], the Collector spent more than five hundred hours per year to this revenue work. It seems that his situation has not changed today.

The Collector is helped by the two Sub-Divisional Officers. These ones act as link between the Collector and the tahsil officers, the Tahsildars. With the help of their staff, they check the work of Tahsildars and make sure the latter apply the laws in matter of land taxation and land reforms. Regularly, they make reports that they pass on to the Collector.

The Tahsildar is the lowest officer of the Revenue Administration. He is appointing authority for inferior village servants. His principal duties are to ensure that the land revenue and other government dues are collected in his tahsil in time and in full without tyranny; to keep in safe custody all government money and property entrusted to him; to supervise the land record work in his tahsil; to watch whether the Patwaris, the Circle Inspectors and other Revenue personnel carry out their duties properly and to report to the Sub-Divisional Officer any unusual occurrences. That is why, in order to carry out his work efficiently, he moves freely about his tahsil. Thus, he can check the situation and acquire his personal knowledges. On account of his large charges, he is helped by the Circle Officers and Inspectors. These ones are appointed to assist the Tahsildar in exercising proper supervision over the village officers and village servants and to make local inquiries of every kind promptly. Moreover the Circle Officers has the right to certify the entries in the different registers used within the land revenue system - for instance, the jamabandi and the mutation register. Their other main duties are the following: the boundary mark inspection, the valuation and inspection of crops, and the preparation of agricultural and other statistical returns.

Considering that the land record computerization attempts to reduce the duties and the power of the Patwari, the next section is devoted to this employee and his work.

The Dungerpur's Revenue Department structure is therefore a traditional organizational administrative structure that can be depicted as a hierarchical or pyramidal structure of positions wherein each position has authority or right to 'command' every below position associated with it. That situation is characterized by:

- regular checkings of employees by their hierarchical superiors. For instance, the Patwari work is checked and testified proper by the Circle Officer
- a lack of initiatives
- an obedience motivated by a fear of sanctions
- the corruption at every level
- heavy and long procedures.

III.2.3. THE PATWARI

III.2.3.1. GENERAL PRESENTATION

The Patwari (or farnam, talati, shambhog) is the representative of the Government in charge of one or several villages. His usual appellation of 'village accountant' is inadequate, because he is much more than this. His local knowledge is so extensive that there is few information about the village

and its occupants which he does not know or can not guess. Consequently he is referred to, not unrealistically, as "the eyes and ears of the Collector". He has the closest contact with the rural population.

In many places, he is still the only person in the village who can read and write, and is able to understand the law regarding land revenue and tenure.

On account of his position, the work of the Patwari is not focused on the land revenue only. He carries out other tasks and services for the rural population. That concerns the social welfare, flood and drought relief, census work, etc. It results that the Patwari is overburdened and that he may therefore not maintain a high degree of accuracy and reliability in his work.

III.2.3.2. QUALIFICATIONS, RECRUITMENT AND TRAINING

The Patwari candidate must not be less than eighteen years of age. His minimum educational qualification is Vernacular Final Examination, i.e. for us the superior secondary diploma.

If his candidature is selected by the Collector, the Patwari has to attend courses during nine months. He learns there the land rules, to survey the fields and how to maintain the documents. He receives also the necessary initiation to his future work from a senior Patwari. Thus the Dungerpur's Patwaris receive their training at Udaipur, main district of Rajasthan.

III.2.3.3. THE DUTIES OF THE PATWARI

It is very difficult to find out all the duties of the Patwari considering the scope of his work. However, the following are his main duties :

- *duties relating to the lands and their records :*

1. To maintain the village accounts relating to demand, collection and arrears of land revenue etc., and the land records including the jamabandi and all other village forms prescribed by the Government.
2. To inspect crops and boundary marks and prepare agricultural statistics.
3. To make an estimate of the areas under various crops and prepare for each landowner his taxation.
4. To detect encroachments on Government lands or public ways and watch wether any such land is unauthorisedly cultivated.
5. To see wether the land tenure law is respected by the landholders.
6. To ascertain and report decreases or increases of land.

- *social duties* :

7. To participate to the assessment of the lands.
8. To submit extracts from the birth and death register every month to the Tahsildar.
9. To report to the Collector if any disease or insects appear in the village.
10. To inform the veterinary officer if any scheduled disease breaks out among the animals in the village.
11. To report to the Collector the natural disasters (drought or flood, etc).
12. To revise electoral lists (rolls).
13. To act as census taker every ten years.

As it has been explained above, the Patwari carries out these duties for a group of four or five villages. He is paid 1700 Roupies per month (± 4250 Belgian francs). Comparitively, an analyst of the Computer Center of I.I.M.A. earns more or less 3000 roupies per month (± 7500 Belgian francs).

III.2.3.4. CORRUPTION

It must not be thought that the qualities of the Patwari are uniform throughout the districts. There are black sheeps in all parts.

At the time of my stay in the district of B. (Rajasthan), I met a former Patwari¹. He explained the Patwari's work, the manner of surveying, the use of jamabandi, the rules, etc. And he ended by saying: " To tell the truth, my explanations are legally proper; for the Government, the Collector and even the Tahsildar, the Patwari acts respecting the laws and rules, but it's not like that on the spot. The Patwari is corrupted ..."

There are three kinds of corruption: measurement corruption, land transfer corruption and falsification of tax amount.

The measurement corruption occurs when the Patwari surveys a field deliberately incorrectly or write false information in the jamabandi and the mutation register. That voluntary corruption act is always committed in favour of one landholder, who paid the Patwari. This practice is facilitated since the majority of peasants are illeterate and can not check the validity of mutation writings.

There are two cases of land transfert corruption. It is either when the Patwari asks the landowner for a tip to supply him with his land records, or when the Patwari takes deliberately a long time before obtaining the land records for the peasant who requests them.

¹ Note : this Patwari asked that his name remains unknown.

In some cases, the Patwari and the landlord get along to falsify the tax return. In fact, just before the crop time, the Patwari has to inspect all the fields and estimate their future crops. It is then, on this basis, that the taxation will be assessed. The corruption consists then to declare the future yields of the crops, lower than estimated in order to be less taxed.

III.2.4. THE ADMINISTRATIVE EQUIPMENT

The land records are composed of books, documents and maps. These ones are detailed one by one.

III.2.4.1. THE JAMABANDI

Definition: In reference to Bihar Act XIV, 1949,

It is a register containing the name of persons holding land in the (registered) village, the area held by each person and the rent, dues or revenue assessed by the settlement officer

or

the jamabandi is a complete record of all rights and interests showing every holding of whatever kind [GEO,84].

Also called Khevat or Khatauni, it is considered as a 'Record of Rights' by the Indian administration and population. Constituting the principal land record of a village, all the owners, governmental or private, are there registered [RAO,89].

The jamabandi is a big and wide book, each page of which is cut in some columns. A part of these columns is devoted to information concerning the holder(s), namely his/her khata number, the husband name in case of female holder, his/her caste, his/her address and his/her share that represents the percentage of the area that he/she possesses in case of multiproperty. So if he/she owns alone the whole area, his share is of 1/1. An other part of columns concerns the field(s): the plot number said kahsra number, the area in hectare, the landtype⁰ and the source of irrigation. In the last but one column in front of each field is registered the cadastral tax to pay per hectare. The last column contains for each plot the amount of its tax. Moreover let us note that on each page there is a heading with general information (State - District - Tahsil - Circle and Village names) and that a space is devoted to remarks and annotations on the right side. This general description is drawn in the figure III.3.

⁰ Note : The landtypes classified by State in Dungerpur are :

- Irrigated from type IA - getting irrigation from a canal
- Irrigated from type IB - getting irrigation from a river
- Irrigated from type IC - getting irrigation from a well
- Canal
- River
- Road
- Forest
- Housing
- Barren (not cultivated but can be improved)
- Grazing
- Hill

HEADING

VILLAGE NAME : DARBAN

TAHSIL NAME : RODA

PATWARI CIRCLE NAME : XXXX

DISTRICT NAME : DUNGERPUR

STATE : RAJASTHAN

YEAR : 2042 - 2045

GOVERNMT
KHATA

PRIVATE
KHATAS

BANK
KHATAS

GEAIR
KHATAS

KHATA No	NAME - HUSBAND NAME ADDRESS - CASTE - SHARE	PLOT No	AREA Ha	TYPE	IRRIG. SOURCE	TAX / Ha	AMOUNT	
1	Government	43 45d 47 87a 99c	1.2 0.6 1.5 0.1 4.2	IA IIA IIB IC IA	Well Rain Channel Pump Well			
	TOTAL	5	7.6					
2	Theymoury, scheduled Darban, 1/1	18	1.0	IA	Well	15	15	
		1	1.0			15	15	
...								
15	Bhatt, Brahman Darban, 1/1	7 10 14	0.5 1.2 0.3	IIB IC IA	Channel Pump Well	18 10 15	9 12 5	Inherited by Bhatt Ch.and Bhatt D. On the 10th May 89 Mutation No: 14
		3	2.0			13	26	
16	Bhatnagar S., Brahman Darban, 1/3 Bydiut, Brahman Darban, 2/3	13 28	1.0 2.0	IA IC	Well Pump	15 10	15 20	
		2	3.0			12.5	25	
...								

FIGURE III.3.: THE JAMABANDI

The records are gathered together in KHATA. A khata is a set of lands which belong to a landholder, single or not, private or not. The lands are regrouping within a same khata because of their landholding to a same landholder. In some parts of India, one takes the localisation of land into account too. So if two fields belong to a same owner, but are located at different places of the village, they are registered in two different khatas. There are four kinds of khata :

- *Government khata* : set of governmental lands, including roads, forests, ways, etc.
- *Private khatas* : those of landholders
- *Bank khatas* : they index all the mortgaged lands by the landholders. There is one khata by bank, which are the only ones permitted to ratify the mortgage procedure.
- *Geair khatas* : set of lands offered by the Government to poor peasants. There is one khata by peasant. In reality, the offered lands do not belong yet to the peasants. It is only fifteen years after the donation, that the fields will become the property of these peasants. Then the Geair khata is changed in a private khata.

Originally at the time of land settlement (every thirty years), the jamabandi is completely written afresh. Then, to each khata, corresponds only one landholder (State, private or bank) and his plots, and to each holder a number : the khata number. The jamabandi is ranked alphabetically Hindi vernicular according to the name of owner. Changes occur gradually in the ownership of land : for instance in case of sale or inheritance. These changes are registered in the mutation register which records the position before and after the transfer of holding. At the same time, the jamabandi is annotated through the remark space, showing thus that a change has occurred.

The structure of the jamabandi is simple. The khatas are registered one after the other , in the following order: governmental khata, private khatas, bank khatas, geair khatas. After each khata, a total line is calculated: number of fields, area total in hectare and tax amount (see figure III.3)

In the Dungerpur's district, the average of khatas and records per jamabandi is respectively of 220 khatas and 1400 records.

III.2.4.2. THE MUTATION REGISTER

The mutation register is another important book. In fact, whenever a change occurs in the ownership of land¹, it is recorded in an annotated form in the jamabandi and detailed in the mutation register.

The mutation register structure is almost the same everywhere in India and is like a double jamabandi. The mutation register records the position before and after the transfer of ownerships. Its left part/page is reserved for writing the former jamabandi record, and the right for the new.

¹ Note : more details in the section III.2.5.

BEFORE MUTATION

AFTER MUTATION

VILLAGE NAME : DARBAN DISTRICT NAME : DUNGERPUR									TAHSIL NAME : RAJKOT STATE : RAJASTHAN									PATWARI CIRCLE NAME : XXXX YEAR : 2042 - 2045								
Mutat No	Khata No	Name-Husband-Caste Address-share	Plot No	Area	Type	Irrig source	Tax/Ha	Amount	Mutat No	Khata No	Name-Husband-Caste Address-share	Plot No	Area	Type	Irrig source	Tax/Ha	Amount									
1	15	BHATT Chetan, Brahman, DUNGERPUR, 1/1	7 10 14	0.5 1.2 0.3	IA IB IB	Well Pump Rain	15 12 20	7.5 14.4 3	1	15	BHATT Bidyut, Brahman DUNGERPUR, 1/2 BHATT Rajid, Brahman DUNGERPUR, 1/2	7 10 14	0.5 1.2 0.3	IA IB IB	Well Pump Rain	15 12 20	7.5 14.4 3									
2	17				IIA	No	0.5	1.25	2	17	BATHNAGAR CD, Sunias DARBAN, 1/1	5	2.5	IB	Pump	12	25									

COPY OF JAMABANDI STRUCTURE

COPY OF JAMABANDI STRUCTURE

FIGURE III.4.: THE MUTATION REGISTER

As the figure III.4. shows it, the records are registered ones after the others.

As for the jamabandi, there is obviously one mutation register per village. However let us well notice the importance of the mutation register. This one allows to trace the ownership of land at any particular point of time. Without that the past and the story of lands would be lost.

III.2.4.3. THE MAP AND THE KAHSRA

One of the most important documents of the cadastral system is the map. The cadastral map is known as the village map. It is on a scale² sufficiently large to show each individual field, and its distinctive number. Usually, it measures about one hundred twenty centimetres by one hundred fifty, for about fourteen hundred fields. That way of working brings obviously about overloaded maps.

The map is important because it shows each field in its proper position and thus serve as an index to the land. It is therefore desirable that it is sufficiently accurate to enable the area of each field to be calculated from it.

To each map corresponds a kaksra, that is an index arranged in the descending order of field number. Its other main information are the khata number and name of the landholdert(s), allowing in this way to do a link with the jamabandi.

III.2.4.4. THE KAHSRA GIRDAWARI

During the crop season, the Patwari is required to physically inspect each field in his Patwari Circle - that is on average 4000 to 5000 fields to inspect !!! - and records in his diary the crops grown on it along with the area in which each crop is planed. This area is measured with the help of a chain of specified length.

After the crop season, the Patwari will fill in the kashra girdawari from his diary. This one is arranged in the descending order of field number given at the time of settlement and has besides the details pertaining to the landholder(s) repeated in it (name, caste, address, share).

The kaksra girdawari has two functions:

- fiscal function : on the basis of these records, the Circle Officer draws up regularly the new assessment of land revenue. In fact, the assessment of land revenue is not based only on land use, but also on the crops grown in each season [BAN,84]. This necessitates thus a continous detailed record of crop.

² Note : the usual scale is: sixteen inches = one mile; but in some places the fields are so small that it has been necessary to map considerable areas on a much larger scale. In some cases sixty four inches to the mile.

- statistical function : the agricultural planning of the country are prepared on the basis of the exspected yield and exspected production statements.

FIELD No	KHATA	NAME-CASTE ADDRESS-SHARE	AREA	EXSPECTED YIELD
7	15	BHATT Bidyut, Brahman DUNGERPUR, 1/2	0.5	200 KG OF WHEAT
.		BHATT Rajid, Brahman DUNGERPUR, 1/2		
9	17	BATHNAGAR CD, Sunias DARBAN, 1/1	2.5	400 KG OF PATATOES
10	15	BHATT Bidyut, Brahman DUNGERPUR, 1/2	1.2	500 KG OF SOJA
.		BHATT Rajid, Brahman DUNGERPUR, 1/2		

FIG III.5.: THE KASHRA GIRDAWARI

III.2.4.5. OTHER BOOKS

In order to be exhaustive, let us quote two significant books :

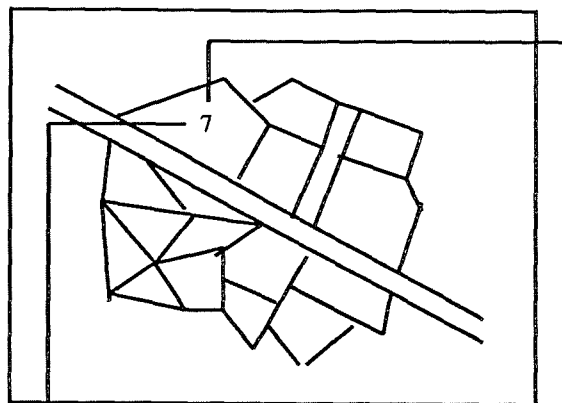
- the kahsra parvarthanseel : it records the unauthorized cultivation on the Government lands.
- the demand / collection / receipt books : they are associated with the land revenue collection.

III.2.4.6. A GENERAL VIEW

The figure III.6. shows the different links existing among the documents presented above.

III.2.5 THE GENERAL LAND RECORD SYSTEM

In the previous sections, the organization, the staff and the material of the Revenue Department have been developed. We can thus now present the general system in which they are inserted. That will be done in examining one by one the main procedures that occur normally within the framework of land record system. There are the time of settlement, the rewriting of jamabandi, the mutation procedure, the assessment and collection of land revenue, and the inquiry of land records.



MAP

JAMABANDI

VILLAGE NAME :		TAHSIL NAME :		PATWARI CIRCLE NAME :			
DISTRICT NAME :		STATE :		YEAR : 2042 - 2045			
KHATA No	NAME - HUSBAND NAME ADDRESS - CASTE - SHARE	PLOT No	AREA	TYPE	IRRI. SOURCE	TAX/Ha	AMOUNT
15	BHATT	7	2.5				

INHERITED
MUT No 1

FIELD No	KHATA	NAME-CASTE ADDRESS-SHARE	AREA	EXSPECTED YIELD
7	15	BHATT Bidyut, Brahman DUNGERPUR, 1/2	0.5	200 KG OF WHEAT
		BHATT Rajid, Brahman DUNGERPUR, 1/2		
9	17	BATHNAGAR CD,Sunias DARBAN, 1/1	2.5	400 KG OF PATATOES
10	15	BHATT Bidyut, Brahman DUNGERPUR, 1/2	1.2	500 KG OF SOJA
		BHATT Rajid, Brahman DUNGERPUR, 1/2		

KASHRA GIRDAWARI

KASHRA

PLOT No	AREA	KHATA	NAME
7	2.5	15	BHATT

MUTATION REGISTER

VILLAGE NAME : DARRAN		TAHSIL NAME : RAJKOT		PATWARI CIRCLE NAME : XXXX													
DISTRICT NAME : DUNGERPUR		STATE : RAJASTHAN		YEAR : 2042 - 2045													
Mutat No	Khata No	Name-Husband-Caste Address-share	Plot No	Area	Type	Irrig source	Tax/Ha	Amount	Mutat No	Khata No	Name-Husband-Caste Address-share	Plot No	Area	Type	Irrig source	Tax/Ha	Amount
1	15	BHATT Chetan, Brahman, DUNGERPUR, 1/1	7	0.5	IA	Well	15	7.5	1	15	BHATT Bidyut, Brahman DUNGERPUR, 1/2	7	0.5	IA	Well	15	7.5
			10	1.2	IB	Pump	12	14.4				10	1.2	IB	Pump	12	14.4
			14	0.3	IB	Rain	20	3				14	0.3	IB	Rain	20	3
2	17	BATHNAGAR CD,Sunias DARBAN, 1/1	9	2.5	IIA	No	0.5	1.25	2	17	BATHNAGAR CD,Sunias DARBAN, 1/1	9	2.5	IB	Pump	12	25

FIGURE III.6: A GENERAL VIEW

III.2.5.1. THE TIME OF SETTLEMENT

Once every twenty years, the land settlement task is carried out for each village. It is the time of settlement, i.e. the time of a complete system review. It involves the survey of fields, the preparation of new village maps, the writing of the jamabandi afresh.

Carrying out such tasks requires obviously the presence of all the Revenue Department employees (from the Collector to the Patwari) and the documents that they use, but also the presence of the Survey's scientific staff and Settlement Departments.

The land settlement results are otherwise:

- for each village : a new jamabandi and a new map;
- for each district : new tables of land revenue rates.

Because of the hugeness of the task and the poor availability of the staff and the resources, this work is done at much longer intervals than twenty years. The last land settlement was in 1958.

III.2.5.2. THE REWRITING OF JAMABANDI

The jamabandi is a dynamic register taking the changes occurring in the ownership of land into account. It becomes therefore quickly an annotated version of itself. That is why the jamabandi is rewritten every four years in two copies by the Patwari, one for him and one for the Tahsildar. The latter rewrites the new jamabandi on the basis of the former jamabandi and its relative mutation register.

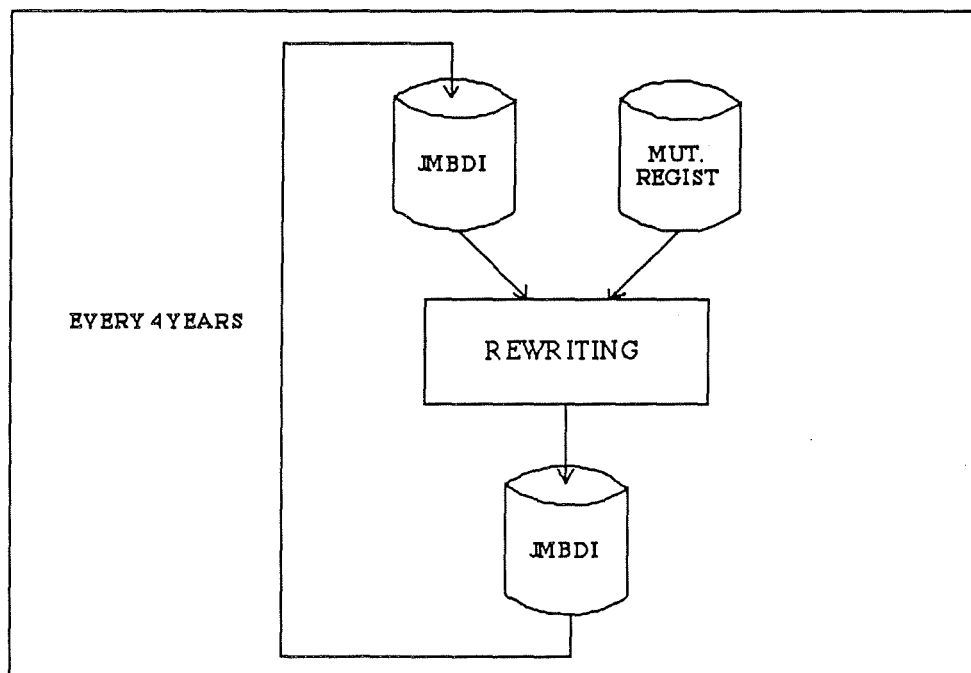


FIGURE III.7. : THE REWRITING OF JAMABANDI

At the land settlement time, this figure changes and becomes the figure III.8.

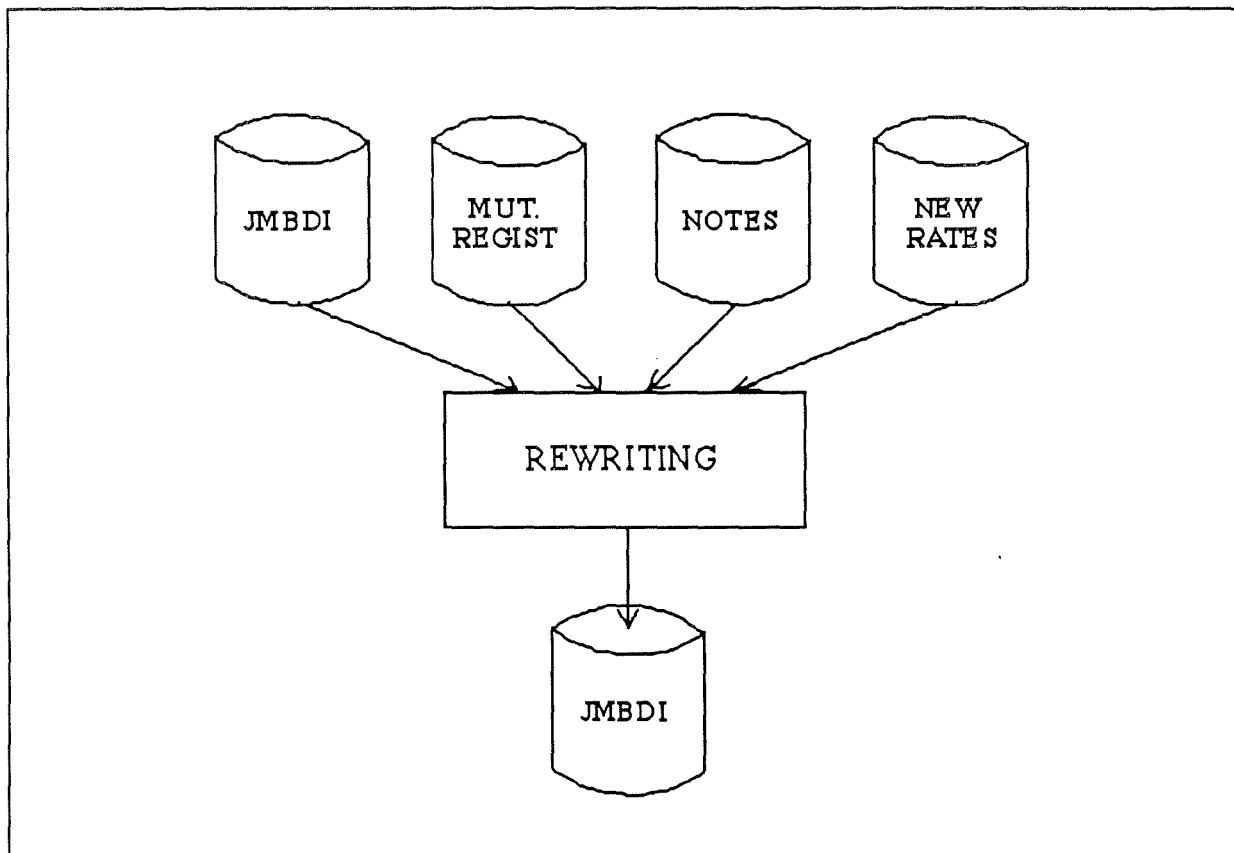


FIGURE III.8. : REWRITING OF JAMABANDI AT SETTLEMENT TIME

III. 2.5.3. THE MUTATION PROCEDURE

A mutation may be briefly defined as a change occurring in the holding of land or in its nature³. Thus, for instance, the sale of a field or the change of land quality as a result of the building of a well are regarded as mutations.

The mutation procedure is a fairly complex procedure. Here are the main stages :

1. The landholder appeals to the Patwari for mutation.
2. The Patwari listens both parties in case of simple mutation or else visits the site in order to check the facts.
If it is necessary, he draws a sketch.
He may then claim to the landholder all documentary proofs. For instance, the birth certificate in case of inheritance.

³ Note : a complete definition is given in the section V .

3. He writes then in the jamabandi with red ink a mutation reference number. This shows that this account must be mutated.
4. He fills in the mutation register, left and right parts, with the correct datas.
5. At the end of the month, he goes with the jamabandi, the mutation register and the sketches to the Circle Inspector office. The latter checks then the accuracy of mutations. For that, he may sometimes decide to go on the spot.
6. Once the checking over, the Circle Officer puts checking marks and stamps in the mutation register and notes in his administrative diary the main features of performed mutations.
7. The records (jamabandi and mutation register) are sent to the tahsildar for final decision. If this one agrees, he signs the documents, or else he asks for more information.
8. In similar way, the jamabandi and the signed mutation register are sent back to the Patwari by a Circle Inspector.
9. In his office, the Patwari writes the main mutation features with red ink in the remark column of jamabandi: the date, the names of parties and the kind of mutation. On the other hand, he updates the maps through the mean of a sketch.
10. Finally, from the updated mutation register and jamabandi, the Patwari prepares copies that will be given to each party. He will collect then mutation fees which will be brought to Kanungo.

The time which elapses from the beginning to the end of the procedure is on average fifteen to twenty days, but may reach one month.

III.2.5.4. THE ASSESSMENT AND COLLECTION OF LAND REVENUE

To understand clearly the assessment of land revenue, it is necessary to specify what are the permanent and temporary settlement and the fluctuating assessment.

The permanent settlement is characterized by a fixed in eternity assessment. It remains today only few areas in which the assessment is permanently fixed. These ones are mainly located in Bengal.

On the contrary, the temporary settled areas are those in which the assessment is fixed for a period of years only (twenty to thirty years). They represent the big majority of Indian areas. Their case has been discussed in the section III.2.5.2. .

Two major results of temporary settlement are the creation of a new jamabandi and new fixed revenue rate table for each village. It could therefore be possible from the details registered in jamabandi (cultivator's name, area

and land class) to frame the revenue amount having to be levied on each khata. But in reality it doesn't work like that. The process of revenue assessing is more complex. In fact, armed with the kaksra girdawari, namely an estimation of future crops, the fixed rate tables, statistics and rules, the Circle Inspector estimates for each one the amount of his/her land revenue. His estimation consists mainly of the evaluation of net produce (or net assets), i.e. the difference between the assumed value of the gross produce and a very liberal estimate of the expenses incurred in raising and disposing of the crop.

Once this work completed, the Inspector produces a report that will follow the usual hierarchical line to come finally in the hands of the Collector who will take the final decision. This process is known as the fluctuating assessment [ROY,88]. It takes thus the form of acreage rates estimated from the combination of the rates fixed at the time of settlement and the estimation of future yields.

Owing partly to the prevailing lack of capital among the agricultural population, the land revenue is generally recovered not by a single annual payment, but in instalments, the dates and amounts of which are fixed to meet local circumstances.

The revenue is levied by means of a cash demand on each khata. However as said above, a khata may be owned by a single proprietor or by a proprietary body of co-sharers; in that case, every co-proprietor is jointly responsible for payment of the revenue. Now, the land revenue amounts to less than one seventh of the net produce.

III.2.5.5. THE INQUIRY OF LAND RECORDS

There are some reasons for which a private landholder or the Government may claim a copy of their land records:

- a landholder requires usually his/her certificate:
 - > to get a loan from a bank. For that, he will have sometimes to mortgage his lands.
 - > to have a proof of his ownership in case of dispute or litigation.
- the Government needs otherwise a copy of land records [BHA,89] :
 - > at the time of an irrigation or reforestation scheme.
 - > to implement the agrarian reforms.
 - > to lead some land development schemes, like for instance the distribution of granes to little and marginal farmers⁴.

⁴ Note : the little and marginal farmers are those who own less than two hectares of land

III.2.6. A ENTITY-RELATIONSHIP DIAGRAM

The figure III.9. shows the entity-relationship diagram of the land records just as they have been explained in the previous sections.

III.2.7. PRESENT STATUS OF LAND RECORDS IN LAND

According to D.C. Wadhwa [WAD,89], " as regards the present status of Records-of-Rights⁵ in land, studies in all states are going to ascertain the same (...). The preliminary investigation, however, have revealed that in all parts of the country, records relating to land are in a very bad shape(...). Millions of cases of mutations and measurment are pending in the country. Apart from this, there are many more other cases in which the Government, the public bodies and the private persons in whose names the lands stand in the Records-of-Rights in land are not in possession of those lands. On the other hand, the names of the persons who possess those lands do not exist in the Records-of-Rights in land. Such disharmony between the record - which thus becomes a negative defect - but also misleads any persons who has to deal with the land. This is obviously unfortunate because of the importance of land economically, socially and emotiannaly. No wonder, this unhappy situation has led to incessant litigation and the clogging of the judicial machinery in the country."

Although it will be detailed later, it is already possible to give some reasons which explain the present status of land records.

First, the duties of Patwari are too heavy for a single person. That generates many delays and explains why the Patwari cannot maintain a high degree of accuracy and reliability in his work. It may therefore happen that he forgets to note a mutation which has been pointed out, or that he does not have time enough to survey the fields, to place limitation marks,etc.

Secondly, the changes which occur in the ownership of the lands may not be known by the Patwari because the holder has sold his field(s) orally. In the Indian culture the sales done by word of mouth are common. They allow the cultivators to avoid the expensive and long administrative procedures. This way of doing generates regularly litigations and violent disputes among the peasants.

Thirdly, there is a lack of coordination between the judicial system and the land revenue system. In fact, let us assume anyone selling his field to another one. Agreeing together over the field price, they both decide to appeal to a solicitor in order to draw up and pass a sale certificate. It may then happen two things: either the holders inform the Patwari over the change of ownership or they do not. But the solicitor will never do that. Several legal changes are therefore unknown to the Land Revenue Department.

⁵ Note : Record-of-Rights = Jamabandi

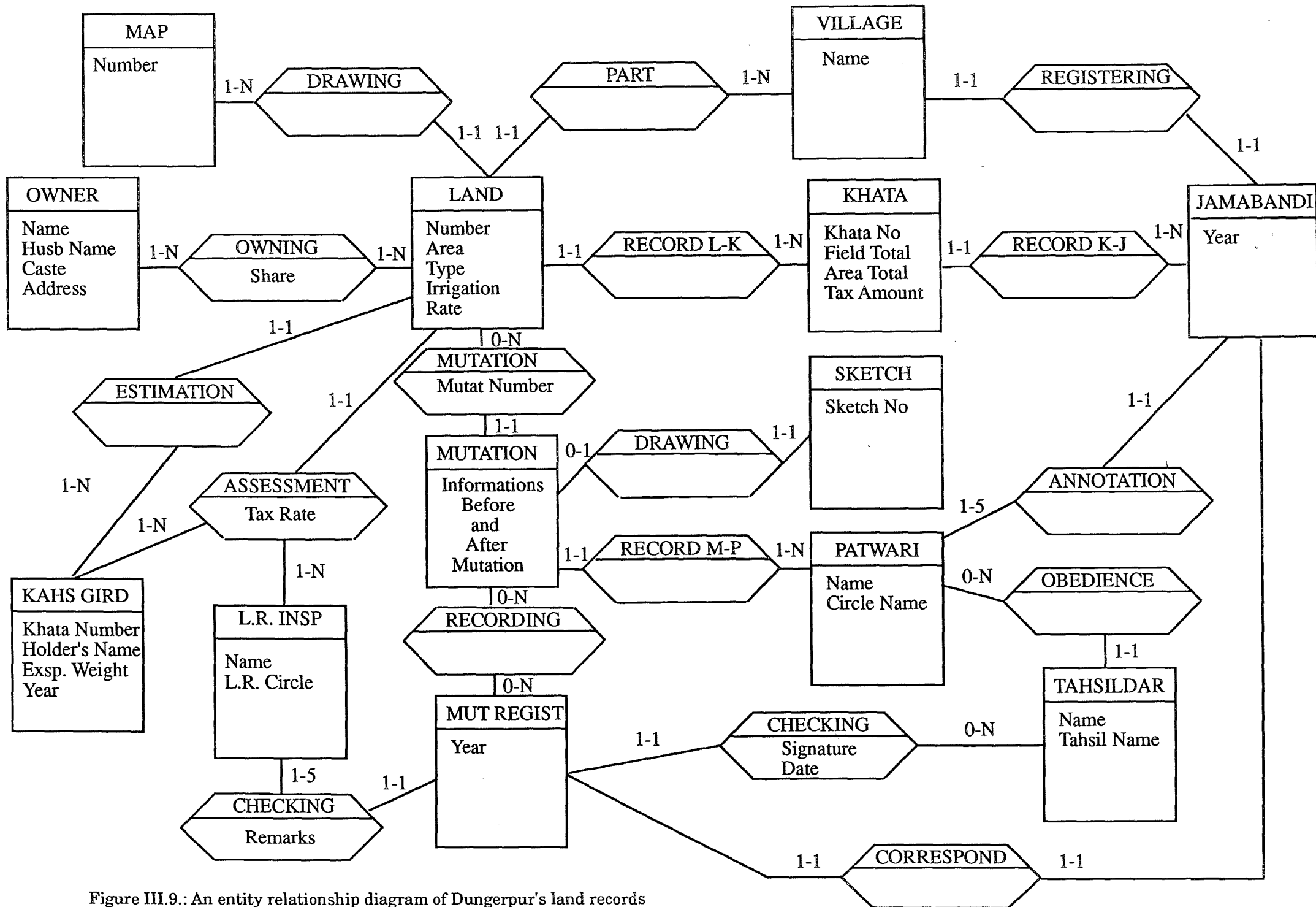


Figure III.9.: An entity relationship diagram of Dungerpur's land records

III.3. CONCLUSION

The major land records are the jamabandi, the mutation register, the maps and the kahasra girdawari. Introduced three centuries ago, they are always used and maintained by the Revenue Department although additional tasks of development (social welfare, census work, etc) were handed over to it after the independence.

These additional tasks are an increase in work for the Patwari, the key element in the chain of functionaries. It is therefore quite likely that he may not maintain a high degree of accuracy and reliability in his work. This is not to presume that the other parts of the system are not overburdened, but to underline that the Patwari originates all the procedures (III.2.5.); the other officials merely supervise, verify, approve, finalize and collate his work, these being activities wherein short cut methods may be applied. The quality of information thus suffers further as it is transmitted up to the hierarchical pyramid.

Like in Belgium, the first function of land records is fiscal. So, through the mean of the Revenue Department, the State levies the estimated land revenue of each landholder. However, contrary to the Belgian's one, the Indian cadastral system has also a legal function. In fact, with the time, the land records have come to form of sole proof of asset ownership for the agricultural population [RAO,89] . Today, on account of the huge delays of maintenance and the numerous errors (often inequitous) in the land records, these two functions are less and less applied. In fact, on the one hand, the total of land revenue amounts to less than three per cent of the Indian national revenue, on the other hand, the judicial system refuses to accept the land records as legal proofs [WAD,89].

Undoubtedly, it may occur that the system must thus evolve to provide an information secure, accurate and readily accessible.

IV AN OPPORTUNITY STUDY OF THE DUNGERPUR'S PROJECT

IV.1. INTRODUCTION

This chapter aims to present the opportunity study of the Dunderpur's project. It has mainly been elaborated from the principles and advices given by Bodart and Pigneur [BOD,89].

After a brief recall of the general structure of an opportunity study, each stage of the latter is stated within the framework of the Dunderpur's project.

IV.2. OPPORTUNITY STUDY : REMINDERS

An opportunity study aims to elaborate a project of solution from a thorough examination of expressed needs. That involves the research of the real reasons and insatisfactions that urge the officials to formulate new objectives and the way to resolve them.

An opportunity study is composed of several elementary stages (figure IV.1). One distinguishes two kinds of elementary stage: the **technical stages** and the **checking stages**. The technical stages are the different stages of opportunity study conception, whereas the checking stages are the stages during which the responsible members check the accuracy of the work carried out at the time of the previous technical stages.

On account of the few time I have spent at IIM, it has not been possible for me to elaborate there each one of the opportunity study steps in detail. This study bases itself on many long talks that I had with the responsible members of IIM, Mr Bathnagar and Mr Bhatt, as well as on some documents they provided me. However, our discussions bore essentially on the framework program and the critical study of the existing, namely the first part of the figure IV.1, and never on the elaboration of solutions, the second part of the figure. That is why it looks preferable to suppress the checking stage of the recommended solution, and obviously the one which checks the opportunity study in its entirety.

The withdrawal of these two checking points is acceptable for two reasons:

1. Since the IIMA has not thought about any solution yet, one of the goals of this dissertation is to propose some solutions.

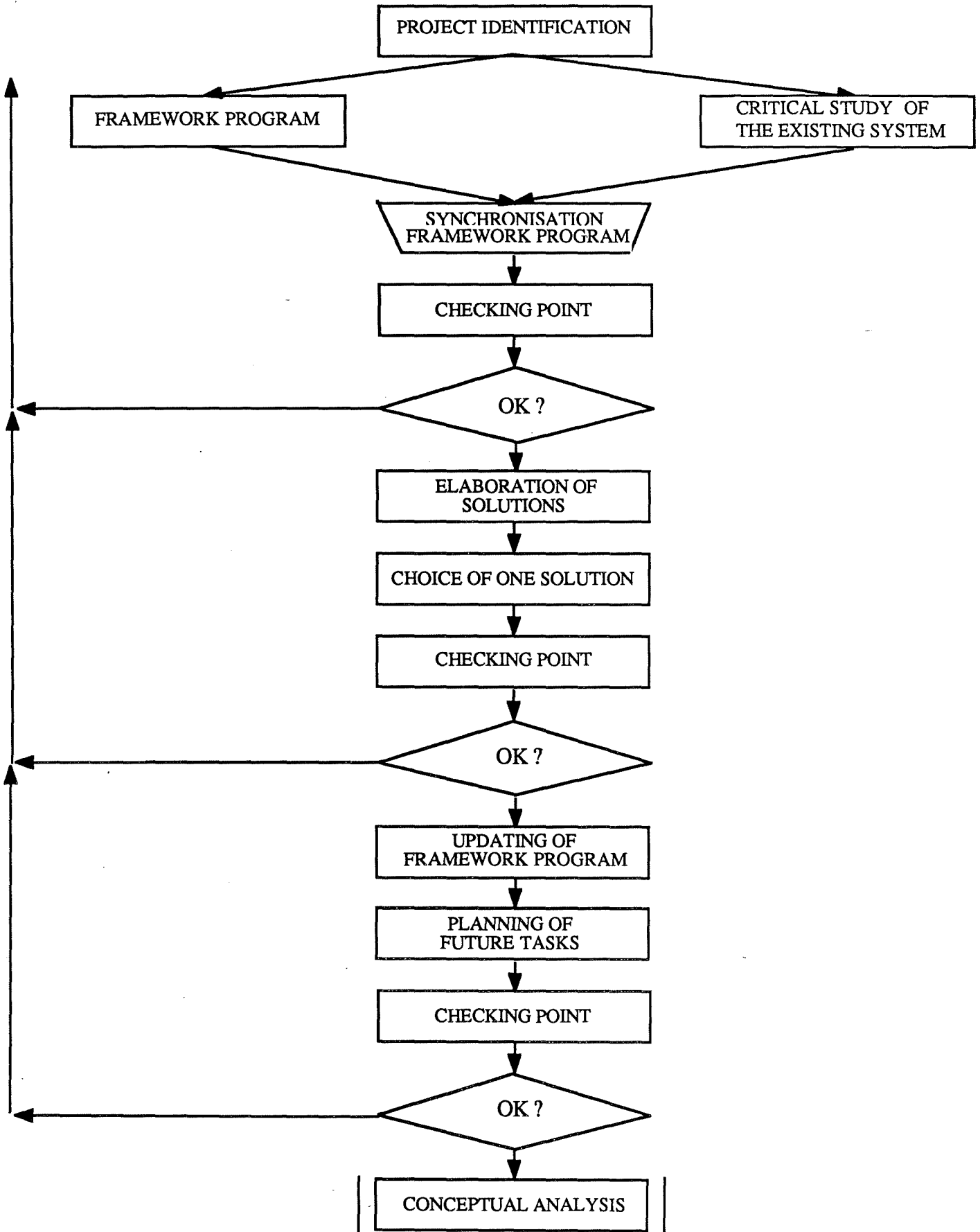


FIGURE IV.1 : A CLASSICAL OPPORTUNITY STUDY

2. It is in agreement with the IIM's philosophy. In fact, their approach is mainly centred on the contentment of the user, who becomes by that fact the real "checker" of the proposed solution.

It appears thus already that the recommended solution will have to be in one hand enough "general" and "modifiable" in order to be able to answer to all the expectations of the officials and users - and so to their possible wishes of modification -, and on the other hand sufficiently concrete to correspond with the reality and to be implemented. It is in this perspective that the usual process following the opportunity, namely the functional analysis, will be reviewed in the chapter V. As we will see then, the functional analysis will be replaced by an evolving approach in which the planning, of tasks will be specified. The functional analysis box may therefore be taken off from the initial figure and replaced by the 'evolving approach' box.

The diagram, resulting of these precisions, is represented by the figure IV.2. The study is made from the structure of this figure.

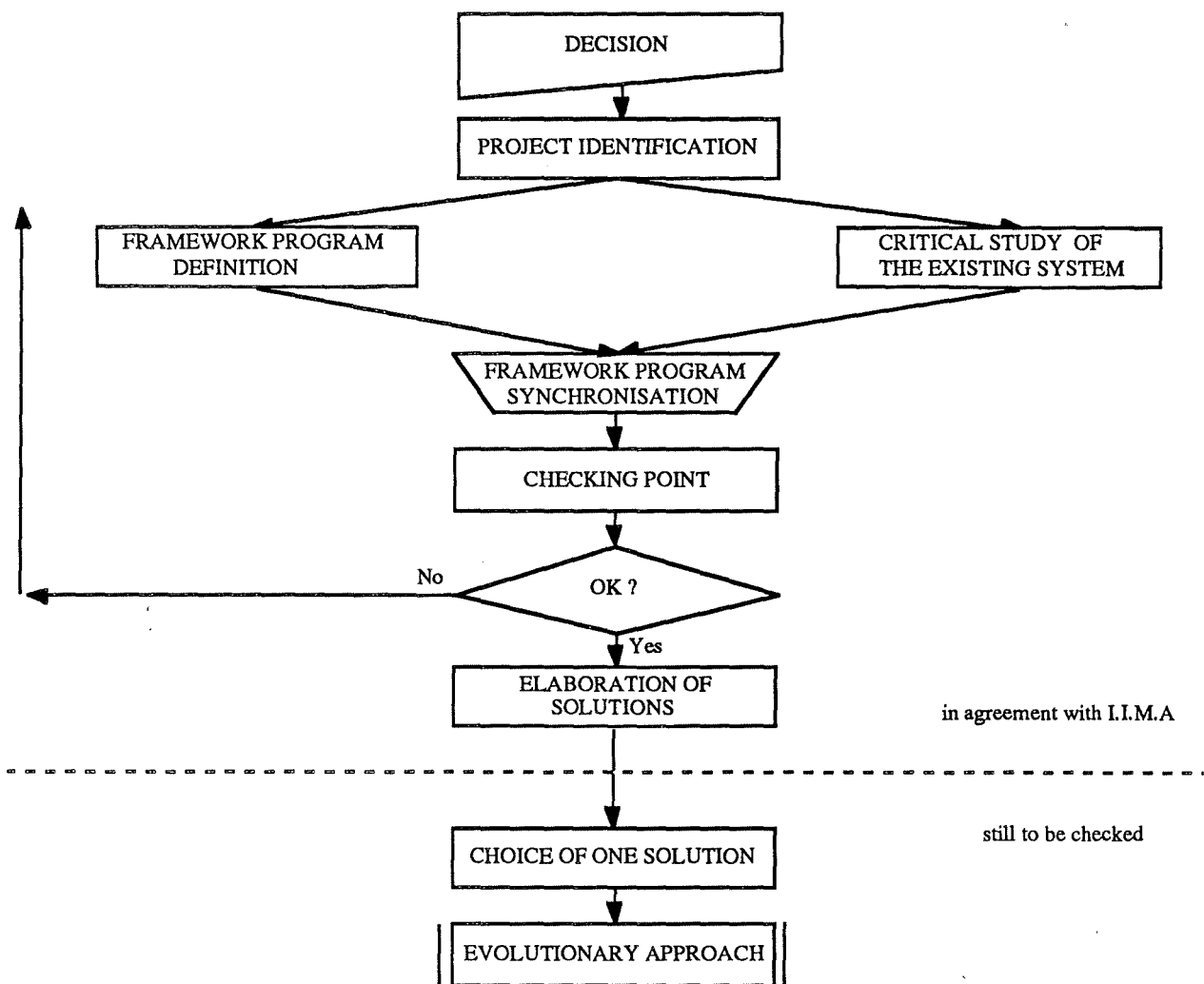


FIGURE IV.2: STAGES OF DUNGERPUR'S OPPORTUNITY STUDY

IV.3. THE ELEMENTARY STAGES OF THE OPPORTUNITY STUDY

Each elementary stage is presented according to the following standard framework :

- Definition and objectives.
- Presentation of the content of the most important objectives within the scope of Dunderpur's project.

IV.3.1. DECISION

IV.3.1.1. DEFINITION AND OBJECTIVES

The first stage of any opportunity study is the decision, taken by an official, of developing a new information system. The goal is simple : to improve the information system if this one exists or else to create it. In Dunderpur's case, the information system to improve is the land records Information System.

IV.3.1.2. IMPROVEMENT OF LAND RECORDS

Originally, in 1981, the Central Government of India, feeling the need of reviewing the entirety of its land record system, decided to launch a pilot project of computerization of the Bikaner's¹ land records.

Despite some shortcomings, the Bikaner's experiment was a convincing demonstration that it is feasible to computerize the revenue records with tangible benefits. So at the time of the Workshop of Revenue Secretaries of all States convened by the Department of Rural Development, Ministry of Agriculture, at New Delhi on 27th August 1987, it was decided to select five or six districts in the country to launch the same pilot project again. The Dunderpur's project was approved in October '88. A grant of 2,500,000 Rupees was then made available for each one by the Central Government.

Its collector and magistrate is Mr Anirudh Khrisna. He can be regarded as the project initiator. Let us note that he was the former Collector who conducted the Bikaner's experiment [RAO,89].

IV.3.2. THE PROJECT IDENTIFICATION

IV.3.2.1. DEFINITION AND OBJECTIVES

This stage aims to identify the project according to different axes. There are, among other things, the localisation of the project within its organizational context and the general environment, the delimitation of the project, the

¹Note : Bikaner is a district of Rajasthan

specification of the main operations, the detection of insatisfaction causes and the general objectives.

This stage describes the project only roughly. More details are given below in the study of the existing and the framework program definition.

IV.3.2.2. THE ORGANIZATIONAL CONTEXT

Dungerpur is a district of Rajasthan State. Its area amounts to 3,752.8 square kilometers. Its population is mainly rural. In 1986, 638,719 peasants (310,724 males and 327,995 females) lived in the country. That means today about 700,000 are living in the 856 villages that make up the district. 150,000 cultivators share the 168,000 hectares of the cropped area, distributed in more than 1,000,000. Since for each plot there is one record, the total of records amounts therefore to more than 1,000,000 plots. The village average is of 500 to 2000 inhabitants among whom 150-200 are registered as holders. That brings about an average operational size of 1.47 hectare per holder.

Let us point out at last that the electrical network is large, making easier the introduction of computers on the site.

The Dungerpur's administrative headquarter is located in the town of Dungerpur itself. That is where Mr Anirudh Khrisna, Collector and Magistrate, resides. He has under his responsibility 2 Sub-District Officers, 4 Tashildars, 33 Circle Inspectors and 210 Patwaris.

The administrative system is there obviously bureaucratic, but nevertheless well managed. And in particular, it seems that contrary to many places in India [III.2.7], the land records are regularly maintained.

Like everywhere in India, the Patwari is overburned. In fact there are 210 Patwaris for a total of 856 villages. That means therefore that one Patwari has to deal with the land records of 4 villages, i.e. 4000 to 5000 plots or records.

IV.3.2.3. THE GENERAL ENVIRONMENT

As it is well shown in the diamond of Leavitt [LEA,65], the environment is an important element to consider in a context of organizational change. Therefore let us examine the main features of Dungerpur's environment which play a decisive role in the introduction of computers.

1. **The climate** : it is tropical, requiring therefore the building of air-conditioned computer rooms. In case of calamity (flood/drought) the calculation of land revenue is entirely revised.
2. **The electrical and phone networks** are rudimentary and not very large. That implies thus:
 - a reflexion at the time of software development, in order to fight efficiently the power cuts.
 - that it is currently impossible to use a data communication network.

3. **The language** : the records are maintained in the written form in vernacular, i.e. in Hindi at Dungerpur District. It is the only language known by Patwaris. The outputs of interactive softwares must therefore be in Hindi and not in English.
4. **The slowness** : it is present everywhere. For instance, to get information, logicials, materials, etc. or to deal a problem. Obviously, the bureaucratic organizational context emphasizes this defect.
5. **The lack of precision** : often the information is inaccurate or incomplete. Thus, for instance, the information registered in jamabandi is not upto date, an exhaustive list of mutation cases does not exist (more in chapter V).
6. **The administrative system** (see [III.2.2.]), two major implications have to be considered :
 - the bad quality of datas, due to huge delays of maintenance and the Patwari corruption. It is advisable therefore to think how to resolve the problem of "Garbage in-Garbage out";
 - the Patwaris accept currently the computers only by obedience. It is necessary that this feeling changes into a voluntary involvment in the computerization process.
7. **The economic resources** : as in every developing country, the economic resources are small and limited. This limitation has consequences :
 - on the choice of the hardware and software;
 - on the number of the analysts and programmers;
 - on the formation of the employees.
8. **A distrustful population**, culturally inclined to conservatism : the introduction of computers will undoubtedly disturb the employees. That is why they have to receive sufficient time and adequate formation to get accustomed to the use of computers and the modifications which they involve in the work. In a first stage, it would be wishful that the computerization does not modify the current procedures, but automates only the manual work. Moreover, very ergonomic interactive applications need to be developed.

IV.3.2.4. DETECTION OF INSATISFACTION CAUSES.

In order to find out the real causes of insatisfaction, the main deficiencies are located. We will distinguish two kinds of deficiency : **the operational deficiencies** and **the organizational deficiencies**.

The operational deficiencies are underlined within the procedures explained above [III.2.5.] :

- The last settlement dates from 1958. Ever since, the datas have not been reviewed [III.2.5.1.];
- The jamabandi rewriting in two copies is a long and tiresome process [III.2.5.2.] occasioning errors and delays;

- Many mutations are pending [III.2.5.3.];
- Many registered mutations are erroneous because of lack of appropriate checkings [III.2.5.3.];
- The inspection of each field (4000 - 5000) by the Patwari during each crop season is a heavy work, almost impossible to carry out physically. That generates errors at the time of land revenue assessment.

The organizational deficiencies are :

- A lack of checkings. A better checking of Patwari's work would allow to avoid many errors wilful or otherwise;
- A bureautic organization occasionning huge delays and lack of flexibility.

IV.3.2.5. THE GENERAL OBJECTIVES

The two general objectives of the Government are the complete review of land record systems and the integration of computers within the procedures. In this case the land record system represents more than the cadastral system.

These two objectives will try to remove the above deficiencies in focusing on:

- Time saving,
- Improvement of work qualities,
- Improvement of land records availability,
- Improvement of land records quality.

IV.3.2.6. THE DELIMITATION OF THE PROJECT

The general project bears on the land records in their entirety [II.2.1.]. However, it is obviously impossible to deal with project of such scale. That is why the project is limited to the cadastral system.

If we define the frontiers of the project by considering the management activities, the project is delimited by :

- the management of jamabandi;
- the processing of mutation;
- the management of maps and kashras;
- the land revenue assessment.

IV.3.2.7. A FIRST STRUCTURATION

So defined and delimited, the Dungerpur's project can be splitted in "applications", namely in almost autonomous processings [BOD,89]. These applications are :

- **Data entry application** : this graphical application tends to allow the entry of the jamabandi datas through the mean of a Hindi keyboard, and to generate as result a usable data base.
- **Enquiry application** : it allows the questioning the data base. The search may be performed at the same time on the combination of some fields. Result can be printed as well.
- **Mutation updating application** : it allows the updating of the land records data base from mutations recorded by the Patwari each month. Depending on the chosen solution, the output will be the printing either of a new jamabandi page or of a mutation page. Several mutations are accompanied by an updating of the involved map. That would perhaps be automated. These problem is however complex to deal. At the moment, it would be advisable to create just a sketch number that would be linked to the sketch of the mutation.
Finally, a recapitulative mutation report will be printed . It will allow the Tahsildar to check quickly the passed mutations.
- **Revenue collection application** : that application aims to help the employees at the time of land revenue assessment. It gets as inputs, the kahsra girdawari datas and the rate table and provides as output the land tax of each landholder.

IV.3.3. A CRITICAL STUDY OF THE EXISTING SYSTEM

IV.3.3.1. DEFINITION AND OBJECTIVES

The role of this stage is to present the existing system and to show where it is deficient and where it can be improved in order to fulfill the general objectives.

First, the data flow diagram [BOD,89] of each procedure of the existing system [II.2.5.] are drawn. Next, the critical study is set out.

IV.3.3.2. THE FLOW DIAGRAM OF THE MUTATION PROCEDURE

The figure IV.3. presents the flow diagram of the mutation procedure. Some details are given to explain this latter.

• MUTATION PROCESSING :

- the Patwari can register the mutation;
- the Patwari must go in other offices to get documents;
- the Patwari goes on the spot to survey and collect information.

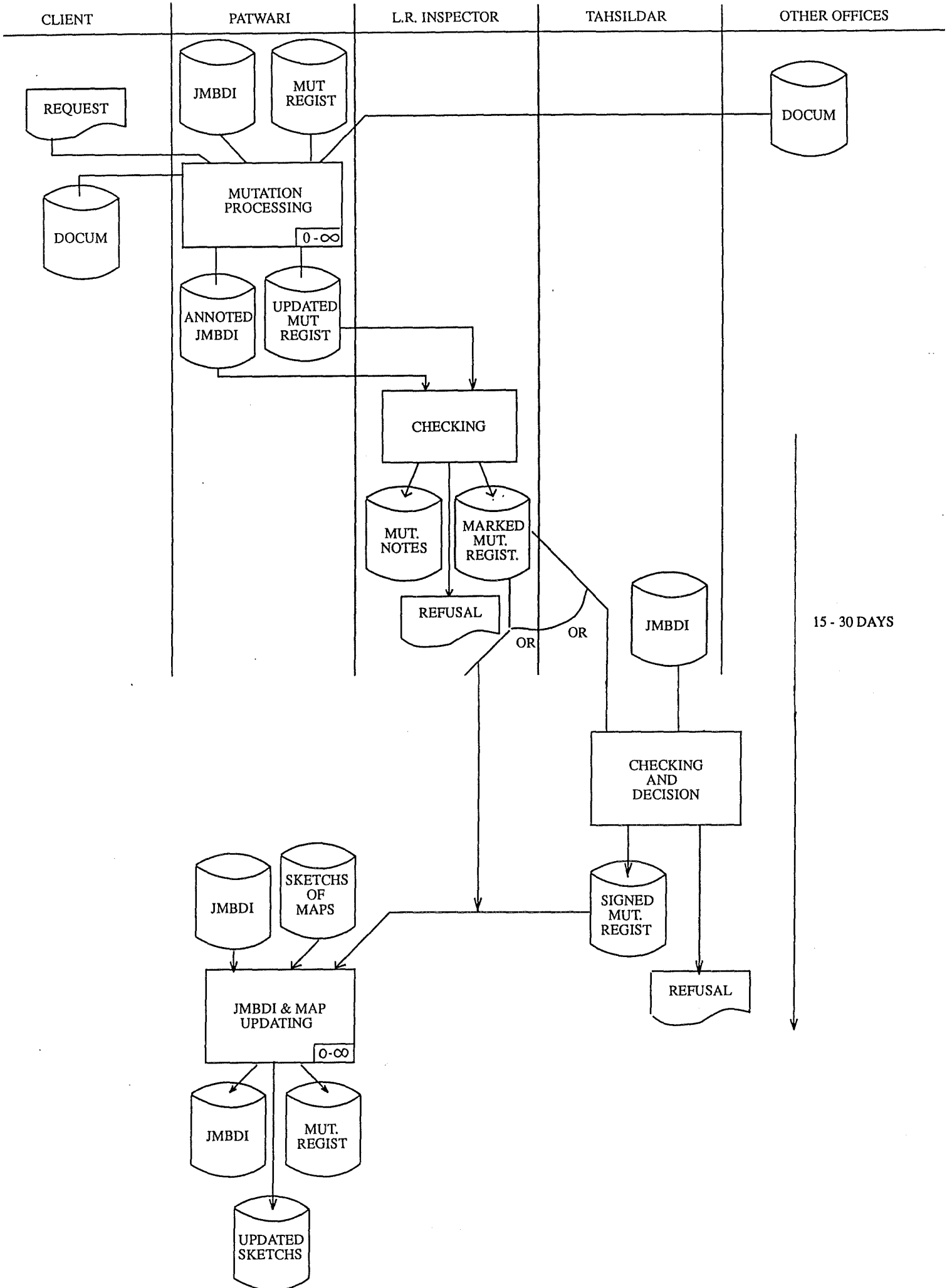


Fig IV.3. : Flow diagram of the mutation procedure

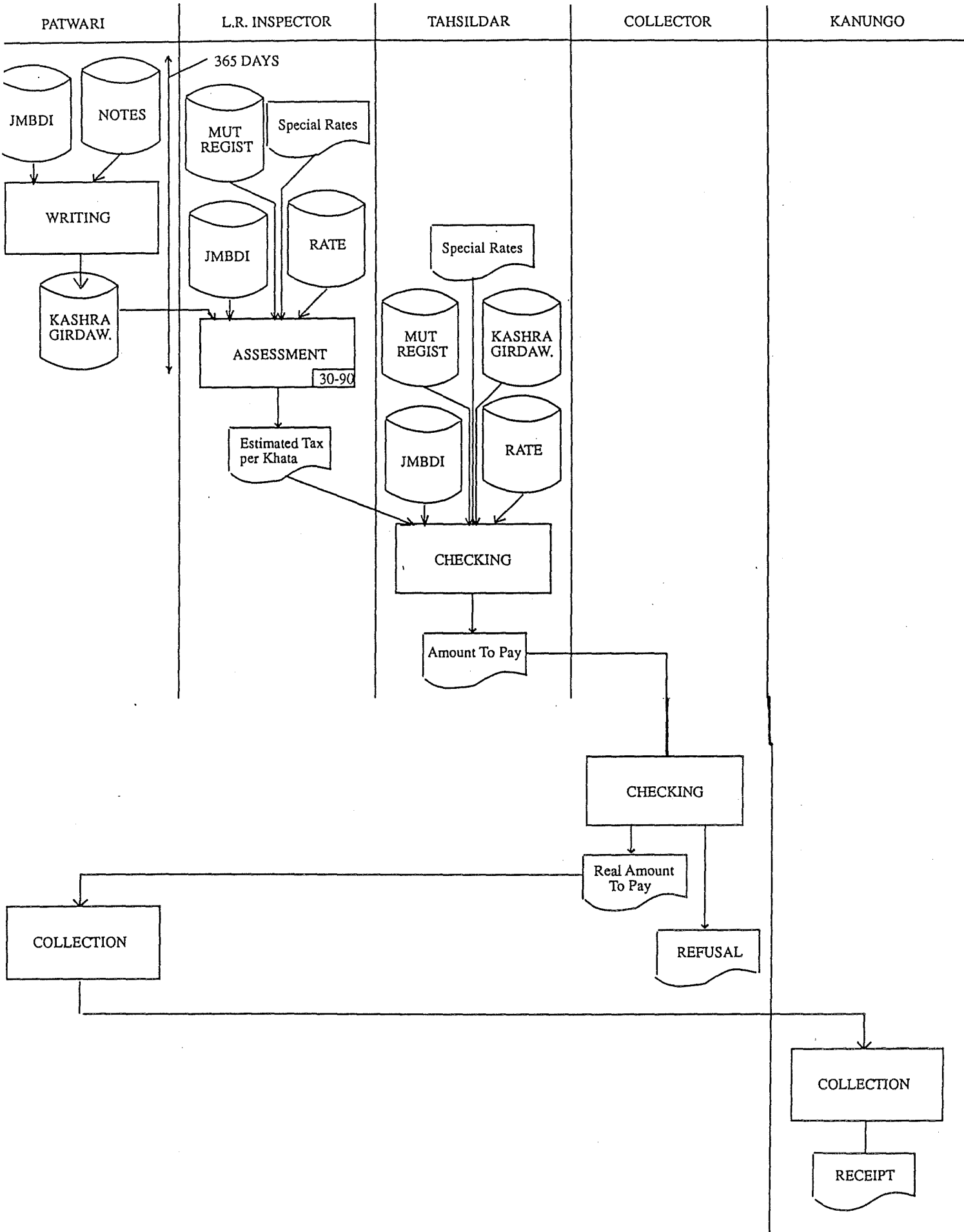


Fig IV.4. : Flow diagram of the jamabandi rewriting procedure

- CLIENT : may be a landholder, a bank or the State.
- CHECKING : the land records Inspector is supposed to check 50% of the mutations on the spot.
- OR : it may happen that the land records inspector that finds the passed mutations are simple and do not require the Tahsildar checking.

IV.3.3.3. THE FLOW DIAGRAM OF THE LAND REVENUE ASSESSMENT PROCEDURE

The figure IV.4. shows the flow diagram of the land revenue assessment procedure.

- SPECIAL RATES : these rates are applied in case of calamity (flood/drought, etc.).

IV.3.3.4. THE FLOW DIAGRAM OF THE JAMABANDI REWRITING PROCEDURE

The figure IV.5. shows the flow diagram of the jamabandi rewriting procedure.

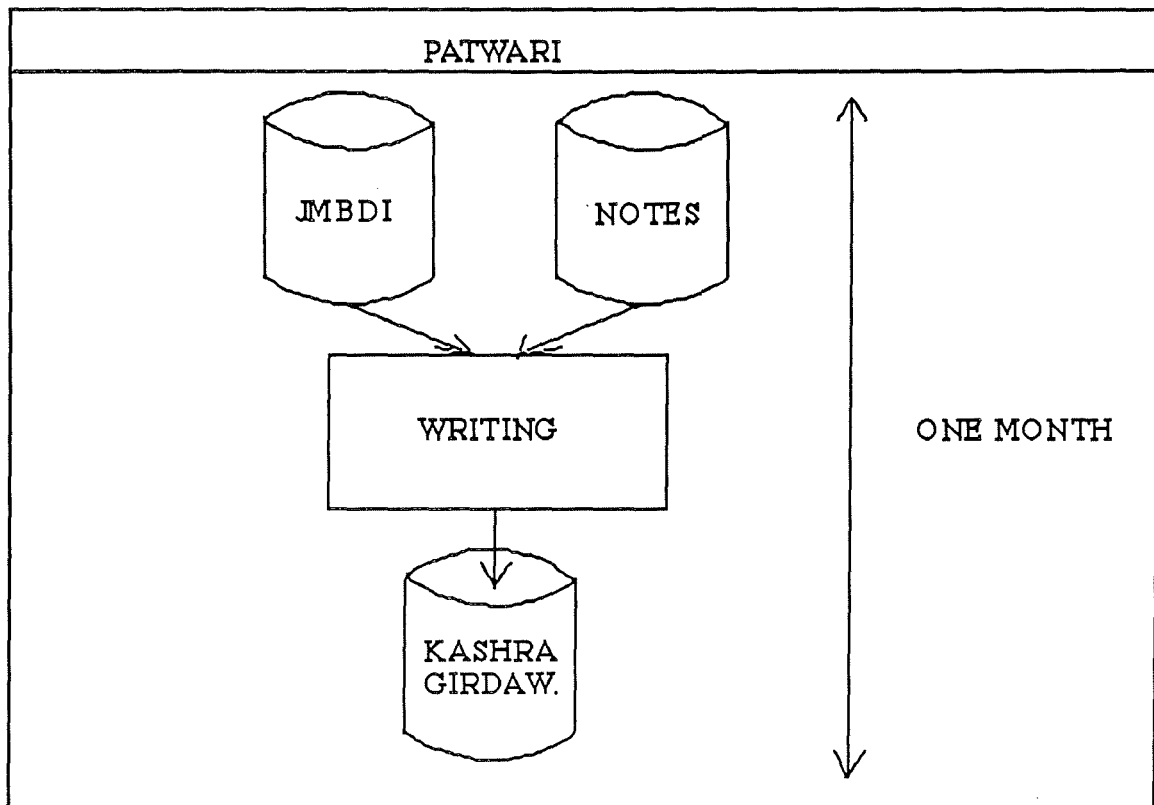


FIGURE IV.6.: FLOW DIAGRAM OF JAMABANDI REWRITING

IV.3.3.5. THE FLOW DIAGRAM OF THE INQUIRY PROCEDURE

The figure IV.6. shows the flow diagram of the inquiry procedure.

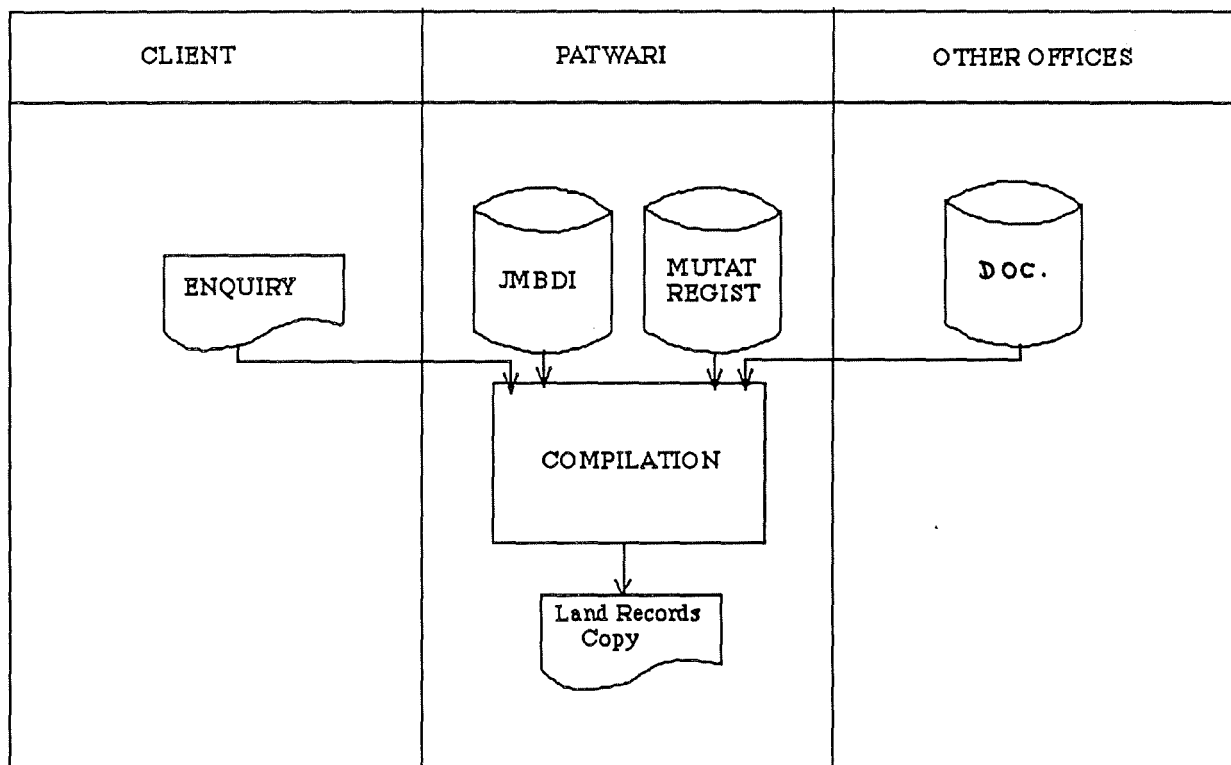


FIGURE III.6.: FLOW DIAGRAM OF INQUIRY PROCEDURE

IV.3.3.6. A CRITICAL APPROACH

The first deficiency, which is the real cause of land records inefficiency, is the presence of several delays. The delays are caused by :

- the extra work of Patwari,
- the long procedures of maintenance,
- a little lack of coordination among employees.

However, although these delays can be seen in the flow diagram, it appears that they do not depend on the way of processing procedures, but on persons. In fact, how could these processing be reduced in time ? There are a few answers. One of them would be to reduce the jamabandi rewriting period from four years to one. That would allow on the one hand to lose less time when a land record is searched. In fact the search of a land record may generate several readings in the Mutation Register. This solution increases on the other hand the work of Patwari.

Another way to reduce the length of procedures would be to remove a part of the numerous checkings. That stands however a good chance of decreasing the quality of datas.

Thus in reality, if land records are not updated, it is not because of a bad organization but because of the extra work demanded from a single person : the Patwari. That would not be so important if he was not the key link in the "procedure chain"; let us well understand that the first objective of computerization is not to modify deeply the system of procedures - although it will certainly do - because this one is defective, but to save time thanks to the processing speed of the computers.

If this first observation shows that the length of procedures is not caused by a defective system of procedures, it does no comment on the quality of the information to deal. A bad information quality may bring about the ineffectiveness of the best thought procedures. In our case, it is a real danger. One of the first works will be to secure a good information quality.

The true shortcoming of land records system is a lack of informational cohesion. Between two rewritings of the jamabandi, the land records are represented by two books : the jamabandi and the mutation register. For instance let us assume that Mr X owns some fields at the time of jamabandi rewriting. Some times later, Mr X dies. His three sons inherit the fields. The Patwari registers a mutation. Afterwards, the sons agree upon selling Mr Y one field. And the Patwari passes a new mutation. The landholders are thus the three sons and Mr Y. The jamabandi has been annotated two times.

Now if we look the information of the jamabandi we can notice that the part pertaining to the holder is obsolete. Mr X is no longer the holder. To find out this information, one needs to search in two different pages of mutation register.

This lack of informational cohesion has two consequences. First, it is seldom possible to have an accurate idea about a land record without examining the jamabandi and the mutation register in several places. Secondly this situation generates a waste of time when one works on land records.

If we look attentively the diagram, we can also observe that the datas presentation is problematic. In fact, the place in the remark column devoted to the recording of annotations pertaining to the mutations relative to Mr X fields is full. It often happens that the remark column is so loaded that it becomes unreadable. Moreover the quality of paper deteriorates very quickly due to repeated handlings and usage.

Lastly, a lack of coordination among employees may be mentioned. During the mutation checking time, the Patwari leaves the mutation register¹ in the Inspector or Tahsildar office. After some days, he will recover it, checked marked and signed. So, if during this time a mutation occurs, the Patwari deprived of mutations register will not be able to deal with it. It would therefore be advisable to review how to check the mutations in order to minimize a waste of time.

¹Note: He does not leave the jamabandi because the Tahsildar belongs the copy made at the rewriting time.

IV.3.4. THE FRAMEWORK PROGRAM

IV.3.4.1. DEFINITION

The goal of framework program is to describe the objectives and their degree of realization, the constraints, the expected efficiencies and the involved "phases". It is diagrammatically represented by the figure IV.7.

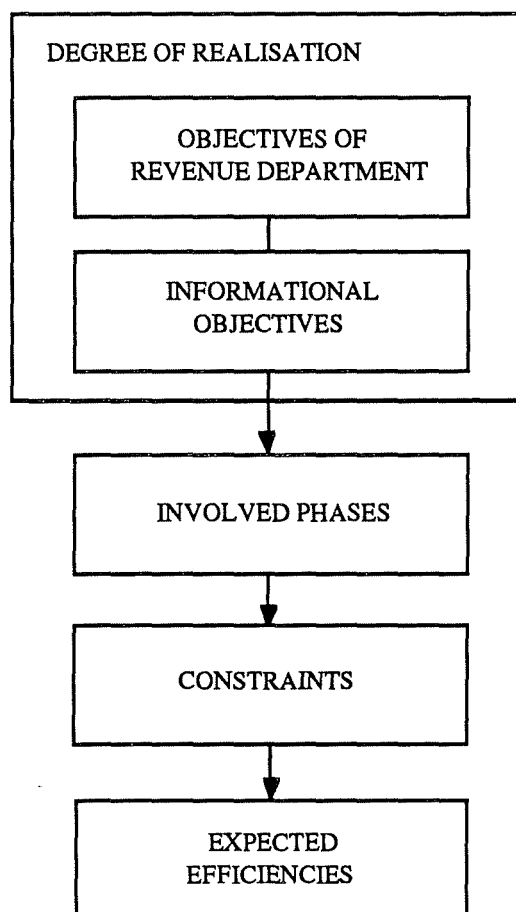


Figure IV.7.: The framework program stages

IV.3.4.2. THE OBJECTIVES

IV.3.4.2.1. THE OBJECTIVES OF THE REVENUE DEPARTMENT

The objectives presented in this section are those which have been expressed at the Dunderpur's Revenue Department Workshop on 25th July '89. Let us underline that all the employees, from Patwaris to Collector, have been there convened.

1. **Time saving** : the first objective of everyone is to decrease the time spent on long and tiresome office works. For instance, the rewriting of jamabandi or other information. It happens that sometimes, the Patwari rewrites up to seven times the same information. That time saving will allow employees to be closer to lands and mutations.

2. **Improvement of work qualities** : the use of computers will allow to reduce the number of wilful and unwilful errors, to standardize the data processings, and to deal more easily with the mutations and revenue assessment. That will bring about a bigger confidence in the accuracy of land records.
3. **Improvement of land record availability** : ease of availability will be useful to all the Revenue Department employees within their work, to landholders and credit organisms [III.2.5.5.], to other administrative departments (about 40) which work with land record, and to the State for its development schemes [III.2.5.5.].
4. **Improvement of land records quality** : This fundamental characteristic will allow to resolve many cases of disputes.
5. **Development of a national data base.**

IV.3.4.2.2. THE INFORMATIONAL OBJECTIVES

From these objectives, one may deduct some objectives having to be fulfilled by the information.

The **information** must be :

- *accurate* : i.e. representative of the reality; otherwise it will not be useful in spite of its automatization. The Patwari's work and mutation procedures will have to be carefully checked;
- *available* : very quickly, even instantly, for the working employees and in reasonable time limits for the others (landholders, credit organisms, State); in several copies in order to allow the Collector, the Tashildars and the Patwaris to get their own copies;
- *readable* and therefore for Dungerpur in Hindi ;
- *portable* : to allow the development of a national data base;
- *protected* : to avoid any corruption through the medium of computers.

The **processor** needs therefore to be able:

- to deal at the very least with the land records of one village, about 1400 records of 300 characters;
- to accept a Hindi translation interface;
- to assure the security of datas;
- to be easily and quickly rebooted on account of frequent power cuts;
- to have acceptable response time;

- to allow memory extensibility in order to fight the increasing of the databases.

IV.3.4.2.3. THE DEGREE OF REALIZATION

This section discusses the degree of precision of each presented objective. Are these ones relevant, workable ?

Undoubtedly, after the formation time, the employees will save time thanks to computers. In fact,

- for the Collector : his land record work boil down to deal with special cases;
- for the Tahsildar : he continues checking the accuracy or mutations, but his work is simplified thanks to the land record availability and mutation reports [III.3.2.7];
- for the land record Inspector : he will be assisted in his work of land record estimation;
- for the Patwari : he will not have to rewrite several times the same information.

If the use of computer will allow to reduce unwillful errors and standardize the data processings, it is not so sure that it will permit to decrease highly the corruption and to handle the mutations and the revenue assessment so easily. In fact, if the computer can perform some simple checkings on datas - for instance, to make sure that the sum of each field area is equal to the total of Khata area - it can not assume the datas validity, or in other words, fight the measurement corruption and the falsification of tax amount. The only way of avoiding that kind of corruption is a checking of Patwari's work on the spot.

Moreover it appears that the mutations and revenue assessment procedures are so complex than it seems that they will not be usable before long. Also on account of number of analyst-programmer - currently only one - and time limits [IV.3.4.4] it would be advisable to develop a model and a prototype.

Let us, finally underline that the information quality and availability remain entirely dependent on the number of computers, on their localisation and on their processor power.

IV.3.4.2.4. REMARK

There is still a last objective formulated at the time of Workshop, but which can not be inserted in the two previous sections. It pertains to the use of computers. It may be defined by the two following questions :

- How to use computers appropriately in the Indian administration ?
- To which level may the information system be decentralized ?

Behind these questions there is one of the most important concerns of the Revenue Department officials. In fact these ones would like their staff to get abilities to work with the data processing. That would allow them on the one hand to be independent of any software development "firm" (for instance, to improve, modify or execute applications) and on the other hand to reduce the costs of development and maintenance. This opinion is obviously debatable because if it allows to make sure that the applications will answer more appropriately to the needs of employees, it does not ensure the quality of applications.

Moreover one can not imagine that the officials will have time and competence enough to modify by themselves their applications.

IV.3.4.3. THE CONCERNED PHASES

The phase is a processing (manual or automated) carried out without time interruption and space change [BOD 89]. It is an homogeneous unit of an application.

Here are the phases of the Dunderpur's applications.

- The jamabandi rewriting application :
 - + Field surveying and estimation of land revenue rate: the information is written in a notebook.
 - + Elaboration of rate tables on the basis of the notebook.
 - + Jamabandi updating on the basis of the notebook and rate tables (involved).
 - + Checking of new jamabandi by Collector and Tahsildar.

- The mutation procedure :
 - + Request for mutation : orally or by writing to the Patwari.
 - + Inquiry of necessary documents : by the Patwari or landholder. (involved).
 - + Writings : passed in the jamabandi and mutation register by the Patwari (involved).
 - + Affixing of checking marks : by the land records Inspector. (involved). The latter takes note of it in his administrative diary.
 - + Checking of Tahsildar : if he agrees, he signs or else he asks more information (involved).
 - + Jamabandi and map updating : once the mutation accepted (involved).
 - + Dealing of a refusal : if the Tahsildar refuses a mutation, a land record Inspector goes on the spot to get more information.

- The assessment and collection of land revenue :
 - + Notes taking : by the Patwari during each crop season.
 - + Writing of kahasra girdawari; on the basis of the notes and jamabandi (involved).
 - + Land revenue assessment : by the land record Inspector (involved).

- + Verification and correction : the Tahsildar checks and rectifies the Inspector's work (involved).
 - + Verification and decision : after having checked the land revenue, the Collector takes the final decision.
 - + Dealing of a refusal : if the Collector refuses the proposed assessment, all the procedure has to be performed once again.
- The query procedure :
- + Request for information : orally or by writing to the Patwari
 - + Information search in the different documents by the Patwari (involved)
 - + Delivery of information : copy given to the claimer.

A phase is said concerned or "involved" if it is associated with one or several informational objectives presented above. So for instance the phase "jamabandi and map updating" is linked to the objectives of information accuracy and availability. That approach allows us to see what are the critical points of the project. These points are the basis on which the future solution will be build.

IV.3.4.4. THE CONSTRAINTS

In order to carry through the development of a project, one needs to respect the constraints surrounding the project. For the Dungerpur's project, the constraints to respect are :

- **Environment** : these constraints have already been explained in the general environment section [3.2.3.]. Let us remind of them briefly :
 - > tropical climate : air-conditioned rooms,
 - > rudimentary electrical and phone networks,
 - > vernacular : Hindi,
 - > slowness,
 - > bureaucratic hierarchy.
- **Financial resources** : the budget is limited to 2,400,000 Rupées¹. That sum must permit the building of air conditionned rooms, the purchase of hardware ² and software materials, the wages of the analysts, etc; If one takes as point of reference the mensual wage of an analyst (about 3000 Rupees³) we can say that the grant allowed by the central government is not sufficient for a project of such scale.
- **Pertaining to the project complexity** : the Indian land records are a quite complex subject, about which there is few information. Moreover, since the employees are not very educated, they can not explain accurately how they work. This situation has heavy outcomes. In fact it is impossible to find out all the reasons which urge someone to call for land records or also to list all the mutation cases and the way of dealing with them.

¹Note : 6,000,000 Belgian Francs.

²Note :The hardware is only indian

³Note :7,500 Belgian Francs.

- **Time constraint** : as said above, there are five other districts wherein the same pilot project of land records computerization is developed with the help of Institutes like IIMA. Next July, two years after the grant allocations, the District officials and the persons in charge of computerization will meet to show their work to the Government officials. At the end of these meeting, it will be decided which computerizations will be carried on in the future.
- **Pertaining to the employees** : it is well known that the introduction of computers disturbs the employees in their work. And there, more than ever, the employees and their reactions have to be considered. In fact, it is the first time that they see computers. They fear it ! Just like us, in the sixties.
Let us remind of the rudimentary education of the employees. It is why very friendly and ergonomical applications need to be developed.

IV.3.4.5. EXPECTED EFFICIENCIES.

The expression of expected efficiencies aims to show criteria on which the proposed solutions will be based. We will distinguish four classes of efficiency criteria : organizational, economic, operational and informational efficiencies.

IV.3.4.5.1. INFORMATIONAL EFFICIENCIES

These efficiencies are stated according to the informational objectives [IV.3.3.2.2.] :

- **availability** : - for the employees whom the work is dependent of land records availability, the time of waiting the information should not exceed some seconds. That concerns mainly the mutation procedure and the assessment procedure.
 - for the others, this time might be of some minutes to some days. That concerns mainly the inquiring procedure.
- **Accuracy** : the information accuracy expressed in time may be evaluated:
 - from some minutes to 2/3 days : excellent;
 - from some days to one month : very good;
 - from one month to one year : acceptable;
 - more than one year : bad.

Let us notice that currently in Belgium, the datas are updated only one time per year.

- **Readable** : one of the Bikaner's experiment results was to show the uselessness of land records in English. In fact, this is a serious limitation to the participation of the users since all the original land records are maintained in Hindi [RAO 89], [GOV 87]. It is why the interactive applications must be developed in Hindi or vernacular.

- **Security** : although that objective is important, it remains for the moment secondary.

IV.3.4.5.2. ORGANIZATIONAL EFFICIENCIES

The aim of these efficiencies is to evaluate how to answer the organizational changes caused by the introduction of computers. At this point of the approach, we can say that on account of the disruptive character of computers, the involvement of staff is essential. More particularly, because of his key work, the Patwaris have to be highly involved within the whole computerization process. A good formation needs therefore to be given.

IV.3.4.5.3. ECONOMICAL EFFICIENCIES

One of the most important constraints is the limited budget. So on account of time limits [III.3.3.4.], it would be advisable to develop a solution limited, but economic and presentable. That is why we think to the building a prototype. More details will be given in the chapter.VII

IV.3.4.5.4. OPERATIONAL EFFICIENCIES

The previous sections have shown the complexity of land records. These complexity is the basis of a certain fuzziness that reigns on the land records system. However, let us notice that, if we do not know accurately each detail of land records, we have a very good idea about the general land records procedures. In such a situation the most efficient answer is the "open-closed principle" [MEY 88]. An application is said to be open if it is still available for extension and said to be closed if it is available for use. In this case, it means that the application must be on the hand enough "closed" to be workable and representative of land records, and on the other hand be enough "open" to be extended and modified. This principle will be the main criterion of operational efficiencies.

IV.3.5. ELABORATION OF SOLUTIONS

IV.3.5.1. DEFINITION AND OBJECTIVES

The usual goal of this stage is the elaboration and evaluation of solutions. However, on account of the objectives of this dissertation, the proposed solutions in this section will not be developed in detail. We will restrict ourself to present their advantages and shortcomings. Finally in the next section [III.3.6.] we will analyse the solutions and select the best one.

IV.3.5.2. SOLUTIONS

The presentation of solutions follows always the same framework :

- definition;
- advantages;
- shortcomings.

The use of computers generates naturally a set of informational and operational advantages such as speed of processing, information reliability, and decrease of work difficulties. These ones will not be quoted in the next "advantages paragraph".

IV.3.5.2.1. A SIMPLE AUTOMATISATION

A. DEFINITION

The first solution is simple. It would consist of automating the procedures without changing them. This idea is based on the first remarks made in the critical approach [III.3.4.6.], according to which the true problem of land records is the extra work of employees and not the presence of defective procedures. That solution does therefore not suppress the mutation register. This one would then be handled as a file by the computer. The staff carries on maintaining the documents as before. However, on account of the speed of processing and of the ease of computers to make copies of their information, the rewriting of jamabandi would be performed every year. That would reduce the time of finding out information.

Note also that the little lack of coordination can be reduced by a appropriate number of copies.

B. ADVANTAGES

- the use of a system effective for three centuries that has already proved itself;
- the staff would not be much perturbed by the use of computer in their work. It is undoubtedly an important advantage;
- their formation could be reduced to the minimum.

C. SHORTCOMINGS

- the informational cohesion and its consequences remains irresolute [III.3.4.6.];
- the computerization of a procedure such as the inquiry will be long and difficult, on account of separate files.
- the presence and maintenance of files require the use of a bigger memory;
- the staff is always obliged to maintain the jamabandi and the mutation register.

IV.3.5.2.2. A REGULAR UPDATING

A. DEFINITION

This solution is a variant of the first one. The only difference is the updating of the jamabandi data base when a mutation occurs. However, if the mutation file does not exist any more for the computer, the mutation register on paper does not disappear.

B. ADVANTAGES

- the work of Tahsildar and land records Inspector is simplified. It boils down to check just as before the mutations on the spot. The writings are registered by the computer.
- the members of the staff would not be much disturbed in their work.
- time saving : for the Tahsildar and land records Inspector.
- being updated every month, the information of the data base is a good image of the reality.

C. SHORTCOMINGS

- the two different ways of updating the jamabandi creates problems of comprehension and coordination. In fact, the Patwari works on datas different to those of Tahsildar and land records Inspector.
- the Patwari is always obliged to maintain the jamabandi and mutation register.

IV.3.5.2.3. A COMPLETE REVISION

A. DEFINITION

This solution tries to resolve both the lack of informational cohesion and the bad structuration of jamabandi.

In the two previous solutions, the updating of documents is made by hand. The reason is simple : before bringing the mutation register to the land records Inspector, the Patwari has already passed the mutations and begun the jamabandi updating. Without changes of the present procedure, it looks impossible to help him in this task. In fact, it is obviously inconceivable to supply each Patwari with computers in order to help him in the writing of the mutations. There is only one solution : take the mutation writing away from the Patwari. This task would be handled at the tahsil office by special employees. These employees already exist. Specialists in the mutation handling (checking, rectification, special cases) they work on behalf of Tahsildar.

If the Patwari does not need to write the mutations, it remains henceforth that he is the only employee of the Revenue Department knowing the changes occurring in the lands. His function is therefore important in the procedure. However, it could be reduced to a formal communication of changes that he observes. That would be performed through the mean of a fixed mutation form, on which the Patwari would write the information necessary to the recording of the mutations.

The best way of resolving the lack of informational cohesion is to remove the mutation register and to update regularly the jamabandi so that it gives a good image of the reality. Obviously a historical file, recording each handled mutation, must be then developed. It will allow to retrace the history of lands. To fight both the lack of informational cohesion and the bad structuration of jamabandi, it would be relevant to change the way of recording the khatas in jamabandi. In fact as seen above, to record the kathas ones after the other quickly brings about the unreadability of annotations, but also a complete rewriting of jamabandi every four years. We say complete because the Patwari must also rewrite the records that have not been changed between the two rewritings. Let us notice that the use of computers does not at all remove this phenomenon of complete rewriting but on the contrary increases it if a copy of jamabandi is printed after each mutation session. A good way of recording the land records is to devote one page of jamabandi per khata. It allows indeed to rewrite only the page holding the information which has been mutated.

B. ADVANTAGES

- all the previous shortcomings (informational cohesion - bad structuration of jamabandi) have been removed.
- the work of Patwari is reduced to produce the mutation form and to maintain the maps.
- the information used by the Patwari is similar to those of other employees who work with computerized files.

C. SHORTCOMINGS

- this solution is probably less economical than the others.
- the staff will be more disturbed. Indeed their job is changed. A new formation will have therefore to be given.

V THE AUTOMATED SOLUTION A COMPLETE REVISION OF DUNGERPUR'S LAND RECORDS SYSTEM

V.1. INTRODUCTION

This chapter aims to detail the solution 'complete revision' of the section IV.3.5.2.5. This solution seems indeed to be the best way of using the computers to reach the settled objectives and to remove some deficiencies.

That is in this perspective that new documents and new information processings are presented. These ones have been elaborated according to the advices of MR VAN EMELRIJK and Mr FILEE who work for the Belgian cadastral administration. Their experience of land records and of their computerization has allowed me to find out some characteristics of land records and to improve the solution developed below.

Let us note that the first objective of the solution has been to improve the quality of administrative work. It is by the improvement of the administrative work and the job conditions that any result will be achieved in all the country. This opinion will be explained more in detail in chapter VII.

Undoubtedly this solution will take several months, or years, to be installed and perfected. Its evolution will be marked by some necessary stages. These ones are explained in the planning section.

Lastly, the proposed solution is criticized. Its innovator nature may threaten and reduce its chances of success.

V.2. THE DELIMITATION OF THE SOLUTION

As said above, the general project bears on the land records in their entirety. It is however impossible to deal with a such scale project. That is why the project has been limited to the cadastral system [III.3.2.6]. The below solution is still more limited. It focuses on the jamabandi and its updating and neglects its fiscal side. Some reasons have led to take such a decision :

- the cadastral matrix (= the jamabandi) has a central position where the ascending information flow pertaining to the landowning meets the descending information flow of the taxation [EME,90].

- from the cadastral matrix it is possible to build easily other files: the plot register, the register of landowners, the taxation documents, etc [EME,90].
- the taxation system is entirely dependent upon the jamabandi information. Moreover in some regions the taxation is not in force any more because of the poverty of peasants; and where it is applied only the rich owner are taxed.

We have thus decided not to change the taxation procedure but to keep it such as it is currently. It seems however obvious that it will be able to be reviewed as soon as the jamabandi will be recorded on disks and corrected. In the section V.6. some general ideas are given in order to show which tracks could be taken to improve the tax collection.

V.3. THE JAMABANDI

We have seen that the true shortcomings of land records system is a lack of informational cohesion (IV.3.3.6). Between two rewritings - every four years - the land records are represented in two different books : the jamabandi and the mutation register. This way for registering the information is problematic because it entails a bad image of the reality, a waste of time when the records are consulted and a deterioration of documents (the remarks space is covered with mutations).

The best way for resolving the lack of informational cohesion is to remove the mutation register and to modify the jamabandi itself whenever a mutation occurs. However, if we keep the jamabandi such as it is currently, it could not be updated. Indeed the khata are registered after the others and so do not leave enough place to write there any change. This problem of structuration is resolved if each page of the jamabandi is devoted to only one khata. This decision is acceptable from the informational and administrative point of view because on the one hand each khata is independent and gathers the records which are linked between them, and on the other hand the khata is an administrative number, unknown to the owners and useful only for the land records employees.

A page of the jamabandi will have the structure of the figure V.1. :

- in the right corner, there is a box with the khata number and the mutation number. This allows to identify the records of a same owner¹. It is the number through which the jamabandi is sorted. According to the advices of Mr FILEE, it looks more practical to arrange the jamabandi by the katha number than by the ownername. This method is used in Belgium. However at the time of khata number creation, one will take the ownername into account by creating the khata number after having sorted the khatas through the ownername. This way of doing allows to keep a semblance of alphabetical order in the presentation of records. We say a semblance because on account of the

¹ Note: the term 'owner' means either a single owner or a group of co-holders.

ADMINIST
INFOR-
MATION

VILLAGE NAME : DARBAN
DISTRICT NAME : DUNGERPUR

TAHSIL NAME : RAJKOT
STATE : RAJASTHAN

PAT. CIRCLE NAME : XXXX
YEAR : 2042 - 2045

Khata : 012
Mut. No : 0123

HOLDER'S
INFOR
MATIONS

NAME - HUSBAND NAME

ADDRESS

CASTE

SHARE

..LATOUR DENIS.....RAIKOT STREET.....OUTCASTE.....1/3...

..LATOUR CHRISTIAN.....RAIKOT STREET.....OUTCASTE.....2/3...

FIELD
INFOR-
MATIONS

	PLOT No	AREA Ha	TYPE	IRRIG. SOURCE	TAX / Ha	AMOUNT
	43	1.2	IA	Well	1.5	1.8
	45d	0.6	IIA	Rain	5	3
	47	1.5	IIB	Channel	10	15
	87a	0.1	IC	Pump	15	15
	99c	4.2	IA	Well	1.5	6.3
TOTAL LINE	TOTAL	5			11	40.1

FIGURE V.1.: A NEW STRUCTURE OF JAMABANDI PAGE

mutations the order will evolve without respect of the alphabetical criterion.

Also, to be able to use the jamabandi, an alphabetical ownerlist needs to be created. In this list, ranked alphabetically according the ownername, to each ownername corresponds its khata number.

The mutation number is the number of the last mutation operated on the khata. As we will see it allows to retrace the khata evolution.

- the upper part is devoted to the usual administrative information.
- the frame underneath is reserved for the information pertaining to the owner(s). Its size is such as it will permit to write easily the information pertaining to five owners. It appears indeed that there are never more than five co-owners.
- the field information frame contains the usual information pertaining to the plot.
- the lower part is devoted to the total, namely the number of owned plots, the total area and the total tax amount.

The pages of jamabandi are filed away in a file. They are thus removable. This allows to replace easily a page when its information is modified as a result of a mutation.

One can object that this solution is not economical in paper. Indeed let us remind that there are on an average 300 khatas per village. It means therefore that the jamabandi will have about 300 pages, on which about 1500 records are registered. One considers that there is 15 per cent of this records which change every year, i.e. about 225. There will be therefore at worst 225 pages which will be removed and replaced. For a total of 300 pages, we can say that is consequent; but for an administration is that really so much ?

This number of 225 pages must not be overestimated. It is only if the 225 changes occur all in different khatas that 225 pages will be rewritten. Now often the changes occur by group and pertain to the same khata. Moreover, if the changes are not registered immediately, but only every month or every six months or even every year as in Belgium, a khata that would have got several changes will be rewritten only one time over this period.

The production of new jamabandi pages will be entirely automated. They are produced from the information recorded by the Patwari at the time of the mutation.

V.4. THE MUTATIONS

V.4.1. A COMPLETE DEFINITION

A mutation can be defined as :

- any change undergone by a property concerning either its owner or its type, its area or other elements which are registered in the cadastral documents. One may quote among other things the cases of : inheritance, sale, division, unification, modification of limits, partial and total demolitions, buildings, boundary marking, fiscal modification, etc.; this is therefore every change of judicial or physical nature requiring a modification within the land records or the cadastral maps [CAD,]
- any correction to be brought in consequence of errors introduced unintentionally by the employees in the information [CAD,].
- any mortgage which is ratified.
- any governmental allotment of fields in favour of poor peasants.

V.4.2. THE CLASSIFICATION

From this definition, five big categories of mutation can be pointed out :

1. *legal - judicial mutation* (sale, inheritance, marriage, etc.)
2. *landwise mutation* : concerning the type, area, taxation.
3. *bank lease*
4. *governmental allotment*
5. *mutation of correction - rectification*

Four different types of mutation may be distinguished :

- *the global mutation* : a mutation is global as all the properties of an owner are assigned to a new owner not still registered in the jamabandi. The khata number is preserved: the name of the new owner is simply substituted for that of the old owner.
- *the simple mutation* : a simple mutation is the transfer of one or several plots from one khata to another without any modification of information.
- *the complexe mutation*: : a mutation is complex if it modifies the cadastral information without requiring the drawing of a sketch. It means therefore that the configuration of the plot does not change. Let us note that a global mutation is preferred to a complex mutation.
- *the sketch mutation*: : a mutation is a sketch mutation if it requires the drawing of a sketch. This mutation relates therefore to changes of limitation or configuration.

If we gather the information together, we get the table V.1.

Category Type	Legal Mutation	Land-wise Mutation	Bank Lease	Gvnmtal Allotment	Correction Rectification
Global	X		X		
Simple	X		X	X	
Complex	X	X			X
Sketch	X	X	X	X	

TABLE V.1.: POSSIBLE CASES OF MUTATION.

This table has been elaborated with the help of BHATT C., Systems Analyst at I.I.M. . The method that he has used to find out the information of this table, is simple : he has read some jamabandis and picked out there the different cases of mutations that he saw. We have then gathered under five categories such as presented. We think that these categories are complete. However, we do not have any idea about the set of the mutation cases that each category represents. For instance, for the legal mutation case, the sale of plots and the inheritance have been listed by BHATT C. But if we compare it with the Belgian cases of legal mutation, for which 47 cases are listed, we can come to the conclusion that all the cases of judicial mutation within the Indian land records are not yet listed exhaustively. So the cases of expropriation and marriage may be undoubtedly added to the two cases listed by BHATT C.

This incapacity for enumerating the set of mutation cases for each category is problematic in the land records computerization.

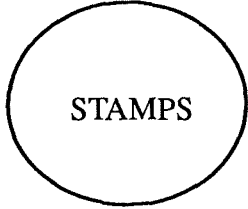
V.4.3. THE MUTATION FORM

The mutation form is the only form that the Patwari will have still to fill in. That is by this document that a mutation is notified drawn in the figure V.2.

V.4.3.1. DESCRIPTION

The first part is devoted to the usual administrative information. The Patwari will have just to enter the tahsil name, the village name, the Patwari circle name and the date. The latter allows to identify the mutation in the time.

In the right corner, the mutation number is stated. It progresses incrementally by step of one after each mutation.

A	VILLAGE NAME :			TAHSIL NAME :			PATWARI CIRCLE NAME :			00123		
	TAHSIL NAME : DUNGERPUR			STATE : RAJASTHAN			YY / MM / DD :					
B	+ MUTATION CASE : Category.-Cause.....											
	+ MUTATION TYPE : Global - Simple - Complex - Sketch						SKETCH NUMBER (1):.....					
	+ KHATA NUMBER :						PLOT NUMBERS (2):.....					
	+ LAST MUTATION NUMBER OF THE KHATA :										
C	BEFORE THE MUTATION						AFTER THE MUTATION					
	NAME - ADDRESS - CASTE - SHARE						KHATA - NAME - ADDRESS - CASTE - SHARE					
					
					
					
					
					
					
					
					
C2	PLOT No	AREA Ha	TYPE	IRRIG	TAX Ha	AMOUNT	PLOT No	AREA Ha	TYPE	IRRIG	TAX Ha	AMOUNT

(1) to fill in if the mutation type is sketch

(2) to fill in if the mutation type is simple

FIGURE V.2.: THE MUTATION FORM

A part of the mutation form (B) is devoted to the identification of the mutation. The following information is there identified:

- the mutation case : this data is composed of the mutation category and the label of one of the cases registered in the corresponding list of mutation cases. This list as said earlier must still evolve.
If that is useful the Patwari will be allowed to write some comments.
Example : legal - inheritance will mean: the mutation is a legal mutation; the case is a case of single inheritance.
- the mutation type : it can be global - simple - complex - sketch.
- the khata number : to which the mutation refers.
- the last mutation number of the involved khata : this allows to keep a trace of the evolution and the story of the khata.
- the involved plot numbers : if the mutation type is simple.
- the sketch number : if any.

The lower part (C) is devoted to the jamabandi information. On the left side, there are information such as it was before the mutation, on the right side the information after the mutation applying. For a sketch case, the right part will be divided into two parts, the first to note the new configuration of the old plots, the second to note the plots of the new owner.

Part D is a space for the stamps. It seems interesting to consider the mutation form as a legal paper whereby a mutation may be validated. This would permit to ensure the mutation validity and therefore the validity of the jamabandi. The jamabandi would have so a good image of landholdings and could be seen as a legal proof of landpossession.

V.4.3.2. THE HANDLING

In order to reduce the work of the Patwari, we will try to ease the filling in of the mutation form. Therefore each mutation type is looked into.

- the global mutation : the Patwari has to fill in the part A,B and C1.
- the simple mutation : the Patwari has to fill in the part A,B and C1 without forgetting the field intituled 'plot numbers'.
- the complex mutation : the Patwari operates differently according to the cases :
 - . if the change pertains to the holder information, only parts A,B and C1 must be filled in.
 - . if the change pertains to the plot information, only parts A,B and C2 must be filled in and only the information which changes has to be written down.

V.4.4. THE USE OF COMPUTERS

Having presented the new cadastral documents, it is now interesting to show how the computers can be useful in the land records maintenance. This section has three parts: the first considers which computer type is preferable, the second explores in which part of the Revenue Administration Structure to use the computers and the third tries to enlighten for which task to use them.

V.4.4.1. THE TYPE OF THE COMPUTERS : THE MICROCOMPUTERS

After reflection the heads of I.I.M. computer centre have decided to computerize the land records with compatible microcomputers. The reasons of such a choice were :

- the poor infrastructure : the rudimentary electrical and phone networks prevent from developing a mainframe centralized system. The infrastructure that requires the use of a mainframe (recooling system, etc.) is far bigger than those of a microcomputer. Moreover the rebooting of a microcomputer is undoubtedly easier than those of a mainframe.
- the financial resources are limited.
- the absence of a competent technical staff, that would be able to maintain the material and the applications. It will be easier to train the staff to use micros than mainframes.
- the wish of not modifying the organizational habits in order not to disturb the administrative staff. On that score, the use fourth generation language available on micros allows to fit rather quickly and easily the procedures to the demands of the staff.

The major shortcoming of microcomputer is its limited memory space. We know that the required memory space to process the land records is consistent. Per jamabandi, there are on an average 220 khatas, i.e. 1400 records. Each record has a length of 230 characters. The number of bytes necessary to record a jamabandi amounts therefore to about 320,000 bytes, i.e. less than one third of megabyte. Since the number of jamabandis for the Dungerpur's district is of 856, the total space for its land records is equal to 273,920,000 bytes, i.e. about 274 megabytes. It is so nearly impossible to process the information of all the district without having to record the data on floppy disks.

V.4.4.2. HOW AND WHERE TO USE THE MICROCOMPUTERS IN THE ADMINISTRATIVE STRUCTURE

The essential idea to lead the reflection about the use of microcomputers in the administrative environment is to try to perturb as few as possible the staff, and particularly the Patwaris. The use of computers must not involve them in an overloading work, but on the contrary remove several of their repetitive administrative works. It seems that in a country like India where the computers are still badly known by the administrative public, the persons must be well

supervised because the success or the failure of the project will depend upon them.

In order to disturb the staff as few as possible, the organizational structure must be kept such as it is, i.e. in districts divided in tahsils and villages. Their officers - the Collector, the Tahsildar, the Patwari - must keep the same power. Thus, the Collector keeps a post of general responsibility. He secures that in each tahsil of his district, the land records are well maintained. Only the Tahsildar, and sometimes the Circle Inspector but never the Patwari, has the possibility and the right to certify the accuracy of land records. This fact has an important consequence on the computer use because it means that to be optimal, the computers must be worked in the tahsil office. Indeed, if they are located in one of the district offices, on the one hand the updating time of land records will increase significantly, because after their passage in the tahsil office where they are checked, the mutations have to be sent in the district office to be recorded in the computer, and on the other hand, since the computer is not used where the decision about the information is taken, its use becomes less interesting. The consequences of these two reasons on the result are however difficult to estimate. That is why this solution must not be thrown up without being tested.

On the other hand, the idea of providing a computer per Patwari looks as stupid, because it is economically impossible and because the Patwari has no legal right on the land records.

If the tahsil office is the most suitable place to obtain an optimal return on computers, they present however a technical difficulty because they are not yet fit out with air-conditioned rooms. They will have thus to be built one after the other.

The choice of Dungerpur to build the first office where the computer will be used to computerized the land records, is a judicious choice, because it allows to test the two possible computerization situations : of the district office or of the tahsil office. One can indeed launch two different experiences from this first office located in the district capital, but separated from the other administrative offices : the first in simulating the 'tahsil office' situation by processing only the data of the villages which surround Dungerpur and the second in simulating the 'district office' situation by processing the data of a tahsil long away from Dungerpur.

For these reasons and due to the fact that there is only four tahsils to fit out in the Dungerpur's district, the localization of microcomputers in the tahsil office appears as the best solution. That is why the future explanations will relate to this.

Even if the phone network is too rudimentary to install a network, it does not mean that it is impossible to link the microcomputers in network. India have indeed a system of satellites at its disposal. It seems however that its use is not a priority. If we observe the actual cadastral system, we may note that the information is not distributed amongst all the tahsils but belongs to one and only one tahsil.

A tahsil has no knowledge about the land records which its adjoining tahsil processes. One could anyway wonder if it would be interesting for a tahsil to

know the land records of another tahsil to maintain its own records. To know the land records of the other tahsils and have thus a global view is interesting because that allows to know per owner the entirety of properties that he owns in the district. It would be thus possible on the one hand to check if the holder does not possess more than the land ceiling law permits and on the other hand to levy only one global cadastral tax per holder.

V.4.4.3. FOR WHICH TASK OF MAINTENANCE TO USE THE MICROS

The use of computer gives several advantages to the staff who works closely with the maintenance of land records. There are the different tasks for which the computer will be advantageous :

- to check the data written on the mutation form by the Patwari : as we have said earlier, the mutation form consists of some parts (A,B,C) whose one is devoted to the recall of information existing before the mutation. This information may be automatically displayed on the screen and allow so the one who types the mutation to compare quickly their value with those of the mutation form. Any incompatibility will result in a rejection of the mutation.
- to facilitate the mutation handling by leading the one who types the mutation : from the mutation case and type, it is possible to ask only the information which will change after the mutation. To each mutation case corresponds a specific set of data which will change. For instance, the sale of fields to a person who is not yet registered as owner in the jamabandi requires information different from that which is required to record a change of landtype on account of the building of a house.
- to check if all the information is available and if the results are similar to that of Patwari.
- to provide the new page of jamabandi and all the documents which would be linked to the land records (landowner list, plot list, etc.).
- to record in an historical file the mutations and produce regularly a report that the Circle Inspector will file away in a file or in his diary.

From this five points, it is possible to give the great features of the mutation application.

Getting the mutation form, the Circle Inspector - or anyone who could deal with the mutations - types information of the A and B frame. Thanks to this information, the khata as it exists in the jamabandi is displayed. It can be then compared with the left part of the C frame, i.e. with the records before mutation. If the Circle Inspector notes any discordance, the procedure is interrupted in order to get more information about the mutation.

Let us assume that the information is identical and the Circle Inspector has accepted them. The next screen displays itself then. Its title consists of the category and case of the mutation. In this screen, the Circle Inspector has to fill in a set of fields. These fields are those which will have changed after the

SINGLE SALE - MUTATION 01248

KHATA NUMBER : 000

HOLDER NAME : CHETAN

HOLDER CASTE : BRAHMAN

SHARE : 1/1

HELP :

Figure V.7.: Second screen with mutation information

Some comments :

- figure V.5. : the field 'involved plot numbers' is automatically displayed when the typed mutation type is simple.
- figure V.6. : the records that will be mutated are highlighted. They can be so easily noticed.
- figure V.7. : if the value of the khata number is nul, a khata number is created and the name, the caste and the share of the holder must be given.

V.4.6. THE GLOBAL MUTATION PROCESSUS

The different stages of the new mutation procedure are:

1. The landholder report orally or by writing the case of land mutation to the Patwari.
2. The Patwari listens both parties in case of simple or global mutation or otherwise visits the site to check the facts and takes notes (sketch, etc.).
3. He fills in the mutation form.
4. At the end of the month he brings the mutation forms to the Circle Inspector. If he has not enough time to go there he can send them by post.
5. The Circle Inspector - or any other clerk of the tahsil office who would have the right to deal with the land records - encodes the mutations . All the mutations that are incomplete, false or having to be checked on the spot are deferred later.
The encoded mutation forms are stamped. The new pages of jamabandi are printed.
6. The stamped mutation forms are given to the Tahsildar, who signs them.
7. The new jamabandi pages, the stamped and signed mutation form and the sketches are sent back to the Patwari.
8. In his office, the Patwari replaces the old jamabandi pages by the new ones. He staples then together the mutation form, the old jamabandi page, the sketch (if any) and other possible documents. These ones are filed.

V.4.7. TIME SAVING

A relevant question is to ask if the solution reduces the time spent to maintain the land records and so ensure a constant accuracy of them. Firstly we can note that the job of Patwari has lessened. Indeed his main work is the filling of the mutation form. This filling is quite simple because reduced to a minimum : it consists to note the changes of the reality. Moreover thanks to the computer the Patwari has not to copy the information again and again on different documents (the jamabandi page, the owner list, etc) because these ones are provided automatically. Thus the rewriting of jamabandi that takes several months to the Patwari is removed.

Secondly, the work of the Circle Inspector is helped by the use of computer. To check the mutation he gets automatically the land records at his disposal and he is led by the computer to process it. One can say however that the Circle Inspector work has increased since he will have henceforth to record the mutations, thing that he has never done before. That is true. That is why he will be helped by one clerk who will handle the easiest mutation cases.

Thirdly, the Tahsildar work consists mainly in signing the mutation form. This signature certifies the accuracy of land records. The Tahsildar will therefore act to secure it.

V.5. THE INQUIRY OF LAND RECORDS

We have seen that the land records are regularly claimed by the private landholders and the State government [III.2.5.5]. With the help of the microcomputers it will be easy to provide them with the claimed records.

In order to facilitate the delivery of the land records, the landholder would have to be able to get his land records at the tahsil office. That will reduce the time that a landholder will have to await before getting his land records. This proposition would so reduce the land transfer corruption [III.2.3.2].

As shown in table V.2., the proposition of opening an office where the landowner gets directly a printed copy of his land records is physically acceptable. This table shows indeed some interesting distances. Among them, there is the distance which separates a village from its tahsil. This average distance from 3 to 20 miles can be easily covered by rail, bus or on foot.

Distance from	Number of villages situated at a distance (mile) of							
	< 1	1 - 3	3 - 5	5 - 10	10 - 20	20 - 50	50 - 100	> 100
District Headquarter	---	2	6	7	7	52	24	8
Tahsil Headquarter	1	5	15	36	41	17	1	---
Nearest Railway Station	7	5	16	24	30	27	6	1
Nearest Bus Stop	22	36	29	24	3	2	---	---
Nearest Post Office	18	38	23	26	8	3	---	---

Table V.2.: Distances separating a village from some important places ¹

On the other hand, to optimally reply to the governmental land records inquiries, it would be advisable to install the automated query procedure at the district level. Indeed, very often the governmental inquiries concern owners or fields belonging to several villages. Let us remind for instance the distribution of granes to marginal farmers or the building of a road.

¹ Note: these data are the result of a study made on a sample of 116 Rajasthan's village. These villages are spread over 25 tahsils of 13 districts selected from all the five old revenue division of the State [SIN,64]

V.6. THE TAXATION : A TRACK

As said in the section V.2., the taxation procedure is complex. Its main features have been given in the sections III.2.4.4.1. and III.2.5.4. Let us remind that during the crop season, the Patwari inspects each of the 4000-5000 fields of his Circle in order to record in his diary the different crops. After the crop season, he fills in the kahasra girdawari from the data of his diary. On that basis, The Circle Inspector draws up the assessment of land revenue.

The computer can highly reduce the time spent to evaluate the tax amount that each landowner has to pay. It will be easy to help the Patwari in the elaboration of kahasra girdawari by supplying him with a detailed plot list. This list would be arranged numerically by the plot number. To each plot number would correspond its khata number, the name of the owner(s), its area, its type, the nature of its cultivation, its expected crop and a remark column where the Patwari would be able to note any change he would observe. The figure V.10. shows an example of this document.

From this information it will be possible to help the land records Inspectors at the time of taxation assessment. At the opposite of what he had to do before when he had to search in diverse places of kahasra girdawari and mutation register to fix the tax amount of one khata, he could then make use of information sorted through the khata number and so directly calculate the tax amount per holder.

V.7. THE ROLES

The roles of the different revenue administration employees have changed. As seen in the previous sections, their tasks, and consequently their roles and their relations, have been modified by the computerization. The main idea which leads these changes is a wish to share better the land records maintenance among the employees and so to make easier the Patwari work.

We know that the staff is the key element in the success or the failure of the land records computerization. That is why the changes have been limited in order to disturb the staff as few as possible. The staff will have however to be informed and trained step by step to his new roles.

Thus the Patwari administrative work consists mainly in noting the changes which occur among the fields and in inspecting the crops in order to pick out the information which is necessary for the taxation assessment. Thanks to the computer, he gets effortlessly an updated information.

The role of the Circle Inspector is to handle the information brought by the Patwaris. Since his job remains still heavy, he takes advantages of a clerk to help him for encoding the information. This clerk will be quickly trained to work with the different land records applications and particularly the mutation application. There will be one clerk per tahsil.

PLOT No		KHATA No	OWNER NAME	AREA Ha	TYPE	CULTIVATION TYPE	EXPECTED CROP	REMARK
VILLAGE NAME : DARBAN DISTRICT NAME : DUNGERPUR			TAHSIL NAME : RAJKOT STATE : RAJASTHAN			PAT. CIRCLE NAME : XXXX YEAR : 2042 - 2045		
1B	124	BHATNAGAR	1.2	IA	POTATOES	150 KG		
2F	025	BHATT	0.6	IIA	WHEAT	50 KG		
3P	069	RAO	1.5	IIB	JUTE	450 KG		
4	111	PATEL	0.1	IC	COTTON	80 KG		
5I	087	SANWAL	4.2	IA	TOBACCO	110 KG		
...								

Figure V.10.: Example of a new kahasra girdawari page

The Tahsildar role is mainly a role of responsibility. The Tahsildar must secure that the land records of his tahsil are regularly updated and the taxes properly levied.

The Collector role remains unchanged. The Collector has however a very important role to play at the beginning of the computerization because he is the only person who has enough power to secure a fair participation of the employees.

V.8. A ENTITY - RELATIONSHIP DIAGRAM OF THE SOLUTION

Figure V.11. shows the entity relationship diagram of the land records solution presented in the previous sections.

V.9. THE BIG STEPS OF THE INSTALLATION OF THE COMPUTERIZED SOLUTION

The land records computerization will take a lot of time before being usable and complete. The big steps of the path that it will have to follow to become usable and complete are presented in this section. Let us note that a step can consist of several tasks which unfold simultaneously.

Step 1 : - Reflection over the land records with the revenue department officials and the staff; decision of recording the jamabandi and of maintaining the mutation in Hindi.
- Choice of microcomputers.

Step 2 : - Development of an Hindi interface to record the jamabandi data.

Step 3 : - Recording of jamabandis by typists : spread over steps 3 and 4
- Reflection over the land records maintenance and availability :
Revision of the current cadastral system.
Proposition of implementation.

Step 4 : - Development of a maintenance application and a query.
Integration with the Hindi interface.

Step 5 : - Presentation of the first prototype to the land revenue officials

Step 6 : - "cleaning" of land records, i.e. the correction of all that differentiates the records from the reality. There are two reasons for which land records can be different from the reality :

- typing errors made at the time of encoding
- a change pertaining to an owner or a field has not been recorded as a mutation. This case occurs often among the land records because :
 - . the Patwari is overburdened and has not enough time to record all the changes

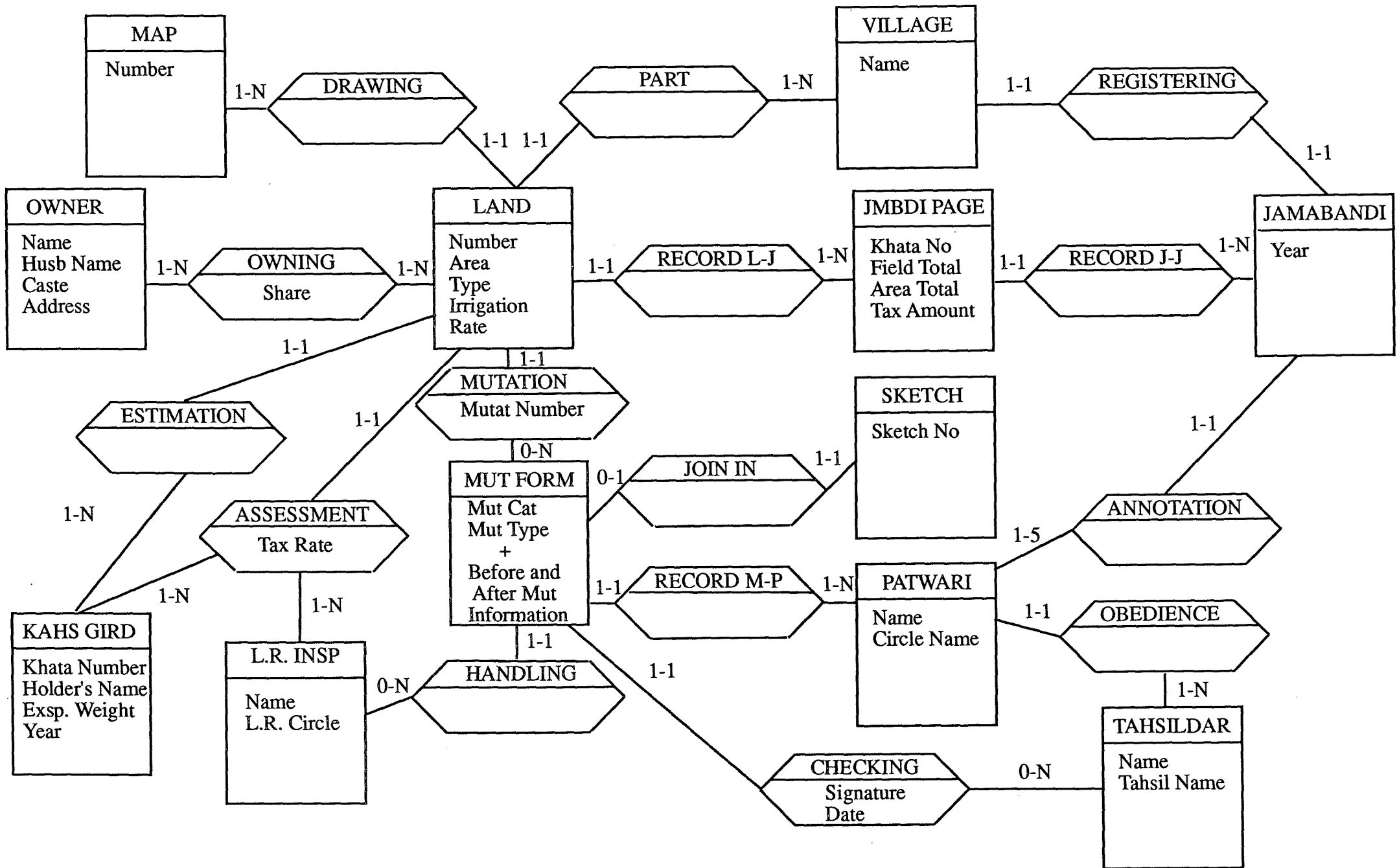


Figure V.11.: An entity relationship diagram of the Dunderpur's solution

. the Indian culture is an oral culture. Thus often bargains (sale, tenancy, etc.) are made orally.

The typing errors can be easily corrected. On the contrary, the other errors resulting of a not recorded change are more difficult to find out. It appears that the single way to resolve this problem is on the one hand to deliver to each registered landholder his land records and on the other hand to advertise the revision of the land records to the population. That would be made in each village through the Sarpanch, the village responsible.

This step will take a long time and may cause a lot of disputes among the peasants. It must be thus well thought about.

Step 7 : - Normalization of land records. It consists of a same computerized representation (spelling, abbreviation, etc.) for a same word.

For instance, Saint Georges street = St Georges street but are two different data for the computer.

- Development of some applications, including the taxation assessment application.

Step 8 : - Presentation of the second prototype to the land records officials. It is an improved version of the first prototype.

Step 9 : - Introduction of land records computerization at the tahsil level.

Step 10 : - Computerization of the maps (digitalization) and integration with the previous system.

Steps 1 and 2 are already over. Steps 3 and 4 are the subject of this dissertation. Undoubtedly, the steps 6 and 10 will be the most difficult steps; Step 6 because it will cause many perturbations in the country life, step 10 because this computer science domain is still underdeveloped.

It seems beter to begin the experience of land records computerization by the district level than by the tahsil level, and to fit out the tahsil offices with microcomputers when the application will be become stable and the staff will be accustomed to the presence of computers. Step 9 is the time of this change district - tahsil. It must not be too early, not to late.

V.10. REVIEW OF THE PROPOSED SOLUTION

Although the presented solution in the previous sections seems to be the best solution, it is far to be perfect. This section aims to discuss its qualities and shortcomings and to observe if the objectives expressed in the framework program are reached.

V.10.1. QUALITIES AND SHORTCOMINGS

The heart of the solution is the restructuration and the implementation of the jamabandi. This choice is undoubtedly the best which can be taken. Indeed the jamabandi information is the central information of the cadastral system. Moreover, in several other offices they are used to handle diverse administrative

works. So even if the land records restructuration and implementation will take time and will not be able to show real advantages before the data are normalized, we can affirm that once this step is reached the new cadastral system will be proved profitable. This affirmation is based on the following arguments :

- The lack of informational cohesion has been removed by the suppression of the mutation register and the creation of one jamabandi page per khata. The reading of land records becomes therefore easy.
- The mutation form is a legal document whereby the administration certifies the changes that have occurred. It could therefore be considered as a legal proof as regards the Indian law. Consequently the jamabandi would become also a legal document for the Indian law. Each of its pages would show the state of the title to land and the person in whom the title is vested. This cadastral system would not be only fiscal but also judicial. This system is known as the Torrens cadastral system [CAD,78].
- The work is better spread over the staff, and the role of each one has become more interesting. The Patwari will not have to rewrite any more several times the same information to maintain the land records. The Circle Inspector is helped by the computer and a clerk in his tasks of maintenance and taxation assessment. At the end the role of Tahsildar has mainly become a role of responsibility.

The solution will generate however a problem linked to the decentralization of microcomputers. As said earlier, the micros are located in the tahsil office. In Dungerpur's district there are four tahsils. That means that four offices will have to be fit out with an air-conditioned system and a microcomputer. That will be very expensive. This cost is however warranted for three reasons :

- The pilot experience made in the Surendranagar's district¹ shows that the distances that separate the administration clerks from district microcomputers with which they can work are one of the biggest problems. Indeed these distances make them lose time and money. The result is that they prefer to work as before than to use the 'complex' microcomputers.
- The land records are not the only work carried out in the tahsil office. The computer could also be used to help the Tahsildars and the clerks to carry out these other works.
- The problem of memory space is solved. The total of the tahsil land records amounts to about 150,000 records. Since each record has a length of 230 bytes, the memory space to record the data of a tahsil is equal to 34 Megabytes. A hard disk can have this capacity.

Another problem linked to the computerization at the tahsil level is the weak security. Land records are sensitive documents. If they fall into irresponsible or undiserable hands, a lot of complications would arise resulting in considerable misery to the people. At present, manipulations do take place but computerized manipulations and fraud can cause greater havoc and confusion.

¹ Note: the objective of this pilot experience is the computerization of the main administrative works carried out by the district departments.

Manual manipulations can be detected more easily than the computerized manipulations.

The localisation of the microcomputer in the district office is a potential solution if one accepts a restructuration of cadastral system and a land records updating only once a year. This solution would be very similar to the previous one. The only change is the following: once a year, the Tahsildar brings all the signed mutation forms to the district office where they are encoded. He gets then later the new jamabandi pages, which he distributes to the Patwaris.

If this solution is less expensive, it has however some deficiencies:

- the updating is made only once a year
- the answer to land records inquiry made by a landowner takes a long time
- the total of land records to process raises to more than 1,000,000 records. The use of microcomputers becomes more difficult.

These deficiencies have led Mr Rajkumar N. [BAN,87] to say about the land record computerization : "Thus, may it be seen that by centralising the computerisation of basic land records at the district level, the basic objective, namely, availability of the records in shortest possible time, is defeated, while the infrastructure at present available would not permit computerisation at the taluk¹ level."

As said earlier, the choice of Dunderpur to install the first microcomputer is a good choice, because it will be possible to test the two solutions.

V.10.2. ARE THE OBJECTIVES OF FRAMEWORK PROGRAM REACHED ?

The objectives of the framework program are :

1. Time saving : by decreasing the time spent on long and tiresome office works
2. Improvement of work quality : i.e. the reduction of the number of wilful and unwilful errors, the standardization and the improvement of land records processing
3. Improvement of land records availability
4. Improvement of land records quality : this objective aims at solving the dispute cases
5. Development of a national database.

These objectives are partly fulfilled by the solution. The improvement of work quality and improvement of land records availability are the two best fulfilled objectives. The use of computer allows to reduce the errors, to standardize the land records processing and to improve the availability of land records. Let us stress about the standardization of land records processing that the fact that the mutation procedure leads the user in the mutation processing rather than to let him record the mutation as he wants secures that a mutation will be identically dealt by two different users. This fact is important because as

¹ Note: taluk = tahsil

said earlier the mutation processing can be different from one district to another, and so be ununderstable for anyone not belonging to the district.

The objective of time saving has been already discussed in the section V.4.7. We can here conclude that it is partly fulfilled and will be ever more achieved. Indeed as the planning shows it the solution is a solution of prototyping. So when step 7 will be reached i.e. when the data normalization will be over, the prototype will evolve quickly in order to make easier the land records work. The availability and accuracy of data will be then undoubtedly the real cause of time saving. The real difficulty lies therefore in the fact of reaching step 8.

The improvement of land records quality is an objective partially fulfilled. The computer will secure the presence of regularly updated land records and will reduce the number of unwilful errors by checking and comparing the given data. But, it will be unable to find out any wilful error (corruption) and to correct it. We can just say that free of several administrative land records work thanks to computer, the Circle Inspector will be more able to be on the spot to check the facts noted by the Patwaris.

VI DESIGN OF IMPLEMENTATION

VI.1. INTRODUCTION

The land records computerization is a complex problem. The real cause of this complexity is the incapacity of defining the reasons why an information may be modified or claimed. The usual detailed functional analysis of land records computerization has to be replaced by other methodology.

The methodological approach is drawn towards two key elements : the prototyping and the modularity. These two elements, which begin today to be better known and valorised by computer scientists, are detailed hereunder. We will try more particularly to show how they can secure a good design of land records implementation.

DBASEIII+, a fourth generation language, has been chosen because it offers the qualities of an integrated tool. However its use makes the modularization difficult.

VI.2. THE COMPLEXITY

The complexity of land records computerization directly derives from the complexity of land records and their maintenance. This complexity is not peculiar to the Indian cadastral system. Everyone can find the same everywhere in the world, whatever system considered. However, the situation varies from one country to an other. So if we compare the Belgian cadastral system with the Indian system, we may observe that in Belgium all the cadastral procedures are well defined by the legislation and updated regularly in order to correspond to the realities of the society. On the oposite in India, land records procedures are old and badly defined. Moreover, the books wherein the whole cadastral system is explained are rare and hardly available.

Such a situation in the Indian land records brings about the following consequence : the application area is neither well defined nor limited. The whole set of functions which have to be filled by the general land records application is unknown. Only the main functions have been empirically listed by the I.I.M. analyst [V.4.2].

Within the limits of the above solution [V.2], we may note the consequences of this lack of land records procedures :

- on the mutations : five mutation categories and four mutation types have been pointed out in the section V.4.2. However, if it seems that other mutation categories do not exist , it is impossible to have an idea of all the mutation cases that each category represents. It is therefore impossible to develop directly a complete and correct mutation application. It would have indeed to be extended every time a new mutation case, not yet implemented, would be found.
- on inquiries : the land records are regularly claimed by the private landholders and the State Government [VI.2.5.5]. However if it seems that the private inquiries are easy to deal with because they pertain either to the owner name or to the field number, the governmental inquiries are unpredictable. They can correspond to special demands. It would be possible for instance that for one of its development schemes, the Government claims all the records which belong to owners from tribal castes or owning less than two hectares.

VI.3. METHODOLOGICAL APPROACH

VI.3.1. THE PROTOTYPING

Prototyping is common in areas such as engineering where mass production makes it imperative for the design to be tested thoroughly. It is also found in areas where the final version is one-off, like a bridge or a building, and it would be very expensive if the designers got it wrong. Information systems tend to be one-off but the cost of building a prototype has in the past been a major proportion of final costs and therefore has been rarely a feature of information systems development. Prototyping was not common until the availability of software tools - fourth generation systems, the formal languages (Z, etc) [GOF,89] and the non procedural languages (Prolog, etc) - which greatly reduce the costs associated with prototyping [AVI,88].

By implementing a prototype first, the analyst can show the users' input, intermediary stages, and output from this system. These are not diagrammatic approximations, which tend to be watched as abstract things, but the actual figures on computer paper or on screen. The formats can be changed quickly, as the users suggest changes, until the users are given a reasonable approximation of their requirements. It may only be by using this technique that the users discover exactly what they want from the system, as well as what is feasible. It is thus a **way of encouraging user participation** [BOD,90]. We know how the user participation is essential for the success of the land records computerization. Thanks to the prototype it is possible on the one hand to show to the Collector the power of an automated solution and so get quickly his support, and on the other hand to search with the Circle Inspector and the clerk, who are the main users, the best way of using the computer in their job.

There are two main kinds of prototypes : the prototypes which are used only as development tool and the prototypes on which the operational system is built [AVI,88].

Many prototypes are intended to be discarded. They have not been designed to be used as operational systems. They are then incomplete, performing only some of the required tasks. Some analysts recommend that only the most critical aspects of the new system have to be prototyped in order to give a good image of the future final system. The prototype is then used only as a development tool or as a learning vehicle. According to Dearnley and Mayhew [DEA,83] the life cycle of such a prototype should have :

- an analysis phase, designed to understand the present system and to suggest the functional requirements of an alternative system;
- a prototyping phase to construct a prototype for evaluation by users;
- a set of evaluation and prototype modification stages;
- a phase to design and develop the target system using the prototype as part of the specification.

Prototyping may be more than just another tool available to the analyst. It may also be used as **a basis for the methodology of the operational system development**. In this scenario, the system evolves by an iterative process. Once the users are satisfied, the prototype can be converted to become an operational system. The proposition made for the land records computerization is very similar to this kind of prototype. We propose **an evolutionary information system development**. In this case there is a possibility of iterative revision when the system is running. The different stages of the evolutionary information system approach are :

- an analysis phase, designed to understand the present system and suggest the functional requirements of an alternative system,
- a prototyping phase to construct the initial prototype,
- a set of evaluation and prototype modification stages in order to come up to users expectations. At the end of these stages the initial prototype is efficient, operational and accepted by the users,
- evolution stages : the prototype is changed to reflect the new conditions or functions which have not yet been implemented.

The analysis phase of the land records computerization has been presented in chapter IV. It consists in a critical study of the existing system and a framework program. Chapter V has allowed to define the limits of the first prototype. The developed solution proposes to implement the heart of the land records : the jamabandi and its updating. Only few mutation procedures are known. But for each mutation category, several mutation cases, the most frequent, have been listed and the initial prototype has been built. Once the functions of this initial prototype will have been checked and corrected in order

to correspond to the law and come up to Circle Inspector's expectations, it will be 'operational', i.e. workable.

Obviously since all the mutations cases may not be implemented, the prototype will have to evolve, new cases will have to be implemented. We estimate that this situation will last about two years. Indeed in two years, a great majority of the mutation cases will have occurred and been listed. After that, the prototype will become stable; the data could be entirely cleaned, the taxation procedure added and the prototype allowed to be introduced in other districts.

A prototype is usually built using tools such as **screen painter and report generator** which facilitate the quick design of screens and reports. The user may be able to see what the outputs will look like a few days later. Whereas a hand drawing of the screen layout will need to be drawn again for each iteration which leads to satisfactory solution, the prototype is quickly drawn (or painted) again using the tools available. Thus the prototype may be modified easily and quickly. This is very important for the development of an application as land records which is entirely user-oriented. To train some users to modify the screens with the help of the screen painter is an easy task, so that the interface corresponds then to their requirements.

Moreover, the use of program generator may reduce the necessary time to the changes implementation. For instance, FOXCODE, the program generator of FOXBASE+, is a language which describes the 'template' of the FOXBASE+ programs which can be generated (like file maintenance, form generation and custom report program). Templates are written with 'blanks' in them; the details are filled in later when the application is generated. The real advantage of FOXCODE is to permit to make the user interface independent, which is painted by FOXVIEW, from the procedures. Let us note finally that it is easy to convert a DBASEIII+ program to FOXBASE+[FOX,88].

The tools usually integrated by the fourth generation languages are a database management system, a data dictionary, a query language, a screen painter, a report generator and a program generator. These languages fit therefore to the prototyping. Several fourth generation languages have been developed on microcomputer. The most well-known are the DBASE family, CLIPPER, FOXBASE+, R-BASE. For the land records computerization, the I.I.M. officials have chosen DBASEIII+ for its qualities of simpleness and robustness. Moreover it is easily available in India. This choice however doesn't seem to be the best. DBASEIII+ has some shortcomings : it runs rather slowly and it doesn't have a lot of tools i.e. it has no program generator and its screen painter is rudimentary. The use of CLIPPER or FOXBASE+ could remove the shortcomings. They have indeed a compiler which allows them to make run quickly their programs, an efficient screen painter and a program generator. Their use would thus permit to better meet the users expectations. The true difficulty is the availability of these softwares on the Indian market. There are currently not available and must be imported. The import duties on software amount to 60 per cent of the sale price. However despite of these high duties, CLIPPER and FOXBASE+ remain more interesting than DBASEIII+.

Finally let us note that all these languages have a **relational database system**. It allows to have a good flexibility to query the land records database.

That is very important since all the queries which will have to be carried out in order to deal with the mutations are yet unknown. Thanks to this flexibility, it will be possible to implement all the queries which will occur.

VI.3.2.THE MODULARITY

VI.3.2.1. A DEFINITION

A single definition of the modularity would be insufficient. We must look at modularity from more than one perspective. We will use a set of five 'criteria' and three 'principles' [LAM,88], [MEY,88]. The criteria are independent : it is possible to use some of them while violating the others. The principles are just as important in practice as the criteria, but they derive logically from them.

The five criteria are :

- *modular decomposability* : the modular decomposability criterion is characteristic of the method who helps in the decomposition of a new problem into several subproblems. The solutions of these subproblems may then be pursued separately.
- *modular composability* : a method satisfies the criterion of modular composability if it favors the production of software elements which may be freely combined with each other to produce new systems. The main advantage is the possibility of developing the module in an environment quite different from the one in which they were initially developed.
- *modular understandability* : a method favors modular understandability if it helps to produce modules that can be separately understood by a human reader.
- *modular continuity* : a design method satisfies modular continuity if a small change in a problem specification results in a change of just one or few modules.
- *modular protection* : a method satisfies the modular protection criterion if it yields architecture in which the effect of an abnormal conditions occuring at run-time in a module will remain confined to this module, or at least will propagate to a few neighbouring modules only.

The three 'principles' are :

- *few interfaces* : every module should communicate with the others as few as possible.
- *explicit interface* : when two modules communicate which each other, it must clearly appear at least in one of the two modules.
- *information hiding* : all information about a module should be private to the module unless it is specifically declared public. The fundamental reason behind this principle is the continuity criterion. If a module

changes, but only in a way that affects its private elements, not the interface, then other modules which use it will not be affected.

VI.3.2.2. THE OPEN-CLOSED PRINCIPLE

If we want a satisfactory modular decomposition for the land records computerization, one more requirement must be satisfied : the open-closed principle [MEY,86]. The success of the whole land records computerization will depend upon its good implementation.

Each module has to abide by the open-closed principle :

- a module is open if it is available for extension. For instance, it should be possible to add fields to the data structures or new elements to the set of functions.
- a module is closed if it is available for use by other modules. This assumes that the module has been given a well-defined, stable description.

The importance of the open-closed principle for land records computerization may easily be understandable. On the one hand, if each module is open, the implementation of new mutation cases will not be too difficult, on the other hand if each module is closed, the prototype is workable.

VI.3.3. THE MODULARITY, A KEY ELEMENT ?

The five previous criteria are fundamental if we want to develop a prototype able to evolve and to be used by other districts/tahsils.

The modular decomposability helps to reduce the apparent complexity of the land records system by decomposing it into a set of less complex subsystems connected by a simple structure. In the Dungerpur's case, some particular modules may be distinguished : the jamabandi updating, the land records query and the land assessment.

The modular composability must be respected because it will permit to adapt the land records application according to the user requirements and to modify it when it will be introduced in other districts of the State (see objectives of the framework program [4.3.4]). The abiding of the information hiding principle is the key element of a good modular composability.

The modular understandability is the best mean for meeting the independence objective of the Revenue Department officials [IV.3.4.2.4.]. If the modules are well built and documented, the Revenue Department staff should be independent of initial application developers and could carry out the maintenance activities. One will take care of well specified module before implementing them.

The modular continuity is strongly linked to the extendibility problem. Continuity means that small changes should affect individual modules in the

modular architecture of the system rather than the architecture itself. The use of parameters whose the value changes according to the situation is a way of favouring the modular continuity. Thanks to parameters, it will be easier, for instance, to modify a screen or to reuse a procedure.

Another way to insert the modular continuity in the application architecture is to separate clearly the interface from the data procedures. This separation is fundamental. It allows any change in the interface has without any repercussion in the procedures. That separation is quite difficult with a language like DBASEIII+ which integrates a language, a database system and a screen painter.

VI.4. A MODULAR ARCHITECTURE

Figure VI.1. gives a possible modular architecture of the land records computerization. The comments about this architecture and each of its modules will be structured according the following framework :

- presentation of the modular level
- presentation of each module of this level

The modules are linked between them by the "use" relation [LAM,88].

LEVEL 6 : GENERAL APPLICATION LEVEL

- The general application level allows to coordinate the lower modular levels.
- **LAND RECORDS MODULE** : this module allows to generate the different scenarios which may occur when the land records are dealt.

LEVEL 5 : FUNCTIONAL LEVEL

- The functional level is composed of all the functional modules which have been mentioned in the previous chapters.
- **MUTATION MODULE** : this module allows the updating of the land records data base from mutations recorded by the Patwari. As output it produces a new jamabandi page for each dealt mutation. It must ensure the security and the quality of data. Each month, it prints a summary of the mutations dealt at the tahsil office. This document is then given to Tahsildar for a last checking.
- **QUERY MODULE** : the query module aims to produce the land records extracts which are claimed by the Revenue Department staff, the Government, the other administrative departments and the private owners.
- **ASSESSMENT MODULE** : the assesment module helps the Circle Inspector in his land taxation work. It allows him to record in the

kahsra girdawari the information given by the Patwaris after the crop season, to calculate and print the taxation amount of each owner.

- **MAP MODULE** : The aim of map module is the updating of cadastral map whenever a sketch mutation occurs.

LEVEL 4 : FUNCTIONAL TOOLS LEVEL

- The functional tools level is composed of tool-modules used by several functional modules of the level 5.
- **INPUT/OUTPUT MODULE** : The input/output module secures the independence of the functional modules in relation with the screen manager. It gets from the functional modules the data to display and calls the screen(s) which correspond(s) to them.
- **REPORT MODULE** : The report module secures the independence of the functional modules in relation with the printer manager module. It gets from the functional modules the data to print and chose the report(s) which correspond(s) to them. If several printers are available, it choses the adequate printer.

LEVEL 3 : TOOL MODULES

- These modules are more physical than the modules of the level 4. They do the link between the functional modules and the physical elements : screen, memory, printer.
- **DATA BASE SYSTEM MODULE** : That is those of DBASEIII+. It is relational. It allows to fulfil the usual commands applied to a database : research of a field, updating, etc.
- **SCREEN MANAGER MODULE** : That is those of DBASEIII+. Its function is the management of the screen.
- **PRINTER MANAGER MODULE** : This module allows to manage the printer. Its functions will be the paper eject, the choice of the paper, etc.

LEVEL 2 : PHYSICAL INTERFACE LEVEL

- **HINDI TRANSLATION MODULE** : This module aims to made the correlation between the ASCII characters to display or to print and the Hindi characters.

LEVEL 1 : OPERATING SYSTEM LEVEL

- **OPERATING SYSTEM MODULE** : In this case that is MS-DOS

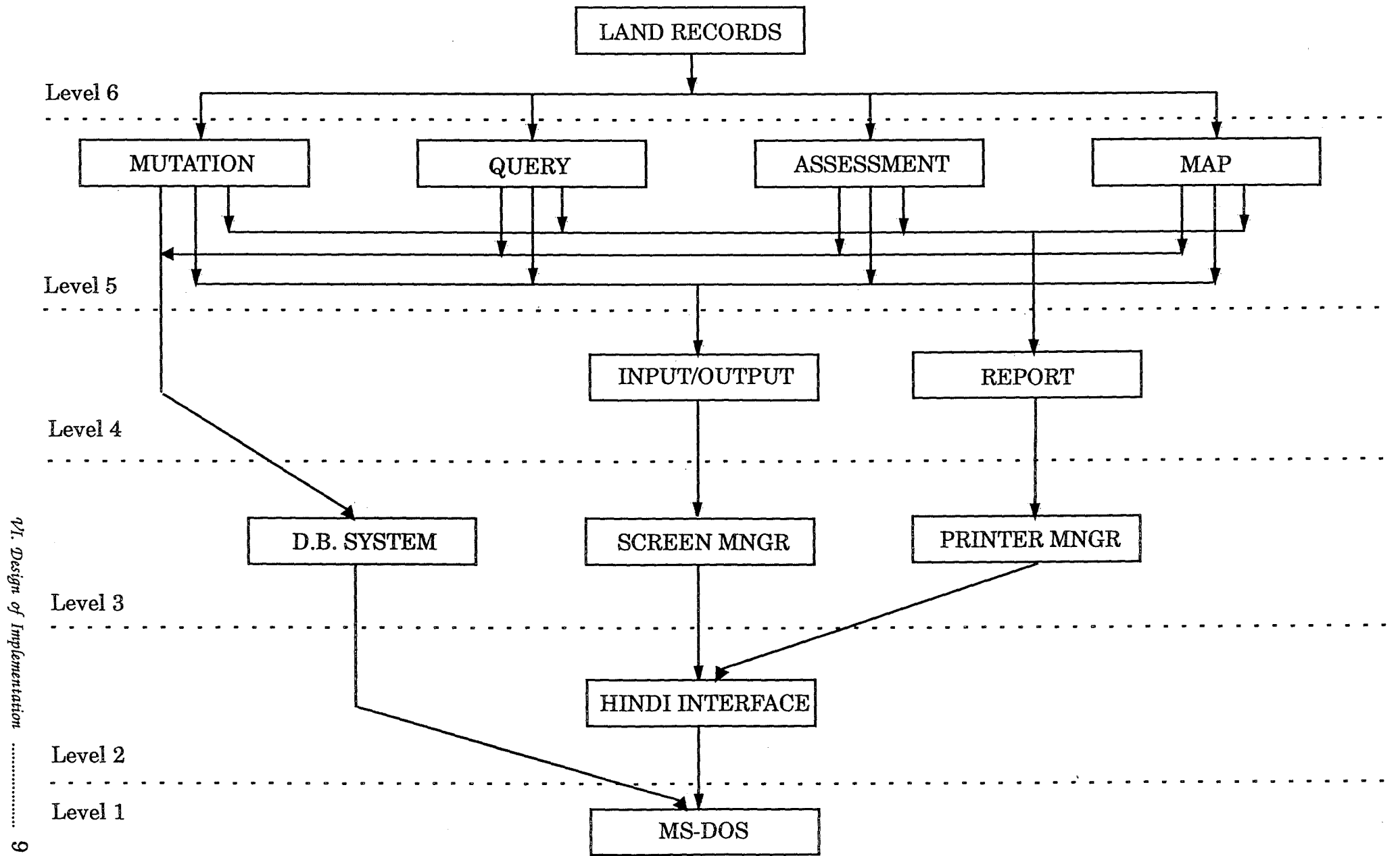


Figure VI.1.: The modular architecture of land records computerization

VII COMPUTERS AND DEVELOPING COUNTRIES

VII.1. INTRODUCTION

Indian computer policy has changed [ZIM,89]. In 1984, Mr Rajiv Gandhi emphasized the political decisions taken by his mother, Mrs Indira Gandhi. This policy has led to the computerization of National and State level. Today the lower levels need to make use of computers if they want to increase the development of India.

The Dungerpur's land records computerization progresses in that direction. Thanks to the presence of computer in the district or tahsil offices, the rural development will evolve. The consequences of the computer on development will be twofold, direct and indirect. The direct consequences are economic, the indirect are brought about by the availability of jamabandi information.

VII.2. THE NATIONAL POLICY

Since the independence, India has known two different industrial policies. At the death of Indira Gandhi, October 1984, the new prime minister Mr Rajiv Gandhi decided to suppress the industrial policy of autarcism in order to promote a more opened one. This policy is chiefly centered on the use of new technologies, the modernization of administrative and economic system and a competitive export [ZIM,89]. These two different policies, before and after 1984, are presented in the two first sections. Some figures will be then given in order to show the main differences of these two political choices.

Next the present results of these policies are then formulated. Today, computers, mainframe as well as micro, are used at the Central and State Government level. On the other hand, only few districts and tahsils have been provided with computers. That is in this direction that the Government policy has to progress in creating District Information Centre. However some difficulties and problems make this approach difficult.

VII.2.1. BEFORE 1984

In 1967, with the arrival of microcomputers, India decides to create a domestic computer industry and set up the Electronics Corporation of India Ltd, ECIL.

At the end of '70, the growing computer industry was subjected to the Department of Electronic (DOE). The DOE played the role of coordinator and applied the decisions of the Commission of Electronic. At this time, the objective was the technological autonomy with an insistence for the production of micros. The Indian market was then isolated from the worldwide market [ZIM,89].

In 1977, the Indian government decided to regulate activities of multinationals by imposing upon them the transfer of sixty per cent of their capital to Indian enterprises. IBM, the alone foreign computer multinational, preferred then to withdraw. In 1979, after long negotiations it left the Indian territory leaving behind a significant number of technicians trained in its school and a major part of the national stock of computers, made of mainly old machines like IBM-1401 [BER,80].

The necessity for the Government to assure the maintenance of this stock - with the creation of the Computer Maintenance Corporation (CMC) - has marked the genuine start of an original policy with the explicit goal to be self sufficient in the area of information technology. This policy, conducted under the cover of important protectionist measures, has allowed real advances towards a technological autonomy but it has also led to resounding failures such as an accumulated technological tardiness, the lack of dynamism of overprotected manufacturers, the high import taxes and the non-competitiveness on the worldwide market [VAS,90].

VII.2.2. AFTER 1984

In November 1984, a major shift took place. The existing policy as well as the procedures for manufacture and import of computer systems were changed. The government decided to actively promote applications of computers, because of their catalytic effect on development and a major expansion in the computer base was envisaged therefore during the Seventh Plan (85-90) (see Table VII.1 and Figure VII.1.)

1964	40
1972	150
1977	200
1980	1,000
1985	10,000
1990	120,000

Table VII.1.: Growth of number of computers in India

In setting out this new policy the basic objectives were stated as :

- Enabling manufacture of computers in the country based on the latest technology, comparable with international prices and progressively increasing indigenization consistent with economic viability

- simplifying existing procedure to enable users to obtain computers according to their requirements, either from indigeneous sources or from overseas mainly regulated through fiscal measures
- promoting appropriate application of computers with due regard for long term benefit.

The policy also aimed at promoting standardization of computer components and peripherals to generate demand on sufficiently large scale. This would enable future exports.

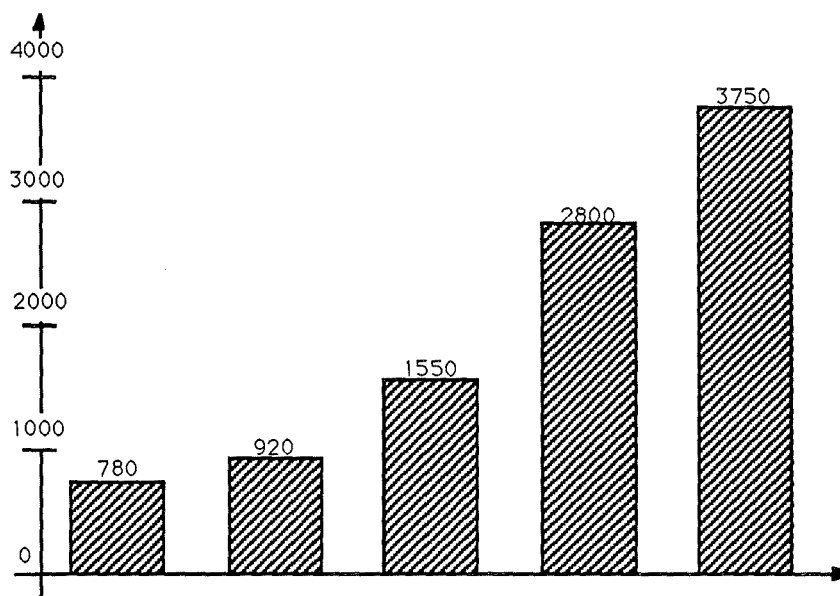


Figure VII.1.: Computer production in India (Dataquest, Dec 86)

VII.2.3. RESULTS OF THESE POLICIES

Earlier, computers were looked upon as being valuable to India mainly in science and technology. Data processing and managerial applications were not given encouragement. There was a fear that they would create problems of unemployment and a lack of appreciation of their role in increasing efficiency and effectiveness. Trade unions traditionally opposed computerization and there were a few strikes in protest against moves for computerization in some organizations.

Today, growing realization shows that computers are part and parcel of the modernization process, although some trade unions still officially oppose their use. Their main argument is that future potential employment will be reduced. However, in several sectors (for instance, banking, insurance, and railways) it is obvious that the size and complexity of operations make it almost impossible to operate without computers. Accordingly, agreements have been reached with unions [PAT,87].

The government, with its new electronics policy, strongly believes that if India wants to have an efficient industrialized economy, computers are essential.

Mr Rajiv Gandhi has gone on record several times on the importance of using computers.

The following excerpt from the Seventh Five-Year Plan sums up the prevailing mood :

- Recognizing that electronics can make a very significant contribution towards improvements in productivity, the Seventh Plan envisages rapid introduction of electronics in almost all sectors of the economy.

Having step by step realized the real role that computers can play for the modernization and the development of India, the authorities have consolidated the infrastructure which allows them to develop the Indian computer science : Department of Electronics (DOE), Data Communication Networks (NICNET, INDONET), National Information Centre (NIC), Research & Development (CMC Ltd), formation and training institutions - see section II.3. about this matter.

These different elements have progressively allowed to introduce the computer science at a National and State level, mainly in the ministries and the administrative departments. Being charged with the total responsibility for providing Government and States with information and for assisting them in decision making and keeping with the country's needs, the NIC is the principal actor of this computer introduction. Having thus to deal with problem at a large scale, the NIC has only a global view. It has no thought about the computerization of smaller entities as the district or the tahsil. Development of India is played undoubtedly at these lower levels too. That is why the creation of District Information Centre (DIC), which would have the same functions than the NIC but at the district level, is today considered as vital.

In the last five years (1985-90) a few districts have experimented the use of computers for planning and monitoring. Let us quote for instance the experiment in Surendranagar, where a project of decision support for district administration was launched, and the Karwar experiment of National Rural Employment Program computerization. Consequently to the Karwar experiment the Rural Development Department launched in co-operation with the NIC the Computerized Rural Information Systems Project (CRISP) for implementation during the Seventh Plan period (1985 - 1990). CRISP is implemented in 150 districts. That means the fitting of 150 micros and the development of software on the successful Karwar model. They are the first steps of Indian computing activities in direction of districts.

VII.3. THE LAND RECORDS AND THE DEVELOPMENT

The previous section has showed that the Government policy has changed for some years in order to improve the development thanks to the new technologies. Is this policy good ? We think that yes. In order to support this assertion, let us see how the land records computerization participates to the Indian development.

VII.3.1. THE DEVELOPMENT : A DEFINITION

The development is stated in the Study Guide on Development of the Food and Agriculture Organisation as :

- "The ultimate purpose of development is to provide everyone with ever-increasing opportunities for a better life. It, therefore, acquires an equitable distribution of incomes and other social resources in order to promote justice and efficient production, to raise levels of employment substantially, to expand and improve facilities for education, health, nutrition, housing and social and cultural well-being. The qualitative and structural changes that development thus imposes on society must go hand in hand with economic progress while racial, ethnic and social inequalities must be substantially reduced. These are decisive factors in hastening development and hence must be handled with dynamism." [FAO,75]

The development has to be considered therefore as social and cultural change as well as economic growth.

For Lassey [LAS,77], the focus of rural development should be on :

- the preservation of ecological integrity with a view to providing a continuing supply of life supporting resources,
- efficient and appropriate land use,
- healthy living conditions,
- esthetically pleasing environment,
- effective social, economic, and governmental institutions,
- improved human welfare in terms of a minimal economic and social level of existence,
- physical structures and adapted landscape of pleasing design.

As we will see, the Dunderpur's pilot project can participate to several points of this rural development definition.

VII.3.2. PILOT PROJECT AND DEVELOPMENT

As said, the use of computers at the district or tahsil level may, if the applications are well chosen, take part in the development of India. The pilot project of Dunderpur is a proof of this assertion. It takes part in the most important development of India, the rural development.

To think however that the first objective of land records computerization is the rural development is a mistake. Work improvement and data quality, achieved thanks to the computers are most probably the preminent factors which bring about consequences on the rural development. These consequences are direct as well as indirect.

The main direct consequence of land records computerization on the rural development is economic. The accuracy and availability of land records will entail important economic changes in the country scenery. Thanks to well organized and computerized procedures, the landholders will be secured that their

ownerships are registered carefully and therefore that in case of dispute or loan request they will be able to show a copy of their goods. They will not fear any more thus to invest in their lands.

The indirect consequences are multiple. They concern mainly the different laws and development schemes launched by the Government and the States. Let us quote among others the reforestation schemes, the irrigation schemes, the tenure law, the land ceiling law, etc.

VII.3.2.1. THE LAND RECORDS, FIRSTLY AN ADMINISTRATIVE WORK

To think that the land records are computerized firstly for the rural development would be a misinterpretation. The real problem of land records is their lack of updating and availability. The land records maintenance remains an administrative work, which is badly managed and needs to be cured. The results on the rural development will undoubtedly follow since, as it is well stated in the rural development definition, to work for the efficiency of governmental institutions is to work for the rural development.

If we observe the Dunderpur's project as it has been presented, we can note that the project has been studied from the point of view of an administrative procedure to be analysed, reviewed and computerized. Indeed that is the improvement of this procedure that will bring about the rural development and not the opposite. If we want the computer to be a development factor, its use needs to be well thought; it has not to be compulsorily linked to a specific and precise development scheme.

The two next sections present the consequences which will be brought by the land records computerization.

VII.3.2.2. DIRECT CONSEQUENCES ON DEVELOPMENT

It is accepted on all hands that records-of-rights in land have an important part to play in the functioning of the economy. Land is not only the most important economic asset in an agricultural economy, it is an essential resource because without land there can be no state, no habitation and no ground-work for carrying on human activities. Land is a mother resource giving rise to various other things of economic value. Even in urban societies, it is regarded as the most valuable resource from the economic point of view [WAD,89].

The need for registration of land records is really important for a country. That is still far more true for a developing country as India, where land has become scarce, where well-defined boundaries have become imperative, where credit is required on the security of the land and where, in fact, individual proprietary rights have become very important because land has acquired a negotiable value. The absence of such registration comes in the way of supply of capital for development and is responsible for the excessive cost of credit in agriculture and therefore its slow growth. It renders title to land so insecure that

is highly unsafe to buy land without heavy expense for legal advice. Lastly, it generates a great deal of litigation.

Moreover with the increasing pressure on land caused by the increasing population, the importance of certainty of title to land will increase. One can not say whether the move towards urbanisation will continue in India or whether it will be checked by some factors that may suddenly emerge on the economic scenery. In any case, with land changing hands more frequently than before, with more and more land passing into the hands of companies and corporations, and with more and more securities being created on land, the desirability of good title in land must grow in importance. [WHA,89]

VII.3.2.3. INDIRECT CONSEQUENCES ON DEVELOPMENT

The indirect consequences on development are multiple. Their source may be found in the availability of land record information. Thanks to the information recorded in the computer and the capacity of computer to process it in different ways, the opportunities of development are numerous and varied. We can divide them into two parts : one for the consequences pertaining to the agrarian laws and reforms, an other for those pertaining to the rural development schemes or programmes.

VII.3.2.3.1. INDIAN LAND REFORMS

Agrarian reforms have been undertaken in India with a view to promote both economic growth and social equity. At the time of independence, a large part of the agrarian system was characterised by feudal and semi-feudal production relation. The legal rights of landownership were concentrated in the hands of a parasitic landlords classes : the zamindaris, the jagirdars, the ryotwaris.

The Jagir, Zamindari and Ryot systems emerged during the Moghul period from emperor's right to transfer power to collect revenue to certain people : the jagirdars, the zamindaris and the ryotwaris. At this time, a great majority of the cultivators had so either no right in land or had only limited rights as tenants; all was in the hands of these landlords, intermediaries between the king and the peasantry.

With the time, the jagirdar behaved in all respects as the 'owner' of the land. He was required to pay a fixed amount of tribute to the state. However, the tribute he paid and the rents he realised from his tenants and cultivators did not bear any direct relation. In fact, he realised much more than what he paid as tribute.

After the independence, the agrarian policy of the government aimed to change this feudal situation into a democratic system. These changes are known as the land reforms. They have generated many laws. The main are : intermediaries abolition law, land ceiling law and tenure law. Let us detailed each of them in specifying which role the computer can play to improve their efficiency that remains quite weak, at least until now.

- *Intermediaries abolition law* : During the '50s, almost all states in India enacted legislation for the abolition of intermediaries. These ones were allowed to retain possession only of lands under their 'personal cultivation'. Their tenants were given the right to purchase lands from them. It has been estimated that as a result about twenty million cultivators were brought into direct contact with the government.

However, the lengthy procedure followed by various State Governments in matters of legislation and implementation, coupled with many legal flaws, administrative indifference and judicial delays, gave the intermediaries an opportunity to evade the law through paper partitions of properties by influencing village officials in changing the land records and pressurizing the tenants to register themselves as farm servants or wage labourers. All these factors have led to a partial failure of the measures undertaken to abolish intermediaries with the result that even today many ex-zamindaris continue to own large areas of land on which cultivation is done mainly with the help of farm servants or share-croppers. [HAQ,86]

In this case, the help of computer is rather limited. It will allow to check the real value of ex-intermediaries ownerships. By crosscheckings, one will be able to gather the holdings of a ex-intermediary and so check if he does not own more than he could cultivate personally. Perhaps will it be possible to find out some wilful errors registered in the records.

- *land ceiling law* : the principle is simple. The amount of land that a person may hold is subject to an upper limit. The ceilings vary from 3.68 hectares of irrigated land to 24.28 hectares of unirrigated land.

Thanks to the computer, it will be possible to count the total amount of irrigated and unirrigated areas of each owner and than to find out who owns more than it is permitted.

- *tenure security and regulation of rent* : the land tenure laws and reforms are numerous and often complex. We can however distinguish two important categories : those pertaining to the tenure security or to regulation of rent.

The tenure security aims to protect the tenants from any arbitrary eviction. A tenant has not to fear to loose the right to work on the lands that he rents.

The regulation of rent tries to avoid renting-rack. The rents have been fixed by State Government and range generally between 1/4 and 1/6 of gross output.

From the jamabandi information, one could specify per holder which fields are rented, who are their tenants, and how much the tenure amounts. This would improve the tenure security and could allow to check if the rent regulation laws are abided. This idea is more developed by T. Haque and A.S. Sihori [HAQ,86] : " (...) Moreover, it looks doubtful, if any rent regulation measure can ever be effective in the absence of absolute security of tenure and detailed land records."

Let us stress that before the independence, in many places in India, the information pertaining to the tenants was written in the jamabandi.

VII.3.2.3.2. RURAL DEVELOPMENT SCHEMES AND PROGRAMMES

The rural development programmes launched since the independence are very numerous and therefore can not be reviewed all here. Only the most important programmes having a link with the land records information are here presented.

- *Small and marginal farmers* : it has been estimated that about 72.6 per cent of the total operational holdings in India are small (< 1.42 hectares) and marginal (< 0.39 hectares) which accounts for nearly 23.5 per cent of the total operated area in the country. In fact, small and marginal farmers constitute the largest group of cultivating population in India and therefore, any agricultural development to make sense, must make its impact felt through improvement in their economic condition [HAQ,86]. In recent years, some special measures have been undertaken to improve the socio-economic conditions of small and marginal farmers through increased institutional facilities of irrigation, credit, subsidy and the setting up of subsidiary occupation like dairing, poultry, piggery etc. Thanks to the computer it would be easy to find out which landholders are marginal or small.
- *Consolidation of landholdings* : an important problem in the Indian countryside is the fragmentation of landholdings. The reasons of land fragmentation are numerous. The main are the sale, the mortgage and the leasing of patches of land. The reduction of land size has of course economic consequences. The bad investment-benefit ratio is undoubtedly that which has the most important ones consequences in the rural scene because it entails a refusal of investment, and therefore of improvement, from the peasants for their fields. The consolidation of landholdings tries to reduce the land fragmentation by gathering together low landholdings. Thanks to the computer, it would be easy to find out the low landholdings.
- *Reforestation and irrigation schemes* : the reforestation and irrigation schemes are the most important rural schemes in India. The land records are very useful for a good achievement of these ones. They allow indeed to find out where it would be advisable to launch a reforestation/irrigation programme and to know which landholder and fields will be affected. The use of computer would undoubtedly make easier these tasks.
- *Schemes pertaining to caste, sex or poverty of landholder* : there is several schemes that help the low caste, female and poor peasants. It would be easy thanks to the computer to find out these persons. That will become still more interesting when the tenants will be registered in the jamabandi.

VII.4. DISTRICT INFORMATION CENTRE - DIC

We think that the true origin and the realisation of all the consequences presented above are strongly linked to computerization of the district office. The next sections try to prove this. We will go even farer by saying that the tahsil office computerization could really participate to a better development of India.

VII.4.1. WHY TO WORK AT THE DISTRICT LEVEL

On account of its administrative position - all the departments are represented -, the district is often the basis from where the rural development programmes are launched, supervised and analysed.

The continuing importance of rural development is evident from the large outlay for poverty alleviation programmes envisaged in Indian's Seventh Plan. For instance, a sum of Rs. 100 billion (Belgian Francs 250 billion) is to be spent on the Integrated Rural Development Programme (IRDP) which is intended to provide individuals living below the poverty line with assistance. In addition, considerable sums of money are regularly spent in the districts on running existing social services. The emphasis of the new Government which came to power in January 1990 is on spending fifty per cent of the national plan resources in the rural sector. However despite large sums of being spent on rural development in the districts, there is a feeling that much of this expenditure is not properly utilised and the impact of the resources spent on the rural countryside continues to be marginal.

So since expenditure is large and the results quite weak, the potential benefits from using computers could be immense. [BAT,90] and [MEH,84]

Access to district level microcomputers will enhance the capability of planners, administrative officers and clerks in several directions. The most important are :

- *flexible retrieval and analysis of detailed data* : rural planning has suffered and still suffers from a lack of access to detail about the client / village / tahsil / district on which expenditure is being incurred. Officers who make an effort to plan are handicapped by poor access to detailed data. Information required for the monitoring and control of development programmes may be available but is generally inaccessible for purposes of analysis because of the long chain of clerical staff through which it must be retrieved.
- *improved data quality* : using district level computers will improve data quality and enable much better validation since data capture will be close to the source. In the Dungerpur's project, the collection and recording of data at tahsil district already asserts this improvement.
- *integration of data across departments* : the information recorded may be used by several departments.
- *analysis through graphics* : thanks to graphical output it is possible to locate some data on diagrams, maps, etc. That allows quicker and easier analysis.
- *performance comparisons* : a final advantage of using computers is that they can be used to introduce a high degree of *standardization* in the government system and this would enable effective cross-comparisons to be made. Such comparisons will highlight areas of substantially better performance and enable learning to be transferred to other areas.

- *open access to information* : the existing closed and non-participative style of bureaucracy is an outcome of the secrecy built around any kind of data by government functionaries. The fact that any data can be obtained only through a clerk is used as a source of power vis-à-vis superiors. This personal control over data is also used to deny access to the public of data concerning them and is a major source of petty corruption.

We believe that the general trend of providing computing resources exclusively at the State and National level will not be sufficient to make a major impact on rural development and administrative work. It is essential that microcomputers with suitable software are positioned at the district quarters if we wish the culture of computer being integrated to the Indian administration and development. The costs of microcomputers makes this a very real possibility. The level of investment required will be of the order of Rs.300 thousand (Belgian Francs 750,000) for each district in a state - an expenditure that is finally not so great. The benefits, as we have argued would be far more substantial. Ideally the approach should be to have both district-level microcomputers and state/national-level mainframes. [BHA,88]

VII.3.2. HOW TO WORK IN A DIC : SOME IDEAS

The provision of microcomputers will not in itself lead to the above benefits. There are several concomitant factors which are crucial for the success of this effort :

- A clear understanding that automation of existing procedures is not enough. Designers must have a deep understanding of problem context and must not be 'machine-oriented'. Each procedure must be firstly reviewed, analysed, thought in accordance with users and only then adapted to computer. Moreover the designers must have the ability to develop models and to draw on integrated data so as to provide with information what is impossible to produce manually rather than merely 'speeding up' and 'cleaning up' existing data.
- It is essential to involve users closely with the entire effort. Access to computers, user friendly software, accurate and detailed data bases may not necessarily lead to computer use for planning and monitoring. More important is the motivation of the key district functionaries because such use can not evolve without their actual participation and some change in the style of functioning.
- Field level implementation will require substantial use of computer software which is expensive. This means that software will have to be specific but capable of application to many districts to spread its costs over several users.
- Maintenance support for both hardware and software will be critical as the district headquarters will often be quite distant from the major metropolitan towns. The staffing of district computer centres will undoubtedly be a key determinant in the successful use of computers in the districts.

- Extensive implementation training of persons concerned with data use will have to be undertaken.

Lastly, let us underline that it is much easier to implement data processing systems if they do not involve any real change in the way of achieving the department functions. Moreover, considerable clerical effort may be then saved and therefore, there is an intrinsic motivation to develop these systems. For successful implementation of such applications, saving of clerical effort needs to be demonstrated and the clerical operatives need to be trained. Several experiments (Surendranagar, Karwar, Dharampur [PAT,87]) have shown that it is possible to train district level clerical staff to work with computers for inputting data, generating reports and even programming to a limited extent.

VII.3.3. A TAHSIL INFORMATION CENTRE ?

As proposed in the land record solution, it could be interesting to open a Tahsil Information Centre. The tahsil is a good basic unit for computer-aided work and analysis since it is the lowest level of the country's administration. It is small enough to facilitate detailed analysis of needs and opportunities, while at the same time it is large enough to be an economically viable unit - the population of a typical tahsil amounts to 150,000 - 200,000 persons.

The problems that the Tahsil Information Centre would meet at the time of its creation and that will be able to reduce it to a failure are very similar to those which make difficult the District Information Centre life. These main problems are :

- a lack of awareness of the computer technology and their use on the side of the top executive. As long as the computers will be ignored or held in contempt by the officials, their introduction will be successful.
- a lack of computer culture in the administration. That brings about therefore a strong training of all the functionaries, from the top to the lowest clerk.
- a lack of maintenance support. Any problem which would occur within the software or the hardware will take time before being resolved.
- a difficulty to find out the really beneficial applications to be computerized. A great deal of computer professionals do not have any organizational skills. They are computer-oriented. That is not enough to have good return from computers.
- a lack of accurate data. The data quality is very important if we want to avoid a 'garbage in - garbage out' phenomenon. Very often the data are not up to date.

Even if the idea of a Tahsil Information Centre as well as that of a DIC remains still marginal in the Indian policy, the major advantages of these decentralized approaches are many. Let us hope therefore that the difficulties which make difficult their use will not stop the Indian authorities, but that on the contrary the success of experiments like that of Surendranagar or Karwar

will encourage them to progress in this direction which undoubtedly is the direction of the development.

VII.3.4. A GRAPHICAL GLOBAL VIEW

Figure VII.2. gives a global view of the above ideas. It represents the computer science structure that would have to be built in India.

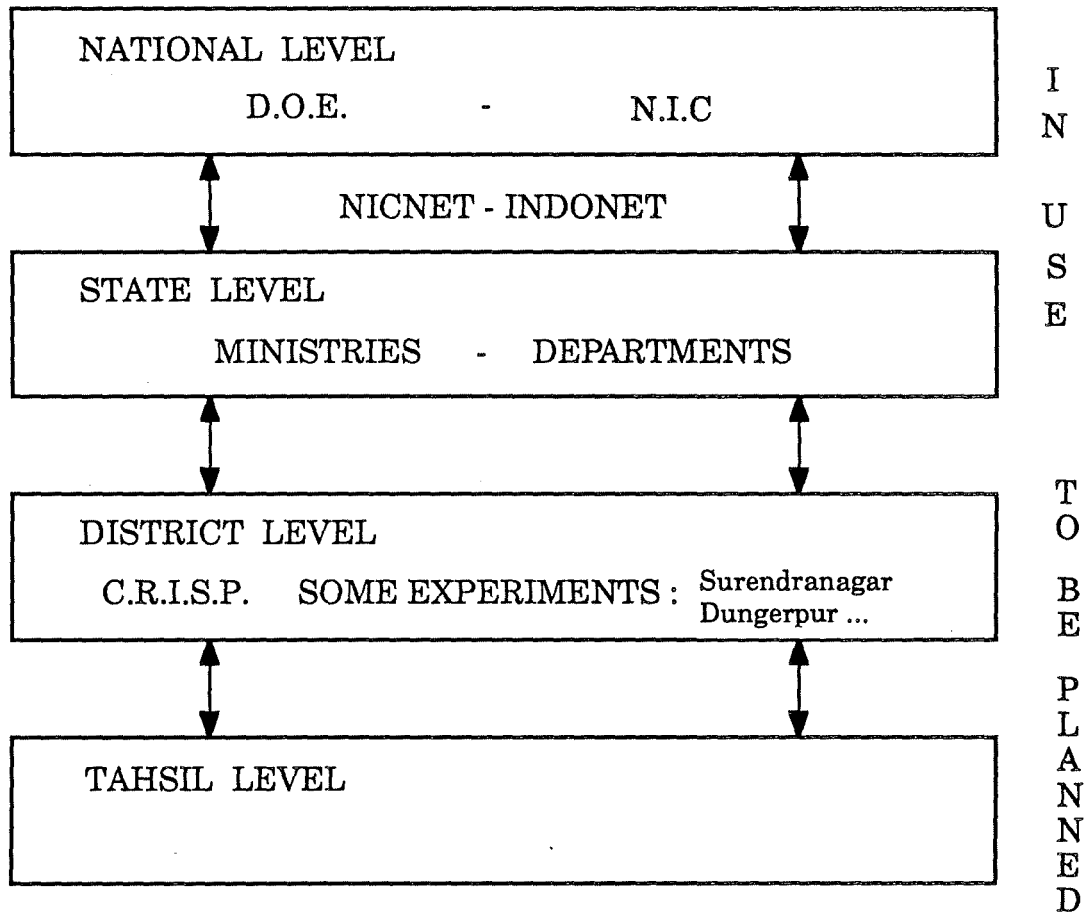


Figure VII.2.: A global view

The reader will notice that all the boxes are linked together by double arrows. These arrows aim to show that the different computer approaches taken at each level must be linked together to be optimal. That will be possible among other things thanks to an integrating thought and the presence of networks.

The repercussion of computers in the development of India will increase in building this computer science structure. As the tasks carried out by the NIC prove it, the domains in which the computer can help are quite open: administration, economy, agriculture, natural resources, transports, demography, energy, education, social planning, etc. The improvement of these domains undoubtedly will increase the development level of India.

Moreover, the more computer will be present at all the levels the more its use will be better understood and assimilated. New ideas of use pertaining to more specific problems will then rise, promoting the development of India.

VII.5. CONCLUSION

Land and human resources are the two main possessions of the Indian population. The maximum and optimum utilization of land resources for productivity as well as accessibility of land to a larger proportion of the village population should be therefore the central focus of rural development.

Today the national policy has elaborated the main orientations of the Indian rural development. Laws have been voted and big schemes/programmes have been launched. Their result are still partial. These laws, schemes and programmes need still to find their real insertion in the Indian rural life.

For Mehta R. [MEH,86], the real problem is the unit of development in rural areas. What should it have to be ? Should it be a village, a group of villages or a block or should it be administered through the district administration ? For him, the district, as a unit of implementing rural development, is ruled out but it can be a suitable unit for planning purposes. The village is a too small to be economically viable. On the other hand, an intermediate level between the village and block level would be ideal.

The computer would have to progress in this direction. A part of the path is already gone over. The National and State levels make use of computers in their administrative and development works. Now lower levels as the district and the tahsil must be computerized. The pilot project of Dungerpur's land records computerization progresses in this direction. It will allow to increase the development level of Dungerpur's district and be an image of what has to be done at the level of all rural India.

VIII CONCLUSION

The land records are important for India, its economy and its development. Land is the only wealth of 70 per cent of the population. So without updated land records the life of all these people are threatened. Indeed the land records are the proof of their landownership.

The opportunity study of the land records computerization has allowed to find out the true shortcomings of the present land records : the extra work and the lack of informational cohesion. The land records computerization will reduce the time spent to tiresome administrative works of updating and rewriting. Moreover it will secure the standardization of the documents and of their information. Such standardization will allow to save the Revenue Department staff as for the other administrative employees which use the cadastral data. The time that will be saved is however difficult to value.

The strengthening of the informational cohesion by the creation of a new jamabandi will certainly improve the time saving, but that is not its first aim. The removal of the mutation register and the continuous updating of the jamabandi by computer allow to have constantly a good image of the land reality. This situation is very important because it gives back to the land records their real meaning : the records-of-right. Indeed as soon as they will be regularly updated, the land records will be a good representation of rights of each landowner. The presence of stamps on the mutation form tries to go even further in this direction, because it materializes the idea according to which a land records could be used as a judicial proof of landownership. This idea yet weakly rooted within the mentality, will take time before being approved.

The decentralization by microcomputer is certainly the best solution for the land records computerization. In comparaisn with the mainframe use the use of microcomputer is advantageous for land record computerization. To work on micro requires neither a complex infrastructure nor a very qualified technical staff to work. Moreover since it can be installed in the district or tahsil office, the micro will be close to the land revenue staff. The risk of disturbing the employees in their work is thus strongly reduced.

The decentralization has however two shortcomings. The first is linked to the microcomputer memory. It is insufficient to deal the entirety of the land records of a district. The second pertains to the number of districts or tahsils which have to be fit out with micros. Their number is consistent and therefore their fit out expensive.

The complexity of land records system has troublesome consequences on the land records computerization because it hinders the analyst from defining the application area. It is therefore impossible to specify all the functions of the land records application. That is why the methodological approach is drawn towards the prototyping and the modularity.

In our approach we do not propose a prototype to discard. The prototype is the basis for the methodology of the operational system development. In this scenario the system evolves by an iterative process, i.e. when a new function is found out and implemented. It is thus an evolutionary information system development.

The modularity is the key element of an easy evolution. If it is strictly respected, the maintenance will be facilitated.

The land records computerization will undoubtedly participate to the development of India. Their consequences will be as well direct as indirect. The certainty for an owner to have an accurate land records copy at his disposal will ensure to him the recognition of his rights on his lands by everybody. This fact brings about direct consequences such as a trust in the land investments or credit facilities.

The indirect consequences are numerous. Their source may be found in the availability of land records information. There are mainly the development schemes and programmes.

Today, at the end of the Seventh Plans, we can conclude that the development policy must take new wings. Thanks to the open Seventh Plans, the National and States development policies are now well established. However if we want to keep the favourable effects and go further in this direction, it is time to think about the planification of the lower levels, the district and the tahsil. The land records computerization is certainly one of the best opportunities which offers to the Government.

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APPENDIX : THE QUERY MODULE

```
*****
*
* MAIN PROCEDURE WITH ALL THE IMPORTANT PROGRAMS *
*
*****
```

```
*
* WAITING MESSAGE
*
```

```
procedure waiting
```

```
clear
```

```
@ 9,20 to 14,58 double
@ 11,25 say " THE PROGRAM IS WORKING !!! "
@ 12,25 SAY " PLEASE, WAIT A MOMENT ... "
```

```
return
```

```
*****
*****
```

```
*
* PROGRAM TO VERIFY THE PRESENCE OF THE DATABASE: TAHSIL-VILLAGE NAME
* CALLING THE SCREEN TO INSERT THE NAMES & THE VERIFICATION ON DRIVE A
* Name: newrec
*
```

```
procedure newrec
```

```
set talk off
set echo off
set bell off
set stat off
set score off
set delimiters off
set safety off
```

```
public tashname,villname
```

```
store space(20) to tashname,villname,mtname,mvname
store .f. to mfound
```

```
do while .not. mfound
```

```
do fnewrec with mtname,mvname
```

```
store " " to mtash,mvill
store ".dbf" to mqueue
store substr(mtname,1,4) to mtash
store substr(mvname,1,4) to mvill
```

```
do floppy with mtash,mvill,mfound
```

```
enddo
```

```
store mtname to tashname
store mvname to villname
```

```
select 1
```

```
use jmbdi
zap
append from a:&mtash&mvill&mqueue
```

```
return
```

```
*****
*****
```

```
*
* MAIN MENU
* Name: fmenu
*
```

```
procedure fmenu
parameters op
```

```
set talk off
set echo off
set bell off
set stat off
set score off
set console off
```

```
clear
store 0 to row,col,firstrow,k,pr,pm,cm
store " " to cr
store space(21) to mes1,mes2,mes3,mes4
mes1 = " WORK ON NEW FLOPPY "
mes2 = " QUERY "
mes3 = " UPDATE - MUTATION "
mes4 = " EXIT TO DOS "
```

```
firstrow = 9
lastrow = 6
col = 30
pm = 1
cm = 1
```

```
@ 0,0 to 2,79 double
@ 1,20 say "DISTRICT REVENUE DEPARTMENT - LAND RECORDS"
@ 3,0 to 23,79
@ 20,1 to 20,78
@ 21,6 say "line down : SPACE or "+chr(25)
@ 21,33 say "line up : "+chr(24)
@ 21,51 say "top : HOME"
@ 21,66 say "end : END"
@ 22,22 say "to accept the selection : RETURN"
@ 5,30 to 7,48
@ 6,35 say "MAIN MENU"
set color to w
row = firstrow
pr = row
```

```
@ row,col say mes1
@ row+2,col say mes2
@ row+4,col say mes3
@ row+6,col say mes4
store .t. to mflaq2
```

```

do while mflaq2

  set color to w/
  cr = str(pm,1)
  @ pr,col say mes&cr
  cr = str(cm,1)
  set color to /w
  @ row,col say mes&cr
  set color to w/
  store .t. to mflaq3

  do while mflaq3

    k = inkey()
    if (k=5 .or. k=1 .or. k=6 .or. k=24 .or.;
        k=13 .or. k=32)
      store .f. to mflaq3
    endif

  enddo

pr = row

do case

  case k = 1
    row = firstrow

  case k = 5
    if row = firstrow
      row = row + lastrow
    else
      row = row - 2
    endif

  case k = 6
    row = firstrow + lastrow

  case k = 24
    if row = firstrow + lastrow
      row = firstrow
    else
      row = row + 2
    endif

  case k = 32
    if row = firstrow + lastrow
      row = firstrow
    else
      row = row + 2
    endif

  otherwise
    op = (row - 7) / 2
    store .f. to mflaq2

endcase

if mflaq2
  pm = (pr - 7) / 2
  cm = (row - 7) / 2

```

```
else
  return
endif
```

```
enddo
```

```
return
```

```
*****
*****
```

```
*
* MAIN PROGRAM
* Name : MAIN
*
```

```
procedure main
```

```
set talk off
set echo off
set bell off
set stat off
set score off
set delimiters off
set color to w/
public tashname,villname
```

```
do newrec
```

```
do waiting
```

```
store .t. to work
```

```
do while work
```

```
  store 0 to op
```

```
  do fmenu with op
```

```
  sele jmbdi
```

```
  do case
```

```
    case op = 1
      do newrec
```

```
    case op = 2
      do query
```

```
    case op = 3
      do mutation
```

```
    case op = 4
      do quit with work
```

```
  endcase
```

```
enddo
```

```
return
```

```
*****
*****
```

```
*
* PROGRAM DISPLAYING THE QUERY MENU
* Name: fquery
*
```

```
procedure fquery
```

```
parameters code1,sell,signel,code2,sel2,signe2,code3,sel3,signe3,flee
```

```
set talk off
set echo off
set bell off
set stat off
set score off
set console off
set delimiters off
set safety off
```

```
store .t. to flag
```

```
do while flag
```

```
store 0 to indx
store " " to signe
store 0 to row,col,firstrow,pr,pm,cm
store 9 to k
store " " to cr
store space(16) to mes1,mes2,mes3,mes4,mes5
store space(18) to mes6,mes7,mes8,mes9
```

```
mes1 = " KHATA NUMBER      "
mes2 = " HOLDER NAME        "
mes3 = " CASTE                "
mes4 = " HOLDER ADDRESS     "
mes5 = " FIELD AREA          "
mes6 = " SHARE                "
mes7 = " PLOT NUMBER         "
mes8 = " LANDTYPE            "
mes9 = " SOURCE OF IRRIG.   "
```

```
firstrow = 9
lastrow = 6
firstcol = 2
seccol = 21
col = firstcol
pc = firstcol
mpcolflag = 0
mccolflag = 0
pm = 1
cm = 1
```

```
clear
```

```
@ 0,0 to 2,79 double
@ 1,20 say "DISTRICT REVENUE DEPARTMENT - LAND RECORDS"
@ 3,0 to 23,79
@ 20,1 to 20,78
@ 20,0 say chr(195)
```

```

@ 20,79 say chr(180)
@ 21,2 say "line down: SPACE or "+chr(25)
@ 21,26 say "line up: "+chr(24)
@ 21,39 say "change col.: "+chr(26)+" "+chr(27)
@ 21,58 say "top: HOME"
@ 21,70 say "end: END"
@ 22,2 say "selection: RETURN"
@ 22,23 say "previous menu: PGDN"
@ 22,47 say "accept query: PGUP"
@ 5,9 to 7,27
@ 6,13 say "QUERY MENU"
@ 4,42 to 19,42
@ 3,42 say chr(194)
@ 20,42 say chr(193)
@ 11,43 to 11,78
@ 11,42 say chr(195)
@ 11,79 say chr(180)
@ 12,45 say "Selection : "
set color to w
row = firstrow
pr = row
rowwin3 = 14
@ row,firstcol say mes1
@ row+2,firstcol say mes2
@ row+4,firstcol say mes3
@ row+6,firstcol say mes4
@ row+8,firstcol say mes5
@ row,seccol say mes6
@ row+2,seccol say mes7
@ row+4,seccol say mes8
@ row+6,seccol say mes9

store .t. to mflag2

do while mflag2

    set color to w/
    cr = str(pm,1)
    @ pr,pc say mes&cr
    cr = str(cm,1)
    set color to /w
    @ row,col say mes&cr
    set color to w/
    store .t. to mflag3

    do while mflag3

        k = inkey()
        if ( k=1 .or. k=2 .or. k=3 .or. k=4 .or. ;
            k=5 .or. k=6 .or. k=13 .or.;
            k=24 .or. k=32 .or. k=18 .or. k=19)
            store .f. to mflag3
        endif

    enddo

pr = row
pc = col
op = 0
do case

```

```
case k = 1
  if col = firstcol
    row = firstrow
  else
    col = firstcol
    row = firstrow
    mcolflag = 0
    mpcolflag = 5
  endif

case k = 19
  col = firstcol
  mpcolflag = 5
  mcolflag = 0

case k = 4
  col = seccol
  mcolflag = 5
  mpcolflag = 0

case k = 5
  if row = firstrow .and. col = firstcol
    row = row + lastrow
    col = seccol
    mcolflag = 5
    mpcolflag = 0
  else
    if row = firstrow .and. col = seccol
      row = row + lastrow + 2
      col = firstcol
      mcolflag = 0
      mpcolflag = 5
    else
      if col = seccol
        row = row - 2
        mcolflag = 5
        mpcolflag = 5
      else
        row = row - 2
        mcolflag = 0
        mpcolflag = 0
      endif
    endif
  endif

case k = 6
  if col = seccol
    row = firstrow + lastrow
    mpcolflag = 5
    mcolflag = 5
  else
    col = seccol
    row = firstrow + lastrow
    mcolflag = 5
    mpcolflag = 0
  endif

case k = 3
  store .f. to mflag2
  store .f. to flag
  store .t. to fl
```



```

store l to flee
store "n" to maccept
@ 21,1 clear to 22,79
set color to /w
@ 21,23 say " ARE YOU SURE THAT YOU WANT TO LEAVE ... "
@ 22,23 say "                press Y to accept "
set color to w/
@ 21,79 to 22,79
k = 0
do while k = 0
    k = inkey()
enddo
if upper(chr(k)) <> "Y"
store .t. to mflag2
store .f. to fl
store .t. to flag
store 0 to flee
@ 20,1 to 20,78
@ 20,0 say chr(195)
@ 20,79 say chr(180)
@ 21,1 clear to 22,78
@ 21,2 say "line down: SPACE or "+chr(25)
@ 21,26 say "line up: "+chr(24)
@ 21,39 say "change col.: "+chr(26)+" "+chr(27)
@ 21,58 say "top: HOME"
@ 21,70 say "end: END"
@ 22,2 say "selection: RETURN"
@ 22,23 say "previous menu: PGDN"
@ 22,47 say "accept query: PGUP"
endif

case k = 18
store .f. to mflag2
store "n" to maccept
@ 21,1 clear to 22,78
set color to /w
@ 21,15 say " THE SEARCH WILL BE PERFORMED WITH THIS
SELECTION "
@ 22,15 say "                press Y to accept
"

set color to w/
k = 0
do while k = 0
    k = inkey()
enddo
if upper(chr(k)) <> "Y"
@ 21,1 clear to 22,78
set color to /w
@ 21,11 say " DO YOU WANT TO ADD AN OTHER CRITERION TO THE
SELECTION "
@ 22,11 say " If no, the whole previous selection will be
removed "

set color to w/
k = 0
do while k = 0
    k = inkey()
enddo
if upper(chr(k)) <> "Y"
store .f. to flag2
else
store .t. to mflag2

```

```

    @ 20,1 to 20,78
    @ 20,0 say chr(195)
    @ 20,42 say chr(193)
    @ 20,79 say chr(180)
    @ 21,1 clear to 22,78
    @ 21,2 say "line down: SPACE or "+chr(25)
    @ 21,26 say "line up: "+chr(24)
    @ 21,39 say "change col.: "+chr(26)+" "+chr(27)
    @ 21,58 say "top: HOME"
    @ 21,70 say "end: END"
    @ 22,2 say "selection: RETURN"
    @ 22,23 say "previous menu: PGDN"
    @ 22,47 say "accept query: PGUP"
  endif
endif
case k = 24
  if row = firstrow + lastrow + 2 .and. col = firstcol
    row = firstrow
    col = seccol
    mcolflag = 5
    mpcolflag = 0
  else
    if row = firstrow + lastrow .and. col = seccol
      row = firstrow
      col = firstcol
      mcolflag = 0
      mpcolflag = 5
    else
      if col = seccol
        row = row + 2
        mcolflag = 5
        mpcolflag = 5
      else
        row = row + 2
        mcolflag = 0
        mpcolflag = 0
      endif
    endif
  endif
endif
case k = 32
  if col = firstcol
    if row = firstrow + lastrow + 2
      row = firstrow
      col = seccol
      mcolflag = 5
      mpcolflag = 0
    else
      row = row + 2
      mcolflag = 0
      mpcolflag = 0
    endif
  else
    if col = seccol
      if row = firstrow + lastrow
        row = firstrow
        col = firstcol
        mcolflag = 0
        mpcolflag = 5
      else

```

```

        row = row + 2
        mcolflag = 5
        mpcolflag = 5
    endif
endif

endif

otherwise
    op = ((row - 7) / 2) + mcolflag
    @ 4,43 clear to 10,78
    indx = indx + 1
    queue = ltrim(str(indx))
    store " " to signe&queue,choice
    store space(30) to holdname
    store 0 to khatanumb,area
    store space(20) to caste,adress,landtype,sourcirri
    store space(10) to share
    store space(24) to plotnumb

    if op = 1

        do while .t.

            @ 5,45 say "ENTER THE KHATA NUMBER"
            @ 7,45 get khatanumb picture "9999"
                read
            if khatanumb = 0
                indx = indx - 1
                exit
            endif
            @ 9,45 say "to confirm , SPACE ..."

            k = 0
            set console off
            do while k = 0
                k = inkey()
            enddo
            if k <> 32
                loop
            endif

            @ rowwin3,45 say "KHATA NUMBER= "+str(khatanumb,4,0)
            store "1" to code&queue
            store str(khatanumb) to sel&queue
            rowwin3 = rowwin3 + 2
            exit
        enddo

    endif

    if op = 2

        do while .t.

            @ 5,45 say "ENTER THE NAME OF THE HOLDER"
            @ 7,45 get holdname
                read
            if holdname = " "
                indx = indx - 1

```

```

        exit
    endif
    @ 9,45 say "to confirm , SPACE ..."

    k = 0
    set console off
    do while k = 0
        k = inkey()
    enddo
    if k <> 32
        loop
    endif

    @ rowwin3,45 say "HN= "+holdname
    rowwin3 = rowwin3 + 2
    store "2" to code&queue
    store holdname to sel&queue
    exit

    enddo

endif

if op = 3

    do while .t.

        @ 5,45 say "ENTER THE CASTE NAME"
        @ 7,45 get caste
            read
        if caste = " "
            indx = indx - 1
            exit
        endif
        @ 9,45 say "to confirm, SPACE ..."

        k = 0
        set console off
        do while k = 0
            k = inkey()
        enddo
        if k <> 32
            loop
        endif

        @ rowwin3,45 say "CASTE NAME= "+caste
        rowwin3 = rowwin3 + 2
        store "3" to code&queue
        store caste to sel&queue
        exit

    enddo

endif

if op = 4

    do while .t.

        @ 5,45 say "ENTER THE HOLDER ADDRESS"
        @ 7,45 get adress

```

```

        read
    if adress = " "
        indx = indx - 1
        exit
    endif
    @ 9,45 say "to confirm, SPACE ..."

    k = 0
    set console off
    do while k = 0
        k = inkey()
    enddo
    if k <> 32
        loop
    endif

    @ rowwin3,45 say "ADRESS= "+adress
    rowwin3 = rowwin3 + 2
    store "4" to code&queue
    store adress to sel&queue
    exit

enddo

endif

if op = 5

do while .t.

    @ 5,45 say "CHOSE IF AREA < = > : " get signe
        read
    if signe = " "
        indx = indx - 1
        exit
    endif
    if signe <> "<" .and. signe <> "=" .and. ;
        signe <> ">"
        signe = " "
        loop
    endif
    @ 7,45 say "ENTER THE AREA: " get area picture

"9,999.999"
        read
    if str(area,9,4) = " "
        exit
    endif
    @ 9,45 say "to confirm, SPACE ..."

    k = 0
    set console off
    do while k = 0
        k = inkey()
    enddo
    if k <> 32
        loop
    endif

    @ rowwin3,45 say "AREA: "+signe+" "+str(area,9,4)
    rowwin3 = rowwin3 + 2
    pr = 17

```

```

        row = 17
        mcolflag = 0
        mpcolflag = 0
        code&queue = 5
        store "5" to code&queue
        store str(area,9,4) to sel&queue
        store signe to signe&queue
        exit

    enddo

endif

if op = 6

    do while .t.

        @ 5,45 say "CHOSE IF SHARE < = > : " get signe
        read
        if signe = " "
            indx = indx - 1
            exit
        endif
        if signe <> "<" .and. signe <> "=" .and. ;
            signe <> ">"
            loop
        endif
        @ 7,45 say "ENTER THE SHARE: " get share
        read
        if share = " "
            exit
        endif

        @ 9,45 say "to confirm, SPACE ..."

        k = 0
        set console off
        do while k = 0
            k = inkey()
        enddo
        if k <> 32
            loop
        endif

        @ rowwin3,45 say "SHARE: "+signe+" "+share
        rowwin3 = rowwin3 + 2
        store "6" to code&queue
        store share to sel&queue
        store signe to signe&queue
        exit

    enddo

endif

if op = 7

    do while .t.

        @ 5,45 say "CHOSE IF NUMBER < = > : " get signe
        read

```

```

if signe = " "
  indx = indx - 1
  exit
endif
if signe <> "<" .and. signe <> "=" .and. ;
  signe <> ">"
  loop
endif
@ 6,45 say "ENTER THE PLOT NUMBER: "
@ 7,50 get plotnumb
      read
if plotnumb = "
  exit
endif
@ 9,45 say "to confirm, SPACE ..."

  k = 0
  set console off
  do while k = 0
    k = inkey()
  enddo
  if k <> 32
    loop
  endif

@ rowwin3,45 say "P.No: "+signe+" "+plotnumb
rowwin3 = rowwin3 + 2
store "7" to code&queue
store plotnumb to sel&queue
store signe to signe&queue
exit

enddo

endif

if op = 8

do while .t.

@ 5,45 say "ENTER THE LANDTYPE"
@ 7,45 get landtype
      read
if landtype = " "
  indx = indx - 1
  exit
endif
@ 9,45 say "to confirm, SPACE ..."

  k = 0
  set console off
  do while k = 0
    k = inkey()
  enddo
  if k <> 32
    loop
  endif

@ rowwin3,45 say "LANDTYPE= "+landtype
rowwin3 = rowwin3 + 2
store "8" to code&queue

```

```

        store landtype to sel&queue
        exit

    enddo

endif

if op = 9

    do while .t.

        @ 5,45 say "ENTER THE SOURCE OF IRRIGATION"
        @ 7,45 get sourcirri
            read
        if sourcirri = " "
            indx = indx - 1
            exit
        endif
        @ 9.45 say "to confirm, SPACE ..."

        k = 0
        set console off
        do while k = 0
            k = inkey()
        enddo
        if k <> 32
            loop
        endif

        @ rowwin3,45 say "SOURCE= "+sourcirri
        rowwin3 = rowwin3 + 2
        store "9" to code&queue
        store sourcirri to sel&queue
        exit

    enddo

endif

endcase

if mflag2
    pm = ((pr - 7) / 2) + mpcolflag
    cm = ((row - 7) / 2) + mcolflag
else
    return
endif

if indx = 3
    @ 21,1 clear to 22,78
    set color to /w
    @ 21,15 say " THE RESEARCH WILL BE DONE WITH THIS SELECTION "
    @ 22,15 say "                press any key ..."
    set color to w/
    k = 0
    do while k = 0
        k = inkey()
    enddo
    return
endif

```



```
enddo
```

```
enddo
```

```
return
```

```
*****
*****
```

```
*
* PROGRAM WORKING ON THE DISPLAY OF THE JAMABANDI
* Name: prtqu
*
```

```
procedure prtqu
```

```
set talk off
set console off
set score off
set status off
```

```
select 6
use rate
index on tashilname+villagname+landtype to indrate
```

```
select receipt
goto top
```

```
j = 0
sw = .t.
store space(30) to a
store space(15) to b
do while j < 20
  j = j+1
  queue = ltrim(str(j))
  store 0 to slect&queue
enddo
```

```
side = "L"
row = 7
mpage = 1
ri = 0
li = 0
```

```
if eof()
```

```
  clear
```

```
  @ 8,22 to 13,57 double
  @ 10,24 say "          THERE IS NO RECORD          "
  @ 11,24 say "CORRESPONDING TO YOUR SELECTION"
```

```
  wait ""
  return
```

```
else
```

```
  do while sw
```

```
    khatasave = 0
```

```

do left

store khatan to khatasave
lect = 0

@ row+li,3 say khatan
@ row+li,10 say holdern
@ row+li+1,10 say fahuname
@ row+li+2,10 say addrh
@ row+li,43 say casteh
@ row+li,67 say shareh
li = li + 4
ri = ri + 1
lect = lect + 1
skip
if eof()
    exit
endif
sw = .f.

enddo

endif

sw = .t.

do while .not. eof() .and. ri < 13 .and. sw

    if khatan = khatasave

        do while khatan = khatasave .and. sw .and. .not. eof() .and. ri <
13

            if holdern = a

                if ri = li - 1
                    li = li + 1
                endif

                ri = ri + 1
                lect = lect + 1
                skip
                if eof()
                    sw = .f.
                    exit
                endif

            else

                @ row+li,10 say holdern
                @ row+li+1,10 say fahuname
                @ row+li+2,10 say addrh
                @ row+li,43 say casteh
                @ row+li,67 say shareh
                li = li + 4
                ri = ri + 1
                lect = lect + 1
                skip
                if eof()
                    sw = .f.
                    exit
                endif
            endif
        endif
    endif
endif

```

```

endif
endif
enddo
else
    ri = li
    if ri < 13

        store khatan to khatasave
        @ row+li,3 say khatan
        @ row+li,10 say holdern
        @ row+li+1,10 say fahuname
        @ row+li+2,10 say addrh
        @ row+li,43 say casteh
        @ row+li,67 say shareh
        li = li + 4
        ri = ri + 1
        lect = lect + 1
        skip
        if eof()
            sw = .f.
            exit
        endif

    endif
endif
enddo

do while .t.

store .f. to flag

do while .not. flag

    k = inkey()
    if ( k=3 .or. k=4 .or. k=5 .or. k=13 .or. k=24)
        flag = .t.
    endif

enddo

slect = 0

do case

    case k = 3

        store "n" to yes

        @ 23,1
        set color to /w
        @ 23,19 say "DO YOU WANT TO RETURN TO QUERY MENU...(Y/N)"
        set color to w/

        k = 0
        do while k = 0
            k = inkey()

```



```

set relation to tashname+villname+landt into rate
@ row+ri,69 say rate->ratef
endif

ri = ri + 1
lect = lect + 1
skip

else

    if plotn <> b
        @ row+ri,2 say plotn
    @ row+ri,18 say str(farea,9,4)
        @ row+ri,30 say landt
        @ row+ri,47 say sourcei
        set relation to tashname+villname+landt into rate
    @ row+ri,69 say rate->ratef
        endif

        li = li + 4
        ri = ri + 1
        lect = lect + 1
        skip

    endif

enddo

else

ri = li

if ri < 13

store khatan to khatasave

if plotn <> b
@ row+ri,2 say plotn
@ row+ri,18 say str(farea,9,4)
@ row+ri,30 say landt
@ row+ri,47 say sourcei
set relation to tashname+villname+landt into rate
@ row+ri,69 say rate->ratef
endif

li = li + 4
ri = ri + 1
lect = lect + 1
skip

endif

endif

enddo

endif

case k = 13

if side = "R"

```

```

khatasave = 0

do left

skip -(lect)

lect = 0
ri = 0
li = 0
store khatan to khatasave
side = "L"

@ row+li,3 say khatan
@ row+li,10 say holdern
@ row+li+1,10 say fahuname
@ row+li+2,10 say addrh
@ row+li,43 say casteh
@ row+li,67 say shareh

ri = ri + 1
li = li + 4
lect = lect + 1
skip

do while .not. eof() .and. ri < 13

if khatan = khatasave

do while khatan = khatasave .and. (.not. eof())
.and. ri < 13

if holdern = a

if ri = li - 1
li = li + 1
endif

ri = ri + 1
lect = lect + 1
skip

else

@ row+li,10 say holdern
@ row+li+1,10 say fahuname
@ row+li+2,10 say addrh
@ row+li,43 say casteh
@ row+li,67 say shareh
li = li + 4
ri = ri + 1
lect = lect + 1
skip

endif

endif

enddo

else

ri = li

```

```

        if ri < 13

            store khatan to khatasave
            @ row+li,3 say khatan
            @ row+li,10 say holdern
            @ row+li+1,10 say fahuname
            @ row+li+2,10 say addrh
            @ row+li,43 say casteh
            @ row+li,67 say shareh
            li = li + 4
            ri = ri + 1
            lect = lect + 1
            skip

        endif

    endif

enddo

endif

case k = 24

    if side = "L"

        ok = .t.

        do while ok .and. .not. eof()

            gul = ltrim(str(mpage))
            store lect to slect&gul
            mpage = mpage + 1

        khatasave = 0

        do left

            lect = 0
            li = 0
            ri = 0
            store khatan to khatasave

            if holdern = a

                @ row + li,3 say khatan
                ri = ri + 1
                li = li + 1
                lect = lect + 1
                skip
                if eof()
                    exit
                endif
                ok = .f.

            else

                @ row+li,3 say khatan
                @ row+li,10 say holdern
                @ row+li+1,10 say fahuname

```

```

@ row+li+2,10 say addrh
@ row+li,43 say casteh
@ row+li,67 say shareh
li = li + 4
ri = ri + 1
lect = lect + 1
skip

if eof()
    exit
endif

ok = .f.

endif

enddo

do while .not. eof() .and. ri < 13

    if khatan = khatasave

        do while .not. eof() .and. ri < 13 .and. khatan =
khatasave

            if holdern = a

                if ri = li - 1
                    li = li + 1
                endif

                if ri = li
                    li = li + 2
                endif

                ri = ri + 1

                lect = lect + 1
                skip

                    if eof()
                        exit
                    endif
            else

                if li < 13

                    @ row+li,10 say holdern
                    @ row+li+1,10 say fahuname
                    @ row+li+2,10 say addrh
                    @ row+li,43 say casteh
                    @ row+li,67 say shareh
                    li = li + 4
                    ri = ri + 1
                    lect = lect + 1
                    skip
                    if eof()
                        exit
                    endif

                else

```



```

        ri = li
    endif

endif

enddo

else

    ri = li

    if ri < 13

        store khatan to khatasave
        @ row+li,3 say khatan
        @ row+li,10 say holdern
        @ row+li+1,10 say fahuname
        @ row+li+2,10 say addrh
        @ row+li,43 say casteh
        @ row+li,67 say shareh
        li = li + 4
        lect = lect + 1
        skip
        if eof()
            exit
        endif

    endif

endif

endif

enddo

else

    ok = .t.

    do while ok .and. .not. eof()

        qul = ltrim(str(mpage))
        store lect to slect&qul
        mpage = mpage + 1

khatasave = 0

        do right with mpage

            lect = 0
            ri = 0
            li = 0
            store khatan to khatasave
            side = "R"

            if plotn <> b
                @ row+ri,2 say plotn
            @ row+ri,18 say str(farea,9,4)
            @ row+ri,30 say landt
            @ row+ri,47 say sourcei
            set relation to tashname+villname+landt into rate

```

```

    @ row+ri,69 say rate->ratef
  endif

ri = ri + 1
li = li + 4
lect = lect + 1
skip
if eof()
  exit
endif
ok = .f.

enddo

do while .not. eof() .and. ri < 13

  if khatan = khatasave

    do while .not. eof() .and. ri < 13 .and. khatan =
khatasave

      if holdern = a

        if plotn <> b
          @ row+ri,2 say plotn
          @ row+ri,18 say str(farea,9,4)
        @ row+ri,30 say landt
          @ row+ri,47 say sourcei
          set relation to tashname+villname+landt into rate
          @ row+ri,69 say rate->ratef
          endif

        if ri = li - 1
          li = li + 1
        endif

        ri = ri + 1
        lect = lect + 1
        skip
        if eof()
          exit
        endif

      else

        if plotn <> b
          @ row+ri,2 say plotn
        @ row+ri,18 say str(farea,9,4)
          @ row+ri,30 say landt
          @ row+ri,47 say sourcei
          set relation to tashname+villname+landt into rate
        @ row+ri,69 say rate->ratef
          endif

        li = li + 4

        ri = ri + 1
        lect = lect + 1
        skip
        if eof()
          exit
        endif
      endif
    endif
  endif
enddo

```

```

        endif
    endif
enddo

else

    ri = li

    if ri < 13

        store khatan to khatasave

        if plotn <> b
            @ row+ri,2 say plotn
            @ row+ri,18 say str(farea,9,4)
            @ row+ri,30 say landt
            @ row+ri,47 say sourcei
            set relation to tashname+villname+landt into rate
            @ row+ri,69 say rate->ratef
        endif

        ri = ri + 1
        li = li + 4
        lect = lect + 1
        skip
        if eof()
            exit
        endif

    endif

endif

enddo

endif

case k = 5

    if mpage > 1

        if side = "L"

            mpage = mpage - 1
            gul = ltrim(str(mpage))
            skip -((lect)+((slect&gul)))

            khatasave = 0

            do left

                lect = 0
                ri = 0
                li = 0
                store khatan to khatasave

                if holdern = a

                    @ row+li,3 say khatan

```

```

li = li + 1
ri = ri + 1
lect = lect + 1
skip

```

```

else

```

```

@ row+li,3 say khatan
@ row+li,10 say holdern
@ row+li+1,10 say fahuname
@ row+li+2,10 say addrh
@ row+li,43 say casteh
@ row+li,67 say shareh

```

```

li = li + 4
ri = ri + 1
lect = lect + 1
skip

```

```

endif

```

```

do while .not. eof() .and. ri < 13

```

```

    if khatan = khatasave

```

```

        do while .not. eof() .and. ri < 13 .and. khatan =

```

```

khatasave

```

```

            if holdern = a

```

```

                if ri = li - 1
                    li = li + 1
                endif

```

```

                if ri = li
                    li = li + 2
                endif

```

```

                ri = ri + 1
                lect = lect + 1
                skip

```

```

            else

```

```

                if li < 13

```

```

                    @ row+li,10 say holdern
                    @ row+li+1,10 say fahuname
                    @ row+li+2,10 say addrh
                    @ row+li,43 say casteh
                    @ row+li,67 say shareh
                    li = li + 4

```

```

                else
                    ri = li
                    lect = lect - 1

```

```

                endif

```

```

                ri = ri + 1
                lect = lect + 1
                skip

```

```

endif
enddo
else
    ri = li
    if ri < 13
        store khatan to khatasave
        @ row+li,3 say khatan
        @ row+li,10 say holdern
        @ row+li+1,10 say fahuname
        @ row+li+2,10 say addrh
        @ row+li,43 say casteh
        @ row+li,67 say shareh
        li = li + 4
        ri = ri + 1
        lect = lect + 1
        skip
    endif
endif
enddo

else
    mpage = mpage - 1
    qul = ltrim(str(mpage))
    skip -((lect)+((slect&qul)))

khatasave = 0

do right with mpage

    lect = 0
    ri = 0
    li = 0
    store khatan to khatasave
    side = "R"

    if plotn <> b
        @ row+ri,2 say plotn
        @ row+ri,18 say str(farea,9,4)
        @ row+ri,30 say landt
        @ row+ri,47 say sourcei
        set relation to tashname+villname+landt into rate
        @ row+ri,69 say rate->ratef
    endif

ri = ri + 1
if holdern = a
    li = li + 1
else
    li = li + 4
endif
lect = lect + 1

```

```

skip
do while .not. eof() .and. ri < 13
    if khatan = khata save
        do while khatan = khata save .and. (.not. eof()) .and.
ri < 13
            if holdern = a
                if ri = li - 1
                    li = li + 1
                endif

                if ri = li
                    li = li + 2
                endif

                if plotn <> b
                    @ row+ri,2 say plotn
                    @ row+ri,18 say str(farea,9,4)
                    @ row+ri,30 say landt
                    @ row+ri,47 say sourcei
                    set relation to tashname+villname+landt into rate
                    @ row+ri,69 say rate->ratef
                endif

                ri = ri + 1
                lect = lect + 1
                skip

            else

                if plotn <> b
                    @ row+ri,2 say plotn
                    @ row+ri,18 say str(farea,9,4)
                    @ row+ri,30 say landt
                    @ row+ri,47 say sourcei
                    set relation to tashname+villname+landt into rate
                    @ row+ri,69 say rate->ratef
                endif

                ri = ri + 1
                li = li + 4
                lect = lect + 1
                skip

            endif

        enddo

    else

        ri = li

        if ri < 13

            store khatan to khata save

            if plotn <> b

```

```

    @ row+ri,2 say plotn
    @ row+ri,18 say str(farea,9,4)
    @ row+ri,30 say landt
    @ row+ri,47 say sourcei
    set relation to tashname+villname+landt into rate
@ row+ri,69 say rate->ratef
    endif

    ri = ri + 1
    li = li + 4

    lect = lect + 1
    skip

    endif

    endif

    enddo

    endif

    endif

    endcase

enddo

return

*****
*****

*
* PROGRAM DISPLAYING THE LEFT PART OF THE JAMABANDI
* Name : left
*

procedure left

clear

@ 0,0 to 0,79
@ 1,0 to 23,0
@ 0,0 say chr(218)
@ 4,1 to 4,78
@ 4,0 say chr(195)
@ 4,79 say chr(191)
@ 6,1 to 6,78

@ 6,0 say chr(195)
@ 5,8 to 21,8
@ 4,8 say chr(194)
@ 5,41 to 21,41
@ 4,41 say chr(194)
@ 5,64 to 21,64
@ 4,64 say chr(194)
@ 5,79 to 21,79
@ 6,8 say chr(197)
@ 6,41 say chr(197)
@ 6,64 say chr(197)

```

```

@ 6,79 say chr(180)
@ 22,1 to 22,79
@ 22,0 say chr(195)
@ 22,8 say chr (193)
@ 22,41 say chr (193)
@ 22,64 say chr (193)
@ 22,79 say chr(217)
@ 1,5 say "Village name : "+ villname
@ 2,5 say "Tahsil name : "+ tashname
@ 3,5 say "District name : DUNGERPUR - RAJASTHAN"
@ 5,2 say "Khata"
@ 5,10 say "Holder/Husband name & Address"
@ 5,50 say "Caste"
@ 5,70 say "Share"
@ 23,3 say "left - right : "+chr(27)
@ 23,21 say chr(26)
@ 23,27 say "up : "+chr(24)
@ 23,38 say "down : "+chr(25)
@ 23,51 say "to return to query : pg dn"

```

```
return
```

```
*****
*****
```

```

*
* PROGRAM DISPLAYING THE RIGHT PART OF JAMABANDI
* Name: right
*

```

```
procedure right
```

```
parameters mpage
```

```
clear
```

```

@ 0,0 to 0,78
@ 1,79 to 23,79
@ 0,79 say chr(191)
@ 4,0 to 4,78
@ 4,79 say chr(180)
@ 6,0 to 6,78
@ 6,79 say chr(180)
@ 22,0 to 22,78
@ 22,79 say chr(180)
@ 5,17 to 21,17
@ 4,17 say chr(194)
@ 6,17 say chr(197)
@ 22,17 say chr(193)
@ 5,28 to 21,28
@ 4,28 say chr(194)
@ 6,28 say chr(197)
@ 22,28 say chr(193)
@ 5,45 to 21,45
@ 4,45 say chr(194)
@ 6,45 say chr(197)
@ 22,45 say chr(193)
@ 5,62 to 21,62
@ 4,62 say chr(194)
@ 6,62 say chr(197)
@ 22,62 say chr(193)

```



```

@ 23,3 say "left - right : "+chr(27)
@ 23,21 say chr(26)
@ 23,27 say "up : "+chr(24)
@ 23,38 say "down `: "+chr(25)
@ 23,51 say "to return to query : pg dn"

```

```

@ 1,5 say "Patwari Circle :".
@ 1,70 say "Page "+str(mpage,2)
@ 2,5 say "I.L.R.          :".
@ 3,5 say "Year           : 2045 - 2048"
@ 5,3 say "Plot Number"
@ 5,21 say "Area"
@ 5,33 say "Landtype"
@ 5,48 say "source irri."
@ 5,69 say "Rate"

```

```
return
```

```
*****
*****
```

```

*
* PROGRAM FOR THE QUERY
* Name: query
*

```

```
procedure query
```

```

set talk off
set echo off
set bell off
set stat off
set score off
set delimiters off

```

```
set color to w/
```

```

close all
sele 1
use jmbdi index indjmbdi

```

```
do while .t.
```

```

store 0 to flee
store "khatan = " to tab1
store " $ holdern " to tab2
store " $ casteh " to tab3
store " $ addrh " to tab4
store "farea " to tab5
store " shareh " to tab6
store "val(ltrim(plotn)) " to tab7
store " $ landt " to tab8
store " $ sourcei " to tab9

```

```

store space(30) to sel1,sel2,sel3
store " " to code1,code2,code3,sign1,sign2,sign3

```

```
do waiting
```

```
sele 1
```

```

do fquery with
code1,sel1,signe1,code2,sel2,signe2,code3,sel3,signe3,flee

  if flee = 1
    return
  endif

do waiting

*clear
*@ 1,1 say "code 1:" get code1
*read
*@ 2,1 say "code 2:" get code2
*read
*@ 3,1 say "code 3:" get code3
*read
*@ 1,15 say "select 1:" get sel1
*read
*@ 2,15 say "select 2:" get sel2
*read
*@ 3,15 say "select 3:" get sel3
*read
*@ 1,55 say "signe 1:" get signe1
*read
*@ 2,55 say "signe 2:" get signe2
*read
*@ 3,55 say "signe 3:" get signe3
*read
* wait "index : " to indx

store space(30) to mcond1,mcond2,mcond3
store 'tahsilname $ tahsilname ' to mcond1,mcond2,mcond3
store 1 to indx
queue = ltrim(str(indx))
quotet = ' "'
quotee = '" '
blank = " "
dollar= " $"
store 0 to pass

do while code&queue <> " " .and. indx < 4

  do case

    case code&queue = "1"
      store tab1+(ltrim(sel&queue)) to mcond&queue

    case code&queue = "2"
      store quotet+(trim(sel&queue))+quotee+tab2 to mcond&queue

    case code&queue = "3"
      store quotet+(trim(sel&queue))+quotee+tab3 to mcond&queue

    case code&queue = "4"
      store quotet+(trim(sel&queue))+quotee+tab4 to mcond&queue

    case code&queue = "5"
      store tab5+signe&queue+blank+(ltrim(sel&queue)) to
mcond&queue

    case code&queue = "6"

```

```

                                store quotet+(trim(sel&queue))+blank+quotee+dollar+tab6 to
mcond&queue

                                case code&queue = "7"
                                store tab7+signe&queue+blank+(trim(sel&queue)) to
mcond&queue

                                case code&queue = "8"
                                store quotet+(trim(sel&queue))+quotee+tab8 to mcond&queue

                                case code&queue = "9"
                                store quotet+(trim(sel&queue))+quotee+tab9 to mcond&queue

                                endcase

                                indx = indx + 1

                                queue = ltrim(str(indx))

                                enddo

sele jmbdi

* sele 1
* use jmbdi
* sele 1
* use

sele 3
use recept1
zap
sele 3
use

sele 5
use recept
zap

sele jmbdi
copy to recept1 fields khatan for &mcond1 .and. &mcond2 .and. &mcond3

sele 3
use recept1
goto top
switch = 0
store khatan to switch

do while .not. eof()
sele jmbdi
seek recept1->khatan
do while khatan = switch
sele recept
append blank
replace khatan with jmbdi->khatan
replace holdern with jmbdi->holdern
replace fathhusb with jmbdi->fathhusb
replace fahuname with jmbdi->fahuname
replace casteh with jmbdi->casteh
replace addrh with jmbdi->addrh
replace plotn with jmbdi->plotn
replace farea with jmbdi->farea

```

```
replace landt with jmbdi->landt
replace sourcei with jmbdi->sourcei
sele jmbdi
skip
if eof()
  exit
endif
enddo

sele 3
skip
if eof()
  exit
endif

do while khatan = switch
  skip
  if eof()
    exit
  endif
enddo

switch = khatan

enddo

do prtqu

enddo

return

*****
*****

* help 1

procedure help1

clear
? "aide"
return
```

```

parameters mtname,mvname

clear
set delimiters on
set delimiters to " "
@ 0,0 to 2,79 double
set color to w/
@ 1,20 say "DISTRICT REVENUE DEPARTMENT - LAND RECORDS"
@ 3,0 to 23,79
@ 21,1 to 21,78
@ 21,0 say chr(195)
@ 21,79 say chr(180)
@ 6,18 say " Before working, insert the floppy "
@ 7,18 say "containing the records of the tahsil and "
@ 8,18 say "the village that you want to query or to update"
@ 10,18 say " After type the tahsil and village name"
@ 13,18 say "TAHSIL NAME : " get mtname
@ 15,18 say "VILLAGE NAME : " get mvname
read
returnparameters mtname,mvname

clear
set delimiters on
set delimiters to " "
@ 0,0 to 2,79 double
set color to w/
@ 1,20 say "DISTRICT REVENUE DEPARTMENT - LAND RECORDS"
@ 3,0 to 23,79
@ 21,1 to 21,78
@ 21,0 say chr(195)
@ 21,79 say chr(180)
@ 6,18 say " Before working, insert the floppy "
@ 7,18 say "containing the records of the tahsil and "
@ 8,18 say "the village that you want to query or to update"
@ 10,18 say " After type the tahsil and village name"
@ 13,18 say "TAHSIL NAME : " get mtname
@ 15,18 say "VILLAGE NAME : " get mvname
read
return* record
clear

sele jbpart1
store str(khatanumb) to knumb1
sele jbpart2
store str(area,9,4) to marea
store str(khatanumb) to knumb2

@ 5,5 say "tahsil name : "+jbpart1->tahsilname
@ 6,5 say "village name : "+jbpart1->>villagname
@ 7,5 say "caste : "+jbpart1->castehold
@ 8,5 say "adress : "+jbpart1->addrhold
@ 9,5 say "share : "+jbpart1->sharehold
@ 10,5 say "plot number : "+jbpart2->plotnumb
@ 11,5 say "area : "+marea
@ 12,5 say "landtype : "+jbpart2->landtype
@ 13,5 say "source irri. : "+jbpart2->sourceirri
@ 14,5 say "khata numb.1 : "+knumb1
@ 15,5 say "khata numb.2 : "+knumb2*
* PRESENTATION
*

```

```
clear
```

```
text
```

```

jamabandi      This program offers to you to work on the
jamabandi      You have the possibility to read the entire
jamabandi      or to do a special research on one to three values
can            of field differents (QUERY). In a other hand, you
               can
               update the jamabandi (MUTATION).

```

```
endtext
```

```
@ 5,7 to 17,70 double
```

```
?
```

```
?
```

```
wait "
```

```
..."
```

```
press any key to start
```

```
return*
```

```
* WAITING MESSAGE
```

```
*
```

```
clear
```

```
@ 9,20 to 14,58 double
```

```
@ 11,25 say " THE PROGRAM IS WORKING !!! "
```

```
@ 12,25 SAY " PLEASE, WAIT A MOMENT ... "
```

```
return*
```

```
* PROGRAM VERIFYING THE PRESENCE OF THE DATABASE
```

```
* Name: floppy
```

```
*
```

```
parameters mtab,mvill,mfound
```

```
set talk off
```

```
set echo off
```

```
set default to A
```

```
set console off
```

```
do while .t.
```

```
store 256 to k
```

```
store "n" to mflag1
```

```
if mtab = " "
```

```
  set default to c
```

```
  return
```

```

endif

if file(mdash+mville+".dbf")
  store "y" to mflag1
  store .t. to mfound
else
  store "n" to mflag1
  store .f. to mfound
endif

if mflag1 <> "y"
  @ 22,5 say "INCORRECT FLOPPY OR INCORRECT TAHSIL OR
VILLAGE NAME"
  wait ""
  set default to c
  return
endif

exit

enddo

set default to c

return
*
* PROGRAM FOR THE QUERY
* Name: query
*

*procedure query

set talk off
set echo off
set bell off
set stat off
set score off
set delimiters off

set color to w/

close all
sele 1
use jmbdi index indjmbdi

do while .t.

  store 0 to flee
  store "khatan = " to tab1
  store " # holdern " to tab2
  store " # casteh " to tab3
  store " # addrh " to tab4
  store "farea " to tab5
  store " shareh " to tab6
  store "val(ltrim(plotn)) " to tab7
  store " # landt " to tab8
  store " # sourcei " to tab9

  store space(30) to sel1,sel2,sel3

```

```

store " " to code1,code2,code3,signe1,signe2,signe3

do waiting

sele 1

do fquery with
code1,sel1,signe1,code2,sel2,signe2,code3,sel3,signe3,flee

if flee = 1
return
endif

do waiting

*clear
*@ 1,1 say "code 1:" get code1
*read
*@ 2,1 say "code 2:" get code2
*read
*@ 3,1 say "code 3:" get code3
*read
*@ 1,15 say "select 1:" get sel1
*read
*@ 2,15 say "select 2:" get sel2
*read
*@ 3,15 say "select 3:" get sel3
*read
*@ 1,55 say "signe 1:" get signe1
*read
*@ 2,55 say "signe 2:" get signe2
*read
*@ 3,55 say "signe 3:" get signe3
*read
* wait "index : " to indx

store space(30) to mcond1,mcond2,mcond3
store `tahsilname $ tahsilname ` to mcond1,mcond2,mcond3
store 1 to indx
queue = ltrim(str(indx))
quotet = ' '
quotee = ' '
blank = " "
dollar= "$"
store 0 to pass

do while code&queue <> " " .and. indx < 4

do case

case code&queue = "1"
store tab1+(ltrim(sel&queue)) to mcond&queue

case code&queue = "2"
store quotet+(trim(sel&queue))+quotee+tab2 to
mcond&queue

case code&queue = "3"
store quotet+(trim(sel&queue))+quotee+tab3 to
mcond&queue

```



```

        case code&queue = "4"
            store quotet+(trim(sel&queue))+quotee+tab4 to
mcond&queue

        case code&queue = "5"
            store tab5+signe&queue+blank+(ltrim(sel&queue))
to mcond&queue

        case code&queue = "6"
            store
quotet+(trim(sel&queue))+blank+quotee+dollar+tab6 to
mcond&queue

        case code&queue = "7"
            store tab7+signe&queue+blank+(trim(sel&queue)) to
mcond&queue

        case code&queue = "8"
            store quotet+(trim(sel&queue))+quotee+tab8 to
mcond&queue

        case code&queue = "9"
            store quotet+(trim(sel&queue))+quotee+tab9 to
mcond&queue

    endcase

    indx = indx + 1

    queue = ltrim(str(indx))

enddo

*@ 10,1 say mcond1
*@ 11,1 say mcond2
*@ 12,1 say mcond3
*wait ""

* sele 1
* use jmbdi
* sele 1
* use

    sele 3
    use receipt1
    zap
    sele 3
    use

    sele 5
    use receipt
    zap

    sele jmbdi
    copy to receipt1 fields khatan for &mcond1 .and. &mcond2 .and.
&mcond3

    sele 3
    use receipt1

```

```

goto top
switch = 0
store khatan to switch

do while .not. eof()
  sele jmbdi
  seek receipt1->khatan
  do while khatan = switch
    sele receipt
    append blank
    replace khatan with jmbdi->khatan
    replace holdern with jmbdi->holdern
    replace fathhusb with jmbdi->fathhusb
    replace fahuname with jmbdi->fahuname
    replace casteh with jmbdi->casteh
    replace addrh with jmbdi->addrh
    replace plotn with jmbdi->plotn
    replace farea with jmbdi->farea
    replace landt with jmbdi->landt
    replace sourcei with jmbdi->sourcei
  sele jmbdi
  skip
  if eof()
    exit
  endif
enddo

  sele 3
  skip
  if eof()
    exit
  endif

do while khatan = switch
  skip
  if eof()
    exit
  endif
enddo

  switch = khatan

enddo

return
*
* RETURN TO DOS
* Name: quit
*

parameters work

store .f. to work
store "n" to maccept
@ 21,1 clear to 22,79
set color to /w
@ 21,23 say " ARE YOU SURE THAT YOU WANT TO LEAVE..."
@ 22,23 say "          press Y to accept          "
set color to w/
@ 21,79 to 22,79

```

```

k = 0
do while k = 0
  k = inkey()
enddo
if upper(chr(k)) <> "Y"
  store .t. to work
  @ 21,1 clear to 22,79
  @ 21,6 say "line down : SPACE or "+chr(25)
  @ 21,33 say "line up   : "+chr(24)
  @ 21,51 say "top : HOME"
  @ 21,66 say "end : END"
  @ 22,22 say "to accept the selection : RETURN"
  @ 21,79 to 22,79
endif

return*
* START PROGRAM
*

clear

close all
clear all
close procedure

do setup

do waiting

set procedure to mainproc

do main

quitset talk off
do while .t.
  touche = 0
  do while touche = 0
    touche = inkey()
  enddo
  wait str(touche)
enddo
* procedure mutform1

set talk off
set echo off
set bell off
set stat off
set score off
set console off

clear

@ 0,0 to 2,79 double
@ 1,20 say "DISTRICT REVENUE DEPARTMENT - LAND RECORDS"
@ 3,0 to 23,79
@ 21,1 to 21,78
@ 4,25 to 6,52
@ 5,30 say "MUTATION PROCESSING"
@ 8,13 say "Mutation Number      : "
set color to /w

```

```
@ 8,35 say "          "  
set color to w/  
@ 10,13 say "Mutation Category  : "  
set color to /w  
@ 10,35 say "          "  
set color to w/  
@ 12,13 say "Mutation Case      : "  
set color to /w  
@ 12,35 say "          "  
set color to w/  
@ 14,13 say "Mutation Type      :  global  simple  complexe  
sketch"  
set color to /w  
@ 14,35 say " global  "  
set color to w/  
@ 16,13 say "Khata Number      :  "  
set color to /w  
@ 16,35 say "          "  
set color to w/
```