

**FIELD PATTERNS IN PUNJAB:
A GEOGRAPHICAL ANALYSIS**

A

Thesis

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DECLARATION

I hereby declare that the thesis entitled “**FIELD PATTERNS IN PUNJAB: A GEOGRAPHICAL ANALYSIS**” prepared and submitted by me under the supervision and guidance of Dr. Ripudaman Singh, Associate Professor in Geography, School of Arts and Languages, Lovely Professional University, Phagwara, Punjab (INDIA) as per the full requirement for the award of the degree of Doctor of Philosophy (Ph.D.) in Geography is entirely my original work and all ideas and references have been duly acknowledged. It does not contain any work that has been submitted for award of any other degree or diploma of any other University.

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ABSTRACT

Field patterns are studied in Rural Settlement Geography within the discipline of Geography. The Geography of Field Patterns may be defined as the study of the spatial structure of agricultural fields created through interplay of nature, man and culture. Diverse field patterns are created due to the influence of physical and human factors. The present study involves the influence of these factors on the field patterns and their essential attributes such as shape, size, boundaries, distribution, scattering and their combinational arrangements. It is a matter of sorrow that the studies on field patterns have largely been ignored by Indian geographers. Very few studies have addressed issues of field patterns in some parts of Punjab. The area of interest of previous studies on field patterns in Punjab remained either a single village or a single landform region. Field patterns for all the landform regions of Punjab have never been studied earlier. No study on field patterns in the state of Punjab covered time period from 1884 to 2016. This leaves a scope for such a meaningful study in the state of Punjab. The present study on field patterns covering all the landform regions of the state from 1884 to 2016 intends to fill this gap both spatially and temporally. This study on field patterns in Punjab will not only enhance the existing literature but will also create a new knowledge with a sound social applicability and policy implications. It is expected that the study will draw the attention of researchers to this very important dimension of field patterns which has not properly been addressed so far. The findings of this research would arouse interest and can be usefully adopted as a model by geographers, anthropologists, sociologists, rural development planners and experts from land records in the state of Punjab as well as other parts of India and other developing countries with similar socio-cultural and geographical backgrounds.

The focus of this research was to achieve objectives such as to describe and analyse the effects of time and space on the field patterns in their phases of settling; undertaking a geographical analysis of field patterns of the villages selected from different landform regions of Punjab; studying the relationship between the elements of field patterns and distance from the settlement proper (*abadi-deh*), land types, consolidation of land holdings, cropping patterns, land-owning castes, sources of

irrigation and ploughing instruments used and to suggest measures to save agricultural fields and to improve their efficiency.

Based upon our research objectives ten hypotheses were proposed for investigation. These were: a field pattern is a cumulative result of phases of settling which have operated through time in an area; diverse field patterns evolve in response to different landform regions; in the irrigated land types the size of the fields is small and in the rain-fed land types the size of the fields is large; large fields are situated far from the *abadi-deh* (settlement proper); the fields facing roads are small in size and elongated in shape; in the villages where consolidation of holdings has taken place the fields are large in size and regular in shape, whereas in unconsolidated villages the fields are small, inconveniently large and irregular in shape; in commercial grain farming areas, the fields are large and regular whereas in vegetable and subsistence farming areas fields are intermediate in size and irregular in shape; high caste groups have large land holdings, whereas low castes possess small land holdings; field patterns are different in areas having different modes of irrigation and tractor ploughed fields are accentuated rectangular in shape and large in size, whereas bullock ploughed fields are small in size.

A variety of sources were tapped for obtaining the relevant data and information. Much of the present study is founded on the primary data derived from extensive field work of the selected villages. The data is obtained from *Patwari* (village level government revenue official), *Kanungo* (tehsil level government official in revenue department) at the district revenue offices of Punjab and from the office of the Director Land Records, Punjab. The thematic maps on different aspects of field patterns in this study were drawn by the author on the basis of data obtained from these sources. This was accompanied by the detailed observations and photographs on the shape and size of the fields, field boundaries, field paths and means of irrigation. Information was also obtained through enquiries and interviews with the farmers. Index of scattering and index of scattering in terms of distance were used for calculating scattering of sites of fields of a farmer during pre and post consolidation phases. Information and data relevant to the theme was also obtained from Economic and Statistical Organisation of Punjab, Directorate of Agriculture-Punjab, Punjab Agricultural University, Ludhiana, Punjab Remote Sensing Centre, Ludhiana and Regional Meteorological Centre, New Delhi.

The state of Punjab is divided into five landform regions according to the geo-physical characteristics on the lines with the schematic division followed by Punjab Remote Sensing Centre, Ludhiana. These landform regions are upland plains, upland plains with sand dunes, piedmont plains, flood plains and the Shiwalik hills. One village each was selected on the basis of purposive sampling from each of these landform regions for a detailed spatio-temporal analysis of its field patterns. The names of these villages are *Dhanowali* selected from upland plains, *Bath* from upland plains with sand dunes, *Pathan Chak* from piedmont plains, *Khera Bagh* from flood plains and *Rohg Teeka Khakhoh* from the Shiwalik hills. The study is confined to the time period from 1884 to 2016. This period of study has been selected due to limitations of data sources because data for most of the villages was available from 1884 onwards only in the state of Punjab. The chapter scheme is ordered in temporal sequence to test the hypotheses during initial phase of 1880s, pre-consolidation phase, post-consolidation phase and in existing phase. The study is not concerned with agricultural production, economics of land holdings and technological aspects, except those factors which affect the elements of field pattern.

The early settlers in the villages acquired the land for making houses and fields by removing forests. Land near the *abadi-deh* (settlement) was brought under cultivation in the first phase due to its relative nearness and expanded to other parts of the village in subsequent phases. This expansion of cultivated land would have been continued till the Britishers defined the actual fields and village boundaries and prepared the map showing field and village boundaries in 1880s after conducting actual field surveys. The earliest available field maps of 1880s of the sample villages reveal that the fields near the *abadi-deh* (settlement) were relatively smaller due to their higher frequency of sub-divisions in response to the desire of every member of the family to have a share in this land due to its relative nearness and more economic value. The fields in earlier phases were mostly large. In the subsequent stages of evolution of field patterns, fields were continuously sub-divided due to increase in the number of male members of different families from generation to generation related to the operation of the law of inheritance. The law of inheritance in the study villages was such as all the sons of a man will share equally his land, regardless of their age, after his death. Each of the sons was given a share in each type of land suggested by the operation of the principle of equitable distribution of benefits and handicaps. It has resulted in the fragmentation of holdings and sub-division

of fields. At some places the principle of compensation operates whereby the proportion of land owned by different sons varies in different land types. He who wants to have maximum land in the best land types is offered fewer fields which are also small and those with a limited share in the best land may have several fields of large size. The same principle was adopted by the consolidation officials at the time of land consolidation in the villages of Punjab and continues to operate more in the study villages. The per capita number of fields and size of holding has been continuously decreasing because of the increasing pressure of population and due to the entrance of females in land owners list made possible by the amendment of Hindu act which lays down that the daughters are entitled to share equally their father's property. The cultivated fields near the *abadi-deh* (settlement) and roads are being continuously encroached upon by expanding settlement. The average size of the landholding has declined to critical levels, especially in villages situated near the urban areas.

Sub-divisions of existing fields resulted by the growing multitude of owners in the genealogical tree of all the families has been the basic governing process in the evolution of field patterns in all the sample villages. The consolidation of land holdings introduced in the villages in Punjab plains in the decade 1950-60, has greatly influenced the size and shape of the fields. The study reveals that in the pre-consolidation phase the fields of farmers were fragmented, irregular, small and inconveniently large scattered in different parts of the village leading to their inefficient management. The scattering of fields has been minimized by consolidating fields into compact rectangular blocks of uniform size of one *kill*a (one acre) each. Scattering in terms of distance from the *abadi-deh* (settlement) of the village was also reduced. Problems related to fragmentation of landholdings which were eliminated by the adoption of consolidation in 1950s have again cropped up in recent years due to the breakup of earlier joint families and by continuous escalating magnitude of owners due to expansion in the family size.

Land types in all the study villages during early phases were dominated by poor quality. The fields were smaller in size in the good quality land types situated more near the *abadi-deh* (settlement). The irrigated fields were relatively smaller than the rain-fed fields in the pre and post consolidation phases also. This relationship has faded away after the adoption of Green Revolution technology due to assured irrigation supply. Presently, there exists no relationship between the distance from the *abadi-deh* (settlement) and productivity and fertility of land due to use of irrigation facilities. Land types have not improved to maximum extent in the hilly and water-logged flood plains

areas due to physiographic limitations. Canals as a source of irrigation and field patterns were related to each other in early phases. Shape of majority of the fields in the earlier field maps were elongated rectangles and accentuated strips to have access to water from canals. Tube-well remains the main source of irrigation in the upland plains of Punjab. Field patterns and tube-well as source of irrigation do not depict any relationship except of the fact that the field in which tube-well is dug tends to be hexagonal in shape. The small size fields are found more near the sources of irrigation because of their more subdivisions as every person wants to have access to water to irrigate his fields.

The cropping pattern has affected the field patterns in the study villages. Medium to large in size and regular in shape fields were found in the villages, where intensive commercial grain farming is practised in comparison to irregular shape fields in the subsistence type agriculture villages. Wheat, the main crop of Punjab is grown in all the villages irrespective of size and shape of the fields in all landform regions. Distance from the *abadi-deh* (settlement) has a little influence on the types of crops grown and the resultant field patterns. Fodder crop is grown more in the fields situated near the *abadi-deh* (settlement). *Ekfasli* (one crop in a year) fields exist nowhere in any village. The *teenfasli* (three crops in a year) fields are relatively larger than the *dofasli* (two crops in a year) fields. Vegetable fields are smaller in size. Farmers decide to allocate fields under different crops not in terms of their size or shape but in terms of price of crops, yield, ripening period and market demands.

The ploughing implement used in the fields has not affected the field patterns. Bullock ploughed fields which were common in the past have been completely replaced by the tractors. All the fields, irrespective of their shape and size, are ploughed by the tractors. A farmer, who does not own tractor, ploughs his fields by a rented tractor. Small sized tractors are used in the hilly villages in comparison to the large size tractors used in the villages situated in plain areas of Punjab.

We do not find complex caste systems and related field patterns in the study villages. *Jat* is the dominant land-owning caste in the Punjab plains. They have big holdings with large and rectangular fields. The fields and holdings of other castes are smaller and found mainly away from the *abadi-deh* (settlement). The fields and holdings of the richer families are larger than those of the poor families, irrespective of their caste. No difference is found in terms of shape of the fields, source of irrigation, crops grown and farm mechanization of different castes.

Most of the fields have four-sided rectangular geometrical regular field boundaries in the Punjab plains where process of consolidation of landholdings was adopted. The villages situated in the Shiwalik hills have irregular quadrilateral field boundaries due to presence of uneven topography. The *wats* (low mud dikes), *arrs* (water drains) *warr of kande* (fence of thorny bushes), row of trees, wires and walls serve as field boundaries. The fields near the *abadi-deh* (settlement), roads and railway lines are protected more by such field boundaries.

It gets beyond doubt that no study can be considered efficacious until it puts forward some suggestions for the rectification of a situation or practice which does not hold water in the modern context. Keeping in view this motto, some suggestions are extended. The fertile cultivated land types should not be permitted to be used for *gairmumkin* (uncultivable) land uses. Vacant *panchayat* lands, wastelands and other poor land types may be used for such activities. Dense and high rise buildings should also be promoted in the villages to reduce pressure on agricultural land. The future requirement of housing provisions should be dominated by small housing units to save precious agricultural land. Minimum land should be allowed to be used as a farm house and no other activity except agriculture should be permitted here. Agricultural land situated outside *phirni* (a circular road around *abadi-deh*, settlement) should be declared as no-construction zone. Efficient use of vacant government lands within the municipal limits of cities will lower down the pressure on agricultural land of villages situated on their peripheries. A re-development strategy to accommodate more population within the city limits should be framed. The master plans of the city areas must give due recognition to rural areas. In the unconsolidated villages, the pockets of plain areas within the villages where consolidation process was not implemented can be brought under the process of consolidation and scattered fields of farmers can also be grouped into less number of sites. Co-operative farming and exchange of holdings should be introduced by clubbing the uneconomic small land holdings and fields. The excessive tube-well irrigation in the upland plains has led to the fall in underground water at an alarming rate after the introduction of paddy cultivation. Planned canal irrigation system through proper water management and cropping patterns, must be adopted to save green fields from *seim* (water-logging). Lift irrigation, sprinkle irrigation and drip irrigation should be introduced in hilly areas to avoid dependence on rainfall. *Barani* (rain-fed) land type fields should be brought under irrigation. *Banjar kadim* (field left vacant for

more than eight cropping seasons) fields along the flood plains can be improved by constructing an embankment along rivers. The hill slopes where fields are difficult to make, may be brought under farm forestry, herbal forestry and orchards to further improve and strengthen the ecology of the hilly villages. Excessive use of irrigation facilities and chemicals should be stopped. There is a lot of pressure on the soil and water after the introduction of intensive commercial agriculture due to the adoption of Green Revolution Technology in many parts of Punjab plains. Most of the fields are now used as *teenfasli* (three crops in a year). The paddy crop introduced after Green Revolution has resulted in the use of water beyond sustainability. Paddy cultivation should either be stopped or minimized to save Punjab from turning into desert. Eco-friendly, traditional and remunerative cropping patterns based on local agro-climatic conditions suitable for small sized fields and land holdings should be adopted for sustainable agriculture.

Therefore, it has become evident from the geographical analysis of field patterns in Punjab that field pattern is not a static phenomenon. Diverse field patterns are created in response to different landform regions through an inter-play of nature, man and culture. The existing field patterns have undergone various evolutionary stages and provide a link and a key in the understanding of the phases of settling in an area. This study has aimed at not only diagnosing the problems related to agricultural fields and land holdings in Punjab but also suggested some measures to make agriculture, if not a lucrative, a rewarding profession.

PREFACE AND ACKNOWLEDGEMENTS

PREFACE

The incitement for this study is derived from the author's sagacious interest in the evolutionary study of rural settlements and the role of fields in agricultural development in Punjab. The study attempts to narrate an inter-play of space and time in the evolution of field patterns within the framework of physical and human factors in the state of Punjab.

Punjab, known as the 'Food Basket of India' is chosen as the study area because it is agriculturally most dynamic and one of the most intensively farmed areas in the world with deep agricultural roots.

Most of the information contained in this study was secured by field work in the state. The field work included searching through historical records in the land record offices from the state to the level of the villages. Village maps showing field boundaries were made by the Britishers after the annexation of Punjab into their Empire and covered the entire state by mid 1880s. It was very difficult task to collect historical data and relevant maps from 1880s to 2016 because of missing links which were not easy to be found.

After traversing more than ninety villages spread over entire length and breadth of state of Punjab, finally one village each was successfully selected from each of the five landform regions of Punjab for a detailed spatio-temporal analysis of field patterns.

The personal contact with the villagers and *Patwaris* of the study villages assisted by observations, enquiries and interviews with the farmers through actual field visits was an invaluable experience which helped the author in having sound personal perspective on field patterns of the study area.

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My family has been the most important magnet that lured me home when I wandered away for field work. They deserve my deepest appreciation for sparing me from many of my family and other social assignments. I am indebted to my parents Late S. Avtar Singh and Late Smt. Vidhya Wanti for ingraining in me perseverance and humility which went a long way in the smooth conduct of this study. My wife Rita Rani deserves special thanks for her constant persuasions and motivation and for looking after the family engagements.

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CHAPTER -1

INTRODUCTION

THE FOCUS OF FIELD PATTERNS ANALYSIS IN GEOGRAPHY

Field patterns are studied in Rural Settlement Geography, which is a distinct branch of Settlement Geography in Human Geography within the discipline of Geography. Rural Settlement Geography concerns mainly with the phases of settling in an area and the results of these phases of settling. The phases of settling suggest the processes of exploitation of natural resources of an area by human beings to fulfill their needs. The natural resources of an area are modified by people to evolve the rural landscape. Rural settlement is the core of this rural landscape. It organizes a group and reflects its mode of living. Therefore, every population group will have its characteristic rural settlements in an area settled by it. The people settled in different areas have differences in physical and human environment and therefore have differences in rural landscapes. There are many material traits of the rural landscape. But the settlement itself- its form, layout and morphology, house types and field patterns are easily the most important, outstanding and visible components of rural landscape in the structure of Rural Settlement Geography of a village (Grover, 1985). It is imperative to emphasize here that the term *pind/gaon* (village) in Punjab is inclusive of the *abadi-deh* (settlement) where people live in their houses, the surrounding agricultural fields and all other land covers and land uses within the village territory. In farming settlement people exploit the natural resources through the creation of agricultural fields. Therefore, rural dwellings and the agricultural fields constitute the fundamental units of the rural landscape. Through practicing agriculture, the farming people establish a permanent relationship with land and in this process create field pattern.

Field pattern is the arrangement of parcels of land to which people attach themselves to, and exploit the agricultural land resources of the area. Therefore, the landscape of fields is created through interaction of people with nature (Mukerji, 1961).

The Geography of Field Patterns may be defined as the study of the spatial structure of agricultural fields created through interaction of people with nature. The differences in space and time of inhabitation result in the creation of diverse field patterns. Therefore, field patterns can be studied either through space or through time

or through a combination of space and time termed as spatio-temporal approach in Geography. The present study is undertaken to analyse the field patterns in various landform regions of Punjab through selected villages with the application of spatio-temporal approach.

ATTRIBUTES OF FIELD PATTERNS

Shape, size, distribution, boundaries and scattering are the basic attributes of field patterns, which are discussed in the following paragraphs:

(a) Shape

It is an important and useful parameter for differentiating field patterns and is intimately related to terrain configuration. The shape of the fields is determined by the boundaries of the land property. In the present study, fields are classified into seven shape categories; three sided- triangular, four sided- square, four sided- rectangular, four sided- elongated or strips, four sided- with one or more sides oblique irregular rectangular or quadrilateral, five sided- polygon, six sided- hexagon or more. Majority of the fields have become rectangular and elongated strips in shape in the villages of Punjab where process of consolidation was implemented.

(b) Size

Size simply refers to the area of a field. Size influences the field pattern. On the basis of size, the fields are classified into four categories; small (below 1 *kanal*), medium (1 *kanal* to 4 *kanals*), large (4 *kanals* to 8 *kanals*) and very large (above 8 *kanals*).

(c) Distribution

The shape and size of fields is affected by the distribution of fields all over the village territory. In the distribution of agricultural fields, we study infields (fields situated near the *abadi-deh*, the main settlement) and outfields (fields situated away from the *abadi-deh*, near the village boundary) and the open fields (without hedges and fences) and closed fields (with hedges and fences).

The shape, size and distribution of the fields are determined by several factors: irrigation method, irrigation sources, slope, crops grown, distance from the *abadi-deh* (settlements), road types, technology used, soil and land types, social structure, extent of cultivated fields in relation to farming, methods of cultivation, land system, tenure system, government policies, the effects of the operation of Hindu law of inheritance,

principle of equitable distribution of benefits and handicaps, principle of compensation and sale or mortgage on the sub-division of land holdings and fields.

(d) Field Boundaries

The study of field boundaries has claimed relatively little attention by the geographers. The pattern formed by well-defined field boundaries within the precincts of a village constitutes an important element of the manmade landscape. Field boundaries delimit, give shape, and separate one field from the other. The field boundaries serve as paths for the movement of human beings and cattle and as embankments to retain water within the fields. Therefore, to trace out field patterns, the study of field boundaries is essential. The field boundaries correspond to the property lines when a field is considered as a property unit. The farmers divide their property units into a number of smaller units for purpose of irrigation and for growing different crops as per the requirements of the crops. These smaller units are separated by mud-dikes but these do not correspond to the property lines. A property unit is a field which has been given a number and entered as such in the *Jamabandi/Lal Kitab* (book of property records). The study is restricted to the pattern formed by these property units. Fields mean these property units. The division of a property unit into smaller units (*kyaris*) is guided by the desires of the farmer and also by requirements of crops and to retain irrigation water properly within these smaller units. The pattern formed by these smaller units cannot be studied because data is available only on the fields as property units and secondly, the division of a field into smaller units, in most cases is liable to change frequently as per the requirements of crops and the desires of the land owner.

(e) Scattering of Fields and Land Holdings

Scattering refers to a condition in which the holding of a farmer consists of a large number of fields located at various sites and in different directions of the village territory. The process of scattering is primarily related to the principle of equitable distribution of benefits and handicaps. The law of inheritance comes into play later. Scattering is quite frequent and extensive in the unconsolidated villages. Scattering of fields and land holdings has reduced to a great extent in the villages where process of consolidation was adopted successfully.

An Index of Scattering of sites of fields of a farmer can be computed by the formula proposed by Mukerji (1962). The formula is $I_S = X/Y \times 100$, where I_S is the Index of Scattering, X is the number of sites and Y is the number of fields.

This formula of Index of Scattering suffers from an inadequacy as it tells only the value of scattering of sites of fields but it has not taken into consideration the distance of sites of fields from the residence of the farmers located in the *abadi-deh* (settlement). The value of Index of Scattering of sites of fields may come to be the same for two farmers, but in terms of distance of sites of fields from the *abadi-deh* (settlement), the farmer whose fields are located near the *abadi-deh* (settlement) enjoys more benefits than the farmer whose fields are scattered at a greater distance from the *abadi-deh* (settlement). The farmer has to spend more time and energy walking and carrying farm implements, seeds, manures, fertilizers and bringing back farm-produce from the fields to his residence at *abadi-deh* (settlement). Therefore, the cumulative distance covered by the farmer from the *abadi-deh* (settlement) to all the sites of his fields will give a real operational meaning to the Index of Scattering. A new formula with the assistance of Index of Scattering proposed by Mukerji has been used which takes into account the cumulative distance of all sites of fields from the *abadi-deh* (settlement). The formula is; $I_{SD} = I_S / \sum D_{SF}$ where I_{SD} is the Index of Scattering in terms of Distance, I_S is the value of Index of Scattering in per cent and $\sum D_{SF}$ is the sum total of distance of sites of fields comprising holding of a farmer measured from the *abadi-deh* (settlement). This formula is used and discussed in detail in Chapter-4 on field patterns in the pre and post consolidation phases in this research work.

These attributes of field patterns are neither static nor the present day field pattern a spontaneous creation. It has evolved gradually over a period of time, each phase being closely related to, and in fact the product of the then existing political conditions and tenure systems, technologically know-how, the culture group and their genre de vie (Grover,1985). It is obvious that it is not only important to describe the various field patterns, but also as far as possible to trace the origin and evolution of the patterns in order to find out the socio-economic and political factors in operation at the time of settlement (Nitz,1966).

Factors Affecting Field Patterns

Field patterns change with the change in the physical and human factors in different areas inhabited by people. These factors are geology, relief, climate, soil and land types, slope of the land on which these fields lie, drainage system, population, level of agriculture, systems of land division, rights of ownership of land, land tenure systems, size of land holdings, irrigation sources, crops grown, distance from the *abadi-deh* (settlement), means of transport, market demand factors, technology used, methods of cultivation, caste, government policies, social customs and cultural practices such as the effect of operation of Hindu law of inheritance, principle of equitable distribution of benefits and handicaps, principle of compensation, sale, mortgage or gifts of land. These elements individually as well as in combination influence the attributes of field patterns namely shape, size, distributions, boundaries and scattering of the fields.

SIGNIFICANCE OF THE STUDY OF FIELD PATTERNS

The importance of field patterns has been discussed by a few Geographers. Mukerji in his work "Field Pattern in a Telangana Village" concluded that field pattern as an element in the synthetic integrated picture of agricultural landscape is the concern of the cultural geographer who alone can observe and interpret fully the pattern of combination of fields with all its related elements like micro-topography, habitation complex, soil types, cropping patterns, tenure, land systems, methods of cultivation and technological and socio-economic organization of irrigation (Mukerji,1962). Settlement Geography also involves the study of the visual imprint made by man on the cultural landscape. These imprints are made on the countryside in the process of occupance and can be well studied through the study of field patterns (Jordan, 1973). American geographers have also assumed correctly for the most part that field patterns are determined largely by systems of land division. Field patterns exhibit considerable but often subtle geographical variations even within an area which has only one system of land division (Hart, 1968). The field pattern is essentially an expression of the community decision through their culture and mode of living. The pattern, function and the evolution of fields can be understood well through an interpretation of the field pattern in an area which may reflect all these attributes and functions (Mukerji, 1961). Through the study of field patterns, we are able to recognise the relationships among different components of the system of rural

settlements and come to know about the processes of settling of an area in different phases by studying its field patterns.

The study of the village and field pattern is a socio-cultural and functional study of landscape, which reflects human and physical aspects. Village patterns and field patterns are very much related to each other and function altogether as a complex in social life as well as in agriculture (Ishida, 1972). A complete understanding of a rural landscape necessitates an analysis of both the settlements and field landscape. Nitz (1966) opined that a particular region is characterised by its field pattern and to get knowledge of evolution of a region, a study of its individual settlements, their topographic sites, their lay-out of residential area, which we call field pattern is necessary. The pattern formed by well-defined field boundaries within the precincts of a village constitutes an important element in the manmade landscape.

The use of land by each farmer is confined to the boundaries of his plots and the pattern of these plots has an impact on the pattern of land utilization. The pattern of land use do not necessarily results from the field patterns, rather they are different in different settings, villages with similar field pattern may have different cropping patterns, subject to differences in soil, climate, topographic situation of the holdings and culture of the people (Nitz,1966). This means that pattern formed by these boundaries will not be the same even in the small area because the descriptive properties of the field, size, shape, slope and tillage patterns are prone to change even in a small area. Therefore, the study of field pattern is largely prompted by the established significance of field patterns in rural settlement geography.

In the present study field patterns have been geographically analysed within the framework of an interacting system of elements of physical and human environment. These elements individually as well as in combination have played their important role in the pattern, origin, evolution, arrangement, form and function of fields. The study involves the field patterns and their essential attributes: shape, size, boundaries, distribution, scattering and their combinational arrangements.

THE STUDY AREA: PUNJAB

The term *Punjab* is a combination of two Persian words *Punj* and *ab*. *Punj* means five and *ab* stands for river or water. Therefore, the literal meaning of the word *Punjab* is five rivers or the land of five rivers. These five rivers are; Jhelum, Chenab, Ravi, Beas

and Sutlej. The territorial boundaries of Punjab kept on changing in the past. During Rig Veda times, Punjab was known by the name "*Sapta Sindhu*" (land of seven rivers, including the river Indus and the Sarasvati in addition to the five rivers mentioned above). The present Punjab came into existence as a unilingual state on 1st November, 1966 at the culmination of *Punjabi Suba Morcha* (Gazetteer, 2001). The present Punjab has the smallest ever size in its history. Punjab is located in the north-western part of India (Figure 1.1). This triangular shaped state forms the western component of the "Indo Gangetic Plains" of India, which extends from 29⁰-30' North to 32⁰-32' North latitude and 73⁰-55' East to 76⁰-50' East longitude (Manku, 2009). The north-south distance is nearly 335 kilometres and east-west distance is extended to 300 kilometres. Punjab shares international boundary with Pakistan on its west, Jammu & Kashmir lies to its north, state of Himachal Pradesh to its north-east, Haryana to its south-east and it borders with Rajasthan in the south-west. Punjab has an area of 50362 square kilometres which is 1.6 per cent of the total area of India. From the point of view of the administration, Punjab is divided into five divisions; namely Jalandhar, Patiala, Ferozpur, Faridkot and Rupnagar. Punjab has 22 districts, 81 tehsils and 147 blocks for administrative purpose. Punjab has 13 Parliamentary Constituencies, 117 Vidhan Sabha Constituencies and has 7 seats in the Rajya Sabha (Manku, 2009).

The physical environment is inducing for the creation and development of agriculture in Punjab. Geology of Punjab is relatively simple. A major portion of the state of Punjab is covered by the "Indo-Gangetic Alluvial Plains". Gradient of slope is gentle with the exception of north-eastern parts along the Shiwalik hills (Gosal, 2000). On the basis of topography, Punjab is divided into five major landform regions (Figure 1.2). These landform regions are upland plains, upland plains with sand dunes, piedmont plains, flood plains and Shiwalik hills. Climate of the study area is continental sub-tropical monsoon type, which varies between sub-humid in the north-east to semi-arid in the south-west. The maximum temperature during June is recorded above 40⁰C and minimum during January comes below freezing point. Annual average rainfall is 65 centimetres, which varies from 22 centimetres in the south-west to 140 centimetres in north-east. Out of total rainfall, 70 to 80 per cent of the annual rainfall is concentrated only during three months from July to September during the monsoon season. On the basis of texture, climate, topography and denudation processes, Punjab Remote Sensing

Department has classified the soils of Punjab into eight major types, namely; fluvial or bet soils, loamy soils, sandy soils, desert soils, kandi soils, seirozems soils, grey-brown podzolic soils and sodic-saline soils. There are three perennial rivers; Satluj, Ravi and Beas and one seasonal river; Ghaggar. Numerous closely spaced *choes* (seasonal streams) traverse the dissected piedmont plains and gullies in the Shiwalik hills. At present only 6.12 per cent of the area of Punjab is covered with forests, majority of which is confined to the Shiwalik hills in Pathankot, Hoshiarpur and Rupnagar districts. Much of the area of Punjab plains is extensively used for agriculture (Manku, 2009).

It is observed that the human factors like social, economic, cultural, technological and organizational factors together help to create and develop a dynamic and progressive environment which is conducive to overall agricultural development of the state. The average density of population in study area as per 2011 Census is 551 persons per square kilometre. The highest density of population is found in the Ludhiana district (978 persons) and lowest population density is recorded in Muktsar district (348 persons). Agricultural worker constitutes more than 40 per cent to the total workers. More than three fourth of the population is literate. The size of holdings is not even. The number of land holdings are 10, 52,554 as per 2010-11 data of Agriculture Census. Out of which marginal land holdings (less than 1 hectare) cover 15.62 per cent, small (1 to 2 hectares) constitutes 18.57 per cent, semi-medium (between 2 to 4 hectares) constitutes 30.83 per cent, medium (4 to 10 hectares) comprise 28.35 per cent and large (above 10 hectares) land holdings comprise only 6.62 per cent of the land holdings. Consumption of chemical fertilizers (NPK) is very high. The total road length in Punjab is 81,808 kilometres. The average road density is more than 140 kilometres per 100 square kilometre of area. Average road intensity is more than 250 kilometres per lac of population. After the mechanization, there are 79.3 tractors per thousand hectares of net sown area. The average density of tube-wells is 300.88 per thousand hectares of net sown area. Seventy five per cent tube-wells are electric operated and 25 per cent are diesel operated. There are 145 agricultural markets. On an average each market serves 340 square kilometres of area in Punjab. (A detailed description of physical and human environment of the study area relating to field patterns is provided in Chapter No.-2).

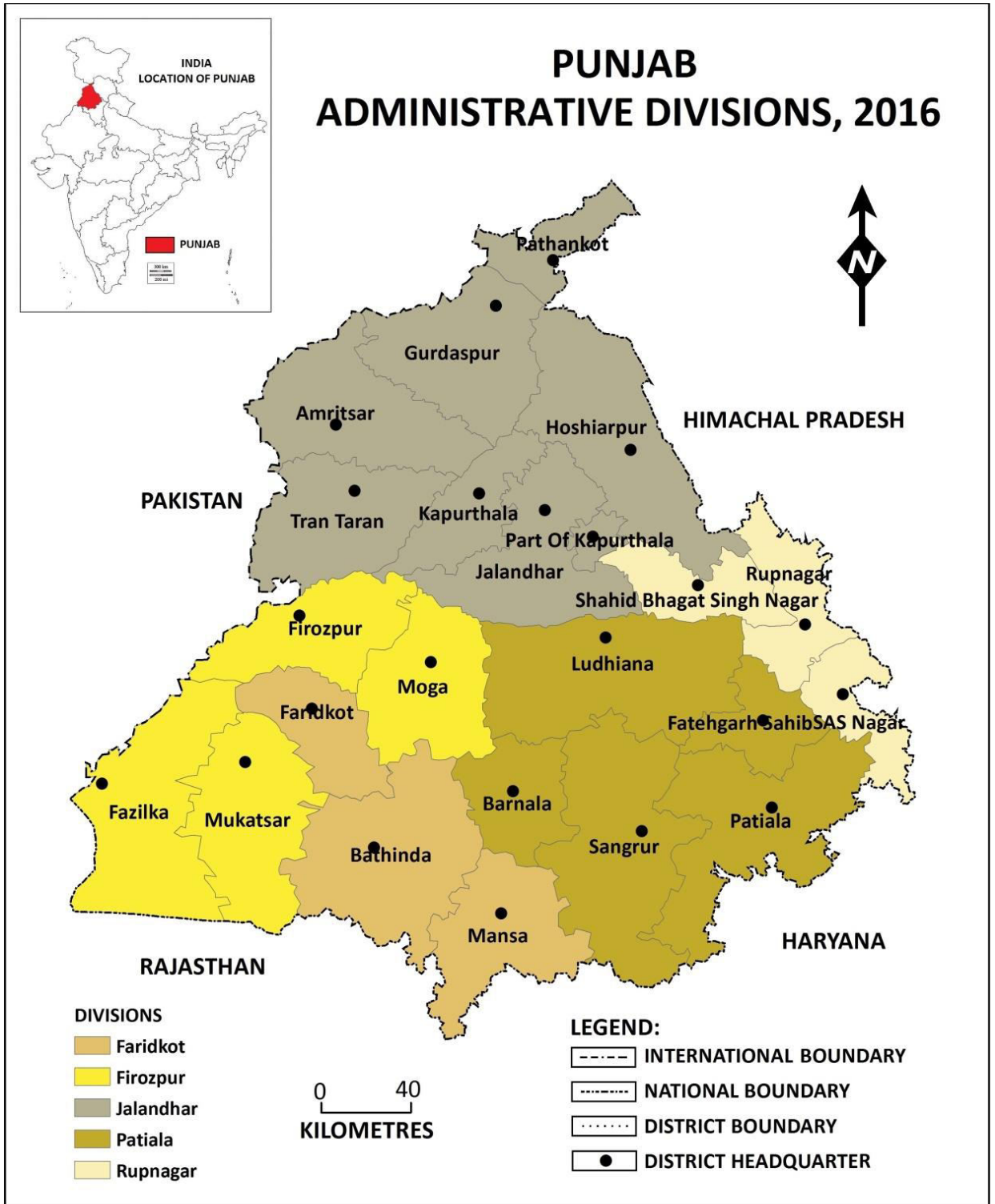


Figure 1.1

PUNJAB LANDFORM REGIONS

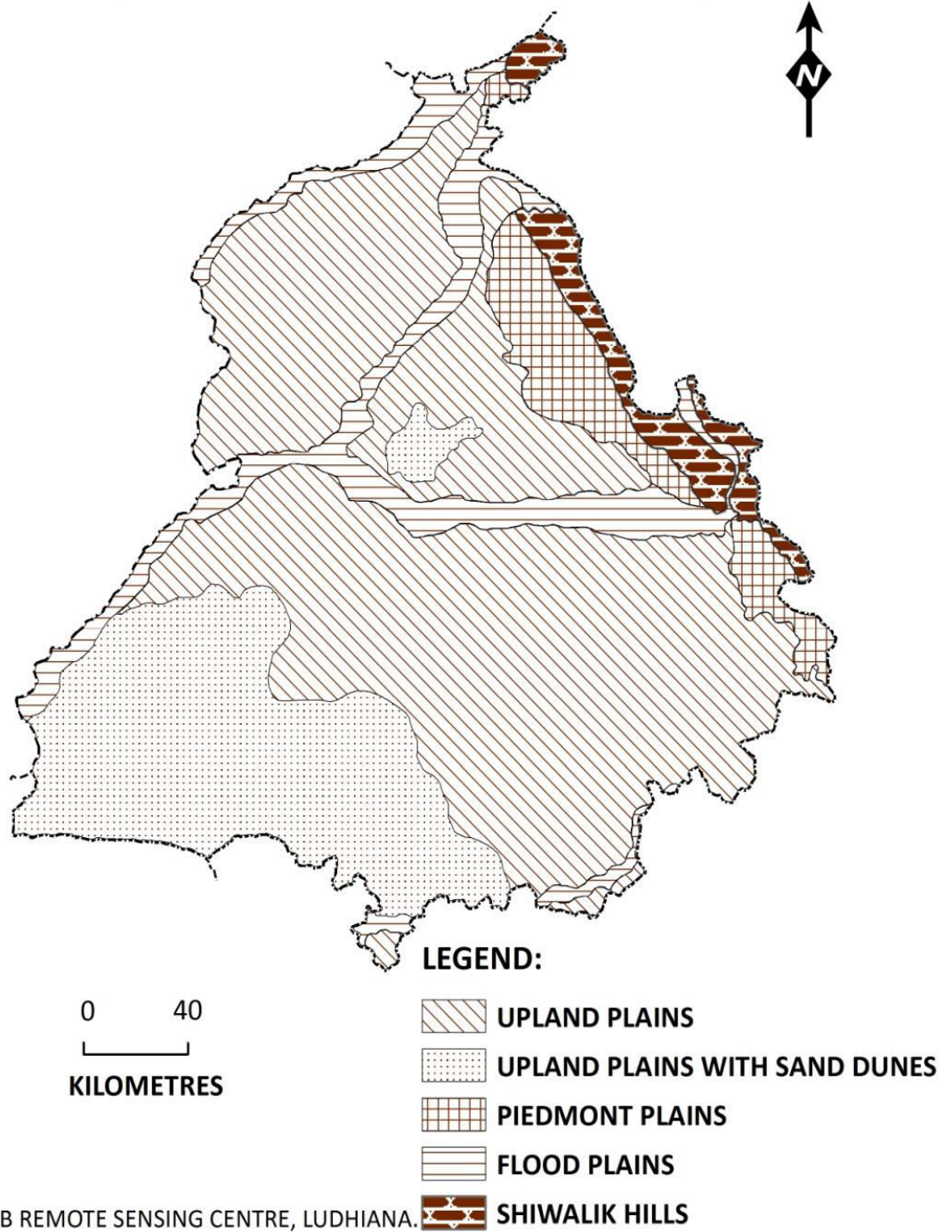


Figure 1.2

THE SYSTEMS OF LAND DIVISION

The chief systems of land division of Punjab can be grouped into Pre-British, British and Post-British periods. The detailed description of these systems of land divisions is given below:

i) Pre-British Rule Systems

During the medieval times under the Mughal rule in the revenue system of Akbar, Punjab was formed of *Sarkars* of the Lahore *Suba*. The *Raja* (King) used to be the landlord of the whole *Raj* (kingdom). Each principality was a single estate, divided for management into a number of circuits such as *mauza*, *tappa* and *chakla*. The circuits were mere groupings of holdings under a collector of rents (Nijjar, 1972). The system of land division, proprietary rights and relationship of farmers with the *Raja* were controlled by the sacred laws. The arable lands were divided among the tenants by a *patta* (deed of grants) from the *Raja*. The tenants had the hereditary rights of cultivation whereas the wastelands were the *Raja's* property. Each tenant had a separate land holding and paid the land revenue direct to the *Raja*. When the crops were harvested, a part of produce was handed over to the village professional men like blacksmith, carpenter, potter, washer-man, barber, water-carrier, tailor, cotton-stuffer, cobbler and the priests for their professional assistance. The rest of the produce, divided between the state and cultivator was termed as *batai* (Moreland, 1988). Cash assessments were not made. The *Raja* had the power to exempt the payment of land revenue to any land holder as an act of favour. The system of alienating land revenue in favour of individual or institutions remained more or less the same during the Mughal and the Sikh times. The service *jagirs* given by the Sikh rulers were similar even in details to the *mansabdari jagirs* of the Mughal rulers. However, the proportion of the revenues alienated by way of *jagirs* was smaller than what it had been during the Mughal times (Banga, 1978).

It was observed by a contemporary that land was a disposable property and field as well as plots were mortgaged and sold among the ordinary *zamindars* with or without the concurrence of the local authorities. Even if such transactions were not very frequent or numerous, their contemporary records leave no doubt about the proprietary rights of the individual. A tenure called *malik-i-qabza* entitled the holders to full ownership of the rent free land he occupied for many generations and had by

long possession gradually acquired proprietary rights. All the land holders derived the original titles from the *Raja* by a *patta* or a deed of grant. This hereditary right to hold and cultivate land was known *warisi* that is an inheritance. It was retained contingent upon the proper cultivation of land and the punctual payment of the government dues. When the tenant had no heirs, he was permitted to select a successor and transfer his land to him in his life time. The land holders of the village also had the right to use the wastelands (*shamlat* property) for grazing, cutting grass or leaves for fodder and to collect wood for fuel. The state had a right of improvement in wastelands of all kinds. The state could empower any person for this purpose through *patta* or deed of grant. During the later part of the Sikh rule revenue as *malikana* were started taken in cash (Banga, 1978).

ii) Under British Rule Systems

After the annexation of Punjab by the Britishers in their Indian Empire in 1849 land records were updated. British government under took fresh assessment of the land revenue of Punjab villages. Village boundaries were laid down defining the limits of a village, waste as well as cultivated land was included in the village boundaries. All persons holding land, who either in their own names or in the names of their ancestors in the male line were recorded as owners of the land. Each parcel of land (field) was given a *khasra* number and was entered in *Jamabandillal-kitab*. Proprietary rights of various kinds of owners were properly determined and records of rights in *Jamabandillal-kitab* were included (Baden, 1974). The *mamla* (revenue) in each village was collected from the owners by one or more headmen or *lambardars* (leading men of the village community) who pay the proceeds into the government treasury and receive a percentage on the collection as their remuneration. Land revenue for the whole village was assessed in lump sum and share of each cultivator was determined by taking into consideration the size of the land holding, total area of the village, land type and availability of irrigation facilities. Wasteland and forests were considered as undivided property of the government (Baden, 1974). However, the villagers had rights to use the wasteland and forest for grazing and wood for fuel.

The tradition and customs regarding rule of property, laws of inheritance which have come down from generation to generation are found recorded in the *Wajib-ul-Arz* and *Riwaj-i-Am* in the settlements records and administration papers of the village. The courts generally accept these traditional rules and customs regarding property rights.

One may observe the following customs of devolution of property among people of Punjab as suggested by Roy (1986):

- a. The females other than the widow or the mother of the deceased were usually excluded by males from property rights.
- b. In case of several sons the ordinary rule was that they take equal share in the property of their father. In Punjab, sometimes the eldest son was allowed a somewhat larger share than his younger brothers, the rule, however, was that sons share equally in the property of their father.
- c. The childless proprietor can gift his/her property to any of his/her relative in his/her lifetime.

iii) Post British Rule Systems

The system introduced by the British rulers with some modifications, is still prevailing in the state of Punjab. After independence (1947), the amendment in the Hindu Law of Inheritance, under which females are also given equal share in the family's property, also affected to some extent the sub-divisions of the holdings and consequently the pattern and scattering of fields. The tenant cultivators have been made the owners of the land with the passage of Punjab occupancy Tenants Act, 1952 (Gazetteer, 2001). The *mamla* (revenue) from farmers has also been waved off in recent years. Concessional registration charges are taken from females. No registration charges are taken in case of hereditary transfer of land in the names of sons and daughters.

REVIEW OF LITERATURE

It has to be regrettably admitted that Indian geographers have made very few attempts to study in detail the individual landscape elements of rural settlements including studies on field patterns. The important and relevant works undertaken by scholars in India and other parts of the world in the form of research papers, review papers, occasional papers, monographs and essays published in journals, books and on the internet related to Geography and other social sciences, proceedings and abstract books of conferences and seminars held at national and international levels, M. Phil dissertations and Ph. D theses and government publications have been reviewed in the following paragraphs:

Seeböhm (1883) in his classic work "The English Village Community Examined in its Relations to the Manorial and Tribal Systems and to the Common or Open Field System Husbandry: An Essay in Economic History" gave a description of role of physical and cultural factors in the origin and evolution of village common lands and the open field system dominated by husbandry. This was the first work presented on the theme in the world. Gray (1915) in his paper "English Field Systems" presented a historical explanation of origin and evolution of field patterns in England in old times. He was interested in finding the role of natural and human factors in the creation and development of open field systems in England. Gray (1915) in his paper "Historical Survey of the English Agrarian Landscape" provided detailed information of the fields and related agrarian landscape distributed in different parts of England. He stated that there is a diversity of field patterns found both in different places at one time and at different times at one place.

Mukerji (1926) in his book "Rural Economy of India" reflected the role of low mud-dikes in giving open appearance to landscape of fields. He concluded that low mud-dikes have resulted in open-field systems. Broek (1932) in his paper "The Santa Clara Valley, California: A Study in Landscape Changes" has given a detailed description of field patterns of the Santa Clara of California in USA with the factors responsible for the landscape changes. Fisher (1934-35) in his paper "The Development of the London Food Market 1540-1640, described the broad changes in the traditional Chiltern field systems started in sixteenth century were triggered by the growth of the London food market. He concluded that there was large scale intensification in the fields during this period to produce more foodgrains to be sold in the market. Lester (1935) in his paper "The relation between Field Patterns and Jointing in the Aran Islands" situated in County Galway of Ireland discussed the relationship of field patterns with the physical features like shoreline and cliff faces and man-made features like roads and houses. Barger (1938) in the paper "The Present Position of Studies in English Field Systems" discussed the status of studies related to the field patterns and field systems in England in pre and post 1930s. Bishop (1938) in his paper "The Rotation of Crops at Westerham, 1297-1350" discussed convertible husbandry in which fields were abandoned in rotation for some time after some years of regular cultivation in infield and outfield areas of Westerham for maintaining productivity and fertility of fields for their better management. Orwin (1938) in her

work on "The Open Fields" discussed the open field systems in different parts of England. He concluded his study by stating that the indications of open fields are doubtful and do not exist at Lancashire and in Cornwall. He suggested that interpretation of aerial photographs and Ordnance Survey Maps belonging to Devon County may show evidences of open fields existing in the past in agricultural landscape.

Rawson (1941) in his paper "The Coal Mining Industry of the Hawarden District on the Eve of the Industrial Revolution" made two tracings from the map and marked the strips of fields in terms of their ownership in coal mining area of Hawarden before and after the exchange of fields. It was clearly demonstrated how such an exchange of scattered fields resulted in their consolidation. Tate (1943) in his paper "Open Fields, Commons and Enclosures in Kent" discussed status of different types of fields prevalent in past in Kent. He did not find evidences of enclosures of fields by their sub-divisions through Chancery Decrees. He stated that consolidation and enclosure of the fields was preceded by private agreements, through exchange and by new purchase of fields. Finsberg (1949) in his article "The Open Field in Devonshire" threw light on the open field systems prevalent in Devonshire in the past. He supported the argument that in the past Braunton Great Field was cultivated as the open field system. Beresford (1950) in his paper "Glebe Terriers and Open Field, Yorkshire" discussed in detail the evidences of ancient field systems prevalent in England in context to open and closed fields. White (1950) in his thesis on the topic "Some Aspects of Agricultural Geography of the Kentish Low Weald" discussed the factors involved in the broad contrasts in the areas of open and closed fields from sixteenth to eighteenth century in the Kentish Lowlands.

Coleman (1951) in his Ph.D thesis on the topic "The Economy of Kent under the Later Stuart" described the agricultural landscape of Kent dominated by small enclosed fields with isolated hamlets and nucleated villages. Nightingale (1952) in his B. Lit. thesis on the topic "Some Evidences of Open Field Agriculture in Kent" discussed the small enclosed fields with isolated farms located at large distances in the village. He said that remnants of open field systems were also visible in some parts of Kent. Nightingale (1953) in the paper "Ploughing and Field Landscape" described the field shapes reflected by the ploughing instrument used in Kent in the seventeenth century. He said that long and narrow fields with flexing boundaries were formed by the

ploughs in early times. The squarish and rectangular strip fields were ploughed in Kent. Rawson (1953) in his paper "The Open Field in Flintshire" traced the history of open fields system with the help of old maps and recent aerial photographs. He described that how some field boundaries of the open fields survived today and suggested that present field patterns can be best interpreted by the study of similar field boundaries survived in the open field arrangements. Clyde & others (1954) in the chapter on Settlement Geography from their famous book "American Geography: Inventory and Prospect" stated that contrasts in settlement patterns in North America need careful investigation by taking examples from the studies related to field patterns. Engene and Hart (1954) in their paper "Fences and Forms" discussed different types of field boundaries like field boundaries made up of woven wires, barbed wires and electric fences prevalent in USA. Orwin & C.S. (1954) in their paper "The Open Fields" gave an interesting explanation of the factors involved in the origin and development of open fields. Eyre (1955) in his work "The Curving Plough-Strip and its Historical Implications" gave an interesting and extensive historical coverage on relationship of field patterns and ploughing instruments used in the fields. Hull (1955) in his lecture note on "Kent from the Dissolution to the Civil War" stated that there is no evidence available from the past records of any parliamentary enclosures of sub-divided arable fields by Chancery Decree in Kent. Beecham (1956) in his paper "A Review of Balks as Strip Boundaries in the Open Fields" illustrated the open field systems with respect to shape of field boundaries. Davies (1956) in the paper "Rhosili Open Field and Related South Wales Field Patterns" discussed different attributes of field and the open fields found in the Rhosili area of South Wales. Beresford (1957) in his paper "History on the Ground: Six Studies in Maps and Landscapes" discussed evidences related to the history of old field patterns with the help of maps. Bradford (1957) in his work "Ancient Landscapes: Studies in field Archaeology" discuss the remnants of field landscapes of ancient times in different parts of the country. Louis (1957) in his paper "Vincennes and French Settlements in the Old Northwest" described the land and fields owned by people from different nations backgrounds. He said that French people who settled in Indiana did not have any interest in land ownerships because originally they were not the farmers but belonged to the business of fur trading. Eidt (1959) in his paper "Aboriginal Chibcha Settlement in Columbia" has thrown light on the reclamation of marshlands for agriculture practised in the higher cultures of the New World in the higher lands of

Mexico and the Andes. Goransson (1959) in his paper "Field and Village on the Island of Oland: A Study of the Genetic Compound of an East Swedish Rural Landscape" has given a vivid explanation of field landscape in Oland of Sweden. Harris (1959) in his paper "The Open Fields of East Yorkshire" gave a historical explanation of open field systems developed in east Yorkshire of England. Marschner (1959) in his classic work "Land Use and its Patterns in the United States" illustrates astonishing geographical variety of field patterns in USA. He described the unregulated divisions of the Spanish, the lots of the French, the towns of New England, the Middle Colonies and the square patterns of the fields that were imposed on most parts of USA as a product of the Ordinance of 1785. Gulley (1960) in his thesis on the topic "The Wealden Landscape in the Early Seventeenth Century and its Antecedents" threw light on the origin and evolution of fields in the Weald and submitted that field patterns performed several functions in the seventeenth century in Weald. He said that combination of trees and hedges surrounding the fields gave the Wealden landscape a closed field densely wooded appearance. He also commented on the paths to the fields which had no frontage to the road.

Bowen (1961) in the paper "Ancient Fields" while discussing the influence of physical environment on the fields stated that constant tilling of a field give a sharp cut to the field in uphill areas termed as negative lynchet and accumulation of soils on its edges known as positive lynchet in the downhill areas. Dussart (1961) in his paper "*Les Types de dessin parcellaire et leur repartition en Belgique*" had identified eighteen field type regions in Belgium and explained the factors affecting field types in these regions. Goransson (1961) in his paper "Regular Open Field Pattern in England and Scandanavian Solskifte" talked about the Sun divisions of the fields. He concluded that the open field patterns of Scandanavian Solskifte were infact derived from the England through the cultural contest between the people of these countries in 10th to 12th century. Krenzlin and Reush (1961) in his paper "*Die Entstehung der Gewinnflur, nach Untersuchungen in nordlichen Unterfranken*" stated that strip field patterns originated from the sub-division of the original large blocks and strip fields. Melling (1961) in his work "Aspects of Agriculture and Industry" discussed arable fields, meadows and marshlands in Kent. He concluded that open arable fields were not concerned with Kentish Enclosure Acts. Mukerji (1961) was the first Indian geographer who wrote on field patterns in detail. His paper "Field Pattern in the

Upper-Doab *Jat* Villages" was the first paper on the theme of field patterns written by an Indian geographer. He observed that the types of houses, the patterns of roads and streets, the forms of settlements and the patterns of agricultural fields are an invitation to a rich field of study the geographers have constantly ignored. It needs to be emphasised that cultural landscape is a synthesis of these individual elements and is comprehended through an understanding of their mutual relationship. The field pattern is essentially an expression of the community decision through their culture and mode of living. The pattern, function and the evolution of fields can be understood well through an interpretation of the field pattern in an area which may reflect all these attributes and functions. Spencer and Hale (1961) in their paper "The Origin, Nature and Distribution of Agricultural Terracing" provided a detailed picture on the role of landforms and slopes in the terraced contour cultivation. They concluded that terracing suggests an advanced stage of contour cultivation. Yates (1961) in his paper "A Study of Settlement Patterns" has shown that multiple open fields were associated with isolated farms and hamlets. He was of the opinion that the foremost settlement patterns were comprised of series of hamlets and farms with arable fields which were continuously used. The secondary settlements later on extended in less fertile soil areas where agriculture was difficult and therefore only scattered population distribution was found in such less productive field areas. Baker (1962) in his paper "Some Early Kentish Estate Maps and a Note on Their Portrayal of Field Boundaries" discussed the signs of disintegrating open field systems. He also found unenclosed fields within large sized enclosed land holdings. Mukerji (1962) in his work "Field Pattern in a Telangana Village" concluded that field pattern as an element in the synthetic integrated picture of agricultural landscape is the concern of the cultural geographer who alone can observe and interpret fully the pattern of combination of fields with all its related elements like micro-topography, habitation complex, soil types, cropping patterns, tenure, land systems, methods of cultivation and technological and socio-economic organization of irrigation. He stated that the study of field pattern has been almost completely ignored by the Indian geographers. Baker (1963) in his Ph.D. thesis on the topic "The Field Systems of Kent" described the rural landscape of Kent in the seventeenth century dominated by small sized enclosed fields at isolated hamlets and farms in nucleated villages. He identified the evidences of open field systems in a few parts of Kent. He said that open arable fields were found largely in early settlements in southeast England. He also discussed the

processes related to the grouping of fields during sixteenth and seventeenth centuries. He concluded that enlargement of fields has been a continuing process in the Weald up to the present times. Baker (1963) in his second paper "The Field Systems of an East Kent Parish" studied the unique seventeenth century names given to many fields in Kent like *South Furlong*, *Shots* and *Furlongs*. He did not find significance of such names given to these fields. Denevan (1963) in his paper "Additional Comments on the Earthworks of Mojos in North-east Bolivia" discussed in detail the field patterns situated on parallel and irregular ridges of Mojos in North-east Bolivia. There is a discussion on similar type of fields in the works of Denevan in later years, also mentioned in this review of literature. Plafker (1963) in his paper "Observations on Archaeological Remains in North-eastern Bolivia" threw light on the ancient remains of fields in his study area. Coe (1964) in his paper "The Chinampas of Mexico" discussed the form and pattern of dry, abandoned Chinampas fields known as 'Floating Garden' agriculture of the valley of Mexico which are similar in appearance to the ridged fields situated in different parts of South America studied by Denevan (1963, 1967), Plafker (1963) and Parsons & Denevan (1967). All of these researchers reached at the conclusion that such fields are indicators of laborious reclamation of marshes for intensive agriculture in those areas which are considered unfit or marginal for agriculture in present times in which crop cultivation has been stopped and fields abandoned permanently. Thirsk (1964) in the paper "The Common Fields" has described the past practice of arable fields left for common use for grazing and other fallows to enhance the productivity and fertility of soils in the fields. Baker (1965) in his paper "Field Patterns in Seventeenth Century Kent" provided a detailed explanation of field patterns found in different parts of Kent in the seventeenth century. Alan (1966) in the paper "Field System in the Vale of Holmesdale" discussed the field systems prevailed in the 17th century Kentish rural landscape. Nitz (1966) in his research paper on "Geographical Studies in the Field Patterns of Northern India and Germany" found that the pattern formed by well-defined field boundaries within the precincts of a village constitutes an important element in the manmade landscape. The use of land by each farmer is confined to the boundaries of his plots and the pattern of these plots has an impact on the pattern of land utilization. The pattern of land use does not necessarily result from the field patterns, rather they are different in different settings, and villages with similar field pattern may have different cropping patterns, subject to differences in soil, climate, and topographic situation of the

holdings and culture of the people. This means that pattern formed by these boundaries will not be the same even in the small culture area because the descriptive properties of the field, size, shape, slope and tillage patterns are prone to change even in a small culture area. He observed that the irregular strip pattern fields in Northern India have similarities to the Gewann field pattern of Southern Germany. He observed that Indian geographers have concentrated much of their work on types and patterns of settlements while neglecting house types and field patterns. This fact has been conceded by the Indian geographers as well.

Normal (1966) in his paper "Original Survey and Land Sub-division: A Comparative Study of the Form and Effect of Contrasting Cadastral Survey" used field patterns incidentally to illustrate the size and orientation of fields in relation to different types of survey systems. Parsons and Bowen (1966) in their paper "Ancient Ridged Fields of the San Jorge River Flood Plain Columbia" opined that most important traces of the ancient ridged fields are found in the seasonal inundated flood plains of tropical Savannas of the San Jorge river area of Northern Columbia. These fields are consisted of parallel or irregular groupings of raised ridges of variable heights, breadth and length. There is a discussion on similar type of fields in the works done by Denevan (1963, 1967), Plafker (1963) and Parsons and Denevan (1967). Roden and Baker (1966) in their paper "Field Systems of the Chiltern Hills and of Parts of Kent from the Late Thirteenth to the Early Seventeenth Century" gave interesting explanations on the role of physiographic and human factors in the origin and evolution of different types of field systems in different parts of England. Denevan (1967) in his another paper "The Aboriginal Cultural Geography of the Llanos de Mojos of Bolivia" gave a detailed description of origin and evolution of fields of Llanos de Mojos of Bolivia in South America. Parsons and Denevan (1967) in their paper "Pre Columbian Ridged Fields" discussed important evidences of the ancient Pre Columbian ridged fields. They observed that such fields are consisted of parallel and irregular groupings of raised ridges. They traced the origin of such fields in Orinoco Llanos in Surinam and near Guayaquil in Ecuador. Hart (1968) in his paper "Field Patterns in Indiana" observed that American geographers have also assumed correctly for the most part that field patterns are determined largely by systems of land division. Field patterns exhibit considerable but often subtle geographical variations even within an area which has only one system of land division. He observed the role of irregular village

boundaries, diagonal roads and *Khads* in producing non-rectangular fields. While discussing relationship of crops grown with the field pattern he concluded that each crop has its own production techniques and eco-technological requirements and consequently the field patterns under different crops tend to be different. Smith & others (1968) in their paper "Ancient Ridged Fields in the Region of Lake Titicaca" discussed different field patterns in the pre-Columbian lowlands of South America. Sylvia (1968) in the paper "A Prehistoric Field System in Chibcha Territory, Colombia" discussed the prehistoric field systems with the help of old maps and the recent aerial photographs taken from height at Andean basin popularly known by the name Sabana de Bogota. Alan (1969) in his paper "Some Terminological Problems in Studies of British Field System" discussed the terminology used in the study of field patterns and the field systems in Britain. Barnes (1969) in the reviewed work paper "Basic Material for the terminology of the Agricultural Landscape" presented the terminology used in agricultural landscape and the field patterns of the paper on types of field patterns written by H Uhlig. French (1969) in his paper "Field Patterns and the Three Field System: A Case of Sixteenth Century Lithuania" identified the field system of three equal sized fields cultivated on a rotation consisting of winter crop, spring crop and fallow existed widely across Europe from the Welsh marshes to the River Volga. Macnab (1970) in his paper "Cultivation and Field Form on three Japanese Islands" concluded that physical environment has been a dominant factor in the evolution of field patterns of the three islands. He also justified that 'An Idea' is a determining factor. One inventive person with such an idea on each island could have given the impetus that initiated the evolution of land use forms, which in turn produced the distinctive field patterns.

Blaikie (1971) in his paper "Spatial organization of agriculture in some north Indian villages" stated that accessibility to the fields, concern public relations more than the physiography within a village. He described the spatial organization of irrigated and un-irrigated fields with respect to crops grown. Ishida (1971) in his paper "Village and Field Pattern in the Middle Ganga Plain: A Diagrammatic Model and Some Overseas Comparisons" read at the I.G.U. Commission on Rural Settlements in Monsoon Asia held in Tokyo in 1971 explained in detail the village territory structure, field pattern and agricultural system of villages selected from the Ganga Plains and compared the findings with examples from Thailand and Japan. Uhlig (1971) in his

paper "Fields and Field Systems in Buchanan" talked at length on the relationship of crops grown with the infields and outfields. Finsberg (1972) in his paper "Anglo-Saxon England to 1042" discussed the ancient system of division of land and the factors governing it. He talks about the fossilisation of ancient land tenure systems and partition of land at later stages as per the new inheritance in the sub-divisions of holdings as a result of partition of estates. Indian Council of Social Science Research (ICSSR) in its first issue of *A Survey of Research in Geography* (1972) highlighted the negligence in the study of field systems and field patterns. According to it, the first paper on field pattern by any Indian geographer was 'Field Patterns in the Upper-Doab Jat Village by Mukerji in 1961 followed by a second paper by him on the "Field Pattern in a Telengana village" in 1962. Ishida (1972) in his book *A Cultural Geography of Great Plains of India: Essays, Techniques and Interim Report-cum-Methods* emphasised that the study of the village and field pattern is a socio-cultural and functional study of landscape, which reflects human and physical aspects. The agriculture system is built on the basis of zonal structure of territory, soil conditions, precipitations of rainfall and crops grown. He concluded that village patterns and field patterns are very much related to each other and function all together as a complex in social life as well as in agriculture. Jones (1972) in his paper "Post Roman Wales" described the ownership of agricultural fields in early societies in Wales. He stated that many societies shared land between members of a kin group, while land allotment between individuals within the restricted area was a trait of slavish tenure of the Welsh bond settlements. Nitz (1972) in his paper on "Objectives and Methods of Geographical Research in the Evolution of Rural Settlement Regions" noted that a complete understanding of a rural landscape necessitates an analysis of both the settlements and field landscape. He found that a particular region is characterised by its field pattern and to get knowledge of the evolution of a region the study of its individual settlements, their topographic sites, their lay-out of residential area, which we called the field pattern is necessary. Singh (1972) has discussed the radical changes in the field patterns in terms of size and distribution after implementation of the land reforms. In his paper "An Approach to the Study of the Morphology of the Indian Village" discussed at length the attributes of morphology of an Indian village with its house types and field patterns and the approach to study the morphology of an Indian village. Baker (1973) in his paper "Field Systems of Southeast England" has given a good description of open and closed field systems prevalent in southeast

England. Jordan (1973) in his work titled "*The European Culture Area*" analysed that Settlement Geography also involves the study of the visual imprint made by man on the cultural landscape. These imprints are made on the country side in the process of occupance and can be well studied through the study of field patterns. Arora (1976) has emphasised on improving the productivity of small and marginal farms through improvements in cropping patterns, irrigation etc through a multidisciplinary approach in his work "Development of Agriculture and Allied Sectors." Mukerji (1977) in his paper "Geographic Perspective on Rural Settlements; Recent Indian Efforts" declared that there has been a conspicuous neglect for the core elements of rural landscape namely, settlement, folk house and fields. A large majority of the research papers deal with illogically conceptualize morphology and various aspects of distribution of types of rural settlements. Studies of house types and morphology, processes of settling and field patterns have been largely ignored. Nitz (1977) in his paper "Settlements Processes and the Field Forms in the Himalayan Foreland of Kumaon" discussed field patterns during different settlement processes in different parts of the Himalayas. Baker (1979) in his paper "Observations on the Open Fields; The Present Position of Studies in British Field Systems" has communicated his observations on the open field systems prevailing in different parts of Britain during different periods of history of origin and evolution of field systems. Sheppard (1979) in his paper "The Origin and Evolution of Field and Settlement Patterns in the Herefordshire Manor of Marden" discussed in detail the origin of settlements and the field patterns. Dahlman (1980) in his work "The Open Field System: A Property Right Analysis of an Economic Institution" has analysed the rights of ownership of fields in the areas dominated by open field system. Dodgshon (1980) in his paper "The Origin of British Field Systems: An Interpretation" has provided detailed study of the origin and evolution of field systems in different parts of Britain.

Fox (1981) in his paper "Approaches to the Adoption of Midland System" discussed methods limitations and the appropriate approaches in the adoption of Midland open field systems in England. Alan (1983) in his paper "Discourses on British Field Systems" discussed the temporal and spatial discovery of field systems in England, the Agrarian history and the field systems in detail. Harvey (1983) in his paper "Planned Field Systems in Eastern Yorkshire: Some Thoughts on their Origin" gave his ideas on the origin and evolution of planned field systems. Grover (1985) in her

paper "Field Patterns in the Chandigarh Dun Gujar Village-An Interaction Study of Ecology, Culture and History" has identified complex co-relationships of field patterns with laws of inheritance, norms and practices of division of land, irrigation, crops, distance from the settlement, slope and farming technology with great effect. Bassett (1986) in interim report on "The Wootton Wawen Project" submitted that the present day field boundaries may reflect the fossilized remains of ancient rectangular field patterns in different parts of England. Manku (1986) in his book *The Gujar Settlements; A Study in Ethnic Geography* analysed the Gujar settlements in the Punjab *kandi* region. He discovered that the key to the unravelling of historical evolution of the settlement is held by the concept of clan (*gotra*) while that of the field pattern is held by clan in combination with ecology. Roger and Roland (1986) in their paper "Problems and Sources in Historical Geography: Agriculture in the Past" discuss the origin and evolution of field patterns in the Cambridgeshire Fens and North Devon in England. Sharma (1986) in her book *Rural Settlements: A Cultural Ecological Perspective* has studied field patterns of Solan district of Himachal Pradesh in the lower Himalayas inhabited by different caste groups with a cultural-ecological perspective. Richard & others (1987) in their paper "Old Field Succession on a Minnesota Sand Plain" found that soil nitrogen concentration increased significantly in an abandoned field with its age of abandonment. Della (1988) in the paper "Early Forms of Open-Field Agriculture in England" examined the separate components of the open field systems like nature of fields and their earlier systems, evidences for shared land and earliest document evidences related to the fields in England. Ford & others (1988) in their paper "The Date of 'Celtic' Field-Systems on the Berkshire Downs" reflected the evidences of ancient field systems found widely distributed in Berkshire and over the British Isles and Northwest Europe. Hall (1988) in his paper "The Late Saxon Countryside-Villages and their Fields" discussed the size, shape, boundaries and other attributes of field systems found in the villages. Johannes (1988) in the paper "Some Aspects of Open Fields in the Southern Part of the Province of Limburg" compared the open fields of Limburg with other regions of Europe. Marshal (1989) in his paper "Distribution Patterns of Plants Associated with Arable Field Edges" discussed the distribution pattern of weeds at the field boundaries and field margins of arable land in Cambridgeshire and Hampshire. Singh (1990) in his unpublished M. Phil dissertation "Field Pattern in a Punjab Village: An Evolutionary Interpretation" discussed in detail evolution of field patterns, field

patterns in pre and post consolidation phases and existing field patterns of a village situated in the flat upland plains of Punjab. Eyring (1999) in the paper "Vegetation Management in Large Cultural Landscapes: Techniques for Preserving Historic Fields and Vistas" discussed in detail landscapes preservation techniques.

Muiris and Downey (2004) in their paper "Prehistoric Field Boundaries" revealed the existence of prehistoric stone-wall field boundaries in Ireland which were found buried beneath blanket peat along the western sea-board margins in Ireland. Singh (2004) in his paper "Evolution of Field Pattern in a Punjab Village" concludes that the field pattern is not a static phenomenon and the existing field pattern provides a link and a key in the understanding of the processes of settling in an area inhabited by a cultural group. Bhat (2009) in his work *Survey of Advances in Research* in the book *Geography of India: Selected Themes* has highlighted the limited coverage of field patterns in India. Nangia (2009) in *Survey of Advances in Research* in the book *Geography of India: Selected Themes* traced the trends in Rural Settlement Geography and highlighted that the limited coverage on field patterns in Settlement Geography has generated the need to carry out studies on distribution of field patterns, as characterized in different areas in different historical periods, and their interpretation in terms of physical, cultural and technological factors. Thurfjell Henrik & others (2009) in their paper "Habitat Use and Spatial Patterns of Wild Boar *Sus Scrofa* (L.): Agricultural Fields and Edges" discussed the rapidly increasing population of wild boar in Sweden and Europe causing large scale harm to crops. They are of the opinion that there is a critical need for getting more knowledge about the wild boar and their habitat utilisation especially situated near the agricultural fields. Sklenicka & others (2009) in their work "Remnants of medieval field patterns in Czech Republic: Analysis of driving forces behind their disappearance with special attention to the role of hedgerows" observed that original historical pattern of fields persisted due to the stabilizing pattern of hedgerows. They stated that well-preserved examples of these landscapes are extremely rare. They concluded that the use of these fields belonging to medieval period for intensive agriculture and residential purposes has resulted to their sharp decline in recent decades. Singh (2010) in his book "*Geography of Settlement*" has illustrated important aspects settlements including field patterns. There is a detailed discussion on the attributes and factors affecting field patterns in different parts of the world.

Singh (2013) in his paper "Evolution of Landscape in a Punjab Village" discussed the spatio-temporal evolutionary changes in the field patterns of Dhanowali village in Punjab. Singh (2014) discussed the problem of encroachment of fields due to fast expansion in urban periphery of a city in his paper "Field Landscape in an Urban Peripheral Village of Jalandhar City". Singh (2015) in his paper "Field Patterns in Punjab" elaborated the affect of physical and cultural factors on field patterns in Punjab. Singh (2015) presented an indepth study on the evolution of field patterns in village Dhanowali in his paper "Field Patterns in Punjab: A Case Study of Village Dhanowali". IGU (2016), International Geographical Union (IGU) Activities in India and National Committee Report (2012-2016) in its report "*Progress in Indian Geography: A Country Report, 2012-2016*" edited by Professor R B Singh (2016) did not have any mention of progress in the study of field patterns in the section on Cultural Geography and agriculture. This fact supports the observations given by Bhat (2009) and Nangia (2009) on the neglect of the study of field patterns. Singh (2016) in his paper "Land Types and Field Patterns in a Punjab Village" discussed the relationship between the land types and field patterns in Dhanowali village situated in Jalandhar district of Punjab. Singh (2016) in his work on "Field Patterns in Irrigated and Rain-fed Lands of a Punjab Village" compared the field patterns of irrigated and *barani* (rain-fed) land types in Dhanowali village situated in Jalandhar district of Punjab. Singh (2017) in his work "Land Types and Field Patterns in a Punjab Village: An Evolutionary Interpretation" discussed the role of land types in the evolution of field patterns in village Dhanowali in Punjab. Singh (2017) in his paper "Field Patterns in Pre and Post Consolidation Phases in Punjab" discussed the changes in field patterns in pre and post consolidation phases in the consolidated and unconsolidated villages in Punjab. Singh (2017) in his research paper "Role of Irrigation Facilities in the Transformation of Land Types and Field Patterns in a Punjab Village" discussed the role of canal irrigation in the improvement of land types and their effect on field patterns along with a discussion on ill-effects of over-irrigation and the problems associated with water-logging and the precautionary measures to avoid such problems. Singh (2017) in his research paper "Relationship Between Crops Grown and Field Patterns in a Punjab Village" compared the Pre-Green Revolution crops grown and field patterns with the Post-Green Revolution crops grown and field patterns of village Bath situated in the upland plains with sand dunes in Bathinda district of Punjab along with a discussion on contemporary

concerns and challenges related to cropping and field patterns. Singh (2017) in his work on “Land Types and Field Patterns in a Punjab Village: An Evolutionary Interpretation of Dhanowali” has discussed in detail the evolution of land types and their effect on the field patterns in village Dhanowali located on the periphery of Jalandhar city and highlighted the problems and solutions relating to encroachment of fields by fast expanding settlement due to the effect of rapid urbanization in the neighbouring Jalandhar city. Singh (2018) in his paper "Field Patterns during Pre and Post Consolidation Phases in a Punjab Village" deliberated on varied attributes of field patterns in the pre and post consolidation phases in village Bath situated in Bathinda district in the state of Punjab. Singh (2018) in his research paper "Field Patterns and Land-owning Castes in a Punjab Village" has compared the field patterns of the fields owned by different castes in 1884 and 2016 for village Dhanowali located in Jalandhar district of Punjab and reached at the conclusion that fields and holdings of farmers owned by different castes display different field patterns in the early stages and at present rich farmers own large size land holdings and fields irrespective of their castes. Singh and Singh (2018) in their research paper “Transformation of Field Patterns Through Irrigation in Punjab: A Case Study of Village Bath of Upland Plains with Sand Dunes” discussed the role of irrigation in the transformation of land types and field patterns in different phases of their evolution and recommended rational use of irrigation for sustainable management of water resources.

Therefore, the study of field pattern is largely prompted by the established significance of field patterns in rural settlement geography. In the present study field patterns have been analysed within the framework of an interacting system of elements related to physical and human environment. These elements individually as well as in combination have played important role in the origin, evolution, arrangement, form and function of fields. Generalizations formulated from the review of literatures were applied to the study of field pattern in the study area and examined as to their applicability.

Inferences from the Literature Review

Above review of literature found that very few studies addressed issues of field patterns in some parts of Punjab. Except one, other studies relating to field patterns in Punjab have been undertaken by the researcher himself especially in the present

decade. Many English, German and American geographers have studied the field patterns and other characteristics of fields of their respective countries but Indian geographers have made very few attempts to study in detail the individual landscape elements namely settlements, folk house and fields. Out of these three, field patterns have largely been ignored by the Indian geographers (ICSSR, 1972 & 2009; Bhat, 2009; Nangia, 2009; and IGU, 2016). Numerous references are available on the study of pre-historic field patterns undertaken by historians as a part of excavations especially in England but studies on geographical analysis of field patterns are rarely conducted in India and other developing countries.

Research Gaps

Studies conducted by Indian geographers on field patterns are very rare. Rarely, any national and state level study on geographical analysis of field patterns exist in India. Geographical studies on field patterns are nearly missing in Punjab and no study exists with a focus on geographical analysis of field patterns covering all the landform regions of Punjab. The area of interest of previous studies remained either a single village or a single landform region covering a few villages, but all the landform regions of Punjab have never been studied in detail earlier from the view point of geographical analysis of field patterns. None of the previous studies related to field patterns has covered the entire Punjab for an indepth study of field patterns and no study on field patterns in the state of Punjab as a whole covered time period from 1884 to 2016.

RATIONALE FOR THE STUDY OF FIELD PATTERNS IN PUNJAB

The significance of research on field patterns in the state of Punjab stems from the fact of its achievements in the successful adoption of Green Revolution and the revolutionary changes in its agriculture in the recent past and their influences on the farmers. It will not be immodest to state that geographers have nearly ignored the study of the phenomenon of field patterns in the Rural Settlement Geography of the state. No comprehensive study on field patterns covering all the landform regions of the state of Punjab for time period 1884 to 2016 exist. None of the studies reviewed provided a comprehensive picture of geographical analysis of field patterns in Punjab. This leaves a scope for such a meaningful study, which captures the whole length and breadth of the state and all of the modern times starting from the British records of the

late nineteenth century. The present study tries to fill the gap highlighted in the literature review. This study on field patterns in Punjab will not only enhance the existing literature but it will also create a new knowledge with a sound social applicability and policy implications. It is expected that the study will draw the attention of researchers to this very important dimension of field patterns which has not properly been addressed so far. The findings of this research would arouse interest and can be usefully adopted as a model by geographers, anthropologists, sociologists, rural development planners and experts from land records in the state of Punjab as well as other parts of India and other developing countries with similar socio-cultural and geographical backgrounds.

OPERATIONAL DEFINITION OF FIELD PATTERN

An operational definition is the description of a term, object or phenomenon which can be validated by data or information and is accessible for independent testing and measurement. The term field pattern has been used by different scholars belonging to different disciplines according to their own requirements and understandings. Geographers are concerned with the spatial dimension of field patterns of an agricultural landscape. The present study is based on the operational definition of field pattern proposed by Mukerji (1961): "*Field pattern is the arrangement of parcels of land in terms of their size, shape, distance from the settlement, their location in different land types and their land use evolved through time and space.*" Due weightage has been given in the present study to all the components highlighted in this operational definition.

Size refers to the relative extent of a field, which influences the field pattern. In the present study, the fields are classified into four categories based on size for their geographical analysis: small (below 1 *kanal*), medium (1 *kanal* to 4 *kanals*), large (4 *kanals* to 8 *kanals*) and very large (above 8 *kanals*). *Shape* is an important and useful parameter for differentiating field patterns and is intimately related to terrain configuration. In the present study, fields are classified into seven *shape* categories: three sided-triangular; four sided-square; four sided-rectangular; four sided- elongated or strips; four sided-with one or more sides oblique irregular rectangular or quadrilateral; five sided-polygon; six sided-hexagon or more. The field pattern is affected by their distance from the *abadi-deh* (settlement). Infields (fields situated

near the *abadi-deh*, the main settlement), outfields (fields situated away from the *abadi-deh*, near the village boundary), open fields (without hedges and fences) and closed fields (with hedges and fences) vary in land types and land use. The distribution, shape and size of the fields are determined by several factors; irrigation method, irrigation sources, slope, crops grown, distance from the settlements, road types, technology used, soil and land types, social structure, extent of cultivated fields in relation to farming, methods of cultivation, land system, tenure system, government policies, the effect of the operation of Hindu law of inheritance, principle of equitable distribution of benefits and handicaps, principle of compensation and sale or mortgage on the sub-division of holdings and fields both through time and space (Mukerji, 1961).

OBJECTIVES OF THE STUDY: The focus of the present study is to achieve the following objectives:

1. To describe and analyse the effects of time and space on the field patterns in their phases of settling.
2. To undertake a geographical analysis of field patterns of the villages selected from different landform regions of Punjab.
3. To study the relationship between the attributes of field patterns and distance from the settlement proper (*abadi-deh*), land types, consolidation of land holdings, cropping patterns, land-owning castes, sources of irrigation and ploughing implements used.
4. To suggest measures to save existing fields and to improve their efficiency.

RESEARCH QUESTIONS

Based on the above listed objectives following questions for investigations are raised:

1. What are the effects of time and space on the field patterns in Punjab?
2. What are the variations in the field patterns in different landform regions of Punjab?
3. What is the relationship of land types, distance from the *abadi-deh* (settlement), consolidation of land holdings, cropping patterns, land-owning castes, sources of irrigation and ploughing implements with the field patterns in Punjab?

4. What is the role of physical and human factors in the creation and evolution of field patterns in Punjab?

HYPOTHESES

Based upon the research objectives and questions, following hypotheses are framed and proposed for investigation, which are elaborated under ten field pattern attributes:

(1) Phases of Settling

A field pattern is a cumulative result of phases of settling which have operated through time in an area. Therefore, in order to understand the field patterns, the study of effect of time and space is imperative.

(2) Landforms

Diverse field patterns evolve in response to different landform regions. Field patterns will be different in different landform regions of hills, piedmont plains, upland plains, upland plains with sand dunes and flood plains.

(3) Land Types

In the irrigated land types the size of the fields is small and in the rain-fed land types the size of the fields is large. The field size and land types are related to each other. In the irrigated land types, the size of the fields is small as every person wants to have a share in irrigated and fertile land types and this leads to more division of such fields. In the *barani* (non-irrigated, rain-fed) land types the size of the fields is large due to its poor productivity and fertility.

(4) Distance from the *Abadi-deh* (Settlement Proper)

Large fields are situated far from the *abadi-deh* (settlement proper). The large fields are situated in the outfield (peripheral) areas of the village and farmers pay less attention to these fields. These fields should be larger than the infields (near the settlement), because the heirs are not keen in dividing intensively the outfield, rather they prefer to have a full unit in a distant part, but they certainly want a share from every field near the settlement (infield). The resulting field patterns in the two cases are different.

(5) Road facing Fields

The fields facing roads are small in size and elongated in shape. This is due to the fact that such fields have greater commercial value and therefore, every land owner wants to have an access to the road.

(6) Consolidation of Land Holdings

In the villages where consolidation of holdings has taken place the fields are large in size and regular in shape, whereas in unconsolidated villages the fields are small, inconveniently large and irregular in shape. Consolidation is a measure to check scattering and to some extent, sub-divisions of holdings. After consolidation the numbers of fields constituting the holdings of a farmer is reduced to the minimum possible number. Every tenure holder is allotted a compact area in each block at the place where is located the largest part of his holding.

(7) Cropping Pattern

In commercial grain farming areas, the fields are large and regular whereas in vegetable and subsistence farming areas fields are intermediate in size and irregular in shape. Each crop has its own techniques and eco-technological requirements and, hence the field patterns under different crops are different.

(8) Land-Owning Castes

High caste groups have large land holdings, whereas low castes possess small land holdings. The land owned by different castes display different field patterns and forms. It is because the amount of land under the possession of each caste varies and there are variations in the characteristics of farming and mode of living.

(9) Sources of Irrigation

Field patterns are different in areas having different modes of irrigation. In general, in the irrigated areas, every land owner wants to have an access to the source of irrigation. Due to this fact the fields are perpendicular to the canal and arranged around a well or tube-well to provide irrigation facilities to every field.

(10) Ploughing Implement Used

Tractor ploughed fields are accentuated rectangular in shape and large in size whereas bullock ploughed fields are small in size. The kind of plough or ploughing implement also determines the size and shape of the fields of a farm. In a large

accentuated rectangular field both time and fuel are saved as the tractor needs less number of turns to plough the entire field. Bullock plough drawn fields will be square in shape and small in size as animals need frequent rest after a period of ploughing.

METHODOLOGY

(a) Sources of Data and Data Collection Tools

A variety of sources were tapped for obtaining the relevant data and information. Much of the present study is founded on the primary data derived from extensive field work of the selected villages. The data is obtained from *Patwari* (village level government official), *Kanungo* (tehsil level government official in revenue department) at the district revenue offices of Punjab and from the office of the Director Land Records, Punjab. The data is available from various unpublished record books and maps in the form of a bundle known as the *Basta* and identified by the village *Hadbast* number. *Shajra Kishtawars* each of different years of the sample villages, have supplied the village maps showing the fields, their boundaries and *Khasra* numbers (identification numbers) prepared at different intervals of time. *Jammabandi/Misalhakiat/Lal Kitab* (book of property records) was used to get *khasra* numbers which constitute the property unit or property units of a farmer or a family for each village. The data on land types is also found recorded in these unpublished hand-written books. *Khasra Gardavari* (harvest inspection book) provides the field-wise record of crops grown, land types, land use and sources of irrigation. *Shajra Nasab/Kursinama/Vanshawali* (genealogical tree) was extensively used to get the genealogy of the owners of the settlements, the history of the settlement and the basis of naming the settlement for each selected village. The data and information regarding the present day ownership of fields was obtained from the *Patwari* of the concerned village. The information and notes were also taken on the farming implements used, sources of irrigation and crops grown. The thematic maps on ownership of fields, land types and field patterns, pre and post consolidation scattering of fields, crops grown and land-owning castes for different phases of the sample villages used in this study were drawn by the researcher on the basis of data obtained from these sources. This was accompanied by the detailed observations and photographs on the shape and size of the fields, field boundaries, field paths and means of irrigation. Information was also obtained through enquiries and interviews with the farmers. The settlement reports written by British officers for different years,

the district gazetteers were used for general information of the area. The books, *The Agrarian Systems of Moslem India* by W.H. Moreland (1988), *Agrarian System of Sikhs* (Late 18th and early 19th century) by Indu Banga (1978) and *The Land Systems of British India* by Powell Baden (1974) were used for understanding the systems of land divisions in Pre-British and British times in the study area. The book, *Customs and Customary Law in British India* by Sripati Roy (1986) was also used for getting knowledge of the systems of land divisions in Pre-British and British times in the study area. The traditions and customs regarding rules of property, laws of inheritance, which have come down from generation to generation are found recorded in the *Wajib-ul-Arz* and *Riwaj-i-Am* in the settlement records of administration papers of the villages. Secondary data sources such as topographic sheets, Google Earth and Google Maps Geographic software were also used to get information of the geographic coordinates and land use details of the sample villages. Index of Scattering and Index of Scattering in terms of Distance were used for calculating scattering of sites of fields of a farmer during pre and post consolidation phases. The reliability of data collected is fairly high. The village *Patwari* to whom the job of collecting facts on fields is a government official, entrusted and native to the area. Information and data provided by Economic and Statistical Organisation of Punjab, Directorate of Agriculture-Punjab, Punjab Agricultural University-Ludhiana, Punjab Remote Sensing Centre-Ludhiana, Regional Meteorological Centre-New Delhi, allied departments, offices and libraries were also used relating to the study of physical and human environment of the state of Punjab. British system of land measurements was used as much of the revenue record especially old record is in British system. Moreover, measurements like *kanal*, *merla*, foot and inch is easily understood and most commonly used by the people in the study area. These data sources provided rich background knowledge on various aspects related to field patterns in the state of Punjab.

(b) Time Period of the Study

The study is confined to the time period from 1884 to 2016. This period of study has been selected due to limitations of data sources. Most of the data for the villages was available from 1884 onward only, in the state of Punjab. The Britishers started defining the actual fields and village boundaries from 1849 after the annexation of Punjab and completed the task of preparing the maps of

villages showing fields and village boundaries by 1880s after conducting actual field surveys. Field maps of the study villages are available 1884 onward after specific time intervals.

(c) Selection of Sample Villages

The state of Punjab is divided into five landform regions according to the geographical characteristics on the lines with the schematic division followed by Punjab Remote Sensing Centre, Ludhiana. These landform regions are upland plains, upland plains with sand dunes, piedmont plains, flood plains and Shiwalik hills (Figure 1.2). It was a very difficult task to collect historical data and relevant maps from 1884 to 2016 because of missing links which were not easy to be found. After traversing and going through the historical records of ninety five short listed villages spreading over entire length and breadth of Punjab, finally one village each was successfully selected from each of these landform regions, on the basis of purposive sampling for a detailed geographical analysis of field patterns (Figures 1.3 and 1.4). The names of these villages are Dhanowali (selected from upland plains), Bath (selected from upland plains with sand dunes), Pathan Chak (selected from piedmont plains), Khera Bagh (selected from flood plains) and Rohg Teeka Khakhoh (selected from the Shiwalik hills). Location of these selected villages is given in Figure 1.5.

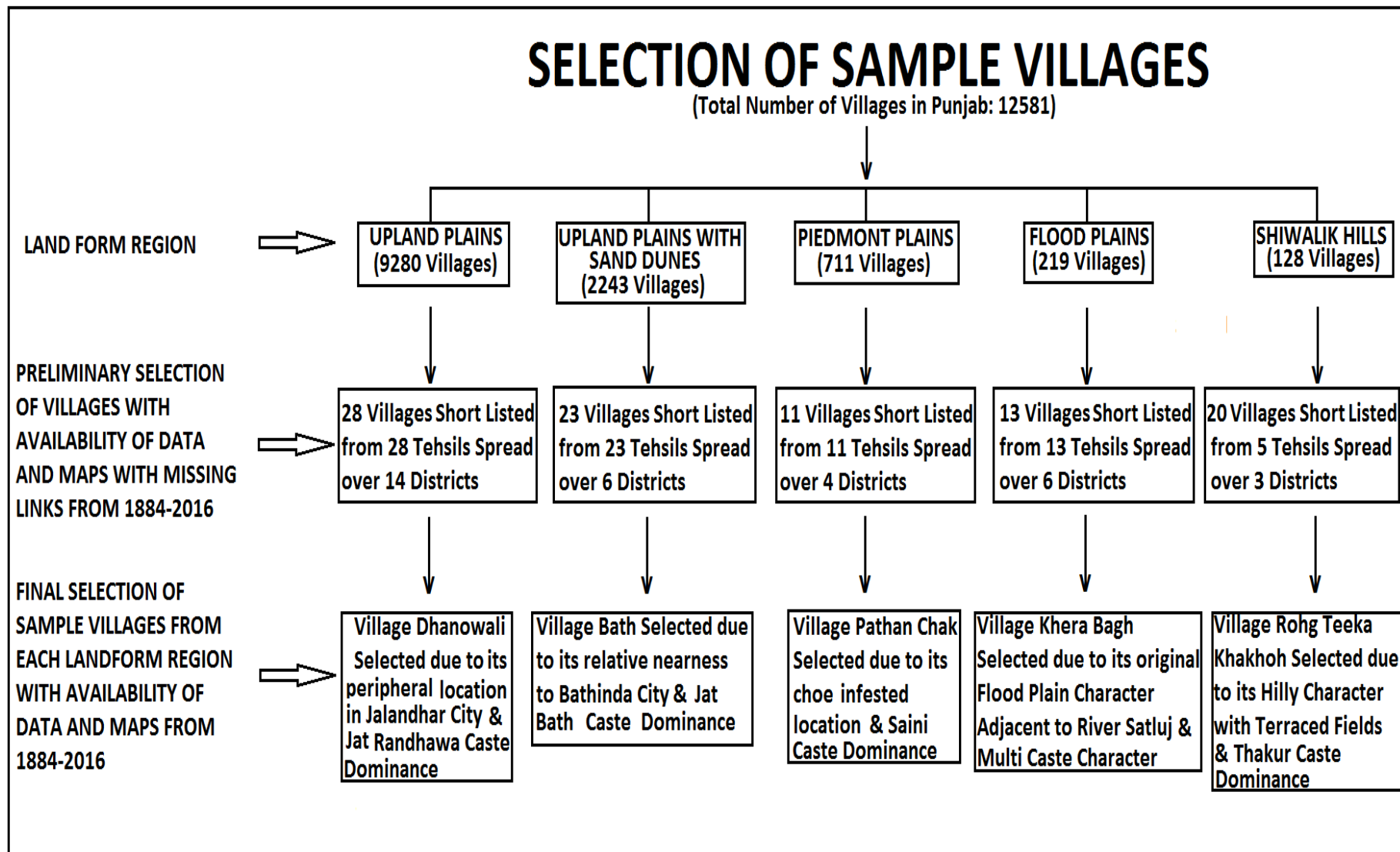


Figure 1.3

PUNJAB LOCATION OF SHORT LISTED VILLAGES 2016



Figure 1.4

PUNJAB

LOCATION OF SAMPLE VILLAGES IN LANDFORM REGIONS

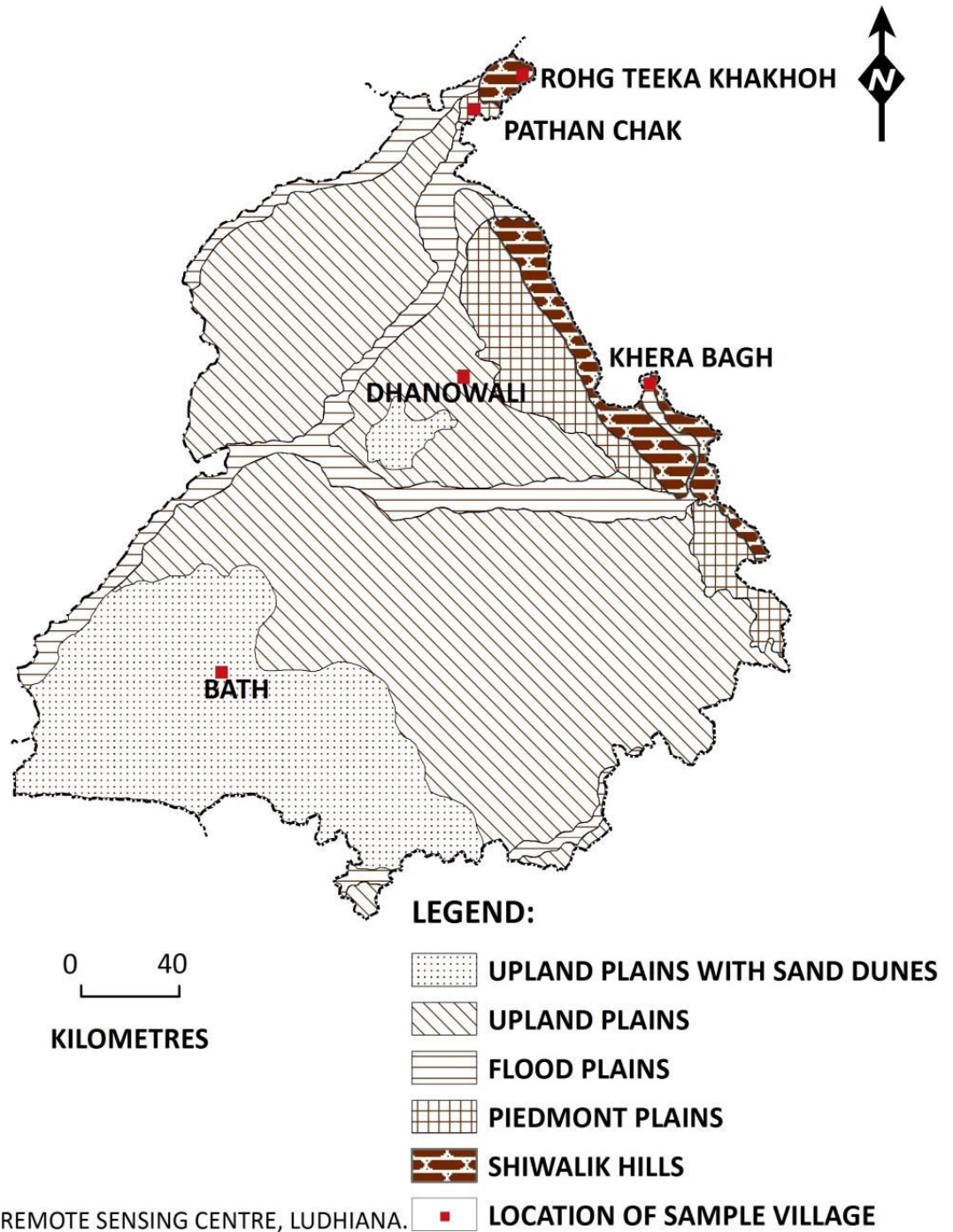


Figure 1.5

(d) Statistical Techniques Used

The **Index of Scattering** and the **Index of Scattering in terms of Distance** of sites of fields of a farmer were used to study the field patterns in pre-consolidation and post-consolidation phases of selected villages.

Scattering refers to a condition in which the holding of a farmer consists of a large number of fields located at various sites and in different directions in the village territory. Scattering was found to be quite frequent and extensive in the pre-consolidation phase and presently found in the unconsolidated villages.

An **Index of Scattering** of sites of fields of a farmer was calculated with the help of following formula as proposed by Prof. A.B. Mukerji (1961):

$$Is = X/Y \times 100$$

Where

‘**Is**’ is the index of scattering in per cent

‘**X**’ is number of sites and

‘**Y**’ is number of fields

This formula of Index of Scattering suffers from an inadequacy. It has not taken into consideration the distance of sites of fields of a farmer from the *abadi-deh* (settlement). The cumulative distance covered by the farmer to all the sites of his fields gives a real operational meaning to the Index. Also, it indicates an increase in the efforts that go into the sustaining of agricultural production. A new formula has been proposed and used with the help of formula of Prof. A.B. Mukerji which takes into account the cumulative distance of all the sites of fields of a farmer from the *abadi-deh* (settlement). It is as follows:

$$ISD = Is / \sum DSF$$

Where

‘**ISD**’ is the Index of Scattering in terms of distance.

‘**Is**’ is the value of Index of Scattering in per cent.

‘ **$\sum DSF$** ’ is the cumulative distance of sites of fields comprising a holding.

Following procedure is adopted for calculating the **ISD** (Index of Scattering in terms of distance):

1. A map of the study village is taken showing field boundaries along with the data of the fields comprising a holding of a farmer of which **ISD** to be calculated.
2. All the fields owned by the farmers are located on the map and the value of Index of Scattering is calculated.
3. Geometric centre is located for each site of fields and given them number from one to onward. If two or more fields are located on the same single site, the point central to all these fields is taken.
4. The distances in the map scale unit (inches) is measured from the geometric centre of *abadi-deh* (settlement) to all the geometric centres of sites of fields.
5. The total value of $\sum \text{DSF}$ (Cumulative Distance of sites of fields) is calculated by summing up all the distances of sites of fields.
6. The **ISD** is calculated by using the above given formula.

The same procedure is followed for calculating the **ISD** for the sample farmers of all the selected villages both in pre-consolidation and post-consolidation phases. The numerical value of **ISD** can be both below and above one. There is an inverse relationship between the numerical value of **ISD** and actual scattering of sites of fields in terms of distance. Higher is the numerical value of **ISD** lower will be the scattering of sites of fields in terms of distance.

(e) Approach of Study

The study is based on spatio-temporal approach, the major thrust of which is on the geographical analysis of field patterns in different landform regions during different phases of time. The chapter scheme is ordered in temporal sequence.

(f) Limitations of the Study

The study is not concerned with agricultural production, economics of land holdings and technological aspects, except those factors which affect the attributes of field pattern. The study is confined to the time periods for which the data and maps are available for the sample villages. Data collection was initiated for a number of villages selected randomly from different parts of the state and finally five villages covering all the landform regions were successfully selected using purposive sampling, for which the historical data and maps were available for the required time

periods. The study is confined to these five villages for which data is available for different phases from 1880s to 2016.

FRAME WORK OF STUDY

The present research is organised into following chapters:

Chapter-1: Introduction

This chapter includes the focus of field patterns analysis in Geography, the attributes of field patterns such as shape, size, distribution, field boundaries, scattering, significance of the study of field patterns, introduction to the study area; Punjab, review of literature, rationale for the study of field patterns in Punjab, objectives of the study, research questions, hypotheses, methodology used and chapter scheme followed in the study.

Chapter-2: The Physical and Human Environment

It includes physical and human environment of the state of Punjab relevant to the study of field patterns. The physical environment includes the study of its geology, relief, landform regions, climate, soils, drainage system and natural vegetation which have a great bearing on the origin, evolution and function of the agricultural fields. The study of human environment includes its population, agriculture, agro-based industries and means of transport. This chapter also covers introduction of all the sample villages selected from all the landform regions of Punjab in context to their physical and human environment.

Chapter-3: Evolution of Field Patterns

To study the evolution of field patterns, a reconstruction of field landscape as it existed at different periods of time for the selected villages is attempted. The phases of settling and ownership of fields for different generations of the same family were discussed through the field maps of different periods of the selected villages.

Chapter-4: Field Patterns in Pre and Post Consolidation Phases

This chapter compares the scattering, size and shape of fields; field boundaries; land types and field patterns in pre-consolidation and post-consolidation phases of all the sample villages.

Chapter-5: Existing Field Patterns

Any comprehensive study of evolution of field patterns is incomplete without a study of the existing field patterns and their functions. This chapter includes a study of existing land types; size and shape of fields; field boundaries; relationship of field patterns with sources of irrigation, ploughing implement, crops grown, land-owning castes and proposes model of existing field patterns.

Chapter-6: Conclusions and Suggestions

The last chapter deals with the conclusions and suggestions for policy implications related to different aspects of fields and field patterns in the study area. Main findings and conclusions are summarized and finally some suggestions are brought forward for policy implications.

Bibliography including References

A comprehensive bibliography including references based on '*Chicago Manual of Style*' as being followed by the *Annals of the Association of American Geographers* has been listed.

Appendices

Glossary of vernacular terms and terminology used in this research work are presented in the form of appendices.

CHAPTER-2

THE STUDY AREA: PHYSICAL AND HUMAN ENVIRONMENT

Field patterns are created through an interaction of physical and human factors prevailing in an area. Human beings interact with the physical environment and thus create field patterns. The differences in physical and human environment result in the creation of diverse field patterns. Field patterns change with the changes in the elements of physical and human environment. These elements are slope of the tract on which these fields lie, irrigation methods, climate, soil types, drainage system, irrigation sources, crops grown, distance from settlement, road types, market demand factors, technological changes, methods of cultivation, land tenure systems, rights of ownership, caste, government policies, social customs and cultural practices. Mukerji (1962) in his work "Field Pattern in a Telangana Village" concluded that 'field pattern as an element in the synthetic integrated picture of agricultural landscape is the concern of the cultural geographer who alone can observe and interpret fully the pattern of combination of fields with all its related elements like micro-topography, habitation complex, soil types, cropping patterns, tenure, land systems, methods of cultivation and technological and socio-economic organization of irrigation. Therefore, the knowledge of physical and human environment of the study area is imperative for the understanding of field patterns. The objective of this chapter is to discuss the study area; the state of Punjab and its sample study villages with context to physical and human environment for understanding the origin, evolution and function of field patterns.

INTRODUCTION TO THE STUDY AREA: PUNJAB

The term *Punjab* is the combination of two Persian words *Punj* and *ab*. *Punj* means five and *ab* stands for river or water. Therefore, the literal meaning of the word *Punjab* is five rivers or the land of five rivers. These rivers are; Jhelum, Chenab, Ravi, Beas and Sutlej. The territorial boundaries of Punjab kept on changing in the past. During *Rig Veda* times, Punjab was known by the name "*Sapta Sindhu*" (land of seven rivers, including the river Indus and the Sarasvati in addition to the five rivers mentioned above). Greeks called it *Penta Potamia* (land of five rivers). During Mughal period it came to be known as Punjab. The present Punjab came into existence as a unilingual state on 1st November, 1966 at the culmination of *Punjabi*

Suba Morcha (Gazetteer, 2001). The present Punjab has the smallest ever size in its history with an area of 50362 square kilometres which is 1.53 % of the total area of India.

Location and Situation

Punjab is located in the north-western part of India (Figure 2.1). This triangular shaped state forms the western component of the “Indo Gangetic Plains” of India. It extends from 29⁰-30' North to 32⁰-32' North latitudes and 73⁰-55' East to 76⁰-50' East longitudes. The north-south distance is nearly 335 kilometres and east-west distance is extended to 300 kilometres. Punjab shares international boundary with Pakistan on its west, Jammu & Kashmir lies to its north, Himachal Pradesh to its north-east, Haryana to its south-east and it borders with Rajasthan in the south-west.

Administrative Structure

From the point of view of the administration, Punjab is divided into five divisions; Jalandhar, Patiala, Ferozpur, Faridkot and Rupnagar. Punjab has 22 districts, 81 tehsils and 147 blocks for administrative purpose. Punjab has 13 *Lok Sabha* Constituencies, 117 *Vidhan Sabha* Constituencies and 7 seats in the *Rajya Sabha* of India (Figure 2.1).

(A) PHYSICAL ENVIRONMENT

Physical environment provides the foundation on which agricultural fields are created by a cultural group. So, the study of physical environment forms the base upon which field patterns evolve. Natural features of the earth which forms the physical environment, consist of relief, drainage, climate, soil and water are studied in Physical geography (Oxford dictionary, 2004). Physical environment provides possibilities as well as challenges for agricultural activities in different areas. The physical environment, in fact determines types of crops, the degree of urgency in the timing of agricultural operations, extent of risk involved in agriculture and its improvements (Singh, 1979). Mukhopodhyay (1976) stated that nearly 60 percent of the variation in agricultural productivity is due to the ‘region effect’ indicating differences in natural environment and innate human ingenuity. Various agricultural activities from the creation of agricultural fields to cultivation of crops operate within the limits set by the diversity of physical environment.



Figure 2.1

In this chapter, an attempt is made to present the elements of physical environment namely; geology, relief, landforms, climate, soils and the drainage system, which have a great bearing on the origin, evolution and function of the agricultural fields. These elements are also vital determinants of agricultural activities and implementation of the modern techniques in agriculture. Thus, there is a serious need to make detailed investigation into the nature of physical environment, so that useful results can be achieved in the study on field patterns. Punjab is a compact geographical unit but still there are variations in its geology, relief, landforms, climate, soil and water resources that require a scientific inquiry.

(A) GEOLOGY

Agricultural fields of any area are the product of its geological structure. Geological structure and nature of rocks have both direct and indirect influences on the land use of an area. Hard rocks, rugged terrain and unproductive soils which are mainly the result of geological conditions are not favourable for converting the land into agricultural fields. Flat surface with alluvial soils is good for the creation of agricultural fields. Sandy layers and incalcareous rock structure are favourable for rich aquifers of ground water. Similarly digging of canals and sinking of tube-wells depend on the nature of rock structure (Singh et.al, 2002).

The geology of the state of Punjab is relatively simple. A large part of the state is covered by the “Indo-Gangetic Plains” with alluvial soils of quaternary age. However northern part of the district of Pathankot and north-eastern parts of Hoshiarpur and Rupnagar districts have exposed rocks forming part of Shiwaliks group. Therefore, on the basis of the geological structure, Gazetteer of Punjab (2001) classifies the state into following two groups;

(a) Areas of Tectonic Formation (Mio-Pleistocene System)

Punjab has a narrow tract approximately six to ten kilometres wide in its north-eastern part called as the ‘Shiwalik hills’. The Shiwalik hills were formed in the last phase of the *Himalayan Orogeny*. Its origin has been explained differently by different geologists. A largely accepted view of geological formation of the Shiwaliks series is that these were formed by the infilling of a long narrow depression with sub-aerial wastes which were swept down by the rivers. The sediments so deposited got elevated and folded during last Himalayan system of upheavals (Krishnan, 1961). Most of the accumulated sediments were derived from the denudation of the newly risen Himalayas. These are mainly composed of

coarsely bedded sandstones, sand rocks, conglomerates, schist, shale and clay. The age of these deposits ranges from upper Miocene (23 million to 16 million years ago) to lower Pleistocene (2.58 million years to 11700 years ago). The depth of the deposits varies from 4,500 to 5,200 metres. These are alluvial remains brought from the waste materials of mountains brought down by the rivers.

The oldest rocks exposed in the state of Punjab are located in Pathankot district and these constitute parts of the Shiwalik formation. In terms of lithology, the lower Shiwalik hills are consisted of grey, micaceous fine and medium grain sand stones, inter-bedded with reddish and brown sandstone and conglomerates of calcareous clay and shale. The middle Shiwalik hills are composed of essentially medium grained soft sandstones inter-bedded with clays and sandstones with conglomerates containing pebbles of calcareous clay and shale. The upper Shiwalik hills are composed of sandstones, siltstones, clays and boulder's conglomerates (Gazetteer, 2001). The intendment of these hilly parts is confined to subsistence farming, which is limited in very small size and uneven shape fields due to various problems such as difficult terrain, soil erosion and shortage of water. Because of such problems, majority of the area of the sample village Rohg Teeka Khakhoh selected from hilly tracts of the Shiwalik hills of Dhar block in Pathankot district could not be converted into fields for cultivation of crops.

(b) Areas of Alluvial Formation (Pleistocene System)

The "Great Alluvial Plains" of Punjab lie to the south-west of the Shiwalik hills. These plains are formed of alluvial deposits brought by the streams of the Indo-Gangetic river system, having a depth of hundreds of metres. These plains are consisted of silt, loam, sand, clay, gravels and pebbles. The thickness of alluvium varies from north to south, which is shallow towards the northern boundary and thicker towards the south. These plains were developed in a trough formed at the time when the Himalayas were being uplifted. The numerous rivers emerged from the deposits of the detrial material in the trough or fore-deep during their period of intense gradational activity. This process continued all through the Pleistocene up to the present (Wadia, 1961).

The alluvial deposits of Punjab plains are comprised of massive beds of clay, silt and sand. Gravel and coarses and is found more near the Shiwalik series. Most of the area of the state is covered with alluvial deposits by rivers of the Indo-Gangetic plains,

which are favourable for the creation of fields and are fertile in nature. This type of geological structure is suitable for sinking tube-wells, digging canals and the cultivation of a wide range of crops (Gosal, 2000). Four out of the five sample villages included in the present study lie in the alluvial plains. *Dhanowali* selected from upland plains; *Bath* from upland plains with sand dunes; *Pathan Chak* from piedmont plains; and *Khera Bagh* from flood plains, belong to areas of alluvial formations of the Great Alluvial Plains of Punjab.

(B) RELIEF

Relief constitutes an important aspect of physical environment. Relief is defined as the form of surface of the earth. High relief signifies large differences in the elevation of the land and low relief means small variations in height. Details of relief are well encompassed by the elements of relative relief, average slope and dissection index (Sharma, 1968). These relief elements have powerful affect on the field patterns and agriculture of any region. The field pattern and agricultural land use are affected by both slope and altitude. Cultivation and accessibility are also affected by relief (Singh, 1979). Parts of Shiwalik hills, where relief is high and slopes are steep, do not favour formation of agricultural fields, whereas the parts of villages in the Shiwalik hills which have gentle slopes favour the formation of terraced fields. Due to this fact the sample village Rohg Teeka Khakhoh, situated in the Shiwalik hills, does not have agricultural fields to its south because of high relief with steep slopes, whereas its northern territory with favourable slopes is converted into terraced fields by the people who occupied this part of the village territory in the beginning.

The relief of the state of Punjab is highly variable. In general, Punjab has extensive alluvial plains with gentle slope. It has an elevation of 500 metres above sea level in the north-east and below 200 metres in the south-west (Figure 2.2). Except the Shiwalik hills and piedmont plains, the state has an elevation which varies between 178 metres in the south-west and 300 metres in the north (Kaur, 2003). The general slope of the land is from north-east to south-west. The south-west region of the state is sandy desert with undulating slope, but has gradually been becoming level by the farmers due to the extension of irrigation (Gosal, 2000). The average gradient of slope

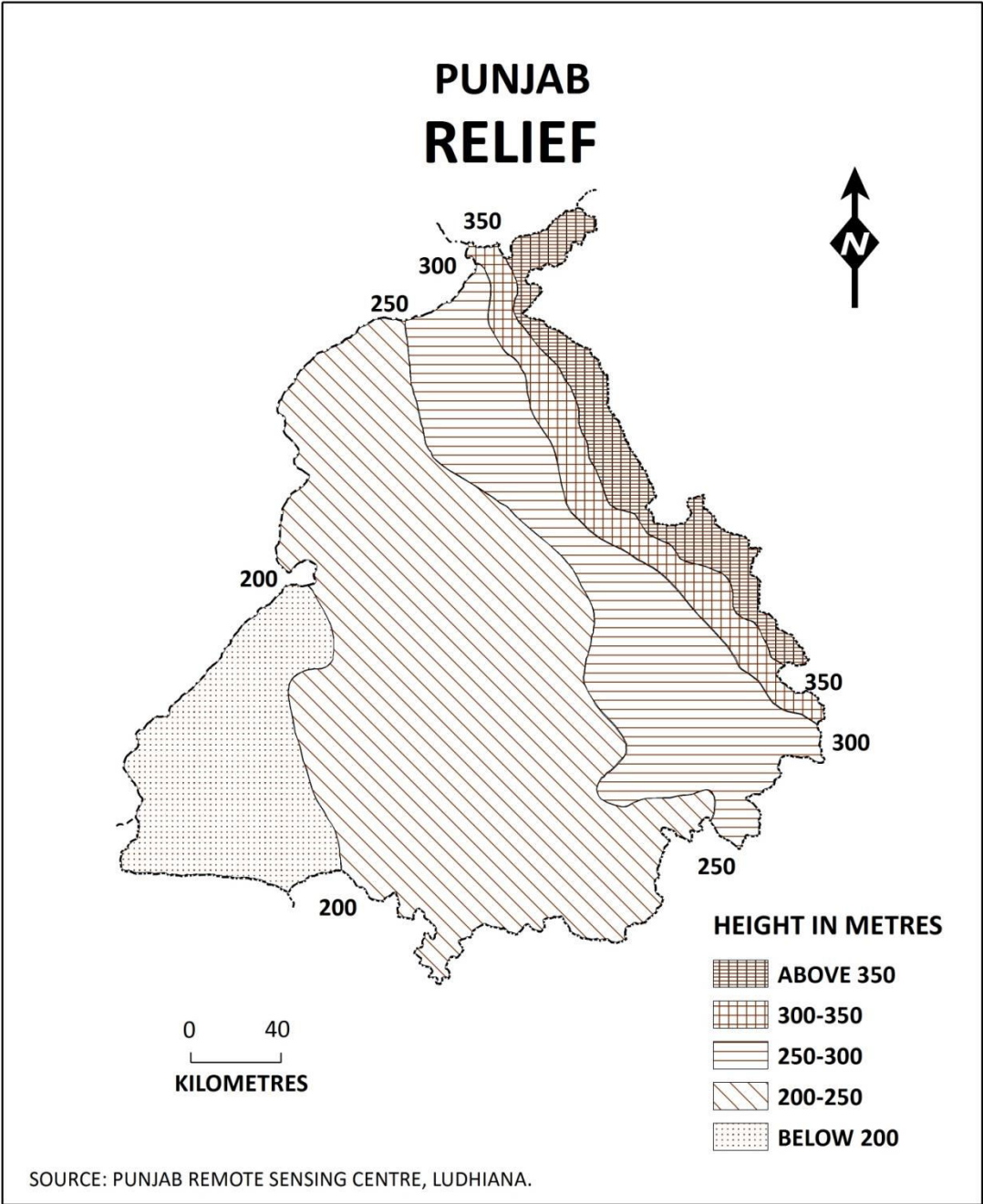


Figure 2.2

is 1:2450. Though its land surface is mostly feature less, yet one can find irregularities such as Shiwalik hills in the north and north-east, sand dunes in the south-west, dissected and undulating *choe*-infested piedmont plains in the foot hills of Shiwalik and flood plains along both sides of all the rivers; Ravi, Beas, Satluj and seasonal stream Ghaggar. One village each has been selected from these land form regions for a detailed geographical analysis of its field patterns. The central upland plain of the state, with gradient of 1:3200 is very flat and highly favourable for creation of fields. A distinct advantage of this type of relief is highly levelled fields, very good for crop production, because mechanized equipment can easily be used and flow irrigation can be provided to its best advantage. The gradient in the north-eastern hilly parts is steep i.e. 1:75. The region is made up of loose sandy rocks with occasional clays, gravels, and conglomerates which may be called 'an ideal lithology for gullies' (Spate and Learmonth, 1967).

Thus, from the above discussion, it is observed that the gradient of slope of the land is steep in the north-east and gentle in the south-west. North-eastern parts are highly dissected, undulating and problematic for the creation of agricultural fields for the cultivation of crops. The rest of the area is plain and viable for the creation of agricultural fields.

Landform Regions

The land of Punjab is predominantly flat and featureless at the macro-regional level. Variations in relief are observed at micro-regional levels. For a detailed understanding of its topography, Punjab is divided into following five landform regions on line with the scheme provided by Punjab Remote Sensing Centre, Ludhiana (Figure 2.3):

- 1) The Shiwalik Hills
- (2) The Piedmont Plains
- (3) The Upland Plains
- (4) The Upland Plains with Sand dunes
- (5) The Flood Plains

PUNJAB LANDFORM REGIONS

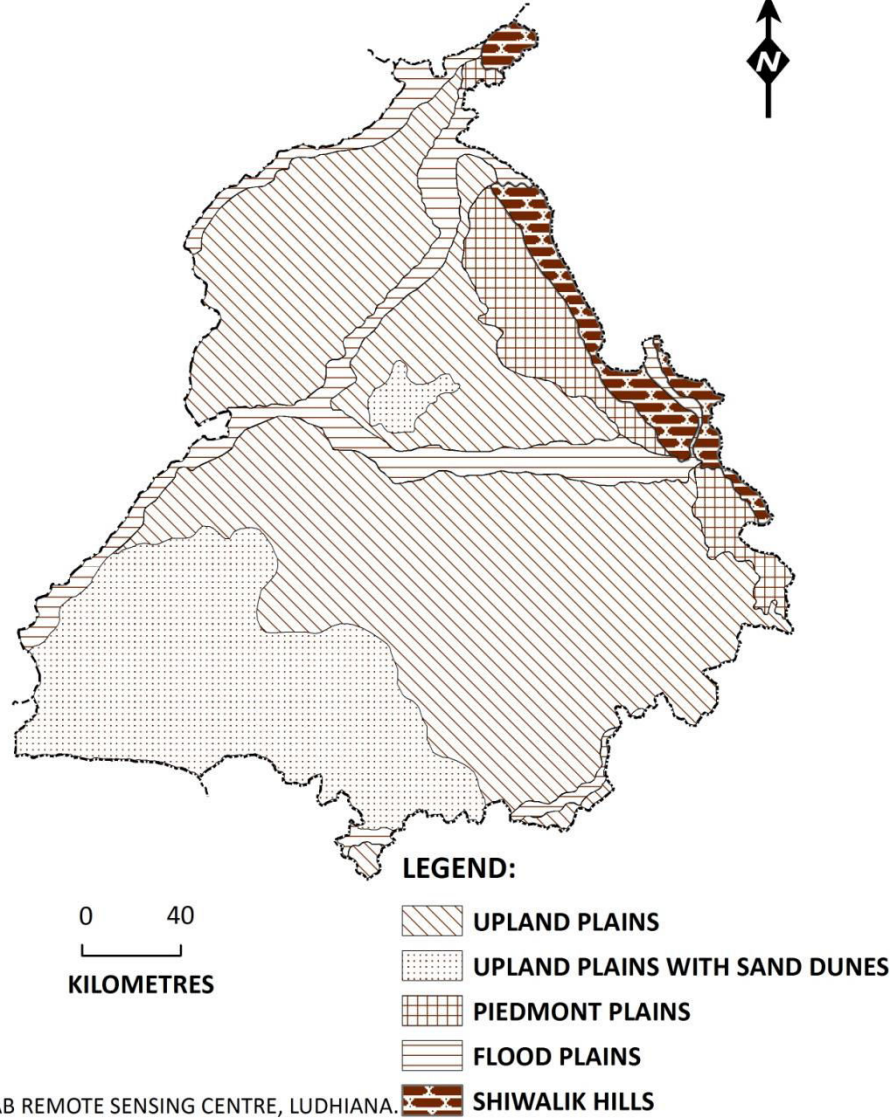


Figure 2.3

(1) The Shiwalik Hills

Shiwalik hills proceed from north-west to south-east direction in the extreme north-eastern part of Punjab along the border of Himachal Pradesh. These hills extend from river Ravi in the north to river Ghaggar, near Chandigarh, in the south-east for about 280 kilometres. In between Ravi and Ghaggar rivers, the continuity of the Shiwaliks is broken by the rivers Beas and Satluj. The Shiwalik hills cover only 2.6 per cent area of the Punjab state. Their width ranges from 5 kilometres to 12 kilometres in various parts. These hills cover upper parts of Pathankot district; disappear between Murthal and Talwara along the river Beas in Mukerian tehsil of Hoshiarpur district; make a continuous regular chain in the rest of the district, enclose the Satluj 'Doon' in Nangal tehsil of Rupnagar district and then run in the remaining part of the district lying along the south-western flanks of the outer Himalayas. The Shiwalik hills are formed of great thickness measuring between 4500 and 5200 metres of Mio-Pleistocene sand, clay, gravel and conglomerates. The Shiwalik hills are products of erosion of Himalayas themselves. These hills are not very high. Their height generally ranges below 1000 metres. They are backed remarkably even and regular (Gosal, 2000). The Shiwalik hills look small when backed by abruptly rising outer Himalayas. They give a look of folded, highly eroded, steep sloping having broken longitudinal valleys popularly known as *doons*. These hills experienced large scale deforestation in later part of the nineteenth century. The impact of deforestation in the form of their denudation is still visible (Gazetteer, 2001). The sample village Rohg Teeka Khakhoh was selected from the Shiwalik hills situated in Dhar Kalan tehsil of Pathankot district in the extreme northern part of Punjab.

(2) The Piedmont Plains or *Choe*-Infested Foot Hills Zone

The piedmont plains are found at the foot of the Shiwalik hills in an elongated stretch ranging between 10 to 15 kilometres wide. It is highly dissected and undulating plain with sand and gravel coarse-grained porous and loose depositional material. These plains are also known as *Bhabbar* plains. These plains are infested with closely spaced seasonal streams (*choes*) descending out from the adjoining Shiwalik hills. These streams make irregular courses across these foothill plains and soon terminate inland in the most cases. These plains extend in the shape of a narrow and long belt along the entire length of the Shiwalik hills under different names such as, *Kandi*, *Ghar*, and *Changar*. They lie roughly to the east of the Pathankot-Hoshiarpur-Rupnagar-Chandigarh road with gaps

formed by flood plains of the rivers Beas and Satluj. Their average width varies between 10 to 15 kilometres. Piedmont plains are comprised of parts of the Pathankot, Hoshiarpur, S.B.S. Nagar, S.A.S. Nagar and Rupnagar districts. The sample village Pathan Chak was selected from piedmont plains situated in Pathankot district.

(3) The Upland Plains

The upland plains are inter-fluvial tracts of the upper *Bari-Doab*, *Bist-Doab* and the Satluj-Ghaggar divide of the Malwa region. It is the largest landform region of Punjab covering about half of the state's geographical area. These plains are composed of old alluvium (*Bhangar*) brought by the rivers from the Himalayas. These plains also contain new alluvium in few parts. These are flat featureless plains in general and range in elevation from 200 metres to 300 metres. Average gradient of these plains is 1: 3200 and appears very gentle. These plains are gentler in the *Malwa* region as compare to the *Bari Doab* and *Bist Doab* regions. Although topography of these plains is the product of alleviation by water action in general, yet wind action has also been important from south-western Malwa region where sand dunes were very common. Many of these sand dunes have been levelled and converted into levelled fields recently with big machines. Soils of the region range from sandy to loamy and are generally good in fertility. Sample village Dhanowali was selected from these upland plains, which is situated in Jalandhar district of *Doaba* region of Punjab.

(4) The Upland Plains with Sand Dunes

The south-western parts of Punjab experience semi-arid climate and border with the Thar Desert of Rajasthan. Wind action is a prominent factor of topographical variations in this region. The frequent occurrence of sand dunes and low sand ridges superimposed on the upland plains convert this region into semiarid region, which is known as the upland plains with sand dunes. This landform region mainly covers Bathinda, Faridkot, Ferozpur, Mansa, Mukatsar and Fazilka districts in south-west Punjab. The sand dunes stand out as low mounds and are believed to be formed by wind action. These sand dunes covered plains are locally known as *tibbas*. These plains have irregular slopes correlating with the dominant direction of the wind prevalent in the dry hot season. Most of the sand dunes of these upland plains have been levelled and converted into agricultural fields after green revolution (Gosal, 2000). The area occupied by sand dunes is gently sloping and the areas lying in between the sand dunes are nearly levelled and have gentle slopes. This landform

region has an elevation of about 220 metres in the east and about 180 metres in the extreme south-west of the state. The region has undulating to rolling topography due to the occurrence of these sand dunes.

The sand dunes varied from 5 to 20 metres in height and 20 to 100 metres in length. Of late, these sand dunes have been levelled and large tracts of this region appear as upland plains and are converted into valuable agricultural fields. Sample village *Bath* has been selected from these upland plains with sand dunes situated in Bathinda district of *Malwa* region of Punjab, for analysis of its field patterns.

(5) The Flood Plains

The flood plains distributed in the shape of ribbons along the rivers Ravi, Beas, Satluj and Ghaggar, form another landform region comprising of four separate linear riverine tracts having similar topographical conditions. These plains are locally known by many names like *bet*, *mand*, *talla*, *bela* and *doon* in Punjab. These plains are new alluvium (Khadar) plains experiencing frequent floods during the rainy season. The average width of these plains range from 5 to 10 kilometres, but at some places their width can be up to 20 kilometres. Their width varies in accordance with the amount of shift experienced by a river in an area in the past. Low scarps separate flood plains from the upland plains. At some places the separation is marked by steep cliffs locally known as *dhaiyas*. Soils are sandy near the river beds but these gradually change into silt and clay with the increase in distance from the river beds. These plains are very rich in fertility and are conducive for the cultivation of different types of crops. These plains experience floods during the rainy season and damage to life and property remains at risk in these areas. In the flood plains, there are certain areas where water remains standing throughout the year and form natural wetlands. Some low lying fields are filled with excess rain or flood water of the neighbouring river resulting in the reduction of cultivated area. Sample village Khera Bagh situated in Rupnagar district, selected from the flood plains region which justifies problems related to floods and water logging and evolved agricultural fields pertinent to this particular region.

It is observed from the above discussion that the study region has great variations in its landform regions. In the north and north-east Shiwalik hills and piedmont plains

are found. Flat upland plains are found more in central areas. Flood plains lie along all the rivers and upland plains with sand dunes are found in the south-western part of the state. One representative village each has been selected from all these landform regions for geographical analysis of field patterns in the present study.

(C) CLIMATE

Climate is a significant factor as it determines the chances of land to be used for agriculture. Agricultural land use, cropping patterns, the availability of water for irrigation purpose of a region, all depends on its climatic elements which consist of temperature, rainfall, humidity, sunshine, winds and air pressure. All these elements of climate, individually and collectively determine the agricultural patterns of a region (Husain, 2007).

Punjab is characterized by semi-arid to sub-humid continental type of climate which is characterized by change of seasons. There is a well marked contrast between summer and winter, which are related with two main cropping seasons of *Kharif* and *Rabi* respectively (Gosal, 2000). Four climatic seasons are experienced in Punjab in a year. Cold or winter season is noted from November to March; hot or summer season is witnessed from April to June; monsoon or rainy season starts from the last week of June to mid September and post monsoon or transition season extends from mid September to beginning of November (Manku, 2009). Some fluctuations in the time of arrival and departure of these seasons from year to year may also be noticed. Amongst climatic elements, major role is played by temperature and rainfall which give character to the seasons.

(a) Temperature Conditions

Temperature conditions have been far less erratic from year to year than rainfall conditions in each landform region. However, great annual ranges may be highly significant in different zones giving rise to two or more cropping seasons. For this reason, especially in Punjab, a wide range of tropical, sub-tropical and temperate crops are grown (Gosal, 2000). Without suitable temperature conditions, germination of seeds and growth of plants are retarded (Singh and Dhillon, 2006). Ideal temperature for crop production in a region is between 18⁰ C to 24⁰ C. The continental and sub-tropical latitudinal location of Punjab makes the monthly variations of temperature very high. Though, the minimum air temperature rarely goes below

freezing point, ground frost is very common in mid-winter. The highest day temperature (above 40⁰ C) is recorded during the months of May to June. The *loo* (dry hot scorching winds) coming from the Thar Desert blow during May and June months. The lowest temperature (-1⁰ C to -2⁰ C) is recorded during the months of December and January. The *Sheet Lehar* (cold wind) coming from the mountains is common in winter season. The mean annual temperature all over the state is around 23⁰ C. The mean annual temperature increases from north-east to south-west (Figure 2.4).

Thus, temperature conditions remain favourable for growing crops in the fields. The differences in summer and winter temperatures allow cultivation of tropical as well as temperate crops in the fields. The plenty of sunshine all the year is available for the photosynthesis process for plant growth.

(b) Rainfall Conditions

Punjab experiences semi-arid to sub-humid climatic conditions. It records 65 centimetres average annual rainfall. About 20 percent year to year fluctuations on either side of the average annual rainfall are common in India's Monsoon. No part in Punjab experience snowfall (Manku, 2009). There are variations in the amount of rainfall received by different regions in Punjab, which influence land-use patterns and types of crops grown in these regions. Amount of rainfall varies from 140 centimetres in Pathankot in north to 22 centimetres in Abohar in the south-west. Rainfall declines as one moves away from the Shiwalik hills (Singh, 1979). Most of the rainfall (70 to 80 percent of the total rainfall) is concentrated in three rainy months from July to September, which is received from the south-west monsoon. Rest of the rain comes during other months of the year particularly in winters. The amount of annual rainfall also decreases from the north-eastern to south-western parts of the state (Figure 2.5). The rainfall is highly variable and unreliable in Punjab (Manku, 2009). The successful crop farming, which requires the application of modern inputs, is not feasible without the application of irrigation facilities. The north-eastern districts of Pathankot and Hoshiarpur receive highest annual rainfall, which is more than 90 centimetres due to nearness of Shiwalik hills. Rupnagar, S.A.S Nagar, S.B.S. Nagar, Fatehgarh Sahib and some parts of Jalandhar, Kapurthala and Gurdaspur receive 70 to 90 centimetres annual rainfall. Amritsar, Tarn Taran, Moga, Patiala and parts of Sangrur get 50 to 70 centimetres annual rainfall.

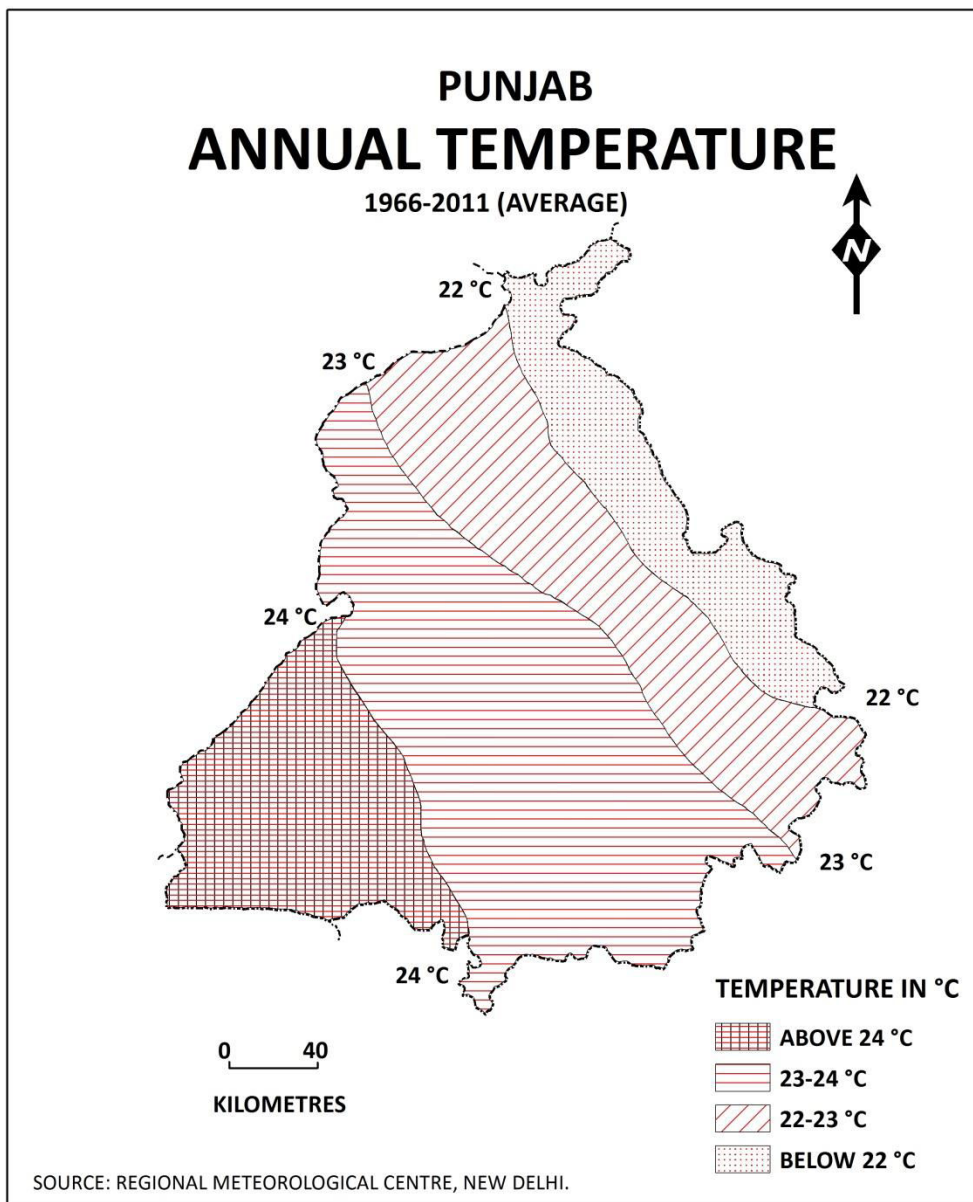


Figure 2.4

PUNJAB ANNUAL RAINFALL

1966-2011 (AVERAGE)

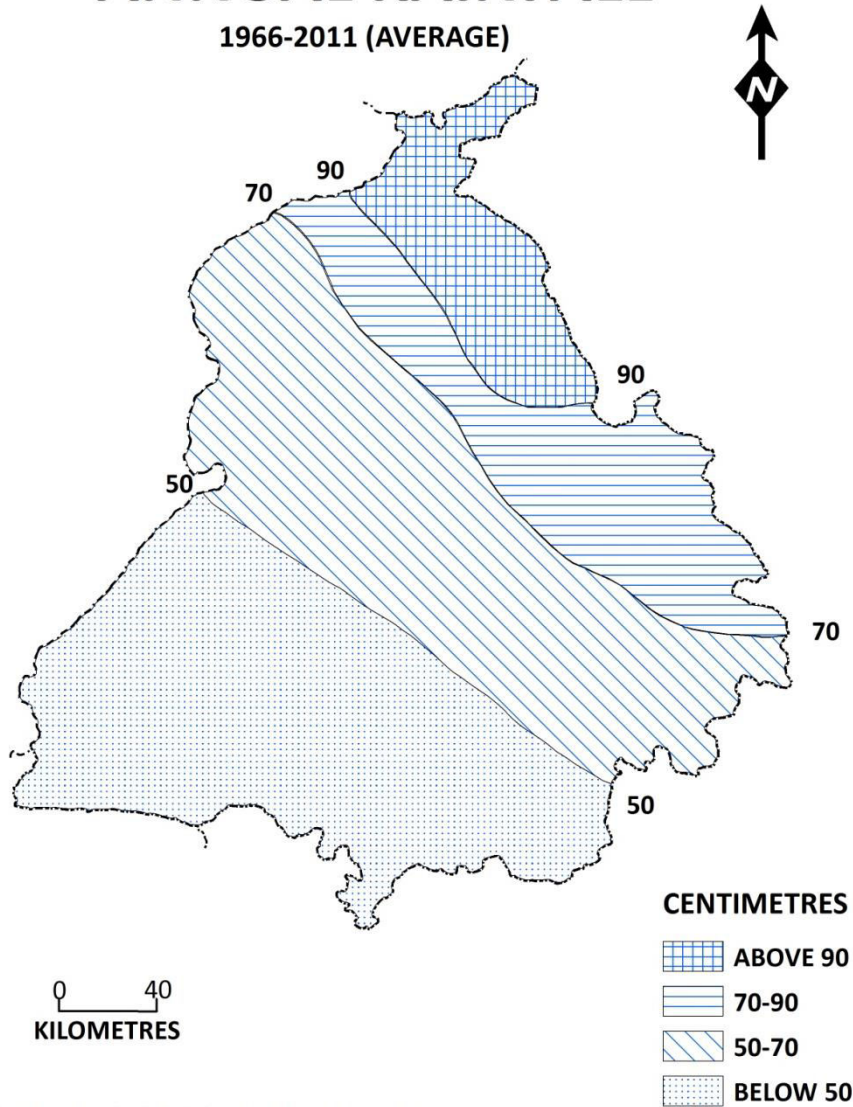


Figure 2.5

The south-western arid parts of Punjab comprising of Ferozpur, Faridkot, Muktsar, Bathinda, Mansa and southern parts of Sangrur get the lowest, less than 50 centimetres annual rainfall. Thus, the above mentioned patterns reveal that north-eastern parts of Punjab receive high annual rainfall, whereas south-western parts receive very low annual rainfall, which decreases from north-east to south-west. About 80 percent rainfall is received during monsoon months i.e. June to September in the summer season. July and August are the rainiest months. Monsoon reaches eastern parts of the state by the end of June which is normal onset date of monsoon season and cover entire state by start of July (Manku, 2009). Punjab also experiences rainfall during winter season which is caused by western disturbances coming from the Mediterranean Sea. Punjab receives an average rainfall of 13 centimetres in winter season. The importance of winter rainfall in Punjab is very high because of its time of occurrence and effectiveness. In Punjab, winter crops depend upon this rainfall in the absence of irrigation facilities in areas adjoining the Shiwalik hills. Winter cyclonic rainfall, popularly known as western disturbances, comes generally in the form of drizzles rather than pours. This gives enough time to the soil to absorb the moisture. Winter rainfall in Punjab also decreases from north-east to south-west.

Climate is a mixed blessing for agriculture in Punjab. Favourable temperature conditions permit growth of crops throughout the year in all parts of Punjab as well as the sample villages. Inadequate, highly variable and seasonally concentrated rainfall makes irrigation a necessity for growing crops in the fields in the sample village Bath, Dhanowali and Pathan Chak. High temperatures and scanty rainfall in the study village Bath in Bathinda has affected its cropping and field patterns and availability of canal irrigation in recent years has also transformed its agricultural landscape. Good temperature and rainfall in the study village Khera Bagh has facilitated *barani* (rain-fed) agriculture in its fields.

(D) SOILS

Soil is the basic natural resource of any region. Human beings get all the lot they need directly or indirectly from it. Soil is a natural mass of minerals and organic matter differentiated into layers, which differ among themselves and from the hidden material in morphology, physical structure, chemical composition and biological properties (Mavi and Tiwana, 1993). Soils of Punjab are derived from the material deposited by rivers (alluvium). Southern and south-western parts of the state adjoining

the Rajasthan Thar Desert and discontinuous belts along the old river courses of the rivers Satluj and the Beas are marked by a sandy cover of varying thickness. Apart from alluviation and wind deposition, the elements of climate like temperature and rainfall have been the most important determinants of soil properties in Punjab. The roles played by topography, vegetation and sub-soil water depths in soil formation are also significant. In accordance with variations in these factors, soils of Punjab vary from area to area. At local level, field to field variations can be seen even within a village.

On the basis of climate, topography, denudation processes and texture, Punjab Remote Sensing Centre has classified the soils of Punjab into the following eight types (Figure 2.6):

(a) Fluvial Soils or Bet Soils

Fluvial soils are found in the flood plains of Punjab. These soils are formed from the sediments deposited by the rivers. The parent material of these soils is transported by the rivers from their origin to the flood plains of Punjab. The rivers bring with them the products of weathering of the rocks from the mountains and deposit them in the low lying areas along the rivers. Their composition differs from drift sand to rich loam and silt to clay. The chemical composition of the fluvial soil makes this soil as one of the most fertile soils of the world. The amount of nitrogen is generally low, but potash, phosphoric acid and alkalies are in good quantity (Manku, 2009). The proportion of iron oxides and lime in these soils vary in wide range. These are known as *Khadar* soils. These are found in the form of ribbons along both sides of the rivers Ravi, Beas, Satluj and Ghaggar. These soils are generally yellowish brown in colour. The soils are very deep, vary in texture and are well drained. These soils are poor in organic matter. These soils are very suitable for the cultivation of rice, wheat and sugarcane.

(b) Loamy Soils

Loamy soils are formed from the mixture of sand and clay in different proportions ranging from sandy loam to clay loam texture with good amount of silt. These are very fertile soils of the state. These soils are spread over nearly 25 per cent area of Punjab. These soils are also deep and have fine grained texture. These soils develop in sub-moist, cool and warm climate. These soils are predominantly found in S.B.S. Nagar, Nakodar tehsil in Jalandhar district, Phagwara tehsil in Kapurthala district in the *BIST Doab* and in parts of Amritsar and Gurdaspur districts in *BARI Doab*.

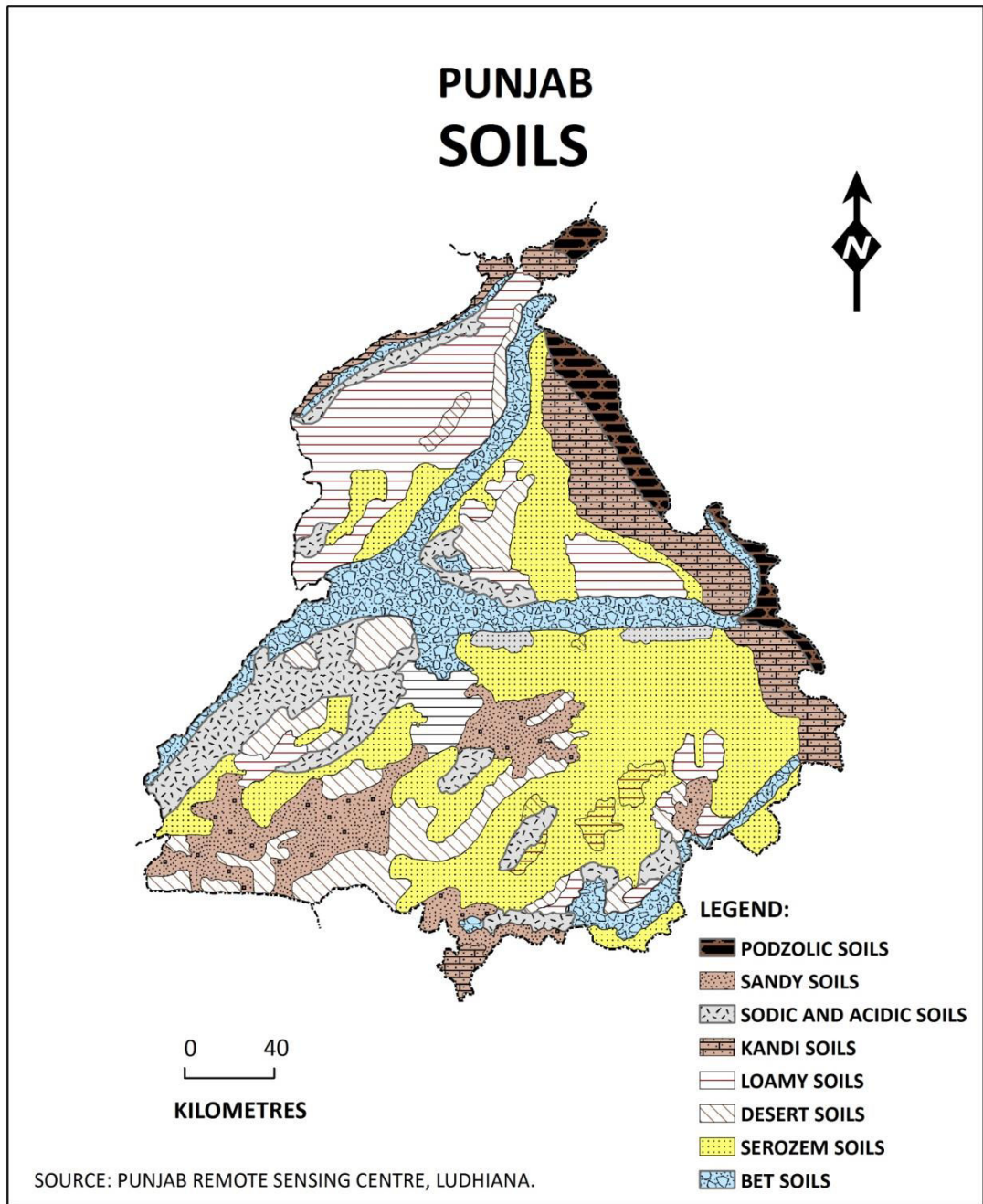


Figure 2.6

In *Malwa* plains these soils are found in Patiala district, some areas in Sangrur district, southern areas in Moga district and small pockets in Muktsar and Bathinda districts. Wheat and paddy crops are intensively cultivated in these soils.

(c) Sandy Soils

Sandy soils are formed in semi-arid, warm to hot climate with annual rainfall ranging from 30 to 50 centimetres. Their colour ranges from yellow to grey. These soils look grey in colour due to scarcity of organic material. Nitrogen, phosphorus and potash are found very less, making them poor in productivity and fertility. Their pH value varies from 7.8 to 8.5. Their texture ranges from sandy loam to silt. These soils are found more in south-western and south-central parts of Punjab. Bathinda, Mansa, southern parts of Firozpur, Muktsar, some parts of Sangrur, south-central parts of Patiala and a few parts of Ludhiana district are the major sandy soil areas in Punjab. These soils are poor in fertility but with the application of irrigation, such soils become productive and suitable for growing crops like cotton, wheat, citrus fruits, oilseeds and fodder.

(d) Desert Soils

These soils are distributed on more than 11 per cent area of Punjab. They develop in hot and arid climatic conditions. These soils are dry and are poor in humus. The proportion of nitrogen, phosphorus and potassium in such soils is very limited. These are generally normal to alkaline and their pH value varies from 7.5 to 8.5. These soils are low to medium in plant nutrient. These soils are influenced by wind erosion in south-western Punjab. These are sand dune studded soils. Their colour ranges from light yellow to light brown. The desert soils are found over large parts of Bathinda and Mansa districts, southern parts of the Firozpur district, Muktsar district and some parts of Sangrur and Ludhiana districts. These soils are used for the cultivation of cotton, wheat, pulses, bajra, fodder and citrus fruits.

(e) Kandi Soils

The kandi soil is found mainly in parts of Pathankot, large parts of Hoshiarpur, S.B.S. Nagar and Rupnagar districts. Their texture ranges from sand, sandy-loamy, silt-loamy and clay to gravel. These are coarse and rough in south of the Shiwalik hills where gravels, pebbles and conglomerates predominate. These soils are formed from the deposition of material brought by numerous *choes* (seasonal streams) coming out

from the Shiwalik hills. These soils are used for dry farming in the absence of sources of irrigation.

(f) Sierozem Soils

Sierozem soils cover approximately 25 per cent area of Punjab. These are grey soils distributed in the semi-arid parts of Punjab. They cover eastern side of the Malwa plains including Ludhiana district, some areas of Sangrur district, Fatehgarh Sahib, eastern and western parts of Patiala and some inter sand dune areas of Faridkot. In *Doaba* and *Majha* region, these soils are found in the form of long belt extending from Mukerian tehsil in Tanda in the north, Jalandhar, Adampur and Nakodar tehsil in the south. These soils are also found in the western parts of Kapurthala, Tarn Taran and Amritsar districts. These soils have grey colour as they are poor in organic matter. Nitrogen and potash are also found in limited quantity. Their pH value varies from 7.8 to 8.5. These soils show very good yield in wheat by using irrigation. Paddy has also been introduced in such soils with the introduction of irrigation facilities. Excessive irrigation has resulted salinity in these soils.

(g) Grey-Brown Podzolic Forest Soils

These soils are stony, gravelly and sandy. These are found in the Shiwaliks in Pathankot, Hoshiarpur, S.B.S. Nagar and Rupnagar districts. These soils are formed in shrub and deciduous forests in the areas of steep slopes, rugged topography and water erosion in warm conditions. Their colour ranges from reddish to olive-brown. These soils are thin and poorly developed but *choe* valleys have thick deposits of sand and loam. These soils are suitable for tree plantation and bush crop cultivation.

(h) Sodic and Saline Soils

Due to water logging conditions along the canal irrigated areas in south-west Punjab, soils suffer salinity and sodicity. The salts move up and down in the soils along with sub-soil water. Their pH value is usually 7.3 to 8.5. Sodium soils have a higher percentage of sodium salt and high pH value, above 8.5. There are large belts of saline/sodic soils in the *Malwa* plains in parts of Firozpur, Faridkot, Muktsar, Bathinda, Mansa and Sangrur districts. Saline/sodic soils in parts of these districts lie along the Bikaner canal, Sirhind canal and Bhakra canal and the branches of these canals.

On the basis of above discussion, it is found that the majority of soils in Punjab are fertile and good for agriculture. These soils provide excellent conditions for the formation of agricultural fields and the cultivation of several foodgrains and commercial crops.

(E) DRAINAGE SYSTEM

Rivers are the most useful natural resource and even lead to the rise of first civilizations along their valleys. The requirement of water for drinking, irrigation, industry and household purposes is mainly met from the rivers. Rivers offer innumerable sites for making dams for producing hydroelectricity and developing canal networks for irrigating the agricultural fields. Most of the fertile areas of the country have been formed by the depositional work of the rivers in the form of alluvial soils.

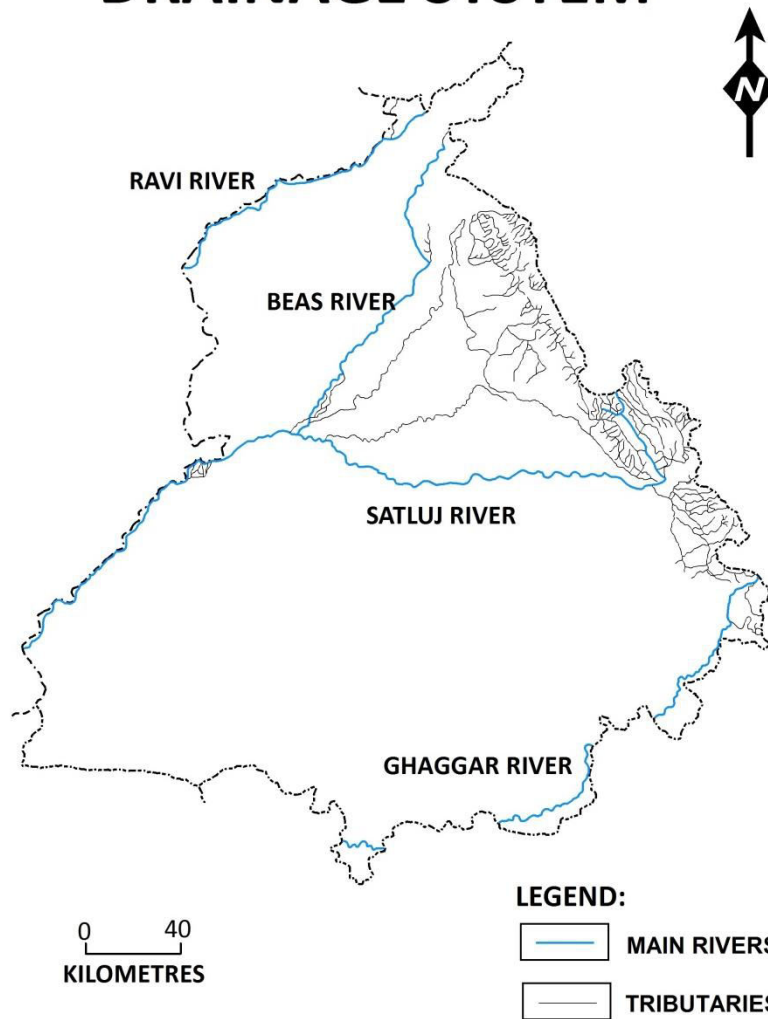
The drainage system of Punjab is formed of three perennial rivers, one seasonal river, numerous *choes* (seasonal streams) and hundreds of gullies (Figure 2.7). Three perennial rivers of Punjab are Satluj, Beas and Ravi and one seasonal river is Ghaggar. The rivers Satluj, Beas and Ravi are full of water in the month of August and the water level in them is lowest in the month of April (Gazetteer, 2001). Numerous closely spaced *choes* (seasonal streams) traverse the dissected piedmont plains and topography with gullies is found in the Shiwalik hills. Rivers have always been very crucial to Punjab. Not only these are instrumental in giving it a physical form, but these rivers also give the name *Punjab* to the state.

The Indus Valley Civilization was basically the civilization along its tributaries of Ravi, Satluj and Sarasvati. The rivers of traditional Punjab provided the unfailing water supply to maximum areas. It was out of these rivers that one of the best canal systems of the world was drawn in Punjab during British Period. Rivers also work as regional divides as the various inter-fluvial tracts or *Doabs* (land between two rivers) gave a distinctive personality through passage of time to *Majha*, *Doaba* and *Malwa* regions of present Punjab.

(1) The Satluj

Satluj is the most important river of the state of Punjab. The source of river Satluj lies in the western Mansarovar Lake of Tibet at 4,633 metres elevation above mean sea level. It is an antecedent river and was present before the rise of the

PUNJAB DRAINAGE SYSTEM



SOURCE: PUNJAB REMOTE SENSING CENTRE, LUDHIANA.

Figure 2.7

Himalayas, which it dissected during its voyage to the Punjab plains. It has formed deep gorges by cutting the high Himayan mountain ranges. Total length of river Satluj is 1450 kilometres and it traverse 720 kilometres in Punjab (Gazetteer, 2001). After origin, the Satluj makes its course along the slopes of the Kailash Mountains. It enters into India from the north of Shipki La in Himachal Pradesh. Then it bends south-west and makes its way through the mountains and hills of Himachal Pradesh and enters Punjab in Shiwalik foot-hills near Nangal town. Above Nangal town, the river has been dammed at the world famous place, Bhakra in Himachal Pradesh, giving it the distinction of being one of the highest gravity dams in the world and second highest in Asia. Jawaharlal Nehru called it *The New Temple of Resurgent India* (BBMB, 2018).

After entering Punjab, the river flows with north-western, south-eastern passage from Jaswan Doon through the ranges of the Shiwaliks in Rupnagar district. At Rupnagar, it penetrates the Shiwaliks and enters in the Punjab plains. Then it takes a turn in west direction to traverse its course through the middle of Punjab. It separates the *Bist Doab* from the *Malwa*. At Harike, it joins the river Beas and flows in south-west direction. After serving as boundary between India and Pakistan, it leaves India and enters Pakistan at some distance to the west of Fazilka. Ultimately, it joins the Chenab to merge into the Indus at Maithankot in Pakistan (Gazetteer, 2001). The river Satluj provided strong base for agricultural prosperity in Punjab. The Bhakra Dam constructed on the river Satluj provides hydroelectricity and many canals like Sirhind canal, Bist Doab canal, Rajasthan canals and Bikaner canal are extracted from the river Satluj for irrigating the agricultural fields. It has also helped in controlling floods and extension of area under cultivation in Punjab.

(2) The Beas

The Beas is another important river of Punjab. It originates from Rohtang Pass on the southern end of the Pir Panjal range situated very close to the source of the river Ravi. After its journey in the hills, it enters Punjab plains near Murthal. It separates the *Bari Doab* and the *Bist Doab*. The Pong Dam constructed on this river at Talwara has helped in controlling floods and increase in the cultivated area in Dasua tehsil of Hoshiarpur district, Gurdaspur and Kapurthala districts. The total length of the river Beas from its source to Harike is 470 kilometres. After flowing over 150 kilometres in Punjab, it joins river Satluj at Harike Pattan. Pong Dam, Beas-Satluj Link Project and

Harike Headworks on the river Beas provide hydroelectricity and water for irrigating the fields.

(3) The Ravi

The Ravi is the third perennial river of Punjab. Its source lies in Kullu hills adjacent to the Rohtang Pass. It flows in the north-west direction from its source and drains the area lying between Pir Panjal and Dhaula Dhar mountains. After traversing through Chamba of Himachal Pradesh, the Ravi enters Punjab from Madhopur in Pathankot district at headworks of U.B.D.C. (Upper Bari Doab Canal) system. The river flows through Pathankot, Gurdaspur and Amritsar districts and forms an international boundary between India and Pakistan. Finally it enters Pakistan near Kakar Manj situated at a distance of 30 kilometres from Lahore. Its total length from its source to Pakistan border near Kakar Manj is 725 kilometres. Ranjit Sagar Dam, Shahpur Kandi Project, U.B.D.C. system and Madhopur Beas Link are the important projects on this river.

(4) The Ghaggar

The Ghaggar is a seasonal river flowing in the south-eastern parts of Punjab. The Ghaggar River is a defunct Saraswati and is closely associated with the evolution of drainage system of Punjab. It forms the Yamuna-Satluj divide. The 320 kilometre long Ghaggar is an inland seasonal stream. It originates in the lower Himalayas from Sirmor in Himachal Pradesh. After a short traverse through Himachal Pradesh, it enters in Haryana near Mulla and after covering a short distance, it moves through Patiala, southern Sangrur and the lowest tip of Mansa district in Punjab. Finally, Ghaggar leaves Punjab near Sardulgarh and enters again in Haryana and ultimately enters Rajasthan to lose itself near Hanumangarh. It is not confined to any clear cut channel and therefore causes extensive floods during the rainy season. Embankments (*bunds*) have been constructed and extensive drain work has been undertaken to control the floods in this river. Spurs and studs have been built to regulate the main current of the river Ghaggar and an inundation canal known as the Banur canal has also been constructed near Banur with a regulator which besides providing irrigation also helps in controlling the floods.

(5) The Seasonal Streams (*Choes*)

Many seasonal streams, locally known as *choes*, provide another important feature to the drainage system of Punjab. These *choes* infest the foothill areas in the south of the Shiwalik hills. Most of these *choes* start from slopes of the Shiwaliks, cut their passage in the piedmont plains up to twenty kilometres and soon dry and end themselves. Some of the *choes* enter in nearby river or its tributaries. These *choes* usually have wide beds filled with sand, stones and gravels and have small valley like walls. These *choes* are spaced closely on an average 3 to 5 kilometres, throughout the piedmont zone. These *choes* are the agents of soil erosion in the piedmont region. At present, many of the villages have constructed small check dams across these *choes* to carry off large volumes of water which have affected the lower parts of these streams and due to *watbandi* (raising of dikes along the boundaries of fields) the flow of rain water into the *choes* or streams has also been almost stopped (Manku,2009). Due to all these factors supply of water into these *choes* has greatly reduced in their lower parts. A *choe* is beneficial to the fields of the villages situated higher up along the course as the *choe* brings fertile silt washed down from the hills. Later on when the *choe* water reaches to distant area and develops its course to a large extent, then it spreads large quantity of sand on the area of its influence and harm agricultural fields.

(6) The Gullies

These are very small seasonal drainage channels distributed in the Shiwaliks and the neighbouring areas in the piedmont zone. These are deep and narrow channels with broken slopes in the form of dissected topography. These are basically the product of mechanical erosion. They are flooded at the times of heavy rains for short time. The dissected topography of these gullies in many parts of Pathankot, Hoshiarpur and Rupnagar districts act as hindrance in bringing the land under cultivation. These gullies act as a big drawback in the construction of roads and railway lines in piedmont region.

The major rivers of Punjab provide the much needed base for agricultural development in Punjab, the seasonal streams, mostly evolved in recent past as result of deforestation in the Shiwaliks have been a misery. The agricultural development and overall progress of the state of Punjab depends on the rational management and sustainable development of its water resources.

(F) NATURAL VEGETATION

Natural vegetation is an important component of physical environment of an area. Vegetation that is found in an environment, which is closely linked to the prevailing relief, climate and soils untouched by human beings, is called natural vegetation. Punjab from the past many centuries has been the centre of human activities related to pastoralism and agriculture. This region was occupied by many indigenous and invading groups of people who pushed the earlier settlers to distant areas. These actions fell heavily on the natural vegetation cover of land and led to the large scale deforestation and extension of agriculture. With the re-organisation of Punjab state in 1966, large parts of forest area went to Himachal Pradesh. The new state of Punjab became nearly forestless and much of its plain area is devoted to agriculture. At present, only 6.12 per cent of the geographical area of Punjab is covered with forests and majority of these forests are confined to the Shiwalik hills in Pathankot, Hoshiarpur and Rupnagar districts. Chir-pine is common in the Shiwalik hills, shisham is found more in Punjab plains, *bhabhar* grass grows widely in the *choe* valley areas and *kikar* and thorny bushes are found in the south-western plains.

Thus, on the basis of the above discussed factors of physical environment, it is found that Punjab agriculture is directly related to its physical environment. Variations in physical environment are bound to affect agricultural fields and their use. From the above discussed factors, it is observed that, geology of Punjab is relatively simple. A major portion of the state of Punjab is covered by the Indo-Gangetic Alluvial Plains. Gradient of slope is gentle in the Punjab state with the exception of north-eastern parts along with the Shiwalik hills. On the basis of topography, Punjab is divided into five major landform regions. These landform regions are upland plains, upland plains with sand dunes, piedmont plains, flood plains and Shiwalik hills. Climate of the study area is continental sub-tropical monsoon type, which varies between sub-humid in the north-east to semi-arid in the south-west. The maximum temperature during month of June is recorded above 40⁰ C and minimum during month of January is below freezing point. Annual average rainfall is 65 centimetres, which varies from 22 centimetres in the south-west to 140 centimetres in north-east. 70 to 80 per cent of rainfall is concentrated in three months from July to September. There are eight major types of soils found in the state, namely; fluvial or bet, loamy, sandy, desert, kandi, seirozems, grey-brown podzolic and sodic-saline soils. There are three perennial rivers which water the land of Punjab; Satluj,

Ravi and Beas and there is one seasonal river; Ghaggar. Numerous closely spaced *choes* (seasonal streams) traverse the dissected piedmont plains and gullies in the Shiwalik hills. Only one sixteenth geographical area of Punjab is covered with forests, confined mainly to the Shiwalik hills in Pathankot, Hoshiarpur and Rupnagar districts. Much of the area of Punjab plains is extensively used for agriculture. Thus, the physical environment is conducive for the creation of agricultural fields and development of agriculture in the state of Punjab.

After discussing the physical environment's relevance to agricultural fields in detail, now, it is imperative to elaborate human environment before undertaking a geographical analysis of the field patterns in Punjab.

(B) HUMAN ENVIRONMENT

There is an increasing appreciation by geographers of the fact that physical and non – physical factors influence overall economic development and all those factors contributing to agricultural growth must also be sought in the same perspective. However, one factor cannot impact the vast multiplicity of interrelated physical and non-physical factors on agriculture, notwithstanding the fact that all of them are not equally significant in influencing the regional variations and temporal development of agricultural phenomena in an area (Singh, 1979).

Shinde (1980) revealed that not only physical environment influences the agricultural landscape but socio-economic factors also have their effects on agriculture. In fact, it is the action, reaction and interaction among the physical as well as human environment, which determines the emergence, evolution and function of field patterns and their impact on agricultural development of any region. Although, physical environment imposes broader limits on agricultural activities, the peasant must conduct his enterprise within a framework of socio-economic considerations, which may favour or restrict agricultural activities. There are varying physical conditions responsible for variations in regional patterns of agricultural phenomena. However, the differential degree of combinations in human factors, such as institutional, bio-technological, operational, demographic, cultural and infrastructural factors influencing field patterns and agricultural operations must be considered useful. This is because of combinations of these circumstances, furnish the basic material needed for explaining the modifications brought in agricultural activities, which otherwise, are the primary creation of natural forces. Therefore, their

discussion is unavoidable to comprehend the varying levels of agricultural development from place to place at a point of time (Singh and Dhillon, 2006). There are numerous socio-cultural, economic, technological and infrastructural factors which also determine the field patterns, agricultural land use, cropping pattern and agricultural processes. Of these factors, land tenancy, size of land holdings, population, labour, farm machinery market and mode of accessibility etc. are vital (Husain, 2007). These factors have been discussed in the following paragraphs:

(A) Population

In simple words, population means persons living in an area. The role of human factor in agriculture is very important (Morgon, 1969). It is observed that population has played important role in the origin, evolution and function of field patterns and development of agriculture in Punjab. Thus, it becomes necessary to have thorough knowledge about the human factor of a particular area. Density of population is of more concern. It is generally expressed in terms of persons per square kilometre. According to the Census of 2011, the total population of Punjab was 277, 43,338. Out of which, 173, 44,192 (62.51 percent) was rural and 103, 99,146 (37.49 percent) was urban. The average density of population in the state was 551 persons per square kilometre, which was uneven in its spatial distribution. Ludhiana (978 persons per square kilometre) was found to be the most densely populated district and Muktsar (348 persons per square kilometre) was the least densely populated district of Punjab. People in Punjab follow many traditional cultural practices in the division of agricultural land and fields. The Hindu Law of Inheritance is universally applicable in the study area. Due to the operation of law of inheritance the land of parents is divided equally among all the sons. After independence unmarried daughters were also made equal partner in their father's property by Hindu Succession Act, 1956 and its subsequent amendments in 2005 entitles unmarried as well as married daughters and 2018 entitles children of married daughters also to claim their mother's share. Principle of equitable distribution of benefits and handicaps, principle of compensation, sale, mortgage, gifts of land, caste system also have their effect on field patterns.

(B) Agriculture

Punjab is known as the food basket of India as it contributes nearly half of wheat as well as rice in the total share of central pool of food grains of India (Manku, 2009).

Punjab experienced Green Revolution in 1966, much before the other states did in India. Of the total geographical area of the state 84.18 per cent is under cultivation, which is highest in the country and nearly double than the national average of 43 per cent. Majority of the farmers in Punjab practice intensive commercial agriculture. Agriculture contributes nearly 25 per cent share in the state's gross income. 98 per cent of the net sown area is under irrigation which is 2.5 times more than the national average (Manku, 2009).

(a) Agricultural workers

Agricultural workers constitute nearly 40 percent of the total workers. The distribution of agricultural workers is not uniform, which is mainly the result of many factors like industrialization, literacy rate, urbanization, level of socio-economic infrastructure. Percentage of cultivators in Punjab to total workers is nearly 60 per cent. The agricultural workers play major role in agricultural operations. The requirement of labour varies in different seasons with type of agricultural crops grown. Additional labour is required in the cultivation of rice. Agricultural labourers comprise nearly 40 percent to the total workers in the study region. 75.8 per cent of the population is literate. Rural literacy rate is 71.4 per cent which is higher than the national average of 67.77 per cent (Census of India, 2011). The educated farmers adopt processes of mechanization in agriculture more than an illiterate farmer (Rana, 2013).

(b) Land Tenure Systems

The land tenure arrangement concerns with the relationship between land owners and tiller cultivators. Land tenure governs the conditions and rules under which land resources are used. Symons (1967) stated that tenure is a system of mutual agreement in writing or oral between two individuals or two parties under which land is held or occupied or tilled. The rent of the land or share cropping depends on the quality of land and available irrigation facilities. Rent of the land is more in fertile lands with irrigation facilities. In general, three land tenure systems exist in Punjab (Gazetteer, 2001). These are owner cultivators, tenants-at-will or share croppers and lessees.

(1) Owner Cultivators

In Punjab, 94 per cent of the total cultivators are owner cultivators (Rana, 2013). According to Symons (1967) owner-occupation tenancy is always preferred as

compared that which is merely rented out, because the farmer gives the cultivator incentive to preserve, control and develop the available assets which can ultimately be kept and maintained for the welfare of his family. The owner cultivator uses his capital resources to bring improvement at his farm by installing latest movable and immovable agricultural machinery. He uses hybrid seeds, chemical fertilizers and takes help of agricultural scientists to equip with the latest innovations in the field of agriculture.

(2) Tenants-at-will

The tenants-at-will or crop sharers pay off the share in terms of crop produced. They can be ejected from the fields at the owner's will. It has been observed that because of insecurity crop sharers are not careful in preparing the fields for crops. They avoid investing in the land of the owner. They are not very keen on increasing the quality of land and output from field because they feel that if the productivity of the land goes up, the rent will also go high. Therefore, share croppers avoid improvements of land. Tenants-at-will cultivators distributed all over the state comprise 4 per cent in the total cultivators of Punjab (Rana, 2013).

(3) Lessees

It is an arrangement wherein the landlord leases out a portion of his land to the tenant, called a lease. It offers tenure security as the tenant cannot cross the limits laid down in lease document for his farming operations. Security of tenure depends largely on the time period of lease. The longer the lease period, greater is the security. Security encourages the lessees to over-crop and exhausted the land in an effort to obtain as large a profit as possible while he remains in possession of the land (Morgan and Munton, 1978). They are found distributed all over the state. Lessees share is only 2 per cent of the total cultivators in Punjab (Rana, 2013).

(c) Size of Land Holdings

There are 10, 52,554 land holdings in the state of Punjab as per 2010-11 data of Agriculture Census of Punjab. The size of land holdings is linked with the pressure of population, economic requirement and fertility of land (Singh and Dhillon, 2004). It appears difficult to maintain a standard size of holding as Hindu law of inheritance operates in the study area, wherein after the death of the father, his land is equally divided among all his sons and daughters. Such a law encourages divisions of land

holdings into small parcels which are often widely scattered (Ojha et.al., 1991). The size of land holdings is one of the aspects influencing the fields and agricultural land use patterns and effects the agricultural development. The easy applications of farm inputs are possible, if the size of land holdings are large. Otherwise it puts limit and difficulties in proper and efficient land utilization (Vaidya, 1997). Punjab, like many other states of India, has high pressure of growing population coupled with the customary laws of inheritance, which has resulted in the continuous sub-divisions of agricultural fields. These small fields and land holdings create many difficulties in the use of modern agricultural implements and there is also less scope for experimentation. As per 2010-11 Agriculture Census of India the average size of land holding in India was 1.15 hectares. Majority of the land holdings in Punjab falls in small to medium size ranging from 1 hectare to 10 hectares. Small size of fields and land holdings has adverse effect on efficient land utilization. It is also observed that the size of land holdings is not uniform in all parts of the state of Punjab. On the basis of size, the land holdings in Punjab can be divided into the following groups:

(1) Marginal Land Holdings (< 1 hectare)

Marginal land holdings constitute 15.62 per cent of total land holdings in Punjab. Their percentage share ranges from 2.83 in Muktsar district to 36.04 in Rupnagar district in Punjab.

(2) Small Land Holdings (1 to 2 hectares)

Small size land holdings comprise 18.57 per cent of total land holdings in study area. Their district-wise percentage share also varies in the state. More than 20 per cent to the total land holdings in Rupnagar, Gurdaspur, Tarn Taran, Amritsar, Kapurthala, Hoshiarpur, S.B.S. Nagar and S.A.S. Nagar districts belong to small size of land holdings. These are between 15 to 20 per cent in Jalandhar, Ludhiana, Sangrur, Fatehgarh Sahib and Firozpur districts. In Moga, Muktsar, Faridkot, Mansa, Bathinda, and Patiala districts less than 15 per cent of the land holdings are small size.

(3) Semi-Medium Land Holdings (2 to 4 hectares)

Semi-medium size land holdings cover 30.83 per cent of total land holdings of the state. Amritsar and Tarn Taran has more than 35 per cent share in semi-medium land holdings. Districts of Jalandhar, Gurdaspur, Kapurthala, Ludhiana, S.B.S. Nagar, Sangrur, Patiala, Moga, Faridkot and Mansa lie between 30 to 35 per cent. Bathinda,

Rupnagar, S.A.S. Nagar, Firozpur, Hoshiarpur and Muktsar districts cover less than 30 per cent of the total land holdings.

(4) Medium Land Holdings (4 to 10 hectares)

28.35 per cent of the total land holdings are medium sized in Punjab. Their spatial distribution varies in the state. The share of medium size land holdings is over 30 per cent in Jalandhar, Bathinda, Firozpur, Faridkot, Moga, Muktsar, Mansa, Sangrur, Patiala and Fatehgarh Sahib districts. It varies between 20 to 30 per cent in Amritsar, Gurdaspur, Tarn Taran, Kapurthala, S.B.S. Nagar, S.A.S. Nagar and Ludhiana districts. Rupnagar and Hoshiarpur districts constitute less than 20 per cent share.

(5) Large Land Holdings (10 hectares and above)

Large size land holdings constitute only 6.12 per cent of total land holdings of the state. The large size of land holdings are more than 10 per cent in the districts of Firozpur, Muktsar, and Bathinda. It is between 5 to 10 per cent in Jalandhar, Kapurthala, Ludhiana, Faridkot, Mansa, Sangrur, Fatehgarh Sahib and Patiala districts. It is less than 5 per cent in Rupnagar, Gurdaspur, Amritsar, Tarn Taran, Moga, S.B.S. Nagar and Hoshiarpur.

Thus, on the basis of above discussion, it is found that the Punjab has more share (i.e. 30.83 per cent) under semi-medium land holdings distributed all over the state. Only 6.62 per cent share of large land holdings are found more in *Malwa* districts in the state of Punjab. While small land holdings are only 18.57 per cent of total land holdings found more in *Majha* and *Doaba* districts.

(d) Use of Chemical fertilizers

Green revolution has introduced HYV (high yielding varieties) of seeds of all the major crops in the state of Punjab. These high yielding variety seeds need greater use of chemical fertilizers to give high yields. So with the introduction of these high yielding varieties, the consumption of chemical fertilizers in the form of Nitrogen, Phosphate and Potassium has increased manifold (Vaidya, 1997). In 2011-12 Punjab recorded highest per hectare consumption of 243 kilogram fertilizers in India, which was 100 times more than Arunachal Pradesh which consumed only 2.4 kilogram fertilizers (Chanda, 2013). It is observed that the consumption of chemical fertilizers is very high in central parts and low consumption is recorded in south-west and the

lowest in north-east parts of the state. Sangrur is the largest consumer of chemical fertilizers and Hoshiarpur is the smallest consumer among all the districts in Punjab.

(e) Mechanization of Agriculture

Agriculture mechanization means the transformation of power from animals and human hands to the machinery. Ploughing is performed by tractors; sowing of seeds and saplings and application of fertilizers is done by tractor run drills; reaping and cutting by harvesting combines. Agricultural produce is transported to markets and inputs from market are brought to the farms with the help of tractors. The old fashioned wooden ploughs driven by bullocks, sickles, etc. are replaced and the work is now done by machines. The mechanization of agriculture stands for the use of machinery in all farming operations, ranging from ploughing to the marketing of the agricultural produce (Dutt, 1966). The easy and timely availability of agricultural implements in agricultural operations is imperative for efficient land use in any region. Many agricultural implements in ploughing and harrowing like kolpa, pawada, khurpa and sickle are used in Punjab. The types of implements used in agricultural operation indicate the types of farming and development level of agriculture in the region (Rana, 2013). It is observed that farmers owning small size of land holdings generally lack required costly implements, which they borrow on rent from other farmers. Farmers with large size of land holdings generally own most of these agricultural implements.

(1) Tractors

Farm mechanization is synonymous with the use of tractors in Punjab. Tractor performs most of the functions on the farm, starting from preparation of fields for growing different crops to the dispose of agricultural produce in the market. Tractor carries a number of farm operations like ploughing, levelling, bund making, mulching, sowing, harvesting, threshing and transporting the inputs and farm produce. The use of tractor requires a relatively large size of the farm. Number of tractors has increased manifold since the advent of green revolution (Chahal et.al., 1999). Punjab has recorded 79.3 tractors per 1000 hectares of net area sown, which was highest in India for 2005-2008, followed by Haryana (56.4), Uttar Pradesh (47.0) and Rajasthan (18.9). Compare to it Assam noted only 0.5 tractor per 1000 hectares of net area sown (Sarkar, 2013 and Bhalla 2009). There were 434 thousand tractors in Punjab in 2010,

which has increased four fold since 1980 (Economic and Statistical Organization, Punjab, 2012). Tractors are used maximum in the central Punjab and their number is the lowest in eastern and western areas in Punjab.

(2) Tube-wells

Tube-well is a device by means of which water is obtained from the sub-soil. The underground water has been tapped for irrigating the fields from very old times in Punjab. A hole is dug in the ground till that sandy aquifers layer is cut which give perennial supply of water (Kurian, 1969). With ushering of green revolution in Punjab, tube-wells have been devised for lifting water from ground reservoirs. Tube-wells operated with diesel or electric power have almost replaced the old system of lifting water from the well with Persian wheel. Tube-wells form a better mode of irrigation in comparison to Persian wheel, because it uplifts more water with great speed than Persian wheel. Most of the tube-wells are owned by individual farmers but there are government owned deep tube-wells also. The irrigation capacity of government owned tube-wells is much large than private tube-wells (Manku, 2009). More than 75 per cent of the tube-wells are electric operated and nearly 25 per cent are diesel operated. There were 11.4 lakh electricity operated tubewells and 2.4 lakh diesel operated tubewells in Punjab as on 31 March, 2011 (Economic and Statistical Organization, Punjab, 2011). The highest number of tube-wells per hundred hectares of net sown area is 45.39 is found in Kapurthala district. The lowest number of 15.19 tube-wells per hundred hectares of net sown area is recorded in Muktsar district. Due to continuous fall in underground water the tube wells in most parts of the state have been replaced by the submersible pumps in recent years.

(f) Agricultural Marketing

Marketing means the performance of business related activities that govern the movement of goods and services from producers to the consumers, so that these may reach the consumer at the particular time and place, and in the form he wishes and at price he is willing to pay (Kohls, 1958). Agricultural marketing is one of the most important factors which stimulate agricultural production of an area. Farmers always need an efficient market to sell their surplus produce. Thompen (1951) has argued that an effective and efficient marketing system, from the point of view of a farmer, is one of which facilitates the production of those products which, when sold to consumers,

will yields maximum returns after denudation of maximum marketing charges and farm production cost incurred by a farmer. It extends selling or purchasing facilities to agricultural commodities. The numerous activities in agriculture ranging from the purchase of seeds to the selling of farm produce needs marketing facilities. The Punjab State Agricultural Marketing Board (PSAMB) a corporate body was established in 1961, to control and supervise the market networks relating to buying, selling, processing and storing of agricultural produce in the state. Punjab has a good network of 145 agricultural produce market committees working under PSAMB. On an average each market serves 340 square kilometres of area in Punjab. It is found that the study area is having fully developed marketing system with well distribution network in the state.

(C) Agro-based Industries

Punjab is an agriculturally dominant state. There is much agricultural surplus due to practice of intensive commercial agriculture. Punjab has a strong base of large number of agro-based industries to convert agricultural raw materials like wheat, rice, sugar cane, cotton and oil seeds into manufactured goods. Flour mills, bakeries, rice milling, sugar mills, cotton textiles, vegetable ghee making, edible oil manufacturing, dairy products and many food processing industries are running successfully in the state providing quality agro-based products within the country and to the outside customers. A number of agro-based industries relating to the manufacturing of agricultural tools, implements, machines, tractors and trolleys, combines, thrashers and many other types of agricultural machine making industries are also developed. Ludhiana, Amritsar, Jalandhar, S.A.S. Nagar, Phagwara and Rajpura are the major agro-based industrial centres. Punjab Agro Industries Cooperation Limited (PAIC) is the premier organization of Punjab Government, entrusted with the responsibility of promotion and facilitation of agro-based industries including agro processing, dairy processing, agro chemicals, poultry processing, agro residue processing, food and horticulture processing, and agro chemicals manufacturing etc. in Punjab. It was incorporated in 1966 with the objective to provide quality agro inputs viz fertilizers, pesticides and tractors to farmers (www.punjabagro.gov.in).

(D) Means of Transport

The role of means of transport in agricultural development of Punjab is significant. It acts as a main vehicle for bringing seeds, fertilizers, farm implements and supplying agricultural produce within and outside the state. The improvement in transport network extends the hinterland of markets and brings isolated products area into light (Vaidya, 1997). Punjab has two types of transport network namely roadways and railways. It has denser linkage of roadways than railways. The roadways play a significant role in the collection and distribution of agricultural products. Roads have been very helpful in breaking isolation of villages and bringing them in close contact with the towns and cities. The increased urban-rural contact has given a market orientation to agriculture. Thus, level of means of transport is an important indicator of agricultural development.

Punjab has total road length of 81,808 kilometres in 2011-12. All the districts have good road length but their spatial distribution is not uniform. The greatest length of roads in Punjab is in Ludhiana district. This district has a road length of 10,099 kilometres, whereas the smallest length of roads is found in Fatehgarh Sahib district i.e. 1,970 kilometres. NH-1, NH-1A, NH-10, NH-15, NH-21 and NH-22 are the important national highways passing through Punjab. Now these numbers have been changed by National Highways Authority of India giving new numbers to North-South and East- West running highways.

Though the total length of roads is an important indicator, but a better index of development of roads, is the length of roads in relation to the area or population. It is known as road density or road intensity. It is expressed as kilometres of roads per 100 square kilometre area or 1 lakh of population. The average road density of Punjab is 140 kilometres per 100 square kilometre area. Road density varies from district to district in the state. The highest road density is recorded in Ludhiana district. It is 240 kilometres per square kilometre area. The lowest road density of 92 kilometres is recorded in Mansa district. Average road intensity per lakh of population is nearly 240 kilometres. It is maximum for S.B.S. Nagar (349 kilometres) and minimum for Amritsar (161 kilometres). It is revealed that the high road density is recorded in central and eastern parts of the state, whereas southern and south-western parts have low density. Rail transport in Punjab was set up after its annexation by the Britishers in 1849. Punjab falls in the Ferozpur division jurisdiction of Northern Railways. The total rail length is more than 4000 kilometres with Bathinda as the biggest railway

junction of the state. Ludhiana-Chandigarh new rail link has recently been started. Amritsar, Chandigarh, Ludhiana, Bathinda, S.A.S. Nagar, Pathankot and Jalandhar are well connected with airways. Amritsar is the chief international airport of the state. A portion of Sirhand canal is used as inland waterway.

Therefore, it can be inferred from the above discussion that the human factors like social, economic, cultural, technological and organizational factors together help to create and develop a dynamic and progressive environment, which is conducive to overall agricultural development of the state. The average density of population in study area as per 2011 Census is 551 persons per square kilometre. But, the highest population density is found in the Ludhiana district (978 persons per square kilometre) and lowest population density is recorded in Muktsar district (348 persons per square kilometre). Average agricultural worker are more than 40 per cent to the total workers. More than three fourth people are literate. There are large variations in the size of land holdings. The number of land holdings are 10, 52,554 as per 2010-11 data of Agriculture Census. Out of which marginal land holdings cover 15.62 per cent, small (1 to 2 hectares) constitutes 18.57 per cent, semi-medium (between 2 to 4 hectares) constitutes 30.83 per cent, medium (4 to 10 hectares) comprise 28.35 per cent and large (above 10 hectares) land holdings comprise only 6.62 per cent share. The consumption of chemical fertilizers (NPK) is very high. The total road length in Punjab is more than 81,808 kilometres. The average road density is more than 140 kilometres per 100 square kilometres of area. Average road intensity is more than 250 kilometres per lakh of population. After the mechanization, the density of tractors is 79.3 tractors per hundred hectares of net area sown. The average density of tube-wells is 30.88 per hundred hectares of net sown area. Out of which 75 per cent are electric operated and 25 per cent are diesel operated. There are 145 agricultural markets. On an average each market serves 340 square kilometres area in Punjab. The existing agriculture system can further be strengthened by implementing new programmes on land reforms, through better roads and marketing facilities, imparting scientific knowledge to farmers so that they may understand the value of HYV (high yielding seeds), farm implements and the application of chemical fertilizers.

Thus, after explaining the physical and human environment in the state of Punjab, it would be useful to study the physical and human environment of individual sample study villages.

THE STUDY VILLAGES

The state of Punjab is divided into five landform regions based on the geo-physical characteristics, on the lines with the schematic division followed by Punjab Remote Sensing Centre, Ludhiana. These landform regions are upland plains, upland plains with sand dunes, piedmont plains, flood plains and Shiwalik hills (Figure 2.3). One village each was selected from each of these landform regions for a detailed spatio-temporal analysis of the evolution of its field patterns. Their names are village Dhanowali selected from upland plains, village Bath selected from upland plains with sand dunes, village Pathan Chak selected from piedmont plains, village Khera Bagh selected from flood plains and village Rohg Teeka Khakhoh selected from the Shiwalik hills (Figure 2.8). The brief introduction of these villages in context to their physical and human environment is sketched as follows;

(1) Dhanowali: An Upland Plains Village

The village Dhanowali representing the upland plains of Punjab is located in the tehsil and district of Jalandhar in Punjab (Figure 2.9). The value of its latitudinal and longitudinal point of intersection at the geometric centre of its *abadi-deh* (main settlement) is $31^{\circ}-18'-5.55''$ North and $75^{\circ}-39'-1.93''$ East respectively. It has an almost central location in *Doaba* region of Punjab. These plains are composed of old alluvium (*Bhangar*) brought by the rivers from the Himalayas. The village is situated on flat featureless plains. Average gradient of these plains is 1: 2000. The slope appears very gentle. The village forms a part of alluvial upland plains of the *Bist Doab* region of Punjab. It is situated at the periphery of Jalandhar city along the Grand Trunk road (NH-1) from Jalandhar to Phagwara. The village falls within the Municipal Corporation limits of Jalandhar city. It has over 5000 population. It covers an area of 519 acres (210 hectares).

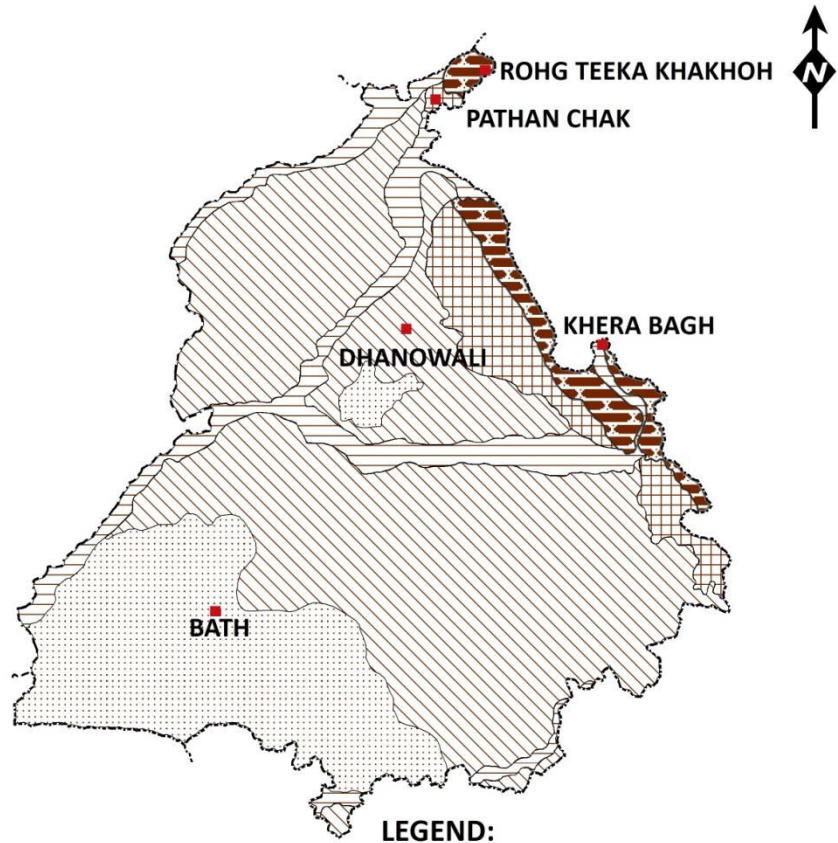
The water level in the village used to be fairly high which facilitated the digging of wells and tube-wells for irrigation. Many of the tube-wells have been replaced by submersible pumps in recent years due to fast falling water table after the introduction of paddy cultivation in the region. The soils are alluvial and their texture range from clay loam to sand. The area in which the village is situated experiences Cwg type of climate as per Koeppen's climatic classification or continental type of climate with cold winters and rainy summers. The normal mean temperature in December ranges from 12°C to 13°C and in June ranges from 33°C to 34°C . The normal mean annual

rainfall ranges from 60 centimetres to 70 centimetres. Majority of rainfall comes in the summer monsoon season and some amount of rainfall is brought by the western disturbances during winter months. No river, stream and canal pass through or near the village and it has no area under natural vegetation.

The people in the study village are dominantly engaged in agriculture. The fields are under permanent cultivation. The rural communities of the study village are comprised of different class-owners with the majority of owner-cultivators and negligible percentage of tenants and agricultural labourers. The agricultural system has become intensive commercial type after the adoption of Green Revolution technology. Agriculture is highly mechanized with universal use of tractors and other farm machinery, H.Y.V. (high yielding variety) seeds, chemicals and tube-well and submersible pump irrigation. Tractors have completely replaced the bullock plough. Wheat, paddy, fodder and potato are the commercial crops. Two crop seasons *Kharif/Saoni* (summer) and *Rabi/Harri* (winter) are prevalent. Vegetables and fodder crops are also grown in the transitional cropping seasons joining the main *Kharif/Saoni* (summer) and *Rabi/Harri* (winter) seasons.

The village was founded by the *Jat Randhawa* (a *gotra* of *Jat* caste) caste family who came from Amritsar to settle in the study village. They are the dominant land-owners in the village even today although people from many other castes also own agricultural fields. Due to high percentage of owners average per capita size of land holding is less than one *killa*. A large area of the village has been encroached upon by new settlements in recent years due to immigration of non-agricultural population from the neighbouring Jalandhar city (Figure 2.9).

PUNJAB
LOCATION OF SAMPLE VILLAGES IN LANDFORM REGIONS



0 40
 KILOMETRES

- LEGEND:**
- UPLAND PLAINS WITH SAND DUNES
 - UPLAND PLAINS
 - FLOOD PLAINS
 - PIEDMONT PLAINS
 - SHIWALIK HILLS
 - LOCATION OF SAMPLE VILLAGE

SOURCE: PUNJAB REMOTE SENSING CENTRE, LUDHIANA.

Figure 2.8

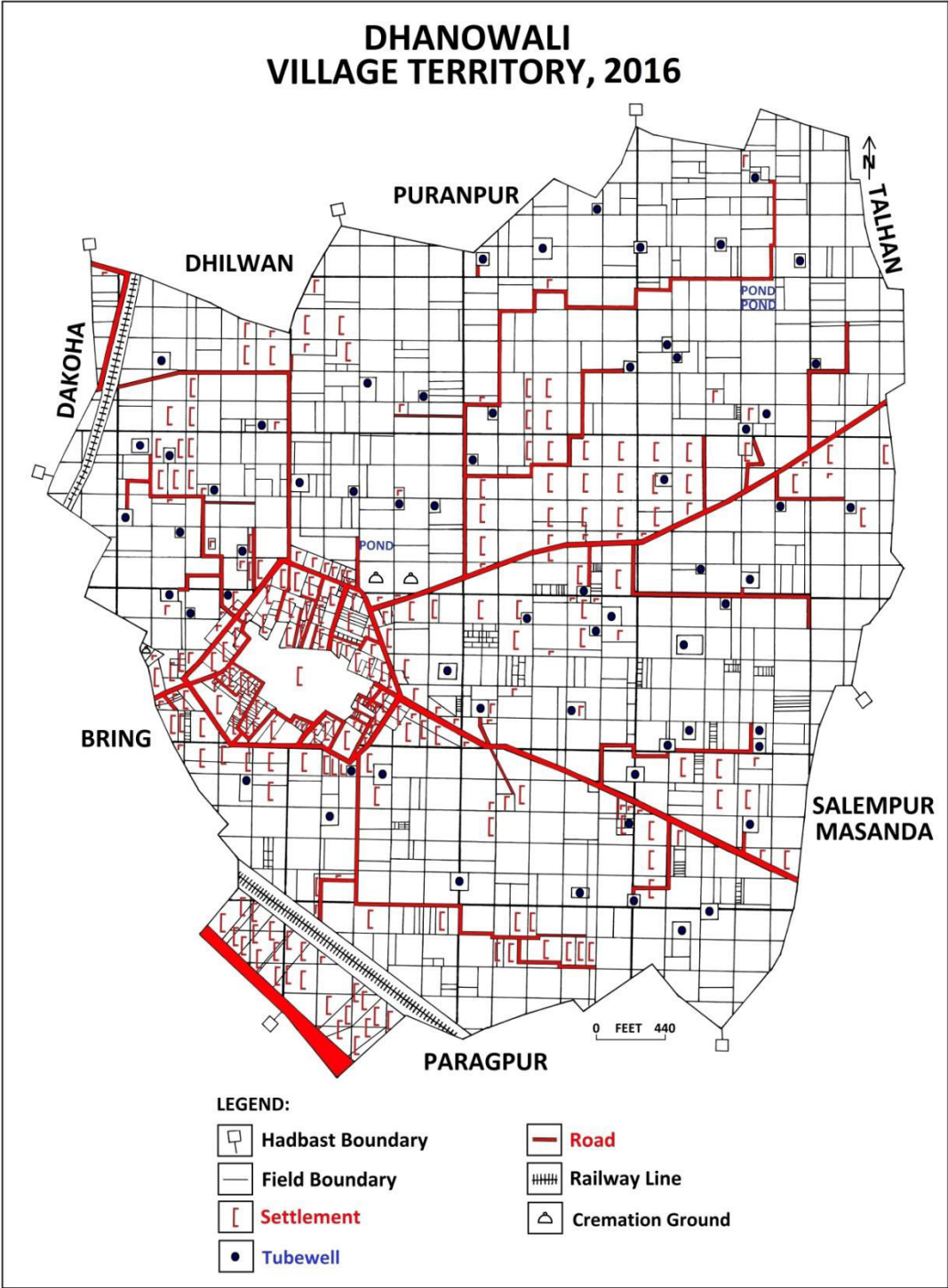


Figure 2.9

(2) Bath: An Upland Plains with Sand Dunes Village

Village Bath, selected as a representative of upland plains with sand dunes is located in Bathinda district of Punjab near the Thar Desert of neighbouring Rajasthan (Figure 2.10). The value of its latitudinal and longitudinal point of intersection at the geometric centre of its *abadi-deh* (main settlement) is 30°-17'-13.29" North and 75°-8'-37.51" East respectively. The land of the village is termed as *maru* means affected with sand dunes. It covers an area of 684 acres (276.76 hectares). The saline and alkaline sandy soils have affected the underground water. Therefore, wells and tube-wells are not popular for irrigation. The area in which the village is situated experiences BShw (semi-arid steppe hot climate with winter drought) type of climate as per Koeppen's climatic classification. The village has continental type cold winters and little rainy summers. The normal mean temperature in December ranges from 13° C to 14° C and in June ranges from 34° C to 35° C. The normal mean annual rainfall ranges from 30 centimetres to 40 centimetres. More rainfall comes in the summer monsoon season and little amount of rainfall is brought by the western disturbances during winter months. A distributary of Bathinda branch of Sirhind Canal passes through extreme north-west corner of the village. Due to desert character, village has no area under natural vegetation. As per the Census 2011, the village has a total population of 1465 persons. The people in the study village are dominantly engaged in agriculture as small and marginal farmers. Majority of the farmers are owner-cultivators and there is negligible percentage of tenants. Agricultural labourers are employed by the farmers more during sowing and harvesting time. The agricultural system is subsistence cum commercial type. The fields are under permanent cultivation. Wheat, paddy and cotton are the main commercial crops.

Two main crops seasons *Kharif/Saoni* (summer) and *Rabi/Harri* (winter) and one transitional *Zaid* crop season are prevalent. Agriculture is highly mechanized with abundant use of high yielding variety seeds, chemicals and canal irrigation. The village was founded by the *Jat Bath* (a *gotra* of *Jat* caste). They are the dominant land-owners in the village. Due to high percentage of owners average per capita size of land holding is only a little above one *Killa*.

BATH VILLAGE TERRITORY, 2016

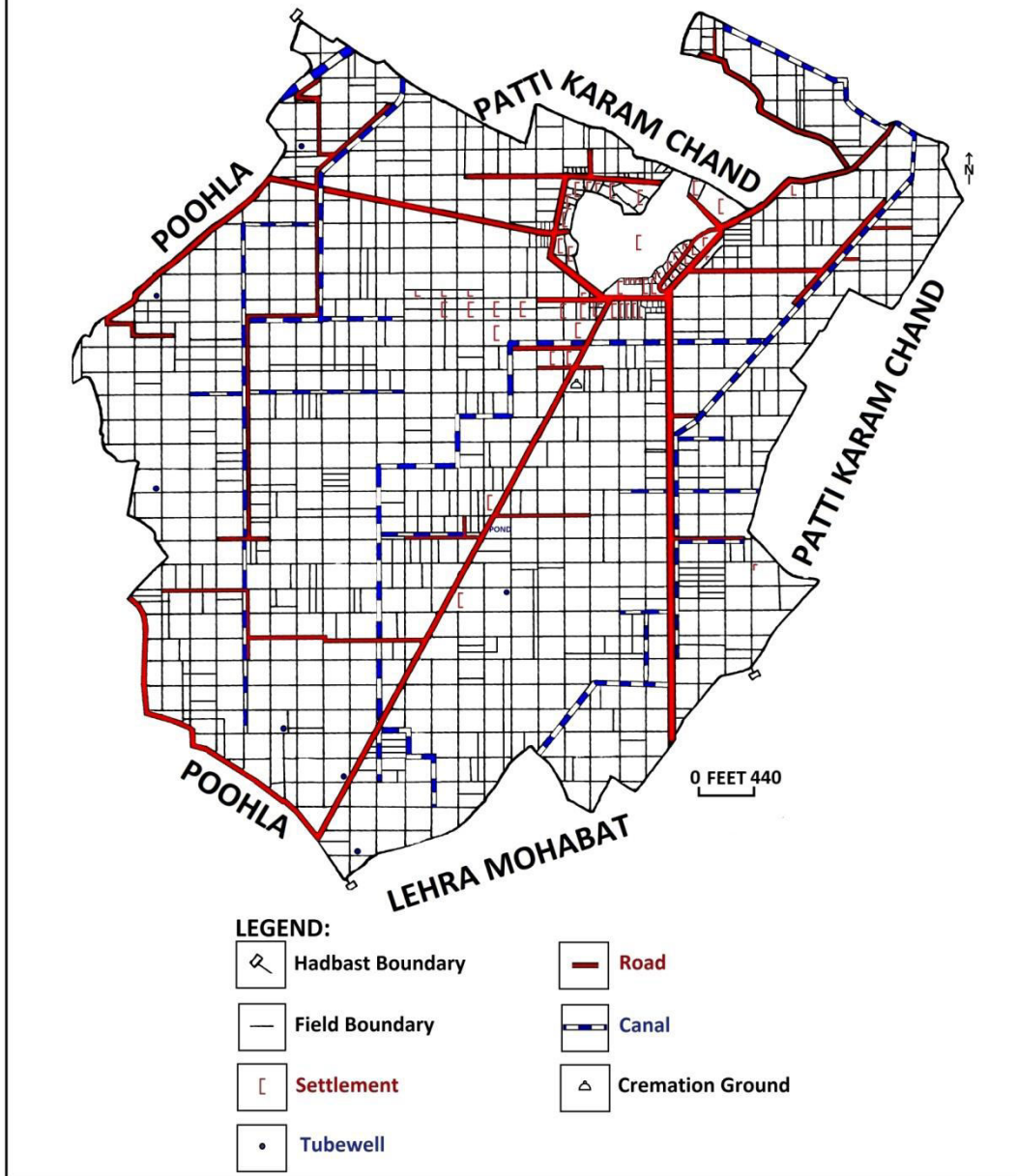


Figure 2.10

(3) Pathan Chak: A Piedmont Plains Village

Village Pathan Chak located in Pathankot district has been selected from piedmont (foot-hill/*kandi*) plains from the Punjab *Kandi* (an edge) region (Figure 2.11). The value of its latitudinal and longitudinal point of intersection at the geometric centre of its *abadi-deh* (main settlement) is 32⁰-13'-31.03" North and 75⁰-31'-41.44" East respectively. It is a *choes* (small seasonal streams) infested and dissected foot-hill plain village, which is higher than the neighbouring upland plains and lower than the Shiwalik area. The boundaries of the village are largely marked by irregular *choes* descending out from the adjoining Shiwalik hills in the east, west and to some extent in the north directions. The village is situated within an elevation range from 300 metres to 400 metres. It covers an area of nearly 285 acres (115 hectares). The soils are young *kandi* type ranging from sandy loam to clay-silt. The village experiences Cwg type of climate as per Koeppen's climatic classification or continental type of climate with cold winters and rainy summers. The normal mean temperature in December is more than 12⁰ C and in June it is more than 33⁰ C. The normal mean annual rainfall is more than 100 centimetres. Majority of rainfall comes in the summer monsoon season and some amount of rainfall is distributed in winter months brought by western disturbances. As per the 2011 Census, the village has a total population of 904 persons. People are mainly engaged in agriculture. The fields are under permanent cultivation. Agricultural population is comprised of different class-owners with the majority of owner-cultivators and there is negligible percentage of tenants and agricultural labourers. The agricultural system has become intensive subsistence to commercial type. Traditional *Kuhal* irrigation techniques are used. Agriculture is mechanized with the use of tractors, farm machinery, H.Y.V. (high yielding variety) seeds and chemicals. Tractor has replaced the bullock plough. Wheat, paddy and fodder are the main crops. Two crop seasons *Khariif/Saoni* (summer) and *Rabi/Harri* (winter) are prevalent. The village was founded by *Saini* caste family and slowly the village was established as a multi-caste and multi-clan settlement. Many *gotras* (clans) of *Saini* caste dominate the village territory in terms of amount of land possessed by them. Many other castes also own agricultural fields in the study village. Due to high percentage of owners average per capita size of land holding is only 1.25 *killas*.

PATHAN CHAK VILLAGE TERRITORY, 2016

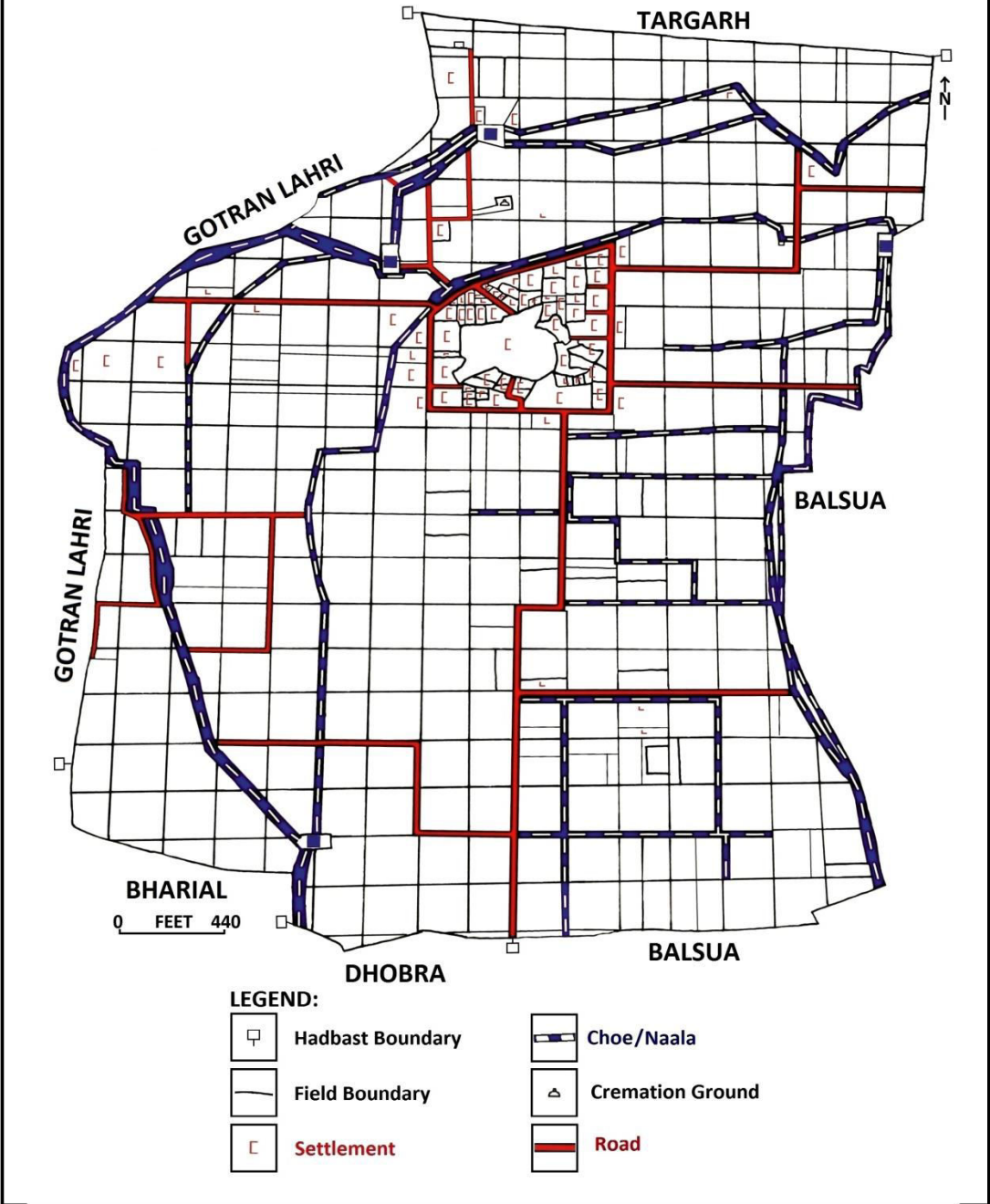


Figure 2.11

(4) Khera Bagh: A Flood Plains Village

Flood plains locally known as *bet* plains are found along the rivers of Punjab in the shape of long and narrow ribbons. Village Khera Bagh has been selected from the flood plains along the *Doon* area of river Sutlej situated in Nangal tehsil of Rupnagar district (Figure 2.12). The value of its latitudinal and longitudinal point of intersection at the geometric centre of its central *abadi-deh* (settlement) is 31⁰-24'-49.20" North and 76⁰-23'-7.48" East respectively. The village is surrounded by the Shiwalik hill ranges in the neighbourhood. The river Sutlej flows along the eastern and south-eastern side of the village giving a wetland character to the fields situated in the close vicinity of the river. Such fields are usually not cultivated due to the water logging conditions leading to wild growth of long grass with more than ten feet height. Wild animals are very common in these fallow lands. Wild animals such as boars (wild pigs) not only damage the crops in the nearby fields but also attack the farmers and other villagers especially in their mating season to counter human interference. The farmers protect themselves and their fields by wiring the fields. The village experiences alluviation as well as eluviation during active floods resulting into change in the total area of the village. For example, total area of the village has reduced by 6 *merlas* from 993 *kanals*-6 *merlas* in 2007 to 993 *kanals* in 2016 due to the process of eluviation or erosion by flood water of river Sutlej. The village is situated within an elevation range from 200 metres to 300 metres. It covers an area of more than 124 acres (above 50 hectares). The soils are fluvial *bet* type ranging from sandy loam to silt and clay loams. The village experiences Cwg type of climate as per Koeppen's climatic classification or continental type of semi-arid and less hot climate with cold winters and good rainy summers. The normal mean temperature in December is around 13⁰ C and in June it is nearly 33⁰ C. The normal mean annual rainfall is above 100 centimetres. *Barani* (rain-fed) agriculture is practised successfully due to efficient amount of rainfall well distributed throughout the year. The moist winds coming from the Govind Sagar Lake of the famous Bhakra Dam and the river Satluj result in local orographic rainfall due to the presence of the Shiwalik hills in the neighbourhood. Majority of rainfall comes in the summer monsoon season and some amount of rainfall is distributed in winter months brought by cyclones. As per the 2011 Census, the village has a total population of 367 persons. Majority of people are engaged in agriculture.

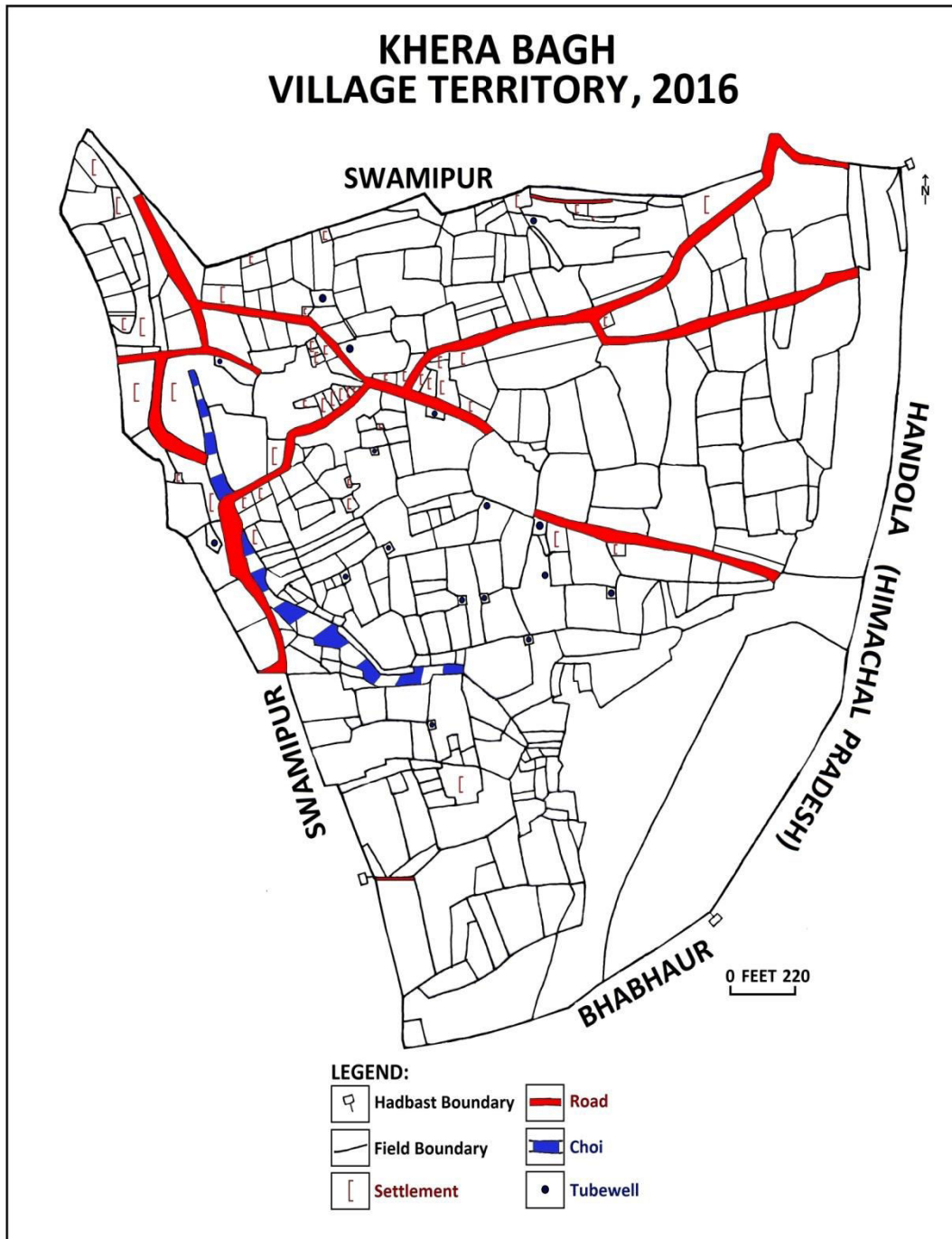


Figure 2.12

Most of the fields are under permanent cultivation and some fields are permanently left fallow due to water logging. The communities of the study village are comprised of different class-owners, majority of them are owner-cultivators. There is negligible percentage of tenants and agricultural labourers in the total agricultural workers. The agricultural system is mainly subsistence type. The fields are under constant threat of floods due to location of the village in the Satluj flood plains. The risk of frequent floods has declined after the construction of Bhakra dam on the river Satluj which flows in the vicinity of the village. The seepage and transfer of water of the Satluj through aquifers has resulted in favourable underground water level. The underground water is available at a depth of 25 feet to 40 feet only which is favourable for the digging of wells. The water of the wells and the river Satluj at favourable sites is pumped up with the help of diesel engines and electricity to irrigate the fields. Agriculture is moderately mechanized with use of small size tractors and farm machinery. H.Y.V. (high yielding variety) seeds are used. Manures are used more than the chemical fertilizers to maintain the productivity and fertility of the soils. Wheat and maize are the main crops. Two crop seasons *Kharif/Saoni* (summer) and *Rabi/Harri* (winter) are prevalent. The village is inhabited by multi-caste and multi-clan people like other *bhaichara* village of Punjab. Many castes own agricultural fields in the study village. Due to high percentage of owners the size of land holdings is small (one *killa*).

(5) Rohg Teeka Khakhoh: A Shiwalik Hills Village

Village Rohg Teeka Khakhoh has been selected from the *Shiwalik* hills region. The village is situated in the extreme northern tehsil Dhar Kalan in Pathankot district at an altitude of more than 600 metres (Figure 2.13). The village has uneven hilly terrain with some sloping land towards its north-west direction, where fields for cultivation have been developed by converting the slopes into terraces and by levelling the uneven topography. The value of its latitudinal and longitudinal point at the roads intersection near the *abadi-deh* (settlement) is 32⁰-23'-21.01" North and 75⁰-49'-45.06" East respectively. It covers an area of nearly 168 acres (68 hectares). The village has one *khal* passing through the middle of the fields, with east-west extension. Due to hilly topography, village has maximum of its area under forests, *birs*, plantations and orchards.

ROHG TEEKA KHAKHOH VILLAGE TERRITORY, 2016

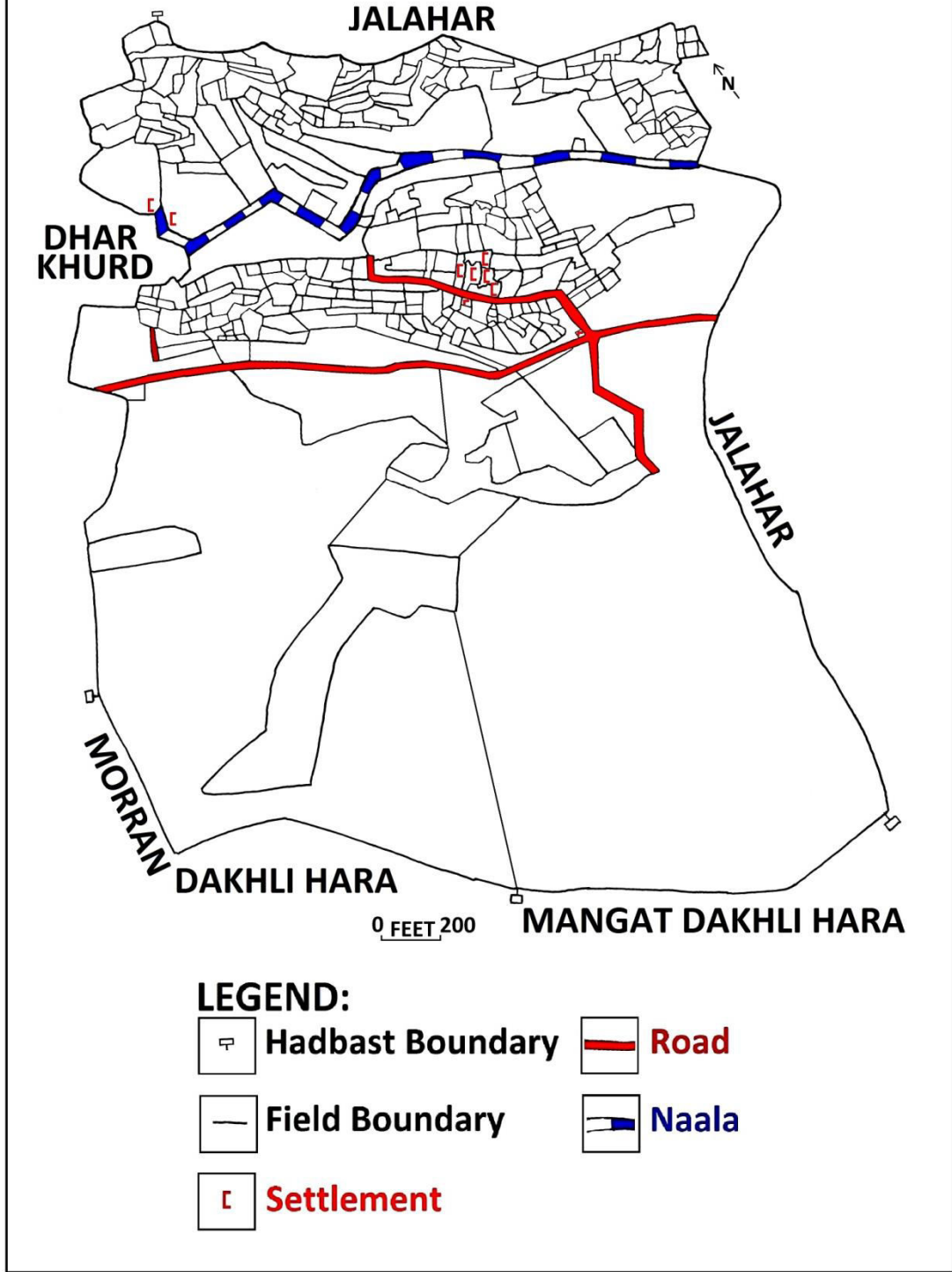


Figure 2.13

The soils are mainly stony, gravelly and sandy developed under deciduous forests, steep stony slopes and rugged topography known as grey-brown podzolic soils. The village experiences Cwg type of climate as per Koeppen's climatic classification or continental type of climate with cold winters and rainy summers. The normal mean temperature in December is less than 12⁰ C and in June it is less than 33⁰ C. The normal mean annual rainfall is more than 150 centimetres. Due to hills and neighbouring Himalayan mountain, the annual rainfall is well distributed but still majority of rainfall comes in the summer monsoon months and some amount of rainfall is distributed in winter months. People are mainly engaged in agriculture. Most of the fields are under permanent cultivation. The area occupied by the settlement is less due to low population size. The majority of the farmers are owner-cultivators and there is negligible proportion of tenants and agricultural labourers. The agricultural system is subsistence in nature. Agriculture is mainly traditional, moderately mechanized and better quality seeds and chemicals are also used by big farmers. Use of bullock plough is replaced by use of small size tractors. Wheat, paddy and maize are the main crops. Two crop seasons *Kharij/Saoni* (summer) and *Rabi/Harri* (winter) are prevalent. The village was first owned by a *Thakur Khakhoh* caste family after whom the Khakhoh name has been added to the village Rohg. Thakurs dominate the village territory in terms of amount of land possessed by them and many of the fields are also owned by Rajputs. No other caste owns agricultural fields in the study village. Due to sparse population, the land holdings are large in size. The average size of land holding is nearly 4.5 *killi*.

Different field patterns have emerged in these villages situated in different landform regions in response to their physical settings and human response expressed through their culture, value systems, technology used and mode of living. Thus, on the basis of the above discussion it is found that variations in physical environment and human response in all the villages selected from different landform regions of upland plains, upland plains with sand dunes, piedmont plains, flood plains and Shiwalik hills have a strong bearing on their field patterns.

CHAPTER-3

EVOLUTION OF FIELD PATTERNS

The evolution of field pattern reflects its dynamism both in time and space. A study of the village and field patterns is a study of the cultural and functional landscape, which reflects human and physical aspects (Ishida, 1972). The existing field pattern provides only a link in the evolutionary process of fields and a key in the understanding of phases of settling. It reflects the community decisions expressed by their culture, value systems, technology used and their mode of living. The pattern, function and the evolution of fields can be understood well through an interpretation of the field patterns in an area, which reflects all these attributes and functions (Mukerji, 1961). The evolution of field pattern should be analysed geographically, both through time and space. It is, therefore obvious that it is not only important to describe the various field patterns, but also as far as possible, to trace the origin and evolution of the patterns in order to find out the socio-economic and political factors in operation at the time of the settlement (Nitz, 1966). The existing field pattern is not a spontaneous creation but it has undergone various stages. It has evolved gradually over a period of time, each phase being closely related to, and in fact, the product of, the then existing political condition, land tenure system, technological know-how, the culture group and their *genre de vie* (Grover, 1985).

INITIAL PHASES OF SETTLING

The evolution of field patterns can be better understood by the phases through which it has passed. Villages situated in Punjab plains were settled first by people, than the hills, because of the advantages of plain areas for agriculture and settlement (Manku, 1986). In the initial phases, upland sites within the village territory with good sources of water were selected first for making *abadi-deh* (settlement), which was usually surrounded by the agricultural fields and fields were surrounded by extensive wild growths and forests. In initial phases, land was abundant and families were few. For full utilisation of abundant land resources and for clan solidarity the original families used to invite other families of their own caste and clan for settlement in the village. The other immigrating families used to settle in the village by the permission of the founding families. This type of joint village system termed as *bhaiyachara* was universal among *Jats* and other castes living in Punjab. It marked the first stage in the

evolution of proprietary rights in land (Baden, 1972). A single caste and clan village turn into multi-clan community, when the people of other castes and clans were invited to settle in the village for better social and economic organisation and safety (Manku, 1986). A study of *Shajra Nasabs* (genealogical trees) of the study villages supports this generalisation. The ancestral joint land was sub-divided in the subsequent stages on the basis of laws of inheritance. The land of the villages, which were jointly founded by two or more pioneer settlers, was divided into equal number of *tarafs* or *pattis* (division of village territory generally on the basis of caste). Each *patti* used to belong to one caste. Examples were provided by Dhanowali, Bath and Pathan Chak villages in the study area. The land of the whole village *taraf* or *patti* is divided among the clan families as *thulas* known as *thulawand* (division of land in large chunks). A clan may have many *thulas* distributed in different parts of the village territory. Further each lineage family was allotted land in the form of a block known as *dheri* or *dheriwand* (division of large chunks of land in to smaller sections) on the basis of law of inheritance and the principle of equitable distribution of benefits and handicaps. At the final stage of initial division of land each *dheri* was sub-divided into family *khata*s (fields) known as *khatawand* for each nuclear family (Manku, 1986). The first occupants of the village land might have divided the property on a scheme of shares based on each man's ability to bring land under cultivation, though subsequent division of property has been in accordance with ordinary rules of inheritance (Douie, 1899). A study of *Shajra Nasabs* of the sample villages supports this statement. *Jat Randhawa* clan founded the village Dhanowali and they occupy the maximum land of the village even today. Similarly, families of *Jat Bath* occupy maximum land in Bath village as the village was founded by them. Village Pathan Chak was founded by *Saini Bhangura* family and this dominant clan has the maximum land since the settlement of the village. *Thakurs* own maximum land in the village Rohg Teeka Khakhoh because of their early settlement in the study village. Village Khera Bagh is a multi-caste village, where *Thakur Dwara* has maximum land since initial settlements.

1. EVOLUTION OF FIELD PATTERNS IN UPLAND PLAINS (VILLAGE DHANOWALI)

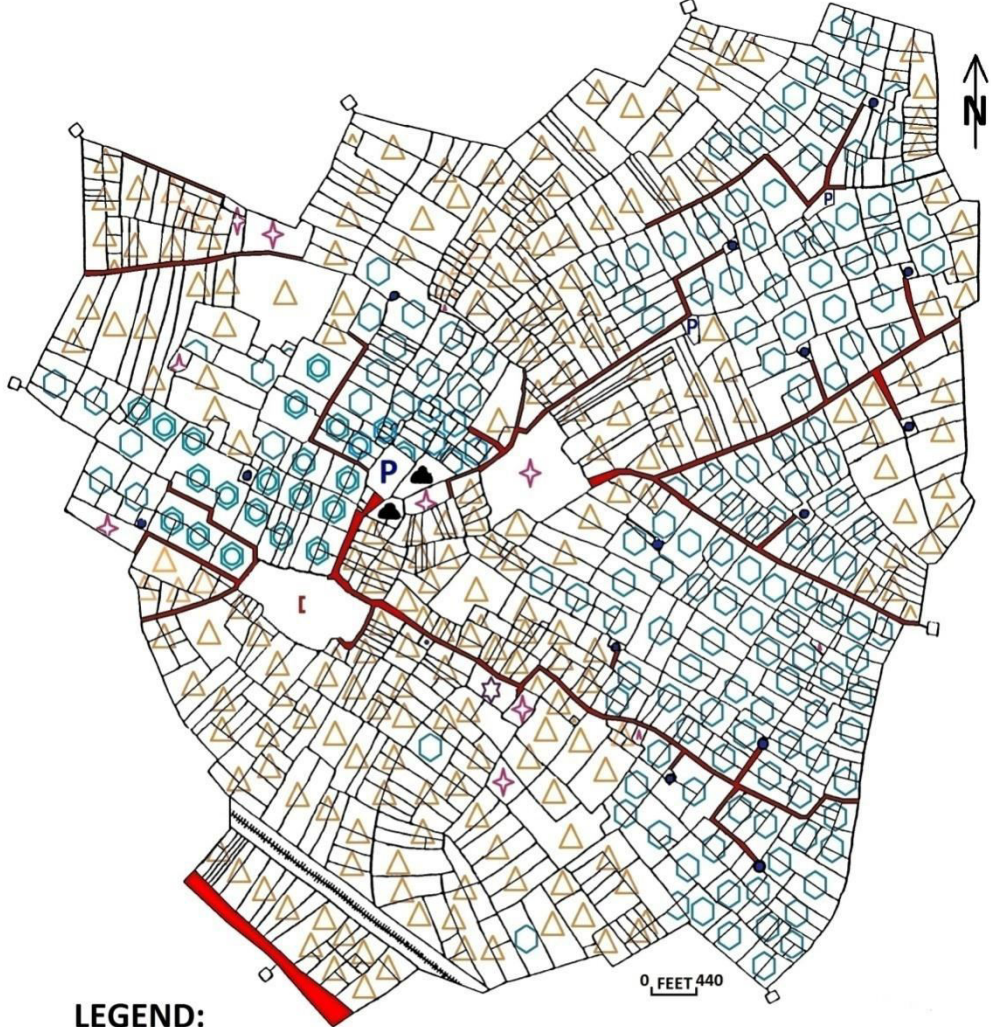
To study evolution of field patterns in Dhanowali village, selected from upland plains landform region of Punjab, a reconstruction of field landscape, as it existed at different periods of time, has been attempted. The earliest available field map of

village Dhanowali for the period 1884 is comprised of several types of land characterized by variations in their inherent fertility and productivity (Figure 3.1). The land types of 1884 field map include *nyayi chahi*, *meera chahi*, *tibba*, *banjar kadim* and *banjar jadid*. *Nyayi* denotes the best quality land in terms of its proximity to the *abadi-deh* (settlement) and inherent fertility. The term *chahi* stands for the land which is being irrigated by *chah* (well/tube-well). *Meera chahi* land type is found away from *abadi-deh* (settlement). A *tibba* is an uneven sandy track which cannot retain water for long. Therefore, it is not good for cultivation. *Banjar kadim* and *banjar jadid* terms of land types are used for fallow lands: *jadid* refers to the land which has been left fallow for at least three cropping seasons and *kadim* refers to the land, which has been left fallow for at least eight cropping seasons, as this type of land is very poor in inherent fertility and productivity.

According to *Shajra Nasab* (genealogical tree) of 1884, village Dhanowali was owned by a *Jat Randhawa* family, who came in this village from Amritsar (Figure 3.2). They found the land vacant and acquired the village territory by clearing the forests and bushes. The boundaries of the village were marked largely by *tibbas* (sand ridges) and forests. However, for administrative purposes, village boundaries were demarcated by the Britishers in 1846, when Jalandhar Doab came under British after first Anglo Sikh war. Thereafter most of the areas were surveyed for administrative operations by the Britishers. Since then, the village territory has not changed. The village territory was then divided among the founder members. Information from old records recount that due to certain natural and political disturbances, people left this village and settled in the village Rampur Lallian in Amritsar, and this village became *bechirag* (abandoned). After a gap of five generations their successors Diwani, Roora, Gurdita, Gurdial, Dharam Singh, Mangta and Masamian came to this village and settled permanently. They got the property rights and divided the village land among them in equal share. Subsequently, people of other castes were also invited to settle here. However, the evolution of field patterns and division of land was related mostly to the *Jat Randhawas*, even though, it is a multi-caste village today. Village records describe that Dhanowali village was established by *Jat Randhawas* and it began as a uni-religious, uni-caste and uni-clan settlement. The village territory was initially divided into two *Pattis*: *Patti Diwani* and *Patti Roorewali* named after Diwani and Roora amongst the founder settlers. The *abadi-deh* (settlement) in the village is located near

the periphery rather than in the centre of the village, to get advantage of proximity to the Grant Trunk road (G T Road/N.H.1). Agriculture was the main occupation; therefore, the process of converting the village territory into cultivated land was started immediately. The entire village territory was not brought under cultivation simultaneously, but it was gradually extended in different directions of the village territory, in different phases. The land adjacent to the *abadi-deh* (settlement) was the first, to be brought under cultivation. In the first phase, cultivated land was extended in the north and north-east directions of the *abadi-deh* (settlement). In the second phase, land near the eastern and north-eastern territory of the village was brought under cultivation due to high level of inherent fertility and productivity of land. In the subsequent phases, cultivated land was extended to the south and south-east directions of the *abadi-deh* (settlement) and then to the other peripheral parts of the village. These phases of bringing village territory under cultivated land are indicated by land types and smaller size of fields reflecting higher degree of their sub-divisions. The fields are larger where the incidence of sub-divisions is less. The fields are elongated rectangles and strips in shape. This was the result of the ancient notion that the field should be of such a size that a single plough team of farmer's family would plough the whole field in a single day. This was essentially related to the use of the wooden ard plough suited to a long furrow, so that there would be no wastage of time in turning in the plough too frequently (Mukerji, 1961). Figure 3.3 reveals several theoretical models in the sub-divisions of the fields in the evolution of an original block, rectangular and accentuated rectangular field. This model suggests that the division of these fields in the most cases has resulted in the creation of elongated rectangular and strip fields. Many of these theoretical field shapes are found validated in the evolution of field patterns in the sample villages, including Dhanowali.

VILLAGE DHANOWALI LAND TYPES AND FIELD PATTERNS, 1884



LEGEND:













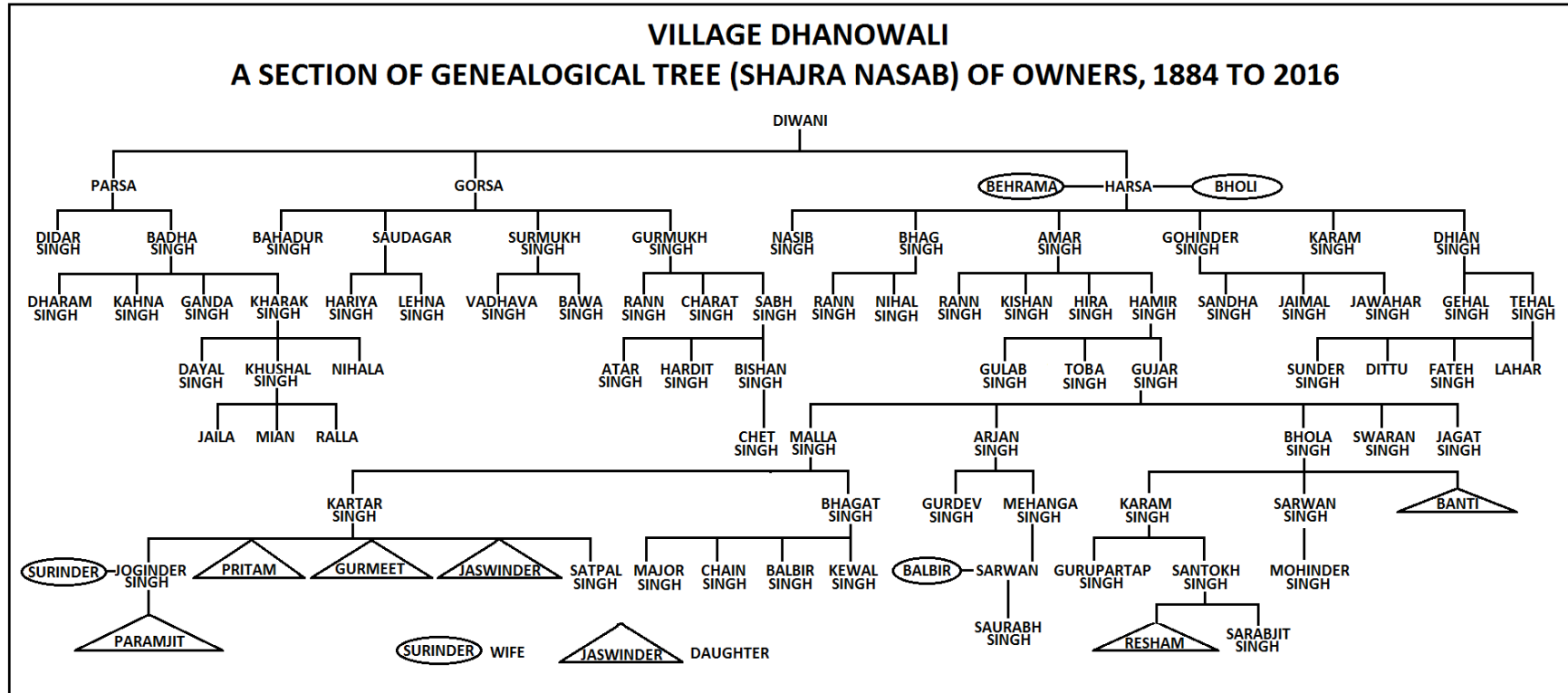
- | | | |
|--|--|--|
|  Hadbast Boundary |  Railway Line |  Nyayi Chahi |
|  Field Boundary |  Cremation Ground |  Meera Chahi |
|  Settlement |  Well/Pond |  Banjar Kadim |
|  Road |  Tibba |  Banjar Jadid |

Figure 3.1



Source: *Shajra Nasab* of Village Dhanowali-1884, 1914, 1958, 1990 and 2016.

Figure 3.2

ALTERNATIVE POSSIBLE MODELS IN THE SUB-DIVISIONS OF ORIGINAL ACCENTUATED RECTANGULAR, RECTANGULAR AND SQUARE FIELDS

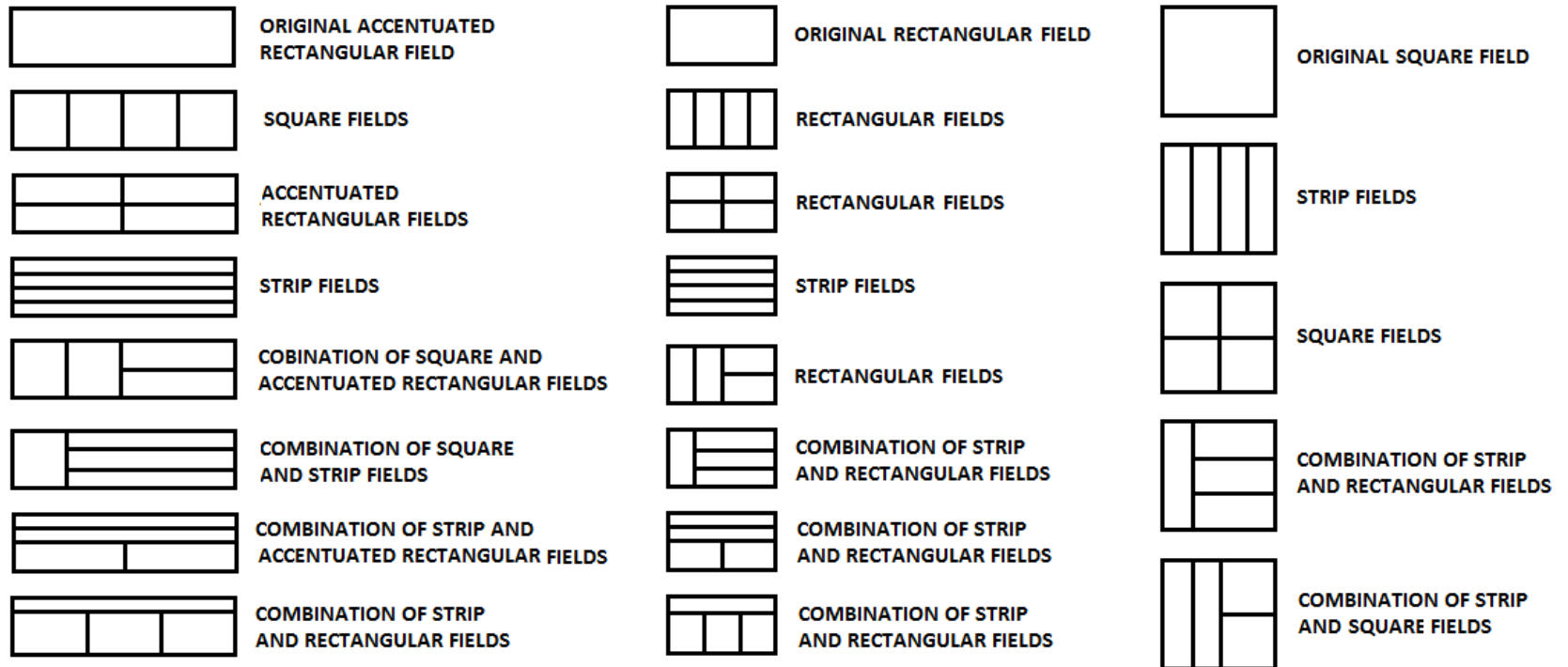
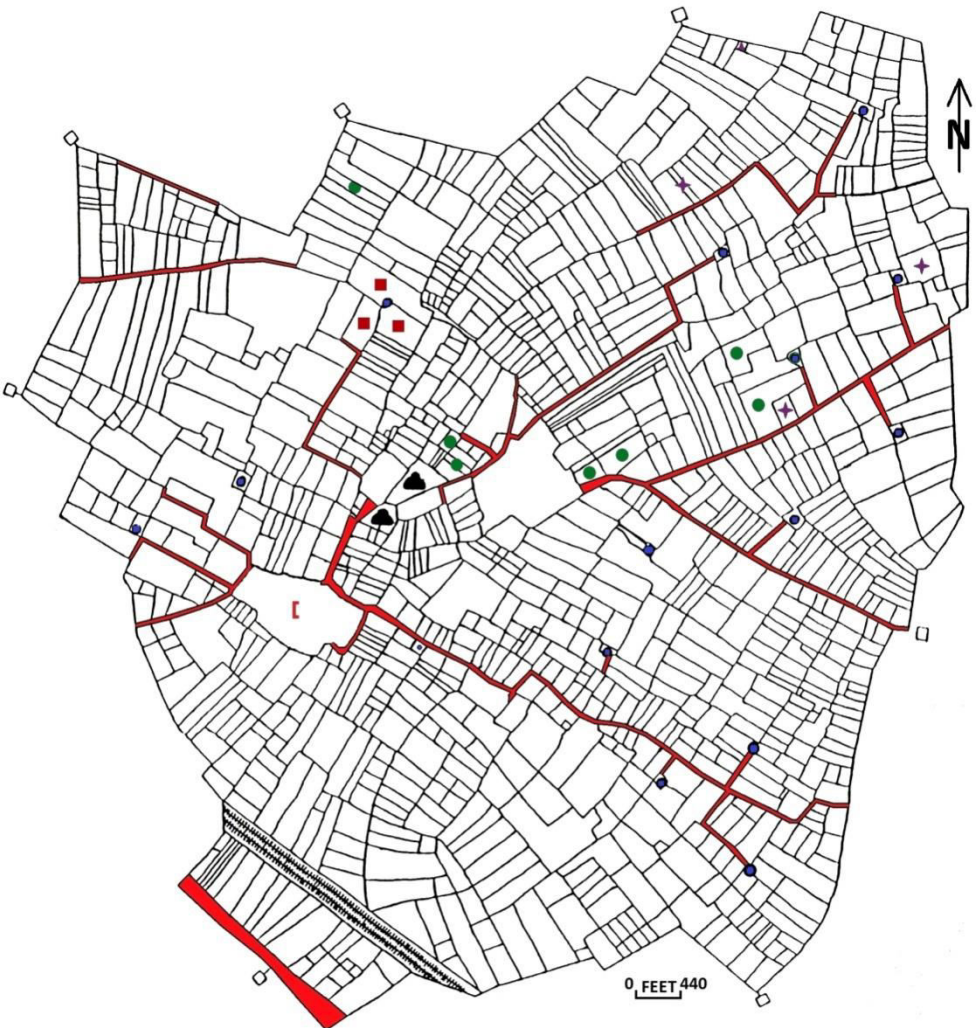


Figure 3.3

The elongated rectangular and strip shape of the fields at that stage would have also been determined by the micro topography, uneven *tibbas* (sandy ridges), poor land type, sources of irrigation, farm implements used, bullock plough, subsistence nature of farming and poor management of fields due to small size of families and large size of land holdings scattered at different sites of the village territory. The local micro topography has also played an effective role in the orientation of the long-side extension of the rectangular and strip fields. Therefore, as evident from the map (Figure 3.1) the alignment of the fields varies in different directions of the village territory. Many of the elongated rectangular and strip fields comprising the land holdings of different farmers are oriented to the village roads for easy movement of human beings and cattle. The evolution of field patterns in the subsequent phases involved only an increase in the number of fields due to the sub-divisions of existing fields. Presently, the number of cultivated fields and area under cultivation has been reducing due to the continuous encroachment of cultivated fields by expanding settlement both near the *abadi-deh* (settlement) and other parts of village territory.

In the beginning, village territory of Dhanowali was divided equally among the seven founder members of *Jat Randhawa* caste family. Diwani was one of these founder members. Either within Diwani's lifetime or soon after his death, his land was divided among his three sons Harsa, Gorsa and Parsa around the beginning of the 19th century (Figure 3.2). Who got how much and where, is not known, because data and maps for that period is not available. The division of land would have been made according to the then prevailing customs. In the third generation, the land belonging to Harsa was divided among his six sons; Dhian Singh, Karam Singh, Gohinder Singh, Amar Singh, Bhag Singh and Nasib Singh. Karam Singh and Nasib Singh died heirless and therefore, their share of land was also given to remaining four brothers. It was expected that due to the operation of law of inheritance, the land would have been divided equally among all the sons following the Pan-India Great tradition (Marriot, 1955).

**VILLAGE DHANOWALI
OWNERSHIP OF CULTIVATED LAND, 1884
(FOURTH GENERATION OF ONE FAMILY)**

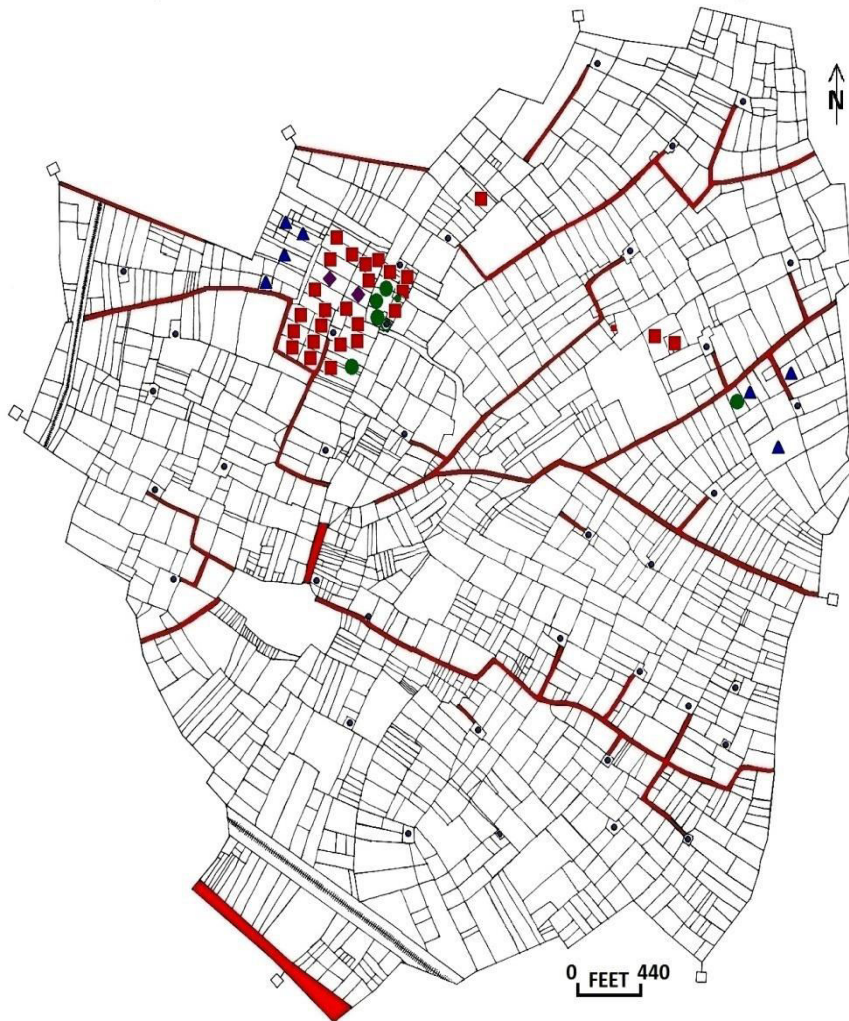


LEGEND: NAME OF OWNERS

- Hamir Singh and his sons (Gujar Singh, Toba Singh and Gulab Singh)
- Rann Singh, Kishan Singh, Hira Singh and Hamir Singh
- + Hira Singh

Figure 3.4

**VILLAGE DHANOWALI
OWNERSHIP OF CULTIVATED LAND, 1914
(FIFTH GENERATION OF ONE FAMILY)**

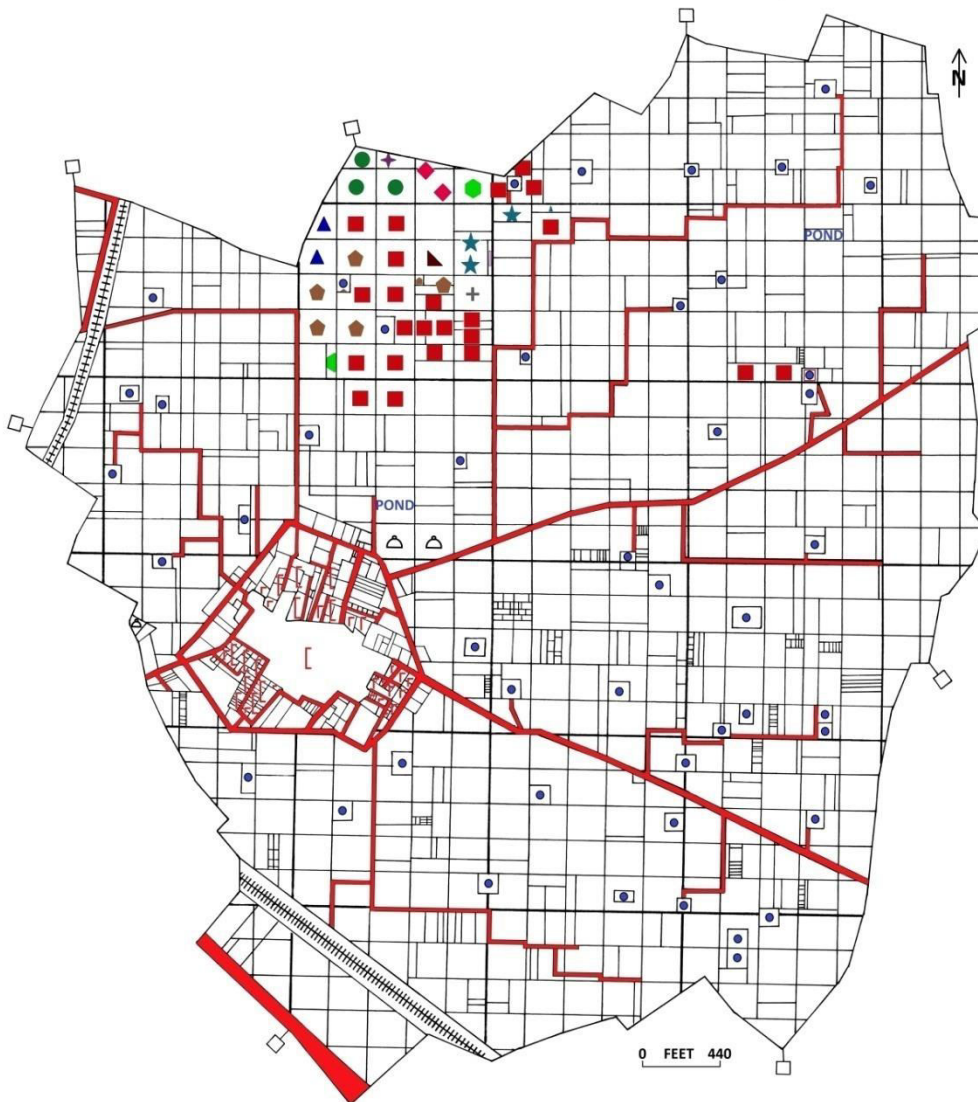


LEGEND: NAME OF OWNERS

- Gujar Singh and Toba Singh
- Gujar Singh and Gulab Singh
- Gujar Singh
- Toba Singh

Figure 3.5

**VILLAGE DHANOWALI
OWNERSHIP OF CULTIVATED LAND, 1958
(SIXTH AND SEVENTH GENERATION OF ONE FAMILY)**



LEGEND:	NAME OF OWNERS
	Bhola Singh, Malla Singh, Jagat Singh Sons of Gujar Singh Mehanga Singh, Gurdev Singh Sons of Arjan Singh
	Bhola Singh, Malla Singh Sons of Gujar Singh Mehanga Singh, Gurdev Singh Sons of Arjan Singh
	Malla Singh S/o Gujar Singh Mehanga Singh, Gurdev Singh Sons of Arjan Singh
	Bhola Singh, Malla Singh Sons of Gujar Singh, Mehanga Singh, Gurdev Singh Sons of Arjan Singh, Jagat Singh S/o Toba Singh
	Mehanga Singh, Gurdev Singh Sons of Arjan Singh Malla Singh S/o Gujar Singh
	Mehanga Singh, Gurdev Singh Sons of Arjan Singh Bhola Singh, Malla Singh Sons of Gujar Singh

LEGEND:	NAME OF OWNERS
	Mehanga Singh, Gurdev Singh Sons of Arjan Singh Jagat Singh S/o Gujar Singh
	Mehanga Singh, Gurdev Singh Sons of Arjan Singh Bhola Singh S/o Gujar Singh
	Bhola Singh S/o Gujar Singh
	Jagat Singh S/o Gujar Singh and adopted S/o Toba Singh
	Malla Singh S/o Gujar Singh

Figure 3.6

**VILLAGE DHANOWALI
OWNERSHIP OF CULTIVATED LAND, 1990
(EIGHTH GENERATION OF ONE FAMILY)**

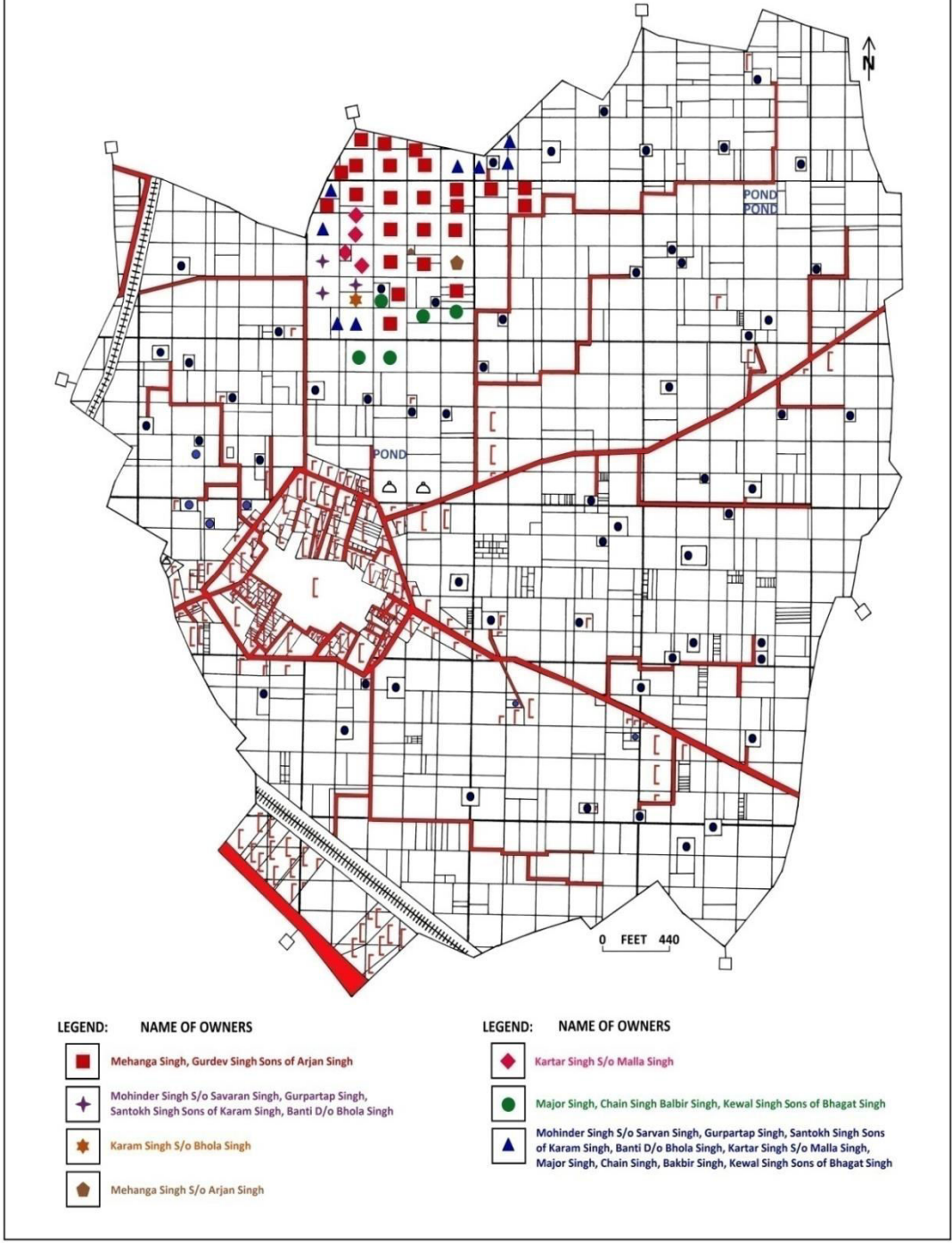
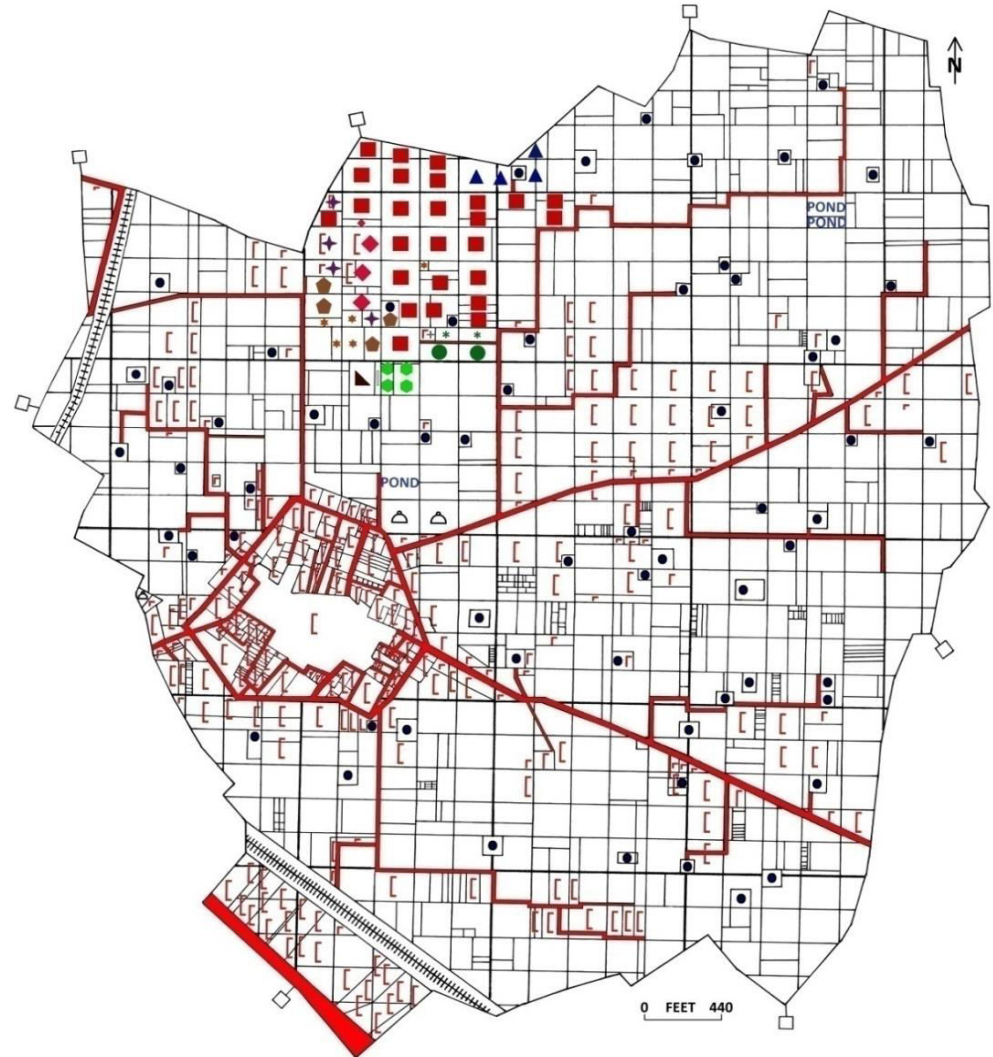


Figure 3.7

**VILLAGE DHANOWALI
OWNERSHIP OF CULTIVATED LAND, 2016
(PRESENT, NINTH GENERATION OF ONE FAMILY)**



LEGEND:	NAME OF OWNERS
▲	Baljit Kaur W/o Sarwan Singh S/o Mehanga Singh Saurabh Singh S/o Sarwan Singh S/o Mehanga Singh
■	Mehanga Singh S/o Arjan Singh S/o Gujar Singh Saurabh Singh S/o Sarwan Singh S/o Mehanga Singh
✦	Sarabjit Singh S/o and Resham Kaur D/o Santokh Singh S/o Karam Singh
⬢	Gurpartap Singh, Santokh Singh sons of Karam Singh S/o Bhola Singh
◆	Pritam Kaur D/o Kartar Singh S/o Malla Singh
✳	Mohinder Singh S/o Savaran Singh S/o Bhola Singh

LEGEND:	NAME OF OWNERS
+	Major Singh S/o Bhagat Singh S/o Malla Singh
✳	Chain Singh S/o Bhagat Singh S/o Malla Singh
●	Major Singh, Chain Singh, Balbir Singh, Kewal Singh sons of Bhagat Singh S/o Malla Singh
●	Major Singh, Chain Singh sons of Bhagat Singh S/o Malla Singh
▲	Kewal Singh S/o Bhagat Singh S/o Malla Singh
	Balbir Singh S/o Bhagat Singh S/o Malla Singh

Figure 3.8

The discourse with the village elders reveal that it was customary at that time for the eldest son to take the charge of his father's property and divide it among all his brothers in a spirit of mutual adjustments. The fourth generation field patterns and distribution of land among Amar Singh's four sons: Hamir Singh, Hira Singh, Kishan Singh and Rann Singh are shown in figure 3.4 as obtained around 1884. As illustrated on the map, it was the eldest son Hamir Singh who got the largest share, about half of the total land (39 *kanals-6 merlas*) of the property of his father. Hamir Singh holds land jointly with his three sons: Guzar Singh, Toba Singh and Gulab Singh. All of his individual fields were located on one site on a productive land, *meera chahi*, irrigated by *chah* (well) and was relatively situated near the *abadi-deh* (settlement). Hira Singh who was younger to Hamir Singh got not only less number of fields but his fields were also widely scattered in varying land types: *tibba* and *meera chahi*. His fields were largely located near the periphery of the village territory. The rest of the fields belonging to Amar Singh were owned jointly by all his four sons. It is interesting to note here a kind of gradation, where the elder son gets the maximum and the best; the second eldest son gets less than the eldest son and the remaining land which is minimum is given to the youngest son. The size of land holding and the number of fields owned by Guzar Singh, Toba Singh and Gulab Singh, all sons of Hamir Singh in the fifth generation were larger than those of Amar Singh's descendants of fourth generation. In the fourth generation (1884), Amar Singh's family owned sixteen fields comprising a holding of 104 *kanals-9 merlas*. The number of fields in 1914 jumped to 51 and size of land holding increased to 173 *kanals-9 merlas* (Figure 3.5). It was possible either due to direct purchase of land or surrender of property in lieu of debt or by the return of a previously mortgaged land. Post independence field map of 1958 depict the size of their compact holding further increasing to about 250 *kanals*, whereas the number of fields remained nearly the same as in 1914 (Figure 3.6). The number of fields has not increased because of the process of consolidation of land holdings by which most of the small fields of less than 8 *kanals* were converted into uniform size of 1 *killa* (198 feet x 220 feet or 8 *kanals*). All the family members hold the land jointly either with their fathers, brothers, uncles or sons of their uncles. Therefore, the period of twentieth century onwards demonstrates further evolution of field patterns affected by the sub-divisions of the existing fields from generation to generation. The principles which were evolved earlier, with certain deviations and modifications continue to operate in the present times and are still significant. The

cultivated land is being divided equally among the descendants of each family with a fair distribution of advantages and handicaps. There is no instance where the eldest son has the maximum share or has the fields in the best land types. The principle of mutual adjustment and compensation is widely accepted.

In the eighth generation, the fields get further sub-divided among the descendants of the families (Figure 3.7). Sarvan Singh transferred his property in the name of his only son Mohinder Singh. Karam Singh sub-divided his land between his two sons; Santokh Singh and Gurpartap Singh. Bhagat Singh's land was divided among his four sons; Kewal Singh, Balbir Singh, Chain Singh and Major Singh. Presently, in the ninth generation, the number of female owners in the form of wife and daughter are increasing (Figure 3.8). Santokh Singh has sub-divided his land equally between his son Sarabjit Singh and his daughter Resham Kaur. Baljeet Kaur wife of Sarvan Singh has transferred her property in the name of her only son Saurabh in her life-time. Similarly, the generation to generation evolution of field pattern is almost the same for other families of this village, with sub-division as a basic governing process. A comparative study of the field maps of 1884, 1914, 1958, 1990 and 2016 indicates the gradual increase in the number of property owners. The number of property owner has increased from 108 in 1884 to 492 in 2016 (Table 3.1). The number of fields has jumped from 970 in 1884 to 1436 in 1914 in 30 years of time. This was mainly due to the sub-divisions of existing fields because of increase in the number of owners. The fields have undergone an increasing incidence of fragmentation. The fields of a single owner may have also divided into several fields due to local micro-topography and for easy supply of water to the fields. There is no increase in the cultivated land in the village. The cultivated land as it exists today had already been emerged on the landscape after the creation of village territory as an agricultural property. On the contrary, cultivated land which was created in the early phases is continuously declining due to encroachment of existing cultivated lands by expanding settlements, roads, railways and other *gairmumkin* (uncultivable) land uses.

Table 3.1

Village Dhanowali: Number of Cultivated Fields and Owners

Year	Gap in Years	Number of Fields	Number of Owners
1884	-	970	108
1914	30	1436	176
1958	44	1044	313
1990	32	1006	400
2016	26	954	492

Source: *Jamabandi* of Village Dhanowali-1884, 1914, 1958, 1990 and 2016.

The consolidation of land holdings has put a halt to the historical evolution of field patterns, which is evident from 1958 onwards field map of Dhanowali. The irregularities of the evolved field patterns and earlier fragmentations have disappeared. The fields have become regular rectangular and uniform in size of one *killa* (198 feet x 220 feet) each. The process of consolidation has reduced the number of fields from 1436 in 1914 to 1044 in 1958 (Table 3.1). The number of sites of fields, which constitute the land holding of a farmer, has also been reduced leading to fall in scattering of fields. In 1990 and 2016 field maps the number of fields have further reduced to 1006 and 954 respectively. The reduction in the number of fields is related to the encroachment of cultivated land by the fast expanding settlements, roads, railways and other *gairmumkin* (uncultivable) land uses. The rate of encroachment has increased to maximum level in the recent years due to the close proximity of village Dhanowali to Jalandhar City. This village has been brought under the Municipal Corporation Limit due to fast increase in its population and its peripheral location to Jalandhar City attracting more immigration of people from the Jalandhar city to this village because of cheap land available for construction of houses.

The number of fields and the size of land holdings of a farmer between 1884 and 2016 have reduced to a great extent. The per capita number of fields is reduced from 9 in 1884 to little less than two (1.93) in the year 2016. Similarly, the per capita size of

land holdings has also reduced from 46 *kanals* in 1884 to only 6 *kanals* in the year 2016 due to increase in the population pressure (Table 3.2).

Table 3.2

Village Dhanowali: Per Capita Number of Fields and Size of Land Holdings

Year	Per Capita Number of Fields	Per Capita Size of Land Holdings (In <i>Kanals</i>)
1884	9	46
1914	8	29
1958	4	12
1990	3	9
2016	2	6

Source: *Jamabandi* of Village Dhanowali-1884, 1914, 1958, 1990 and 2016.

The continuation of joint ownerships of two or more generations in different phases is very evident from the study of generation to generation ownership maps. Complex pattern of single and joint ownership of fields and land holdings is noticeable. In the present generation, a trend has started where joint ownerships are slowly weakening due to the outmigration of population from the village to other areas of the country and abroad mainly for the purpose of better employment. A person while leaving the village for longer time or permanently, often wants to make an official separation of his own share of inherited land from that of his or her brothers and sisters in order to avoid quarrels over land in future. After getting official separation of his or her land, he or she sometimes rents or sells his or her share of land to his brothers or to someone else. Thus, the field patterns have been changing, both in time and space, soon after these were created by the first settlers. The most important feature in the evolution of field patterns has been the operation of process of sub-divisions of the existing fields among the descendants of each family in all the generations. This has resulted in the increase in the number of fields but has reduced the size of fields and land holdings.

2. EVOLUTION OF FIELD PATTERNS IN UPLAND PLAINS WITH SAND DUNES (VILLAGE BATH)

Village Bath situated in Bathinda district has been selected from the upland plains with sand dunes of *Malwa* region of south-west Punjab to analyse the effect of time and space on the field patterns in different phases of their evolution. The land of the village is termed as *maru* means affected with sand dunes due to the influence of Great Indian *Thar* Desert of Rajasthan situated in close proximity to south-west Punjab. The village Bath is named after the *Bath gotra* (clan) of *Jat* caste people who were the first settlers in the village. They divided the village territory into two *Pattis*: *Patti Hariya* in the east and *Patti Baghela* in the west after the names of first settling founder members of the village. The land covered with sand dunes was abundant, but with inherent poor productivity and fertility due to dominance of sandy soils. Because of abundance of land in the beginning, each family might have as much land as it could have manage. Bath village is a multi-caste village dominated by *Jat Baths* and *Jat Sidhus*. It was a *bhaichara* (joint) village with other castes also occupying the land in the village. These were the *bhaichara* (joint) villages and clan families from the very beginning lived under their elders in groups of equal rights (Baden,1972). The initial *thulawand* division of the village land among the founder families may have been effected by the limited size of levelled land, free from the sand dunes. *Patti Hariya* was divided into three *thulas*: *Thula Nathu*, *Thula Mazkooor* and *Thula Sahaviya* after the names of the first settlers. *Patti Baghela* situated in the western side of the village was also divided into three *thulas*: *Thula Meeha*, *Thula Sheeha* and *Thula Badal* after the names of the first settlers. After *thulawand* the *thulas* were subdivided in to lineage families as *dheris* known as *dheriwand*. *Dheris* were further subdivided into individual family *khatas* (fields) of unequal size on the basis of laws of inheritance, principle of equitable distribution of benefits and handicaps as per the generalized scheme of land division among multi-caste and multi-clan inhabitants of a village with the same processes as in case of sample village Dhanowali located in the upland plains. The territory of the village was brought under cultivation in different phases. The northern part of the village was selected first for settlement due to its levelled sand free land. The land near the *abadi-deh* (settlement) was brought under cultivation in the first phase. This is indicated by the small size of fields around the *abadi-deh* (settlement) as every family member wants to have share in land near the

abadi-deh due to its more economic value and the scope for construction of new house in future (Figure 3.9). The cultivated land was then extended to the east, west and south directions respectively in a phased manner. These phases are indicated by the small size of the fields reflecting their higher degree of sub-divisions due to better land types. Sand dunes covered majority of the land area of the village which is indicated by the *tibba* (sand dune) land type of 1884 field map. The village was suffering from shortage of water because of its desert character. There was absence of wells and canals in the village in the early phases. The agriculture was based on availability of water from rainfall only, which is indicated by *barani* (rain-fed) land types of fields. The amount of rainfall was also very less due to the desert character of the village. The fields were scattered in different parts of the village territory in the areas where some levelled land was available. The fields were larger in size and uneven in shape in *tibba* land types. The land types found in the earliest field map of 1884 included *tibba*, *barani*, *banjar kadim* and *banjar jadid* (Figure 3.9). The meanings of these land types have already been discussed earlier in this chapter. Many of the fields were not oriented towards the roads due to the presence of sand dunes. Micro topography and orientation of sand dunes were different in different directions, which resulted in varied orientation of fields in different parts of the village territory. Few of the fields were oriented towards the roads for easy movement of human beings and cattle in 1884 and 1910 field maps. The number of fields has increased from 326 in 1884 to 369 in 1910 due to the sub-divisions of the existing fields as a result of the increase in the number of owners from 108 in 1884 to 152 in 1910. The extra ordinary large fields of *tibba* and *barani* land types have also been divided into smaller size fields for their better management (Figure 3.12). The consolidation of land holdings in village Bath in 1960 has disrupted the historical evolution of field patterns. The majority of the fields have become uniform of 8 *kanals* in size and rectangular in shape. The numbers of very large size fields of above 8 *kanals* have declined drastically after the adoption of process of consolidation in 1960 (Figure 3.13). The sand dunes of *tibba* land types have been levelled with the help of machines, converting the village territory into a flat upland plain. *Khals* (irrigation channels) have been built in different parts of the village territory. Many of the *barani* (rain-fed) land type fields have been converted into *nahari* (canal irrigated) land type fields. Field patterns have improved in the post consolidation phase,

providing a solid foundation for the introduction of green revolution technology in the *Malwa* region of Punjab.

The earliest available 1884 *Shajra Nasab* (genealogical tree) of the village Bath reveals that Ram Singh was one of the fifth generation descendant of Nathu's family who were the first settlers of the village during the last part of the seventeenth century (Figure 3.10). Fields of Ram Singh were located in the south of the *abadi-deh* (settlement) near the village pond (Figure 3.11). Ram Singh had his fields in his own name independently. Majority of his fields were located in *tibba* land type, where sand dunes were very common. Some fields, where micro-topography was favourable, were used for *barani* (rain-fed) land type cultivation. Entire cultivated land of the village territory was dependent on rainfall in the absence of sources of irrigation. Sand dune topography was neither good for digging wells, nor for construction of canals due to limited technology and economic limitations. The amount of rainfall was also very less due to influence of desert climate. The limited rain water and waste water of the *abadi-deh* (settlement) was usually stored in the village ponds, which was used for watering the crops. Pond water might have been used by Ram Singh to irrigate his fields, as his fields were located around the pond. During 1880s Ram Singh and his only son Sundar Singh jointly owned the cultivated land in the sixth generation (Figure 3.12). In the seventh generation Sarwan Singh, Arjan Singh, Dalip Singh and Balwant Singh all four sons of Sundar Singh jointly owned 21 fields measuring 147 *kanals*-13 *merlas* in equal share as per the law of inheritance in the middle of the twentieth century in 1960s (Figure 3.13). In the eighth generation between 1960 and 1990 the land holding and fields were fragmented due to the entry of new owners from their families (Figure 3.14). Karnail Singh and Jarnail Singh, sons of Sarwan Singh jointly owned the land with their uncle Arjan Singh with total of 18 fields spread over an area of 145 *kanals*-7 *merlas*. Arjan Singh also jointly owned land with his other nephews, Gurbhagat Singh and Buta Singh sons of Dalip Singh.

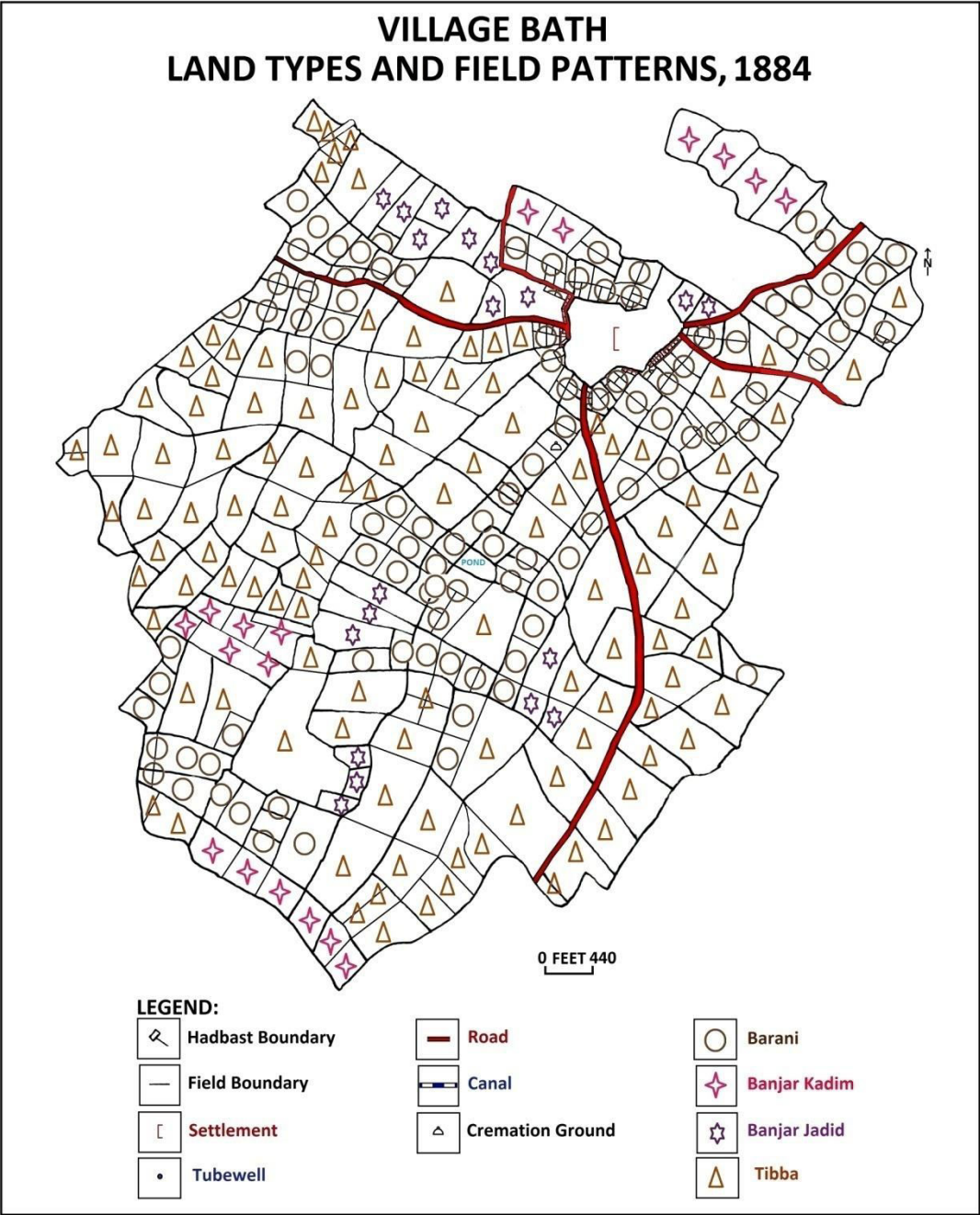
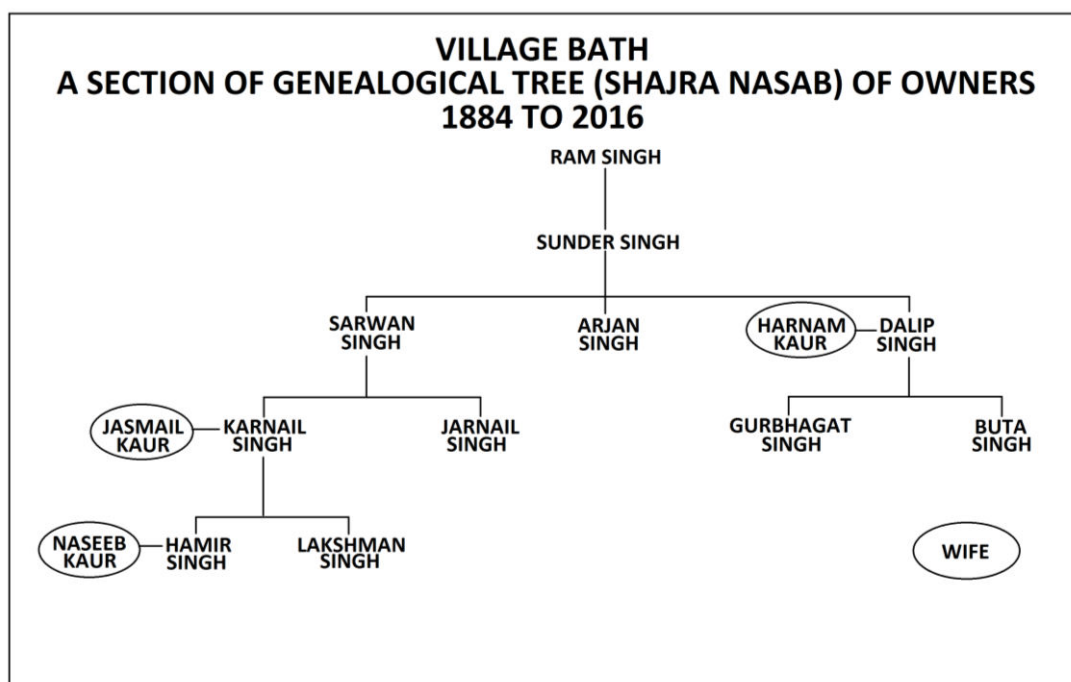


Figure 3.9



Source: *Shajra Nasab* of Village Bath-1884, 1910, 1960, 1990 and 2016.

Figure 3.10

Such types of joint ownerships between the uncles and their nephews and nieces are common in other villages of Punjab also, especially, where father and grand-father has died and share of their land was transferred equally among the sons and grand-sons as per the laws of inheritance. The wife of the deceased was also given share in the land of her husband. The joint ownerships have further increased in the present 2016 generation of Ram Singh's family (Figure 3.15). The total number of fields of this family has increased from 21 in 1960 to 35 in 2016, more due to the sub-divisions of the existing fields and partially by the fresh purchase of land. The per-capita share of land in the total holdings has decreased from 43 *kanals-3 merlas* in 1960 to 12 *kanals-2 merlas* in 2016 of Ram Singh's family. Similarly, the generation to generation evolution of field patterns is same for other families of the village and in other sample villages of Punjab.

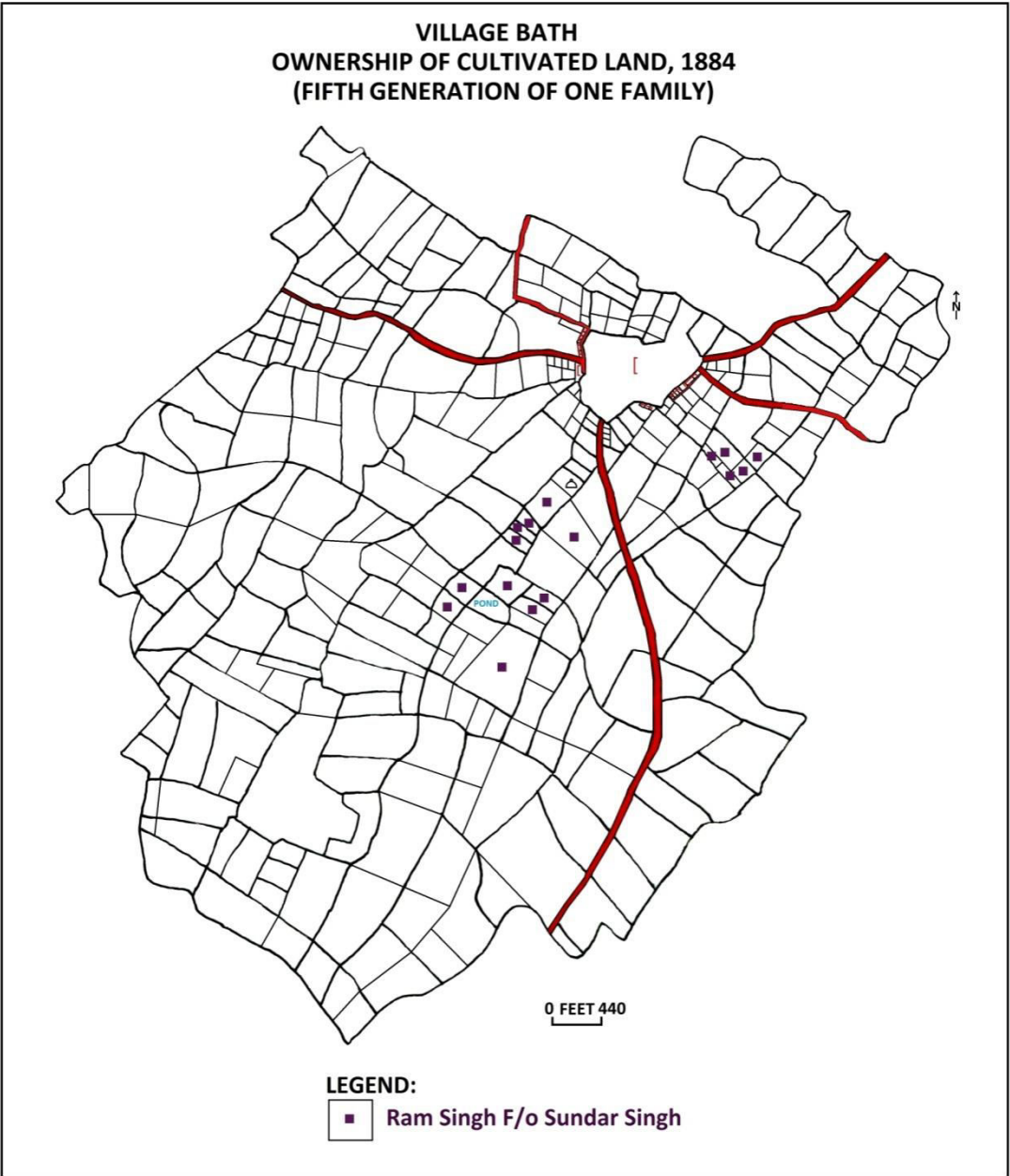


Figure 3.11

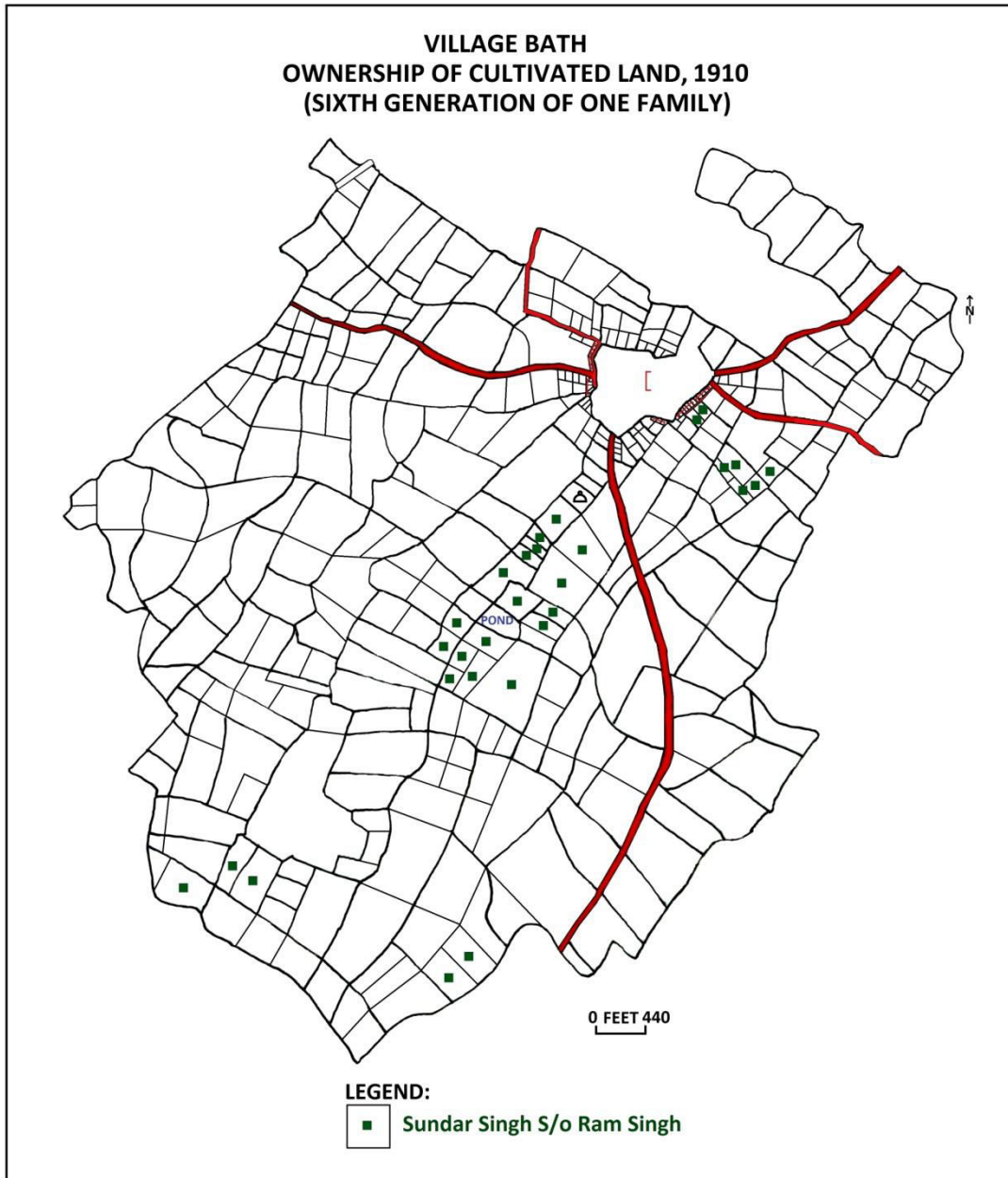
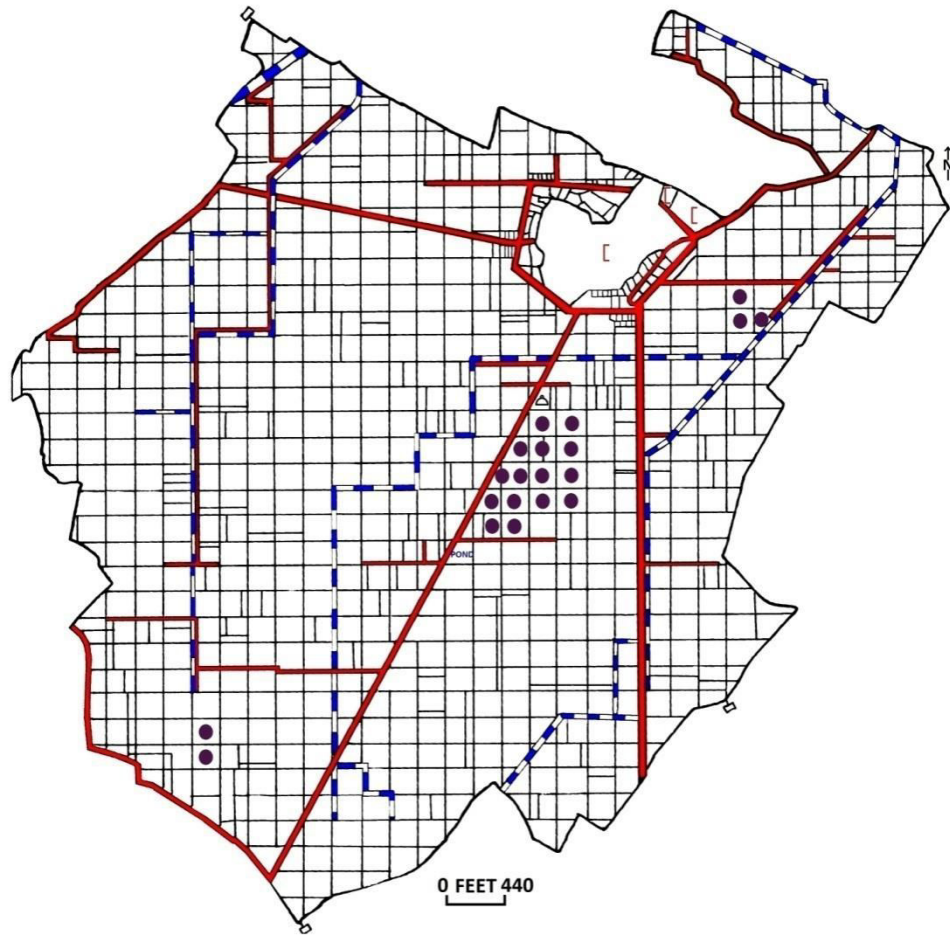


Figure 3.12

VILLAGE BATH
OWNERSHIP OF CULTIVATED LAND, 1960
(SEVENTH GENERATION OF ONE FAMILY)

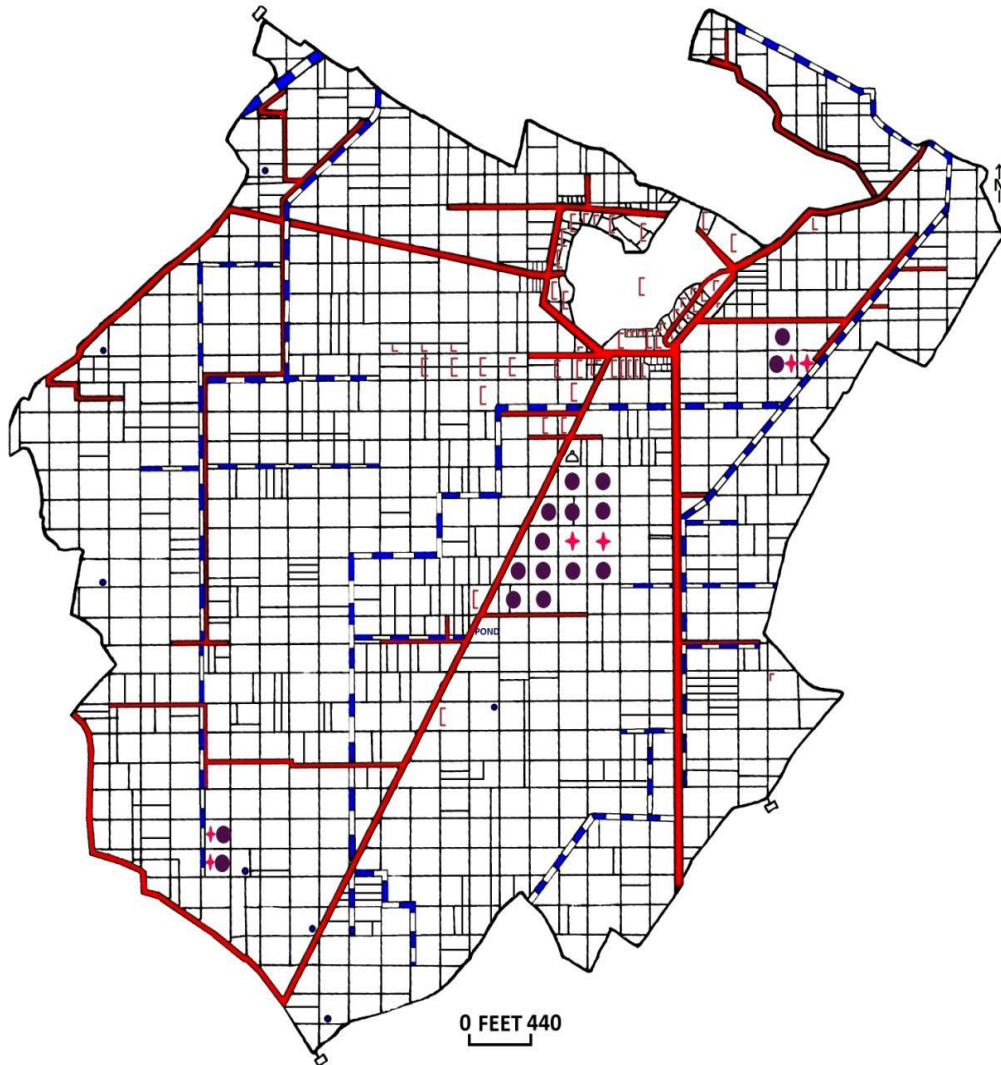


LEGEND:

- Sarwan Singh, Arjan Singh, Dalip Singh Sons of Sunder Singh

Figure 3.13

**VILLAGE BATH
OWNERSHIP OF CULTIVATED LAND, 1990
(EIGHTH GENERATION OF ONE FAMILY)**

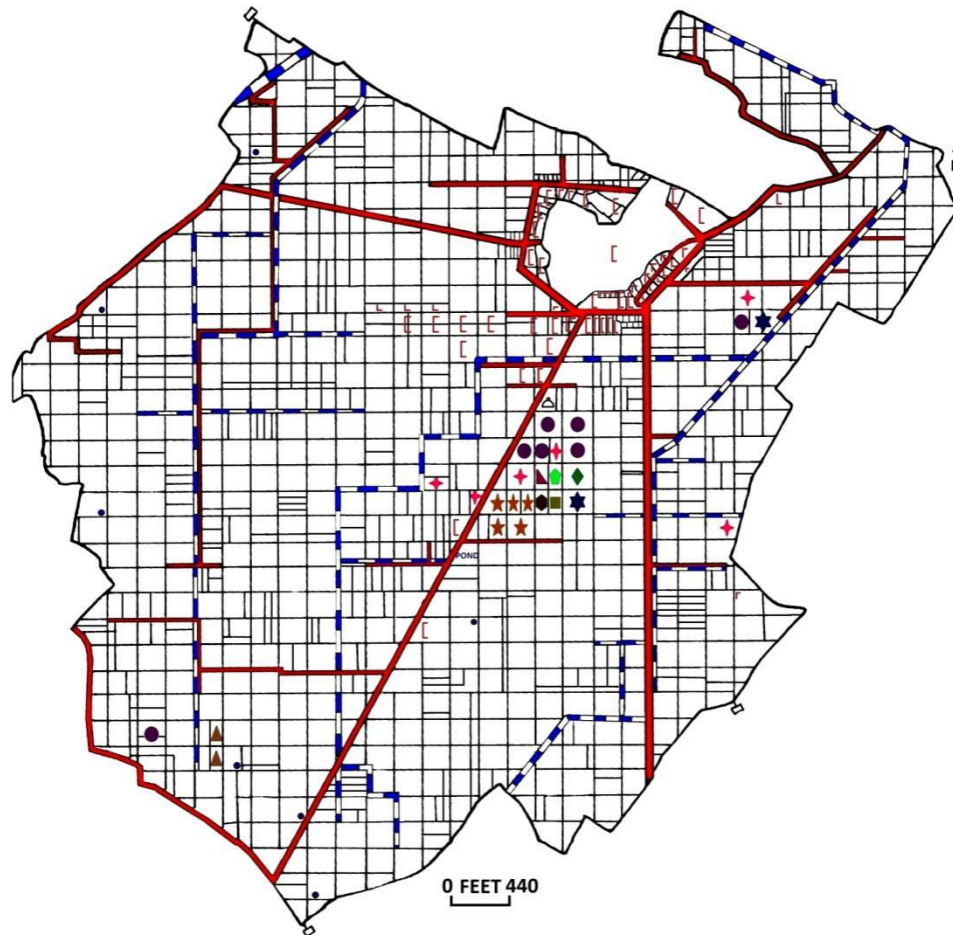


LEGEND:

- Karnail Singh, Jarnail Singh Sons of Sarwan Singh, Arjan Singh, Dalip Singh Sons of Sunder Singh
- ✦ Gurbhagat Singh, Buta Singh Sons of Dalip Singh, Arjan Singh S/o Sunder Singh

Figure 3.14

**VILLAGE BATH
OWNERSHIP OF CULTIVATED LAND, 2016
(NINTH,THE PRESENT GENERATION OF ONE FAMILY)**



LEGEND:

<ul style="list-style-type: none"> Gurbhagat Singh,Buta Singh Sons of Dalip Singh,Harnam Kaur W/o Dalip Singh + Arjan Singh S/o Sunder Singh,Karnail Singh S/o Sarwan Singh ★ Karnail Singh S/o Sarwan Singh ★ Arjan Singh S/o Sunder Singh,Gurbhagat Singh,Buta Singh Sons of Dalip Singh 	<ul style="list-style-type: none"> ▲ Karnail Singh S/o Sarwan Singh,Gurbhagat Singh,Buta Singh Sons of Dalip Singh, Harnam Kaur W/o Dalip Singh, Jasmal Kaur W/o Karnail Singh,Hamir Singh S/o Karnail Singh,Naseeb Kaur W/o Hamir Singh ■ Karnail Singh S/o Sarwan Singh,Naseeb Kaur W/o Hamir Singh,Jasmal Kaur W/o Karnail Singh,Hamir Singh S/o Karnail Singh ● Jarnail Singh S/o Sarwan Singh 	<ul style="list-style-type: none"> ▲ Jarnail Singh S/o Sarwan Singh,Jasmal Kaur W/o Karnail Singh,Hamir Singh S/o Karnail Singh,Naseeb Kaur W/o Hamir Singh ◆ Arjan Singh,Dalip Singh Sons of Sunder Singh ■ Jasmal Kaur W/o Karnail Singh,Hamir Singh S/o Karnail Singh,Naseeb Kaur W/o Hamir Singh
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Figure 3.15

Sub-divisions of existing fields have been the basic governing process in the evolution of field patterns in the sample villages of Punjab selected from different landform regions. The cultivated land is being divided equally among all the brothers and sisters in their father's property. Law of inheritance, principle of fair distribution of advantages and handicaps, principle of compensation and mutual adjustments is universally applicable in Punjab with certain regional deviations and modifications (Manku, 1986). The number of female owners is increasing due to constitutional amendment and facility of concessional registration charges offered to the female owners in Punjab.

The number of fields has increased from 326 in 1884 to 994 in 2016 (Table 3.3). A comparative study of field maps of 1884 and 1914 reveals the gradual increase in the number of fields from 326 to 369 due to the sub-divisions of the existing fields. The number of fields has jumped from 369 in 1914 to 934 in 1960.

Table 3.3

Village Bath: Number of Cultivated Fields and Owners

Year	Gap in Years	Number of Fields	Number of Owners
1884	-	326	108
1910	26	369	152
1960	50	934	461
2016	56	994	525

Source: *Jamabandi* of Village Bath-1884, 1910, 1960 and 2016.

This increase in number of fields was related more to the adoption of process of consolidation, wherein very large sized fields of above 8 *kanals* were divided into blocks of 8 *kanals* each. The sand dunes were levelled in the entire village territory and very large sized fields of *tibba* and *barani* land types were converted into blocks of 8 *kanals* for easy supply of water from the newly constructed *khals* (small water channels) taken out from a distributary of Bathinda branch of famous Sirhind Canal.

Most of the *barani* (rain-fed) and *tibba* (sand covered) land types fields were converted into *nahari* (canal irrigated) land type fields. The agricultural landscape of the village was transformed by the process of consolidation and introduction of irrigation by the construction of canals, like many other villages of Punjab. This provided a solid foundation for the introduction of Green Revolution technology in Punjab in the mid 1960s. The number of fields has further increased from 934 in 1960 to 994 in 2016, mainly due to the sub-divisions of existing fields because of increase in the number of owners from generation to generation inspite of the fact that 64 fields have been converted into *gairmumkin* (uncultivable) land uses especially near the *abadi-deh* (settlement) and roads during this period (Figure 3.15).

The per capita number of fields and size of land holdings has decreased continuously from 1884 to 2016 (Table 3.4). The per capita number of fields has decreased from 3 in 1884 to 1.89 in 2016. Similarly, per capita size of land holding has declined from 49 *kanals* in 1884 to 9 *kanals*-11 *merlas* in 2016. This has happened because of the increase in the number of owners. The number of owners has increased from 108 in 1884 to 525 in 2016. Field survey reveals that the per capita number of fields and the size of land holdings are declining continuously due to increase in the number of owners resulting in the continuous sub-divisions of existing fields. Thus, the field patterns in village Bath like other villages of Punjab are experiencing change, soon after they have been created. The most important characteristic in the evolution of field patterns in the village Bath, like other villages have been the operating process of sub-divisions of existing fields, among the descendants of each family from generation to generation, resulting in the increase in the number of fields, but simultaneous reduction in the size of fields and land holdings.

Table 3.4

Village Bath: Per Capita Number of Fields and Size of Land Holdings

Year	Per Capita Number of Fields	Per Capita Size of Land Holdings (<i>Kanals-Merlas</i>)
1884	3.0	49-00
1910	2.42	34-15
1960	2.0	11-07
2016	1.89	09-11

Source: *Jamabandi* of Village Bath-1884, 1910, 1960 and 2016.

**3. EVOLUTION OF FIELD PATTERNS IN PIEDMONT PLAINS
(VILLAGE PATHAN CHAK)**

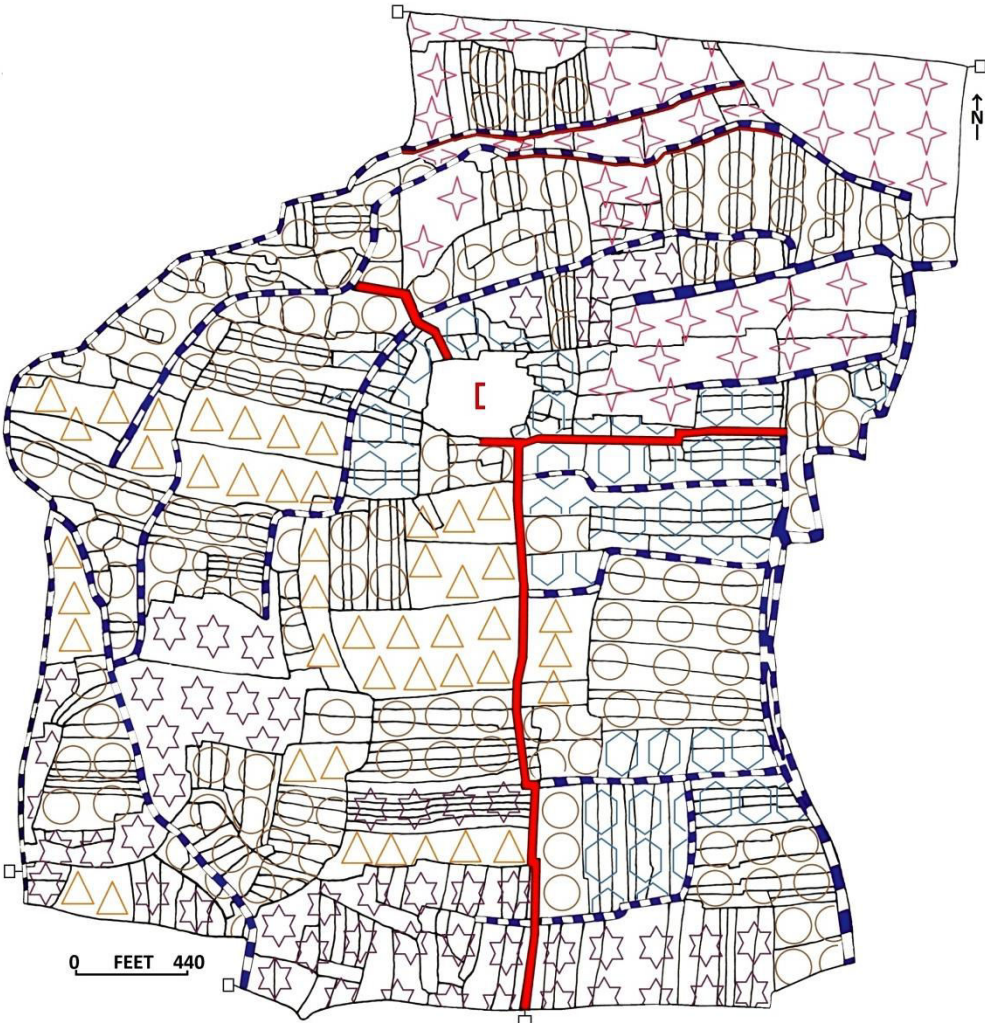
Village Pathan Chak has been selected from piedmont (foothill/*kandi*) plains from the Punjab *Kandi* (an edge) region. Piedmont plains are situated in the north eastern border of Punjab covering parts of Pathankot, Hoshiarpur, S B S Nagar, Rupnagar and S A S Nagar districts of Punjab. This is a long and narrow undulating *choes* (small seasonal streams) infested and dissected foothill plains landform region which is higher than the neighbouring upland plains. The village Pathan Chak has been named after the *Pathan* community people who once lived and later abandoned it in distant past. The earliest field map of Pathan Chak (1890) reveals that the village was infested by the *choes* in different directions with many land types such as *barani*, *banjar kadim*, *banjar jadid*, *tibba* and *nahari* (Figure 3.16). According to genealogical tree (*vanshavali/kursinama*), the village Pathan Chak in the beginning was first owned by people belonging to *Bhanguri* clan of *Saini* caste (Figure 3.17). The village territory was first divided into two *tarafs*: the *chardi taraf* (Sunrise side) and the *lehndi taraf* (Sunset side). The *chardi taraf* land was fertile and was occupied first by the *Sainis*. They divided the *chardi taraf* village territory into three *Pattis* and named them after their elders: *Patti Kolan*, *Patti Mehar Singh* and *Patti Bhag Singh*. The land was abundant and families were small. Therefore, people of other clans of their own caste and other castes such as *Jat Bhullar* families, who came here from Vachhoya village of Ajnala from Amritsar district, were offered land in the less productive unoccupied *banjar* (barren) and *be-abad* (uninhabited) lands in the *lehndi*

taraf for safety and better socio-economic organisation. The land during this phase was abundant and each family occupied as much land as it could possess. Who got how much and where, is not known because of non-availability of data and maps for that period. The village territory belonged to all these early settling families. It is also amongst the *bhaichara* (joint) villages and clan families from the very beginning lived under their elders in groups of equal rights (Baden, 1892). They acquired the village territory by removing and clearing the trees and *kharkana* (wild bushes) and levelled the uneven *tibbas* formed of sand brought by the *choes* traversing from the Shiwalik hills. The boundaries of the village were largely marked by *choes* in the north, east and west directions. The village boundaries in terms of law and administrative purposes were defined by the Britishers in 1849, after conducting actual field surveys. The village territory has not changed since then. The earlier agriculture landscape was characterised by poorly defined irregular fields with *barani* (rain-fed) cultivation.

The earlier settlers divided the land of village *tarafs* and *pattis* into *thulas* called *thulawand*. Each clan was allotted land in the form of *thula* on the basis of possession rights. The *thula* land was divided among the heirs in the form of *dheris* known as *dheriwand* according to the principle of equitable distribution of benefits and handicaps and the *dheris* were ultimately divided into individual nuclear family *khatas* known as *khatawand* on the basis of laws of inheritance when the possession rights were firmly established by the Britishers in 1884 (Gazetteer, 2001). This division of land in *pattis/tarafs*, *thulas*, *dheris* and *khatas* is clearly visible in the field maps through the distribution of land holdings belonging to different clans of *Saini* caste and other castes who were offered land in the village by the first settlers.

The entire territory of the village was not brought under cultivation simultaneously. The land near the *abadi-deh* (settlement) and the *choes* (small seasonal streams) with convenient water levels was brought under cultivation in the first phase.

VILLAGE PATHAN CHAK LAND TYPES AND FIELD PATTERNS, 1890



LEGEND:









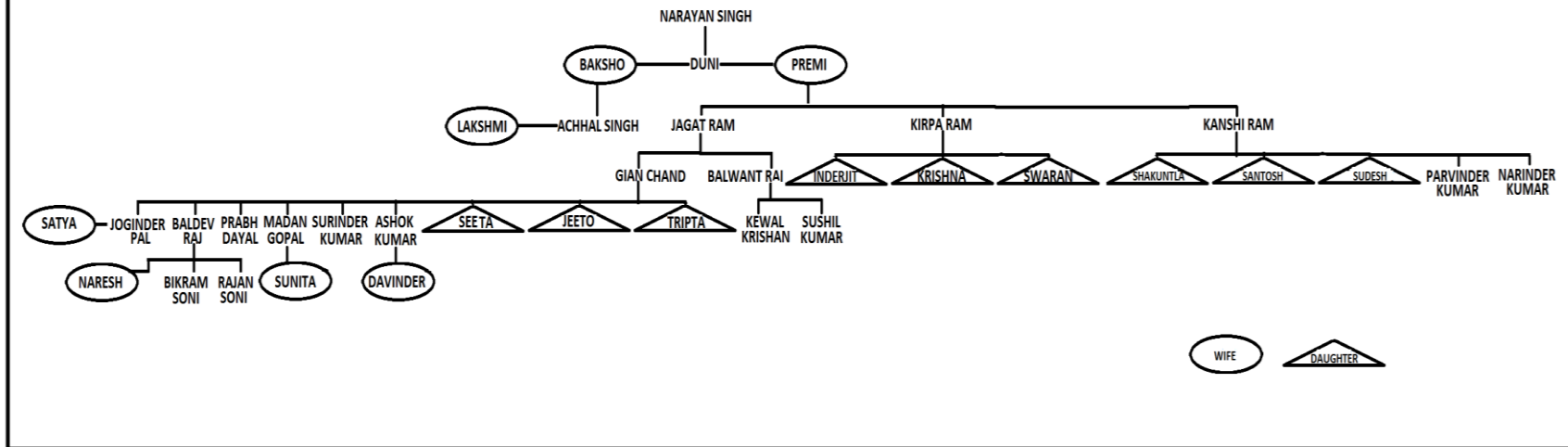
 Hadbast Boundary	 Choe/Naala	 Nahari
 Field Boundary	 Tibba	 Banjar Kadim
 Settlement	 Barani	 Banjar Jadid
 Road		

Figure 3.16

VILLAGE PATHAN CHAK A SECTION OF GENEALOGICAL TREE (SHAJRA NASAB) OF OWNERS 1890 TO 2016



Source: *Shajra Nasab* of Village Pathan Chak-1890, 1910, 1960 and 2016.

Figure 3.17

Cultivated land was then extended towards south east and towards west in the last phase. These phases are indicated by the land types, availability of water for irrigation and smaller size of the fields reflecting higher degree of their sub-divisions. The fields were large in size, where land types were poor and irrigation facilities were not available. Shape of majority of the fields in 1890 and 1910 field maps were elongated rectangles and accentuated strips, to have access to water of *choes*, *khals* and *kuhals* (man-made water channels) for irrigation and also because of micro-topography of the village. The fields were of such size and shape due to the ancient notion that the field should be of such a size and shape that one plough team of farmer's family would plough the field in one day. This was essentially related to the use of the wooden ard plough suited to a long furrow, so that there would be no wastage of time in turning the plough too frequently (Mukerji, 1961). Many of the theoretical models (Figure 3.3) are found validated in the evolution of field patterns in Pathan Chak village too. The *choes*, roads and local micro topography have played effective role in the orientation of long-side extension of the field rectangles and strips. It is evident from the study of field maps of village Pathan Chak of 1890 and 1910 that alignment of fields varied in different parts of the village (Figures 3.18 and 3.19). Many elongated rectangular and strip fields are oriented towards *choes*, *khals* and *kuhals* to have accessibility to water for irrigation. Some elongated rectangular strip fields are also oriented towards the village roads for easy movement of human beings and cattle. The consolidation of land holdings has disrupted the historical evolution of fields in 1960s in the study village (Figure 3.20). The irregularities of the field landscape have disappeared. The fields have become rectangular and uniform in size and shape. The subsequent evolution of field patterns involved only an increase in the number of fields due to continuous sub-divisions of the existing fields (Figure 3.21).

As per the earliest available records, during mid eighteenth century, Narayan Singh was one of the fourth generation descendants of land owner of *Saini Bhanguri* clan, who settled in the study village in the beginning. He and his son had fields distributed in all parts of the village. Most of the fields had accessibility to *choes*, *khals* and *kuhals* for irrigation. Duni was the only son of Narayan Singh, in the fifth generation. Both Narayan Singh and his son Duni had 116 fields occupying more than 600 *kanals* in individual, as well as joint names (Figure 3.18). Most of the fields at that stage belonged to *barani*,

banjar kadim and banjar jadid land types. The water level in the *choes* and *khals* would have been very low resulting into poor land types at this stage. Duni had two wives: Baksho and Premi. Acchal Singh was the only son of Baksho who was married to Laxmi. He died heirless and no land was transferred in his name by Duni. Premi, who was the second wife of Duni, gave birth to three sons: Jagat Ram, Kirpa Ram and Kanshi Ram during sixth generation (Figure 3.19). Jagat Ram the eldest son of Duni got more share of land and fields than his two younger brothers. Jagat Ram got 259 *kanals-1 merla* area of land, whereas Kirpa Ram got 164 *kanals-12 merlas* and Kanshi Ram received 153 *kanals-7 merlas* of land. A discussion with the present descendants of this family revealed that the share of land in the name of Jagat Ram was more, because Baksho transferred her share in his name after the death of her only son Acchal Singh and daughter-in-law Lakshmi, during her lifetime. Otherwise, the land was divided equally among all the three sons due to operation of law of inheritance and minor differences in area occupied by each son was due to operation of principle of compensation with regard to quality of land. In the seventh generation, Jagat Ram divided his land equally between his two sons, Gian Chand and Balwant Rai (Figure 3.20). Gian Chand got 133 *kanals-3 merlas* of land out of which 65 *kanals-6 merlas* (about 50 per cent) land was *nahari* (land irrigated from *choes*, *khals* and *kuhals*) and 66 *kanals-13 merlas barani* (rain-fed) and remaining 1 *kanal-4 merlas* land was under *gairmumkin* (uncultivable). Balwant Rai got 125 *kanals-18 merlas* land out of which 73 *kanals-14 merlas* land (about 58 per cent) was *nahari* (canal irrigated) and 50 *kanals-11 merlas* land was *barani* (rain-fed). He got lesser amount of land than Gian Chand because proportion of *nahari* (canal irrigated) land with more economic value was given more to him than Gian Chand as per the principle of compensation and mutual adjustments. Kirpa Ram divided his share of land equally among his three daughters-Inderjit, Krishna Devi and Swaran Devi. Kanshi Ram transferred his land to his only son, Om Prakash and his daughter-in-law Sheela, wife of Om Prakash in their joint names. In the eighth and the present ninth generation of Narayan Singh family, the fields and land holdings are further sub-divided (Figure 3.21). Gian Chand divided his land equally among his six sons: Joginder Pal, Baldev Raj, Prabh Dayal, Madan Gopal, Surinder Kumar and Ashok Kumar; and three daughters: Sheela Devi, Jeeto Devi and Tripta Devi. All the sons and daughters are holding land jointly

either with their father, brothers or uncles or sons of their uncles or with their mothers as per the latest *Jamabandi* of 2016 of Pathan Chak village. But all of them occupy their share separately as per mutual adjustments within the family and this fact is revealed in the *Gardavari* (crop harvest book of the village). It is interesting to note that daughters and sisters have sold their share of land to their brothers or to the sons of their brothers. Sheela Devi, daughter of Gian Chand, son of Bhagat Ram, sold her share of 14 *kanals*-10 *merlas* land to her brother Surinder Kumar and to Rajan Saini and Bikram Saini, sons of her brother Baldev Raj. Similarly, Jeeto Devi daughter of Gian Chand son of Bhagat Ram sold her 14 *kanals*-2 *merlas* share of land to Sunita Devi, wife of her brother Madan Gopal and to her other sister-in-law, Davinder kumari, wife of her brother Ashok Kumar. A discussion with the present family members reveal that although law allows equal share for daughters in their father's property, yet daughters even today prefer to give their share to their brothers or other family members of their brothers as per the traditional social practice in the study area. Similarly, the generation to generation evolution of field pattern is almost same, for other families of the village with sub-divisions as the basic governing process. The principles, which were discovered earlier with certain deviations and modifications, continue to operate in the present times. The cultivated land is being equally divided among the descendants of the families with fair distribution of advantages and handicaps, the principles of mutual adjustments and laws of inheritance with universal acceptance. The number of female owners in the form of daughter and wife is increasing due to constitutional amendment and concessional registration charges offers given to females by the Government of Punjab.

VILLAGE PATHAN CHAK
OWNERSHIP OF CULTIVATED LAND, 1890
(FOURTH AND FIFTH GENERATION OF ONE FAMILY)



LEGEND: NAME OF OWNERS

- Narayan Singh
- Duni
- ▲ Narayan Singh and his son Duni

Figure 3.18

VILLAGE PATHAN CHAK
OWNERSHIP OF CULTIVATED LAND, 1910
(SIXTH GENERATION OF ONE FAMILY)

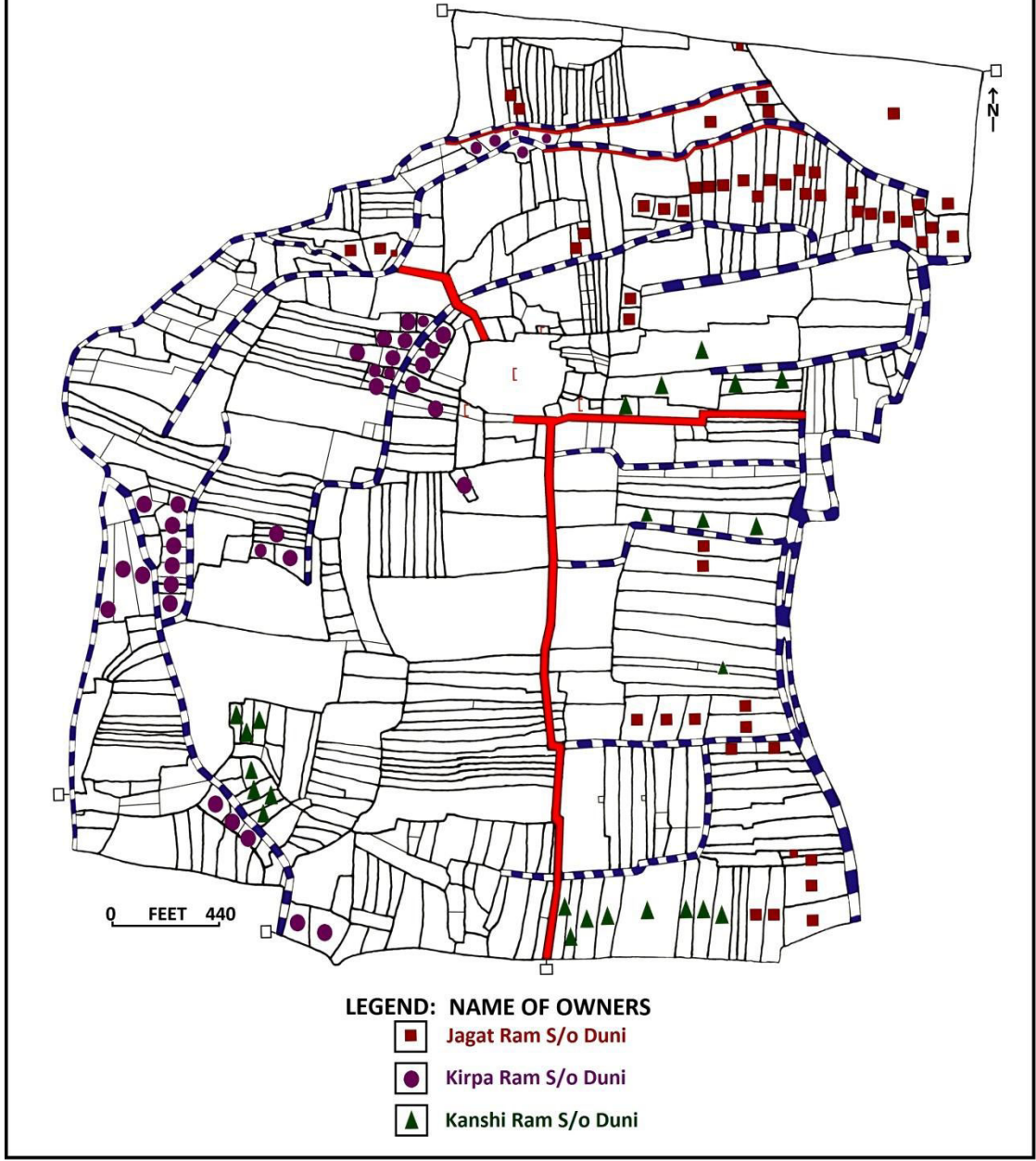


Figure 3.19

VILLAGE PATHAN CHAK
 OWNERSHIP OF CULTIVATED LAND, 1960
 (SEVENTH GENERATION OF ONE FAMILY)

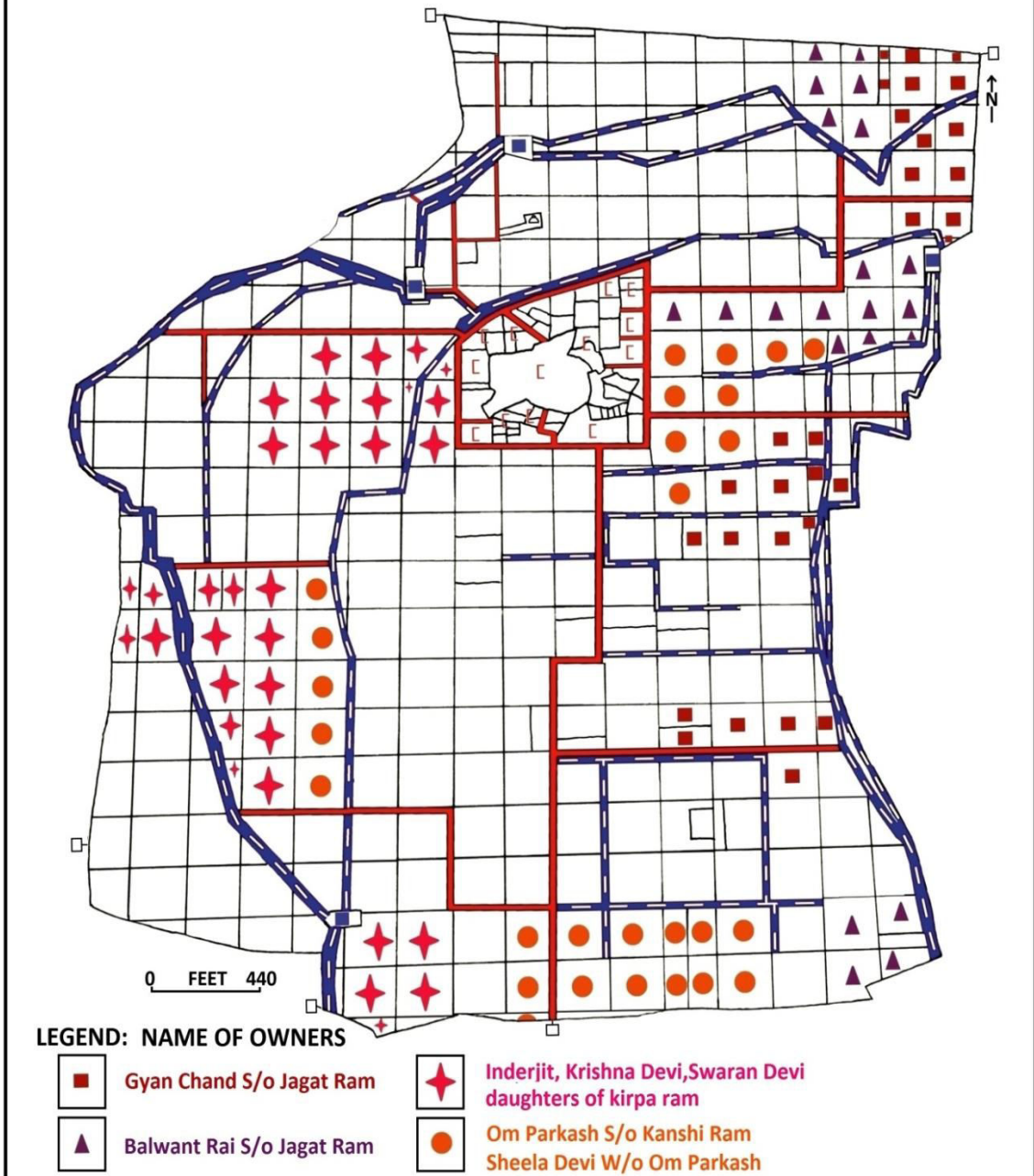


Figure 3.20

**VILLAGE PATHAN CHAK
 OWNERSHIP OF CULTIVATED LAND, 2016
 (EIGHTH AND PRESENT GENERATION OF ONE FAMILY)**

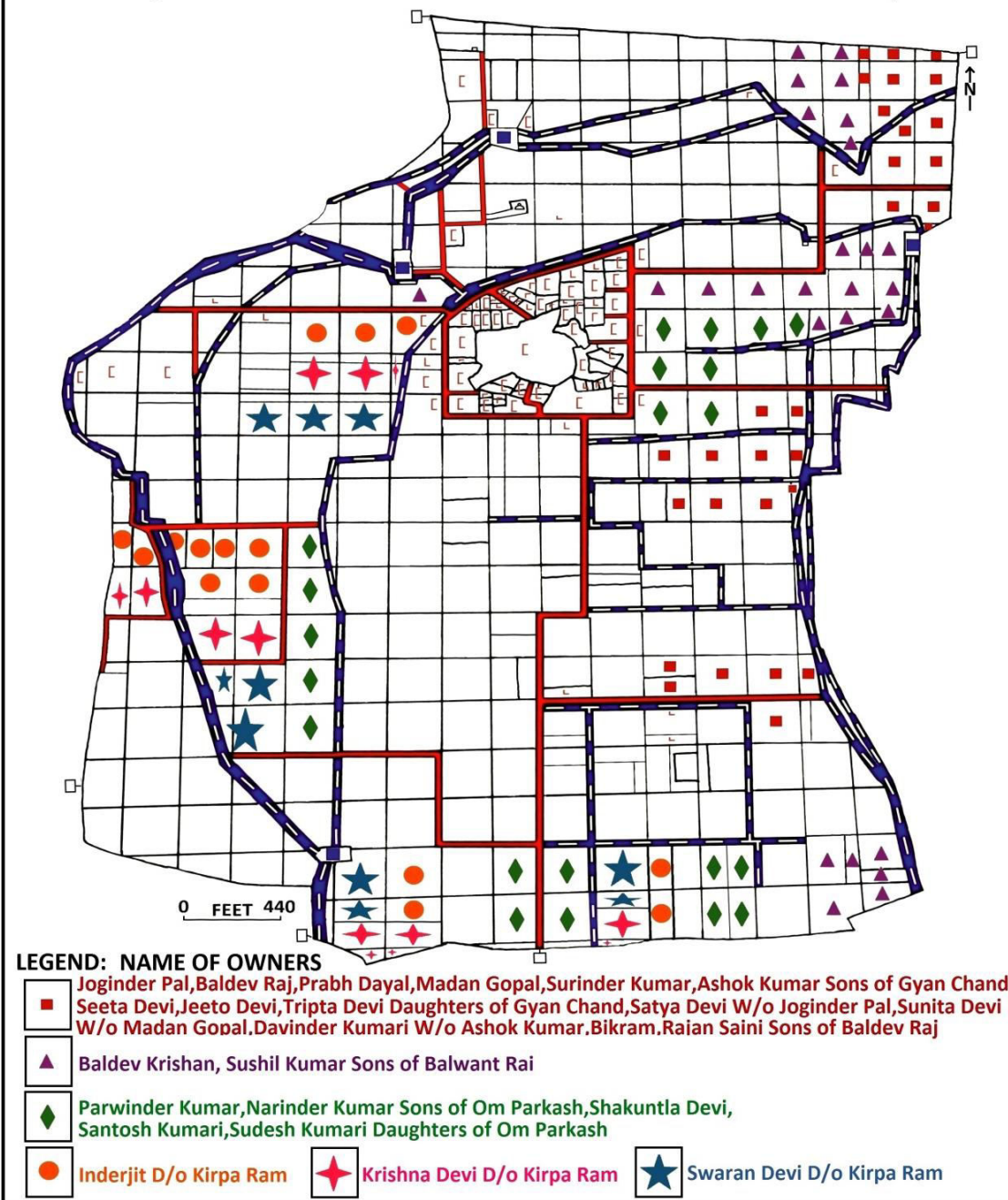


Figure 3.21

A comparative study of field maps of Pathan Chak of 1890, 1910, 1960 and 2016 reveals the gradual increase in the number of land owners. The number of land owners has doubled from 104 in 1890 to 210 in 2016. The number of fields has increased from 421 in 1890 to 471 in 2016 (Table 3.5).

Table 3.5
Village Pathan Chak: Number of Cultivated Fields and Owners

Year	Gap in Years	Number of Fields	Number of Owners
1890	-	421	104
1910	20	477	121
1960	50	430	167
2016	56	471	210

Source: *Jamabandi* of Village Pathan Chak-1890, 1910, 1960 and 2016.

This increase was related to the sub-divisions of existing fields due to increase in the number of owners and by the process of consolidation, where extra ordinary large fields were divided into blocks of 8 *kanals* each. The large fields are sub-divided into smaller fields due to local micro topography and easy water supply from the *khals* and *kuhals* to the fields. The cultivated land has increased in the village due to conversion of *tibba* (uneven sandy tracks) and other waste lands into cultivation but the total area of the village territory has remained same from 1890 to 2016. There is also little impact of encroachments on the fields by other *gairmumkin* (uncultivable) land uses in Pathan Chak in comparison to Dhanowali village of Jalandhar because of less urbanisation levels.

The per capita number of fields and the size of land holdings have reduced between 1890 and 2016. The per capita number of fields is reduced from four in 1890 to little above two in 2016. The per capita size of land holding has reduced from 21 *kanals*-4 *merlas* to 10 *kanals* between 1890 and 2016 due to increase in the number of owners (Table 3.6). The most important characteristic in the evolution of field patterns has been the operation of sub-divisions of existing fields among the descendants of each family in all the generations like village Dhanowali and village Bath.

Table 3.6

Village Pathan Chak: Per Capita Number of Fields and Size of Land Holdings

Year	Per Capita Number of Fields	Per Capita Size of Land Holdings (<i>Kanals-Merlas</i>)
1890	4.04	21-04
1910	3.94	17-08
1960	2.57	11-94
2016	2.24	10-00

Source: *Jamabandi* of Village Pathan Chak-1890, 1910, 1960 and 2016.

4. EVOLUTION OF FIELD PATTERNS IN FLOOD PLAINS

(VILLAGE KHERA BAGH)

Flood plains locally known as *bet* plains are found along the rivers of Punjab in the shape of long and narrow ribbons. Village Khera Bagh has been selected from the flood plains along the *Doon* area of river Sutlej situated in Nangal tehsil of Rupnagar district. The village is a flood plain *Doon* village surrounded by mountains in the neighbourhood. The river Sutlej flows along the eastern and south-eastern side of the village. The village experiences alluviation as well as eluviation during active floods, resulting into change in the total area of the village. For instance, total area of the village has been reduced from 993 *kanals-6 merlas* in 2007 to 993 *kanals* in 2016 due to the process of eluviation or erosion by flood water of river Sutlej. Though, some tube-wells have been dug in the village yet *barani* (rain-fed) cultivation is common in majority of the fields, because of good amount of rainfall, well distributed throughout the year. The major land types found in the earliest available field map of 1884 were *barani*, *banjar jadid* and *banjar kadim* (Figure 3.22). The village prior to the construction of Bhakra dam, used to experience frequent floods. The north-western side of the village territory, situated away from the river Sutlej was selected for construction of houses as *abadi-deh* (settlement). The uplands, free from floods near the *abadi-deh* (settlement) were the first to be brought under agriculture and the land along the river Sutlej in the eastern and south-eastern parts

of the village territory was rarely used for agriculture because of occurrence of frequent floods and water-logging conditions. Fields in such area have *banjar kadim* land types because these fields were abandoned frequently. Such *banjar kadim* land type fields are found in large number in all the 1884, 1914, 1986 and 2016 field maps. The size of *banjar kadim* fields is also larger than the *barani* land type fields in the field maps pertaining to all these years. The field maps belonging to 1884, 1914, 1986 and 2016 reveal that many of the fields have east-west orientation arranged at right angle to the river Sutlej to protect the major part of such fields from damage by the floods. Majority of the fields in all the field maps belonging to different periods are irregular in shape, due to the uneven micro topography. There is no single or main settlement situated at one place. Settlements in the form of small dwellings are found scattered in different parts of the village territory, wherever, some levelled upland mounds were available surrounded by the land free from floods. The village territory has not been divided into *tarafs* or *pattis*. The main settlement is situated farthest from the river Satluj in the north-western corner of the village territory near *Thakur Dwara* temple and the small settlements were found scattered in different parts of village territory depending upon the availability of suitable lands, both for making houses and agricultural fields. The village Khera Bagh was a part of Bangarh Estate before independence. The history of the village as written on the wall of *Thakur Dwara* temple, states that the king gave the land to the priest of *Thakur Dwara* temple in the beginning, who invited people of all castes to settle here and converted this land into a garden of fruit trees and thus, the name *Khera* (human settlement) *Bagh* (garden) was given to the village.

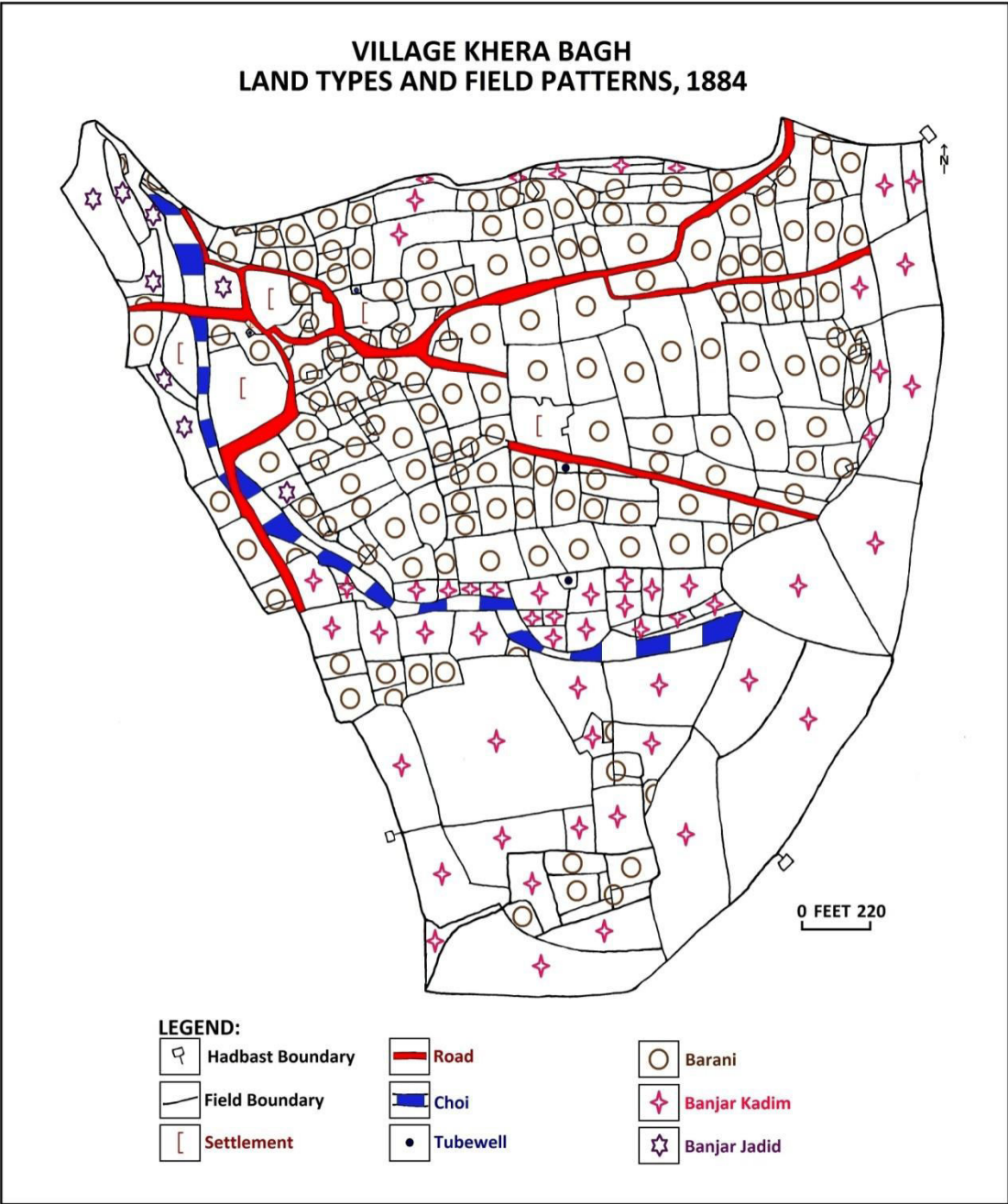
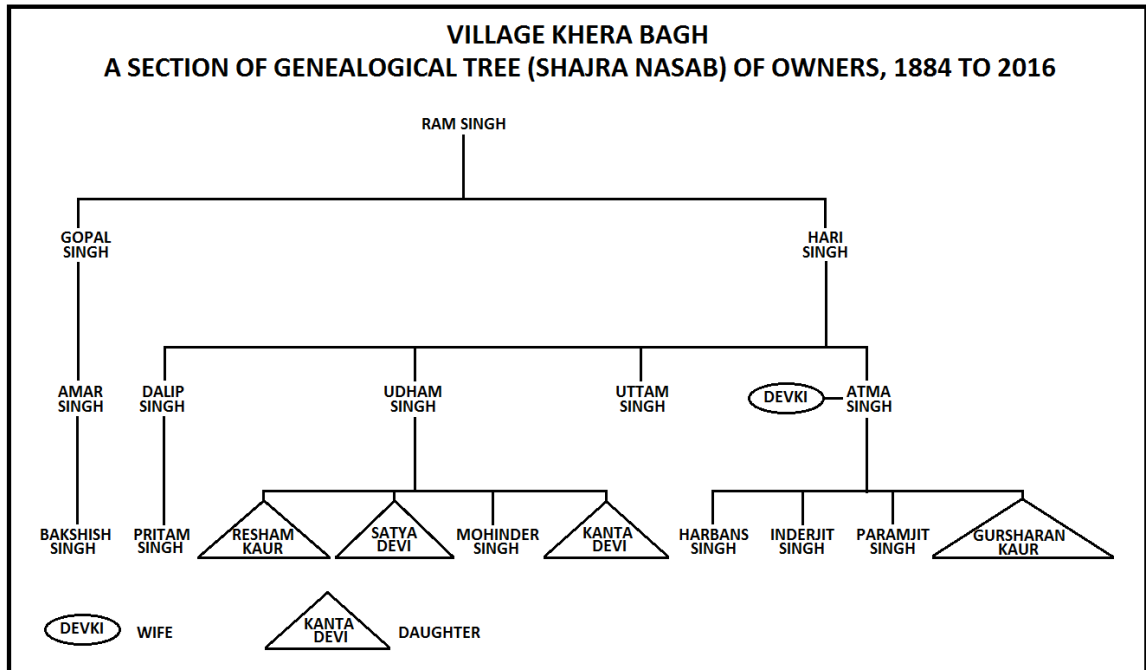


Figure 3.22



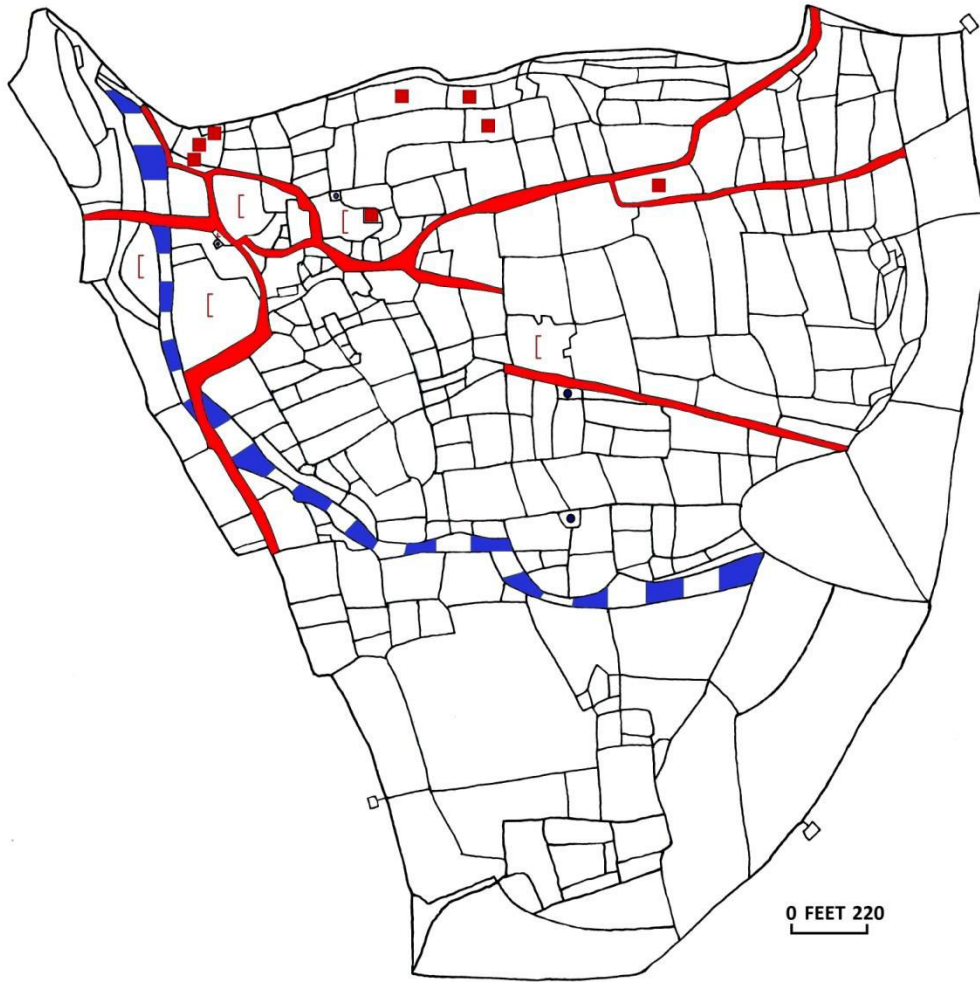
Source: *Shajra Nasab* of Village Khera Bagh-1884, 1914, 1986 and 2016.

Figure 3.23

Many of the agricultural fields are owned by the management of the *Thakur Dwara* temple even today. The village is inhabited by multi-castes and clans people like other *bhaichara* villages of Punjab. The earliest available *Shajra Nasab* records of the village Khera Bagh reveals that Ram Singh who belonged to *Lohar* (ironsmith) caste was one of the oldest fifth generation inhabitant of the village (Figure 3.23). All of his fields were distributed in the northern side of the village near the *abadi-deh* (settlement) in the *barani* land types (Figure 3.24).

Ram Singh divided his fields equally among his two sons Hari Singh and Gopal Singh in the sixth generation (Figure 3.25). During the sixth and seventh generations Hari Singh and Gopal Singh owned the fields independently as well as jointly with their sons (Figure 3.26). The number of joint ownerships has increased further in the present eighth generation of Ram Singh's family (Figure 3.27). All the members owned equal share of land as per the laws of inheritance except Mohinder Singh, who got the share of his uncle

**VILLAGE KHERA BAGH
OWNERSHIP OF CULTIVATED LAND, 1884
(FIFTH GENERATION OF ONE FAMILY)**



 **RAM SINGH F/O GOPAL SINGH AND HARI SINGH**

Figure 3.24

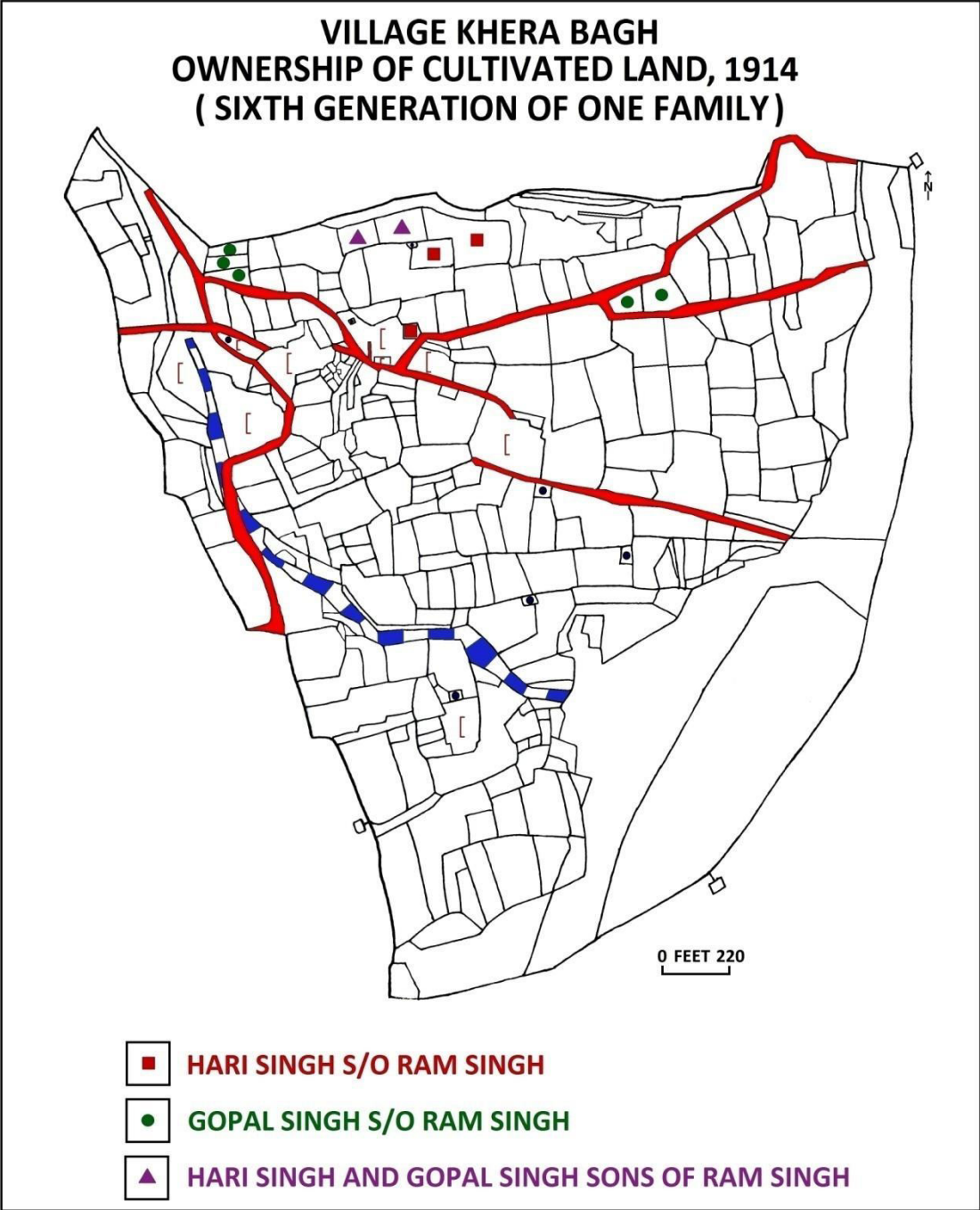


Figure 3.25

**VILLAGE KHERA BAGH
OWNERSHIP OF CULTIVATED LAND, 1986
(SIXTH AND SEVENTH GENERATION OF ONE FAMILY)**

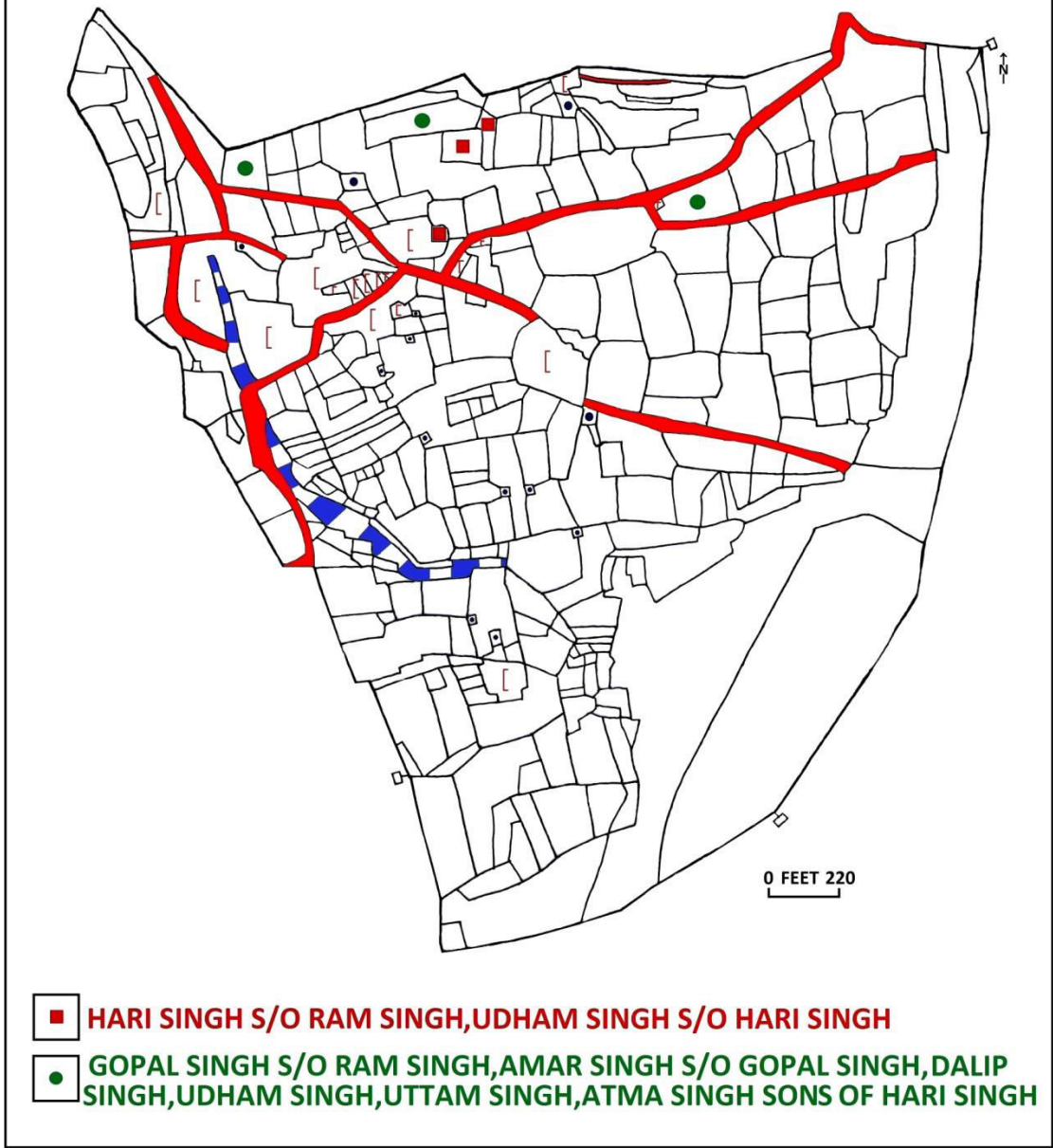
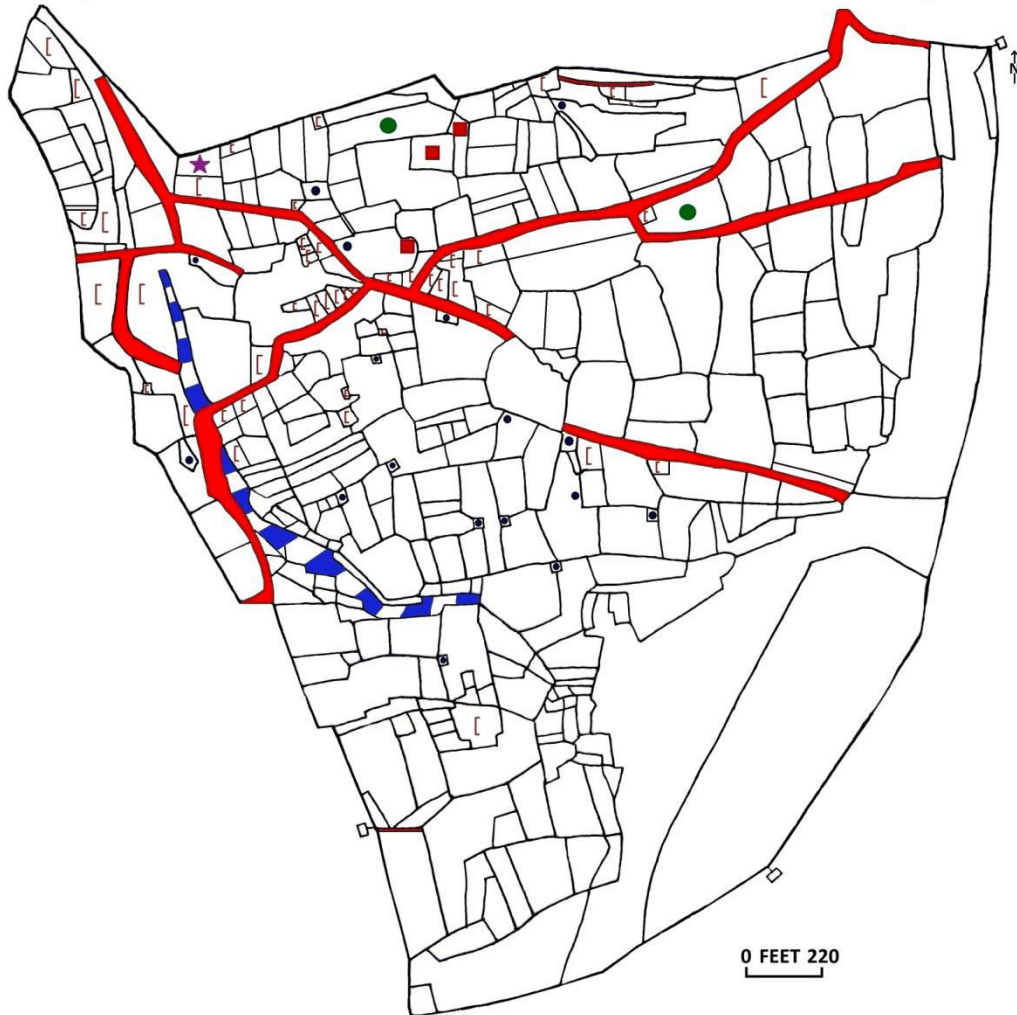


Figure 3.26

**VILLAGE KHERA BAGH
OWNERSHIP OF CULTIVATED LAND, 2016
(PRESENT, EIGHTH GENERATION OF ONE FAMILY)**



- MOHINDER SINGH S/O UDHAM SINGH
- BAKSHISH SINGH S/O AMAR SINGH, MOHINDER SINGH S/O UDHAM SINGH, HARBANS SINGH, INDERJIT SINGH, PARAMJIT SINGH SONS OF ATMA SINGH, GURSHARAN KAUR D/O ATMA SINGH
- HARBANS SINGH, INDERJIT SINGH, PARAMJIT SINGH SONS OF ATMA SINGH, GURSHARAN KAUR D/O ATMA SINGH, DEVKI W/O ATMA SINGH, MOHINDER SINGH S/O UDHAM SINGH, BAKSHISH SINGH S/O AMAR SINGH

Figure 3.27

Uttam Singh, as the later died unmarried. Mohinder Singh was given this extra share as he is the single brother of three sisters Resham Kaur, Satya Devi and Kanta Devi to bear the expenses of their marriage. This type of favour to a particular member of the family is common in other parts of Punjab, to compensate financial obligations. It is interesting to note that an outside member also share land jointly in Pritam Singh's property. A discussion with the present family members revealed that Pritam Singh, who was the only son of Dalip Singh, had no son or daughter. His wife Shakuntla Devi's nephew Raman Kumar was adopted as a son and therefore, his name was included in the ownership papers. The ownership rights are otherwise, restricted to the blood related members belonging to the genealogical tree of the respective families in the village. The per-capita number of fields and the size of land holdings are also decreasing in Khera Bagh from generation to generation (Tables 3.7 and 3.8). The number of fields has increased from 278 in 1884 to 302 in 2016 but the numbers of owners have increased from 47 to 105 during the same period of time. The number of fields has not increased in the same proportion, because many of the fields are jointly owned which is also evident in the ownership maps of this study village. The size of the fields is also declining due to their sub-divisions. The females are also allowed share of land in their father's or husband's property. The agricultural landscape has remained more or less the same from 1884 to 2016 partly due to the joint ownerships and due to the non-adoption of process of consolidation in the village due to physiographic limitations (Gazetteer, 2001).

Table 3.7

Village Khera Bagh: Number of Fields and Owners

Year	Gap in Years	Number of Fields	Number of Owners
1884	-	278	47
1914	30	267	63
1986	72	283	89
2016	30	302	105

Source: *Jamabandi* of Village Khera Bagh-1884, 1914, 1986 and 2016.

Table 3.8

Village Khera Bagh: Per Capita Number of Fields and Size of Land Holdings

Year	Per Capita Number of Fields	Per Capita Size of Land Holdings (<i>Kanals-Merlas</i>)
1884	5.91	20-11
1914	4.23	14-13
1986	3.18	08-16
2016	2.87	08-12

Source: *Jamabandi* of Village Khera Bagh-1884, 1914, 1986 and 2016.

5. EVOLUTION OF FIELD PATTERNS IN SHIWALIK HILLS (VILLAGE ROHG TEEKA KHAKHOH)

Village Rohg Teeka Khakhoh has been selected from the *Shiwalik* hills region of Punjab. The village is situated in the extreme northern Dhar Kalan tehsil in Pathankot district at an altitude of more than 600 metres.

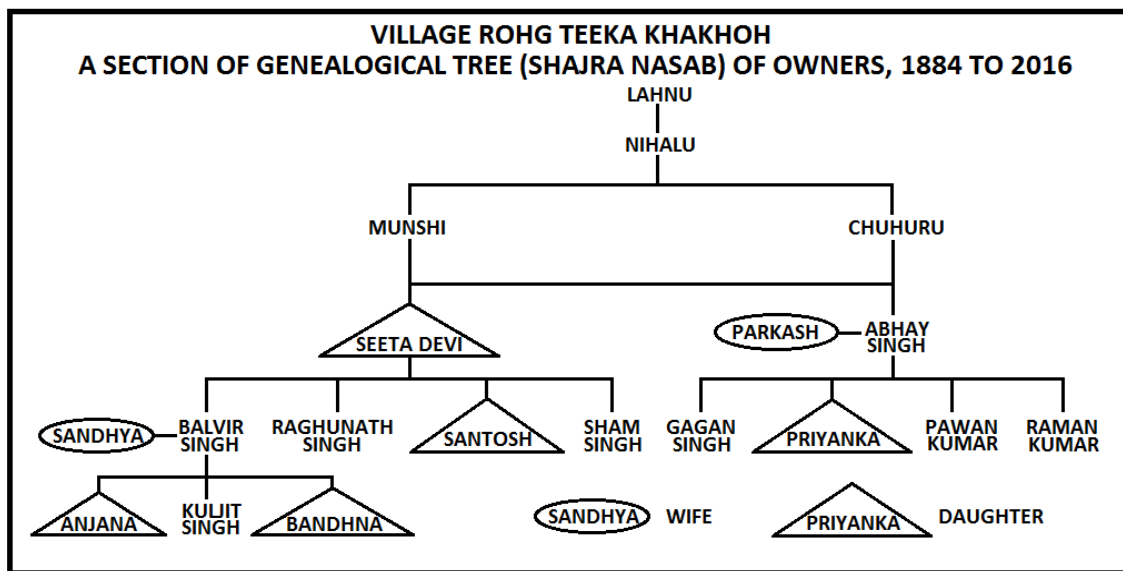
The earliest available 1884 field map of the village Rohg Teeka Khakhoh is comprised of several types of land types which includes *barani awal*, *barani daum*, *barani saum*, *banjar jadid* and *banjar kadim* (Figure 3.28). The major portion of the village territory in the south is covered with *pahar* (hills) with thick cover of *vans* (jungles). The *abadi-deh* (settlement) is situated in the form of a small hamlet near the cultivated land in the north-central part of the village. The *abadi-deh* (settlement) has been developed on the inferior quality levelled land which is indicated by the distribution of *barani daum* land type fields in the north, west and east directions and *barani saum* in the south-east directions of the settlement to save the precious levelled land for cultivation situated away from the *abadi-deh* (settlement). The most important land type, *barani awal* fields are found across the *abadi-deh* (settlement) adjacent to the main road. This *awal* land type area was brought under cultivation in the first phase of settlement due to its favourable topography and nearness to the *abadi-deh* (settlement). The cultivation was then extended to the other parts of the village territory, wherever some levelled and gently sloping land was available, which could be converted into terraced fields. The topography near the *nala* (stream) was not favourable for the development of agricultural fields due to unfavourable terrain. Most of the *awal* land type fields are found in the village territory, wherever some levelled land or gently sloping lands were available both near and away from the *nala* (stream) and the *abadi-deh* (settlement). The size and shape of such fields also vary due to the variations in the topography.

The inferior *barani daum* and *barani saum* land types have relatively large sized fields in comparison to *barani awal* land type fields. The distribution of *barani awal*, *barani daum* and *barani saum* land type fields are found scattered everywhere in the village territory due to the topographical limitations as against the levelled upland plains, where usually *awal* land type fields are found near the *abadi-deh* (settlement) followed by *barani daum*

and *barani saum* land type fields in terms of increasing distance from the *abadi-deh* (settlement). *Banjar jadid* and *banjar kadim* land type fields are highly irregular in shape and relatively larger in size, because of poor terrain and less inherent fertility and productivity. Majority of the fields have east-west orientation parallel to the *nala* (stream) and roads due to favourable contour farming, resulting into terraced type fields. The land types in the subsequent phases during 1914, 1964 and 2016 have improved but the general shape and orientation of the fields have remained more or less the same due to the topographical limitations.

The size of most of the fields has also become smaller due to their continuous subdivisions resulting into increase in the number of fields and reduction in the size of land holdings.

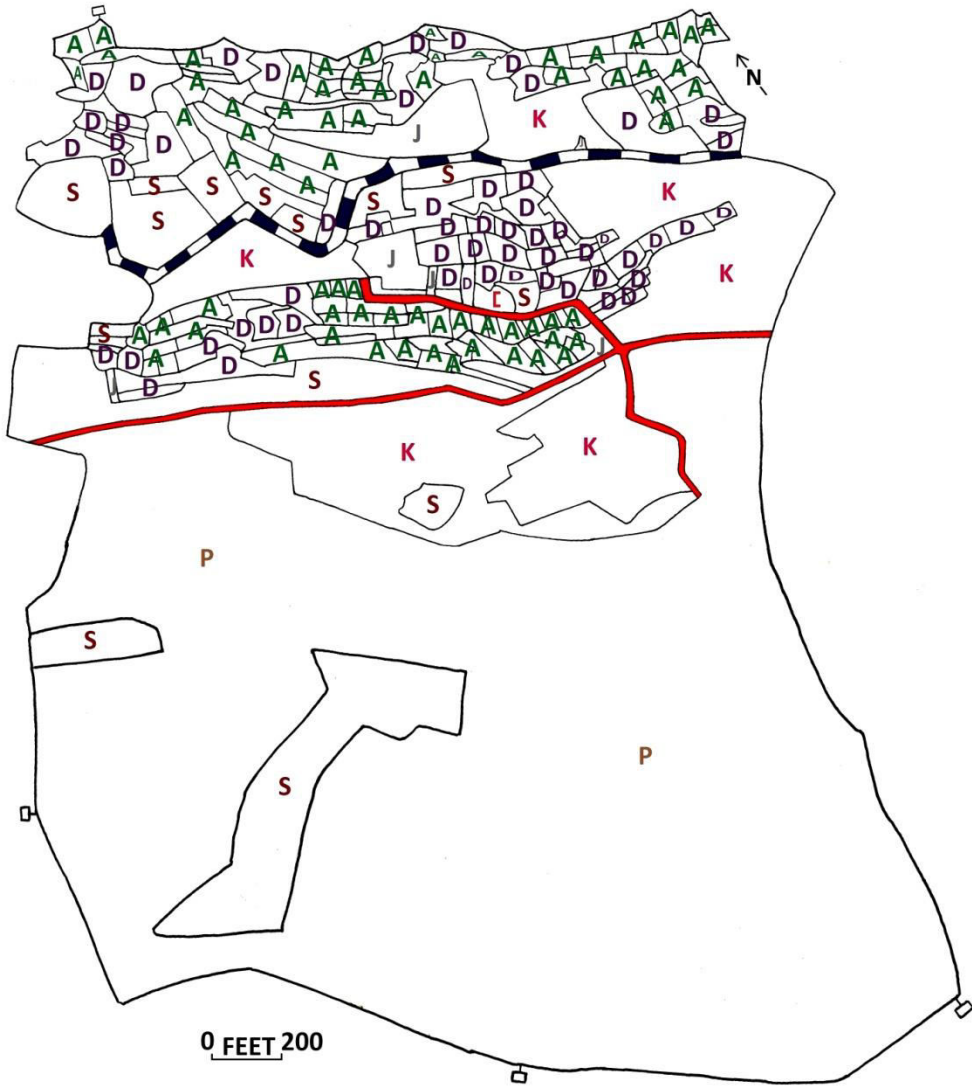
The 1884 *Shajra Nasab* of the village Rohg Teeka Khakhoh states that the village was first owned by Khakhoh clan of Thakur caste, after whom the Khakhoh name has been added to the village Rohg Teeka Khakhoh (Figure 3.29). They converted the sloping land full of jungles into agricultural fields after clearing the forests and cutting the slopes.



Source: *Shajra Nasab* of Village RohgTeeka Khakhoh-1884, 1914, 1964 and 2016.

Figure 3.29

VILLAGE ROHG TEEKA KHAKHOH LAND TYPES AND FIELD PATTERNS, 1884

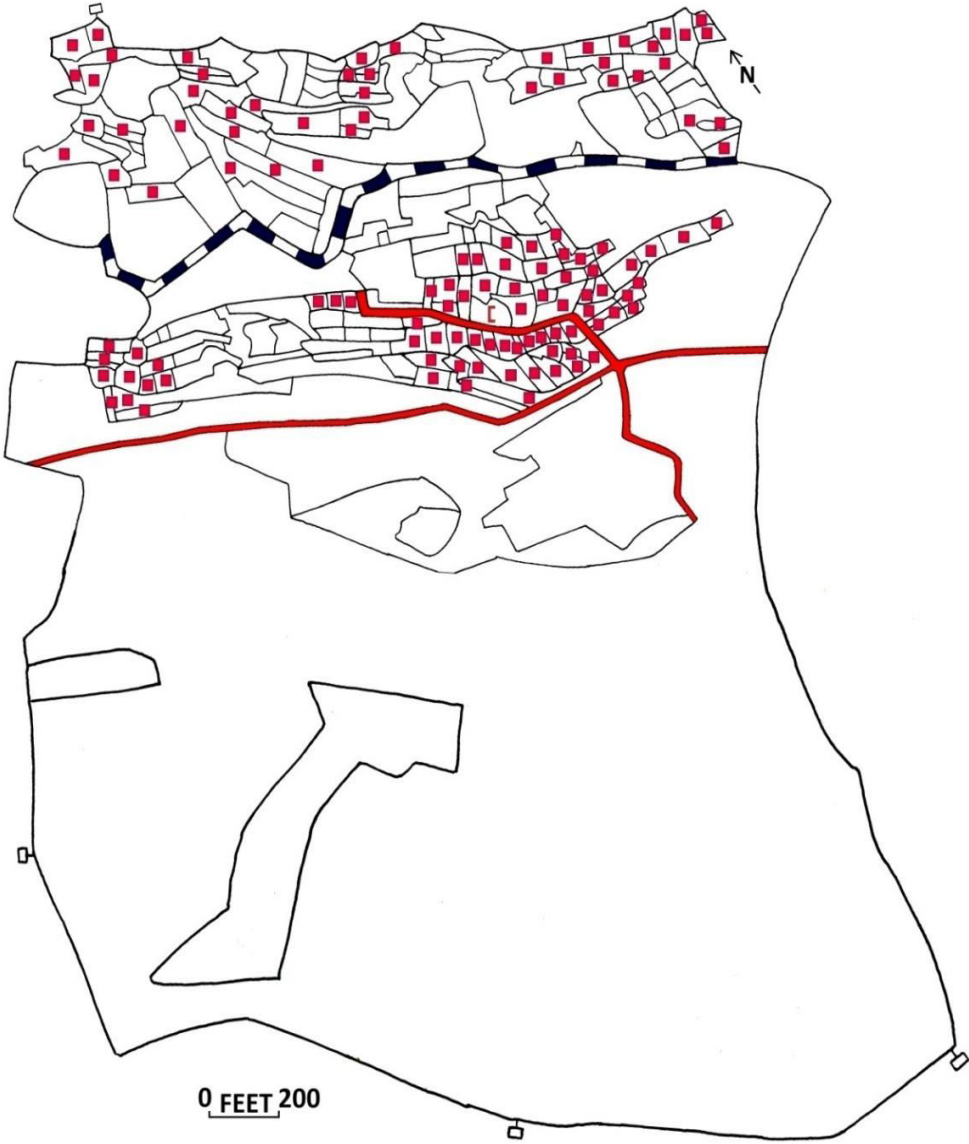


LEGEND:

 Hadbast Boundary	 Road	 Barani Awal
 Field Boundary	 Naala	 Barani Daum
 Settlement	 Pahar	 Barani Saum
	 Banjar Jadid	 Banjar Kadim

Figure 3.28

**VILLAGE ROHG TEEKA KHAKHOH
OWNERSHIP OF CULTIVATED LAND, 1884
(FOURTH GENERATION OF ONE FAMILY)**



LEGEND: NAME OF OWNER

 **LAHNU F/O NIHALU**

Figure 3.30

**VILLAGE ROHG TEEKA KHAKHOH
OWNERSHIP OF CULTIVATED LAND, 1914
(FIFTH GENERATION OF ONE FAMILY)**

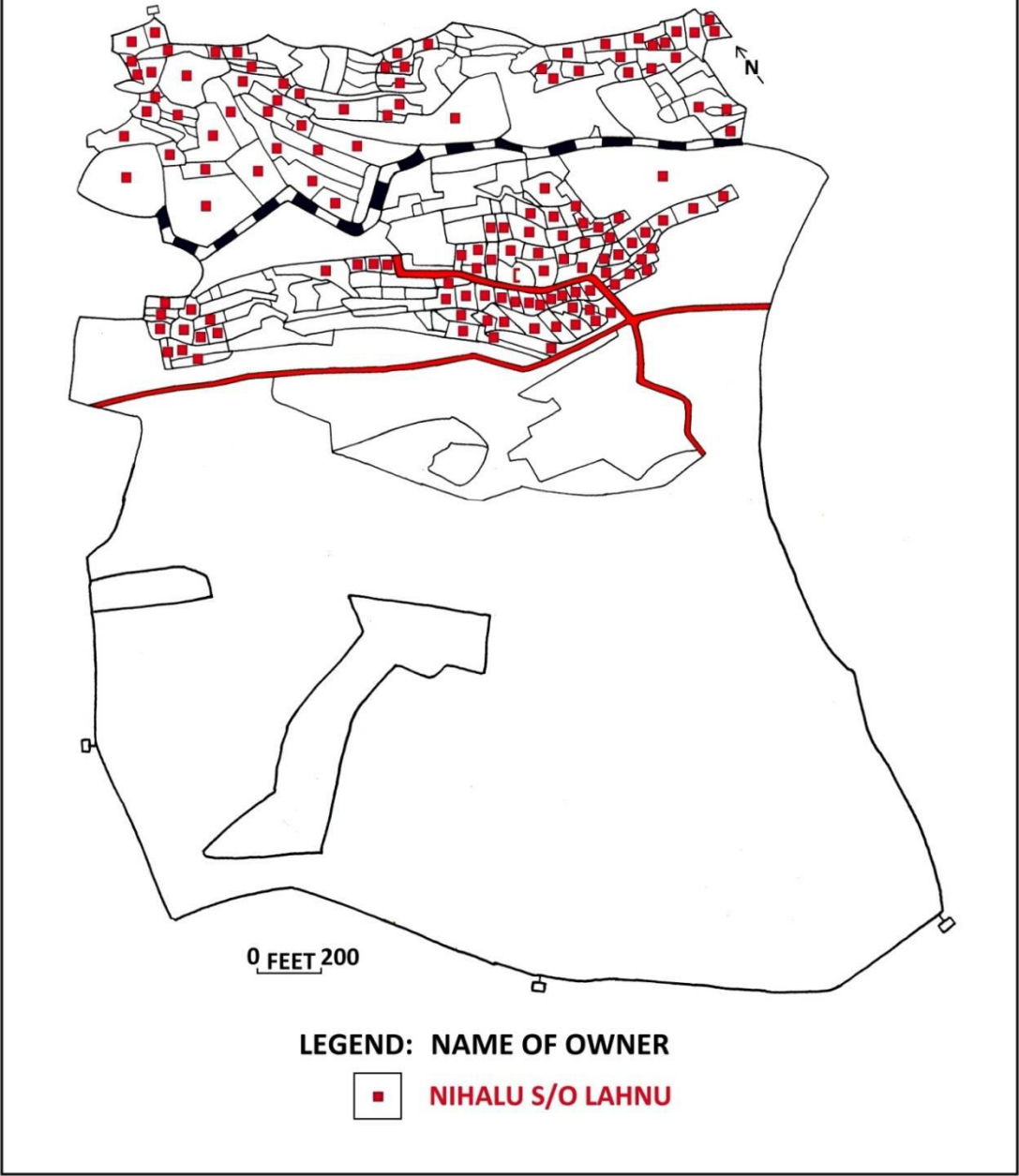
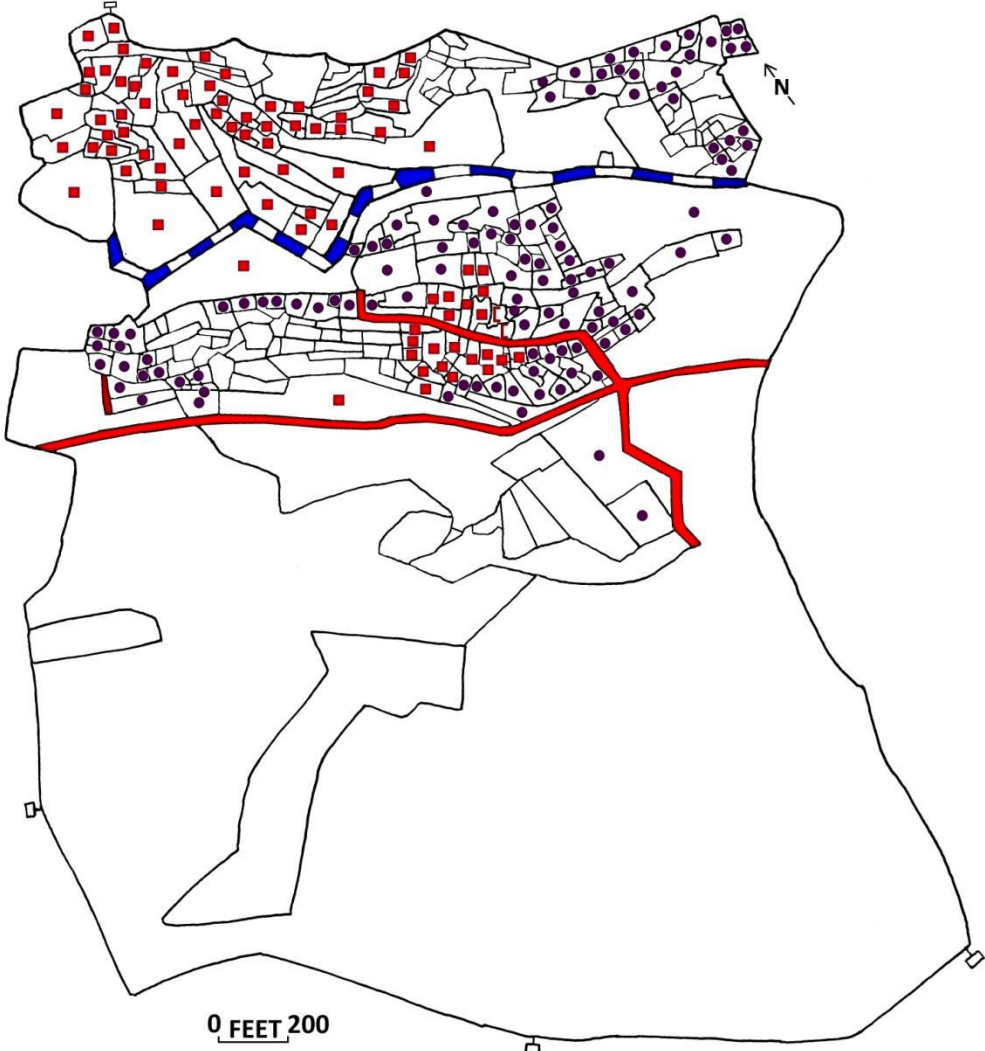


Figure 3.31

**VILLAGE ROHG TEEKA KHAKHOH
OWNERSHIP OF CULTIVATED LAND, 1964
(SIXTH GENERATION OF ONE FAMILY)**

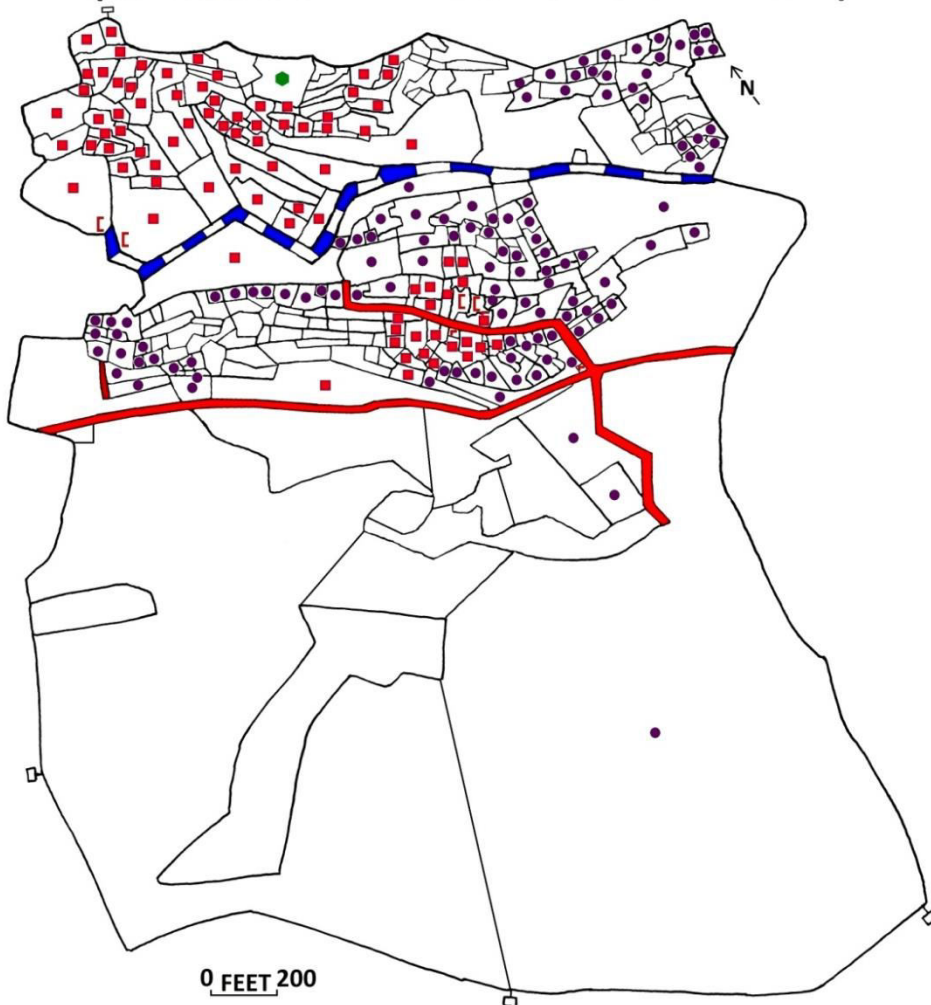


LEGEND: NAME OF OWNERS

- MUNSHI S/O NIHALU**
- **CHUHURU S/O NIHALU**

Figure 3.32

**VILLAGE ROHG TEEKA KHAKHOH
 OWNERSHIP OF CULTIVATED LAND, 1990
 (SEVENTH GENERATION OF ONE FAMILY)**

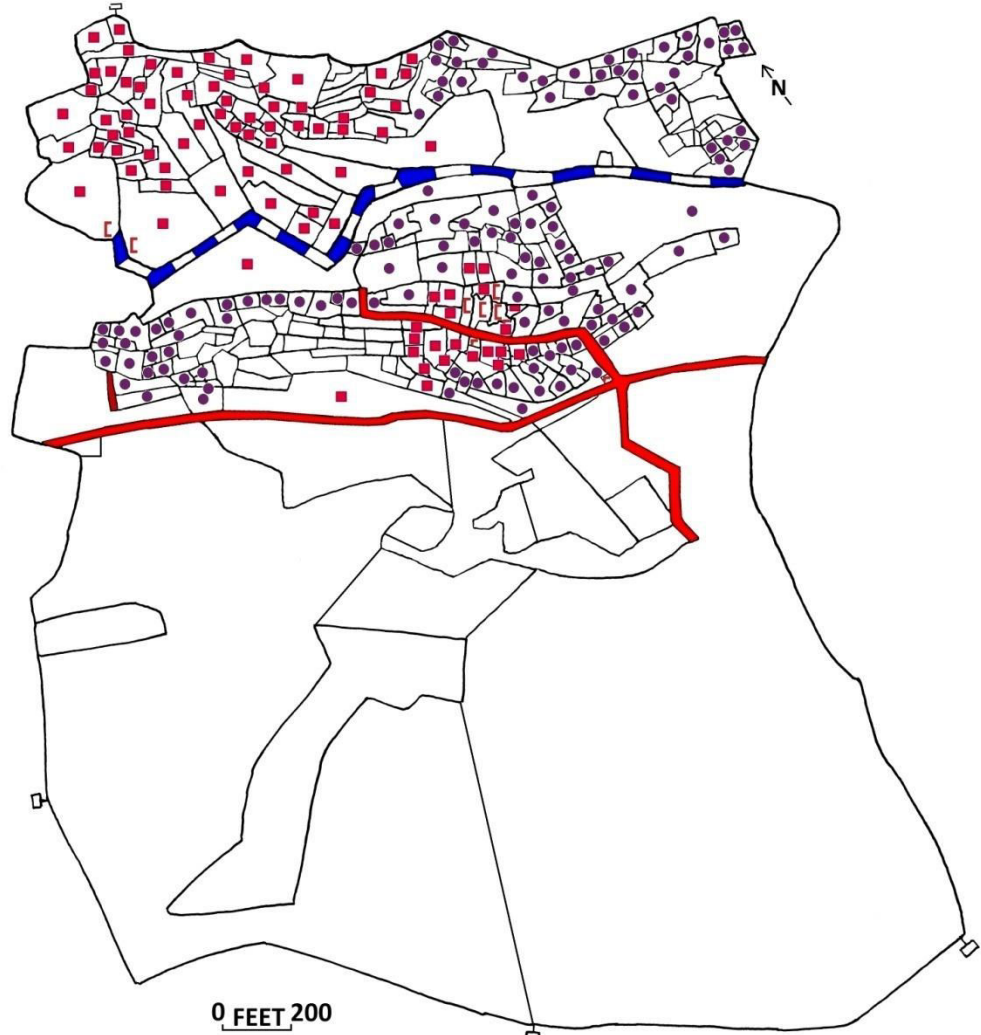


LEGEND: NAME OF OWNERS

- SEETA DEVI D/O MUNSHI
- ABHAY SINGH S/O CHUHURU
- SEETA DEVI D/O MUNSHI
 JATINDER SINGH S/O VEER SINGH

Figure 3.33

**VILLAGE ROHG TEEKA KHAKHOH
OWNERSHIP OF CULTIVATED LAND, 2016
(EIGHTH & PRESENT NINTH GENERATION OF ONE FAMILY)**



LEGEND:	NAME OF OWNERS
<div style="display: flex; align-items: center; margin-bottom: 5px;"> <div style="border: 1px solid black; width: 15px; height: 15px; margin-right: 5px;"></div> </div>	RAGHUNATH SINGH, SHAM SINGH SS/O OF SEETA DEVI D/O MUNSHI SANTOSH KUMARI D/O SEETA DEVI D/O MUNSHI
<div style="display: flex; align-items: center; margin-bottom: 5px;"> <div style="border: 1px solid black; width: 15px; height: 15px; margin-right: 5px;"></div> </div>	KULJIT SINGH S/O BALVIR SINGH S/O SEETA DEVI BANDHNA DEVI, ANJANA DEVI DS/O BALVIR SINGH S/O SEETA DEVI SANDHYA DEVI WIDOW OF BALVIR SINGH S/O SEETA DEVI
<div style="display: flex; align-items: center; margin-bottom: 5px;"> <div style="border: 1px solid black; width: 15px; height: 15px; margin-right: 5px;"></div> </div>	RAMAN KUMAR, PAWAN KUMAR, GAGAN SINGH SS/O ABHAY SINGH S/O CHUHURU PRIYANKA D/O ABHAY SINGH S/O CHUHURU PARKASH RANI WIDOW OF ABHAY SINGH S/O CHUHURU

Figure 3.34

The boundaries of the village were marked in 1884 by the Britishers after actual field surveys. The Thakur khakhoh family got the property rights as per the laws of occupance. Lahnu was the fourth generation owner of the land, whose fields were found scattered in different parts of the village territory in the north direction (Figure 3.30).

Nihalu was the only son of Lahnu, who got the property rights transferred in his name from his father in 1914 (Figure 3.31). The number of field possessed by Lahnu were more than the number of fields previously owned by his father either due to the direct purchase of new fields or by getting back the fields, which were mortgaged earlier by his father. All the fields near the *abadi-deh* (settlement) belonged to Nihalu. His fields were also found scattered in other parts of the village territory more in the *barani awal* land type. Nihalu transferred his property in the name of his two sons, Munshi and Chuhuru in almost equal amount during the sixth generation as per the laws of inheritance (Figure 3.32). The fields belonging to Munshi and Chuhuru were distributed both near the *abadi-deh* (settlement) and in other parts of the village territory as per the principle of equitable distribution of benefits and handicaps. Munshi transferred his entire property in the name of his only daughter, Seeta Devi. Chuhuru transferred his land in the name of his only son, Abhay Singh during the seventh generation in 1990 (Figure 3.33). Seeta Devi owned 610 *kanals*-11 *merlas* land in the form of 106 fields and Abhay Singh got 604 *kanals*-6 *merlas* land distributed in 168 fields. The number of fields owned by Abhay Singh was more than Seeta Devi because of their small size in terms of area covered. Otherwise, the cultivated area owned by Abhay Singh and Seeta Devi were almost same. The number of owners further increased due to addition of new members in the genealogical tree in 2016 (Figure 3.34). After the death of Abhay Singh, his wife Parkash Rani and three sons Gagan Singh, Pawan Kumar and Raman Kumar and one daughter Priyanka, jointly hold the land in their names, in equal share belonging to Abhay Singh, as per the laws of inheritance. Sandhya Devi, widow of Balvir Singh jointly owned the land with her two brother-in-laws, Raghunath Singh and Sham Singh and with one sister-in-law Santosh Kumari, in equal proportion as per the laws of inheritance. In the ninth, the present generation, Sandhya Devi widow of Balvir Singh, jointly owns land with her two daughters Anjana Devi and Bandhna Devi and one son Kuljit Singh in equal proportion as per the laws of inheritance and the new constitutional provision, wherein daughters

were given equal share in their parent’s property (Figure 3.34). Sub-divisions of the existing fields have been the basic governing process in the generation to generation evolution of fields and land holdings. The cultivated land is being equally divided among the descendants of the families as per the laws of inheritance, principle of fair distribution of advantages and handicaps and principle of mutual adjustments with universal acceptance in the village Rohg Teeka Khakhoh and all other sample villages of Punjab. The number of female owners is increasing due to the constitutional amendment, wherein, daughters were given equal share in their parent’s property and the concessional registration fee charged from the females in case the land registration is done in the name of female by the Government of Punjab. The per capita number of fields and the size of land holdings are declining from generation to generation due to the sub-divisions of existing fields and land holdings by the continuous entry of new owners in the genealogical tree of all the families of the villages (Tables 3.9 and 3.10). The number of fields has not increased in the same proportion, because most of the fields are jointly owned by the new members with the old members due to which fields are not sub-divided to a great extent.

Table 3.9

Village Rohg Teeka Khakhoh: Number of Cultivated Fields and Owners

Year	Gap in Years	Number of Fields	Number of Owners
1884	-	192	09
1914	30	223	13
1964	50	287	27
2016	52	305	36

Source: *Jamabandi* of Village Rohg Teeka Khakhoh-1884, 1914, 1964 and 2016.

Table 3.10

Village Rohg Teeka Khakhoh: Per Capita Number of Fields and Size of Land Holdings

Year	Per Capita Number of Fields	Per Capita Size of Land Holdings (<i>Kanals-Merlas</i>)
1884	21.33	142-03
1914	17.15	98-09
1964	10.63	47-08
2016	8.47	35-12

Source: *Jamabandi* of Village Rohg Teeka Khakhoh-1884, 1914, 1964 and 2016.

MAIN FINDINGS AND CONCLUSIONS

In depth analysis of selected sample villages through varied time periods and genealogical lineage depict inferences, which present the evolution of field patterns in Punjab. Findings and conclusions discerned from the study of sample villages are as follows:

- ❖ The field patterns go on changing both in time and space, soon after these were created by the first settlers. The existing field pattern is not a spontaneous creation, but it has undergone changes in various phases. It has evolved gradually over a period of time, each phase being closely related to the next phase and was a product of, the then existing physical and human conditions. The existing field pattern provides only a link in the evolutionary process of fields and a key in the understanding of phases of settling. It reflects the community decisions expressed by their culture, value systems, technology used and their mode of living. Field patterns visible at present in all the study villages are a cumulative result of phases of settling which have operated through time. Therefore, it is proved that the study of effect of time and space is imperative in order to understand the field patterns.

- ❖ It is inferred that diverse field patterns have evolved in the villages of Punjab in response to different landform regions: upland plains, upland plains with sand dunes, piedmont plains, flood plains and Shiwalik hills.
- ❖ Majority of the fields in all the villages were large in size and irregular in shape with poor land types in the early phases of their settlement due to poor micro topography and poor means of irrigation. It is evident that in the irrigated land types, the size of the fields is small and in the *barani* (non-irrigated, rain-fed) land types, the size of the fields is large, in all the study villages. Due to universal availability of irrigation facilities in village Dhanowali and Bath this relationship has been faded away in recent times.
- ❖ Large fields are situated away from the *abadi-deh* (settlement) in the outfield areas in all the villages. These fields are larger than the infields situated near the *abadi-deh* (settlement) because the heirs are not keen in dividing intensively the outfield, rather they prefer to have a full unit in a distant part, but they certainly want a share from every field near the settlement (infield) due to their more economic value, because of their relative nearness to the *abadi-deh* (settlement) and scope for future house construction.
- ❖ The road facing fields were found smaller in size and elongated in shape than the fields which are situated away from the roads in all the villages. The road facing fields have greater commercial value and therefore, every member of the family wants to have an access to the road through such fields. Thus, more elongated sub-divisions of fields are found along the roads.
- ❖ The consolidation of land holdings has disrupted the historical evolution of fields in the villages of plain areas, where process of consolidation has been implemented. The irregularities of the field landscape have disappeared. The fields have become rectangular and uniform in size and shape. The irregularities of the field landscape persisted in the village Khera Bagh in the flood plains and village Rohg Teeka Khakhoh in Shiwalik hills where process of consolidation was not implemented because of difficult terrain.
- ❖ Fields and land holdings owned by different caste groups also showed variations. High caste groups have large land holdings and large number of fields than low castes in the

study villages, which were started as uni-caste and uni-clan villages. Village Khera Bagh due to its multi-caste character does not show this relationship.

- ❖ In village Pathan Chak, in all the phases and in village Bath, after the adoption of canal irrigation, it is seen that source of irrigation has a strong relationship with the field patterns. Fields have ribbon shape and are parallel to each other and perpendicular to the canal and form strip patterns. In general, in the irrigated areas, every land owner wants to have an access to the source of irrigation. Due to this fact, the fields are perpendicular to the canal. Fields are not arranged around a well or tube-well in the study villages because water can easily be taken to any field by the *arrs* (water channels) to provide irrigation facilities.
- ❖ The generation to generation evolution of field pattern is almost same for all the families of all the villages with sub-divisions as the basic governing process. The principles which were discovered earlier with certain deviations and modifications continue to operate in the present times. The cultivated land is being equally divided among the descendants of the families with fair distribution of advantages and handicaps, the principle of mutual adjustments and law of inheritance with universal acceptance.
- ❖ The most important feature in the evolution of field patterns has been the operation of process of sub-divisions of the existing fields among the descendants of each family in all the generations. This has resulted in increase in the number of fields, but has reduced the size of fields and land holdings in the study villages.
- ❖ The number of female owners in the form of daughters is increasing due to constitutional amendments after independence and concessional land registration charges taken from females by the Government of Punjab.

CHAPTER-4

FIELD PATTERNS IN PRE-CONSOLIDATION AND POST-CONSOLIDATION PHASES

The historical evolution of field patterns was disrupted due to the implementation of consolidation of land holdings in late 1950s in many villages in plain areas of Punjab. Up to the middle of the twentieth century, the holdings of farmers were consisted of a number of fields located at different sites and in different directions of the village territory. The fields constituting the holdings of different farmers were mostly intermingled. Dispersed and intermingled locations of fields were the typical features of the field pattern in the pre-consolidation phase (Nitz, 1966). The scattered fields and fragmented holdings ultimately resulted in the low production. The small and fragmented fields retarded enterprise and created hindrances in smooth agricultural operation (Lal,1972). Because of the scattered fields, the farmer wasted a lot of time and energy in walking to and from the fields in carrying farm implements, *roori* (manure) and animals; and bringing back farm produce from the scattered, fragmented and intermingled fields. Quarrels and clashes over boundary disputes were very common. Due to neglect of fields and crops, production remained low. The subdivision of fields resulting from the law of inheritance and equitable distribution of the benefits and handicaps was responsible for such ills. To eliminate and reduce these problems and to improve the economic conditions of the farmer, several policies and measures were introduced by the government. The most effective among these measures, was the consolidation of land holdings by which the scattering of fields have been minimised by consolidating the irregular, small and inconveniently large fields and holdings into compact blocks of rectangular fields of uniform size of one *killa* (one acre). Twenty-five such *killa* fields constitute a *murabba* (25 acres). Any one holding may cut across different blocks. The process of consolidation of *killa* fields is called *killabandi* and consolidation of *murabba* blocks is known as *murabbabandi*. The procedure of consolidation was adopted in many villages of Punjab plains in late 1950s. With the implementation of the consolidation of land holdings, there ushered a stage of a total and dramatic transformation of the field pattern and field landscape (Randhawa, 1974). It marked the end of the historical evolution of the field patterns. The irregularities of evolved landscape and

fragmentation have disappeared in the villages, where process of consolidation of land holdings was implemented.

The process of *killabandi* of land holdings could not be implemented in all the villages of Punjab due to physiographic limitations in different landform regions. The villages falling in the upland plains, upland plains with sand dunes, piedmont plains and flood plains in the lower river courses were successfully brought under the *killabandi* process of consolidation, whereas the villages falling in the Shiwalik hills and upper river courses of the flood plains near the Shiwalik hills, were left out from the *killabandi* process of consolidation of land holdings due to physiographic limitations of these landform regions.

(A) FIELD PATTERNS IN THE CONSOLIDATED VILLAGES

Consolidation of land holdings was successfully implemented in late 1950s in the three sample villages namely Dhanowali, Bath and Pathan Chak situated in the upland plains, the upland plains with sand dunes and the piedmont plains respectively, due to favourable physiographic conditions, like all other villages situated in these landform regions of Punjab.

The consolidation of land holdings was effected on following requirements:

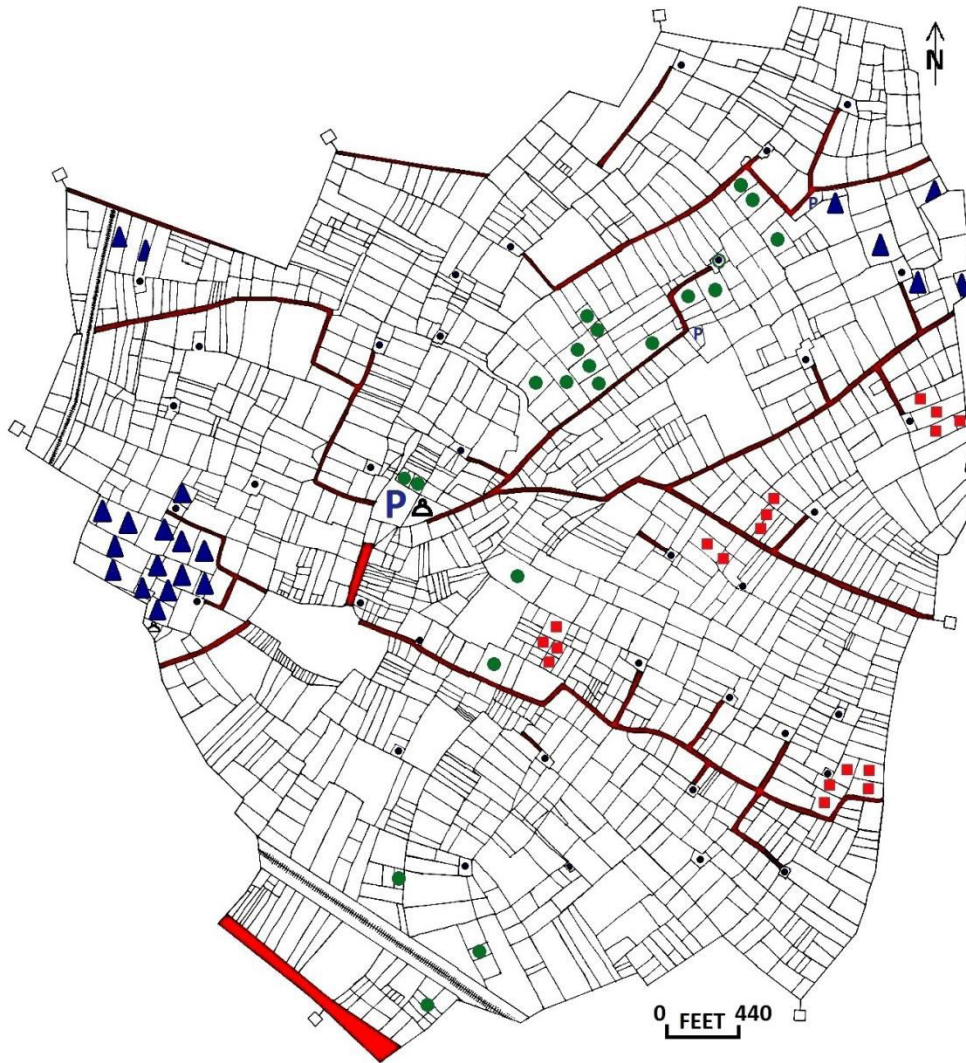
- i. Valuation of fields taking into account the inherent fertility and productivity of land, availability of irrigation facilities and distance of fields from the *abadi-deh* (the settlement).
- ii. The area of the proposed holding of a farmer not to differ by more than 25 per cent from the area of his original holding.
- iii. The holding of a farmer was not to be divided into more than three blocks.
- iv. Each farmer is to be allotted a compact area in each block at the place where he has the largest part of his holding.
- v. Joint land holdings were to be partitioned to the maximum possible extent in order to avoid further fragmentation of land holdings.

(1) FIELD PATTERNS AND CONSOLIDATION OF LAND HOLDINGS IN FLAT UPLAND PLAINS (VILLAGE DHANOWALI)

The historically evolved field landscape in the village Dhanowali located in the upland plains of Doaba region, situated in tehsil and district of Jalandhar, was disrupted due to the implementation of process of consolidation in 1958. Through the process of consolidation, the fields of a farmer which were found scattered at many sites, have been grouped into compact blocks located at not more than three sites, adjacent to the largest part of his holding. It has resulted in the reduction in the number of sites in relation to number of fields. The scattering of his fields has reduced considerably in the post-consolidation phase in comparison to the pre-consolidation phase. An **Index of Scattering** of fields in the pre-consolidation phase and the post-consolidation phase of a farmer can be computed to know the change in scattering of fields brought by the adoption of process of consolidation with the help of a formula proposed by Mukerji (1962). This formula is: $I_s = X/Y \times 100$, where: I_s is the Index of Scattering, X is the number of sites and Y is the number of fields.

To find out the change in the scattering of holdings from pre-consolidation to post-consolidation phases in the study village, a sample of three farmers (farming families) **A**, **B** and **C** have been taken. In the pre-consolidation phase, the fields of these farmers were scattered in different parts of the village territory (Figure 4.1).

**VILLAGE DHANOWALI
PRE-CONSOLIDATION SCATTERING OF HOLDINGS,
FIELD FORMS AND FIELD PATTERNS, 1914**

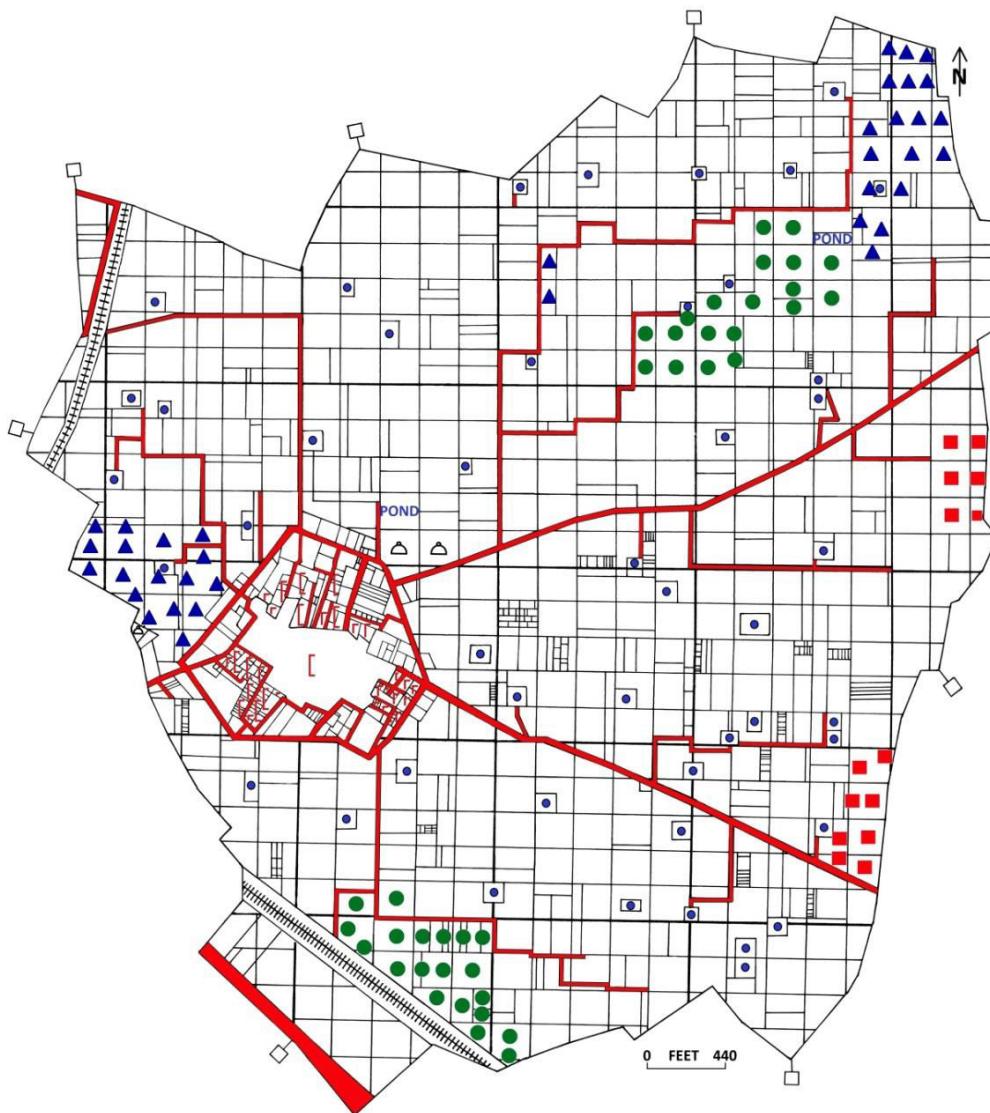


LEGEND:

- FIELD BOUNDARY
- FARMER A
- ▲ FARMER B
- FARMER C

Figure 4.1

**VILLAGE DHANOWALI
POST-CONSOLIDATION SCATTERING OF HOLDINGS,
FIELD FORMS AND FIELD PATTERNS, 1958**



LEGEND:

- FIELD BOUNDARY
- FARMER A
- ▲ FARMER B
- FARMER C

Figure 4.2

Table 4.1

Village Dhanowali: Change in Degree of Scattering of Holdings from Pre-Consolidation to Post-Consolidation Phase

Pre-Consolidation Phase (1914)						Post-Consolidation Phase (1958)				
Owner	Number of Fields	Number of Sites	I _S	$\sum D_{SF}$ (In Inches)	I _{SD}	Number of Fields	Number of Sites	I _S	$\sum D_{SF}$ (In Inches)	I _{SD}
Farmer A	25	13	52	28.60	1.818	46	03	6.52	8.15	0.800
Farmer B	29	08	27.58	28.75	0.959	40	03	7.50	9.5	0.789
Farmer C	18	05	27.77	15.3	1.815	14	02	14.28	8.5	1.680

Source: *Jamabandi* of Village Dhanowali-1914 and 1958.

I_S: Index of Scattering in per cent.

$\sum D_{SF}$: Cumulative Distance of Sites of Fields.

I_{SD}: Index of Scattering in terms of Distance.

In 1914, pre-consolidation phase of village Dhanowali, farmer **A** had 25 fields located at 13 sites, farmer **B** had 29 fields located at 8 sites and farmer **C** had 18 fields located at 5 sites. The values of Indices of Scattering of sites of fields for farmers **A**, **B** and **C** computed to be 52 per cent, 27.58 per cent and 27.77 per cent respectively (Table 4.1). There is a change in the Indices of Scattering of sites of the fields of these farmers, after the consolidation of land holdings. Their scattered fields have been grouped into compact blocks located at three or less than three sites (Figure 4.2).

The newly created 46 fields of farmer **A** have been grouped into three compact blocks located at three sites through the process of consolidation. The Index of Scattering of his fields has been reduced from 52 per cent in the pre-consolidation phase to 6.52 per cent in the post-consolidation phase (Table 4.1). Similarly, the newly created 40 fields of farmer **B** have been compacted into three blocks located at three sites and the Index of Scattering has been reduced to 7.50 per cent after consolidation from 27.58 per cent, previously. In the case of farmer **C**, both the number of fields and sites has been reduced from 18 and 5 after consolidation phase to 14 and 2 in the post-consolidation phase respectively. The Index of Scattering of farmer **C** is reduced from 27.77 per cent to 14.28 per cent, after consolidation. The decline in the percentage value of Index of Scattering is possible in any of the following cases:

- a) Number of fields have increased while the number of sites are reduced;
- b) Number of sites remain the same while the number of fields are increased;
- c) Number of fields remain the same while the number of sites are reduced; and
- d) Number of fields and the number of sites, both are reduced.

This formula of Index of Scattering suffers from an inadequacy and therefore needed to be modified. It depicts only the value of scattering of sites of fields, but it does not take into consideration the distance of sites of fields from the residence of the farmer located in the *abadi-deh* (settlement). The value of Index of Scattering of sites of fields may come to be the same for two farmers, but in terms of distance of sites of fields from the *abadi-deh* (settlement), the farmer whose fields are located near the *abadi-deh* (settlement) enjoys more benefits than the farmers whose fields are scattered at a greater distance from the *abadi-deh* (settlement). The farmer has to spend more time and energy

walking and carrying farm implements, seeds, manures, fertilizers and bringing back farm-produce from the fields to his residence at *abadi-deh* (settlement). Therefore, the cumulative distance covered by the farmer from the *abadi-deh* (settlement) to all the sites of fields will give a real operational meaning to the Index of Scattering. With the modification of Index of Scattering, a new formula is being proposed which takes into account the cumulative distance of all sites of fields from the *abadi-deh* (settlement). The formula is: $I_{SD} = I_S / \sum D_{SF}$, where: I_{SD} is the Index of Scattering in terms of Distance, I_S is the value of Index of Scattering in per cent and $\sum D_{SF}$ is the sum total of distance of sites of fields from the *abadi-deh* (settlement) comprising a holding. The procedure for calculating the I_{SD} (Index of Scattering in terms of Distance) for a farmer is as following:

- I. Take the map of the study village showing field boundaries along with the data of the fields comprising a holding of a farmer of which I_{SD} is to be calculated.
- II. Locate all the fields on the map owned by the farmer and calculate the value of Index of Scattering.
- III. Locate the geometric centre of each site of fields and give them number from one onwards. If two or more fields are located on the same single site, the point central to all these fields is to be taken.
- IV. Measure the distances in the map from the geometric centre of *abadi-deh* (settlement) to all the geometric centres of sites of the fields.
- V. Find out the value of $\sum D_{SF}$ (cumulative distance of sites of fields) by adding all the distances of sites of the fields.
- VI. Calculate the I_{SD} by using the above given formula.

The same procedure is followed for calculating the I_{SD} of the sample farmers **A**, **B** and **C** both in the pre and post-consolidation phases (Table 4.1). There is an inverse relationship between the numerical value of I_{SD} and the actual scattering of sites of fields in terms of distance (Figure 4.3).

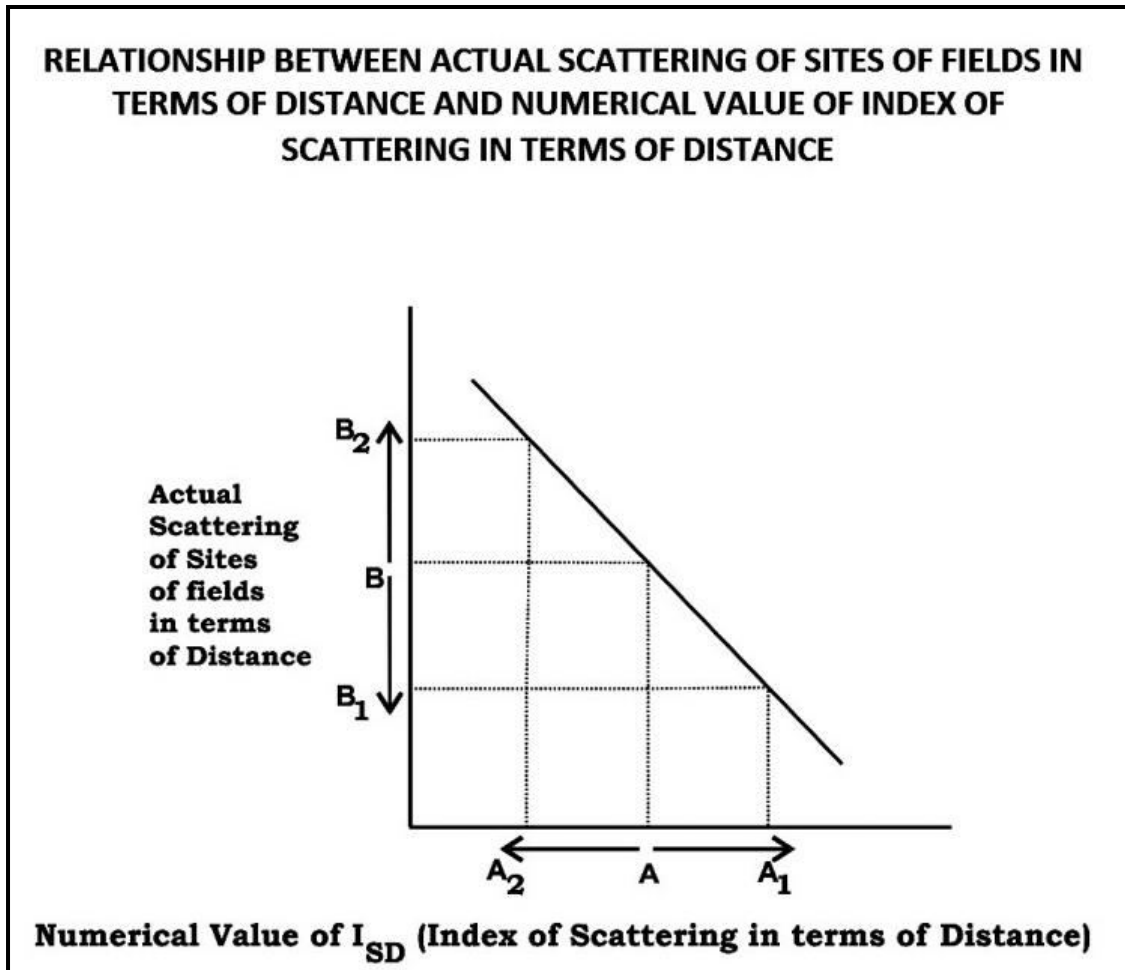


Figure 4.3

Higher is the numerical value of I_{SD} , the lower will be the scattering of sites of fields in terms of distance. The numerical value of I_{SD} can be both, below or above one. I_{SD} changes with a change in the values of I_S and $\sum D_{SF}$. If the value of $\sum D_{SF}$ is more than I_S , the numerical value of I_{SD} will be less than one. The numerical value of I_{SD} is more than one when I_S is more than $\sum D_{SF}$. The numerical value of I_{SD} is more when the I_S is maximum and $\sum D_{SF}$ is minimum. The numerical value of I_{SD} is less when the I_S is minimum and $\sum D_{SF}$ is maximum. It is useful to compare the I_{SD} of two or more farmers. In the pre-consolidation phase in 1914 the value of Index of Scattering for farmers A, B and C is 52 per cent, 27.58 per cent and 27.77 per cent respectively, whereas the numerical value of I_{SD} (Index of Scattering in terms of Distance) is 1.818, 0.959 and 1.815 respectively. The I_S of farmer A is more than that of farmer B and C yet his fields in terms of distance are less scattered as his numerical value of I_{SD} is more than that of

the value of farmers **B** and **C**. In terms of I_S the fields of farmer **B** are less scattered than that of farmers **A** and **C**, but in terms of distance his fields are more scattered as his numerical value of I_{SD} is the least.

In the post-consolidation phase in 1958, change in the I_S and I_{SD} are immensely evident. The I_S is reduced to considerable extent for all the three farmers but scattering in terms of distance has increased for all the three, as their numerical values of I_{SD} are reduced. This is due to the reduction in the I_S , whereas the actual $\sum D_{SF}$ are reduced for these three farmers (Table 4.1). The scattering of fields in terms of distance tends to be almost the same for farmers **A** and **B**, whereas it is the least for farmer **C**, although his I_S is the maximum among them. Therefore, in order to get more favourable results, it is valuable to use the I_{SD} along with I_S .

SIZE OF THE FIELDS

The consolidation of land holdings has influenced the size of the fields to a great extent. The size of the fields was different in the pre-consolidation and post-consolidation phases. The basic purpose of consolidation was to reduce the number of sites of fields. It has led to the change in the number and size of fields. The number of fields has reduced from 1436 in the pre-consolidation phase of 1914 to 1044 in the post-consolidation phase of 1958 (Table 4.2). This reduction in the number of fields was related more to the reduction in area under cultivation. The area under cultivation has reduced by 352 *kanals* from 4040 *kanals*-6 *merlas* to 3688 *kanals* between the pre and post consolidation phases. The cultivated land was encroached upon by the construction of new roads, houses and other *gairmumkin* (uncultivable) land uses, causing reduction in the total number of fields in the post-consolidation phase. The number of fields would have increased in the post-consolidation phase in the absence of encroachment of cultivated land by these *gairmumkin* land uses. The fields of farmer **A** and **B** have increased from 25 to 46 and 29 to 40 respectively. Here the number of fields has increased due to the partition of joint holdings and by reduction in the number of very large fields of above 8 *kanals* in the post-consolidation phase. The number of such very large fields in the pre-consolidation phase was 102, covering an area of 1289 *kanals*-13 *merlas*, which was 31.92 per cent of the total cultivated area of the village. In the post-consolidation phase, the number of

such fields were reduced to only 3 (0.3 per cent of total fields) covering an area of 28 *kanals*-4 *merlas* with less than 1 per cent of the total cultivated area covered (Table 4.2). It is interesting to note that all these 3 fields of very large size were found inside the *phirni* (circular road around *abadi-deh*, the settlement), where the process of consolidation was not undertaken due to the presence of many *gairmumkin* (uncultivable) land uses. Almost all other very large sized fields of above 8 *kanals* were converted into rectangular fields of uniform size of one *Killa* (8 *kanals* or 198 feet x 220 feet) each. *Phirni* (a circular road) was constructed around the village *abadi-deh* (settlement) to restrict the settlement within the *phirni* to reduce the effect of *abadi-deh* (settlement) on the fields outside the *phirni*. The area under cultivated land was reduced due to the provision of such new roads. This has also affected the size of fields near the newly constructed roads.

Large sized fields of 4 to 8 *kanals* are dominant both in terms of cultivated area covered and number of cultivated fields in the post-consolidation phase. These fields account for nearly 26 per cent of the total fields in pre-consolidation phase and jumped to 74 per cent of the total cultivated land in the post-consolidated phase. Most of the large size fields are rectangular in shape and are distributed everywhere in the village territory.

The medium sized fields of 1 to 4 *kanals* have also experienced a change in the post-consolidation phase. The number of medium size fields was largest (668) covering maximum cultivated area of 38.59 per cent of the village in the pre-consolidation phase. Both, the number and area covered by medium size fields have reduced in the post-consolidation phase. Their number has reduced to 385 covering 23 per cent of the total cultivated area of the village. Such fields may be found in any part of the village territory but are common more near the *abadi-deh* (settlement).

Small sized fields of below 1 *kanal* area, experience a little change from pre to post-consolidation phase. Their number has declined from 290 to 235 between pre-consolidation and post-consolidation phases. The area covered by such fields has reduced by nearly half from 142 *kanals*-5 *merlas* (3.5 per cent) to 72 *kanals*-10 *merlas* (2.0 per cent) of the total cultivated area of the village. Although these fields are found scattered in the entire village territory, yet they are more common near the *abadi-deh* (settlement).

Table 4.2

Village Dhanowali: Field Size Analysis in the Pre-Consolidation and Post-Consolidation Phases

Pre-Consolidation Phase (1914)					Post-Consolidation Phase (1958)			
Field Size	Number of Fields	Percentage in Total Number of Fields	Area Covered (<i>Kanals-Merlas</i>)	Percentage in Total Cultivated Area Covered	Number of fields	Percentage in Total Number of Fields	Area Covered (<i>Kanals-Merlas</i>)	Percentage in Total Cultivated Area Covered
Small (Below 1 <i>Kanal</i>)	290	20.2	142-5	3.5	235	22.5	72-10	2.0
Medium (1 <i>kanal</i> to 4 <i>Kanals</i>)	668	46.5	1559-3	38.59	381	36.5	848-14	23.0
Large (4 <i>Kanals</i> to 8 <i>Kanals</i>)	376	26.2	1049-5	25.96	425	40.7	2738-12	74.2
Very Large (Above 8 <i>Kanals</i>)	102	7.1	1289-13	31.92	03	0.3	28.04	0.8
Total	1436	100.00	4040-6	100.00	1044	100.00	3688-00	100.00

Source: *Jamabandi* of Village Dhanowali-1914 and 1958.

The fields near *abadi-deh* (settlement) are small in size due to the greater degree of their sub-divisions. Every member of the family wants to have a small piece of land near *abadi-deh* (settlement) because of its more economic value and scope for construction of house in future.

SHAPE OF THE FIELDS

The process of consolidation also has a great bearing on the shape of the fields. In the pre-consolidation phase, the village territory was characterized by intermingled irregular fields (Figure 4.1). The fields of a farmer were found intermingled with the fields of other farmers due to fragmented holdings. Most of the fields were irregular rectangles, elongated strips and rectangular in shape. These three classes of shape of fields together accounted for 91 per cent of the total fields. Irregular polygons, hexagons and triangular fields were also common (Table 4.3).

As a result of adoption of *killabandi* process of consolidation, these intermingled and irregular fields have been changed into regular rectangular fields of uniform size of 1 *killa* each (Figure 4.1). Majority of the fields have become regular rectangular, elongated strips and quadrilaterals. Nearly half of the total cultivated fields have become rectangular in shape in the post-consolidation phase, whereas in the pre-consolidation phase, only 10 per cent of the fields were rectangular. The share of irregular rectangular and elongated fields has reduced from 43 per cent to 10 per cent and from 38 to 27 per cent respectively during the pre and post consolidation phases. Complete square fields account only for less than 1 per cent both in pre-consolidation and post-consolidation phases. There is no much change in the percentage of triangular, polygon and hexagon fields in the post-consolidation phase. Such non-rectangular fields are found mostly along the irregular village boundary, near the *abadi-deh* (settlement), diagonal roads, railway lines, wells and tube-wells.

Table 4.3

Village Dhanowali: Field Shape Analysis in the Pre-Consolidation and Post-Consolidation Phases

Field Shape Class	Pre-Consolidation Phase (1914)		Post-Consolidation Phase (1958)	
	Number of Fields	Percentage in Total Number of Fields	Number of Fields	Percentage in Total Number of Fields
Three Sided-Triangular	26	2.0	39	3.7
Four Sided-Square	06	0.4	04	0.4
Four Sided-Rectangular	146	10.2	506	48.5
Four Sided-Elongated Strip	552	38.0	284	27.2
Four Sided-With One or More Sides Oblique Irregular Rectangular or Quadrilateral	617	43.0	104	10.2
Five Sided-Polygons	15	1.0	24	2.3
Six Sided-Hexagons or More	74	5.0	83	8.0
Total	1436	100.00	1044	100.00

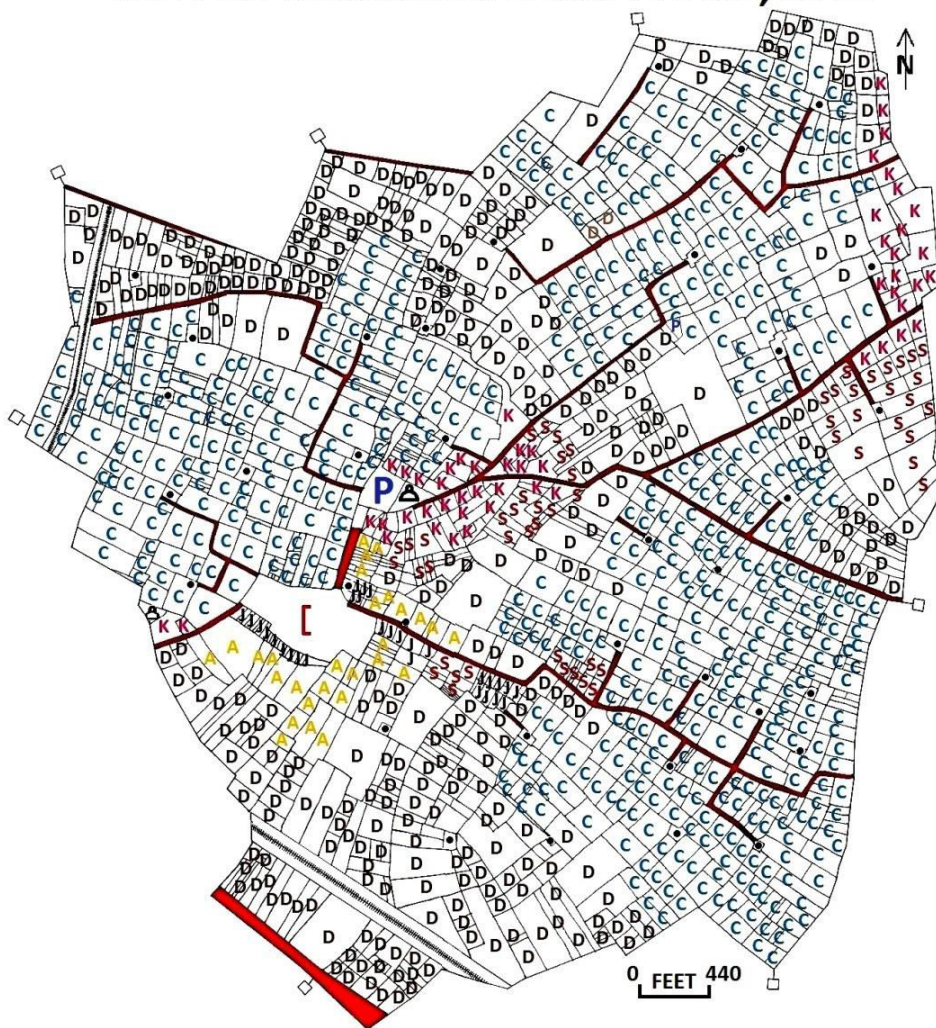
Source: *Shajra Kishtawar* of Village Dhanowali-1914 and 1958.

LAND TYPES AND FIELD PATTERNS

The Land types and field patterns are closely related. Land types have experienced a change both in time and space. Therefore, study of land types become necessary to understand the evolution of field patterns in pre-consolidation and post-consolidation phases in Punjab.

In pre-consolidation phase of 1914, land types in the village Dhanowali included *chahi*, *banjar kadim*, *banjar jadid*, *barani awal*, *barani daum* and *barani saum* (Figure 4.4). The term *chahi* denotes the land which is being irrigated by a *chah* (a well or a tube-well). *Banjar kadim* and *banjar jadid* land types terms are used for fallow lands, *Jadid* refers to the land which has been left uncultivated for at least three cropping seasons and *Kadim* stands for land which has been left uncultivated for at least eight cropping seasons. These land types are very poor in inherent fertility and are not used for growing crops for long periods so that the quality of the land improves naturally. The term *barani* denotes non-irrigated rain-fed land having low productivity and inherent fertility. *Barani* land has further been divided into three types in village Dhanowali namely *barani awal*, *barani daum* and *barani saum* on the basis of distance from the *abadi-deh* (settlement), inherent fertility and use of manures. *Awal* means superior or first ranking, *daum* means inferior or second ranking and *saum* refers to the most inferior land type. *Barani awal* land has relatively lesser proportion of sand and can retain water for long. This type of land is found adjacent to *abadi-deh* (settlement) and therefore, is highly manured. *Barani daum* land has more proportion of sand than *barani awal* and is generally found near the village territory away from *barani awal* land type fields. *Barani saum*, the most inferior cultivated land, is almost sandy and therefore, cannot retain water for long. It is found near the village territory away from *barani daum*, but a few patches of *barani saum* land type are also found in the inner part of the village due to their sandy characters. The fields are relatively small near the *abadi-deh* (settlement) not due to their high productivity but due to their greater degree of sub-divisions and desire of each member of the family to have share in these fields for future scope of house construction.

VILLAGE DHANOWALI LAND TYPES AND FIELD PATTERNS IN THE PRE-CONSOLIDATION PHASE, 1914

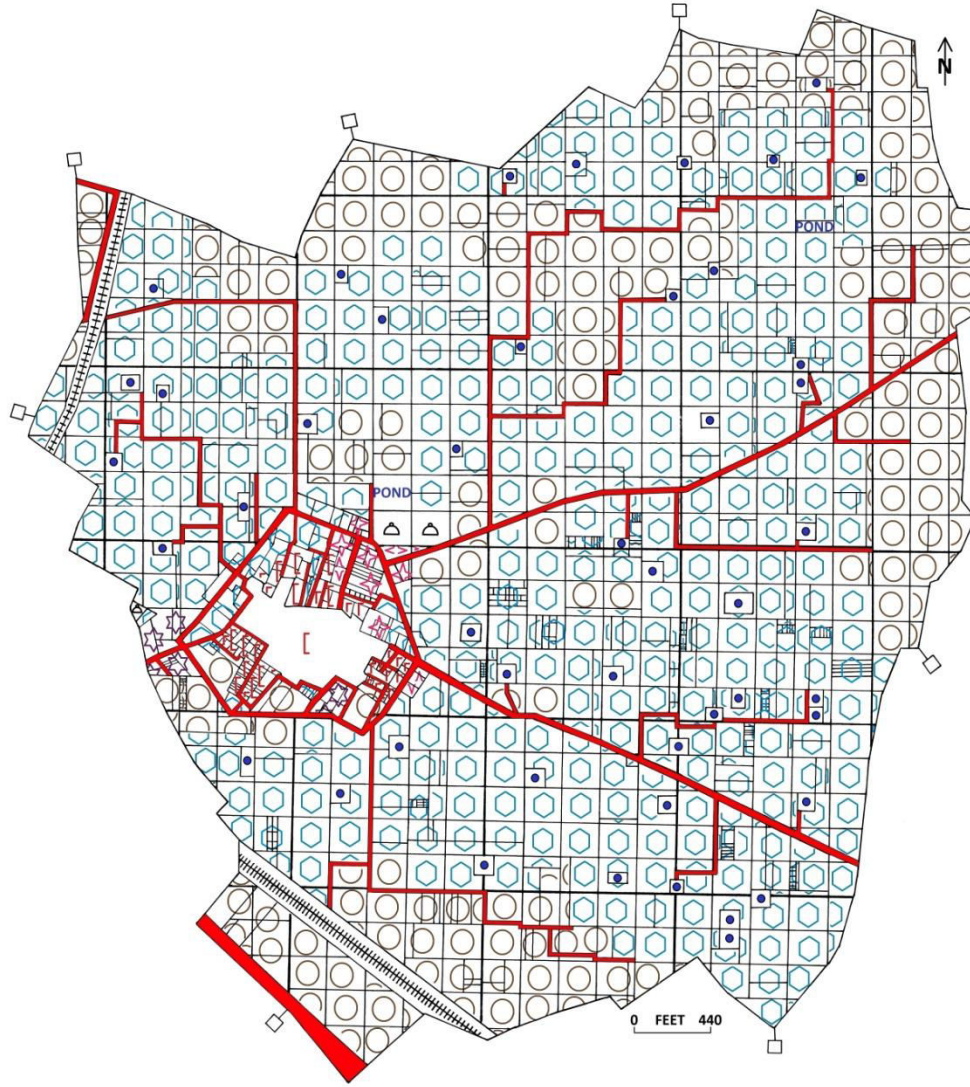


LEGEND:

- | | | |
|--|--|--|
|  Hadbast Boundary |  Cremation Ground |  Chahi |
|  Field Boundary |  Pond |  Barani Awal |
|  Settlement |  Well |  Barani Daum |
|  Road |  Banjar Kadim |  Barani Saum |
|  Railway Line |  Banjar Jadid | |

Figure 4.4

VILLAGE DHANOWALI LAND TYPES AND FIELD PATTERNS IN THE POST-CONSOLIDATION PHASE, 1958



LEGEND:

- | | | |
|--|--|--|
|  Hadbast Boundary |  Railway Line |  Chahi |
|  Field Boundary |  Cremation Ground |  Barani |
|  Settlement |  Well/Tubewell |  Banjar Kadim |
|  Road | |  Banjar Jadid |

Figure 4.5

Except in the north-west direction, *abadi-deh* (settlement) is surrounded by lands of low productivity, *barani* (*awal*, *daum* and *saum*), *banjar jadid* and *banjar kadim*. The predominant land type in the pre-consolidation phase is *chahi* covering about half of the total cultivated land and more than half of the cultivated fields (Table 4.4).

Barani land constitutes around 47 per cent of the total cultivated land and 38 per cent of the total cultivated fields. Among *barani* land types *barani daum* contributes maximum with 40 per cent cultivated area and 30 percent fields. Although fields of different sizes are found everywhere in the village territory in different land types yet on the basis of the number of fields and area covered by these fields in each land type, we have observed that *chahi* fields are smaller than the *barani* fields.

Land types have improved in the post-consolidation phase of 1958 in village Dhanowali. Most of the *barani* fields have been converted into *chahi* fields (Figure 4.5). The percentage of the *chahi* fields to the total cultivated fields and percentage of cultivated area under *chahi* fields both have increased from 53.8 per cent to 67.8 per cent and from 49.5 per cent to 67.7 per cent respectively (Table 4.4). The number of fields and cultivated area under *banjar kadim* and *banjar jadid* has also been reduced. The number of *barani* fields and area under them has reduced to a great extent. This has become possible due to increase in the sources of irrigation, as the number of wells and tube-wells has increased from 36 to 46 from pre-consolidation to post-consolidation phase. *Banjar kadim* and *banjar jadid* fields are found more near the *phirni* (circular road around *abadi-deh*, the settlement) because such fields are left vacant here for purpose of constructing house in future. Most of the *barani* fields are found near the village territory and *chahi* fields are found both near and away from the *abadi-deh* (settlement). The fields of different size are common in the entire village territory irrespective of their land types but *chahi* fields are relatively smaller than the *barani* fields both in the pre as well as post-consolidation phases. The area under *chahi* fields has increased from 49.5 per cent to 67.7 per cent between the pre and post-consolidation phases despite of the fact that many of the *chahi* fields have been encroached upon by the roads, houses and other *gairmumkin* (uncultivable) land uses. The land types have improved from pre-consolidation to post-consolidation phases.

Table 4.4

Village Dhanowali: Land Types of Cultivated Fields in the Pre-Consolidation and Post-Consolidation Phases

Pre-Consolidation Phase (1914)					Post-Consolidation Phase (1958)				
Land Type	Number of Fields	Percentage in Total Number of Fields	Area Covered (<i>Kanals-Merlas</i>)	Percentage in Area Covered	Land Type	Number of Fields	Percentage in Total Number of Fields	Area Covered (<i>Kanals-Merlas</i>)	Percentage in Area Covered
<i>Chahi</i>	772	53.8	2495-2	49.5	<i>Chahi</i>	708	67.8	2496	67.7
<i>Banjar Kadim</i>	74	5.1	147-17	2.9	<i>Banjar Kadim</i>	36	3.4	32	0.9
<i>Banjar Jadid</i>	45	3.1	27-0	0.5	<i>Banjar Jadid</i>	19	1.8	24	0.6
<i>Barani Awal</i>	34	2.4	129-11	2.6	<i>Barani</i>	281	26.9	1136	30.8
<i>Barani Daum</i>	439	30.6	1009-6	39.0	-	-	-	-	-
<i>Barani Saum</i>	72	5.0	231-10	4.6	-	-	-	-	-
Total	1436	100.00	4040-06	100.00	Total	1044	100.00	3688-00	100.00

Source: *Jamabandi* of Village Dhanowali-1914 and 1958.

(2) FIELD PATTERNS AND CONSOLIDATION OF LAND HOLDINGS IN FLAT UPLAND PLAINS WITH SAND DUNES (VILLAGE BATH)

A sample of three farmers (farming families) **A**, **B** and **C** have been taken from village Bath to find out the change in the scattering of holdings from pre-consolidation to post-consolidation phases.

In the pre-consolidation phase in 1914, the fields of these farmers were scattered in different parts of the village territory (Figure 4.6). Farmer **A** had 24 fields located at 9 sites, farmer **B** had 15 fields located at 7 sites and farmer **C** had 10 fields located at 5 sites. The values of Indices of Scattering of sites of fields for farmers **A**, **B** and **C** were 37.50 per cent, 46.66 per cent and 50.00 per cent respectively (Table 4.5). The Indices of Scattering of sites of fields of these farmers, after consolidation of land holdings in 1960 have experienced a big change. Their scattered fields have been grouped into compact blocks located at three sites each (Figure 4.7). The newly created 21 fields of farmer **A** have been grouped into three compact blocks located at three sites through the process of consolidation. The Index of Scattering of his fields has been reduced from 37.50 per cent in the pre-consolidation phase to 14.28 per cent in the post-consolidation phase (Table 4.5). Similarly, the newly created 10 fields of farmer **B** have been grouped into three compact blocks located at three sites and the Index of Scattering has been reduced to 30.00 per cent from 46.66 per cent. Likewise, in the case of farmer **C**, the number of fields has remained 10 both in pre-consolidation and post-consolidation phases, but his Index of Scattering has been reduced from 50.00 per cent in the pre-consolidation phase to 30.00 per cent in the post-consolidation phase because of the fall in his number of sites of fields from 5 to 3. The value of Indices of Scattering for farmers **A**, **B** and **C** are 37.50 per cent, 46.66 per cent and 50.00 per cent respectively, whereas the numerical value of I_{SD} (Index of Scattering in terms of Distance) is 1.524, 2.636 and 4.464 respectively in the pre-consolidation phase in 1914. The I_S of farmer **C** is more than that of farmer **A** and **B** yet his fields in terms of distance are less scattered as his numerical value of I_{SD} is more than that of the values of farmers **A** and **B**.

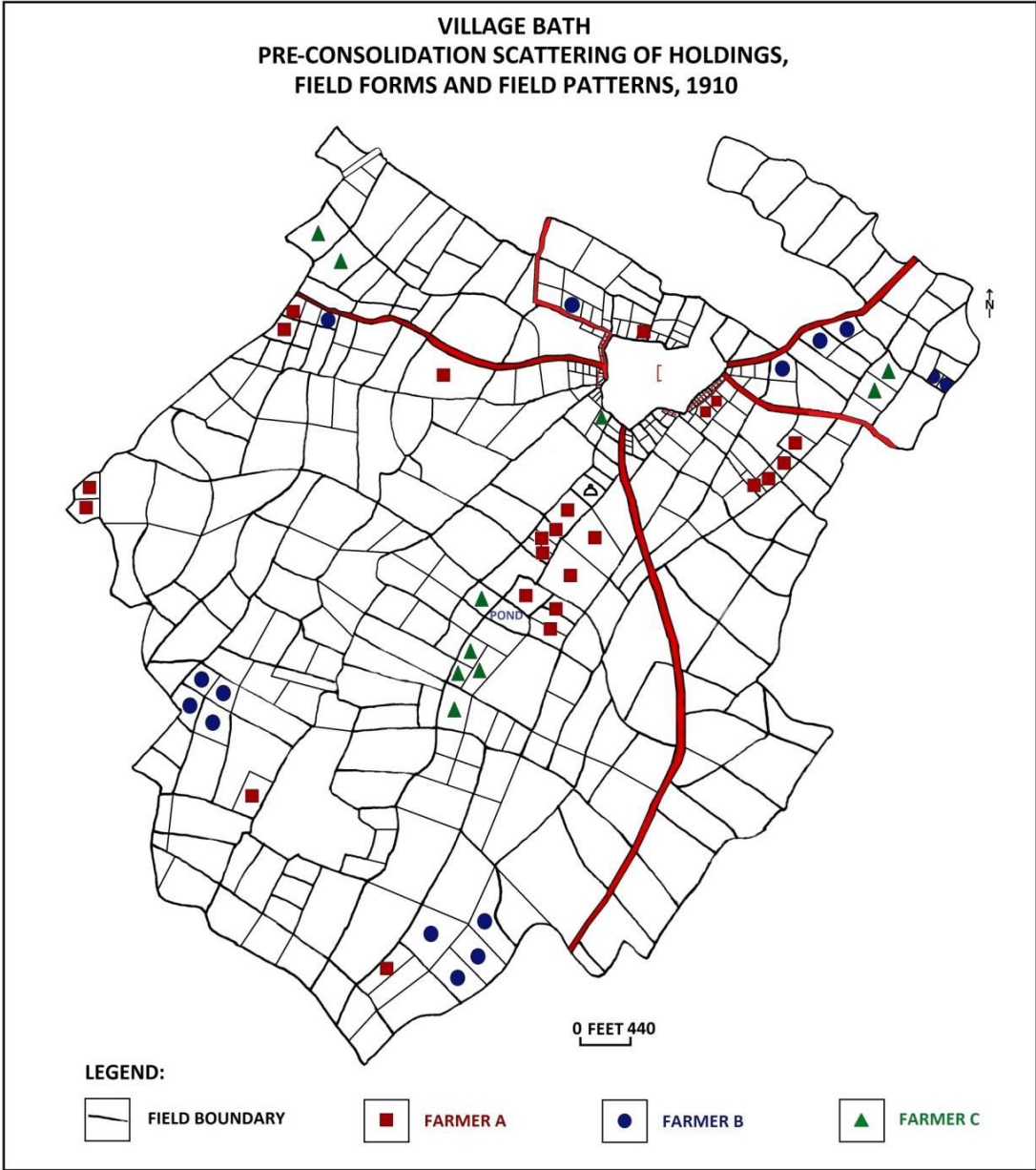


Figure 4.6

VILLAGE BATH
POST-CONSOLIDATION SCATTERING OF HOLDINGS,
FIELD FORMS AND FIELD PATTERNS, 1960

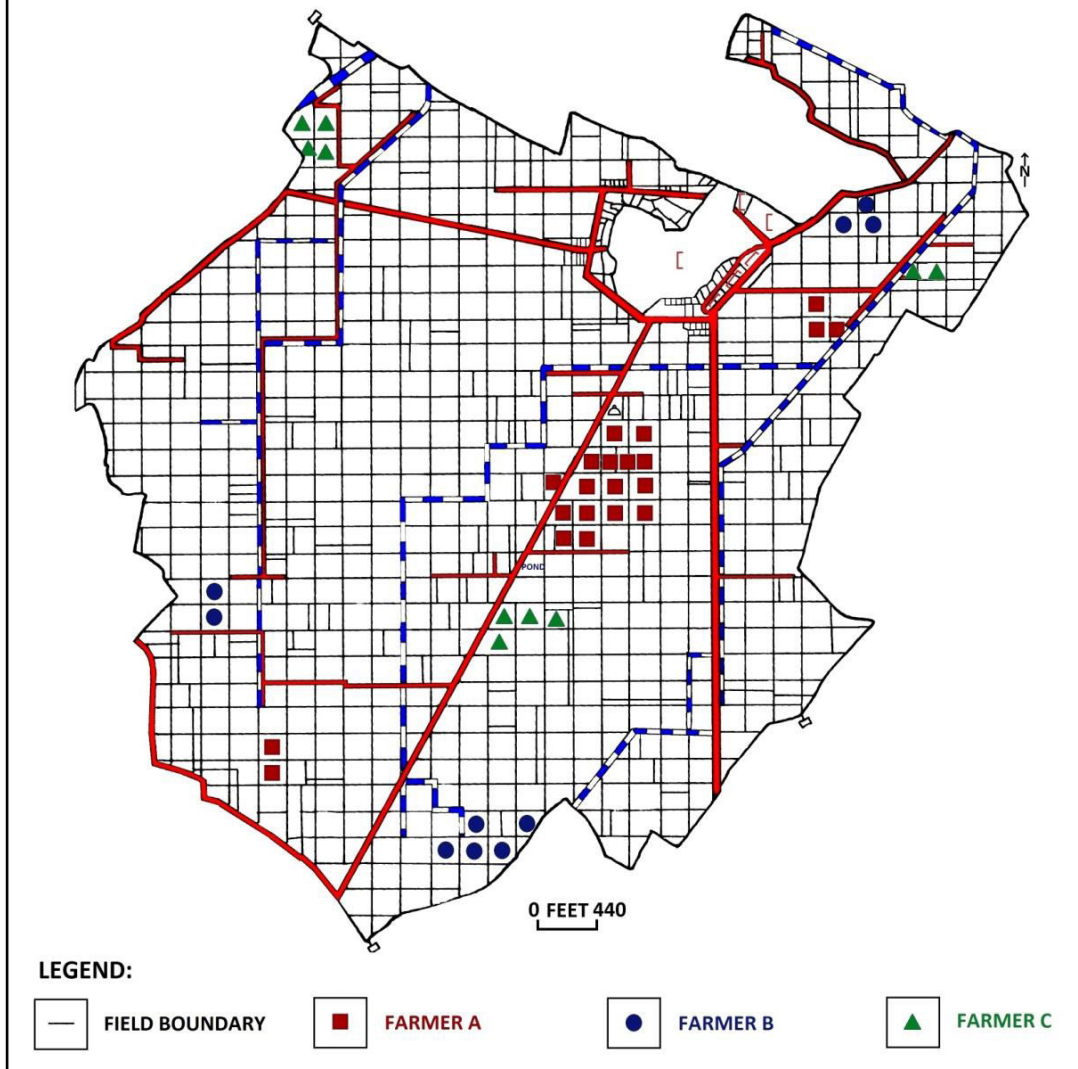


Figure 4.7

Table 4.5

Village Bath: Change in Degree of Scattering of Holdings from Pre-Consolidation to Post-Consolidation Phase

Pre-Consolidation Phase (1914)						Post-Consolidation Phase (1960)				
Owner	Number of Fields	Number of Sites	I _S	$\sum D_{SF}$ (In Inches)	I _{SD}	Number of Fields	Number of Sites	I _S	$\sum D_{SF}$ (In Inches)	I _{SD}
Farmer A	24	09	37.5	24.6	1.524	21	03	14.28	8.7	1.641
Farmer B	15	07	46.66	17.7	2.636	10	03	30.00	11.2	2.678
Farmer C	10	05	50.00	11.2	4.464	10	03	30.00	8.5	3.529

Source: *Jamabandi* of Village Bath-1914 and 1960.

I_S: Index of Scattering in per cent.

$\sum D_{SF}$: Cumulative Distance of Sites of Fields.

I_{SD}: Index of Scattering in terms of Distance.

In terms of I_S , the fields of farmer **A** are less scattered than that of farmers **B** and **C**, but in terms of I_{SD} , his fields are most scattered, as his numerical value of I_{SD} is the least.

In the post-consolidation phase in 1960, I_S and I_{SD} has changed to a great extent (Table 4.5). The I_S is reduced for all the three farmers. Scattering in terms of distance for farmers, **A** and **B** has also been reduced, though marginally as their numerical value of I_{SD} has increased. Scattering in terms of distance for farmer **C** has increased, as his numerical value of I_{SD} has decreased from 4.464 to 3.529 from pre to post consolidation phases. The value of I_S of farmer **B** and **C**, has reduced to 30.00 each in the post-consolidation phase yet in terms of I_{SD} fields of farmer **C** are less scattered than farmer **B**, as his numerical value of I_{SD} is more than farmer **B** in the post-consolidation phase. Therefore, in order to get more favourable results, it is valuable to use the I_{SD} along with I_S . The process of consolidation of land holdings has therefore, reduced the scattering of fields and has also reduced the cumulative distance travelled by the farmer to his fields to a considerable extent.

SIZE OF THE FIELDS

Consolidation of land holdings has also influenced the size of the fields to a great extent in the village Bath. The size of majority of the fields was exceptionally very large in the pre-consolidation phase because of less number of owners and also due to sand dune topography coupled with the complete absence of means of irrigation (Figure 4.6). The basic purpose of consolidation was to reduce the number of sites of fields to control scattering of land holdings. The number of fields has increased from 369 in the pre-consolidation phase in 1914 to 934 in the post-consolidation phase in 1960 (Table 4.6). This increase in the number of fields was due to the conversion of very large sized fields of above 8 *kanals* into uniform size of 8 *kanals*. The area under cultivation has reduced from 5409 *kanals*-5 *merlas* to 5228 *kanals*-18 *merlas*, between the pre and post- consolidation phases. The cultivated land was encroached upon by the construction of new roads, houses and other *gairmumkin* (uncultivable) land uses, causing reduction in the cultivated land in the post-consolidation phase.

Table 4.6

Village Bath: Field Size Analysis in the Pre-Consolidation and Post-Consolidation Phases

Pre-Consolidation Phase (1914)					Post-Consolidation Phase (1960)			
Field Size	Number of Fields	Percentage in Total Number of Fields	Area Covered (Kanal-Merlas)	Percentage in Total Cultivated Area Covered	Number of Fields	Percentage in Total Number of Fields	Area Covered (Kanal-Merlas)	Percentage in Total Cultivated Area Covered
Small (Below 1 Kanal)	40	10.85	27-10	0.51	68	07.28	37-03	0.75
Medium (1 Kanal to 4 Kanals)	42	11.38	13-05	0.24	281	30.08	94-07	1.88
Large (4 Kanals to 8 Kanals)	130	35.23	108-07	2.01	559	59.86	5069-12	96.81
Very Large (Above 8 Kanals)	157	42.54	5260-03	97.24	26	02.78	27-16	0.56
Total	369	100.00	5409-05	100.00	934	100.00	5228-18	100.00

Source: *Jamabandi* of Village Bath-1914 and 1960.

The fields of farmer **A** and **B** have decreased from 24 to 21 and 15 to 10 respectively, because earlier their fields were small in size, whereas fields of farmer **C** have increased from 10 to 14 due to the conversion of very large size fields of above 8 *kanals* into uniform size of 8 *kanals* in the post-consolidation phase. The number of such very large fields in the pre-consolidation phase was 157, which was exceptionally high, covering an area of 5260 *kanals*-3 *merlas*, which was more than 97 per cent of the total cultivated area. In the post-consolidation phase, the number of such fields was reduced to only 26 (2.78 per cent of total fields) covering an area of 27 *kanals*-16 *merlas*, with only 0.56 per cent of the total cultivated area (Table 4.6). These very large sized fields were found either inside the *phirni* (circular road around *abadi-deh*, settlement), where the process of consolidation was not undertaken due to the presence of many *gairmumkin* (uncultivable) land uses, along the village diagonal roads and on the village boundary, where very small sized fields were merged with the neighbouring one *killa* fields. All other very large sized fields of above 8 *kanals* were converted into rectangular fields of uniform size of one *killa* (8 *kanals* or 198 feet x 220 feet) each.

Large sized fields of 4 to 8 *kanals* were dominant both in terms of cultivated area covered and number of fields in the post-consolidation phase. These fields account for 559, nearly 60 per cent in the total number fields and 96.81 per cent of the total cultivated land in the post-consolidated phase. The number of such large sized fields was 130 covering nearly 35 per cent of the total fields with only 2.01 per cent of the total cultivated land in the pre-consolidation phase. Most of the large fields are rectangular in shape and are distributed everywhere in the village territory.

The medium sized fields of 1 to 4 *kanals* have also experienced a change in the post-consolidation phase. The number of medium size fields in the pre-consolidation phase was only 42 with 11.38 per cent share in the total number of fields and only 0.24 per cent in the total cultivated area in the pre-consolidation phase. The number of such fields rose to 281 with more than 30 per cent number in the total number of fields and nearly 2 per cent in the total cultivated area in the post-consolidation phase. These medium size fields were found distributed everywhere in the village territory but were more common near the *abadi-deh* (settlement), village roads and *khals* (water channels) because of more subdivisions of large fields due to their more economic value.

Small sized fields of below 1 *kanal* area experienced a little change in pre-consolidation and post-consolidation phases. Their number has increased from 40 to 68 between pre-consolidation and post-consolidation phases. The area covered by such fields has increased from 0.51 per cent to 0.75 per cent only. Although these fields were found scattered in the entire village territory, yet they were more common near the *abadi-deh* (settlement). The fields near *abadi-deh* (settlement) were small in size due to the greater degree of their sub-divisions. Every member of the family wants to have a piece of land near *abadi-deh* (settlement) because of its more economic value and future scope for house making.

An important dimension of adoption of process of consolidation has been the construction of *phirni* (a circular road around the village *abadi-deh*, main settlement) to restrict the expansion of settlement within the *phirni* and to reduce the effect of *abadi-deh* (settlement) on the size of the fields outside the *phirni*. The area under cultivated land was reduced due to the provision of new roads. The meandering roads common in the pre-consolidation phase were also straightened in the post-consolidation phase to shorten the distances. This has also affected the size of fields near the newly constructed roads.

SHAPE OF THE FIELDS

The process of consolidation has also influenced the shape of the fields in village Bath. In the pre-consolidation phase, the village territory was characterized by intermingled irregular fields (Figure 4.6). The fields of a farmer were found intermingled with the fields of other farmers due to fragmented holdings. Most of the fields were irregular rectangular, five sided polygon and four sided rectangular in shape. These three classes of shape of fields together accounted for 76.7 per cent of the total fields. Most of these three classes of fields were found intermingled with one another and with other shapes of fields. The micro topography dominated by sand dunes, at that time, would have been responsible in giving such shapes and orientations to most of the fields. Remaining 23.3 per cent fields were irregular hexagons, elongated strips, squares and triangular in shape (Table 4.7). As a result of adoption of process of consolidation these intermingled and irregular fields have been changed into regular rectangular fields of uniform size of 1 *killa* each (Figure 4.7). More than 72 per cent fields have become regular rectangular in shape followed by about 10 per cent quadrilateral in shape (Table 4.7). In the pre-

consolidation phase only 15 per cent of the fields were regular rectangular. The share of irregular rectangular quadrilateral fields has been reduced from 44.44 per cent to only 10 per cent during the pre and post consolidation phases. Triangular fields which accounted for only 3.25 per cent in the pre-consolidation phase increased to only 3.74 per cent in the post-consolidation phase. Such triangular fields were found more near the village boundary and the diagonal roads in the post-consolidation phase. Complete square fields have been reduced from 13 in the pre-consolidation phase to only 7 in the post-consolidation phase. The hexagon fields have also been reduced from 32 in the pre-consolidation phase to only 12 in the post-consolidation phase. Such non-rectangular fields were found mostly along the irregular village boundary, near the *abadi-deh* (settlement), diagonal roads, wells and tube- wells.

LAND TYPES AND FIELD PATTERNS

There is a close relationship between land types and the field patterns. Land types have experienced a change from pre to post consolidation phases in village Bath. Therefore, study of land types becomes necessary to understand the evolution of field patterns in pre-consolidation and post-consolidation phases. Pre-consolidation land types in the village Bath included *barani*, *banjar jadid*, *banjar kadim* and *tibba* (Figure 4.8). The characteristics of these land types have already been explained earlier in this chapter. Village Bath is situated in the upland plains with sand dunes with low water table, where deep wells and tube-wells were difficult to dig. *Barani* land type fields vary in size and shape and were found scattered everywhere in the village territory.

Table 4.7**Village Bath: Field Shape Analysis in the Pre-Consolidation and Post-Consolidation Phases**

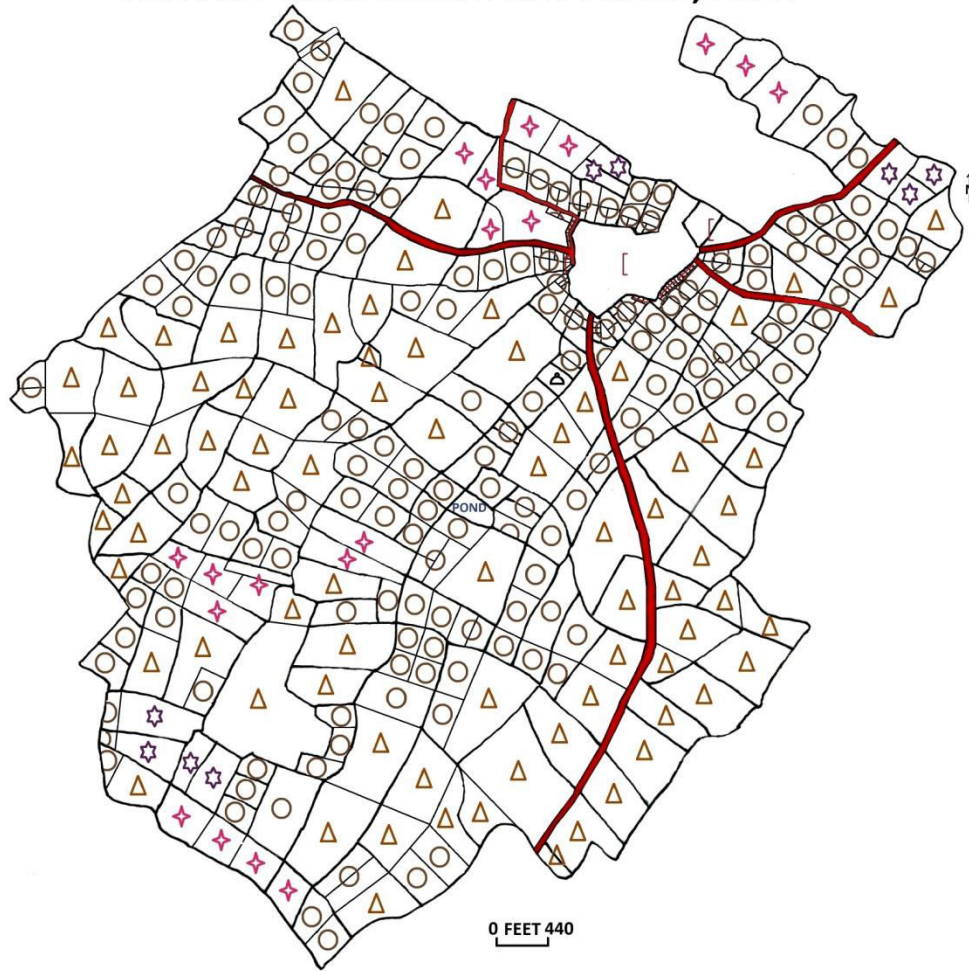
Field Shape Class	Pre-Consolidation Phase (1914)		Post-Consolidation Phase (1960)	
	Number of Fields	Percentage in Total Number of Fields	Number of Fields	Percentage in Total Number of Fields
Three Sided-Triangular	12	3.25	35	3.74
Four Sided-Square	13	3.53	07	0.75
Four Sided-Rectangular	57	15.44	678	72.59
Four Sided-Elongated Strip	29	7.86	71	7.61
Four Sided-With One or More Sides Oblique Irregular Rectangular or Quadrilateral	164	44.44	97	10.38
Five Sided-Polygons	62	16.81	34	3.65
Six Sided-Hexagons or More	32	8.67	12	1.28
Total	369	100.00	934	100.00

Source: *Shajra Kishtawar* of Village Bath-1914 and 1960.

Tibba land type fields found in the pre-consolidation phase in this village signifies the uneven sand dune topography. The shape and size of *tibba* land type fields were largely governed by the shape and size of the sand dunes, which were generally large in size and irregular in shape. Therefore, such *tibba* land types have very large sized and irregular shape fields in the pre-consolidation phase. The farmers did not pay much attention to them because of their poor economic returns. *Banjar kadim* and *banjar jadid* land type fields together covered an area of 8.94 per cent in the pre-consolidation phase and were distributed both near and away from the *abadi-deh* (settlement). Such fields in general were large in size and irregular in shape, with poor inherent fertility and productivity. These fields have largely been converted into *barani* fields in the post-consolidation phase. Both land types and field patterns have improved in the post-consolidation phases (Figure 4.9). The sand dunes of *tibba* land types have been levelled with the help of machines converting the village territory into a flat upland plain almost at par with the villages situated in the flat upland plains of *Doaba* and *Majha* regions of Punjab. *Khals* (irrigation channels) have been built in different parts of the village territory.

Many of the *barani* (rain-fed) land type fields, have been converted into *nahari* (canal irrigated) land type fields. The irregular shaped and very large sized fields, which dominated the landscape in the pre-consolidation phase, were converted into regular rectangular blocks of 8 *kanals* for easy supply of water from the newly constructed *khals* (small water channels) taken out from a distributary from Bathinda branch of famous Sirhind canal. Most of the *barani* (rain-fed) and *tibba* (sand covered) land types fields were converted into *nahari* (canal irrigated) land type fields. More than 67 per cent of the total fields covering more than 75 per cent of the total cultivated area of the village has been converted into *Nahari* (canal irrigated) land types (Table 4.8). *Barani* land type fields which covered more than 51 per cent of total cultivated area in the pre-consolidation phase were reduced to only 22.75 per cent in total cultivated area in the post-consolidation phase.

VILLAGE BATH LAND TYPES AND FIELD PATTERNS IN THE PRE-CONSOLIDATION PHASE, 1914

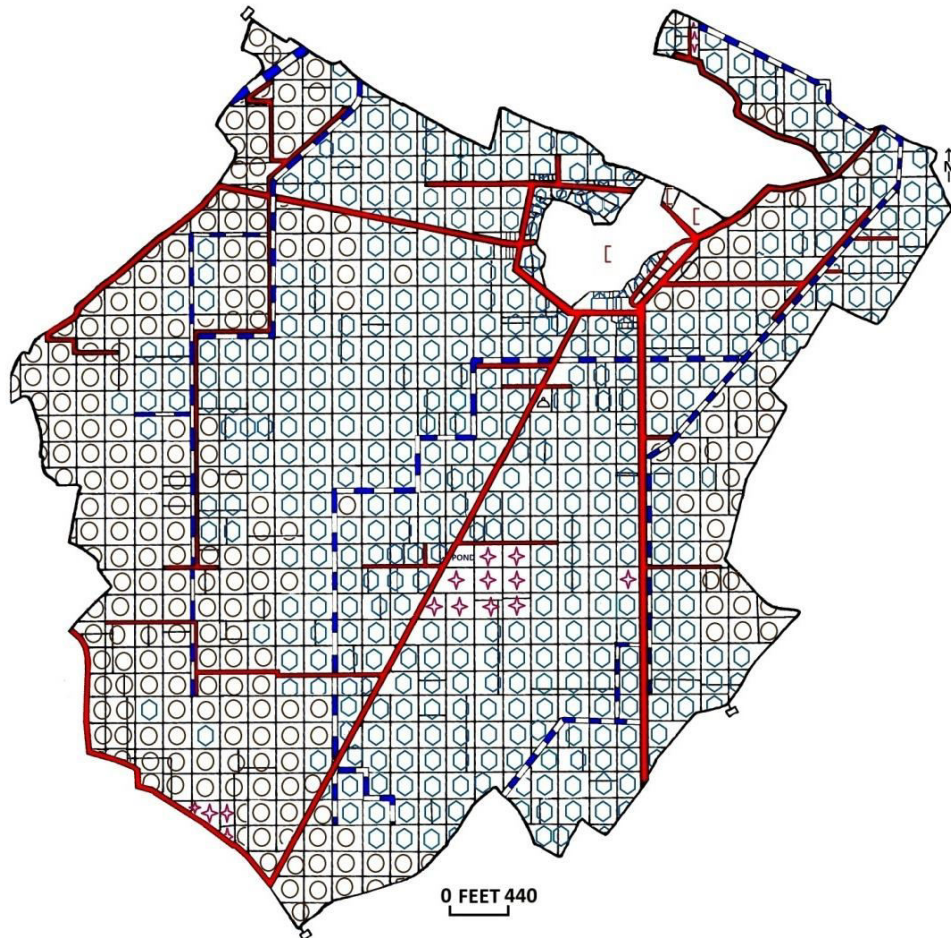


LEGEND:

 Hadbast Boundary	 Road	 Barani
 Field Boundary	 Cremation Ground	 Banjar Kadim
 Settlement	 Tibba	 Banjar Jadid

Figure 4.8

VILLAGE BATH
LAND TYPES AND FIELD PATTERNS IN
THE POST-CONSOLIDATION PHASE, 1960



LEGEND:











- | | | | | | |
|---|------------------|---|------------------|---|--------------|
|  | Hadbast Boundary |  | Road |  | Nahari |
|  | Field Boundary |  | Canal |  | Barani |
|  | Settlement |  | Cremation Ground |  | Banjar Kadim |
|  | Tubewell | | | | |

Figure 4.9

Table 4.8

Village Bath: Land Types of Cultivated Fields in the Pre-Consolidation and Post-Consolidation Phases

Pre-Consolidation Phase (1914)					Post-Consolidation Phase (1960)				
Land Type	Number of Fields	Percentage in Total Number of Fields	Area Covered (<i>Kanals-Merlas</i>)	Percentage in Area Covered	Land Type	Number of Fields	Percentage in Total Number of Fields	Area Covered (<i>Kanals-Merlas</i>)	Percentage in Area Covered
<i>Barani</i>	255	69.11	2785-06	51.49	<i>Barani</i>	284	30.41	1189-13	22.75
<i>Banjar Jadid</i>	11	02.98	23-10	0.44	<i>Banjar Kadim</i>	19	2.03	91-15	1.76
<i>Banjar Kadim</i>	22	05.96	72-06	1.34	<i>Nahari</i>	631	67.56	3947-10	75.49
<i>Tibba</i>	81	21.95	2528-03	46.73	-	-	-	-	-
Total	369	100.00	5409-05	100.00	Total	934	100.00	5228-18	100.00

Source: *Jamabandi* of Village Bath-1914 and 1960.

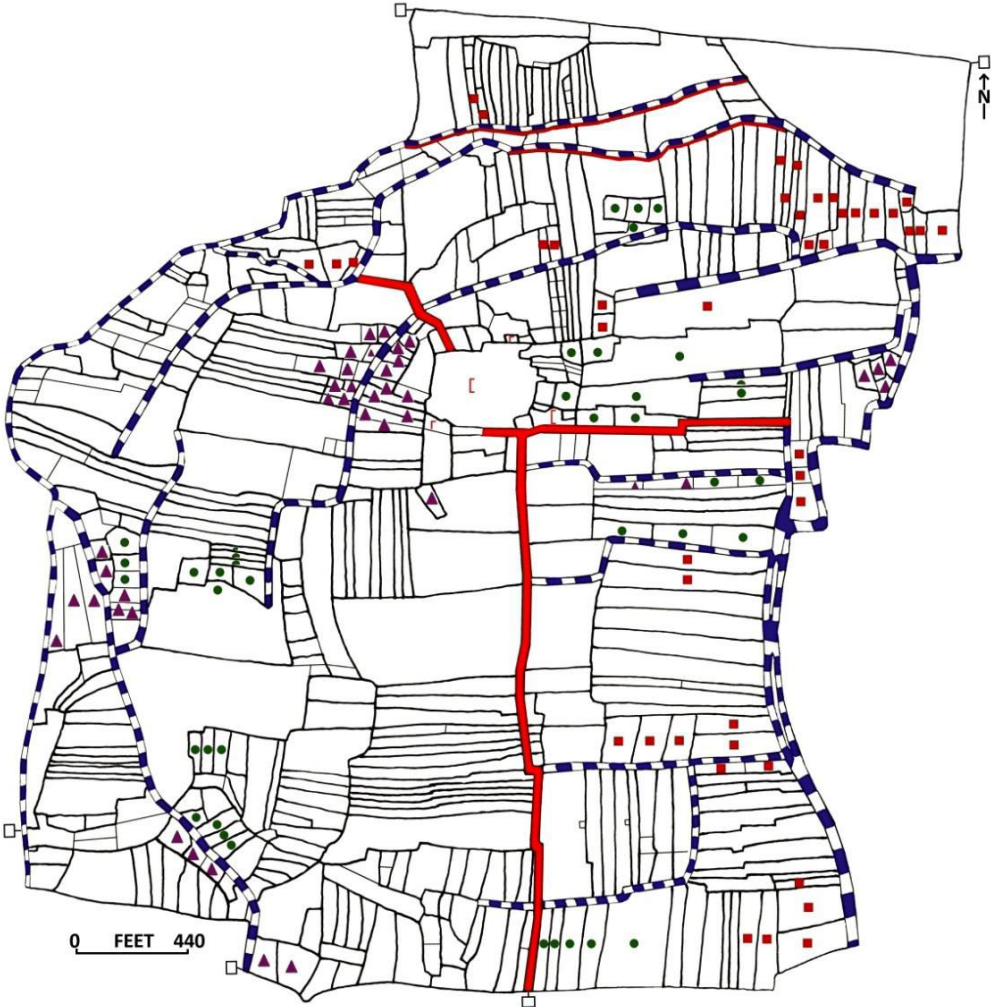
There was not much change with respect to *banjar kadim* land type fields in the number of fields and area covered by them, both in the pre and post-consolidation phases. Such fields in general were large in size and were found in different parts of the village territory largely due to human factors. Therefore, field patterns of the village were transformed by the adoption of the process of consolidation. The introduction of irrigation by the construction of canals has given them more economic value like many other villages of Punjab. This provided a solid foundation for the introduction of Green Revolution Technology in Punjab in 1966 (Randhawa, 1974).

(3) FIELD PATTERNS AND CONSOLIDATION OF LAND HOLDINGS IN PIEDMONT PLAINS (VILLAGE PATHAN CHAK)

To find out the change in the scattering of land holdings from pre-consolidation to post-consolidation phase, in the village Pathan Chak, a sample of three farmers (farming families) **A**, **B** and **C** have been taken to find out the change in the scattering of holdings from pre-consolidation to post-consolidation phases. In the pre-consolidation phase in 1914 the fields of these farmers were scattered in different parts of the village territory (Figure 4.10).

Farmer **A** had 43 fields located at 09 sites, farmer **B** had 45 fields located at 08 sites and farmer **C** had 40 fields located at 10 sites. The values of Indices of Scattering of sites of fields for farmers **A**, **B** and **C** come to be 20.93 per cent, 17.77 per cent and 25.00 per cent respectively (Table 4.9). There is observed a big change in the Index of Scattering of sites of fields of these farmers after consolidation of land holdings. Their scattered fields have been grouped into compact blocks located at three sites (Figure 4.11). The newly created 33 fields of farmer **A** have been grouped in to three compact blocks located at three sites through the process of consolidation.

VILLAGE PATHAN CHAK
PRE-CONSOLIDATION SCATTERING OF HOLDINGS,
FIELD FORMS AND FIELD PATTERNS, 1914



LEGEND:

- FIELD BOUNDARY
- FARMER A
- ▲ FARMER B
- FARMER C

Figure 4.10

**VILLAGE PATHAN CHAK
POST-CONSOLIDATION SCATTERING OF HOLDINGS,
FIELD FORMS AND FIELD PATTERNS, 1960**

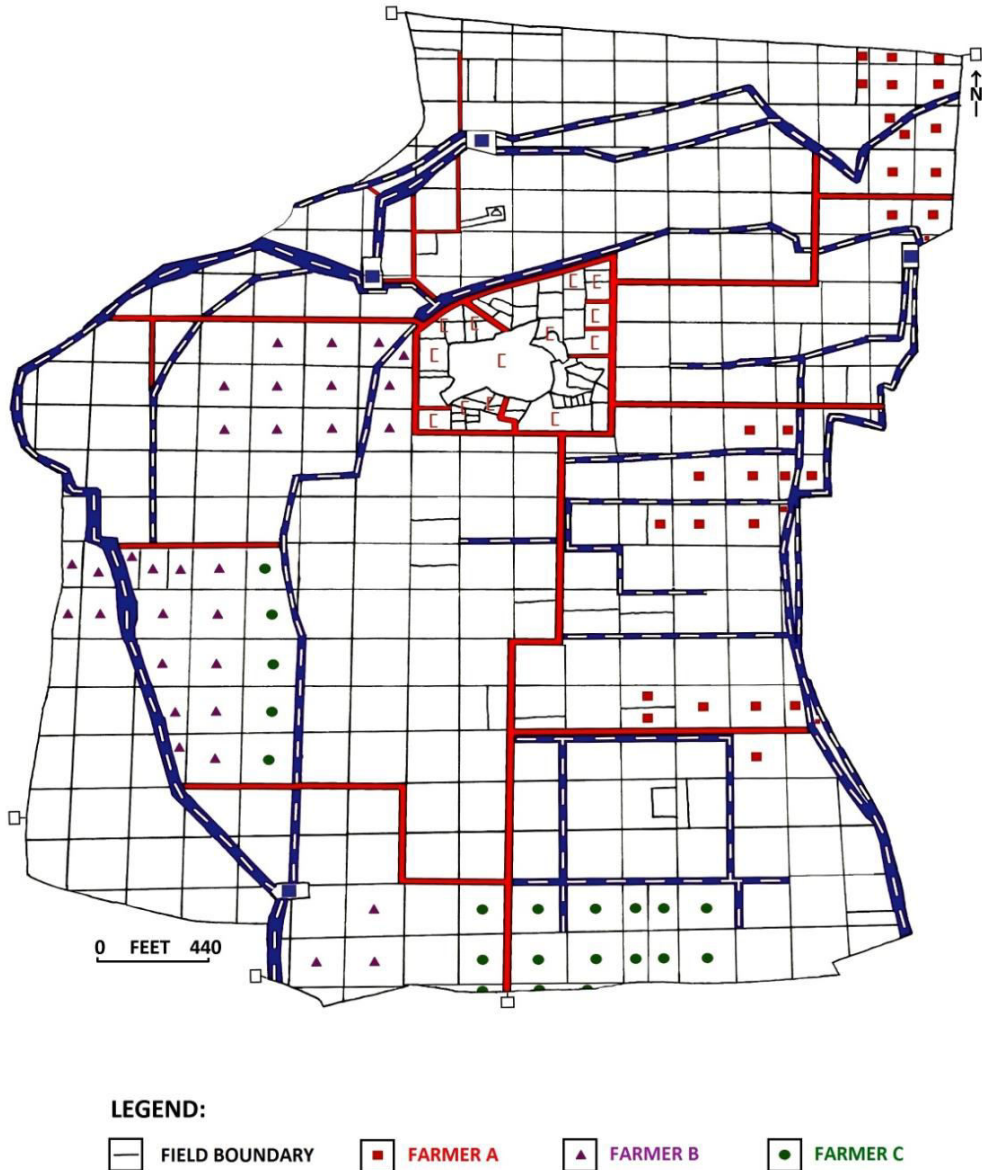


Figure 4.11

Table 4.9

Village Pathan Chak: Change in Degree of Scattering of Holdings from Pre-Consolidation to Post-Consolidation Phase

Pre-Consolidation Phase (1914)						Post-Consolidation Phase (1960)				
Owner	Number of Fields	Number of Sites	I _S	$\sum D_{SF}$ (In Inches)	I _{SD}	Number of Fields	Number of Sites	I _S	$\sum D_{SF}$ (In Inches)	I _{SD}
Farmer A	43	09	20.93	26.4	0.7928	33	03	9.09	8.8	1.0329
Farmer B	45	08	17.77	23.2	0.7620	33	03	9.09	10.6	0.8575
Farmer C	40	10	25.00	30.4	0.8223	30	03	10.0	10.4	0.9615

Source: *Jamabandi* of Village Pathan Chak-1914 and 1960.

I_S: Index of Scattering in per cent.

$\sum D_{SF}$: Cumulative Distance of Sites of Fields.

I_{SD}: Index of Scattering in terms of Distance.

The Index of Scattering of fields of farmer **A** has been reduced from 20.93 per cent in the pre-consolidation phase to 9.09 per cent in the post-consolidation phase (Table 4.9). Similarly, the newly created 33 fields of farmer **B** have been grouped into three compact blocks located at three sites and the Index of Scattering has been reduced to 9.09 per cent from 17.77 per cent. In the case of farmer **C**, both the number of fields and sites has reduced from 40 and 10 in the pre-consolidation phase to 30 and 3 in the post-consolidation phase respectively. The Index of Scattering is reduced from 25.00 per cent in the pre-consolidation phase to 10.00 per cent in the post-consolidation phase. The value of Indices of Scattering for farmers **A**, **B** and **C** were 20.93 per cent, 17.77 per cent and 25.00 per cent respectively, whereas the numerical value of I_{SD} (Index of Scattering in terms of Distance) were 0.7928, 0.7620 and 0.8223 respectively, in the pre-consolidation phase in 1910. The I_S of farmer **C** was found more than that of farmer **A** and **B**, yet his fields in terms of distance were less scattered as his numerical value of I_{SD} was more than that of the value of farmer **A** and **B**. In terms of I_S the fields of farmer **B** were less scattered than that of farmers **A** and **C**, but in terms of distance his fields were the most scattered as his numerical value of I_{SD} was the least.

In the post-consolidation phase in 1960, a change in the I_S and I_{SD} was very much evident. The I_S was reduced roughly by more than half for all the three farmers. Scattering in terms of distance has also been reduced for all the three farmers, as their numerical value of I_{SD} was increased. It is interesting to note here that in the post-consolidation phase, although the value of I_S of farmer **A** and **B** was same, yet in terms of distance fields of farmer **A** were less scattered than farmer **B**, as the numerical value of I_{SD} of farmer **A** was more than farmer **B**.

SIZE OF THE FIELDS

In village Pathan Chak consolidation of land holdings has influenced the size of the fields to a great extent. The size of the fields was different in the pre-consolidation and post-consolidation phases. The basic purpose of consolidation was to reduce the number of sites of fields. The number of fields has been reduced from 477 in the pre-consolidation phase in 1910 to 430 in the post-consolidation phase in 1960 (Table 4.10). This reduction in the number of fields was related more to the reduction in area under cultivation. The

area under cultivation got reduced to 1931 *kanals-8 merlas* from 2067 *kanals-13 merlas* between the pre and post consolidation phases. The cultivated land was encroached upon by the construction of new roads, houses and other *gairmumkin* (uncultivable) land uses, causing reduction in the total number of fields in the post-consolidation phase. The fields of farmer **A**, **B** and **C** have decreased from 43 to 33, 45 to 33 and 40 to 30 respectively. Here the number of fields has decreased due to the conversion of very large size fields of above 8 *kanals* in the post-consolidation phase. The number of such very large fields in the pre-consolidation was 95, covering an area of 773 *kanals-4 merlas*, more than 37 per cent of the total cultivated area. In the post-consolidation phase the number of such fields were reduced to only 3 (0.69 per cent of total fields) covering an area of 26 *kanals-2 merlas* with 1.35 per cent of the total cultivated area (Table 4.10). It is interesting to note that all these 3 fields of very large size were also found inside the *phirni* (circular road around *abadi-deh*, settlement) where the process of consolidation was not undertaken due to the presence of many *gairmumkin* (uncultivable) land uses. All other very large sized fields of above 8 *kanals* were converted into rectangular fields of uniform size of one *killa* (8 *kanals* or 198 feet x 220 feet) each.

Large sized fields of 4 to 8 *kanals* are dominant both in terms of cultivated area covered and number of fields in the pre-consolidation and post-consolidation phases. These fields account for more than 44 per cent of the total fields and 51.53 per cent of the total cultivated land in the pre-consolidation phase. The number of such large sized fields has increased to 51.63 per cent of the total fields covering nearly 79 per cent of the total cultivated land in the post consolidation phase. Most of the large fields were rectangular in shape and were distributed everywhere in the village territory.

Table 4.10

Village Pathan Chak: Field Size Analysis in the Pre-Consolidation and Post-Consolidation Phases

Pre-Consolidation Phase (1914)					Post-Consolidation Phase (1960)			
Field Size	Number of Fields	Percentage in Total Number of Fields	Area Covered (<i>Kanals-Merlas</i>)	Percentage in Total Cultivated Area Covered	Number of Fields	Percentage in Total Number of Fields	Area Covered (<i>Kanals-Merlas</i>)	Percentage in Total Cultivated Area Covered
Small (Below 1 <i>Kanal</i>)	46	9.64	22-02	1.06	69	16.05	38-04	1.97
Medium (1 <i>Kanal</i> to 4 <i>Kanals</i>)	126	26.41	207-05	10.02	136	31.63	394-02	18.59
Large (4 <i>Kanals</i> to 8 <i>Kanals</i>)	210	44.02	1065-02	51.53	222	51.63	1536-06	78.09
Very Large (Above 8 <i>Kanals</i>)	95	19.91	773-04	37.39	03	0.69	26-02	1.35
Total	477	100.00	2067-13	100.00	430	100.00	1994-14	100.00

Source: *Jamabandi* of Village Pathan Chak-1914 and 1960.

The medium sized fields of 1 to 4 *kanals* have also experienced a change in the post-consolidation phase. The number of medium size fields was the second largest both in the pre-consolidation phase with 26.41 per cent share and 31.63 per cent share in the post-consolidation phase in the total number of fields. Such fields may be found in any part of the village territory but were more common near the *abadi-deh* (settlement).

Small sized fields of below 1 *kanal* area experienced a change from 9.64 per cent in pre-consolidation phase to 16.05 per cent in the post-consolidation phase. Their number has increased from 46 to 69 between pre-consolidation and post-consolidation phases. The area covered by such fields has increased from 1.06 per cent to 1.97 per cent. Although these fields were found scattered in the entire village territory, yet they were more common near the *abadi-deh* (settlement). The fields near *abadi-deh* (settlement) were small in size due to the greater degree of their sub-divisions. Every member of the family wants to have a piece of land near *abadi-deh* (settlement) because of its more economic value and future scope for house making. *Phirni* (a circular road) was constructed around the village *abadi-deh* (settlement) like the previous study villages to restrict the settlement within the *phirni* to reduce the effect of *abadi-deh* (settlement) on the fields outside the *phirni*. The area under cultivated land was reduced due to the provision of such new roads. This has also affected the size of fields near the newly constructed *phirni* (a circular road).

SHAPE OF THE FIELDS

The process of consolidation also has a great influence on the shape of the fields. In the pre-consolidation phase, the village territory was characterized by irregular fields (Figure 4.10). Most of the fields were irregular rectangular, elongated strip and rectangular in shape. These three classes of shape of fields together accounted for 78.6 per cent of the total fields. Most of these three classes of fields were oriented towards the *choes* and *khals* for easy access to water for irrigation. Remaining 21.4 per cent fields were Irregular hexagons, polygons, squares and triangular in shape (Table 4.11). As a result of adoption of process of consolidation these irregular fields have changed into regular rectangular fields of uniform size of 1 *killa* each (Figure 4.11). More than 45 per cent fields have become regular rectangular in shape followed by 24 per cent quadrilateral shape (Table

4.11). In the pre-consolidation phase only 13 per cent of the fields were regular rectangular. The share of irregular rectangular quadrilateral fields has reduced from 33.75 per cent to 24 per cent during the pre and post consolidation phases. Triangular fields which accounted for only 0.83 per cent in the pre-consolidation phase jumped to 9.53 per cent in the post-consolidation phase. Such triangular fields have replaced accentuated rectangular strips near the village boundary in the post-consolidation phase. Complete square fields were absent in post-consolidation phase. Not much change was found in the percentage of polygon and hexagon fields in the post-consolidation phase. Such non-rectangular fields were found mostly along the irregular village boundary, near the *abadi-deh* (settlement), diagonal roads, wells and tube-wells as in the case of other villages.

LAND TYPES AND FIELD PATTERNS

The Land types and field patterns are closely related. Land types have experienced a change both in space and time. The study of land types becomes necessary to understand the evolution of field patterns in pre-consolidation and post-consolidation phases.

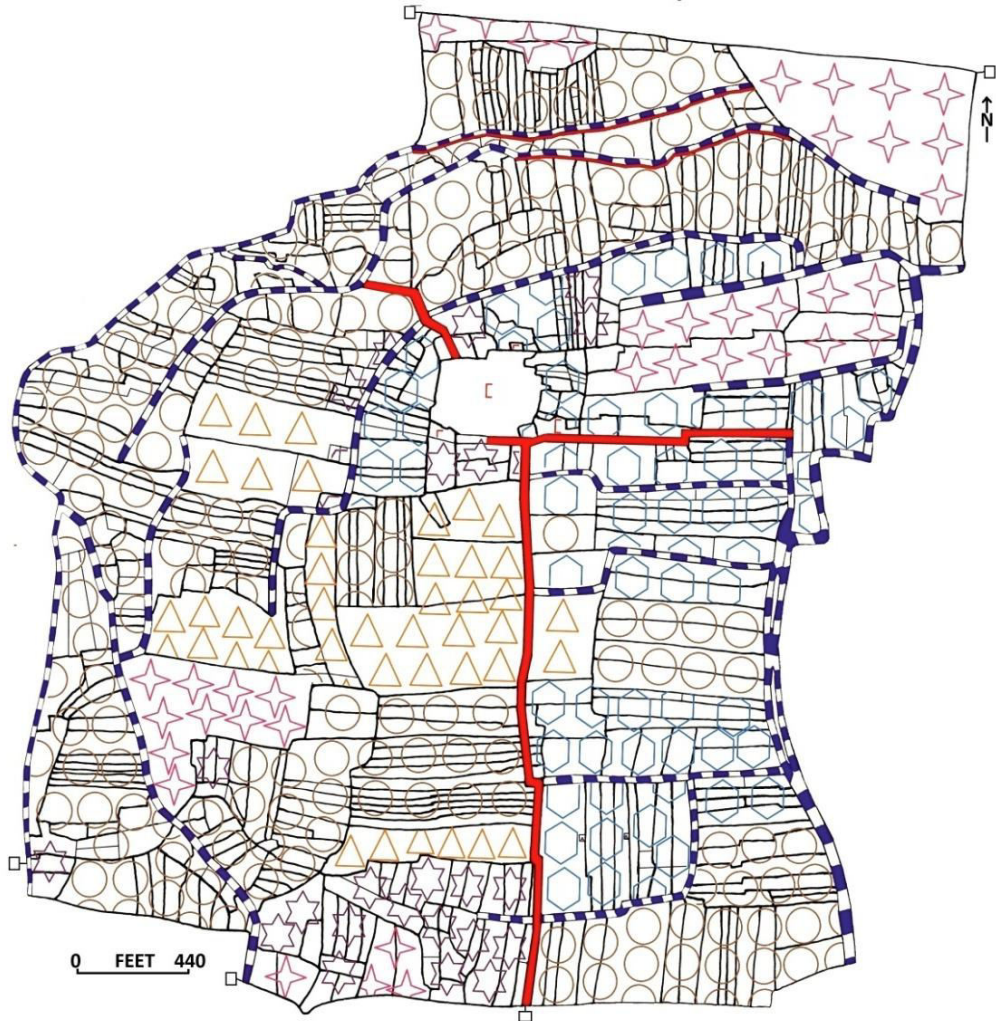
Pre-consolidation land types in the village Pathan Chak included *nahari*, *banjar kadim*, *banjar jadid*, *barani* and *tibba* (Figure 4.12). The characteristics of these land types have already been explained earlier in this chapter. The village Pathan Chak is situated near the Shiwalik hills with low water table, where deep wells and tube-wells are difficult to dig. Therefore, predominant land type found both in the pre-consolidation and post-consolidation phase is *barani* (Figures 4.12 and 4.13). Area under *barani* land type fields has increased from 813 *kanals-6 merlas* to 1080 *kanals-2 merlas* in the post-consolidation phase due to the conversion of *tibba* and *banjar jadid* land types in to *barani* land types. *Barani* land type fields vary in size and shape and were found scattered in the village territory.

Table 4.11**Village Pathan Chak: Field Shape Analysis in the Pre-Consolidation and Post-Consolidation Phases**

Field Shape Class	Pre-Consolidation Phase (1914)		Post-Consolidation Phase (1960)	
	Number of Fields	Percentage in Total Number of Fields	Number of Fields	Percentage in Total Number of Fields
Three Sided-Triangular	04	0.84	41	9.54
Four Sided-Square	05	1.05	NIL	NIL
Four Sided-Rectangular	63	13.21	196	45.59
Four Sided-Elongated Strip	151	31.64	31	07.20
Four Sided-With One or More Sides Oblique Irregular Rectangular or Quadrilateral	161	33.76	103	23.95
Five Sided-Polygons	45	9.44	32	7.45
Six Sided-Hexagons or More	48	10.06	27	6.27
Total	477	100.00	430	100.00

Source: *Shajra Kishtawar* of Village Pathan Chak-1914 and 1960.

**PATHAN CHAK
LAND TYPES AND FIELD PATTERNS IN
THE PRE-CONSOLIDATION PHASE, 1914**

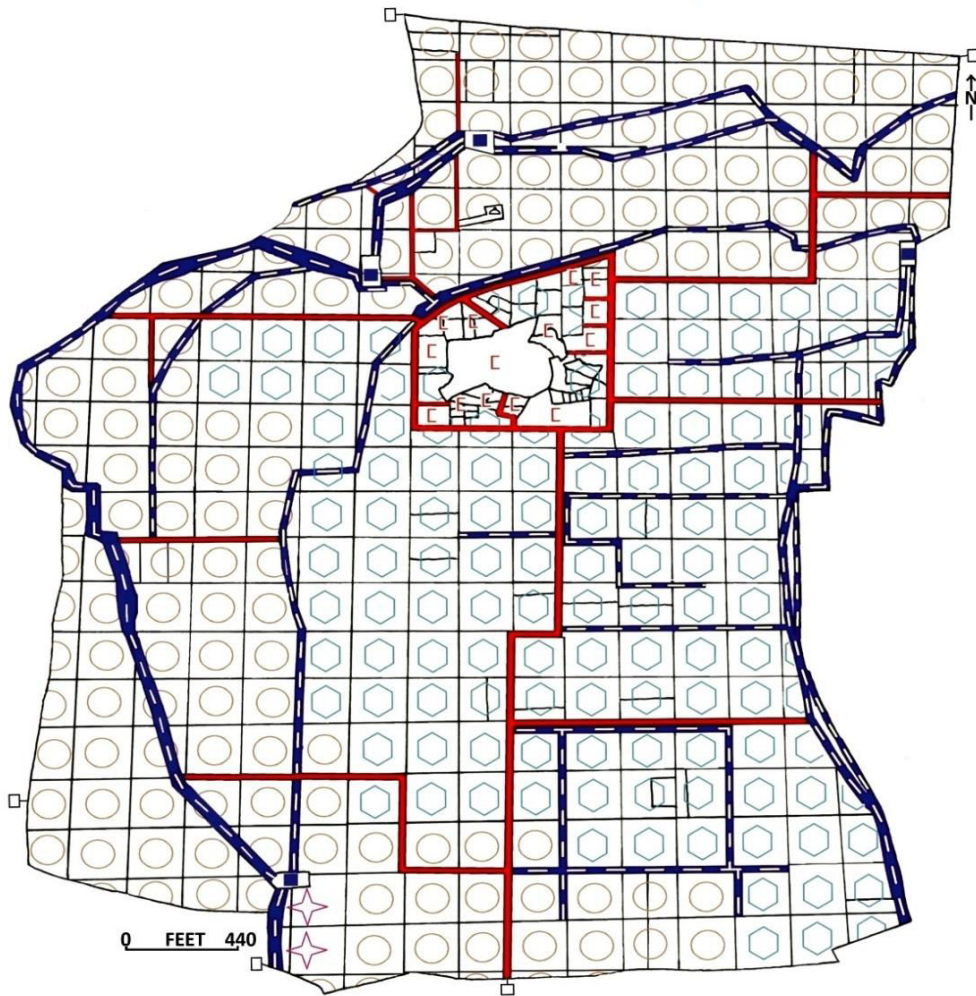


LEGEND:

- | | | | | | |
|--|------------------|--|------------|--|--------------|
| | Hadbast Boundary | | Choe/Naala | | Nahari |
| | Field Boundary | | Tibba | | Banjar Kadim |
| | Settlement | | Barani | | Banjar Jadid |
| | Road | | | | |

Figure 4.12

**PATHAN CHAK
LAND TYPES AND FIELD PATTERNS IN
THE POST-CONSOLIDATION PHASE, 1960**



LEGEND:

- | | | |
|--|--|---|
|  Hadbast Boundary |  Choe/Naala |  Nahari |
|  Field Boundary |  Cremation Ground |  Barani |
|  Settlement |  Road |  Banjar Kadim |

Figure 4.13

Table 4.12

Village Pathan Chak: Land Types of Cultivated Fields in the Pre-Consolidation and Post-Consolidation Phases

Pre-Consolidation Phase (1914)					Post-Consolidation Phase (1960)				
Land Type	Number of Fields	Percentage in Total Number of Fields	Area Covered (Kanals-Merlas)	Percentage in Area Covered	Land Type	Number of Fields	Percentage in Total Number of Fields	Area Covered (Kanals-Merlas)	Percentage in Area Covered
<i>Nahari</i>	139	29.14	416-02	20.12	<i>Nahari</i>	167	38.83	896-10	44.93
<i>Banjar Kadim</i>	13	2.72	248-03	11.99	<i>Banjar Kadim</i>	04	0.93	18-02	0.92
<i>Banjar Jadid</i>	59	12.36	302-00	14.61	<i>Barani</i>	259	60.23	1080-02	54.16
<i>Barani</i>	256	53.66	813-06	39.33	-	-	-	-	-
<i>Tibba</i>	10	2.09	288-02	13.93	-	-	-	-	-
Total	477	100.00	2067-13	100.00	Total	430	100.00	1994-14	100.00

Source: *Jamabandi* of Village Pathan Chak-1914 and 1960.

Tibba land type found in the pre-consolidation phase in this village signifies its uneven topography. Therefore, such *tibba* land types have very large sized fields with irregular shapes in the pre-consolidation phase. *Nahari* land type fields are common both in pre-consolidation and post-consolidation phases. *Nahari* land type in this village signifies the fields which were irrigated by *khals*, *kuhals* and *choes*. Such *nahari* fields covered 416 *kanals-2 merlas* land (20 per cent) in the pre-consolidation phase and area under them increased to 896 *kanals-10 merlas* (44.93 per cent) in the post-consolidation phase. *Nahari* fields were small in size and were usually accentuated strips in shape with orientation towards the *choes* and *khals* during pre-consolidation phase. *Banjar kadim* and *banjar jadid* land type fields together covered an area of 26.61 per cent in the pre-consolidation phase and were distributed both near and away from the *abadi-deh* (settlement). Such fields in general are large in size and irregular in shape with poor inherent fertility and productivity. These fields have largely been converted into *barani* and *nahari* fields in the post-consolidation phase (Figure 4.13). Both land types and field patterns have improved from pre-consolidation to post-consolidation phases.

(B) FIELD PATTERNS IN THE UNCONSOLIDATED VILLAGES

The *killabandi* process of consolidation of land holdings was not implemented in many of the villages situated in north-east Punjab due to physiographic obstacles. Two of the sample villages namely Khera Bagh and Rohg Teeka Khakhoh situated in the flood plains and the Shiwalik hills respectively, were not brought under the process of consolidation due to the physiographic limitations by the State Government. The historical evolution of field pattern was not disrupted due to the non-implementation of consolidation of land holdings in all such villages of the state of Punjab. The holdings of farmers were consisted of a number of fields located at different sites and in different directions of the village territory.

The fields constituting the holdings of different farmers were mostly intermingled. The size, shape and land types of the fields during this phase has not been changed much, which were evident from the land types maps of 1914 and 1986 in the village Khera Bagh (Figures 4.16 and 4.17) and 1914 and 1964 in the village Rohg Teeka Khakhoh respectively (Figures 4.20 and 4.21).

(1) FIELD PATTERNS IN KHERA BAGH BETWEEN 1914 AND 1986

Village Khera Bagh has been selected from the flood plains along the *Doon* (valley) area of river Sutlej situated in Nangal tehsil of Rupnagar district. The village is a flood plain village surrounded by mountains in the neighbourhood. The river Sutlej flows along the eastern and south-eastern side of the village. Majority of the fields situated near the river remain water-logged, giving them an appearance of wetlands. Such fields fall in the category of *banjar kadim* (fields left vacant for more than eight cropping seasons) from 1884 to 2016 continuously. The village also experiences alluviation as well as eluviation during active floods, resulting into frequent changes in the total area of the village. Due to such physiographic limitations the village was not adopted by the Punjab Land Revenue Department for *killabandi* process of consolidation of land holdings. The holdings of farmers were consisted of a number of fields located at different sites and in different directions of the village territory. The maps drawn on ownership of cultivated land of village Khera Bagh in 1914 and 1986 in the chapter on evolution of field patterns justify it. The fields constituting the holdings of different farmers were mostly intermingled. The size, shape and land type of the fields during these phases has not been changed much. Thus, the field patterns have not changed much in the village in comparison to the villages where there was a complete transformation of field patterns due to the implementation of process of consolidation during the same phases.

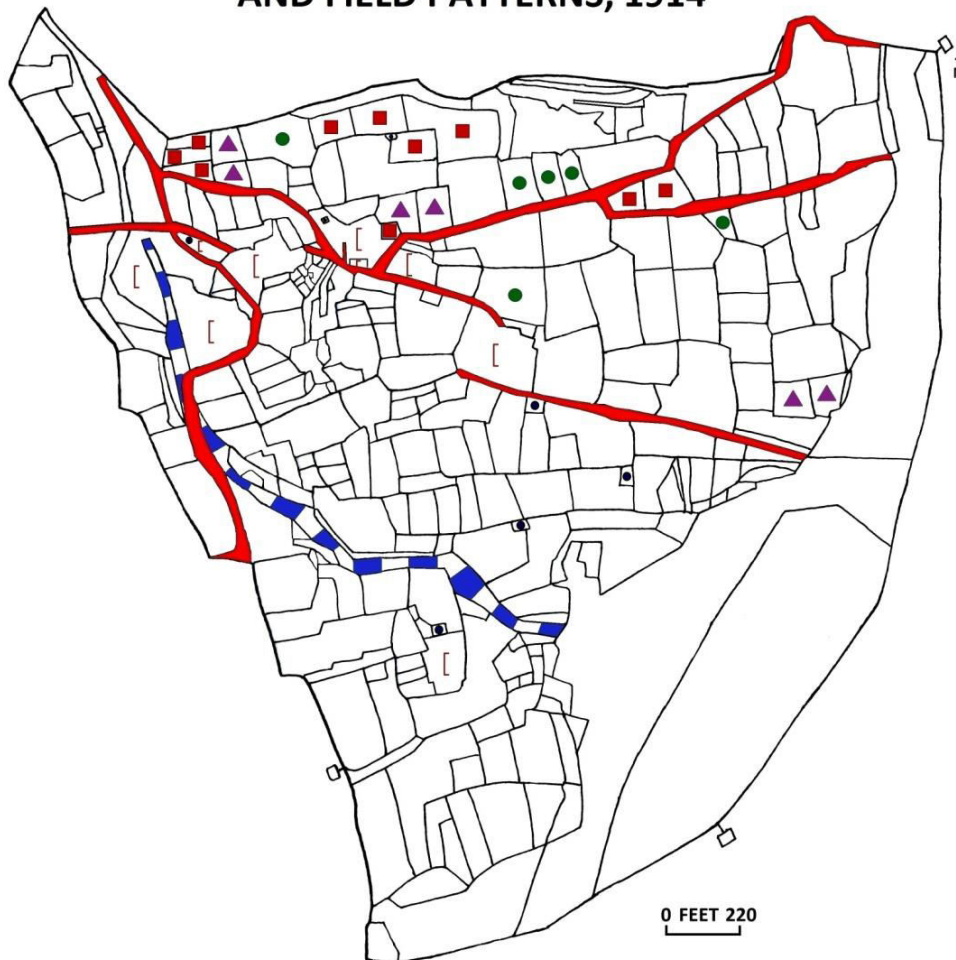
SCATTERING OF HOLDINGS AND FIELD PATTERNS

A sample of three farmers (farming families) **A**, **B** and **C** have been taken from village Khera Bagh to find out the evolutionary changes in the scattering of holdings between 1914 and 1986 phases in the absence of adoption of process of *killabandi*. In 1914 phase, the fields of these farmers were scattered in different parts of the village territory (Fig 4.14). Farmer **A** had 10 fields located at 4 sites, farmer **B** had 6 fields located at 4 sites and farmer **C** had 6 fields located at 3 sites. The value of Indices of Scattering of sites of fields for farmers **A**, **B** and **C** was 40.00 per cent, 66.66 per cent and 50.00 per cent respectively (Table 4.13). The Indices of Scattering of sites of fields of these farmers after a gap of 72 years from 1914 to 1986 has experienced a change but not to the extent which was experienced in the villages where consolidation of land holdings were

implemented. The fields of the farmers remained scattered in 1986 phase due to the non-implementation of *killabandi* of land holdings process because of physiographic limitations (Figure 4.15). The number of fields of farmer **A** has declined from 10 in 1914 to 6 in 1986 but the number of sites remained 4 in both these phases. Therefore, Index of Scattering of his fields has increased from 40.00 per cent in the 1914 phase to 66.66 per cent in the 1986 phase (Table 4.13). Similarly, the fields of farmer **B** have declined from 6 to 5 and his number of sites remained same in both these phases and as a result, the Index of Scattering has increased to 80.00 per cent from 66.66 per cent. In the case of farmer **C**, the number of fields has increased from 6 to 8 during these phases and the number of sites of his fields remained 3 in both the phases. As a result, Index of Scattering of his fields has reduced from 50.00 per cent in the 1914 to 37.50 per cent in the 1986 because of the increase in his number of fields from 6 to 8.

The value of Indices of Scattering for farmers **A**, **B** and **C** were 40.00 per cent, 66.66 per cent and 50.00 per cent respectively, whereas the numerical value of I_{SD} (Index of Scattering in terms of Distance) were 5.555, 7.091 and 7.352 respectively, in the 1914 phase. The I_S of farmer **B** is more than that of farmer **A**, yet his fields in terms of distance are less scattered as his numerical value of I_{SD} is more than that of the values of farmer **A**. Similarly, in terms of I_S , the fields of farmer **B** were more scattered than that of farmers **A** and **C** but in terms of I_{SD} , his fields were less scattered than Farmer **A** as his numerical value of I_{SD} was greater. In the 1986 phase, I_S and I_{SD} have experienced a change but not to the extent of the villages where consolidation of land holdings was adopted. The number of sites of fields occupied by the farmers remained same in this village during 1914 and 1986 phases. The I_S and I_{SD} experienced a change due to the change in the number of fields occupied by the farmers. The I_S has increased for the farmers **A** and **B** due to decrease in the number of their fields from 10 to 6 and from 6 to 5 respectively, between 1914 and 1986, whereas the index of scattering of farmer **C** has reduced from 50.00 to 37.50 between 1914 and 1986, due to increase in the number of his fields from 6 to 8 during 1914 and 1986 respectively. Scattering in terms of distance for farmers **A** and **B** has reduced as their numerical value of I_{SD} has increased. Index of scattering in terms

**VILLAGE KHERA BAGH
SCATTERING OF HOLDINGS, FIELD FORMS
AND FIELD PATTERNS, 1914**



LEGEND:

-  FIELD BOUNDARY
-  FARMER A
-  FARMER B
-  FARMER C

Figure 4.14

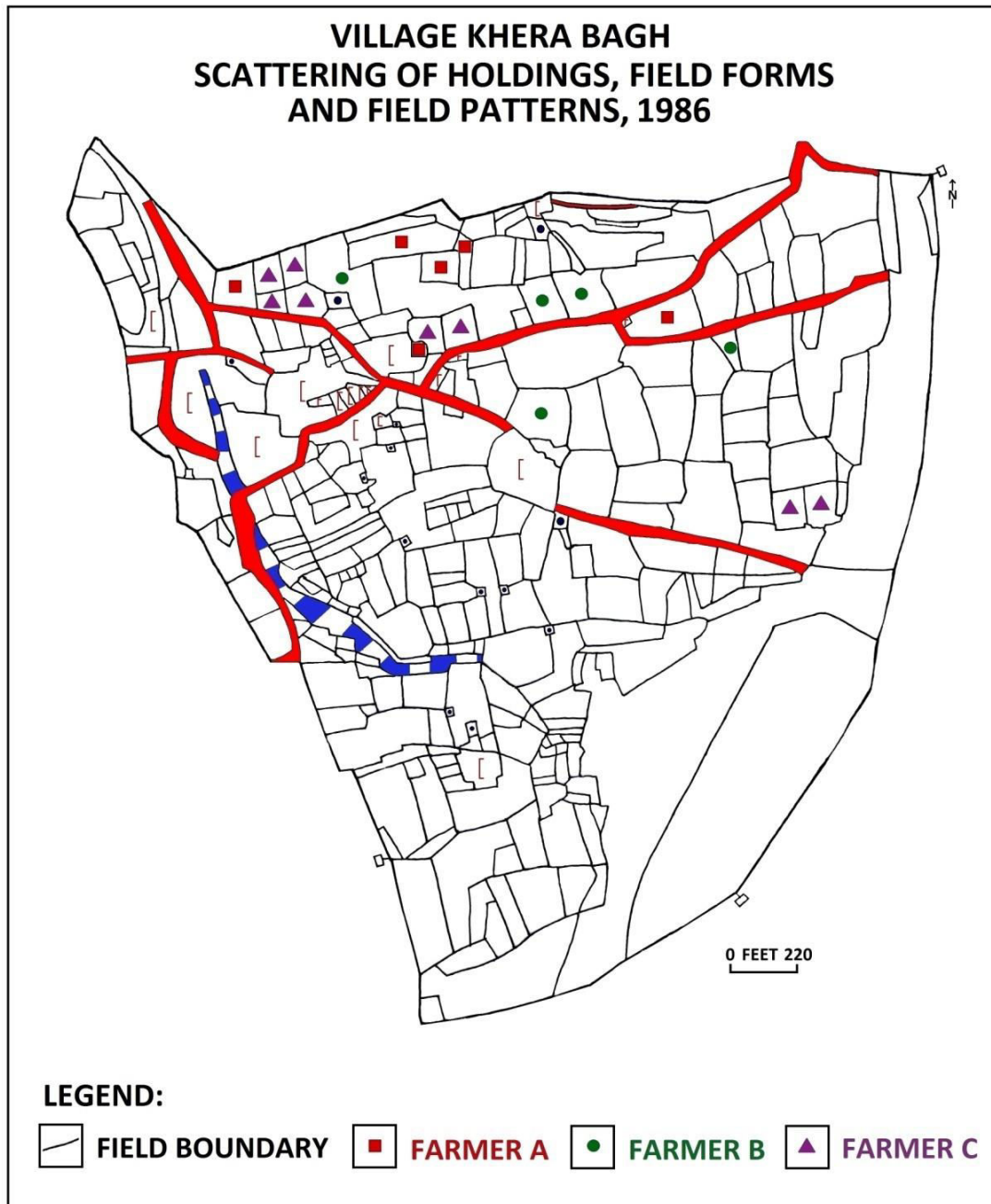


Figure 4.15

Table 4.13

Village Khera Bagh: Change in Degree of Scattering of Holdings from 1914 to 1986 Phase

Scattering of Holdings (1914)						Scattering of Holdings (1986)				
Owner	Number of Fields	Number of Sites	I _S	$\sum D_{SF}$ (In Inches)	I _{SD}	Number of Fields	Number of Sites	I _S	$\sum D_{SF}$ (In Inches)	I _{SD}
Farmer A	10	4	40.00	7.2	5.555	6	4	66.66	7.2	9.258
Farmer B	6	4	66.66	9.4	7.091	5	4	80.00	9.4	8.510
Farmer C	6	3	50.00	6.8	7.352	8	3	37.50	6.8	5.514

Source: *Jamabandi* of Village Khera Bagh-1914 and 1986.

I_S: Index of Scattering in per cent.

$\sum D_{SF}$: Cumulative Distance of Sites of Fields.

I_{SD}: Index of Scattering in terms of Distance.

of distance for farmer **A** has become least as his numerical value of **I_{SD}** has increased to maximum from 5.555 to 9.258. Scattering in terms of distance for farmer **C** has maximised as his numerical value of **I_{SD}** has decreased from 7.352 to 5.514 between 1914 and 1986. Scattering of land holdings still persist and the field patterns have not experienced much change in the village Khera Bagh due to non-implementation of process of *killabandi* of land holdings because of physiographic limitations.

SIZE OF THE FIELDS

The number of fields in the village Khera Bagh has increased from 267 in 1914 to 283 in 1986 due to the sub-division of the existing fields. This has resulted into change in the size of the fields (Table 4.14). The number of small size fields of below one *kanal* has increased from 33 (12.36 per cent share in total number of fields) in 1914 to 45 (15.90 per cent share in total number of fields) in 1986. The percentage in total cultivated area covered by small size fields has increased from 2.48 per cent (23 *kanals*-13 *merlas*) to 3.42 per cent (31 *kanals*-02 *merlas*) from 1914 to 1986. The cultivated area covered by the small size fields of below one *kanal* is least both in 1914 and 1986. The number of medium size fields from one *kanal* to four *kanals* was maximum both in 1914 and 1986 among all the field size categories. The number of medium size fields of one *kanal* to four *kanals* has increased from 164 (61.42 per cent share in total number of fields) in 1914 to 180 (63.61 per cent share in total number of fields) in 1986, due to sub-division of very large size fields. The percentage in total cultivated area covered by medium size fields has also increased from 30.74 per cent (287 *kanals*-08 *merlas*) to 36.11 per cent (329 *kanals*-06 *merlas*) from 1914 to 1986. The number of large size fields of 4 *kanals* to 8 *kanals* has increased marginally from 38 (14.23 per cent share in total number of fields) in 1914 to 40 (14.13 per cent share in total number of fields) in 1986. The percentage in total cultivated area covered by these large size fields has increased from 19.59 per cent (183 *kanals*-03 *merlas*) to 21.39 per cent (195 *kanals*-01 *merla*) only from 1914 to 1986. The number of very large size fields of above 8 *kanals* has reduced from 32 in 1914 to 18 in 1986. The area covered by the very large size fields of above 8 *kanals* is maximum both in 1914 and 1986. The very large size fields cover area of 356 *kanals*-07 *merlas* (39.08 per cent in the total cultivated area) in the village because the extra ordinary very

large size fields of above 8 *kanals* still exist in this category. On the whole there were not many changes in the size of the fields between 1914 and 1986 due to the non-implementation of *killabandi* of land holdings in the village Khera Bagh.

SHAPE OF THE FIELDS

Shape of the fields remained almost the same both in 1914 and 1986 field maps of the village Khera Bagh due to the non-implementation of process of consolidation. The village territory was characterized by irregular fields both in 1914 and 1986 due to unfavourable physiography (Figures 4.14 and 4.15). Most of the fields were irregular rectangular (quadrilateral) and hexagon in shape. Four-sided irregular rectangular quadrilateral shape fields occupied nearly half share in the total number of fields followed by six-sided or more hexagonal shape fields in 1914 and 1986 (Table 4.15). Six or more sided hexagonal shape fields covered nearly thirty per cent share in the total number of fields both in 1914 and 1986. On the whole there were not many changes in the shape of the fields between 1914 and 1986, due to the non-implementation of consolidation of land holdings in the village Khera Bagh.

Table 4.14

Village Khera Bagh: Field Size Analysis in 1914 and 1986 Phases

Field Size Analysis (1914)					Field Size Analysis (1986)			
Field Size	Number of Fields	Percentage in Total Number of Fields	Area Covered (<i>Kanals-Merlas</i>)	Percentage in Total Cultivated Area Covered	Number of Fields	Percentage in Total Number of Fields	Area Covered (<i>Kanals-Merlas</i>)	Percentage in Total Cultivated Area Covered
Small (Below 1 <i>Kanal</i>)	33	12.36	23-13	2.48	45	15.90	31-02	3.42
Medium (1 <i>Kanal</i> to 4 <i>Kanals</i>)	164	61.42	287-08	30.74	180	63.61	329-06	36.11
Large (4 <i>Kanals</i> to 8 <i>Kanals</i>)	38	14.23	183-03	19.59	40	14.13	195-01	21.39
Very Large (Above 8 <i>Kanals</i>)	32	11.99	441-08	47.19	18	6.36	356-07	39.08
Total	267	100.00	935-12	100.00	283	100.00	911-16	100.00

Source: *Jamabandi* of Village Khera Bagh-1914 and 1986.

LAND TYPES AND FIELD PATTERNS

The Land types and field patterns are closely related. Land types have experienced only a little change between 1914 and 1986 (Table 4.16). The fields were covered with *barani*, *banjar kadim* and *banjar jadid* land types in the 1914 field map (Figure 4.16). A few fields (seven in total) were covered with *chahi* (well or tube-well irrigated) land type along with majority of the fields covered with *barani*, *banjar kadim* and *banjar jadid* land types in the 1986 field map (Figure 4.17). Majority of the fields (over 70 per cent) belonged to *barani* (rain-fed) land type both in 1914 and 1986 field maps. The area under *barani* land type was increased from 464 *kanals-03 merlas* (49.61 per cent) to 562 *kanals-13 merlas* (61.70 per cent) from 1914 to 1986. Majority of the *barani* land type fields were found scattered in all the directions, but all of them were situated away from the course of river Satluj flowing in the eastern and south-eastern direction of the village territory. The number of fields belonging to *barani* land type fields increased from 194 in 1914 to 208 in 1986. The number of fields belonging to *banjar kadim* land type declined from 65 in 1914 to 60 in 1986. Most of the fields belonging to *banjar kadim* land type were found situated along the course of river Satluj flowing in the eastern and south-eastern direction of the village territory. The number of *banjar kadim* land type fields were large both in 1914 and 1986 due to the problem of water-logging caused by river Satluj flowing in the eastern and south-eastern direction of the village territory. The number of fields belonging to *banjar jadid* land types remained same (eight) in 1914 and 1986 field maps. These *banjar jadid* land type fields were found more near the *choi* (small seasonal stream) in 1914 field map and near the *banjar kadim* land type fields in the 1986 field map indicating physiographic limitations. Seven fields covering 2.47 per cent of the total number of fields spread over 15 *kanals-2 merlas* area covering 1.66 per cent of the total area were brought under *chahi* (well irrigated) land type in the 1986 field map. Majority of these *chahi* fields were clustered in the northern part of the village territory. On the whole, there were not many changes in the land types of the fields between 1914 and 1986 field maps due to the physiographic limitations in the village Khera Bagh.

Table 4.15**Village Khera Bagh: Field Shape Analysis in 1914 and 1986 Phases**

Field Shape Class	Field Shape Analysis (1914)		Field Shape Analysis (1986)	
	Number of Fields	Percentage in Total Number of Fields	Number of Fields	Percentage in Total Number of Fields
Three Sided-Triangular	05	1.87	05	1.76
Four Sided-Square	NIL	0.0	NIL	0.0
Four Sided-Rectangular	05	1.87	05	1.76
Four Sided-Elongated Strip	23	8.62	26	9.19
Four Sided-With One or More Sides Oblique Irregular Rectangular or Quadrilateral	134	50.18	137	48.41
Five Sided-Polygons	19	7.12	21	7.43
Six Sided-Hexagons or More	81	30.34	89	31.45
Total	267	100.00	283	100.00

Source: *Shajra Kishtawar* of Village Khera Bagh-1914 and 1986.

Table 4.16

Village Khera Bagh: Land Types of Cultivated Fields in 1914 and 1986 Phases

Land Types of Cultivated Fields (1914)					Land Types of Cultivated Fields (1986)				
Land Type	Number of Fields	Percentage in Total Number of Fields	Area Covered (Kans-Merlas)	Percentage in Area Covered	Land Type	Number of Fields	Percentage in Total Number of Fields	Area Covered (Kans-Merlas)	Percentage in Area Covered
<i>Barani</i>	194	72.66	464-03	49.61	<i>Barani</i>	208	73.50	562-13	61.70
<i>Banjar Kadim</i>	65	24.35	398-02	42.55	<i>Banjar Kadim</i>	60	21.20	295-01	32.36
<i>Banjar Jadid</i>	08	2.99	73-07	07.84	<i>Banjar Jadid</i>	08	02.83	40-00	04.38
-	-	-	-	-	<i>Chahi</i>	07	02.47	15-02	01.66
Total	267	100.00	935-12	100.00	Total	283	100.00	911-16	100.00

Source: *Jamabandi* of Village Khera Bagh-1914 and 1986.

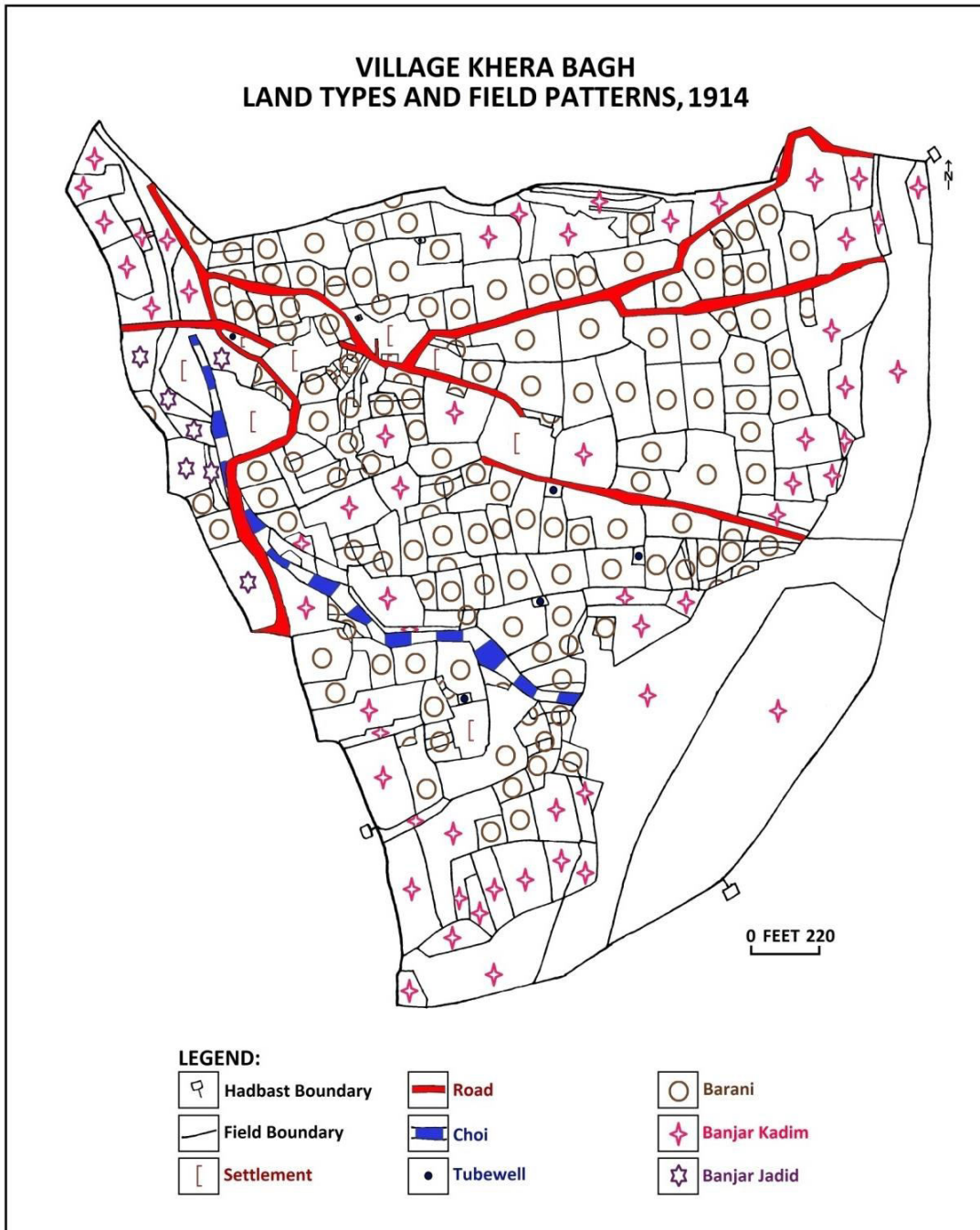


Figure 4.16

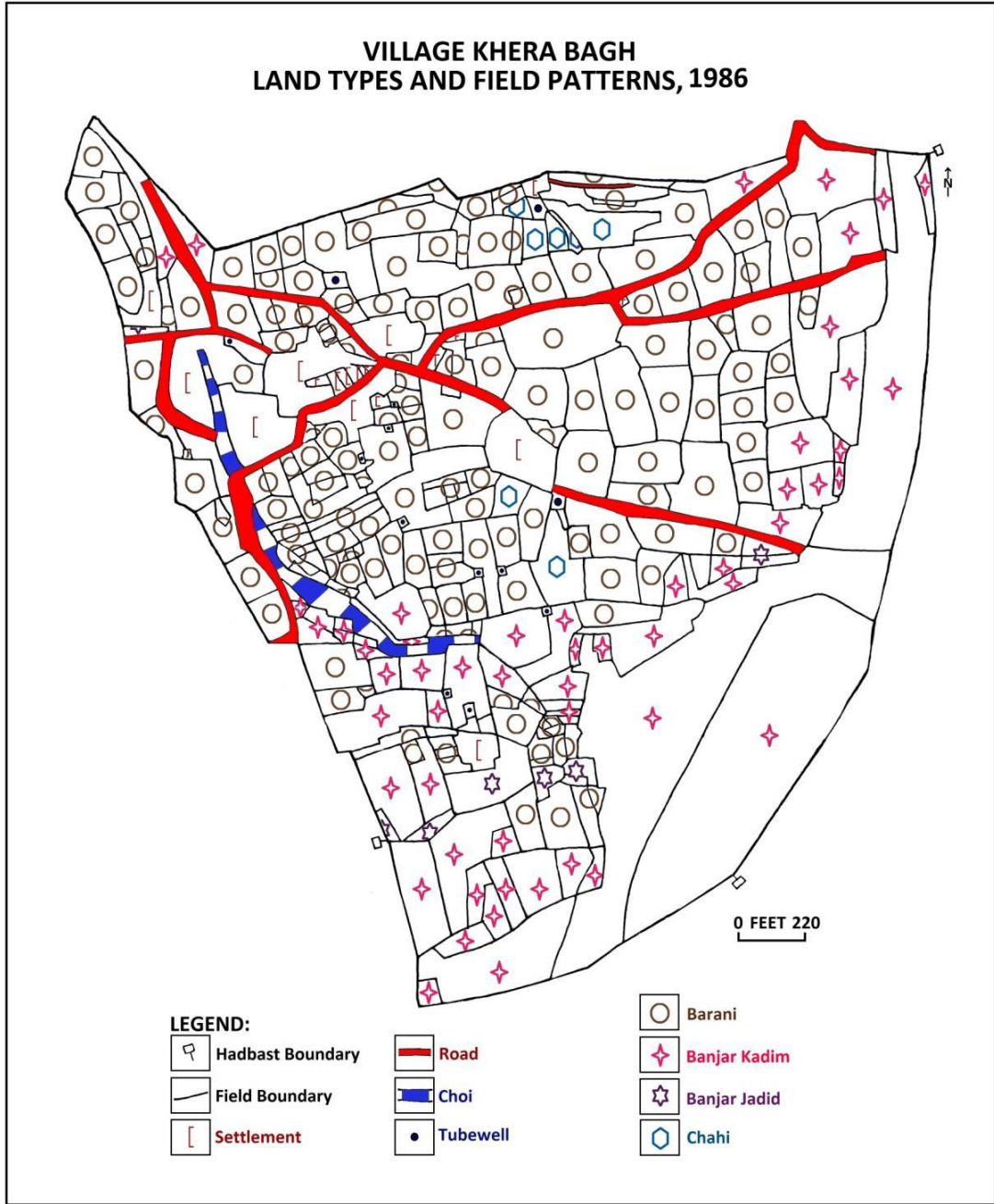


Figure 4.17

(2) FIELD PATTERNS IN ROHG TEEKA KHAKHOH BETWEEN 1914 AND 1964

Village Rohg Teeka Khakhoh is situated the *Shiwalik* hills landform region of Punjab. The village is situated in the extreme northern tehsil of Dhar Kalan in Pathankot district at an altitude of more than 600 metres. Most part of the village has uneven hilly terrain with some sloping land towards its north-west direction, where fields for cultivation have been developed by converting the slopes into terraces and by levelling the uneven slopes. Due to such physiographic limitations the village was not selected by the Punjab Land Revenue Department for the process of *Killabandi* consolidation of land holdings like other hilly villages situated in the Shiwalik hills landform region. The holdings of farmers were consisted of a number of fields located at different sites and in different directions of the village territory. The maps drawn on ownership of cultivated land of village Rohg Teeka Khakhoh in 1914 and 1964 in the chapter on evolution of field patterns justify it. The fields constituting the holdings of different farmers are mostly intermingled. The field patterns have not changed much in the village in comparison to the villages, where there was a complete transformation of field patterns due to the implementation of process of consolidation during the same phase of time which is evident from the study of size, shape and land types of the fields of village Rohg Teeka Khakhoh between the years 1914 to 1964.

SCATTERING OF HOLDINGS AND FIELD PATTERNS

A sample of three farmers (farming families) **A**, **B** and **C** have been taken from village Rohg Teeka Khakhoh to find out the change in the scattering of holdings between 1914 and 1964 phases. In 1914 phase, the fields of farmer **A**, who owned the maximum number of fields in the village were scattered in different parts of the village territory in comparison to farmer **B** and farmer **C** (Figure 4.18). Farmer **A** had 114 fields located at 7 sites, farmer **B** had 12 fields located at 1 site and farmer **C** had 4 fields located at 1 site. The values of Indices of Scattering of sites of fields for farmers **A**, **B** and **C** were 6.14 per cent, 8.33 per cent and 25.00 per cent respectively (Table 4.17). The Indices of Scattering of sites of fields of these farmers after a gap of 50 years from 1914 to 1964 have experienced a change but not to the extent which was experienced in the villages, where

consolidation of land holdings was implemented. The fields were scattered both in 1914 and 1964 phases (Figures 4.18 and 4.19). The number of fields of farmer **A** has increased from 114 in 1914 to 208 in 1964, but the number of sites increased from 7 to 8 only during these phases. Therefore, Index of Scattering of his fields has decreased from 6.14 per cent in the 1914 phase to 3.85 per cent in the 1964 phase (Table 4.17). The fields of farmer **B** have doubled from 12 to 24, but his number of sites remained one in both these phases and as a result, the Index of Scattering has reduced from 8.33 per cent to 4.17 per cent. In the case of farmer **C**, the number of fields has increased from 4 to 5 during these phases and the number of sites of his fields also remained 1 in both the phases. As a result, Index of Scattering of his fields reduced from 25.00 per cent in the 1914 phase to 20.00 per cent in the 1964 phase because of the increase in his number of fields from 4 to 5. The value of Indices of Scattering for farmers **A**, **B** and **C** was 6.14 per cent, 8.33 per cent and 25.00 per cent respectively, whereas the numerical value of I_{SD} (Index of Scattering in terms of Distance) was 0.568, 8.330 and 13.888 respectively in the 1914 phase. The scattering in terms of distance of farmer **A** was more than that of farmer **B** and farmer **C** as his numerical value of I_{SD} was the least. The fields of farmer **C** in terms of distance were least scattered as his numerical value of I_{SD} was maximum among all the farmers. In the 1964 phase, both I_S and I_{SD} have experienced a change, but to a very limited extent. The number of sites of the fields occupied by the farmer **B** and farmer **C** remained the same during 1914 and 1964 phases. The I_S and I_{SD} experienced a change due to the change in the number of fields occupied by these farmers. The I_S has decreased for the farmers **B** and farmer **C** due to increase in the number of their fields from 12 to 24 and from 4 to 5 respectively, between 1914 and 1964. The index of scattering of farmer **A** has reduced from 6.14 to 3.85, between 1914 and 1964 due to increase in the number of his fields from 114 in 1914 to 208 in 1964. Scattering in terms of distance for farmers **B** and **C** has reduced as their numerical value of I_{SD} has increased in 1964. Index of scattering in terms of distance for farmer **A** has maximised as his numerical value of I_{SD} has decreased from 0.568 to 0.315. All the fields of farmer **B** and farmer **C** were located at one site each. The scattering in terms of distance was the least for farmer **C** as he has minimum number of fields located at only one site, situated nearest to the *abadi-deh* (settlement) with maximum numerical value of I_{SD} .

**VILLAGE ROHG TEEKA KHAKHOH
SCATTERING OF HOLDINGS, FIELD FORMS
AND FIELD PATTERNS, 1914**

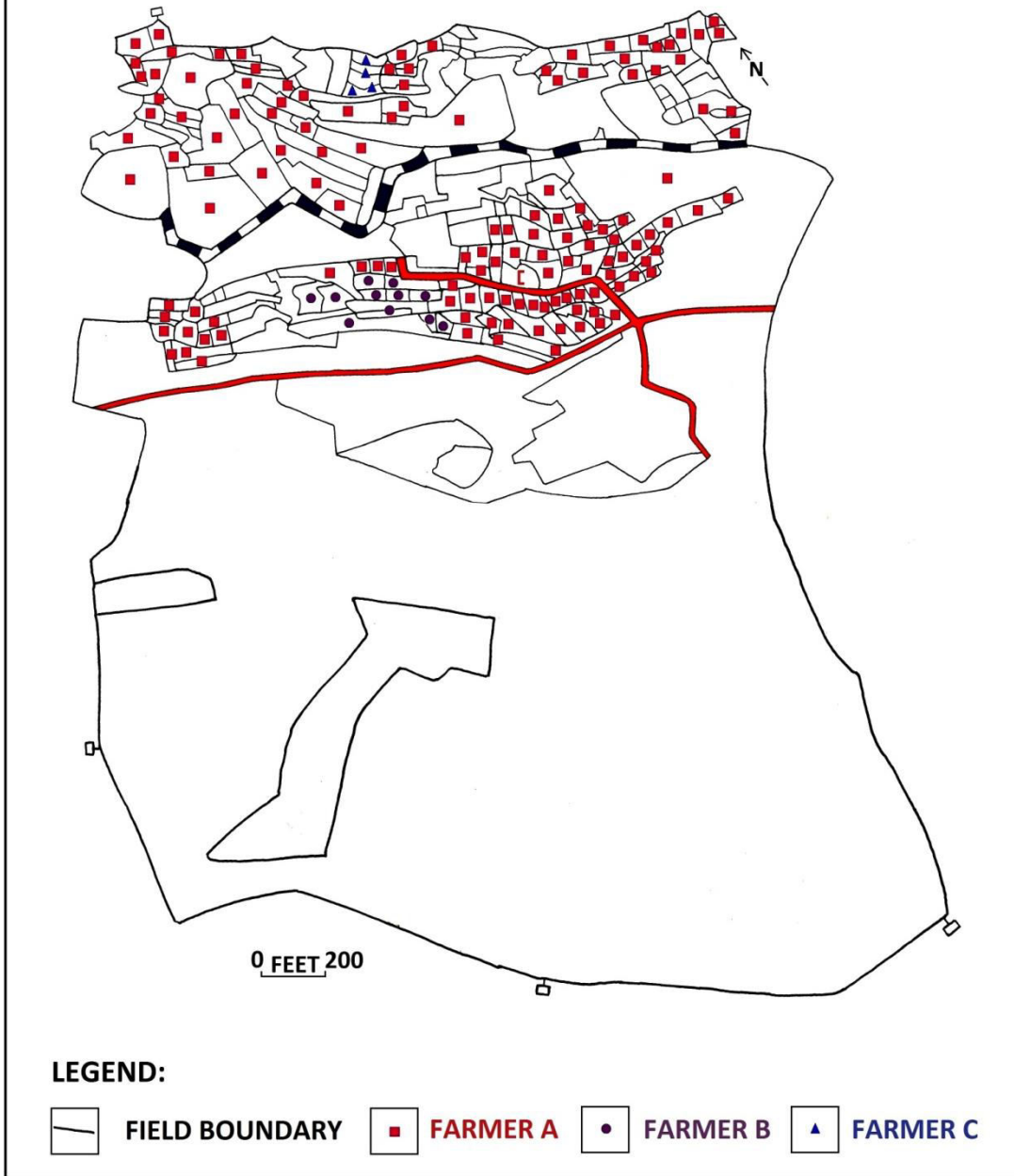
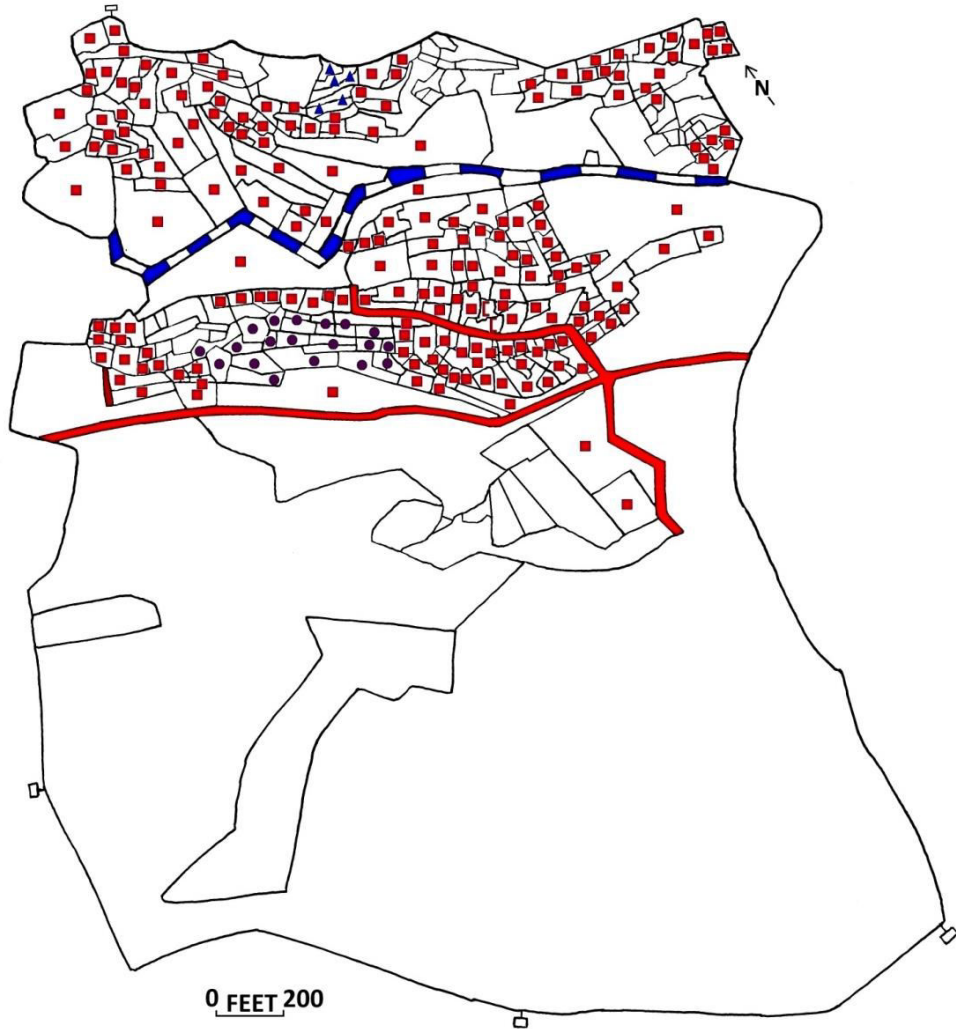


Figure 4.18

**VILLAGE ROHG TEEKA KHAKHOH
SCATTERING OF HOLDINGS, FIELD FORMS
AND FIELD PATTERNS, 1964**



LEGEND:

- | | | | |
|--|--|--|--|
|  FIELD BOUNDARY |  FARMER A |  FARMER B |  FARMER C |
|--|--|--|--|

Figure 4.19

Table 4.17

Village Rohg Teeka Khakhoh: Change in Degree of Scattering of Holdings from 1914 to 1964 Phase

Scattering of Holdings (1914)						Scattering of Holdings (1964)				
Owner	Number of Fields	Number of Sites	I_s	$\sum D_{SF}$ (In Inches)	I_{SD}	Number of Fields	Number of Sites	I_s	$\sum D_{SF}$ (In Inches)	I_{SD}
Farmer A	114	7	6.14	10.8	0.568	208	8	3.85	12.2	0.315
Farmer B	12	1	8.33	1.0	8.330	24	1	4.17	1.0	4.170
Farmer C	4	1	25.00	1.8	13.888	5	1	20.00	1.8	11.111

Source: *Jamabandi* of Village Rohg Teeka Khakhoh-1914 and 1964.

I_s : Index of Scattering in per cent.

$\sum D_{SF}$: Cumulative Distance of Sites of Fields.

I_{SD} : Index of Scattering in terms of Distance.

Scattering of land holdings was not a serious problem of the village because the maximum number of fields in the village was owned by a single family and only few fields owned by other farmers were located at minimum number of sites. Therefore, field patterns have not experienced much change due to non-implementation of process of consolidation of land holdings because of its physiographic limitations.

SIZE OF THE FIELDS

Due to the continuous sub-division of the fields, the number of fields in the village Rohg Teeka Khakhoh has increased from 223 in 1914 to 287 in 1964, which has resulted into change in the size of the fields (Table 4.18). The number of small size fields of below one *kanal* has increased from 65 (29.15 per cent share in total fields) in 1914 to 97 (33.80 per cent share in total fields) in 1964. The percentage in total area covered by small size fields has increased from 2.98 per cent (38 *kanals*-03 *merlas*) to 3.60 per cent (46 *kanals*-02 *merlas*) from 1914 to 1964 due to the sub-divisions of fields. The area covered by the small size fields of below one *kanal* was minimum both in 1914 (38 *kanals*-3 *merlas*) and 1964 (46 *kanals*-2 *merlas*). The number of medium size fields of one *kanal* to four *kanals* has increased from 102 (45.74 per cent share in total fields) in 1914 to 134 (46.69 per cent share in total fields) in 1964 due to sub-division of very large size fields. The percentage in total area covered by medium size fields have increased from 16.03 per cent (205 *kanals*-06 *merlas*) to 46.69 per cent (221 *kanals*-03 *merlas*) from 1914 to 1964. The number of large size fields of 4 *kanals* to 8 *kanals* has also increased marginally from 32 (14.35 per cent share in total number of fields) in 1914 to 34 (11.85 per cent share in total number of fields) in 1964. The percentage in total area covered by these large size fields has increased from 12.21 per cent (156 *kanals*-07 *merlas*) to 13.12 per cent (168 *kanals*-01 *merla*) only from 1914 to 1964. The number of very large size fields of above 8 *kanals* has reduced from 24 in 1914 to 22 in 1964. The number of very large size fields of above 8 *kanals* was maximum both in 1914 and 1964 among all the field size categories. The area covered by the very large size fields of above 8 *kanals* was maximum both in 1914 and 1986. The very large size fields cover area of 845 *kanals*-07 *merlas* (66.01 per cent in the total area) in the village. The very large size fields of above 8 *kanals* were found in the *banjar kadim* and *pahar* land types. On the whole there were

only minor changes in the size of the fields between 1914 and 1964 due to the non-implementation of consolidation of land holdings in the village Rohg Teeka Khakhoh, because of its physiographic limitations.

SHAPE OF THE FIELDS

Shape of the fields for most of shape classes has not changed much both in 1914 and 1986 field maps of the village Rohg Teeka Khakhoh, due to the non-implementation of process of consolidation. Irregular fields were found in the village territory both in 1914 and 1964 (Figures 4.18 and 4.19). Most of the fields in the village were irregular rectangular (quadrilateral) and hexagon in shape both in 1914 and 1964 due to the physiographic limitation. Four sided irregular rectangular quadrilateral shape fields occupied maximum number of fields (104) covering 46.64 per cent share in the total number of fields in 1914. The number of four sided irregular rectangular quadrilateral shape fields further increased to 156 covering 54.35 per cent share in the total number of fields in 1964. Six or more sided hexagonal shape fields occupied 59 fields (26.46 percent in the total number of fields) in 1914 and were increased marginally to 63 (21.95 percent in the total number of fields) in 1964 (Table 4.19). The number of four sided rectangular and four sided elongated strip shape fields experienced little change from 1914 to 1964. None of the field belonged to three sided regular triangular and four sided regular square shapes both in 1914 and 1964 field maps due to physiographic limitations. On the whole there were not many changes in the shape of the fields between 1914 and 1986, because of the non-implementation of consolidation of land holdings in the village Rohg Teeka Khakhoh due to physiographic barriers posed by the Shiwalik hills.

Table 4.18

Village Rohg Teeka Khakhoh: Field Size Analysis in 1914 and 1964 Phases

Field Size Analysis (1914)					Field Size Analysis (1964)			
Field Size	Number of Fields	Percentage in Total Number of Fields	Area Covered (<i>Kanals-Merlas</i>)	Percentage in Total Cultivated Area Covered	Number of Fields	Percentage in Total Number of Fields	Area Covered (<i>Kanals-Merlas</i>)	Percentage in Total Cultivated Area Covered
Small (Below 1 <i>Kanal</i>)	65	29.15	38-03	2.98	97	33.80	46-02	3.60
Medium (1 <i>Kanal</i> to 4 <i>Kanals</i>)	102	45.74	205-06	16.03	134	46.69	221-03	17.27
Large (4 <i>Kanals</i> to 8 <i>Kanals</i>)	32	14.35	156-07	12.21	34	11.85	168-01	13.12
Very Large (Above 8 <i>Kanals</i>)	24	10.76	880-04	68.78	22	7.66	845-07	66.01
Total	223	100.00	1280-00	100.00	287	100.00	1280-13	100.00

Source: *Jamabandi* of Village Rohg Teeka Khakhoh-1914 and 1986.

Table 4.19

Village Rohg Teeka Khakhoh: Field Shape Analysis in 1914 and 1964 Phases

Field Shape Class	Field Shape Analysis (1914)		Field Shape Analysis (1964)	
	Number of Fields	Percentage in Total Number of Fields	Number of Fields	Percentage in Total Number of Fields
Three Sided-Triangular	Nil	0.00	Nil	0.00
Four Sided-Square	Nil	0.00	Nil	0.00
Four Sided-Rectangular	18	8.07	20	6.97
Four Sided-Elongated Strip	19	8.52	22	7.66
Four Sided-With One or More Sides Oblique Irregular Rectangular or Quadrilateral	104	46.64	156	54.35
Five Sided-Polygons	23	10.31	26	9.06
Six Sided-Hexagons or More	59	26.46	63	21.95
Total	223	100.00	287	100.00

Source: *Shajra Kishtawar* of Village Rohg Teeka Khakhoh-1914 and 1964.

LAND TYPES AND FIELD PATTERNS

Land types have experienced only a little change between 1914 and 1964 (Table 4.20). The fields were covered with *barani awal*, *barani daum*, *barani saum*, *banjar kadim* and *pahar* land types in the 1914 field map (Figure 4.20). Majority of the fields were covered with *barani awal* land types both in 1914 and 1964 field maps (Figure 4.21). There were 118 *barani awal* land type fields (52.92 per cent in the total fields) spread over 148 *kanals-7 merlas* covering 11.59 percent of total area in 1914. The number and area under *barani awal* land type was increased to 174 (60.63 per cent in total fields) covering 183 *kanals-05 merlas* (14.31 per cent in total area) in 1964 due to the sub-divisions of the fields. Majority of the *barani awal* land type fields were found scattered in all the directions but more near the *abadi-deh* (settlement) and away from the poor land type fields. The number of fields belonging to *barani daum* land type fields has also increased from 82 in 1914 to 94 in 1964. Most of the *barani daum* land type fields were situated in the neighbourhood of *barani awal* land type fields. The number of fields belonging to *barani saum* land type fields declined from 12 in 1914 to 9 in 1964. The area covered by *barani saum* fields has also reduced from 119 *kanals-16 merlas* (9.36 per cent in total area) in 1914 to 86 *kanals-3 merlas* (6.73 per cent in the total area) in 1964, as many of the fields belonging to *barani saum* land types were converted into better land types, either *barani awal* or *barani daum* land types due to efforts of the farmers. Most of the fields belonging to *barani saum* land type were found situated along the *choe*, where slopes were not favourable. The number of fields belonging to *banjar kadim* land type has reduced from 10 in 1914 to 9 in 1964 field maps. These *banjar kadim* land type fields were found more near the *choe* and *pahar* both in 1914 and 1964 field maps, indicating physiographic limitations. *Pahar* (hills) spread over an area of more than 700 *kanals* covering more than 55 per cent area both in 1914 and 1964 limits the expansion of cultivated area in the village. On the whole, except the increase in number and area under *barani awal* and *barani daum* land types fields, there were not many changes in the land types of the fields between 1914 and 1964 field maps due to the physiographic limitations of hilly terrain in the village Rohg Teeka Khakhoh.

Table 4.20

Village Rohg Teeka Khakhoh: Land Types of Cultivated Fields in 1914 and 1964 Phases

Land Types of Cultivated Fields (1914)					Land Types of Cultivated Fields (1964)				
Land Type	Number of Fields	Percentage in Total Number of Fields	Area Covered (Kanals-Merlas)	Percentage in Area Covered	Land Type	Number of Fields	Percentage in Total Number of Fields	Area Covered (Kanals-Merlas)	Percentage in Area Covered
<i>Barani Awal</i>	118	52.92	148-07	11.59	<i>Barani Awal</i>	174	60.63	183-05	14.31
<i>Barani Daum</i>	82	36.77	149-09	11.68	<i>Barani Daum</i>	94	32.76	160-07	12.52
<i>Barani Saum</i>	12	5.38	119-16	9.36	<i>Barani Saum</i>	09	3.13	86-03	6.73
<i>Banjar Kadim</i>	10	4.48	155-03	12.12	<i>Banjar Kadim</i>	09	3.13	143-06	11.19
<i>Pahar</i>	01	0.45	707-05	55.25	<i>Pahar</i>	01	0.35	707-12	55.25
Total	223	100.00	1280-00	100.00	Total	287	100.00	1280-13	100.00

Source: *Jamabandi* of Village Rohg Teeka Khakhoh-1914 and 1964.

VILLAGE ROHG TEEKA KHAKHOH LAND TYPES AND FIELD PATTERNS, 1914

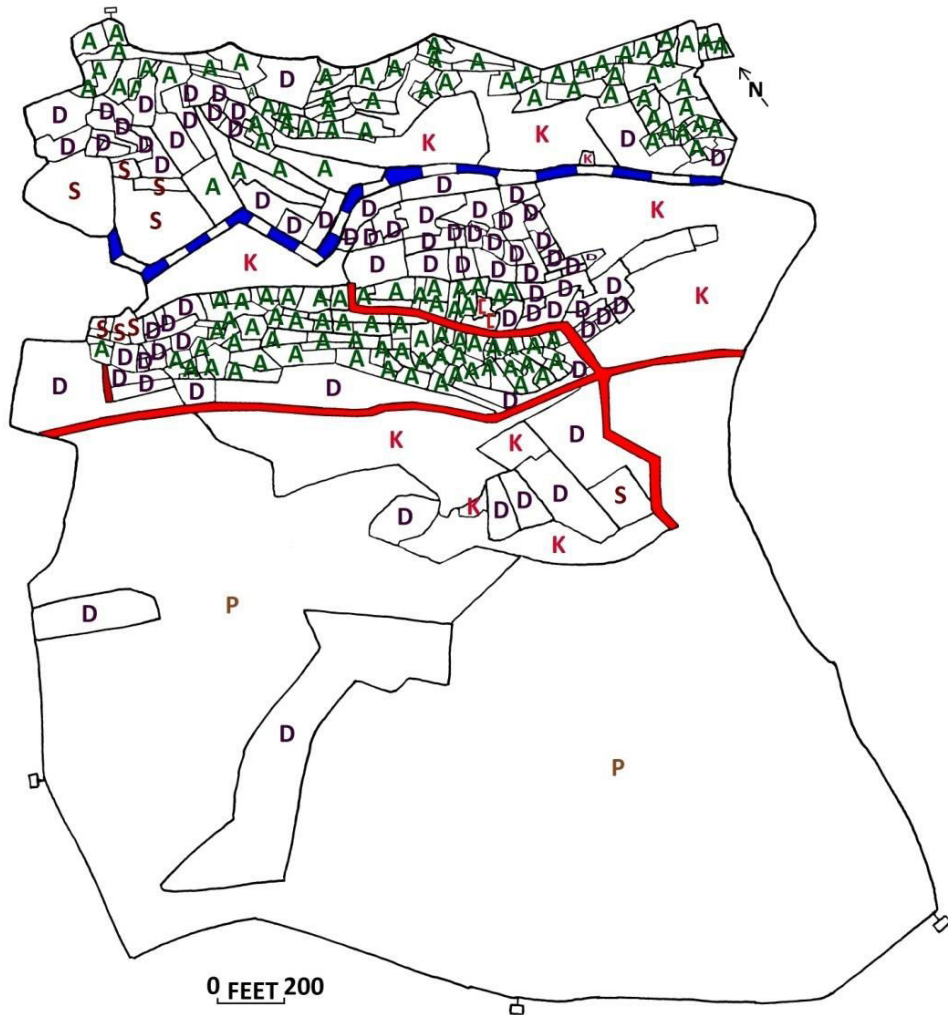


LEGEND:

 Hadbast Boundary	 Road	 Barani Awal
 Field Boundary	 Naala	 Barani Daum
 Settlement	 Pahar	 Barani Saum
		 Banjar Kadim

Figure 4.20

VILLAGE ROHG TEEKA KHAKHOH LAND TYPES AND FIELD PATTERNS, 1964



LEGEND:

 Hadbast Boundary	 Road	 Barani Awal
 Field Boundary	 Naala	 Barani Daum
 Settlement	 Pahar	 Barani Saum
		 Banjar Kadim

Figure 4.21

MAIN FINDINGS AND CONCLUSIONS

From the analysis of scattering, size, shape and land types of fields in pre and post-consolidation phases for villages situated in all the landform regions of Punjab, following findings and conclusions are inferred:

- ❖ The consolidation of land holdings has disrupted the historical evolution of field patterns in the villages where it was adopted. In the pre-consolidation phase the holdings and fields were small and inconveniently very large, irregular and intermingled with irregular field patterns. Field pattern is a cumulative result of phases of settling which have operated through time and this fact is proved through the study of field patterns in the pre and post-consolidation phases.
- ❖ Due to physiographic barriers posed by floods and Shiwalik hills, consolidation of land holdings could not be adopted in two sample villages: Khera Bagh and Rohg Teeka Khakhoh, like other villages situated in north-east Punjab. Field patterns have not changed much in these unconsolidated villages during these phases. Therefore, it has also been proved that the study of effect of space and time is imperative to understand the field patterns.
- ❖ The adoption of consolidation process has successfully checked the scattering of fields and to some extent sub-divisions of land holdings. Every tenure holder was allotted a compact area in each block at the place where the largest part of his holdings was located. The fields in general have become regular in shape and large in size. The scattering of sites of fields has been minimised by consolidating the irregular, small and inconveniently very large fields into compact blocks of rectangular fields of uniform size of one *killa* (8 *kanals* or 198 feet by 220 feet) each, known as *killabandi*. A new formula Index of Scattering in terms of Distance ($I_{SD} = I_S / \sum D_{SF}$) with the assistance of Index of Scattering has been proposed which takes into account the cumulative distance of all sites of fields from the *abadi-deh* (settlement). It has shown better results than the simple I_S (Index of Scattering).
- ❖ The land types have improved from pre-consolidation to post-consolidation phases in all the villages. The area under *chahi* (tube-well irrigated) and *nahari* (canal irrigated) fields have increased between the pre and post consolidation phases. It is also evident

- from the study that in the irrigated land types, the size of the fields was small and in the *barani* (non-irrigated, rain-fed) land types the size of the fields was large both in the pre and post-consolidation phases.
- ❖ Like earlier phases, it is evident in pre and post-consolidation phases also that large fields were situated away from the settlement proper in the outfield and small fields were situated more in the infield areas near the *phirni* (circular road around the main settlement) due to their more economic value, because of their relative nearness to the *abadi-deh* (settlement) and scope for future house construction.
 - ❖ An important dimension of adoption of process of consolidation was the laying of many new roads in the villages including the construction of *phirni* (a circular road around the main settlement) to restrict the expansion of settlement within the *phirni*. The size of *abadi-deh* (settlement) has increased a lot due to the construction of *phirni* in all the villages where process of consolidation was implemented. The area under cultivation was reduced due to the provision of *phirni* and new roads. The meandering roads common in the pre-consolidation phase were also straightened in the post-consolidation phase to shorten the distances. The road facing fields in pre as well as post-consolidation phases were found smaller in size and elongated in shape, than the fields which were situated away from the roads because road facing fields have greater commercial value and therefore, every heir wants to have an access to the road.
 - ❖ After the adoption of consolidation and subsequent application of canal irrigation field patterns have transformed in village Bath. In village Pathan Chak, fields were ribbon shape and were parallel to each other and perpendicular to the *khals* and form strip patterns to have an access to the source of irrigation in pre and post-consolidation phases. Fields were not arranged around a well or tube-well because of the levelled land water can easily be taken to any field by the *arrs* (water channels) to provide irrigation facilities in the upland plains villages.
 - ❖ In the villages where the process of consolidation was applied, fields have become regular, rectangular and more accessible with compact land holdings.

CHAPTER-5

EXISTING FIELD PATTERNS

Any comprehensive study of field patterns is incomplete without a study of the existing field patterns. A study of present field patterns is important to trace out the origin and evolution of field patterns, as it provides a clue and link in the understanding of evolutionary phases of settling and evolution of field patterns in the agriculturally advanced state of Punjab. The existing field pattern is a product of continuous sub-divisions of land over the past generations.

Complete regularity and uniformity in the field landscape is the most peculiar feature of the existing field patterns in village Dhanowali situated in the upland plains, village Bath situated in the upland plains with sand dunes and village Pathan Chak situated in the piedmont plains. The proper regular and uniform shape and size to the fields was given by the process of consolidation, implemented in all the villages situated in the plain areas. Therefore, existing field patterns do not show much variation in the villages where process of consolidation was implemented in the 1950-60 decade.

Existing field landscape has not changed much from the past in village Khera Bagh due to its location in the flood plains with uneven topography and water-logging conditions. Similarly, village Rohg Teeka Khakhoh situated in the Shiwalik hills has age-old original field patterns at present also. The virgin field patterns are preserved here as the process of consolidation could not be implemented due to topographic barriers.

The sub-division of fields and fragmentation of land holdings is evident in all the selected villages. The fields and the land holdings are reduced in size due to their continuous sub-divisions. An analysis of existing field patterns demonstrate that the extent of sub-division of fields are more rapid in the villages which are situated in the close proximity to the cities. At the time of consolidation, each farmer was provided with a big compact contiguous holding against the earlier distribution of a number of small holdings scattered at different sites. The line of sub-division of holding mostly corresponded to the field boundaries.

Earlier, it was mostly the holding which was sub-divided and not the fields. At present, even the fields are sub-divided. This is due to the already very small size of land holdings and by the continuous entry of new owners in the genealogical tree of the families.

The fields and land holdings are owned both individually and jointly. The joint ownership is slowly weakening due to out-migration of population from rural to urban areas, mainly for employment, resulting in further sub-divisions of fields as well as land holdings. The number of owners is increasing, resulting into more and more sub-divisions of fields and fragmentation of land holdings.

The average per-capita size of land holding in all the sample villages is falling. The size of holding of a family may be large due to the presence of joint ownerships and holdings. The agricultural fields of the villages are fast encroached upon by the construction of new houses due to the demands generated from within the village and by the immigration of population from the cities to the nearby villages in search of cheap land for house construction, comparatively clean rural environment and low cost of living in the villages.

1. EXISTING FIELD PATTERNS IN AN UPLAND PLAINS VILLAGE (DHANOWALI)

Complete regularity and uniformity in the field landscape is the most characteristic feature of the existing field patterns in village Dhanowali located in the upland plains. The present field landscape of the village shows stern state with regard to the area under agricultural fields. Many of the previous agricultural fields have already been encroached upon by the fast expanding settlements nearer to the *abadi-deh* (settlement) and the roads (Figure 5.1).

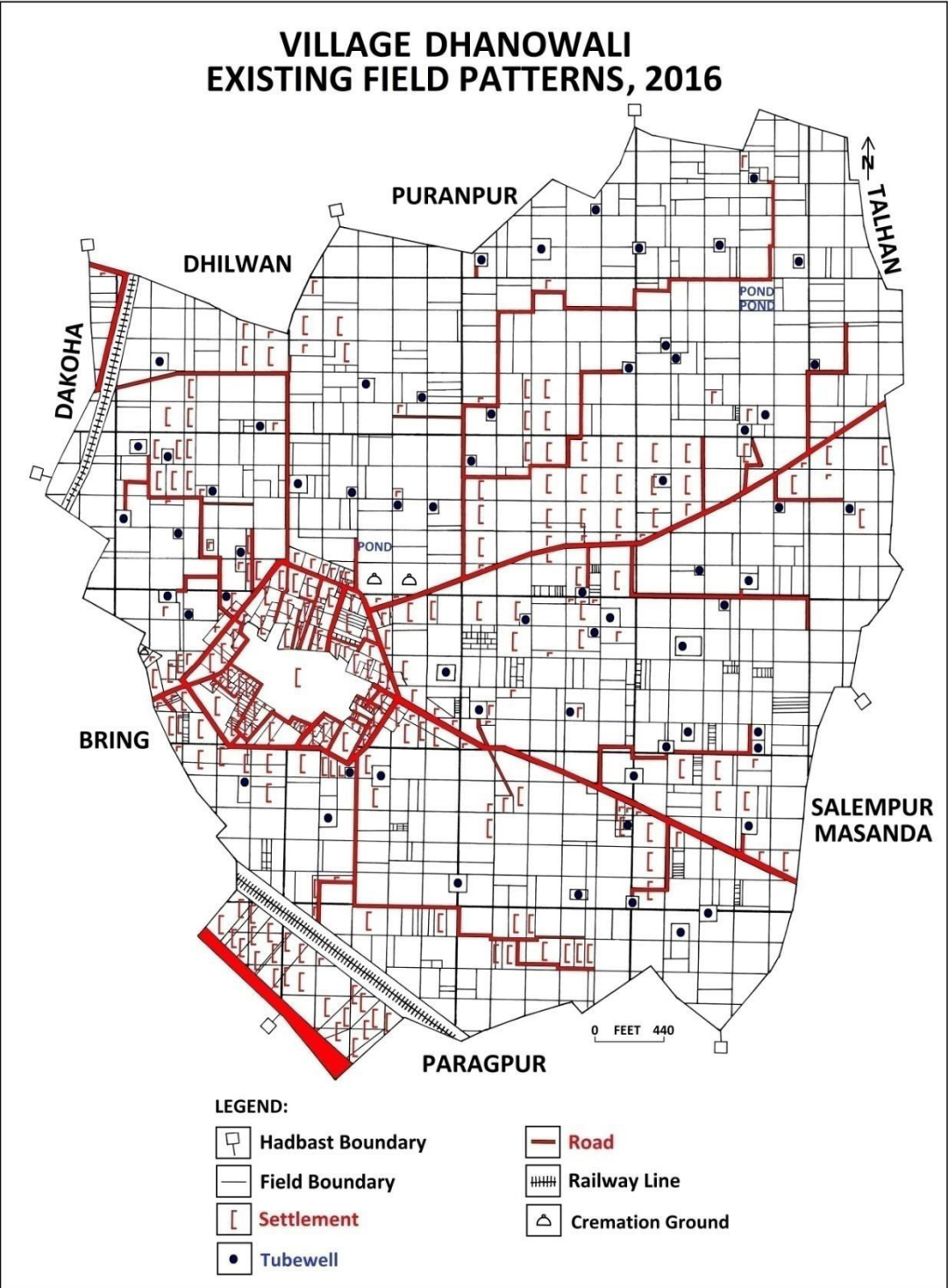


Figure 5.1

LAND TYPES

Land types have improved to the maximum extent due to the adoption of green revolution technology in the study village. Almost all the cultivated fields and cultivated area have been brought under irrigation (Figure 5.2, Table 5.1). Out of 954 fields only three fields (0.31 percent) belong to *banjar kadim* and remaining 951 fields (99.69 per cent) belong to *chahi* (tube-well irrigated) land type. Existing land types and field patterns map (Figure 5.2) of the study village reveals that there exists no relationship between the distance from the *abadi-deh* (settlement) and productivity and fertility of land due to the use of chemical fertilizers and irrigation facilities.

The number and size of fields are declining due to increase in the number of owners and encroachment of fields by fast expanding settlements. The number of fields under *chahi* land type has decreased from 1004 in 1990 to 951 fields in 2016 showing a 5.0 per cent fall. Area under cultivation has also fallen by 16 per cent between 1990 and 2016, due to continuous encroachment of cultivated fields by the fast expanding settlements (Figure 5.3).

More than 28 per cent area of the village has become *gairmumkin* (uncultivable) from the year 1884 to 2016 at an annual rate of 0.21 per cent. This rate of loss of precious land has more than doubled (0.54 per cent per year) in recent years from 1990 to 2016. The cultivable land near the *abadi-deh* (settlement), village roads and NH-1 has been encroached more by *gairmumkin* (uncultivable) land uses such as houses, farm houses, shops, factories and workshops.

The per-capita number of fields has reduced from nine to only two and size of land-holdings has also been reduced from 46 *kanals* to only 6 *kanals* between 1884 and 2016 periods (Table 3.4). This is due to increasing number of new owners in the genealogical tree of the families in the study village and also by the entrance of female land-owners made possible by the amendment of the Hindu Act which lays down that daughters are entitled to share equally in their parent's property.

SIZE OF THE FIELDS

Due to continuous sub-divisions, the fields and land holdings have become small in size. In early phases, it was the holding which was sub-divided, but today even fields are experiencing sub-divisions due to continuous entry of new owners in the genealogical tree of the families. The number of fields has increased due to sub-division of fields due to increase in the number of owners. The continuous encroachment of cultivated land by *gairmumkin* (uncultivable) land uses has also reduced the total number of cultivated fields from 1044 in 1958 to 954 in 2016. This has led to decrease in the size of the fields. The small fields constitute 31.97 per cent of the total cultivated fields, but due to their small size, they cover only 3.20 per cent of the total cultivated area of the village (Table 5.2). Small fields are found more near the *abadi-deh* (settlement) and village roads due to their more economic value and future scope for construction of houses resulting in to their numerous sub-divisions. Many of the small size fields found near the *abadi-deh* (settlement) and village roads are under the continuous threat of encroachment for the construction of new houses.

The number of medium size fields of 1 *kanal* to 4 *kanals* is maximum in the village. Their number marginally got reduced from 381 in 1958 to 372 in 2016, due to their sub-divisions and encroachments. The area under medium size fields has decreased by about 76 *kanals*. The number of medium size fields has not declined much because many of the earlier large size fields were sub-divided into medium size fields. Medium size fields cover more than quarter of the total cultivated area of the village. The medium size fields are also getting converted into small size fields.

Large size fields of 4 *kanals* to 8 *kanals*, though contribute 29.04 per cent in the total number of fields, yet due to their large size, cover more than 70 per cent of the total cultivated area of the village. Large size fields are fast converting into medium and small size fields due to their sub-divisions. All very large size fields of 1958 have been converted into smaller sizes due to their sub-divisions in the existing field map of 2016.

VILLAGE DHANOWALI LAND TYPES AND FIELD PATTERNS, 2016

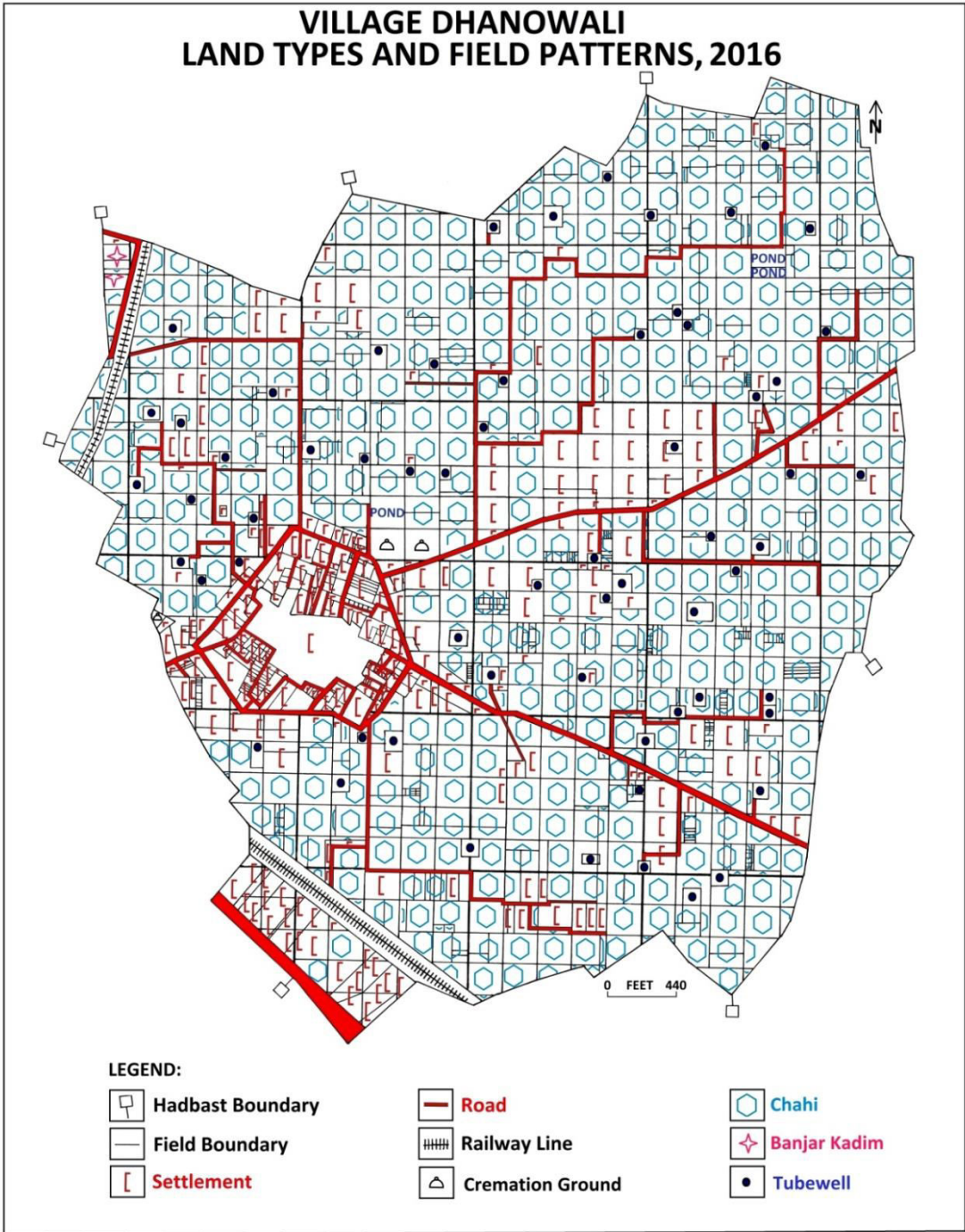


Figure 5.2

Table 5.1**Village Dhanowali: Existing Land Types of Cultivated Fields, 2016**

Land Type	Number of Fields	Percentage in Total Number of Fields	Area Covered (Kanal- Merlas)	Percentage in Total Cultivated Area Covered
<i>Chahi</i>	951	99.69	2975-16	99.83
<i>Banjar Kadim</i>	3	0.31	4-17	0.17
Total	954	100.00	2980-13	100.00

Source: *Jamabandi* of Village Dhanowali, 2016.

The number of large fields of 4 *kanals* to 8 *kanals* has reduced from 425 to 277 and area under these fields has decreased from 2738 *kanals* to 2113 *kanals* between 1958 and 1990 respectively. The medium and large size fields together cover 68 per cent of the total cultivated fields and nearly 97 per cent of the total cultivated area of the village. The medium and large size fields are found scattered everywhere in the village territory.

SHAPE OF THE FIELDS

The most characteristic feature of the existing field landscape is its total regularity and uniformity (Figure 5.1). Nearly half of the total fields are four sided rectangular and thirty per cent of the total fields are four sided strips in shape (Table 5.3).

Table 5.2**Village Dhanowali: Existing Field Size Analysis, 2016**

Field Size	Number of Fields	Percentage in Total Number of Fields	Area Covered (Kanal-Merlas)	Percentage in Total Cultivated Area
Small (Below 1 Kanal)	305	31.97	94-15	3.20
Medium (1 Kanal to 4 Kanals)	372	38.99	772-07	25.90
Large (4 kanals to 8 Kanals)	277	29.04	2113-11	70.90
Total	954	100.0	2980-13	100.0

Source: *Jamabandi* of Village Dhanowali, 2016.

Rectangular fields are more in numbers because of the adoption of consolidation of land holdings and the strip shape fields are mostly the result of sub-divisions of previously rectangular fields. Only the fields adjacent to the village boundary, *abadi-deh* (settlement), tube-well sites, along diagonal roads and railway lines, vary slightly in shape. Such fields are in general triangular, quadrilateral, polygon and hexagon in shape. The percentage of fields under different shape categories tends to be almost the same in 1958 and 2016 field maps.

Table 5.3**Village Dhanowali: Existing Field Shape Analysis, 2016**

Field Shape Class	Number of Fields	Percentage in the Total Number of Fields
Three sided-Triangular	32	3.35
Four sided-Square	03	0.31
Four sided-Rectangular	469	49.16
Four sided-Elongated or Strips	285	29.87
Four sided-with one or more sides oblique irregular Rectangular or Quadrilateral	68	7.13
Five sided-Polygons	15	1.57
Six sided-Hexagons or more	82	8.60
Total	954	100.0

Source: *Shajra Kishtwar* of Village Dhanowali, 2016.

FIELD BOUNDARIES

The study of field boundaries constitutes an important element in the understanding of field patterns. The pattern formed by well-defined field boundaries within the precincts of a village constitutes an important element of the man-made landscape (Nitz, 1966). The boundaries of a field are the property lines, which separate one field from the other (Mukerji, 1961). On the village map, lines representing field boundaries are the limits of the property unit (field) bearing separate *khasra* numbers and entered in the *Jamabandi*. On the ground a farmer divides each property unit into smaller parts for different irrigation requirements and for growing different crops. These smaller units and the property units are separated by low mud dikes known as *wats* and by *arrrs* (Water drains). These *wats* are used as paths for movement of human beings and are used as dams to retain water within the fields (Figure 5.4). *Wats* and *arrrs* constitute the smallest feature of rural agricultural landscape. The *wats* as field boundaries predominate in the study village. The *wats* are about eight to ten inches high, one to two feet wide and has enormous length, corresponding to the length of the field. They are made of locally available soils and mud. They have created the open field landscape (Figure 5.5). The *warr* of *kande* (fence of thorny bushes), the row of trees (mainly popular, eucalyptus, *shahtut* and *dherek*) and fencing-wires also serve as field boundaries in many cases (Figure 5.6). The fields near roads and *abadi-deh* (settlement) without protective boundaries are attacked by the stray cattle (Figure 5.7). The field boundaries give shape to a field. Presently, on an average 86 per cent of the total fields in the village Dhanowali have four boundaries and remaining 14 per cent of the fields have either less than four or more than four boundaries (Table 5.4). Because of the process of consolidation, the field boundaries have become regular in shape. Majority of the field boundaries run straight and meet each other at right angle because of regular rectangular field patterns (Figure 5.1). The fields near the *abadi-deh* (settlement), roads, railway lines and source of irrigation (tube-well) have irregular field boundaries (Figure 5.8). The fields with micro-topographic variations along the wastelands also have irregular field boundaries (Figure 5.9).

Table 5.4

**Village Dhanowali: Existing Classes of Fields
with reference to Number of Boundaries, 2016**

Fields With	Numbers of Fields	Percentage in Total Number of Fields
Three boundaries	32	3.35
Four boundaries	825	86.48
Five boundaries	15	1.57
Six and more boundaries	82	8.60
Total	954	100.0

Source: *Shajra Kishtawar* of Village Dhanowali, 2016.



Figure 5.3 Encroachment on the cultivated fields by the new settlements.



Figure 5.4 Separation of the fields by *Wat* (mud dike) flanking the *arr* (irrigation channel).



Figure 5.5 Rectangular fields in the flat lands with open field landscape



Figure 5.6 Field near road lined by poplar trees without protective fencing against the stray cattle.



Figure 5.7 Standing wheat crop in the field attacked by goats in absence of protective fencing.



Figure 5.8 Irregular field boundaries near the tube well site.

(Note the wastage of land).



Figure 5.9 Wastelands forming irregular field boundaries.

FIELD PATTERNS AND SOURCE OF IRRIGATION

Tube-wells and submersible pumps are the sources of irrigation in the study village. Most of the old wells with Persian wheel common in the village Dhanowali in the past, have been replaced with electric or diesel engine tube-wells after the adoption of Green Revolution technology in late 1960s (Figure 5.10). Due to the excessive

extraction of underground water, the tube-wells are being replaced by the submersible pumps since early 2000s and more recently due to more water requirements for paddy cultivation. The farmers are using more than one submersible pump putting further pressure on underground water (Figures 5.11 and 5.12). Tube-well and submersible pumps are located mostly either in the centre of the holding or near the road, located anywhere within a field or fields. A room or a set of rooms are constructed near the tube-well, which are used for keeping farming implements, housing animals, fodder, fertilizers and farm produce. A few small *kyaris* (small cultivation units) are very common around tube-well, where farmers grow vegetables for domestic use. All the fields of a holding do not necessarily touch one or more sides of a tube-well. The entire village has a uniform gentle slope. Within a levelled holding, water can be brought through *arr* (drain) to all the fields with a great ease. The big size fields are divided into small *kyaris* to water the crops with ease. The fields with tube-wells are primarily hexagon in shape (Figure 5.1). Otherwise, fields of all shapes and sizes are found near the tube-well. The size and shape of the fields do not seem to have any relationship with the source of irrigation. The fields of different size and shape are irrigated with the help of tube-wells and submersible pumps. Irrigation has affected the cropping patterns. The farmers have started growing non-traditional crops, paddy and vegetables in irrigated fields. The distance has not remained the prime determinant of land quality. There exists no relationship between the distance from the *abadi-deh* (settlement) and productivity and fertility of land due to the use of irrigation facilities and fertilizers.

FIELD PATTERNS AND PLOUGHING IMPLEMENTS USED

The kind of ploughing implement used also determines the size and shape of a field. Tractors have completely replaced the bullocks in the village Dhanowali, like other villages in Punjab (Figure 5.13). In a tractor-used farm, the fields are large and accentuated rectangular in shape. In a large accentuated rectangular field both time and fuel is saved, as tractor needs fewer turns to plough the entire field. In the study village it is found that the farmers, who have their own tractors, plough all the fields with tractor irrespective of their size and shape. Bullock-plough drawn fields which were generally small in size have been completely replaced by the tractors in the village. A farmer who does not own tractor, prefer to plough his fields with hired

tractors. Small *kyaris* (cultivation units), where farmer grows vegetables are generally ploughed by farmer him self using hoe and spade.

FIELD PATTERNS AND CROPS GROWN

Intensive commercial grain farming is practiced in village Dhanowali in medium to large size and regular shape fields. Each crop has its own method of cultivation and eco-technological requirements. Consequently, the field patterns under different crops tend to be different (Hart, 1968). An analysis of existing cropping pattern in the study village reveals that there exists no relationship between the types of crops grown and infield and outfield area situated near and away from the *abadi-deh* (settlement). The intensive subsistence cum commercial farming is done both near and away from the *abadi-deh* (settlement). Distance from the *abadi-deh* (settlement) does not appear to have any relationship with the type of crops grown and the resultant field patterns (Figures 5.14 and 5.15).



Figure 5.10 Transformation in the sources of irrigation in 1960s: An old abandoned *Persian Wheel* well (in the right side) replaced by an engine tube-well (in the middle).



Figure 5.11 Transformation of the sources of irrigation in early 2000: An old abandoned well (in the left side) is replaced by a submersible pump.



Figure 5.12 Existing state of water requirement: Two submersible pumps being used together to quench the thirst of paddy fields.



Figure 5.13 Bullocks have been completely replaced by tractors.

Ekfasli (one crop grown in a year) fields exist nowhere in the entire village territory. Farmers grow at least two or more crops in a year both in infield and outfield areas. The *teenfasli* (three crops grown in a year) fields are relatively distributed everywhere in the entire village territory. Early maturing high yielding variety (HYV) seeds are used in these fields. After the harvesting of one crop, new crop is immediately grown without wasting time. Mechanized farming along with intensive irrigation and use of fertilizers, insecticides and pesticides help the crops to grow early. The *teenfasli* (three crops grown in a year) fields are relatively larger than the *dofasli* (two crops grown in a year) fields. Farmers decide to allocate fields under different crops not in terms of their size or shape but in terms of price of crops, yield, ripening period and market demands. The farmer sometimes joins different fields together to grow a crop of high returns. This joining of fields is not recorded in the revenue records. Cropping pattern has shifted from low value traditional crops to economically more remunerative crops. The fields are covered by wheat, potato, fodder (barseem and jawien), maize and vegetables in the *rabi/harri* season and paddy, fodder (*bajra* and *Chari*), maize, sugarcane and vegetables in the *khariif/saoni* season (Figure 5.14, 5.15 and Table 5.5). Fodder is grown relatively near to the *abadi-deh* (settlement) to meet the daily requirements of cattle, as these animals are kept in the *abadi-deh* site (Figure 5.16). Plantation crops like popular and eucalyptus are grown in medium size fields (Figure 5.17). Wheat, paddy and potato crops are grown at commercial level and are sold

mainly at Jalandhar city market. These crops have affected the field patterns to only some extent. The rice grown fields are divided relatively in to smaller sections. Water should remain standing in the paddy-fields almost for first three months. Water can be kept in small sections of fields with ease. All other crops are found in all the fields irrespective of their shape and size. A few small *kyaris* (cultivation units) are created near the tube-well for growing vegetables. Vegetables growing fields are generally smaller in size (Figure 5.18). The cropping pattern has shifted from traditional and subsistence types to non-traditional intensive commercial crops due to the adoption of Green Revolution technology. On the whole the existing cropping pattern does not seem to have affected the field pattern to a large extent.

Table 5.5

Village Dhanowali: Existing *Rabi (Harri)* and *Kharif (Saoni)* Cropping Patterns, 2016

<i>Rabi (Harri)-2016</i>			<i>Kharif (Saoni)-2016</i>		
Crop	Area Covered (Kanals – Merlas)	Percentage in Total Cropped Area	Crop	Area Covered (Kanals – Merlas)	Percentage in Total Cropped Area
<i>Kanak (Wheat)</i>	2313 -14	77.78	<i>Munji (Paddy)</i>	2649-18	89.58
<i>Aloo (Potato)</i>	529-03	17.78	<i>Bajra, Chari (Fodder)</i>	167.16	5.64
<i>Barseem, Jawien (Fodder)</i>	118 -00	3.97	<i>Makki (Maize)</i>	128-07	4.33
<i>Makki (Maize)</i>	7-09	0.25	<i>Ganna (Sugarcane)</i>	8-10	0.29
<i>Sabji (Vegetable)</i>	6-10	0.21	<i>Sabji (Vegetable)</i>	3-06	0.11
Total	2974-16	100.00	Total	2957-17	100.00

Source: *Khasra Gardavari* of Village Dhanowali, 2016.

VILLAGE DHANOWALI RABI (HARRI) CROPPING PATTERNS, 2016

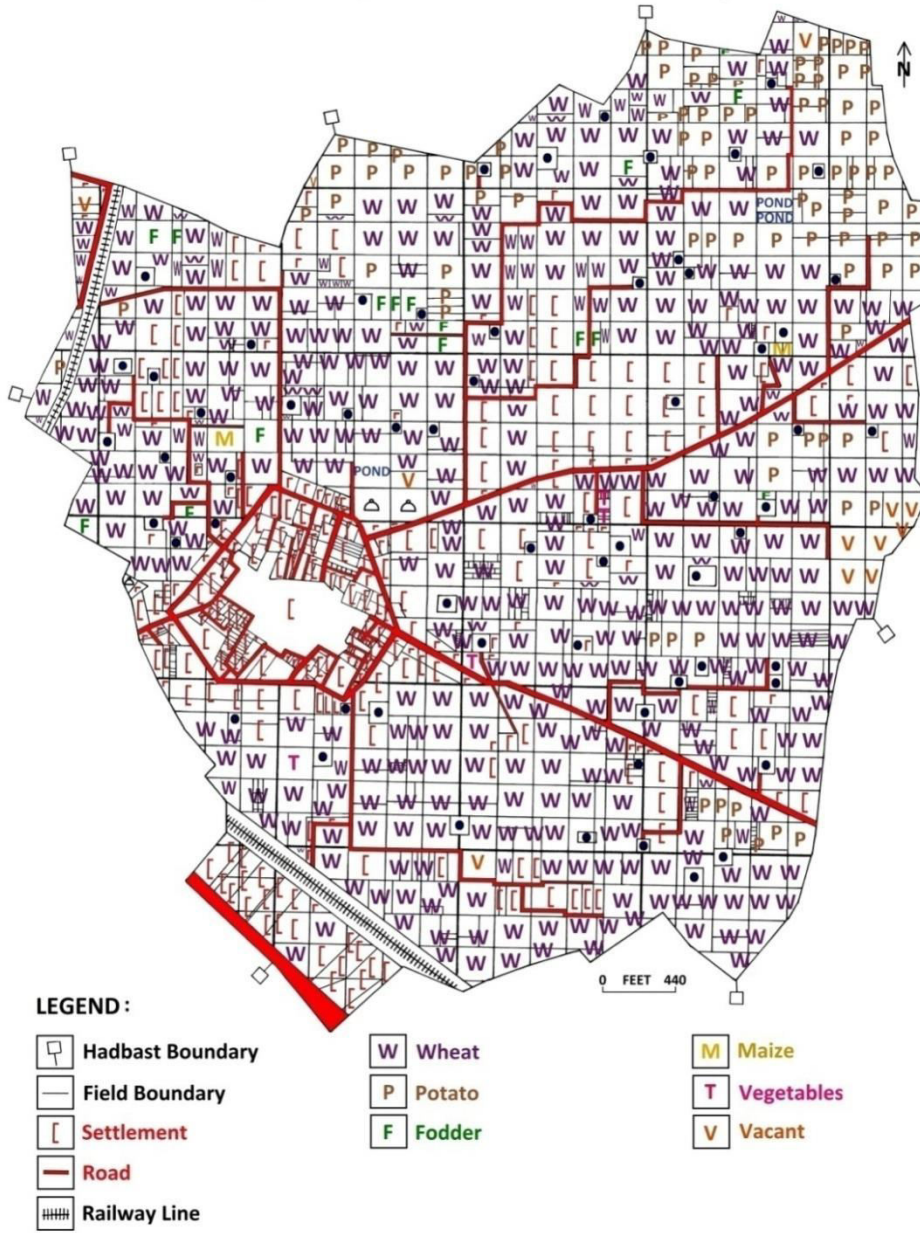


Figure 5.14

VILLAGE DHANOWALI KHARIF (SAONI) CROPPING PATTERNS, 2016

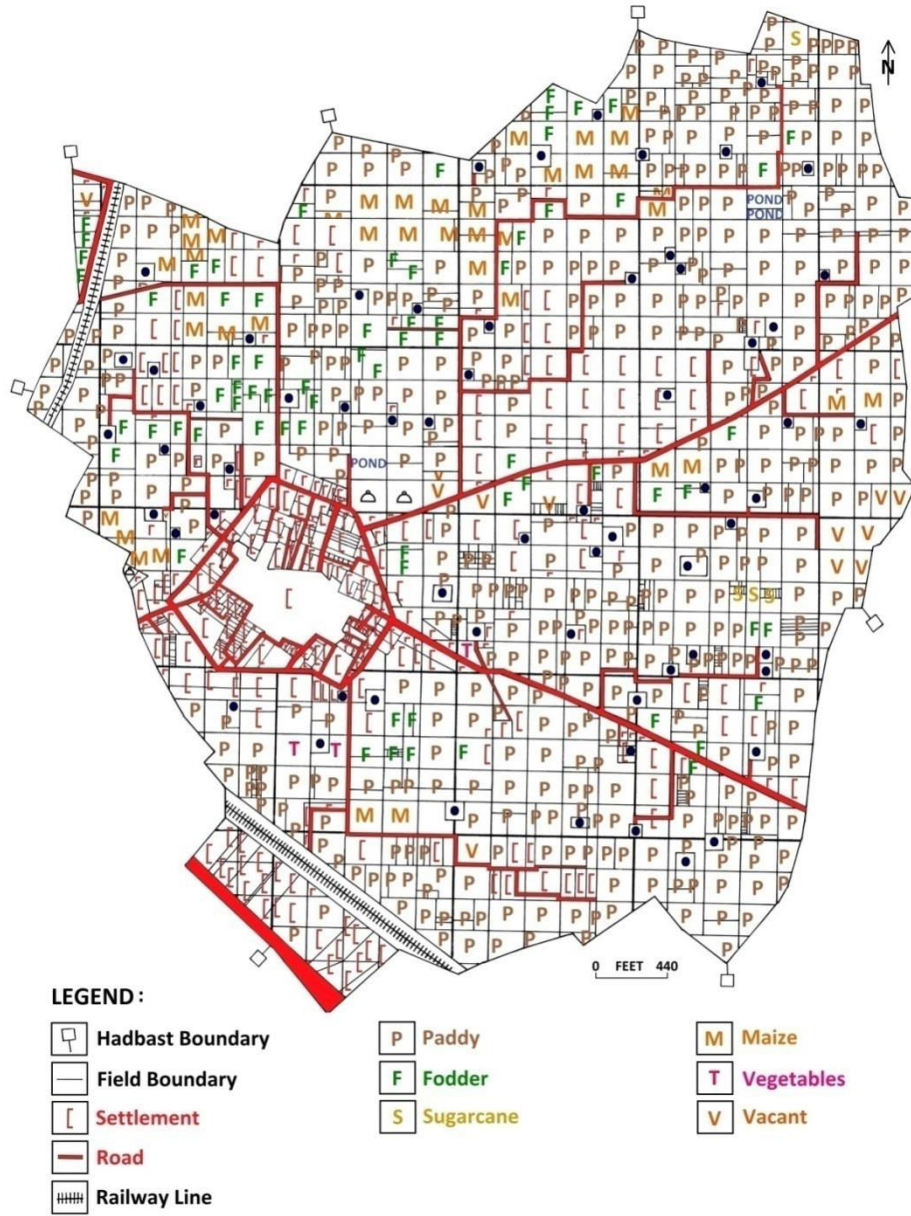


Figure 5.15



Figure 5.16 Fodder fields near the *abadi-deh* (settlement).



Figure 5.17 Plantation of eucalyptus trees standing on the former crop field in the background, *Sarson* (oil-seed) crop in the middle and an abandoned cultivated field in the foreground for making a house, a common site along the major roads.

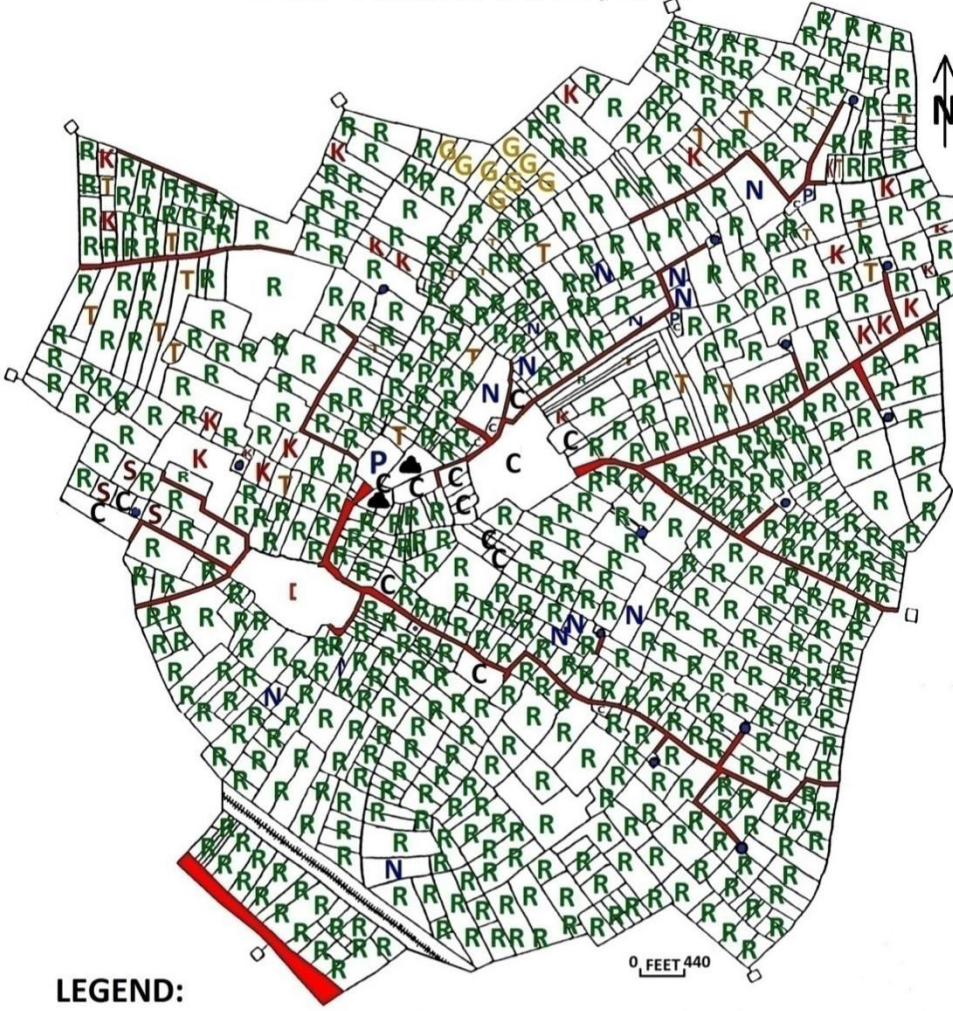


Figure 5.18 Small vegetable fields near the tube-well.

FIELD PATTERNS AND LAND OWNING CASTES

The fields owned by different castes, display different field patterns. In general, fields and holdings of high castes are larger than those of the lower castes. The study village Dhanowali was first inhabited by a family of *Jat Randhawa* caste. At that time the village was a uni-religious, uni-clan and uni-caste settlement. Later on they offered and sold some land to people from other castes such as *Jat Nagra*, *Jat Seikhon*, *Khatri* and *Tarkhan* to settle in the village and practise agriculture on the fields (Figure 5.19). People from other low castes were invited to settle here and were employed as agricultural laborers. They were not given cultivated land. *Jat Randhawa* remained the dominant land-owning caste having more than 90 per cent of the total cultivated fields and the cultivated area. Obviously, the fields and holdings owned by them were larger and regular than other castes. The fields of *Jat Randhawa* and other castes were found intermingled in the entire village territory, but more towards the north, north-east and north-west of the village.

VILLAGE DHANOWALI
 DISTRIBUTION OF FIELDS ACCORDING TO
 LAND-OWNING CASTES, 1884



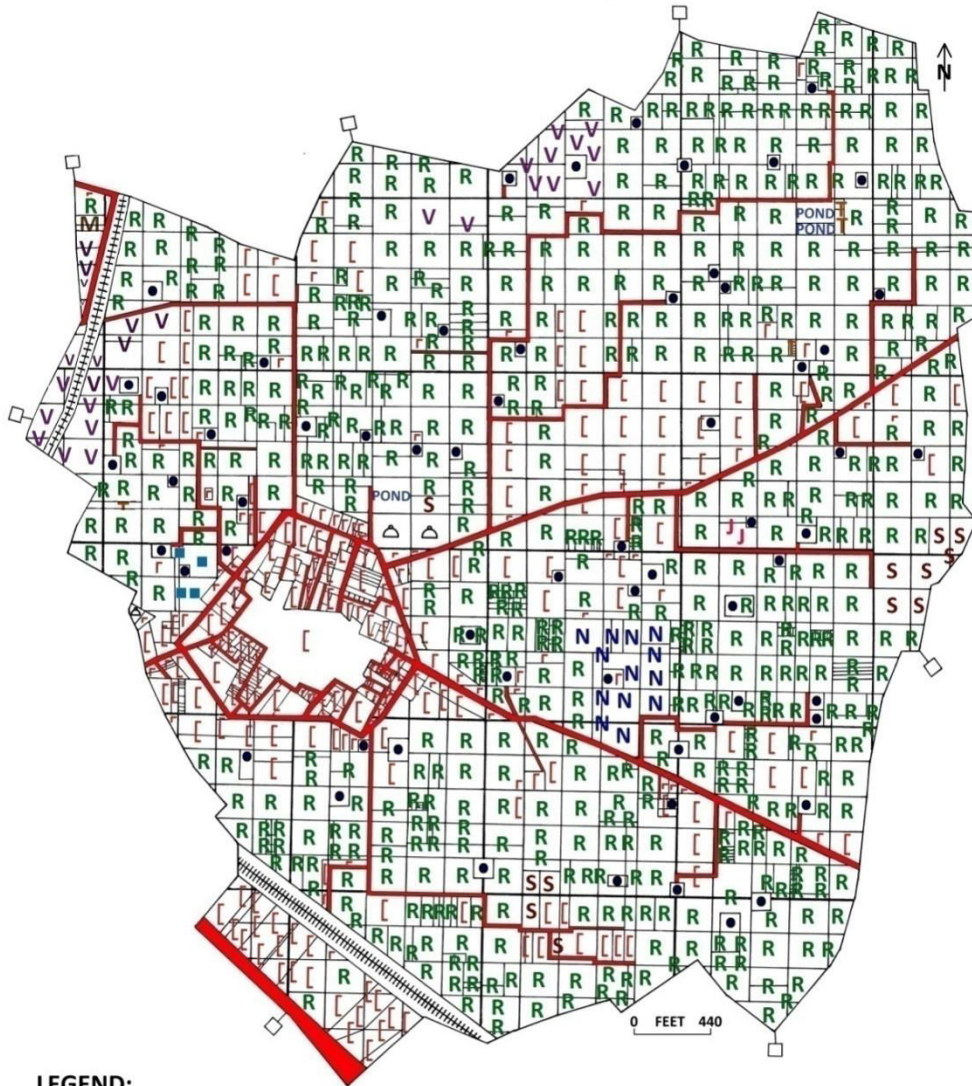
LEGEND:

Hadbast Boundary	Railway Line	Khatri
Field Boundary	Jat Randhawa	Tarkhan
Settlement	Jat Nagra	Sunnar
Road	Jat Seikhon	Shamlat

Figure 5.19

Even today *Jat Randhawa* continues to be the dominant land-owning caste. They have more than 93 per cent of the total cultivated fields and the total area in their possession (Figure 5.20). Their fields are larger and regular rectangular. The fields and holdings of other existing castes (*Jat Nagra*, *Jat Johal*, *Jat Mahli*, *Ramgarhia Vadder*, *Ramgarhia Mander* and *Tarkhan*) are relatively smaller in size. The holdings of these castes are intermingled with the holdings of *Jat Randhawas*. The fields belonging to *Jat Randhawas* are distributed more near the *abadi-deh* (settlement) and fields of other castes are relatively situated more near the village territory. No difference is found in terms of shape of the fields, source of irrigation, crops grown and farm mechanization of different castes. The low castes do not own cultivated land, but they have their own houses in the *abadi-deh* (settlement) and provide labour in farming practices to other castes. In brief no remarkable differences are found in the field patterns owned by the different castes. *Jat Randhawas* is a single-dominant land-owning caste in the village even today. The difference exists only in the amount of land owned by different castes. The economic conditions of land-owning castes seem to have a greater bearing on the field patterns. The rich farmers practise mechanized farming. They have big land holdings, large and regular rectangular fields. The land holdings and fields of poor farmers are small irrespective of their castes.

VILLAGE DHANOWALI
DISTRIBUTION OF FIELDS ACCORDING TO
LAND-OWNING CASTES, 2016



LEGEND:

 Hadbast Boundary	 Cremation Ground	 Jat Nagra
 Field Boundary	 Tubewell	 Ramgarhia Vadder
 Settlement	 Jat Randhawa	 Ramgarhia Mander
 Road	 Jat Mahli	 Tarkhan
 Railway Line	 Jat Johal	 Shamlat

Figure 5.20

2. EXISTING FIELD PATTERNS IN AN UPLAND PLAINS WITH SAND DUNES VILLAGE (BATH)

Regularity and uniformity in the field landscape is the most important feature of the existing field patterns in village Bath located in the upland plains with sand dunes. Most of the sand dunes have already been levelled and brought under agriculture. Some of the previous agricultural fields are encroached upon by the new settlements more near the *abadi-deh* (settlement) and the roads (Figure 5.21).

LAND TYPES

Land types have improved to the maximum extent due to the adoption of canal irrigation in the study village. The latest 2016 land types and field pattern map of the village reveals that the entire cultivated area and all the fields have been brought under irrigation in the form of *nahari* (canal irrigated) and *chahi* (tube-well irrigated) land type fields (Figure 5.22, Table 5.6). Most of the newly sub-divided fields are perpendicular to the *khals* (irrigation channels) to provide irrigation facilities to all such fields. Out of total 994 fields, 961 fields (96.68 per cent) belong to *nahari* (canal irrigated) land type and remaining 33 (3.32 per cent) fields are *chahi* (tube-well irrigated). Tube-wells have been added in the irrigational landscape of the village in recent years. More than 200 *kanals* (4 per cent in total cultivated area) have been brought under tube-well irrigation. Such tube-well irrigated fields though small in number are found scattered in different parts of the village territory. Irrigation by tube-well water has not become popular because of the fact that entire south-west plains of Punjab, in which the study village falls, suffers from brackish water of sub-surface reservoirs. Therefore, the study village like many of the villages in south-west Punjab depends primarily on canals to quench the thirst of the fields.

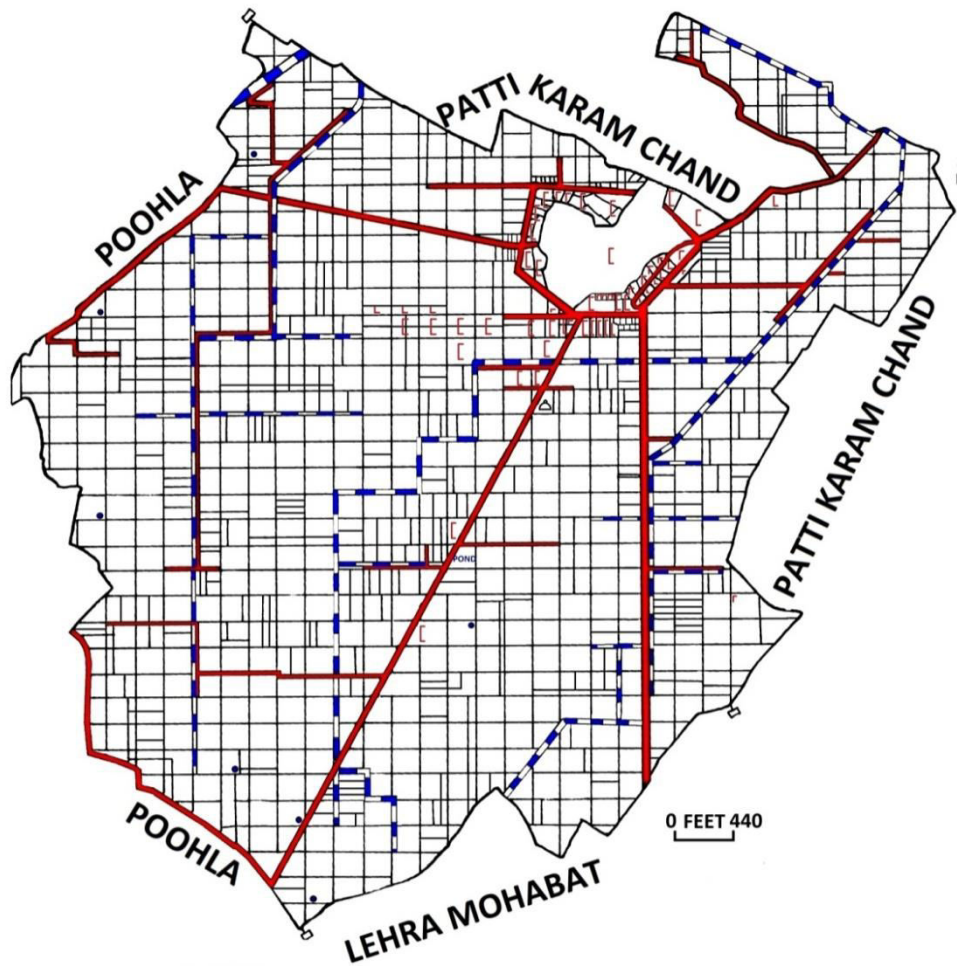
Productivity and fertility of land has become uniform in all parts of the village territory due to the use of irrigation facilities. There is a complete transformation of land types due to the introduction of irrigation. This type of irrigational revolution in the study village and in majority of the other villages in south-west Punjab has provided numerous economic gains to the state and also the country in the form of increase in agricultural production and provided the much needed food security to the country. Excessive irrigation in the absence of proper drainage system can prove to be a serious environmental threat. Canal irrigation has not been proved as a blessing to all the villages in Punjab. It also has the potentiality to turn green fields into *seim*

(water-logged) fields. The canal irrigated areas are often flat and poorly drained. The continuous supply of canal water to such poorly drained fields may result in water-logging over a period of time. Poor water management in some villages of south-west Punjab has led to land degradation in irrigated areas through water-logging and salinity. Due to the unplanned canal irrigation system, inadequate drainage system and over irrigation seepage, the problem of water-logging has become an important issue in different part of Punjab (Singh, 2013). The level of ground water rises due to water-logging. This water reaches to the crop roots and damages it. Crop productivity gets affected, making the land totally unproductive and the cultivated land turns into a wet desert. Water-logging not only adversely affects the crops, soil productivity and fertility, but it also affects roads, buildings and other structures. All precautionary measures should be taken to keep the agricultural landscape of the village free from adverse effects of over irrigation.

Planned canal irrigation system through proper water management and cropping patterns must be adopted. Paddy cultivation introduced in the study village, like many other villages of Punjab, should be minimized. Seepage from the canals should not be allowed. Cemented water channels do not allow the water to seep and therefore protect the fields from water-logging. Water supply to the fields through strong pipe lines instead of open drains, not only save water from wastage in the passage but it also avoid water-logging. Therefore, rational use of irrigation facilities should be promoted for sustainable water resource management.

The per-capita number of fields and size of land holdings has decreased continuously in this study village also. This is due to increasing population pressure by the addition of new members in the genealogical tree of land owners and also by the entrance of females in ownership rights, which has been made possible by the amendment of the Hindu Act, stating that daughters are entitled to share equally in their father's property.

VILLAGE BATH EXISTING FIELD PATTERNS, 2016



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



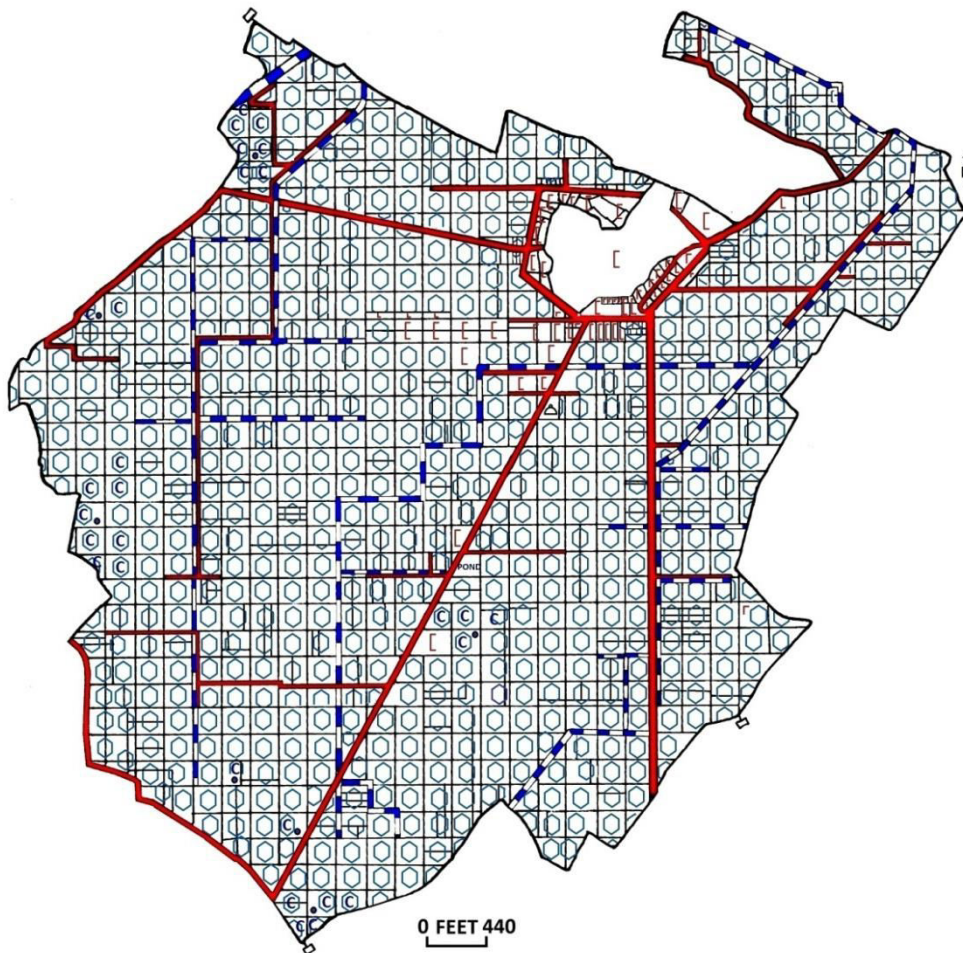
- | | |
|--|--|
|  Hadbast Boundary |  Road |
|  Field Boundary |  Canal |
|  Settlement |  Cremation Ground |
|  Tubewell | |

Figure 5.21

VILLAGE BATH
 LAND TYPES AND FIELD PATTERNS, 2016



LEGEND:

- | | | | | | |
|--|------------------|--|------------------|--|----------|
| | Hadbast Boundary | | Road | | Nahari |
| | Field Boundary | | Canal | | Chahi |
| | Settlement | | Cremation Ground | | Tubewell |

Figure 5.22

Table 5.6
Village Bath: Existing Land Types of Cultivated Fields, 2016

Land Type	Number of Fields	Percentage in Total Number of Fields	Area Covered (Kanals-Merlas)	Percentage in Area Covered
<i>Nahari</i>	961	96.68	481-17	96.01
<i>Chahi</i>	33	03.32	200-08	03.99
Total	994	100.00	5016-05	100.00

Source: *Jamabandi* of Village Bath, 2016.

The number of owners has increased from 108 in 1884 to 525 in 2016 (Table 3.3). The per-capita number of fields has decreased from 3 in 1884 to only 1.89 in 2016 and per-capita size of land holding has declined from 49 *kanals* in 1884 to only 9 *kanals-11 merlas* in 2016 (Table 3.4). The per-capita number of fields and the size of land holding are declining continuously due to increase in the number of owners resulting in the continuous sub-divisions of existing fields and fragmentation of land holdings.

The cultivated land has shrunk due to encroachment by the expanding settlements, both near and away from the main settlement in recent years. The most important concern has been the operation of process of sub-divisions of fields among the descendants of each family from generation to generation, resulting in the increase in the number of fields but reduction in their size. At present, most of the land holdings are jointly owned by a number of family members, which will ultimately lead to their further fragmentations and scattering in future, as every member wants to have a share in the field, which is located near *abadi-deh* (settlement) and along roads. There is a serious challenge to stop further sub-divisions and fragmentations of fields and to keep size of land holdings economical. Co-operative farming, small family size and availability of more jobs outside farming sector can control this problem.

SIZE OF THE FIELDS

Due to continuous sub-divisions, the fields and holdings have become small in size (Table 5.7). The number of fields has increased from 326 in 1884 to 994 in 2016 more due to sub-division of fields due to increase in the number of owners from 108 in 1884 to 525 in 2016 (Tables 3.3).

Table 5.7
Village Bath: Existing Field Size Analysis, 2016

Field Size	Number of Fields	Percentage in Total Number of Fields	Area Covered (<i>Kanals Merlas</i>)	Percentage in Total Cultivated Area
Small (Below 1 <i>Kanal</i>)	59	5.94	23-07	0.47
Medium (1 <i>Kanal</i> to 4 <i>Kanals</i>)	303	30.48	101-13	2.02
Large (4 <i>Kanals</i> to 8 <i>Kanals</i>)	617	62.08	4875-02	97.18
Very Large (Above 8 <i>Kanals</i>)	15	1.50	16-03	0.33
Total	994	100.0	5016-05	100.0

Source: *Jamabandi* of Village Bath, 2016.

The *gairmumkin* (uncultivable) land uses like expanding settlements have continuously encroached upon the cultivated fields. The small fields have 5.94 per cent of the total cultivated fields, but due to small size, they cover only 0.47 per cent of the total cultivated area. Small fields are found more near the *abadi-deh* (settlement) and village roads due to their more economic value and future scope for

construction of houses. The number of medium size fields of 1 *kanal* to 4 *kanals*, increased from 281 in 1960 to 303 in 2016. The area under medium size fields has increased from 94 *kanals* in 1960 to 101 *kanals*-13 *merlas* in 2016, due to increase in their numbers. The number of large fields of 4 *kanals* to 8 *kanals* has increased from 559 to 617, but the area under these fields has decreased from 5069 *kanals* to 4875 *kanals* between 1960 and 2016 respectively, as many of the large size fields have been encroached by the expanding settlements. The medium and large size fields together cover 92.56 per cent of the total cultivated fields and above 99 per cent of the total cultivated area of the village in 2016. The medium and large size fields are found scattered everywhere in the village territory. The number of very large size fields of above 8 *kanals* has declined from 26 in 1960 to 15 in 2016 because of their subdivisions. Such very large size fields are found more near the village boundaries where the neighboring very small sized field has been merged with the *killa* field converting a *killa* field in to very large size field.

SHAPE OF THE FIELDS

The most characteristic feature of the shape of the existing fields is the total regularity and uniformity due to the process of consolidation (Figure 5.21). The percentage of four sided rectangular shape fields has decreased from 72.59 per cent in 1960 to 45.81 per cent of the total fields in 2016, as many of these rectangular shape fields have been converted into four sided strips in shape due to their sub-divisions (Table 5.8).

Thirty-seven per cent of the total fields are four sided strips in shape in 2016, whereas such strip fields occupied only 7.60 per cent share in the total number of fields in 1960. Only the fields adjacent to the village boundary, *abadi-deh* (settlement), tube-well sites, diagonal roads and sand dunes vary slightly in shape. Such fields are in general triangular, quadrilateral, polygon and hexagon in shape. The percentage of fields under such shape categories tends to be almost the same in 1960 and 2016 field maps. Because of the process of consolidation, the field boundaries have become regular in shape (Table 5.9). Majority of the field boundaries run straight and meet each other at right angle because of regular rectangular field patterns (Figure 5.21).

Table 5.8**Village Bath: Existing Field Shape Analysis, 2016**

Field Shape Class	Number of Fields	Percentage in the Total Number of Fields
Three sided-Triangular	41	4.12
Four sided-Square	07	0.70
Four sided-Rectangular	456	45.88
Four sided-Elongated or Strips	367	36.92
Four sided-with one or more sides oblique irregular Rectangular or Quadrilateral	85	8.55
Five sided-Polygons	29	2.92
Six sided-Hexagons or more	09	0.91
Total	994	100.0

Source: *Shajra Kishtwar* of village Bath, 2016.

FIELD BOUNDARIES

The field boundaries constitute an important element of the existing field patterns. The low mud dikes known as *wats* and *arrs/khals* (irrigation channels) act as field boundaries in the village field landscape.



Figure 5.23 Open field systems. Note the dry fields with *wats* (mud dike) and absence of any protective fencing.



Figure 5.24 Wired fencing of the fields: a protection against stray cattle.

These *wats* are used as paths for movement of human beings and cattle and are used as dams to retain water within the fields. *Wats* and *arrs/khals* constitute the smallest feature of rural agricultural landscape. The *wats* as field boundaries predominates in the study village, with absence of protective fencing around the fields. The *wats* are about eight to ten inches high, one to two feet wide and have enormous length. They are made of locally available soils and mud. They have created the open field landscape (Figure 5.23). The *warr* of *kande* (fence of thorny bushes), the row of trees (*beri* and *dherek*) and fencing-wires also serve as field boundaries in some cases (Figure 5.24). Fields near roads and *abadi-deh* are enclosed by such boundaries to protect the standing crops in the fields from stray cattle and children. The fields near the *abadi-deh* (settlement), village boundary, diagonal roads and tube-well have irregular field boundaries. The fields with micro-topographic variations near sand dunes also have irregular field boundaries (Figure 5.26).

Table 5.9

Village Bath: Existing Classes of Fields with reference to Number of Boundaries, 2016

Fields With	Numbers of Fields	Percentage in Total Number of Fields
Three boundaries	41	4.12
Four boundaries	915	92.05
Five boundaries	29	2.92
Six and more boundaries	09	0.91
Total	994	100.0

Source: *Shajra Kishtawar* of village Bath, 2016.



Figure 5.25 Cemented *Khal* (irrigation channel): A major source of irrigation in village Bath.



Figure 5.26 Irregular shape field boundaries along a sand dune.

FIELD PATTERNS AND SOURCE OF IRRIGATION

Canals and tube-wells are the sources of irrigation in the study village (Figure 5.21). *Khal* (irrigation channel taken out from canal) is the chief source of irrigation (Figure 5.25). Tube-well is located mostly either in the centre of the holding or near the road. It is located anywhere within a field or fields. A room or a set of rooms are constructed near the tube-well, used for keeping farming implements, housing animals, fodder, fertilizers and farm produce. A few small *kyaris* (small cultivation units) are very common around tube-well, where farmers grow vegetables for domestic use. All the fields of a holding do not necessarily touch one or more sides of a tube-well. The entire village has a uniform gentle slope and within a levelled holding, water can be brought through *arrs* (small irrigation channels) to all the fields with ease (Figure 5.27). Most of the newly sub-divided fields are perpendicular to the *khals* (irrigation channel taken out from canal) to provide irrigation facilities to all such fields. The big size fields are divided into small *kyaris* to water the crops with ease.



Figure 5.27 Irrigated fields in foreground and sand dune topography in the background.

The field, in which tube-well is dug, mostly becomes hexagon in shape. Otherwise, fields of all shapes and sizes are found near the tube-well. The size and shape of fields do not seem to have any relationship with the tube-well. The fields of different size and shape are irrigated with the help of tube-wells. Irrigation has affected the

cropping patterns. The farmers have started growing non-traditional crops like paddy in irrigated fields (Figure 5.30). The distance has not remained the prime determinant of land quality. There exists no relationship between the distance from the *abadi-deh* (settlement) and productivity and fertility of land due to the use of irrigation facilities and fertilizers.

FIELD PATTERNS AND PLOUGHING IMPLEMENTS USED

The kind of ploughing implement also determines the size and shape of a field. In village Bath also, in tractor-used farms the fields are large and accentuated rectangular in shape (Figure 5.28). In a large accentuated rectangular field both time and fuel are saved, as tractor needs fewer turns to plough the entire field. In the study village it is also found that the farmers, who have their own tractors, plough all the fields with tractor irrespective of the size and shape. Bullock-plough drawn fields which were generally small in size have been replaced completely by the tractors. The farmer who does not own tractor, prefer to plough his fields with hired tractors.



Figure 5.28 Large sized accentuated rectangular field in a tractor used farm.

(Note Guru Hargobind Thermal Plant, Lehra Mohabbat in the background).

FIELD PATTERNS AND CROPS GROWN

Intensive commercial grain farming is practiced in village Bath in large size and regular shape fields. An analysis of existing cropping pattern in the study village reveals that there exists no relationship between cropping pattern and infield and outfield areas situated near and away from the *abadi-deh* (settlement). The intensive commercial farming is practised both near and away from the *abadi-deh* (settlement). Distances from the *abadi-deh* (settlement) do not appear to have any relationship with the type of crops grown and the resultant field patterns. Fodder is grown relatively in the fields situated near the roads and near to the *abadi-deh* (settlement) to meet the daily requirements of cattle, as these are kept in the *abadi-deh* (settlement) site.

Ekfasli (one crop) fields exist nowhere in the entire village territory. Farmers grow at least two or more crops in a year both in infield and outfield areas. The *teenfasli* (three crops) fields are relatively distributed everywhere in the entire village territory. Early maturing high yielding variety seeds are used in these fields. After the harvesting of one crop, new crop is immediately grown without wasting time. Mechanized farming along with intensive irrigation and use of fertilizers, insecticides and pesticides help the crops to grow early. The *teenfasli* fields are relatively larger than the *dofasli* fields. Farmers decide to allocate fields under different crops not in terms of their size or shape but in terms of price of crops, yield, maturing period and market demands.

Cropping pattern has shifted from low value traditional crops to economically more remunerative crops. The fields are covered by wheat, *javi* (cereal), *barseem* (fodder), potato, vegetables and *sarson* (oil-seed) in the *rabi/harri* season and *dhaan* (paddy), *narma* (American cotton), *chari* (fodder) and *guar* (beans) in the *kharif/saoni* season (Table 5.10, Figures 5.29 and 5.30). Wheat, paddy and *narma* (American cotton) crops are grown at commercial level and are sold mainly at Bathinda city market. Wheat covering 93 per cent of the total cultivated area and paddy covering 72 per cent of the total cultivated area are the dominant *Rabi* and *kharif* crops respectively.

Table 5.10

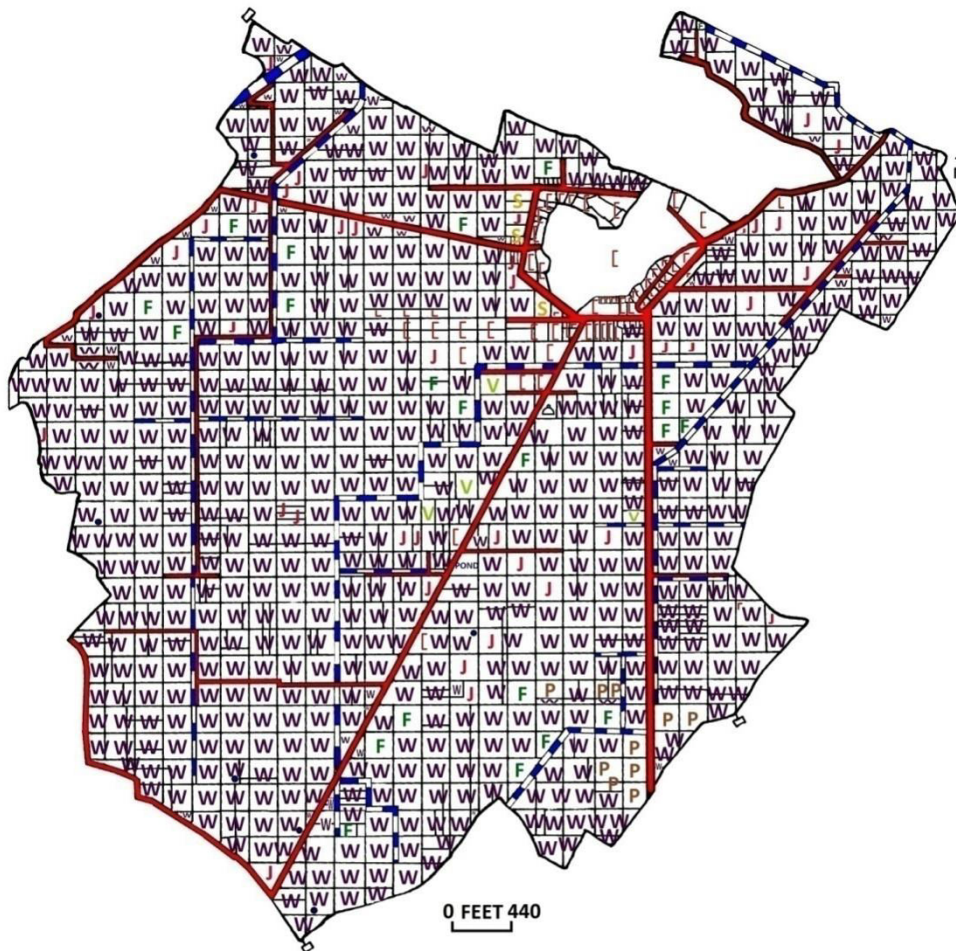
Village Bath: Existing Rabi (*Harri*) and *Kharif* (*Saoni*) Cropping Patterns, 2016

<i>Rabi (Harri)–2016</i>			<i>Kharif (Saoni)–2016</i>		
Crop	Area (Kanals)	Percentage in Total Cropped Area	Crop	Area (Kanals)	Percentage in Total Cropped Area
Kanak (Wheat)	4544	92.81	<i>Dhaan</i> (Paddy)	3544	72.18
<i>Barseem</i> (Fodder)	144	2.94	<i>Narma</i> (American Cotton)	1016	20.70
<i>Javi</i> (Cereal)	136	2.78	Chari (Fodder)	304	6.19
<i>Aloo</i> (Potato)	40	0.83	<i>Guar</i> (Pulse)	16	0.33
Sabji (Vegetable)	16	0.32	-	-	-
<i>Sarson</i> (Oilseed)	16	0.32	-	-	-
Total	4896	100.00	Total	4910	100.00

Source: *Khasra Gardavari* of village Bath, 2016.

These crops have affected the field patterns to only some extent. The rice grown fields are divided relatively into smaller sections. Water should remain standing in the paddy fields almost for first three months. Water can be kept in small sections of fields with ease. All other crops are found in all the fields irrespective of their shape and size. A few small *kyaris* (cultivation units) are created near the tube-well for growing vegetables. Vegetables growing fields are generally smaller in size. The cropping pattern has shifted from traditional and subsistence types to non-traditional commercial crops due to the adoption of canal irrigation and Green Revolution technology. On the whole the existing cropping pattern does not seem to have affected the field pattern to a large extent.

VILLAGE BATH RABI (HARRI) CROPPING PATTERNS, 2016



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








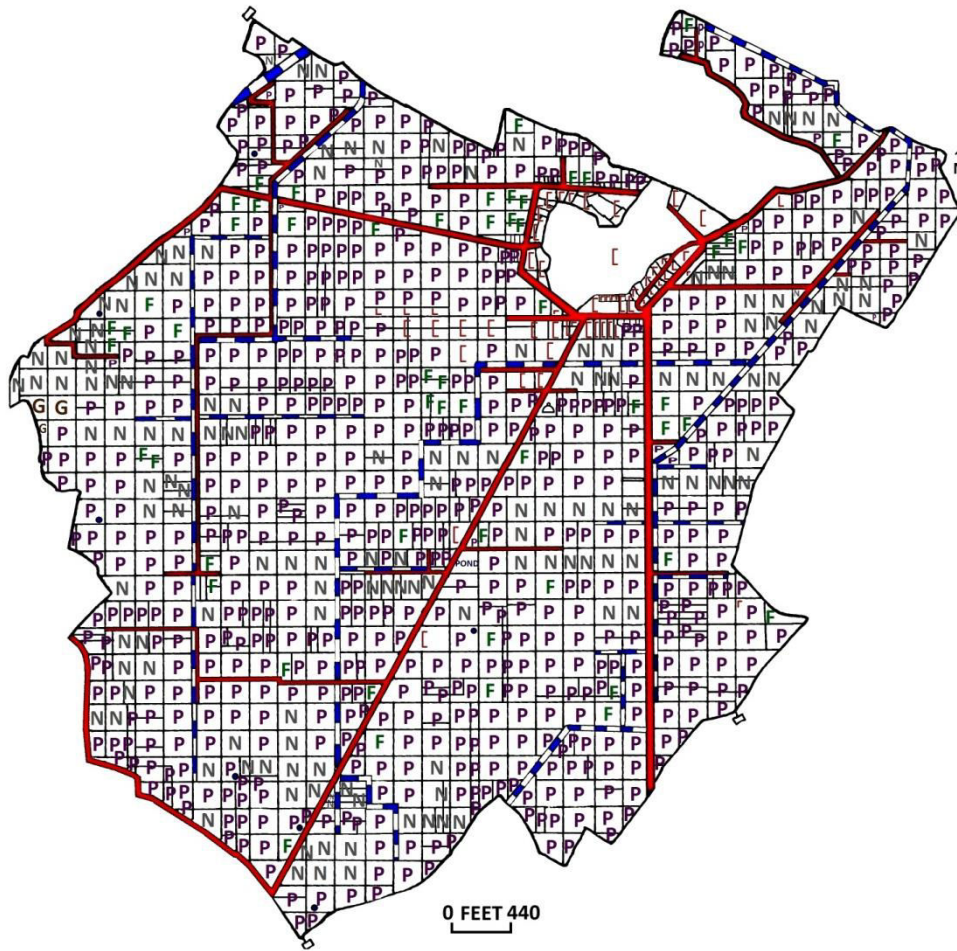
 Hadbast Boundary	 Road	 Wheat
 Field Boundary	 Canal	 Javi
 Settlement	 Potato	 Fodder
 Tubewell	 Vegetables	 Sarson

Figure 5.29

VILLAGE BATH KHARIF (SAONI) CROPPING PATTERNS, 2016



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









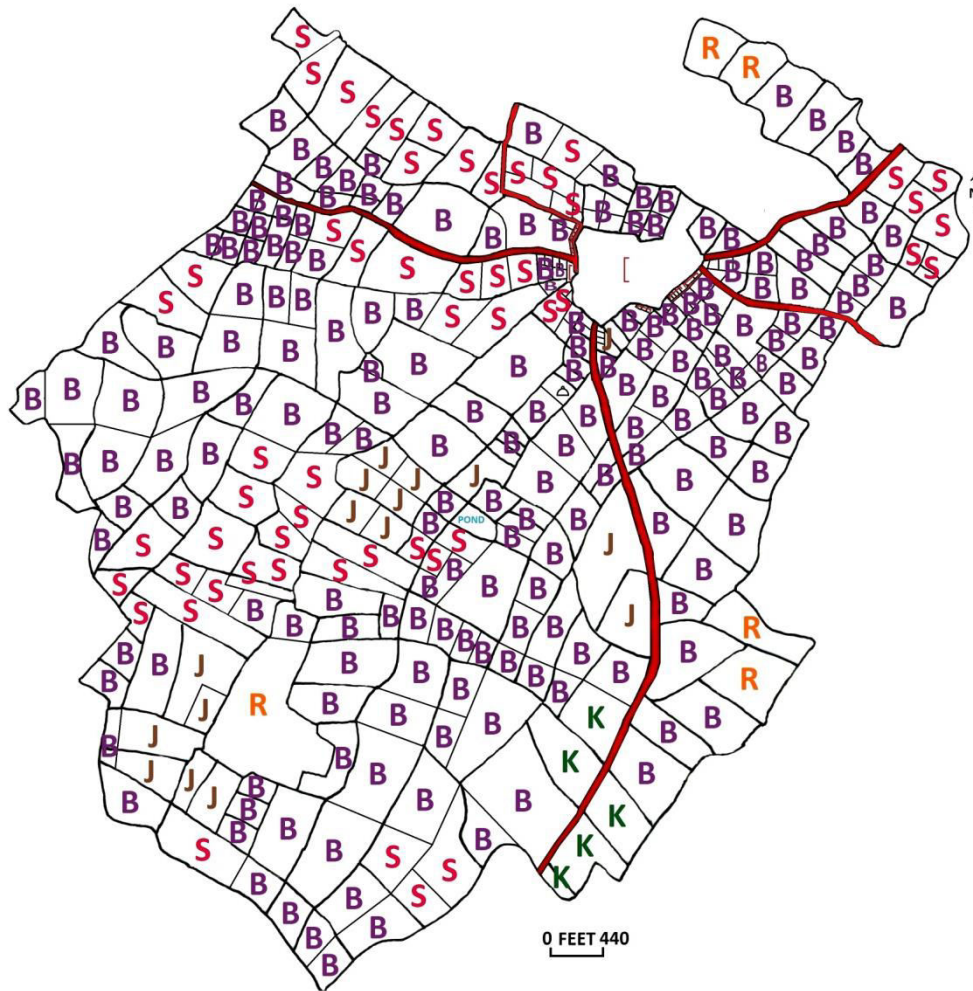
	Hadbast Boundary		Road		Paddy
	Field Boundary		Canal		Narma
	Settlement		Cremation Ground		Fodder
	Tubewell				Guar

Figure 5.30

FIELD PATTERNS AND LAND OWNING CASTES

The land owned by different castes display different field patterns. In general, fields and holdings of high castes are larger than those of the lower castes. The study village Bath was first inhabited by a family of *Jat Bath* caste and they named the village after their caste Bath. At that time the village was a uni-religious, uni-clan and uni-caste settlement. Later on they offered and sold some land to people from other castes, such as *Jat Sidhu*, *Jat Kaler*, *Jat Bhullar* and *Ramgarhia* to settle in the village and practise agriculture on the fields (Figure 5.31). People from other low castes were invited to settle here and were employed as agricultural laborers. They were not given cultivated land. *Jat Bath* remained the dominant land-owning caste having majority of the total cultivated fields and the cultivated area. Therefore, the fields and holdings owned by them were larger and regular than other castes. The fields of *Jat Bath* are found more near the *abadi-deh* (settlement) and are also found intermingled in the entire village territory with the fields belonging to other castes. Even today *Jat Bath* continues to be the dominant land-owning caste. They have majority of the total cultivated fields and area in their possession (Figure 5.32). Their fields are larger and regular rectangular. The fields and holdings of other existing castes *Jat Sidhu*, *Jat Kaler*, *Jat Bhullar* and *Ramgarhia* are relatively smaller in size. The fields and holdings of these castes are distributed away from the fields and holdings of *Jat Bath*. The fields belonging to *Jat Bath* are distributed more near the *abadi-deh* (settlement) and fields of other castes are relatively situated more near the village territory. No difference is found in terms of shape of the fields, source of irrigation, crops grown and farm mechanization of different castes. The low castes do not own cultivated land, but they have their own houses in the *abadi-deh* (settlement) and provide labor in farming practices to other castes. In brief, there are no remarkable differences in the field patterns owned by the different castes. *Jat Bath* is a single dominant land-owning caste in the village even today. The difference exists only in the amount of land owned by different castes. The economic conditions of land-owning castes seem to have a greater bearing on the field patterns. The rich farmers practise mechanized farming. They have big land holdings, large and regular rectangular fields.

VILLAGE BATH
DISTRIBUTION OF FIELDS ACCORDING TO
LAND-OWNING CASTES, 1884



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










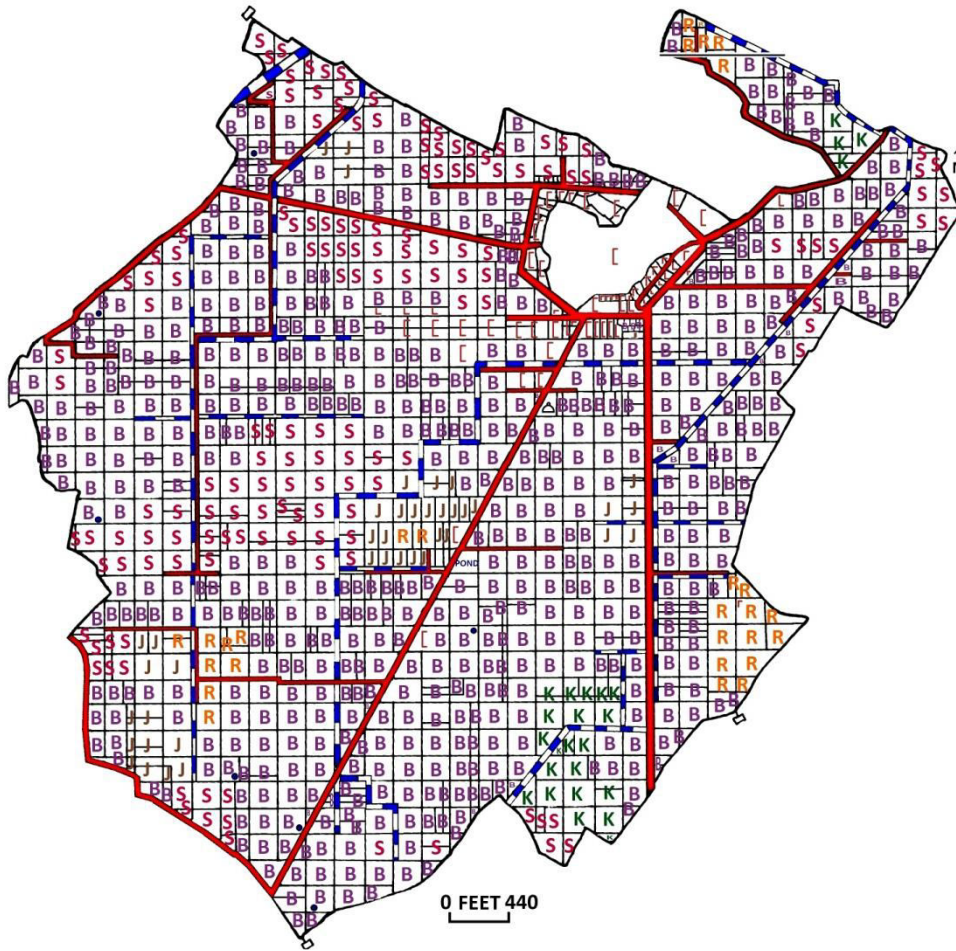
	Hadbast Boundary		Road		Jat Bath
	Field Boundary		Canal		Jat Sidhu
	Settlement		Cremation Ground		Jat Kaler
	Tubewell		Ramgarhia		Jat Bhullar

Figure 5.31

VILLAGE BATH DISTRIBUTION OF FIELDS ACCORDING TO LAND-OWNING CASTES, 2016



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










	Hadbast Boundary		Road		Jat Bath
	Field Boundary		Canal		Jat Sidhu
	Settlement		Cremation Ground		Jat Kaler
	Tubewell		Ramgarhia		Jat Bhullar

Figure 5.32

3. EXISTING FIELD PATTERNS IN A PIEDMONT PLAINS VILLAGE

(PATHAN CHAK)

The existing field patterns in village Pathan Chak, located in the piedmont plains shows complete regularity and uniformity (Figure 5.33). The present field patterns of the village show variations in comparison to the post-consolidation field patterns but not to the extent observed in the village Dhanowoli, which has experienced large scale encroachments due to its very close proximity to Jalandhar city and village Bath where irrigation has been the major factor of change in its field patterns. Various attributes of existing field patterns of village Pathan Chak are discussed in detail below:

LAND TYPES

Land types have improved due to the conversion of many *barani* land type fields in to *nahari* land type fields in village Pathan Chak. The latest 2016 field map of the village shows that 1368 *kanals*-8 *merlas* cultivated area (70.84 per cent in total cultivated area covered) spread over 357 fields (75.79 per cent in total number of fields) have been brought under *nahari* (canal irrigated) irrigation and 93 *kanals* cultivated area (4.82 per cent in total cultivated area covered) with 15 fields (3.19 per cent in total number of fields) has been brought under *chahi* (tube-well irrigated) land type fields (Figure 5.34, Table 5.11). These two irrigated land types of the village today cover nearly 79 per cent of the total number of fields and 75.65 per cent of the total cultivated area of the village.

Nahari land type fields in the village are irrigated by ancient methods of irrigation by *kuhal* and *jhikli* by taking the water from the *khals* and *choes*. *Nahari* fields are small in size and many of such fields are accentuated strips in shape with orientation towards the *choes* and *khals*. Many of the newly sub-divided fields are perpendicular to the *khals* to have access to the irrigation facilities. A new dimension has been added in the irrigational landscape of the village in the form of introduction of tube-well irrigation in recent years. Cultivated area of 93 *kanals* (4.82 per cent in total cultivated area covered) with 15 fields (3.18 per cent in total number of fields) has been brought under *chahi* (tube-well irrigated) land type fields. Such tube-well irrigated fields though small in number are found scattered in the extreme northern

parts of the village territory. Irrigation by tube-well water has not become popular because of the fact that the village is located in the foot-hills of the *Shiwalik* hills.

The study village like many of the villages in the foot-hills of Punjab depend primarily on *khals* and *choes* descending down from the *Shiwalik* hills to quench the thirst of the fields. Productivity and fertility of land has increased in the parts of the village territory, where irrigation facilities have been introduced. Area under *barani* land type fields has decreased by more than half (56.48 per cent) from 1080 *kanals-2 merlas* in the post-consolidation phase in 1960 to 470 *kanals* in 2016, as many *barani* fields have been converted into irrigated fields due to continuous efforts by the farmers. But still nearly one fourth (24.34 per cent) of the total cultivated area of the village with 99 fields (21 per cent in the total number of fields) are under *barani* land type and are dependent on rainfall. The *barani* land type fields are found more near the northern, western and southern territorial boundaries of the village. *Barani* fields in general are large in size and irregular in shape with poor inherent fertility and productivity.

Table 5.11

Village Pathan Chak: Existing Land Types of Cultivated Fields, 2016

Land Type	Number of Fields	Percentage in Total Number of Fields	Area Covered (Kanals-Merlas)	Percentage in Area Covered
<i>Nahari</i>	357	75.79	1368-08	70.84
<i>Chahi</i>	15	3.19	93-00	04.82
<i>Barani</i>	99	21.02	470-00	24.34
Total	471	100.00	1931-08	100.00

Source: *Jamabandi* of Village Pathan Chak, 2016.

VILLAGE PATHAN CHAK EXISTING FIELD PATTERNS, 2016

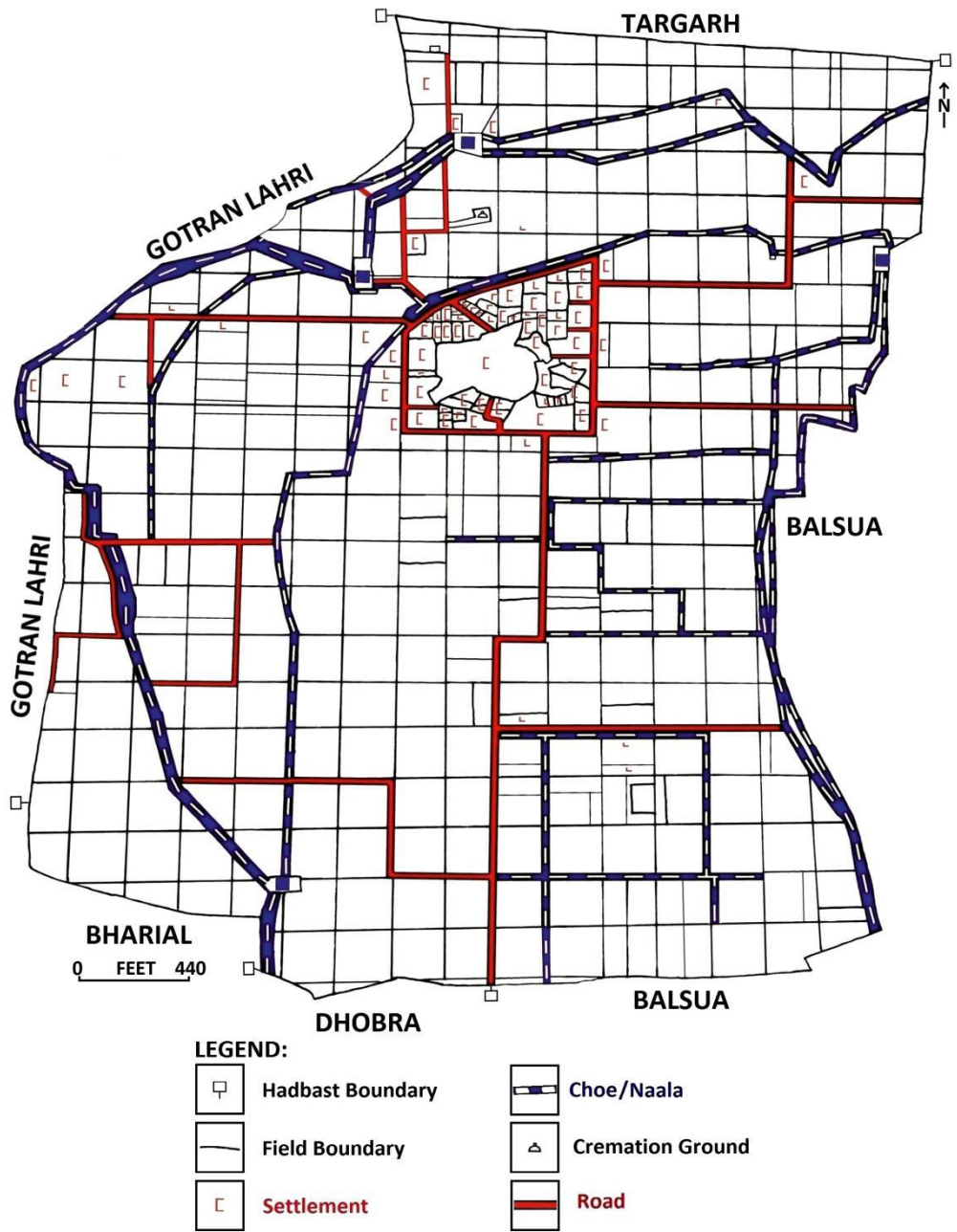
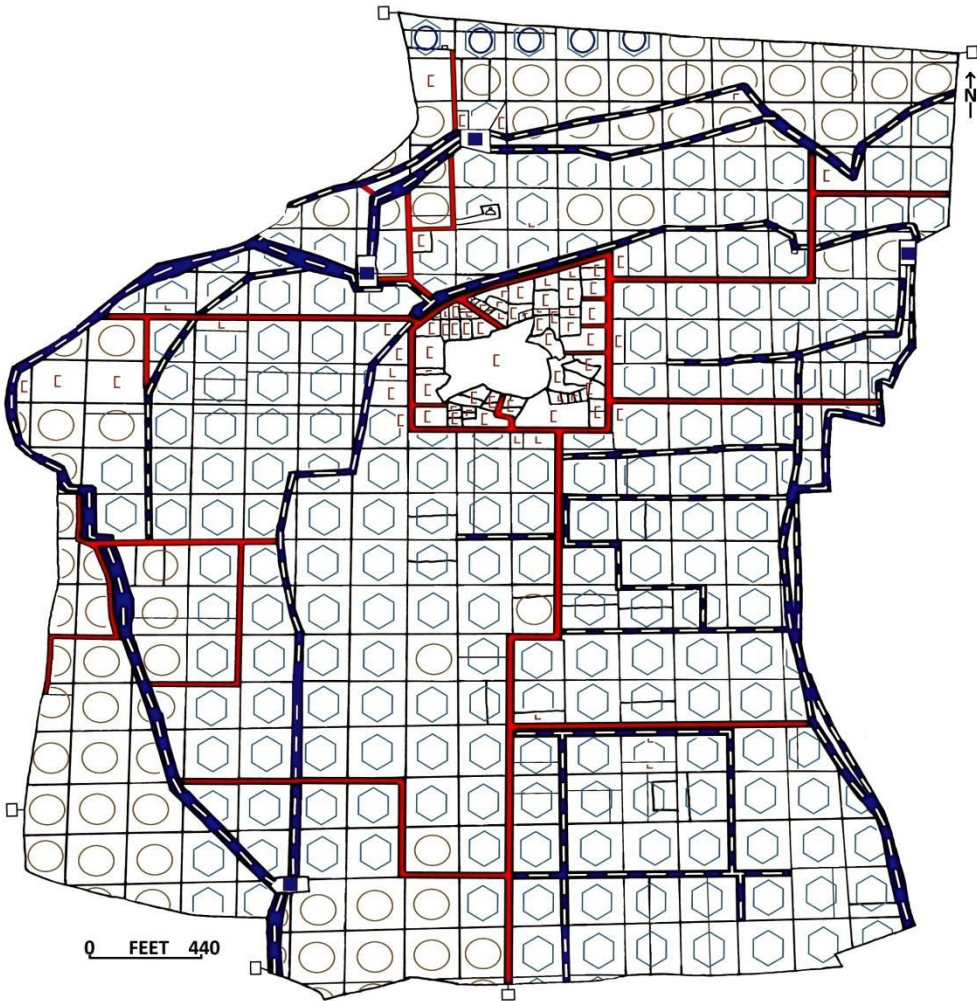


Figure 5.33

PATHAN CHAK LAND TYPES AND FIELD PATTERNS, 2016



LEGEND:

 Hadbast Boundary	 Choe/Naala	 Nahari
 Field Boundary	 Cremation Ground	 Chahi
 Settlement	 Road	 Barani

Figure 5.34

SIZE OF THE FIELDS

Due to continuous sub-divisions, the fields and holdings have become small in size. The number of fields have increased from 421 in 1890 to 471 in 2016, more due to sub-division of fields because of increase in the number of owners from 104 in 1890 to 210 in 2016 (Table 5.12). The *gairmumkin* (uncultivable) land uses like settlements, roads and *khals* (irrigation channels) have encroached upon the cultivated fields. The number of small fields has decreased from 69 in 1960 to 43 in 2016, as many of the small fields situated near the *abadi-deh* (settlement) have been encroached by the construction of new buildings. Small fields occupy 9.14 per cent of the total number of cultivated fields, but due to their small size, they cover only 1.41 per cent of the total cultivated area. Small fields are found more near the *abadi-deh* (settlement), roads and *khals* (irrigation channels) due to their more economic value. The number of medium size fields of 1 *kanal* to 4 *kanals* has increased from 136 in 1960 to 174 in 2016. The area under medium size fields has increased from 394 *kanals* in 1960 to 413 *kanals*-13 *merlas* in 2016 due to increase in their numbers. The number of large size fields of 4 *kanals* to 8 *kanals* has increased from 222 to 252 (53.50 per cent in the total number of fields), but the area under these fields has decreased from 1536 *kanals* to 1474 *kanals* between 1960 and 2016 respectively because many of the large size fields have been encroached by the expanding settlements. The medium size fields cover 21.41 per cent of the total cultivated area and the large size fields cover 76.33 per cent of the total cultivated area of the village in 2016. The medium size fields are found more near the *abadi-deh* (settlement), roads and *khals* (irrigation channels). The large size fields are found scattered everywhere in the village territory but more in the *barani* land types. The number of very large size fields of above 8 *kanals* has decreased from 3 in 1960 to 2 in 2016. Such very large size fields are found more near the village boundaries, where the neighbouring very small sized field has been merged with the *killa* (8 *kanals*) field converting a *killa* field in to very large size field.

Table 5.12**Village Pathan Chak: Existing Field Size Analysis, 2016**

Field Size	Number of Fields	Percentage in Total Number of Fields	Area Covered (Kanal – Merlas)	Percentage in Total Cultivated Area
Small (Below 1 Kanal)	43	9.14	27-05	1.41
Medium (1 Kanal to 4 Kanals)	174	36.94	413-13	21.41
Large (4 Kanals to 8 Kanals)	252	53.50	1474-08	76.33
Very Large (Above 8 Kanals)	02	0.42	16-02	0.83
Total	471	100.0	1931-08	100.0

Source: *Jamabandi* of Village Pathan Chak, 2016.

SHAPE OF THE FIELDS

The process of consolidation implemented in the village in 1960 has given the most characteristic feature to the shape of the existing fields in the form of their total regularity and uniformity, which is visible in the present field landscape also in 2016 (Figure 5.33).

Table 5.13**Village Pathan Chak: Existing Field Shape Analysis, 2016**

Field Shape Class	Number of Fields	Percentage in the Total Number of Fields
Three sided–Triangular	37	7.86
Four sided–Square	Nil	0.00
Four sided–Rectangular	174	36.94
Four sided–Elongated or Strips	52	11.04
Four sided–with one or more sides oblique irregular Rectangular or Quadrilateral	157	33.33
Five sided–Polygons	30	6.37
Six sided–Hexagons or more	21	4.46
Total	471	100.0

Source: *Shajra Kishtwar* of Village Pathan Chak, 2016.

The percentage of four sided rectangular shape fields has decreased from 45.58 per cent in 1960 to 36.94 per cent of the total fields in 2016, as many of such rectangular shape fields are converted into four sided strips in shape due to their sub-divisions (Table 5.13). Four sided strips in shape fields have therefore increased from 7.20 per cent in 1960 to 11.04 per cent in 2016. The number of oblique quadrilateral fields has increased from 103 in 1960 to 157 in 2016 because of their sub-divisions. Most of such irregular quadrilateral fields are found along the *choes*, *khals* and the village boundary. The share of polygon fields is 6.37 per cent and under hexagon fields is 4.46 per cent in the total number of fields in 2016. The fields situated near *choes*, *khals*, village boundary, *abadi-deh* (settlement), tube-well sites and roads are also polygon and hexagon in shape.

FIELD BOUNDARIES

The field boundaries constitute an important element of the existing field patterns. The low mud dikes known as *wats* and *khals* (irrigation channels), *choes* (seasonal streams) and roads act as field boundaries in the village field landscape. These *wats* are used as paths for movement of human beings and cattle and are used as dams to retain water within the fields (Figure 5.35). *Wats* and *khals* constitute the smallest feature of agricultural landscape of the village. The *khals* as field boundaries predominates in the study village. The *khals* are about 2 to 3 feet deep and wide and have enormous length (Figure 5.36). The *warr* of *kande* (fence of thorny bushes), the row of trees and fencing-wires also serve as field boundaries in many cases. Some of the fields near roads and *abadi-deh* (settlement) are enclosed by such boundaries to protect the standing crops in the fields from stray cattle (Figure 5.37).



Figure 5.35 *Wats* separating the fields: used as embankment to retain water within the fields and for movement of human beings.



Figure 5.36 The deep and wide *khals* having enormous length act as a field boundary.



Figure 5.37 Fields near *phirni* (circular roadaround settlement) enclosed by wired boundaries to protect the standing crops in the fields from stray cattle.

Many *khals* running on the field boundaries have been bricked and cemented to save the water loss in the passage. Most of the newly sub-divided fields are perpendicular to the *khals* to provide irrigation facilities to all such fields. These field boundaries give shape to a field. Presently, on an average 81 per cent of the total fields have four boundaries, 7.85 per cent of the fields have three boundaries and 6.37 per cent have

five boundaries (Table 5.14). Because of the process of consolidation, the field boundaries have become regular in shape. Majority of the field boundaries run straight and meet each other at right angle because of regular rectangular field patterns (Figure 5.33). The fields near *khals*, *choes*, the *abadi-deh* (settlement) and roads have irregular field boundaries (Figure 5.38). The fields with micro-topographic variations near *choes* also have irregular field boundaries.

Table 5.14

Village Pathan Chak: Existing Classes of Fields with reference to Number of Boundaries, 2016

Fields With	Numbers of Fields	Percentage in Total Number of Fields
Three boundaries	37	7.85
Four boundaries	383	81.32
Five boundaries	30	6.37
Six and more boundaries	21	4.46
Total	471	100.0

Source: *Shajra Kishtawar* of Village Pathan Chak, 2016.



Figure 5.38 An irregular field boundary near *khal*.

FIELD PATTERNS AND SOURCE OF IRRIGATION

Village Pathan Chak is situated in the *choes* (small seasonal streams) infested and dissected foothill plains which are higher than the neighboring upland plains. The village is infested by the *choes* from different directions with convenient water levels. In past *Jhiklis* (old traditional method of lifting water from the *choes*) were also popular which are now replaced by the diesel pumps. *Khals* (man-made water channels) are drawn to have access to water for irrigating the fields. *Kuhals* (man-made water channels) have been extracted from Kotli canal to irrigate the fields. Many elongated rectangular and strip shaped fields are oriented towards *choes*, *khals* and *kuhals* to have accessibility to water for irrigation both in 1890 and 1911 field maps of the village. *Khals* and *kuhals* are the chief sources of irrigation in the study village. Tube-wells have been recently introduced in the village as a modern means of irrigation. Tube-well irrigated fields are located only in the northern most boundary of the village. A few small *kyaris* (small cultivation units) are very common around tube-well where farmers grow vegetables for domestic use (Figure 5.39). A room or a set of rooms are constructed near the tube-well used for keeping farming implements, housing animals, fodder, fertilizers and farm produce (Figure 5.40). All the fields of a holding do not necessarily touch one or more sides of a tube-well. Most of the newly sub-divided fields are perpendicular to the *khals* (irrigation channels) to provide irrigation facilities to all such fields. The big size fields are divided into small sections to water the crops with ease. Fields of different shapes and sizes are found near the tube-well. The strip shape of newly sub-divided fields has relationship with the *khal*, as every owner of field wants to have access to water of the *khal*. The fields of different size and shape are irrigated with the help of tube-wells. Irrigation has affected the cropping patterns. The farmers have started growing non-traditional crops like paddy in irrigated fields. The distance has not remained the prime determinant factor of land quality. There exists no relationship between the distance from the *abadi-deh* (settlement) and productivity and fertility of land due to the use of irrigation facilities and fertilizers.



Figure 5.39 Small *kyaris* (cultivation units) used for growing vegetables for domestic use.



Figure 5.40 A modern tube-well room.

FIELD PATTERNS AND PLOUGHING IMPLEMENTS USED

The kind of ploughing implement also determines the size and shape of a field. In village Pathan Chak, in a tractor-used farm, the fields are large and accentuated rectangular in shape. In a large accentuated rectangular field both time and fuel is saved, as tractor needs fewer turns to plough the entire field. In the study village it is found that the farmers, who have their own tractors, plough all the fields with tractor irrespective of their size and shape. Bullock-plough drawn fields which were generally small in size have been replaced by the tractors in most parts of the village. A farmer who does not own tractor, prefer to plough his fields with hired tractor. The small *kyaris* (cultivation units), where farmer grows vegetables are generally ploughed by farmer himself using small farming implements.

FIELD PATTERNS AND CROPS GROWN

Field pattern is also influenced by the cropping pattern. Commercial grain farming is practiced in village Pathan Chak, in medium to large in size and regular in shape fields. An analysis of existing cropping pattern in the study village reveals that there exists no relationship between cropping pattern and in fields (fields situated near the *abadi-deh*, settlement) and outfields (fields situated near village boundary) area. The commercial farming is practised both near and away from the *abadi-deh* (settlement). Distance from the *abadi-deh* (settlement) does not appear to have any relationship with the types of crops grown and the resultant field patterns. Fields where fodder crops like *barseem* and *chari* are grown are relatively situated near the roads and near to the *abadi-deh* (settlement) to meet the daily requirements of cattle, which are kept in the settlements.

Ekfasli (one crop) fields exists nowhere in village Pathan Chak. Two or more crops are grown in a year both in infield and outfield areas. The *teenfasli* (three crops) fields are distributed everywhere in the entire village territory. Early maturing high yielding variety seeds are used in these fields. After the harvesting of one crop, new crop is immediately grown without wasting time. Mechanized farming along with use of traditional *khal* and *kuhal* irrigation systems, fertilizers, insecticides and pesticides help the crops to grow early. The *teenfasli* fields are relatively larger than the *dofasli* fields. Farmers decide to allocate fields under different crops not in terms of their size or shape but in terms of price of crops, yield, maturing period and market demands. Cropping pattern has shifted from low value traditional crops to economically more

remunerative crops. The fields are covered by wheat, *barseem* (fodder) and *sarson* (oilseed) in the *rabi/harri* season and paddy, *chari* (fodder), and *haldi* (turmeric) in the *kharif/saoni* season (Figures 5.41 & 5.42, Table 5.15). Wheat and paddy crops are grown at commercial level and are sold mainly at Pathankot city market. Wheat, which is grown on 1801 *kanals*-10 *merlas* area covering 94.94 per cent of the total cultivated area and paddy grown on 1699 *kanals* area covering 92.1 per cent of the total cultivated area are the dominant *rabi* and *kharif* crops respectively. Wheat and paddy crops are grown in all the fields irrespective of their shape and size. Fodder crops (*barseem* and *Chari*) growing fields are distributed more near the *abadi-deh* (settlement), as livestock are reared in the *abadi-deh* (settlement). A few small *kyaris* (cultivation units) are created near the tube-well for growing vegetables. Vegetables growing fields are generally smaller in size.

The cropping pattern has shifted from traditional and subsistence types to non-traditional commercial crops due to the adoption of Green Revolution technology. On the whole the existing cropping pattern does not seem to have affected the field pattern to a large extent.

Table 5.15

Village Pathan Chak: Existing *Rabi (Harri)* and *Kharif (Saoni)* Cropping Patterns, 2016

<i>Rabi (Harri) -2016</i>			<i>Kharif (Saoni) -2016</i>		
Crop	Area Covered (Kanals-Merlas)	Percentage in Total Cropped Area	Crop	Area Covered (Kanals-Merlas)	Percentage in Total Cropped Area
Kanak (Wheat)	1801-10	94.94	Jhona (Paddy)	1699-01	92.11
Barseem (Fodder)	88-08	4.64	Chari (Fodder)	144-16	7.85
Sarson (Oilseed)	7-13	0.42	Haldi (Turmeric)	0-13	0.04
Total	1897-11	100.00	Total	1844-10	100.00

Source: *Khasra Gardavari* of Village Pathan Chak, 2016.

VILLAGE PATHAN CHAK RABI (HARRI) CROPPING PATTERNS, 2016

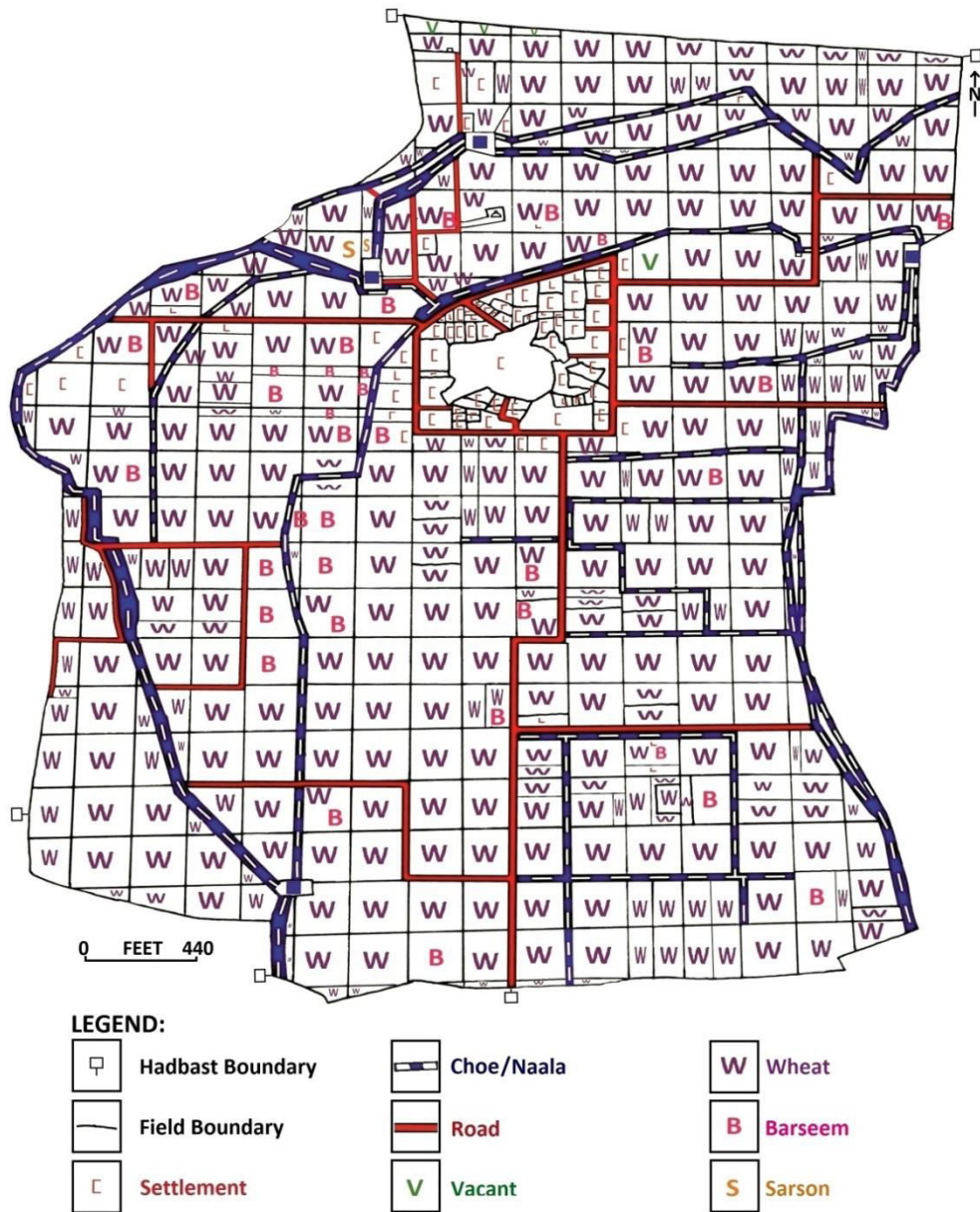


Figure 5.41

VILLAGE PATHAN CHAK
 KHARIF (SAONI) CROPPING PATTERNS, 2016

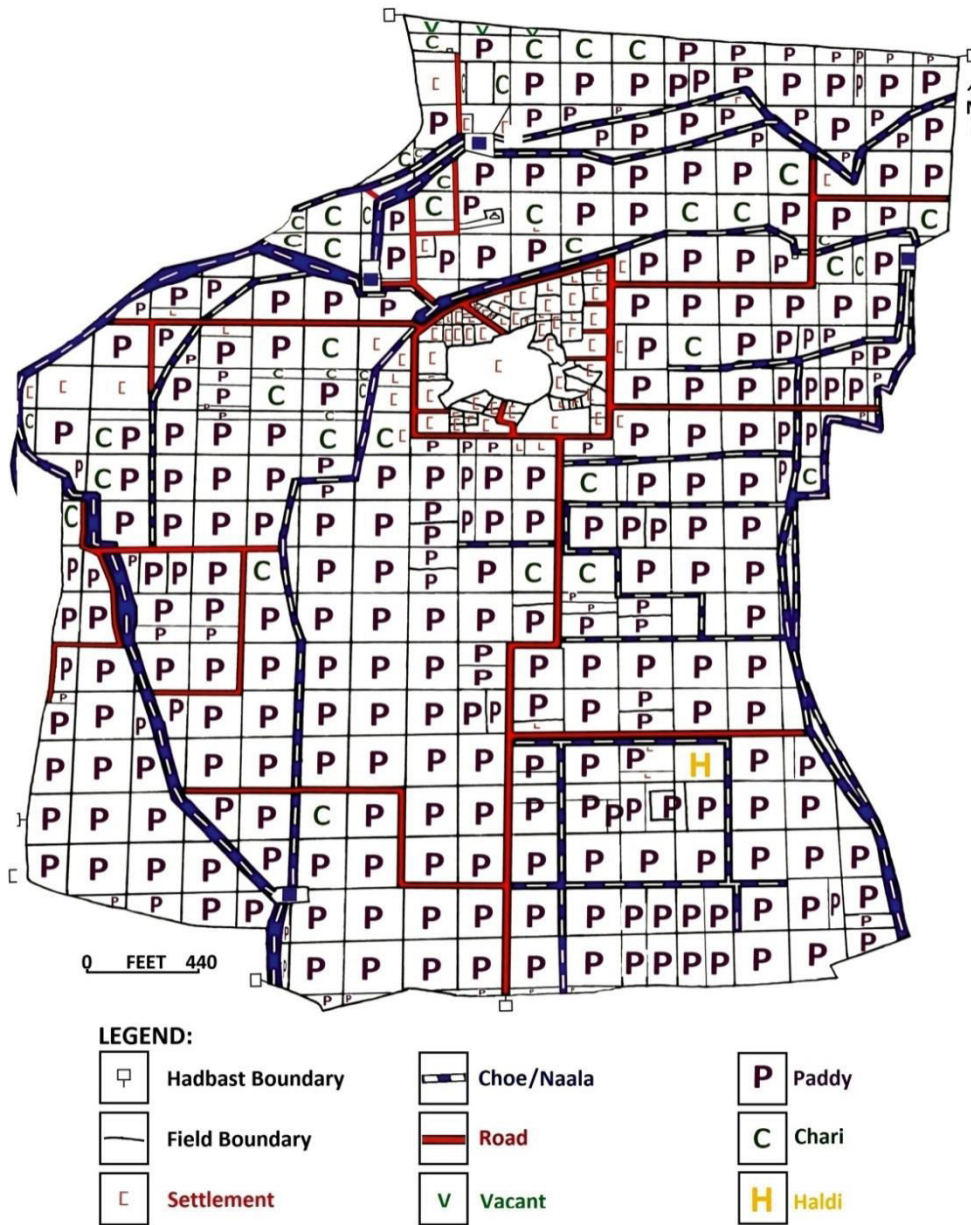


Figure 5.42

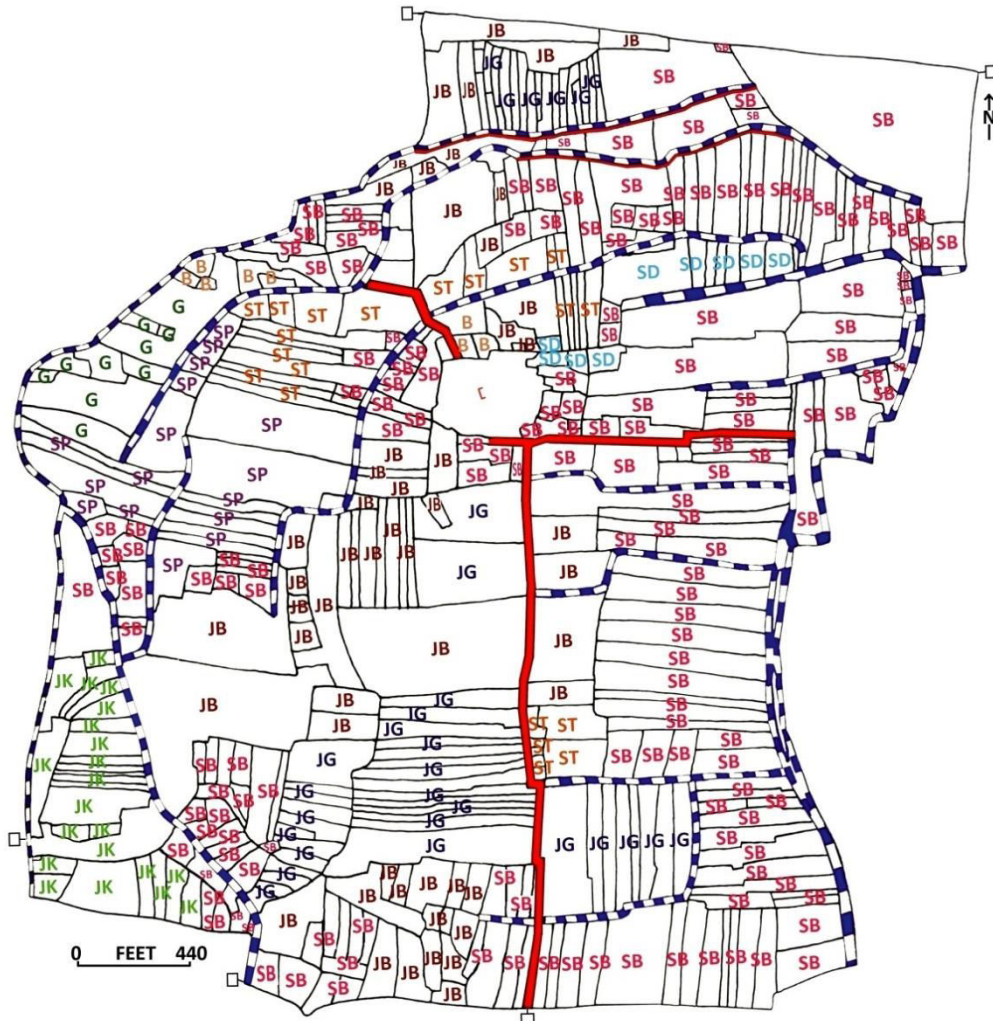
FIELD PATTERNS AND LAND OWNING CASTES

The fields owned by different castes display different field patterns in the village. According to genealogical tree (vanshavali/kursinama) of 1890, the village Pathan Chak, in the beginning was owned by people belonging to *Bhanguri clan of Saini* caste. They invited people from other clans of their own caste like *Saini Taroti* and *Saini Pahbe* to increase their strength as the land was abundant at that time. Later on they offered and sold some land to people from other castes, such as *Jat Bhular*, *Jat Kahlon*, *Jat Ghuman*, *Gujars* and *Brahmin Bhardwaj* castes to settle in the village and practise agriculture on the fields (Figure 5.43). People from other low castes were invited to settle here and were employed as agricultural laborers. They do not own cultivated land. *Saini* remained the dominant land-owning caste, having majority of the total cultivated fields and the cultivated area. Obviously the fields and holdings owned by them were larger and regular than other castes.

The fields belonging to all the clans of *Saini* caste, are found more near the *abadi-deh* (settlement) and are also found intermingled in the entire village territory with the fields belonging to other castes. Even today clans of *Saini* caste continue to be the dominant land-owning people. They have majority of the total cultivated fields and the total cultivated area in their possession (Figure 5.44). Their fields are larger and regular rectangular. The fields and holdings of other existing castes *Jat Bhular*, *Jat Kahlon*, *Jat Ghuman*, *Gujars* and *Brahmin Bhardwaj* castes are relatively smaller in size and situated away from the *abadi-deh* (settlement).

No difference is found in terms of shape of the fields, source of irrigation, crops grown and farm mechanization of different castes. The low castes do not own cultivated land, but they have their own houses in the *abadi-deh* (settlement) and provide labor in farming practices to other castes. *Saini* is a single dominant land-owning caste in the village even today. The difference exists only in the amount of land owned by different castes.

VILLAGE PATHAN CHAK DISTRIBUTION OF FIELDS ACCORDING TO LAND-OWNING CASTES, 1890

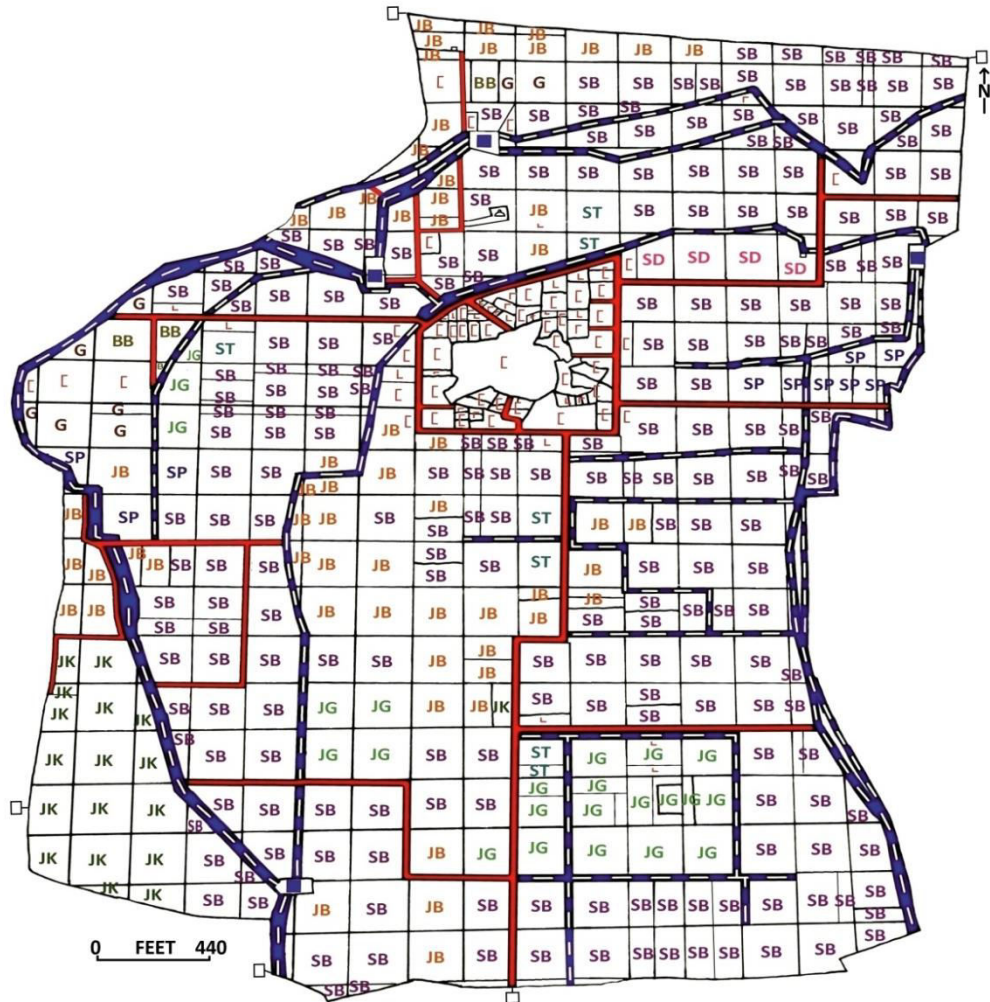


LEGEND:

	Hadbast Boundary		Saini Bhangura		Jat Bhullar
	Field Boundary		Saini Taroti		Jat Kahlon
	Settlement		Saini Pahbe		Jat Ghuman
	Choe/Naala		Brahmin Bhardwaj		Gujar
	Road				

Figure 5.43

VILLAGE PATHAN CHAK DISTRIBUTION OF FIELDS ACCORDING TO LAND-OWNING CASTES, 2016



LEGEND:

	Hadbast Boundary		Saini Bhangura		Jat Bhullar
	Field Boundary		Saini Taroti		Jat Ghuman
	Settlement		Saini Pahbe		Jat Kahlon
	Choe/Naala		Saini Dhambar		Gujar
	Road		Brahmin Bhardwaj		

4. EXISTING FIELD PATTERNS IN A FLOOD PLAINS VILLAGE

(KHERA BAGH)

The existing field pattern is not much different from the past phases in village Khera Bagh due to its location in the flood plains in comparison to the Dhanowali, Bath and Pathan Chak villages situated in other landform regions, where there was a complete transformation of field patterns due to the implementation of process of consolidation in the past. The size, shape and land type of the fields has not changed to a large extent (Figure 5.45). Detailed illustration of the existing field pattern attributes of village Khera Bagh in 2016 is given below:

LAND TYPES

Land types have not improved to maximum extent due to the physiographic limitations as the village is located in the flood plains surrounded by Shiwalik hills. The fields situated in the eastern and southern side of the village are continuously falling in the *Banjar kadim* land type due to permanent water-logging conditions owing to their nearness to the river Satluj. The latest 2016 field map of the village shows that only 27 *kanals*-18 *merlas* cultivated area (3.10 per cent in total cultivated area covered) confined only to 12 fields (3.97 per cent in total number of fields) have been brought under *chahi* irrigation (tube-well irrigated) land type, which was nil in 1884 (Figure 5.46, Table 5.16).

The amount of rainfall is adequate and well distributed to facilitate *barani* (rain-fed) agriculture. Due to this more than 61 per cent of the total fields numbering 185 are occupied by *barani* land types. The area under *barani* land type in 2016 was at the top in the village with 451 *kanals*-16 *merlas* scattered over more than half of the total cultivated area and 61.26 per cent of the total number of fields. The village is situated on the bank of river Satluj on its eastern side and therefore experiences water-logging and frequent floods. The water-logging hinders agricultural operations and floods damage the standing crops especially in the fields situated in the eastern and southern side of the village. Therefore, many fields situated on the eastern and southern directions were abandoned in the form of *banjar kadim* and *banjar jadid* land types in 1884 as well as 2016 field maps.

Nearly 22 per cent of the total fields numbering 61, spreading over more than 40 per cent of the total cultivated land, were under *banjar kadim* land type and nearly 3 per

cent of the total number of fields covering 64 *kanals* of the total cultivated fields (6.64 per cent) were under *banjar jadid* land types in 1884. The share of *banjar kadim* land type has increased to 46.65 per cent in 2016 because of the addition of 6.64 per cent *banjar jadid* land type non-cultivated area in *banjar kadim* category. Most of the *banjar kadim* and *banjar jadid* land type fields in general are very large in size and irregular in shape with water-logging, very poor inherent fertility and productivity and therefore these fields are continuously abandoned by the farmers from 1884 to 2016. The number of fields under *barani* land types has decreased from 209 fields (75 per cent) to 185 fields (61.26 per cent) in the total number of fields between 1884 and 2016 respectively. The area covered by the *barani* land type fields has decreased from 507 *kanals-18 merlas* to 451 *kanals-16 merlas* that is from 52.51 per cent to only 50.25 per cent between 1884 and 2016 periods.

Tube-well irrigated fields, though small in number, are found scattered in different parts of the village territory. Irrigation by tube-well water has not become popular, though the village is located in the flood plains area and underground water is available at shallow depth of 25 feet to 40 feet. The amount of rainfall is good and well distributed to facilitate *barani* (rain-fed) agriculture. Therefore, the study village depends primarily on rainfall for agriculture. *Barani* fields in general are small to medium in size and irregular in shape.

SIZE OF THE FIELDS

Due to sub-divisions, the fields and holdings have become relatively small in size but not to the extent experienced in the upland plains. The number of fields has increased from 278 in 1884 to 302 in 2016 periods, due to increase in the number of owners (Table 5.17). The *gairmumkin* (uncultivable) land uses like settlements and roads have also encroached upon the cultivated fields. The number of small fields has increased from 31 in 1884 to 109 in 2016 periods because many of the large fields have been sub-divided into small fields either due to partition of the land property or for better management. Small fields occupy 36.09 per cent of the total number of cultivated fields, but due to their small size, they cover only 6.19 per cent of the total cultivated area spreading over 55 *kanals-13 merlas* area. Small fields are found more near the *abadi-deh* (settlement) and roads due to their more economic value.

The number of medium size fields of 1 *kanal* to 4 *kanals* has reduced from 167 in 1884 to 139 in 2016 period. The area under medium size fields has decreased from 297 *kanals* in 1884 to 225 *kanals*-5 *merlas* in 2016, due to fall in their numbers. The number of large size fields of 4 *kanals* to 8 *kanals* has also reduced from 43 (15.47 per cent in the total number of fields) to 37 (12.25 per cent in the total number of fields), but the area under these fields has increased from 193 *kanals*-7 *merlas* to nearly 235 *kanals* between 1884 and 2016 respectively, because area of many of the very large size fields have shifted in large size fields due to their sub-divisions. The medium size fields are found more near the settlement and roads. The large size fields are found scattered more near the eastern village territory more in the *banjar kadim* land types. The number of very large size fields of above 8 *kanals* has declined from 37 in 1884 to 17 in 2016 period.

The area occupied by very large size fields was maximum both in 1884 and 2016 among all field size categories. The area under very large size fields has declined from 453 *kanals*-6 *merlas* (46.86 per cent) in 1884 to nearly 383 *kanals* (42.59 per cent) in 2016. Such very large size fields are found more near the extreme eastern and southern village boundaries at the bank of river Satluj. Majority of the very large size fields belong to *banjar kadim* land types. These fields have been abandoned since 1884 due to water-logging and frequent floods caused by the river.

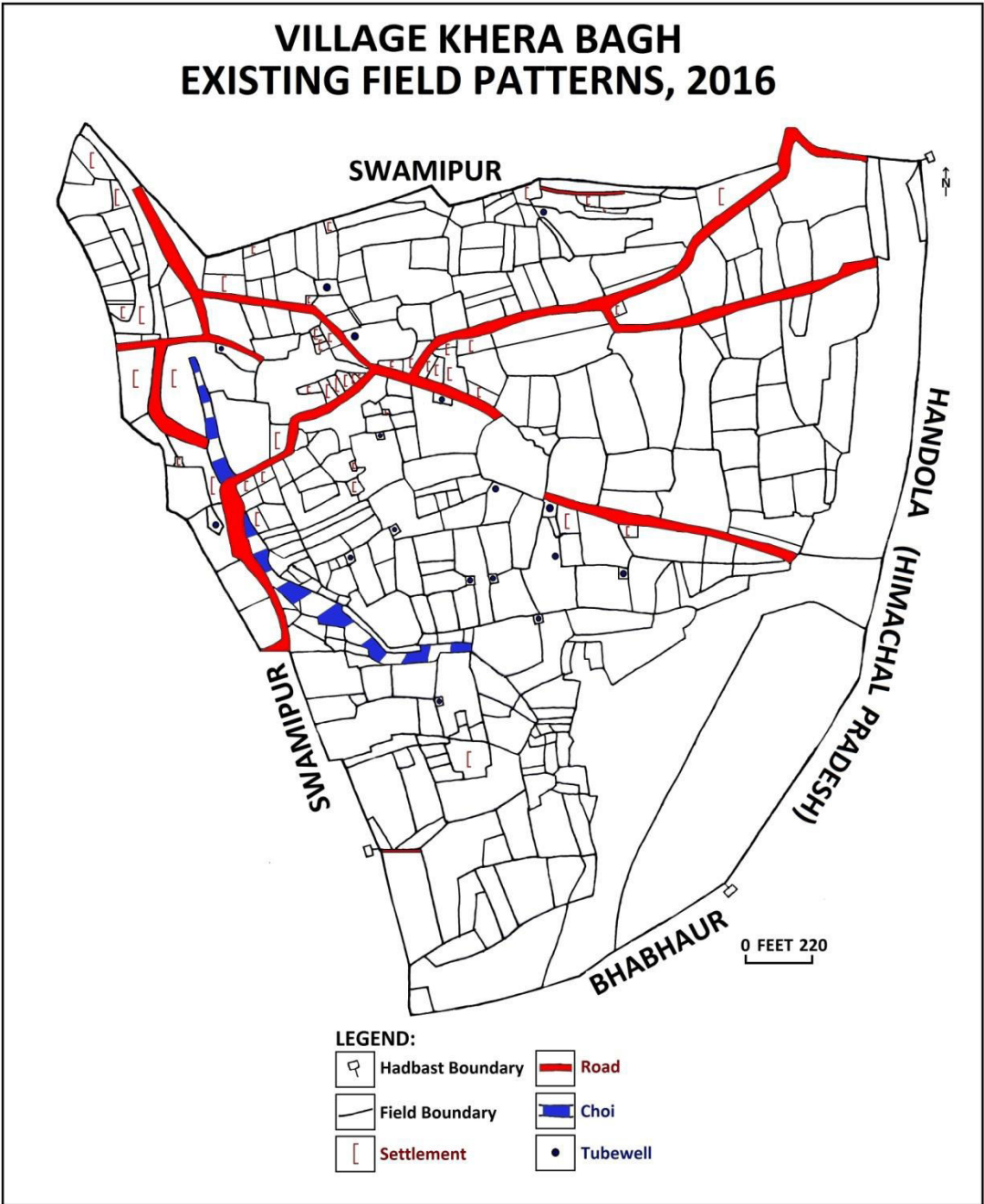


Figure 5.45

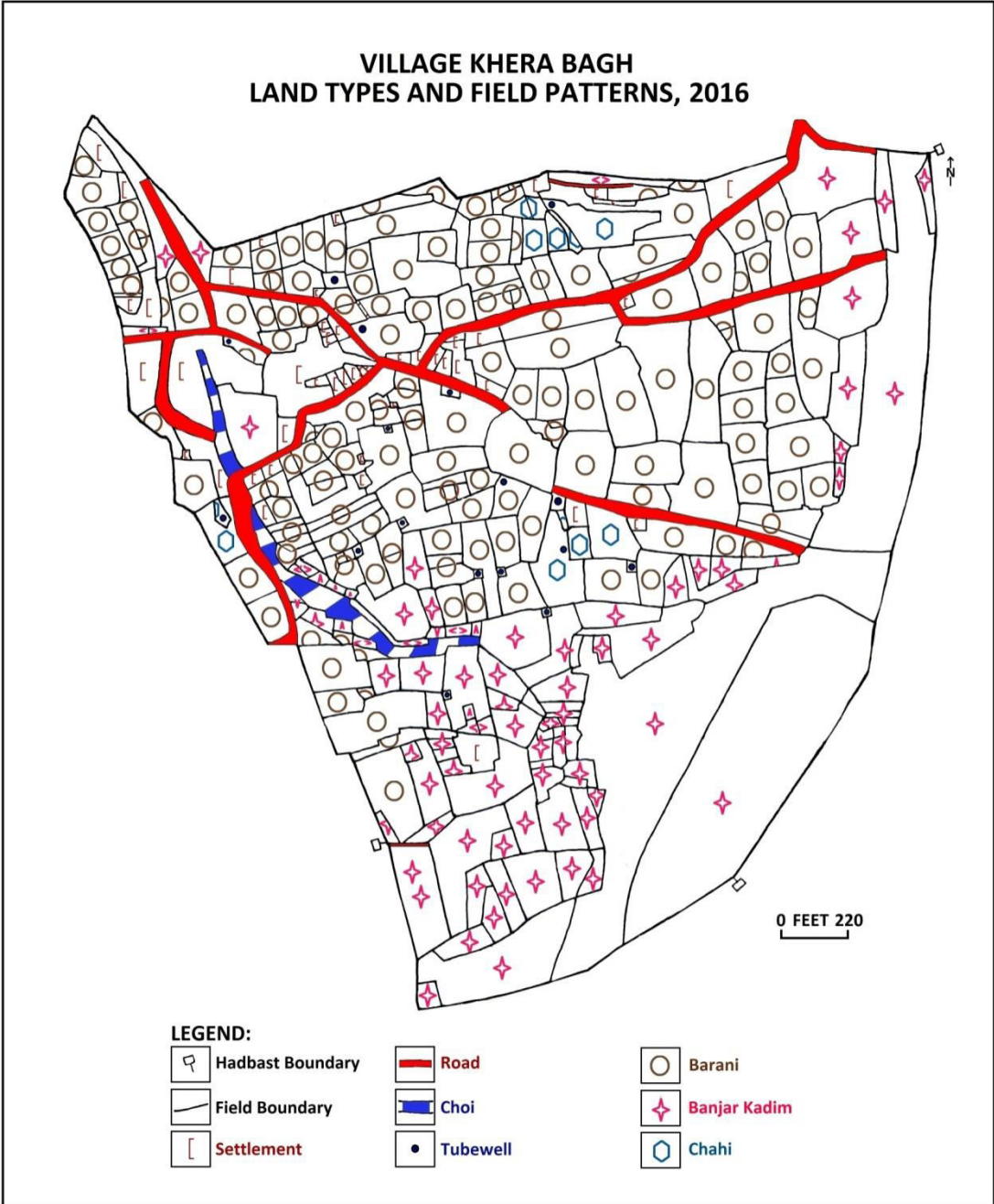


Figure 5.46

Table 5.16**Village Khera Bagh: Existing Land Types of Cultivated Fields, 2016**

Land Type	Number of Fields	Percentage in Total Number of Fields	Area Covered (Kanals-Merlas)	Percentage in Area Covered
<i>Chahi</i>	12	03.97	27-18	03.10
<i>Barani</i>	185	61.26	451-16	50.25
<i>Banjar Kadim</i>	105	34.77	419-09	46.65
Total	302	100.00	899-03	100.00

Source: *Jamabandi* of Village Khera Bagh, 2016.

SHAPE OF THE FIELDS

The most characteristic feature of the shape of the fields in the village Khera Bagh, is their almost uniformity from the past to present, because process of consolidation was not implemented in this village. The naturally evolved centuries old field landscape of the village is intact even today with minor changes in the shape of the fields due to their sub-divisions (Figure 5.45). The number and percentage under triangular, four sided rectangular, strip, quadrilateral, polygon and hexagon shape fields has remained almost same both in 1884 and 2016 field maps. The number and percentage of four sided fields with one or more sides oblique irregular rectangular or quadrilateral fields was maximum both in 1884 and 2016. They covered 52.52 per cent cultivated area of the village in 1884 and it was reduced to 47.02 per cent in 2016 in the total cultivated area of the village (Table 5.18).

Most of the irregular quadrilaterals fields are found scattered everywhere in the village territory, but these are found more along the eastern side of the village near the bank of the river Sutlej. Due to topographic characteristics and the problem of water-logging such fields are not cultivated. Water-logging conditions have led to growth of long wild grass with more than ten feet height (Figure 5.48). The boundaries of the fields in these water-logged areas merge with each other and are not identifiable as these are covered under water. Many times wild animals use such fields as their shelters. Wild animals such as boars (wild pigs) not only damage the crops in the

nearby fields, but also attack the farmers and other villagers, especially in their mating season to counter human interference. The farmers protect themselves and their fields by wiring the fields with wires tied with wooden logs (Figure 5.49). Rich farmers use good quality nets to protect their crops and lives from the wild life (Figure 5.50).

The fields situated away from water-logged area have *wats* (low mud dikes) as field boundaries. These *wats* are used as paths for movement of human beings and cattle and are used as embankments to retain water within the fields (Figure 5.51). *Wats* constitute the smallest feature of agricultural landscape of the village. Cemented embankments along the roads are constructed by the village *Panchayat* with financial aid from the government where fields are situated at higher or lower levels than the roads (Figure 5.52). Such field boundaries have given permanent shape to the fields. The *warr* of *kande* (row of thorny bushes), the row of trees, and the row of wooden logs with fencing-wires and a net of wires are commonly used as field boundaries.

Table 5.17
Village Khera Bagh: Existing Field Size Analysis, 2016

Field Size	Number of Fields	Percentage in Total Number of Fields	Area Covered (Kanals – Merlas)	Percentage in Total Cultivated Area
Small (Below 1 Kanal)	109	36.09	55-13	06.19
Medium (1 Kanal to 4 Kanals)	139	46.02	225-05	25.06
Large (4 Kanals to 8 Kanals)	37	12.25	235-02	26.16
Very Large (Above 8 Kanals)	17	05.63	383-01	42.59
Total	302	100.00	899-03	100.00

Source: *Jamabandi* of Village Khera Bagh, 2016.

Table 5.18**Village Khera Bagh: Existing Field Shape Analysis, 2016**

Field Shape Class	Number of Fields	Percentage in the Total Number of Fields
Three sided–Triangular	08	02.65
Four sided–Square	Nil	00.00
Four sided–Rectangular	05	01.65
Four sided–Elongated or Strips	27	08.94
Four sided–with one or more sides oblique irregular Rectangular or Quadrilateral	142	47.02
Five sided–Polygons	23	07.62
Six sided–Hexagons or more	97	32.12
Total	302	100.00

Source: *Shajra Kishtwar* of Village Khera Bagh, 2016.

Some of the fields near roads and *abadi-deh* (settlement) are enclosed by such boundaries to protect the standing crops in the fields from stray cattle and wild animals. These field boundaries give shape to a field. In 2016 field map on an average 57.61 per cent of the total fields have four boundaries, 32.12 per cent of the fields have six and more and 7.62 per cent of the fields have five boundaries and they covered almost same proportion in 1884 field map of the village (Table 5.19). Because of the non-implementation of the process of consolidation, the field boundaries have not changed much in shape. Majority of the field boundaries are irregular and meet each other at oblique angles because of irregular shape field patterns (Figure 5.53). The fields have irregular boundaries due to topographic limitations of flood plains.

FIELD PATTERNS AND SOURCE OF IRRIGATION

Village Khera Bagh is situated in the flood plains of river Sutlej which are lower than the neighboring upland plains and the *Shiwalik* hills. *Barani* (rain-fed) agriculture is practised successfully, due to efficient amount of rainfall, well distributed throughout the year. The moist winds coming from the Govindsagar Lake of the famous Bhakra dam and the river Satluj result in local orographic rainfall due to the presence of the Shiwalik hills in the neighborhood. Majority of rainfall comes in the summer monsoon season and some amount of rainfall occurs in winter months brought by cyclones through western disturbances. Therefore, agriculture in the village is not seriously dependent on irrigation. Tube-wells have been recently introduced in some parts of the village as a means of irrigation. A room or a set of rooms are constructed near the well or tube-well, which are used for keeping farming implements, housing animals, keeping fodder and farm produce. A few small *kyaris* (small cultivation units) are very common around the well or tube-well, where farmers grow vegetables for domestic use (Figure 5.54).



Figure 5.47 The mud and stone dikes known as *bandhs* along road act as field boundaries



Figure 5.48 *Banjar Kadim* (fallow land): fields having wild growth of long grass with more than ten feet height due to the water-logging conditions.



Figure 5.49 Wiring of the fields to protect the crops from wild animals.



Figure 5.50 Use of good quality nets to protect the crops from the wild life.

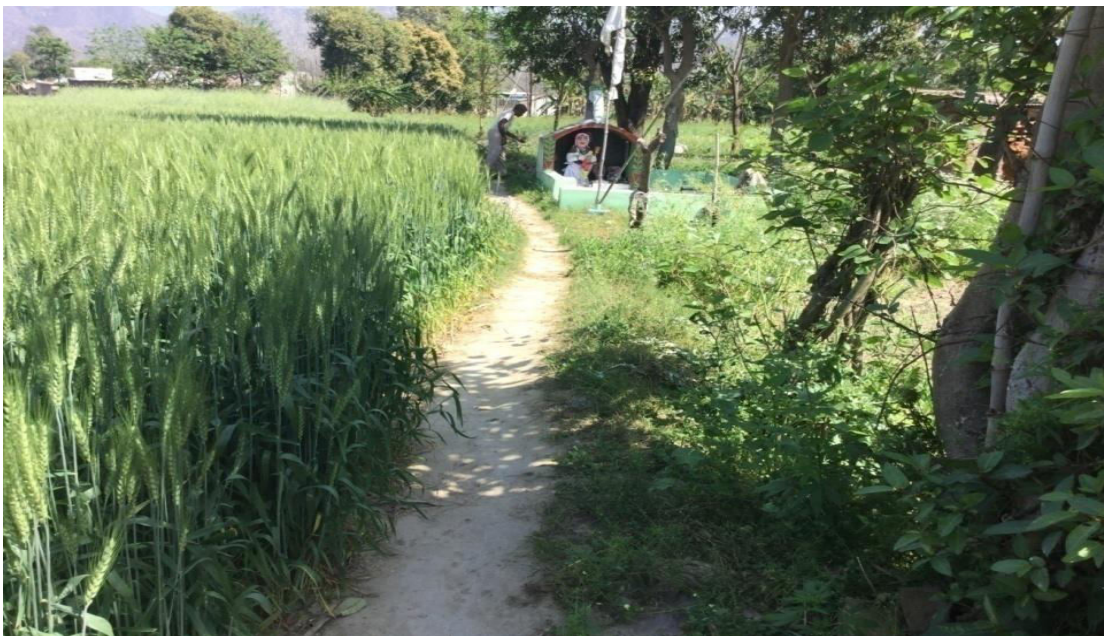


Figure 5.51 The *wat* separating the fields: used as path for movement of human beings and cattle and to retain water within the fields.



Figure 5.52 Cemented embankments along the roads where fields are situated at higher or lower levels than the roads.



Figure 5.53 Irregular fields: Majority of the field boundaries are irregular and meet each other at oblique angles due to topographic limitations.



Figure 5.54 A well converted into a tube-well.

Table 5.19

Village Khera Bagh: Existing Classes of Fields with reference to Number of Boundaries, 2016

Fields With	Number of Fields	Percentage in Total Number of Fields
Three boundaries	08	02.65
Four boundaries	174	57.61
Five boundaries	23	07.62
Six and more boundaries	97	32.12
Total	302	100.00

Source: *Shajra Kishtawar* of Village Khera Bagh, 2016.

All the fields of a holding do not necessarily touch one or more sides of a tube-well. The big size fields are divided into small *kyaris* to water the crops with ease. Fields of different shapes and sizes are found near the tube-well. The fields of different size and

shape are irrigated with the help of tube-wells. Only 12 fields out of total 302 fields (only 3.97 per cent in the total number of fields) with 27 *kanals*-18 *merlas* area with 3.10 per cent in the total cultivated area of the village are under irrigation. Therefore, irrigation has not affected the field patterns. The farmers have started growing non-traditional crops like paddy in these irrigated fields.

FIELD PATTERNS AND PLOUGHING IMPLEMENTS USED

The kind of ploughing implement also determines the size and shape of a field. In village Khera Bagh, tractor used fields are large in size. In a large field both time and fuel are saved, as tractor needs fewer turns to plough the entire field. In the study village it is found that the farmers, who have their own tractors, plough all the fields with tractor irrespective of the size and shape. Bullock-plough drawn fields are replaced by small size tractors (Figure 5.55). A farmer who does not own tractor, prefer to plough his big fields with hired tractor. The small size fields are ploughed by bullocks. The small *kyaris* (cultivation units), where farmer grows vegetables are generally ploughed by farmer himself, using hoe and spade.



Figure 5.55 Bullocks are replaced by the use of small size tractors.

FIELD PATTERNS AND CROPS GROWN

Subsistence type farming is done in village Khera Bagh in medium to small size and irregular shape fields. The infields situated near the abadi-deh (settlement) are small in size and are used more for growing wheat in winters during *rabi* (*harri*) season and maize in summers during *kharif* (*saoni*) season.

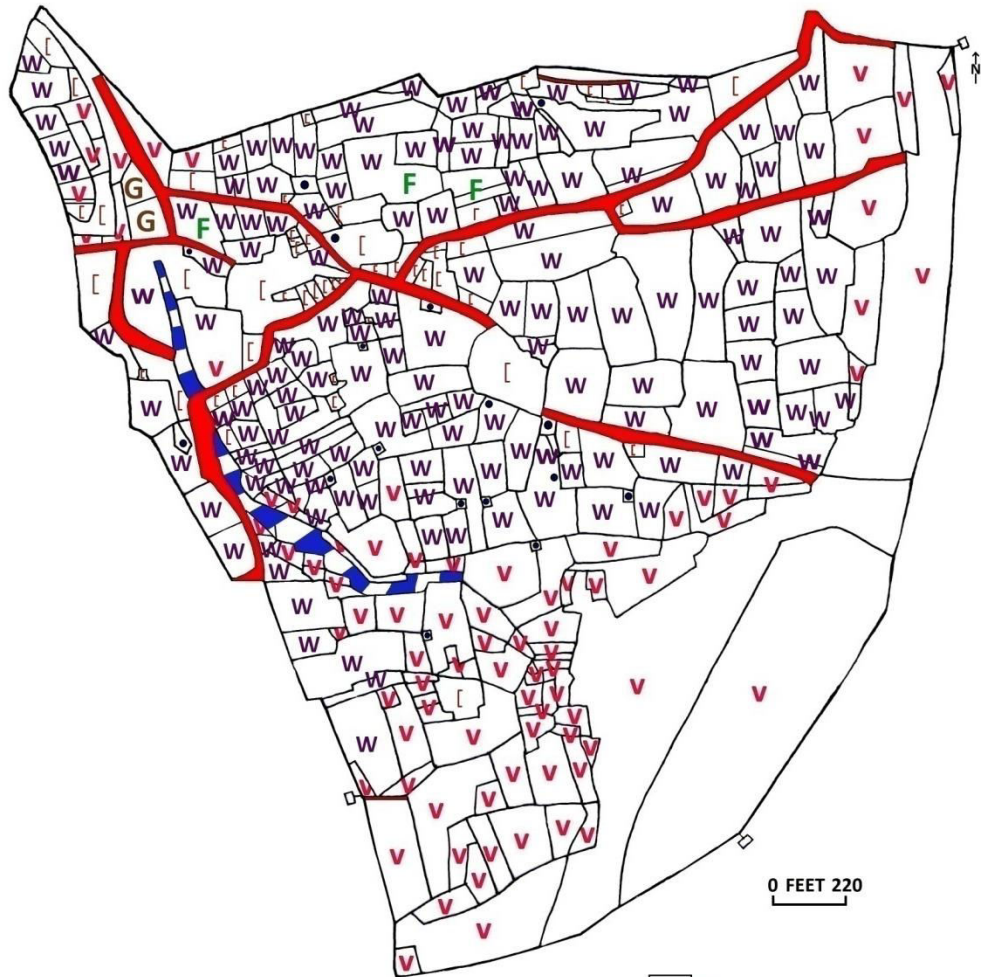
Table 5.20

Village Khera Bagh: Existing *Rabi (Harri)* and *Kharif (Saoni)* Cropping Patterns, 2016

<i>Rabi (Harri)-2016</i>			<i>Kharif (Saoni)-2016</i>		
Crop	Area Covered (Kanals-Merlas)	Percentage in Total Cropped Area	Crop	Area Covered (Kanals-Merlas)	Percentage in Total Cropped Area
<i>Kanak</i> (Wheat)	465-13	97.06	<i>Makki</i> (Maize)	486-10	96.21
<i>Barseem</i> (Fodder)	10-02	02.11	<i>Dhaan</i> (Paddy)	08-16	01.74
<i>Chhole</i> (Black Grams)	03-19	00.83	<i>Maah</i> (Black Pulse)	06-11	01.30
-	-	-	<i>Chari</i> (Fodder)	03-16	00.75
Total	479-14	100.00	Total	505-13	100.00

Source: *Khasra Gardavari* of Village Khera Bagh, 2016.

VILLAGE KHERA BAGH
RABI (HARRI) CROPPING PATTERNS, 2016

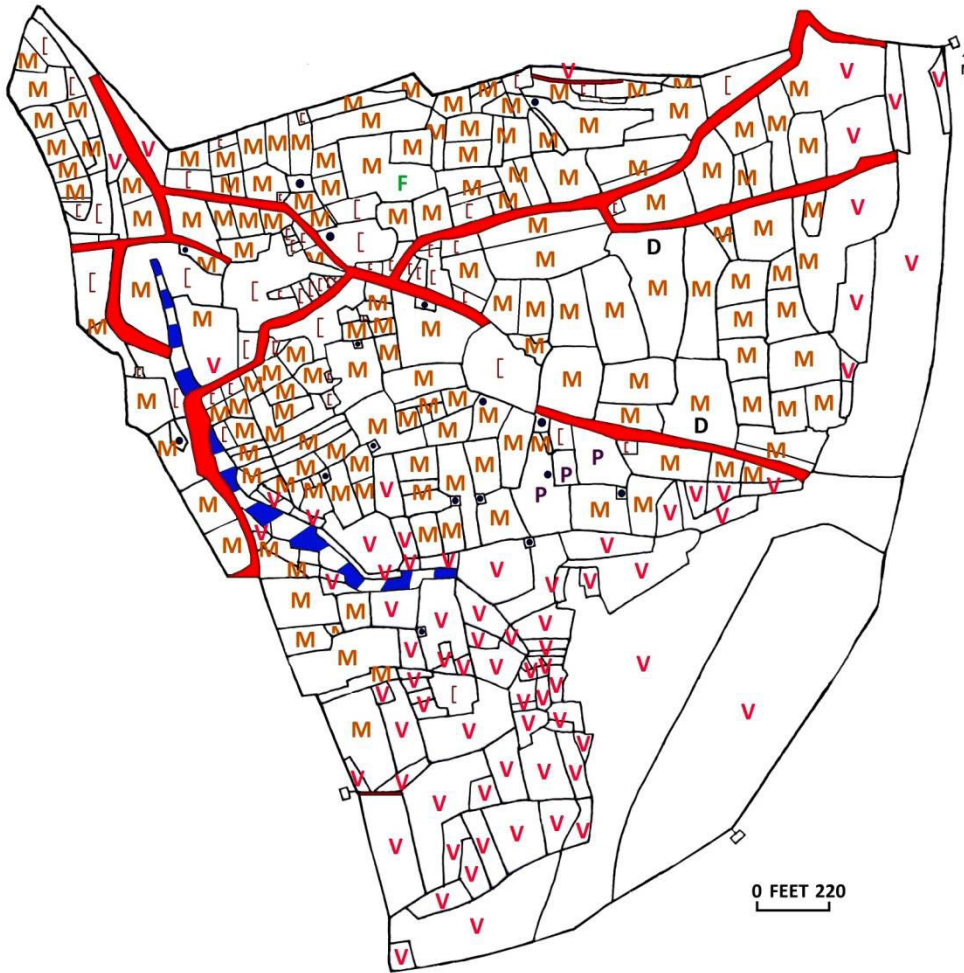


LEGEND:

 Hadbast Boundary	 Road	 Wheat
 Field Boundary	 Choi	 Fodder
 Settlement	 Tubewell	 Grams
		 Vacant

Figure 5.56

VILLAGE KHERA BAGH
KHARIF (SAONI) CROPPING PATTERNS, 2016



LEGEND:

Hadbast Boundary	Road	Maize	Fodder
Field Boundary	Choi	Paddy	Vacant
Settlement	Tubewell	Pulse	

Figure 5.57

Wheat is grown on more than 97 per cent of the total cultivated area and maize is grown on more than 96 per cent of the total cultivated area during *rabi (harri)* and *kharif (saoni)* seasons respectively, as dominant crops (Table 5.20). The cropping pattern of winter wheat and summer maize is traditional and is well suited to the agro-climatic conditions of the area. Both these crops are grown in small as well as big size fields both in infield as well as outfield areas irrespective of their shapes. These are traditional crops grown more on subsistence level. Distance from the *abadi-deh* (settlement) does not appear to have relationship with the types of crops grown and the resultant field patterns.

Ekfasli (one crop) and *teenfasali* (three crops) fields exist nowhere in the entire village territory. Farmers grow two crops in a year both in infield and outfield areas. The outfield area is covered with *banjar kadim* land type and is not used for growing crops. Use of chemical fertilizers, insecticides and pesticides is very limited. Cropping pattern is slowly shifting from low value traditional crops to economically more remunerative crops.

The fields are covered by wheat, *barseem* (fodder) and *chhole* (grams) in the *rabi/harri* season and *makki* (maize), *jhona* (paddy), *chari* (fodder), and *maah* (pulses) in the *kharif/saoni* season (Figures 5.56, 5.57 and Table 5.20). Wheat and maize crops are now grown at commercial scale. Fodder crops (*barseem* and *chari*) growing fields are distributed more near the *abadi-deh* (settlement) as livestock is reared in the *abadi-deh* (settlements). Paddy has recently been introduced in the small size fields, where tube-well irrigation facilities have been introduced. A few small *kyaris* (cultivation units) are created near the tube-well for growing vegetables, which are generally smaller in size. The cropping pattern is slowly shifting from traditional and subsistence types to non-traditional commercial crops, due to influence of Green Revolution technology.

FIELD PATTERNS AND LAND OWNING CASTES

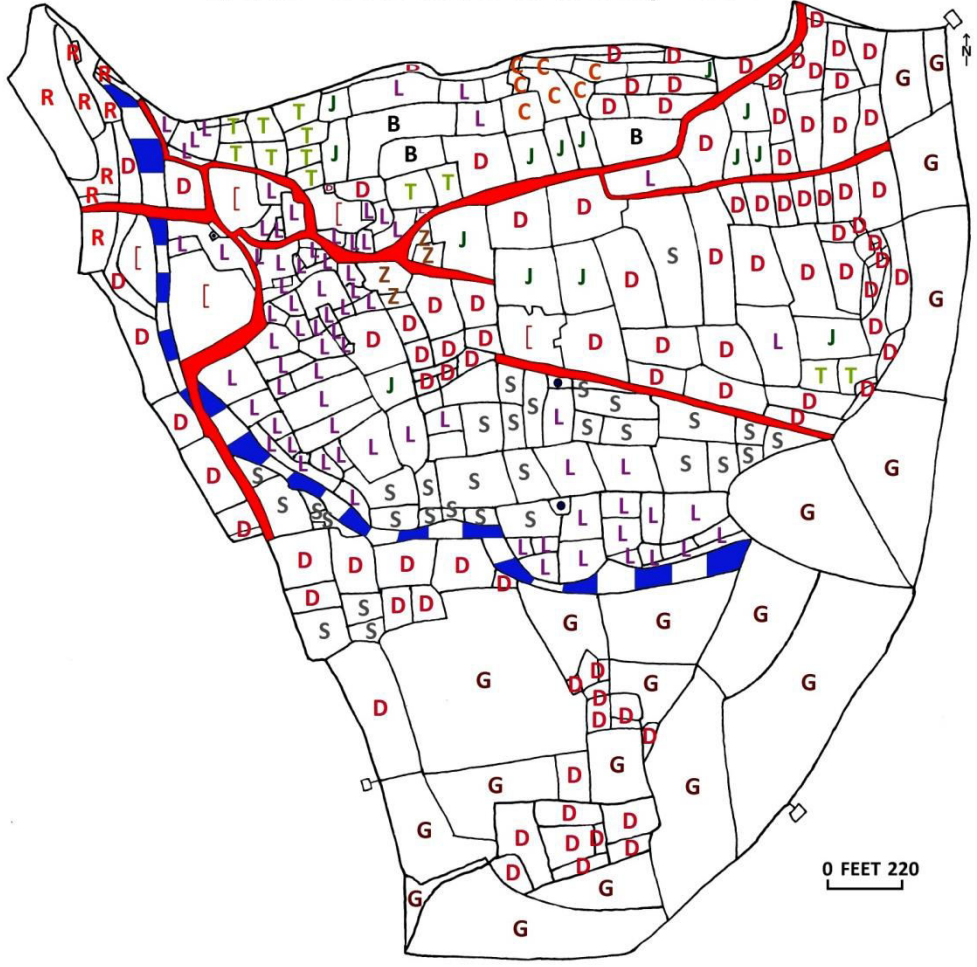
The land owned by different castes display different field patterns. According to genealogical tree of 1884, the village Khera Bagh was owned by people belonging to diverse castes (Figure 5.58). The 1884 field map reveals that people from *Jat*, *Saini*, *Lohar*, *Tarkhan*, *Chammar*, *Zulaha*, *Rajput* and *Brahman* castes owned agriculture land in the village. Most of the agricultural fields were owned by a religious body

Thakur Dwara. Land was offered to people belonging to different castes for agriculture and the village acquired the character of a multi-caste village. Majority of the total cultivated fields and the cultivated area even today is owned by the *Thakur Dwara*. The fields and holdings owned by *Thakur Dwara* are large in size. They have majority of the total cultivated fields and of the total area in their possession both in 1884 and 2016 village maps (Figure 5.59).

The fields belonging to *Jat, Saini, Lohar, Tarkhan, Chammar, Zulaha, Rajput* and *Brahaman* castes are found intermingled in the entire village territory both in 1884 and 2016 village maps. Their fields and land holdings are smaller in size. The difference exists only in the amount of land owned by different castes. Fields belonging to *Lohars* and *Tarkhans* are situated near the *abadi-deh* (settlement) than the fields belonging to *Sainis, Rajputs* and *Chammars*. No difference is found in terms of shape of the fields, source of irrigation, crops grown and farm mechanization of different castes. Most of the *banjar kadim* fields situated in the eastern and south-eastern side of the village territory near river Sutlej are owned by the government in the form of wastelands and are declared as wetlands. The low castes do not own cultivated land, but they have their own houses in the *abadi-deh* (settlement).

Interestingly the fields belonging to *Jats*, a traditional agriculture practising caste, are not only few but also small in size. This is due to the fact that agriculturally the village has less attraction than the villages located in the fertile upland plains of central Punjab dominated by *Jat* caste people. Therefore, field patterns and land-owning castes do not have any relationship in this village.

VILLAGE KHERA BAGH DISTRIBUTION OF FIELDS ACCORDING TO LAND-OWNING CASTES, 1884

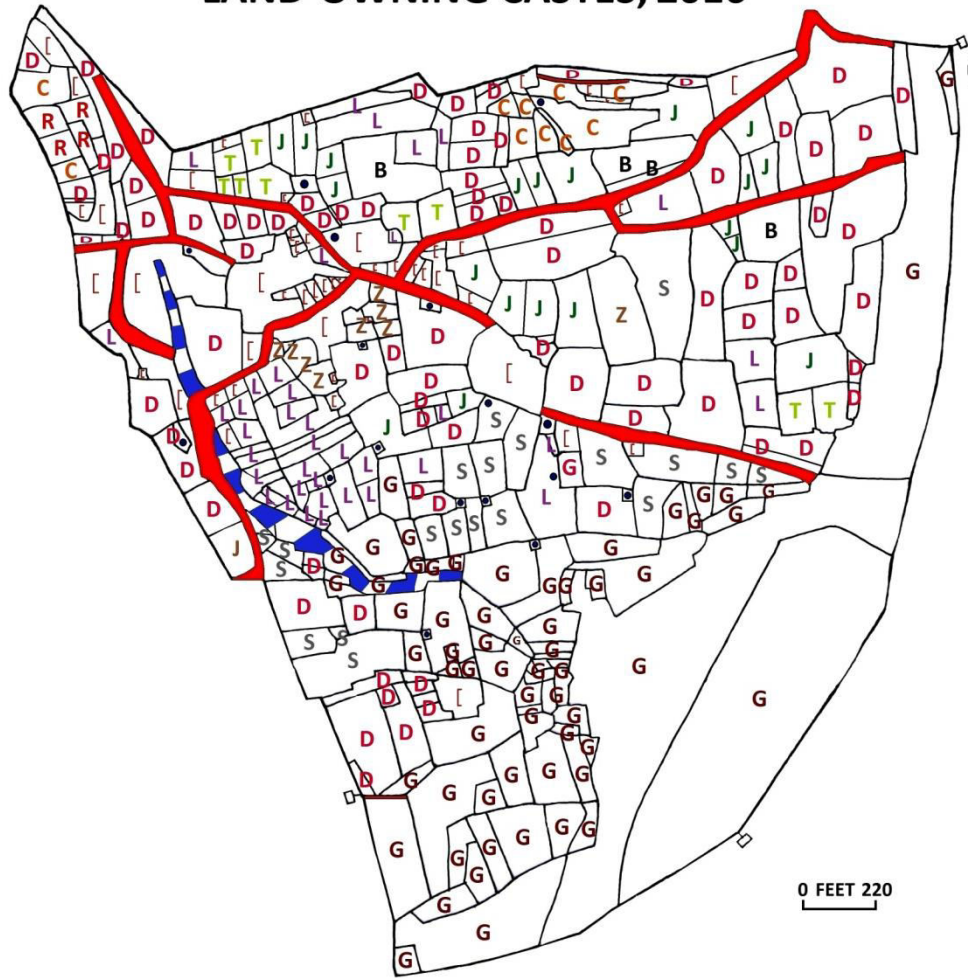


LEGEND:

Hadbast Boundary	Chai	J Jat	C Chammar
Field Boundary	Tubewell	S Saini	Z Zulaha
Settlement	G Government	L Lohar	R Rajput
Road	D Thakur Dwara	T Tarkhan	B Brahman

Figure 5.58

VILLAGE KHERA BAGH DISTRIBUTION OF FIELDS ACCORDING TO LAND-OWNING CASTES, 2016



LEGEND:

Hadbast Boundary	Choi	Jat	Chammar
Field Boundary	Tubewell	Saini	Zulaha
Settlement	Government	Lohar	Rajput
Road	Thakur Dwara	Tarkhan	Brahman

Figure 5.59

5. EXISTING FIELD PATTERNS IN A HILLY VILLAGE

(ROHG TEEKA KHAKHOH)

The existing field pattern is not much different from the past phases in village Rohg Teeka Khakhoh due to its location in the Shiwalik hills owing to physiographic limitations. The size and shape of the fields have changed to a limited extent only but land types of the fields have improved considerably due to human efforts (Figure 5.60). Detailed description of existing field pattern attributes of village Rohg Teeka Khakhoh is given below:

LAND TYPES

Nearly half of the total area of the village is occupied by *pahar* (hills) covered with *van* (jungle). Land types have improved to considerable extent from 1884 to 2016 period in spite of the physiographic limitations as the village is located in the Shiwalik hills (Figure 5.61, Table 5.21). The hilly relief of the village does not favor digging tube-wells and laying canals in the village. Therefore, none of the field was under irrigation from 1884 to 2016. Nearly 65 per cent of the total fields numbering 198 are occupied by *barani awal*, the best land type and 91 fields covering nearly 30 per cent of the total fields occupying 191 *kanals*-15 *merlas* cultivated area spreading over nearly 15 per cent of the total area belongs to *barani daum*, the second rank land type and only seven fields constituting 2.30 per cent in the total number of fields spreading over 6 *kanals*-19 *merlas* cultivated area covering only 0.54 total area of the village is under *barani saum*, the most inferior *barani* land type. The aggregate number of fields and cultivated area under *barani awal*, *barani daum* and *barani saum* land type in 1884 was 180 occupying 93.75 per cent total number of fields and 359 *kanals*-8 *merlas* of cultivated land spread over 70.21 per cent of total cultivated area excluding *pahar* (hills) covered with *van* (jungle) of the village. This aggregate total number of fields and cultivated area under *barani awal*, *barani daum* and *barani saum* land type in 2016 has risen to 296 occupying 97.05 per cent total number of fields and 415 *kanals* of cultivated land. *Barani awal* fields are smaller in size than *barani saum* because of their greater sub-divisions. Fields belonging to other poor land types like *banjar kadim* and *pahar* are larger in size, because of their lesser sub-divisions, due to their fewer usages.

**VILLAGE ROHG TEEKA KHAKHOH
EXISTING FIELD PATTERNS, 2016**

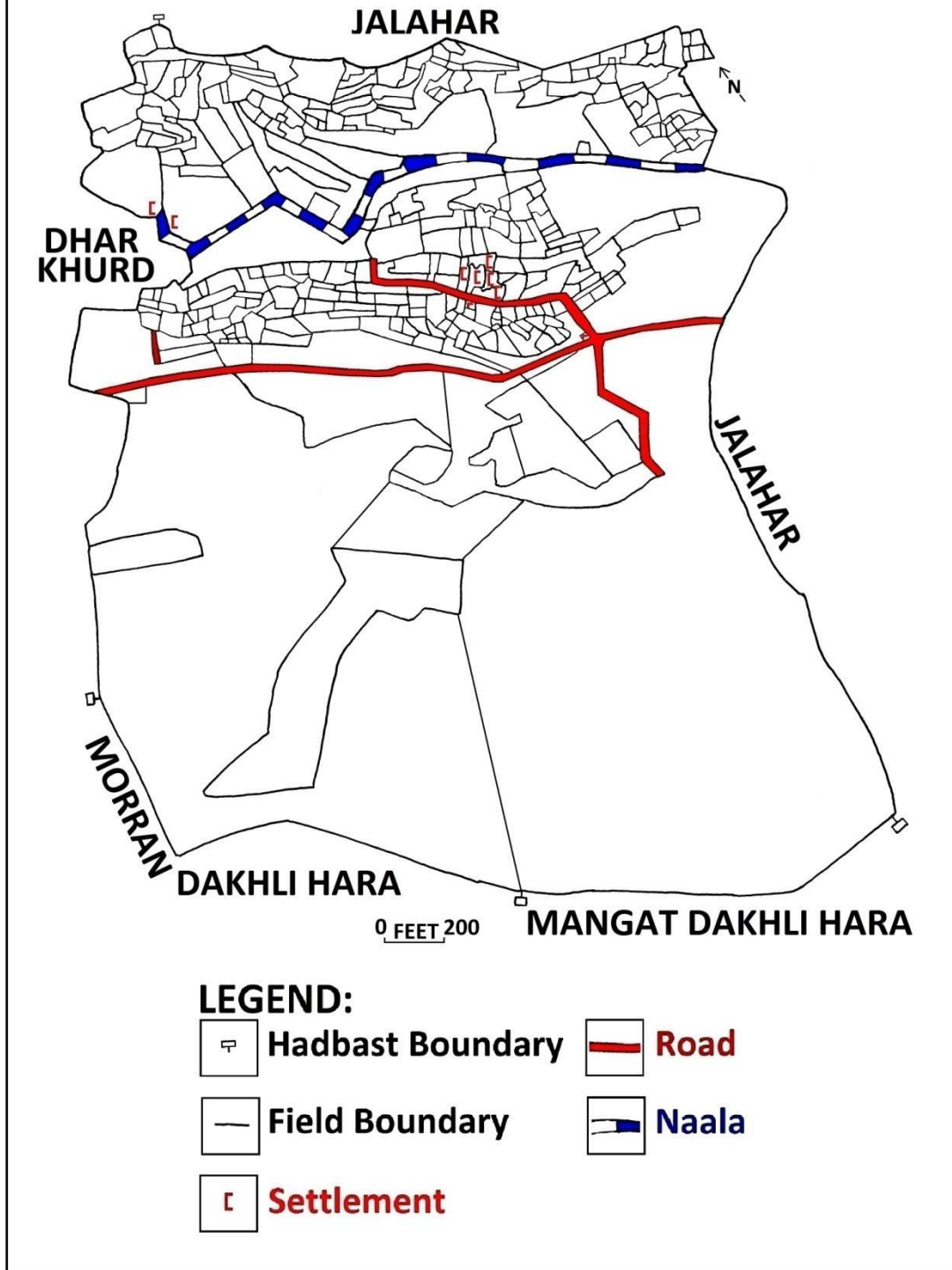


Figure 5.60

In 1884, 2.60 per cent of the total fields numbering five spreading over more than 130 *kanals* area of the village, were under *banjar kadim* land type and six fields spreading over 3.12 per cent of total fields covering 22 *kanals*-3 *merlas* of the total area of the village, were under *banjar jadid* land types. Area under *banjar kadim* land type has increased from 130 *kanals*-7 *merlas* (10.19 per cent) in 1884 to 159 *kanals*-11 *merlas* (12.45 per cent) in 2016, because much of the area under *banjar jadid* land type has been converted into the category of *banjar kadim* land type. No field belongs to *banjar jadid* land type in the 2016 field map of the village. Most of the *banjar kadim* and *banjar jadid* land type fields in 1884 field map and *banjar kadim* land type fields in 2016 field map are very large in size and irregular in shape with very poor inherent fertility and productivity. These fields are therefore, left fallow by the farmers. *Barani awal* and *barani saum* fields in general are small to medium in size and irregular in shape. *Barani saum* fields are larger in size and more irregular in shape. Maximum area of the village (55.18 per cent) is under *pahar* (hills) covered with *van* (jungle), which should be preserved for maintaining ecosystem of the village and the surrounding region. The study village depends entirely on rainfall to quench the thirst of the fields. Poor rainfall sometimes leads to failure of crops.

SIZE OF THE FIELDS

Due to continuous sub-divisions, the fields and holdings have become small in size but not to the extent experienced in the plains of Punjab. The size of the fields is smaller in the north direction in the sloping land (Figure 5.60). The number of fields have increased from 192 in 1884 to 305 in 2016 due to increase in the number of owners and by the conversion of some area falling under *pahar* (hills) covered with *van* (jungle) into new fields. The *gairmumkin* (uncultivable) land uses like settlements have also encroached upon the cultivated fields but not to the extent experienced in the upland plains of Punjab. The number of small fields has increased from 48 in 1884 to 115 in 2016, as many of the large fields have been sub-divided into small fields, either due to partition of the land property or for their better management (Table 5.22).

VILLAGE ROHG TEEKA KHAKHOH LAND TYPES AND FIELD PATTERNS, 2016

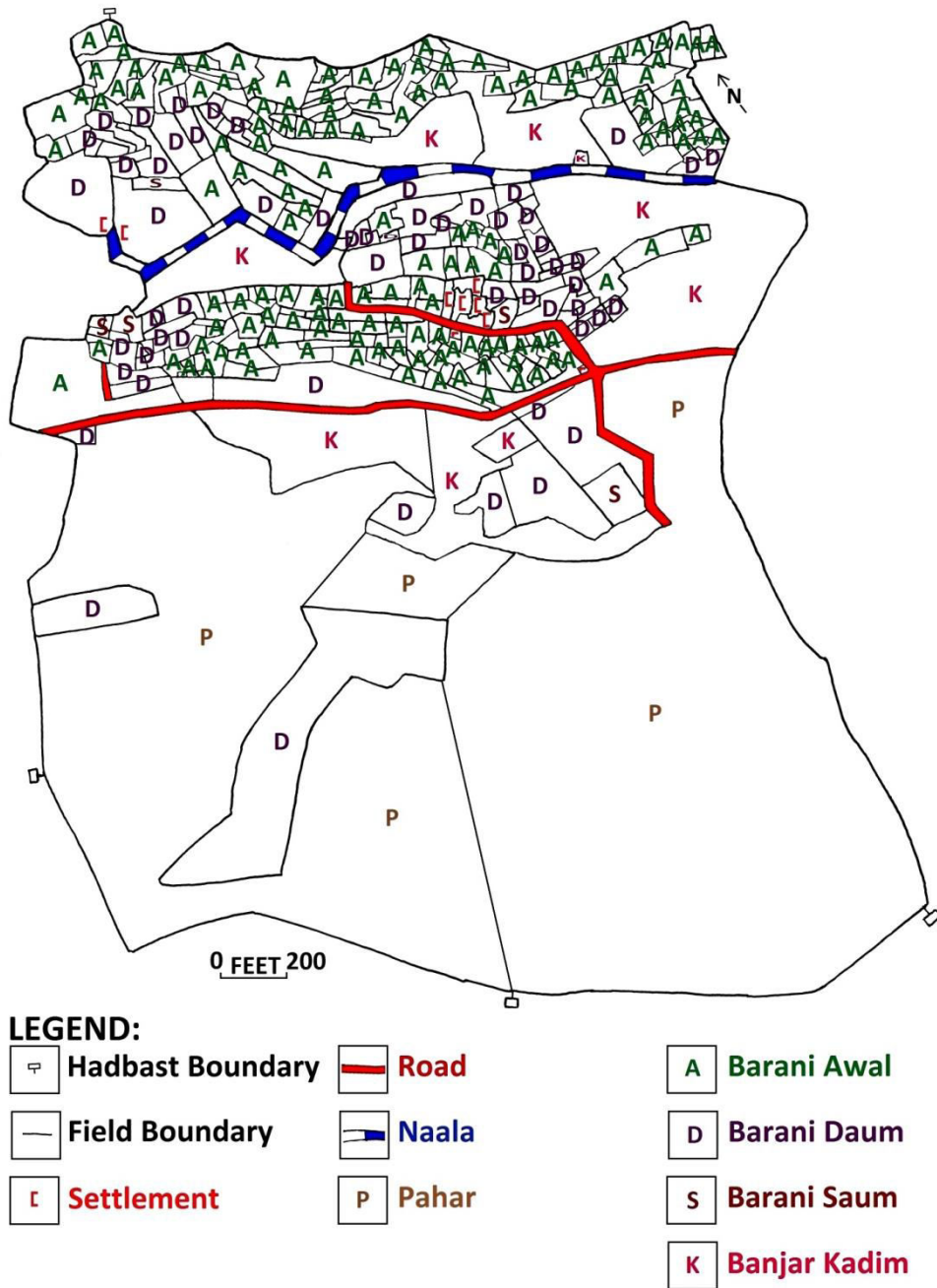


Figure 5.61

Table 5.21

Village Rohg Teeka Khakhoh: Existing Land Types of Cultivated Fields, 2016

Land Type	Number of Fields	Percentage in Total Number of Fields	Area Covered (Kanal-s-Merlas)	Percentage in Area Covered
<i>Barani Awal</i>	198	64.92	216-06	16.87
<i>Barani Daum</i>	91	29.84	191-15	14.96
<i>Barani Saum</i>	7	02.30	6-19	00.54
<i>Banjar Kadim</i>	8	02.61	159-11	12.45
<i>Pahar</i>	1	00.33	707-05	55.18
Total	305	100.00	1281-16	100.00

Source: *Jamabandi* of Village Rohg Teeka Khakhoh, 2016.

Small fields occupied 25 per cent share in the total number of fields in 1884 and 37.77 per cent in 2016 of the total number of fields, but due to their small size they covered only 2.14 per cent of the total area spreading over 27 *kanals-7 merlas* area in 1884, which rose to 53 *kanals-7 merlas* spreading over 4.16 per cent area of the village. Small fields are found more near road, near the (settlement) and in the good quality land type areas with gentle slopes situated in the northern direction of the village (Figure 5.61). The number of medium size fields was at the top in 1884 and the village has maintained this position in 2016 field map also. The number of medium size fields of 1 *kanal* to 4 *kanals* has increased from 85 (44.27 per cent) in 1884 to 151 (49.51 per cent) in 2016. The area under medium size fields has increased from 178 *kanals-9 merlas* in 1884 to 251 *kanals-2 merlas* in 2016 due to increase in their numbers. The medium size fields are found more near the *abadi-deh* (settlement) and roads. The number of large size fields of 4 *kanals* to 8 *kanals* has reduced from 33 (17.19 per cent in the total number of fields) to 21 (6.89 per cent in the total number

of fields) and the area under these fields has decreased from 166 *kanals- 6 merlas* to 104 *kanals-3 merlas* between 1884 and 2016 respectively.

The large size fields are found scattered in the *banjar kadim* and near the *pahar* (hills). The number of very large size fields of above 8 *kanals* has declined from 26 in 1884 to 18 in 2016. The area occupied by very large size fields was maximum both in 1884 and 2016 among all field size categories. The area under very large size fields has declined from 907 *kanals-8 merlas* (70.91 per cent) in 1884 to nearly 873 *kanals-4 merlas* (68.12 per cent) in 2016 due to conversion of *banjar kadim* and *pahar* (hills) covered with *van* (jungle) in to new fields. Such very large size fields are found more in the *banjar kadim* and *pahar* (hill) areas of the village largely in the south direction due to their less value for cultivation.

Table 5.22

Village Rohg Teeka Khakhoh: Existing Field Size Analysis (2016)

Field Size	Number of Fields	Percentage in Total Number of Fields	Area Covered (<i>Kanals – Merlas</i>)	Percentage in Total Cultivated Area
Small (Below 1 <i>Kanal</i>)	115	37.70	53.07	04.16
Medium (1 <i>Kanal</i> to 4 <i>Kanals</i>)	151	49.51	251-02	19.59
Large (4 <i>Kanals</i> to 8 <i>Kanals</i>)	21	06.89	104-03	08.13
Very Large (Above 8 <i>Kanals</i>)	18	05.90	873-04	68.12
Total	305	100.00	1281.16	100.00

Source: *Jamabandi* of Village Rohg Teeka Khakhoh, 2016.

SHAPE OF THE FIELDS

The most characteristic feature of the shape of the fields in the village is their irregular shape (Figure 5.60). The process of consolidation was not implemented in the village because it falls in the hilly region of Punjab. The naturally evolved old field patterns of the village are intact even today with minor changes in their shape due to their sub-divisions. None of the field belonged to triangular and square shapes in 1884 as well as 2016 field maps. The number and percentage under four sided rectangular and strip fields have declined marginally. Four sided quadrilateral shape fields occupying maximum share have doubled from 82 (42.71 per cent) in 1884 to 164 (53.77 per cent) in 2016 due to the sub-divisions of earlier such large size fields (Table 5.23). Polygon and hexagon shape fields have also increased between 1884 and 2016 field maps. Most of these irregular shape fields are found in the form of terraces aligned parallel to one another adjacent to the *choe* (seasonal stream) in the sloping northern part of the village territory (Figure 5.62).

FIELD BOUNDARIES

The field boundaries constitute an important visible element of the field patterns and give shape to the fields. The low mud and stone dikes known as *wats* act as field boundaries in the village field landscape. These *wats* (embankments) are used to retain water within the terraced fields (Figure 5.63). *Wats* constitute the smallest feature of agricultural landscape of the village. The *warr* of *kande* (fence of thorny bushes), bushes, the row of trees and fencing-wires serve as field boundaries in many cases. Some of the fields near roads are enclosed by such boundaries to protect the standing crops in the fields from stray cattle and wild animals.



Figure 5.62 Small irregular terraced fields on a sloping land.



Figure 5.63 *Wats* (embankments) used to retain water within the terraced fields.

Table 5.23**Village Rohg Teeka Khakhoh: Existing Field Shape Analysis, 2016**

Field Shape Class	Number of Fields	Percentage in the Total Number of Fields
Three sided–Triangular	Nil	00.00
Four sided–Square	Nil	00.00
Four sided–Rectangular	21	06.88
Four sided–Elongated or Strips	22	07.21
Four sided–with one or more sides oblique irregular Rectangular or Quadrilateral	164	53.77
Five sided–Polygons	29	09.52
Six sided–Hexagons or more	69	22.62
Total	305	100.00

Source: *Shajra Kishtwar* of Village Rohg Teeka Khakhoh, 2016.

In 2016 field map on an average 67.87 per cent of the total fields have four boundaries, 22.62 per cent of the fields have six and more and 9.52 per cent of the fields have five boundaries (Table 5.24). Because of the non-implementation of the process of consolidation, the field boundaries have not changed much in shape. Majority of the field boundaries are irregular. The terraced fields have irregular boundaries due to topographic limitations.

Table 5.24

**Village Rohg Teeka Khakhoh: Existing Classes of Fields
with reference to Number of Boundaries, 2016**

Fields With	Numbers of Fields	Percentage in Total Number of Fields
Three boundaries	Nil	00.00
Four boundaries	207	67.87
Five boundaries	29	09.51
Six and more boundaries	69	22.62
Total	305	100.00

Source: *Shajra Kishtawar* of Village Rohg Teeka Khakhoh, 2016.

FIELD PATTERNS AND PLOUGHING IMPLEMENTS USED

The kind of ploughing implement also determines the size and shape of a field. In the village Rohg Teeka Khakhoh big tractors are not used to plough the fields because of hilly topography. Bullock drawn fields are replaced by the use of small sized tractors. A farmer who does not own tractor prefers to plough his small size fields manually using implements like hoe and spade and hire tractor to plough large size fields. The small *kyaris* (cultivation units), where farmer grows vegetables are generally ploughed by farmer himself using small size farm implements.

FIELD PATTERNS AND SOURCE OF IRRIGATION

Village is situated in the *Shiwalik* hills. The hilly relief of the village does not favor digging tube-wells and laying canals in the village. Therefore, none of the fields was under irrigation from 1884 to 2016. Rainfall is the only source of water and *barani* (rain-fed) agriculture is practised. The deficient rainfall many times retards the growth of crops and lead to crop failures (Figure 5.64).



Figure 5.64 Retarded growth of wheat crop due to deficient rainfall.



Figure 5.65 Cemented channel made to bring rain water to the fields.

Rain water from the high slopes, is brought in the fields for irrigation (Figure 5.65). One *choe* (seasonal stream) is situated in the northern part of the village with east-west orientation. This *choe* is surrounded mostly by poor quality land type fields due to highly uneven topography. Fields are not oriented towards *choe* (seasonal stream) because it remains dry for most part of the year and level of water is also not convenient to be brought to the fields. So, the water of this *choe* is not used for irrigating the fields.

FIELD PATTERNS AND CROPS GROWN

Cropping patterns influence field patterns. The village is sticking to the traditional cropping patterns. Subsistence type farming is done in village Rohg Teeka Khakhoh in medium to small size and irregular shape fields. An analysis of existing cropping pattern in the study village reveals that there exists relationship between cropping pattern and infield and outfield areas situated near and away from the *abadi-deh* (settlement). The infields situated near the *abadi-deh* (settlement) are small in size and are comparatively used more for growing wheat in winters during *rabi* (*harri*) season and *maah* (black pulse) and maize in summers during *kharif* (*saoni*) season (Figures 5.66 and 5.67). Wheat is grown on more than 88 per cent of the total cultivated area followed by barseem (fodder) on 10.78 per cent of total cultivated area and less than one per cent of the cultivated area is used for growing *sarson* (oil seed) during *rabi* (*harri*) season. *Kharif* (*saoni*) season crops grown in the village are *maah* (black pulse) cultivated on 36.68 per cent of the total cultivated area, *jhona* (paddy) on 24.37 per cent, maize on 21.20 per cent, *chari* (fodder) on 14.33 per cent and *til* (oilseed) on nearly 4 per cent of total cultivated area (Table 5.25). All these crops are grown in small as well as big size fields both in infield as well as outfield areas. These crops are grown more on subsistence level.

Distance from the *abadi-deh* (settlement) does not appear to have influence on the types of crops grown and the resultant field patterns. *Ekfasli* (one crop) fields do not exist in the village territory. Farmers grow usually two crops in a year, both in infield and outfield areas. The majority of the outfield areas are covered with *banjar kadim* and *pahar* (hill) land type and are not used for growing crops. Most of the *banjar kadim* fields are left vacant and *pahar* (hills) land type large size outfields are covered with orchards, *bir* and eucalyptus plantations. Chemical fertilizers, insecticides and pesticides are not used. Wheat and maize crops are grown in all the fields irrespective

of their shape and size. *Maah* (black pulse) is grown more in *barani daum* medium to large size fields away from the *abadi-deh* (settlement). Paddy has recently been introduced in the small size fields in *barani awal* land type fields with clay soils. A few small *kyaris* (cultivation units) are created near the *abadi-deh* (settlement) for growing vegetables. Vegetables growing fields are generally very smaller in size. The cropping pattern is traditional and subsistence type and paddy cultivation has recently been introduced due to influence of Green Revolution technology common in the plains of Punjab. On the whole crops grown and field patterns are not closely related to each other. Different types of crops are grown in all the fields irrespective of their size, shape and distance from the *abadi-deh* (settlement).

Table 5.25

Village Rohg Teeka Khakhoh: Existing *Rabi (Harri)* and *Kharif (Saoni)* Cropping Patterns, 2016

<i>Rabi (Harri)-2016</i>			<i>Kharif (Saoni)-2016</i>		
Crop	Area Covered (Kanals-Merlas)	Percentage in Total Cropped Area	Crop	Area Covered (Kanals-Merlas)	Percentage in Total Cropped Area
<i>Kanak</i> (Wheat)	315-13	88.32	<i>Maah</i> (BlackPulse)	168-07	36.18
<i>Barseem</i> (Fodder)	38-11	10.78	<i>Jhona</i> (Paddy)	113-08	24.37
<i>Sarson</i> (Oilseed)	03-04	00.90	<i>Makki</i> (Maize)	98-13	21.20
-	-	-	<i>Chari</i> (Fodder)	66-13	14.33
-	-	-	<i>Til</i> (Oilseed)	18-04	03.92
Total	357-08	100.00	Total	465-05	100.00

Source: *Khasra Gardavari* of Village Rohg Teeka Khakhoh, 2016.

VILLAGE ROHG TEEKA KHAKHOH RABI (HARRI) CROPPING PATTERNS, 2016

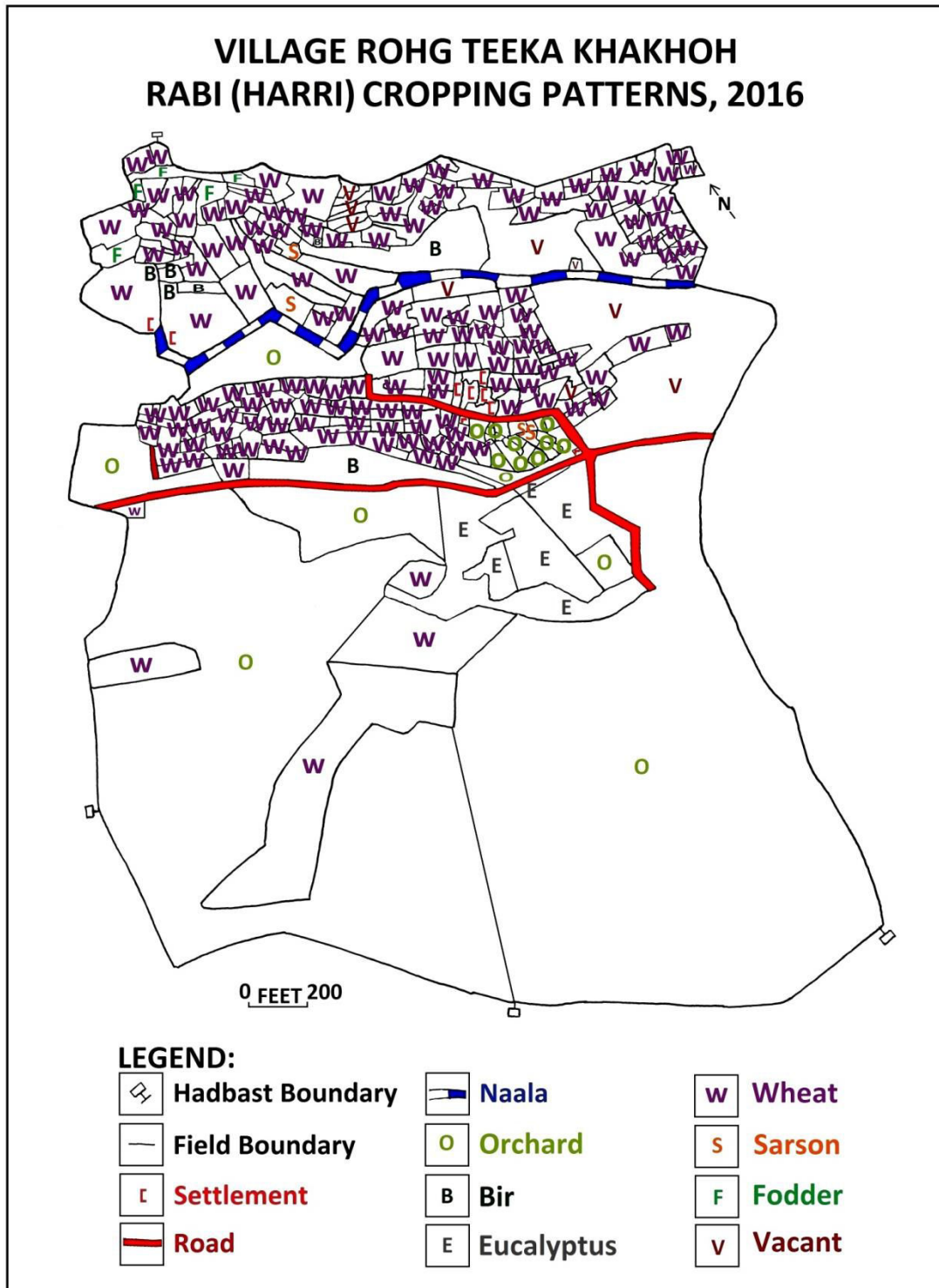
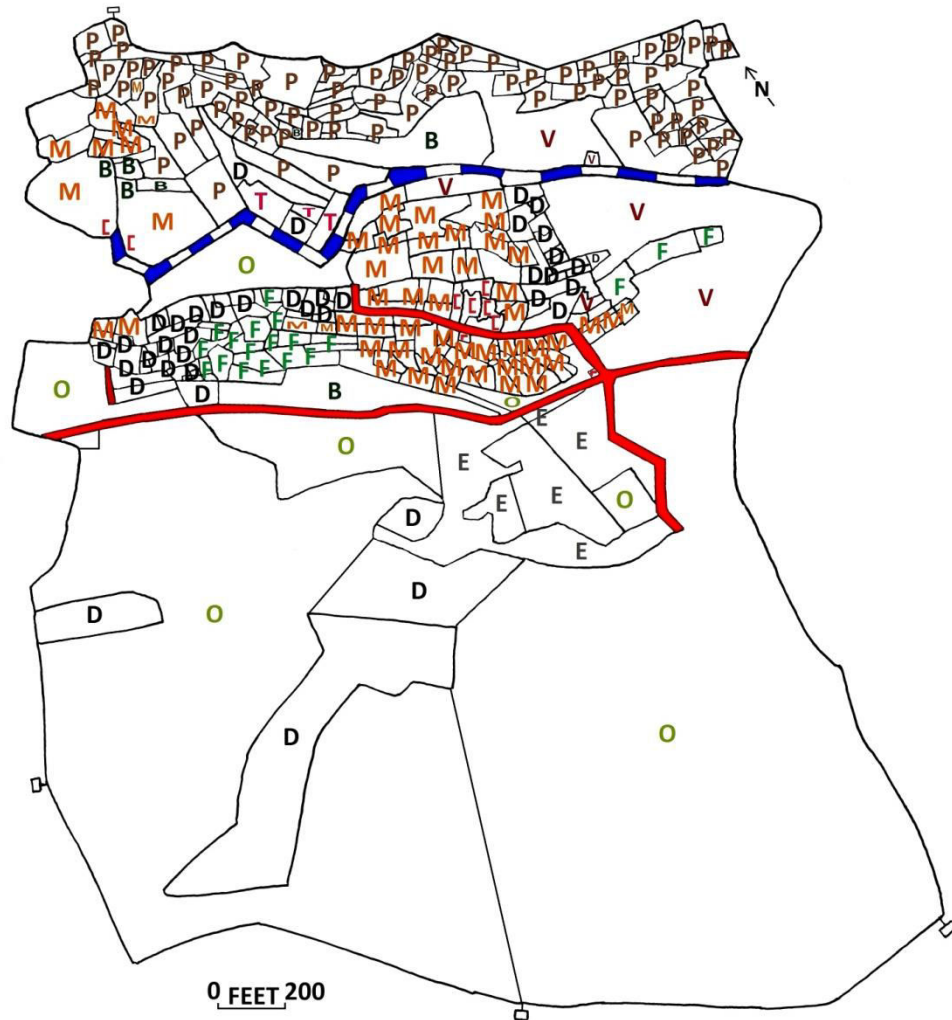


Figure 5.66

VILLAGE ROHG TEEKA KHAKHOH KHARIF (SAONI) CROPPING PATTERNS, 2016



LEGEND:

Hadbast Boundary	Orchard	Paddy
Field Boundary	Bir	Maize
Settlement	Eucalyptus	Daal
Road	Til	Vacant
Naala	Fodder	

Figure 5.67

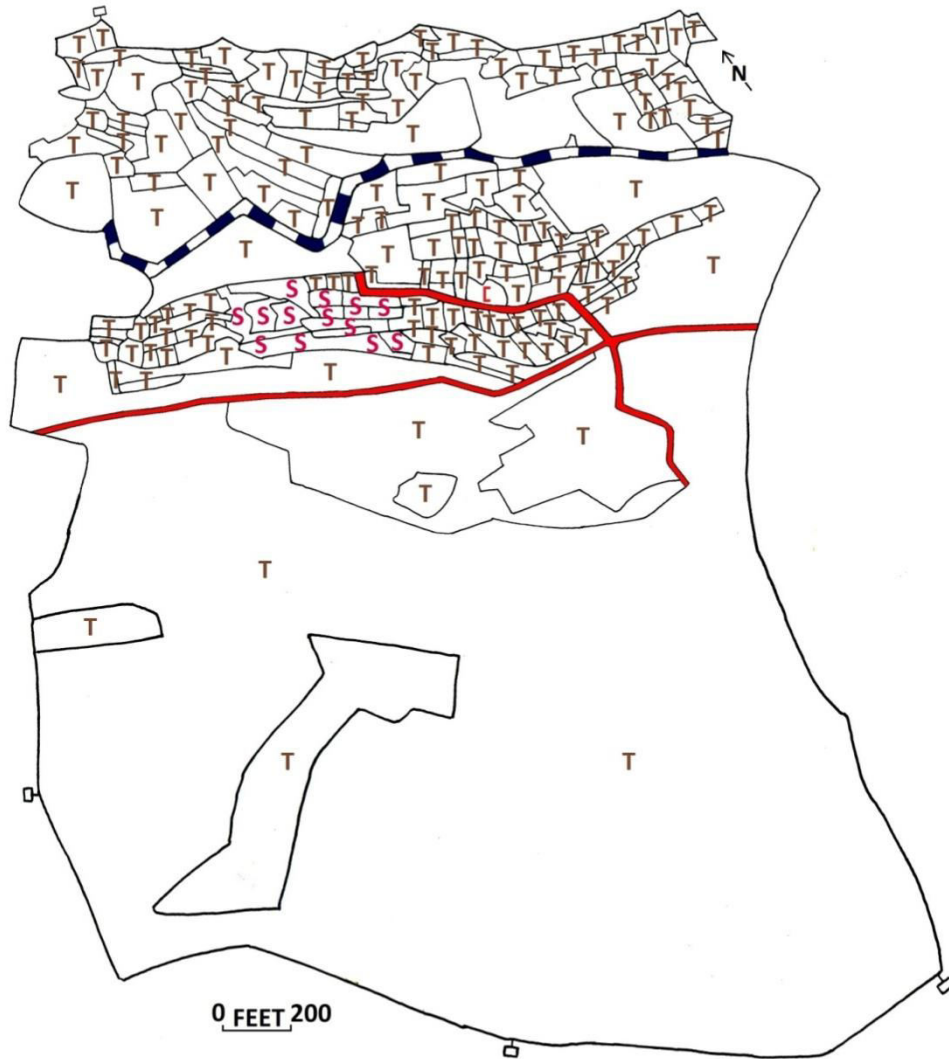
FIELD PATTERNS AND LAND OWNING CASTES

Field patterns and land owning castes are related to each other. The land owned by different castes display different field patterns. The fields and holdings of high castes are larger than those of the lower castes. According to genealogical tree of 1884, the village Rohg Teeka Khakhoh was first owned by people belonging to *Thakur Khakhohhtrey* castes and the name Khakhoh was added to the name of the village after the *gotra* (clan) of their caste (Figure 5.68). People belonging to *Rajput Sobhreyae* castes were offered some *barani awal* superior land type fields and were allowed to settle in the village from old time. The 1884 field map reveals that both these castes, *Thakur Khakhohhtrey* and *Rajput Sobhreyae* owned agriculture land in the village. Majority of the total cultivated fields and the cultivated area even today are owned by *Thakur Khakhohhtrey*. Therefore, the fields and holdings owned by *Thakur Khakhohhtrey* are larger in size (Figure 5.69). The fields and land holdings belonging to *Rajput Soobhreyae*, *Rajput Balotrey*, *Rajput Pathania* and *Jat Gill* are smaller in size.

No difference exists in terms of shape and size of fields with respect to caste of the owners. Fields belonging to *Thakur Khakhohhtrey*, the original settlers are situated near the *abadi-deh* (settlement) than the fields belonging to other castes. No difference is found in terms of crops grown and farm mechanization of different castes. Most of the *banjar kadim* and *pahar* (hill) big size fields situated in different directions of the village territory are also owned by *Thakur Khakhohhtrey*. The low castes do not own cultivated land, but they have their own houses in the *abadi-deh* (settlement).

Interestingly, the fields belonging to *Jats*, a traditional agriculture practising caste are not only few but also situated in poor land types away from the *abadi-deh* (settlement). This is due to the fact that agriculturally the village has less attraction than the villages located in the fertile upland plains of central Punjab dominated by *Jat* caste people. *Thakur Khakhohhtrey* continues to be the most dominant caste in terms of ownership of fields.

**VILLAGE ROHG TEEKA KHAKHOH
DISTRIBUTION OF FIELDS ACCORDING TO
LAND-OWNING CASTES, 1884**










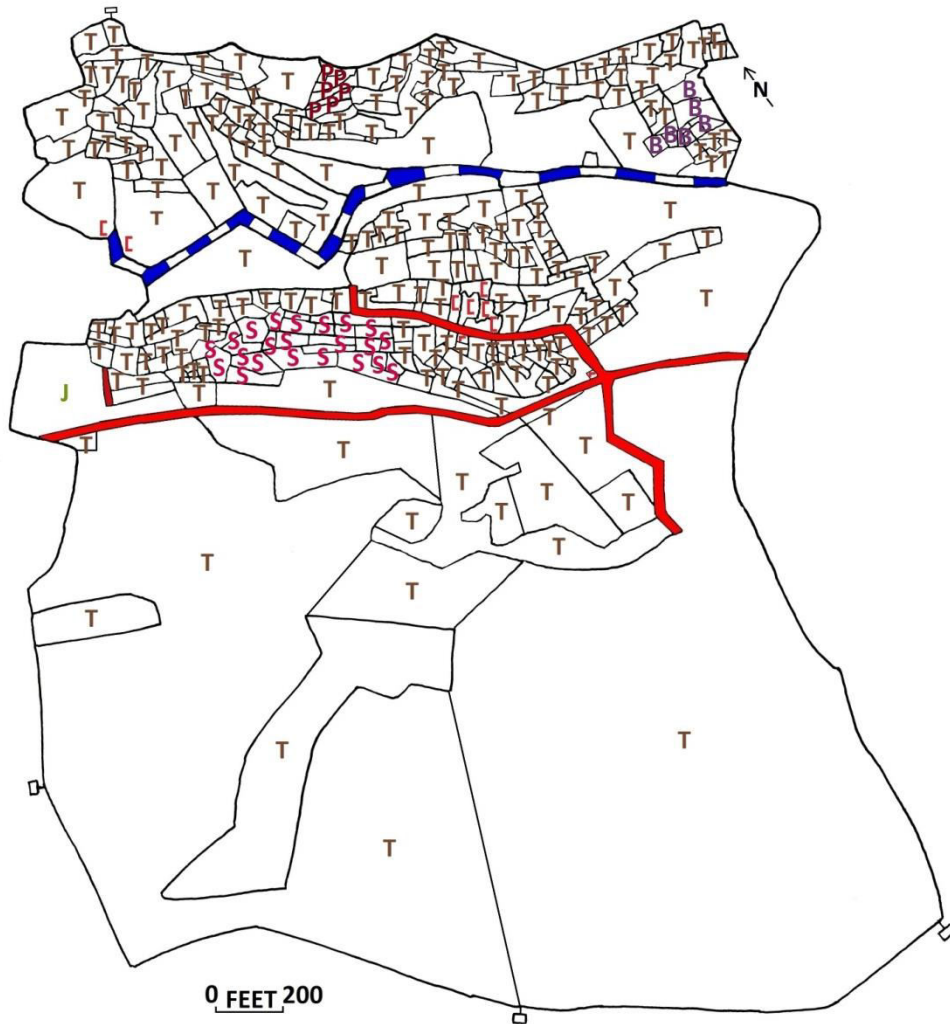
- LEGEND:**
- | | | |
|--|---|---|
|  Hadbast Boundary |  Road |  Thakur Khakhohtrey |
|  Field Boundary |  Naala |  Rajput Sobhreyae |
|  Settlement | | |

Figure 5.68

VILLAGE ROHG TEEKA KHAKHOH DISTRIBUTION OF FIELDS ACCORDING TO LAND-OWNING CASTES, 2016



LEGEND:











 Hadbast Boundary	 Road	 Thakur Khakhohtrey
 Field Boundary	 Naala	 Rajput Sobhreyae
 Settlement	 Jat Gill	 Rajput Balotrey
		 Rajput Pathania

Figure 5.69

MODEL OF EXISTING FIELD PATTERNS IN PUNJAB

Field pattern is a reflection of physical settings and way of life of people living over that area. It varies from village to village in different landform regions. However, viewed at state level there are some similarities hidden under the visible differentiation. On the basis of broad similarities observed during the field work throughout the state of Punjab in general and on the basis of findings of intensive study of field patterns of the sample villages in particular, a diagrammatic model of existing field patterns in Punjab is presented (Figure 5.70).

Village patterns are not separate from field patterns. Both function intricately together in social life as well as in agriculture. A village or field pattern is the history projected on the village landscape. Ishida (1972) has given a three-fold ring-shaped structure of a village territory in Punjab prevalent in the pre-consolidation phase (Figure 5.70). It included *bara*, *nyayee* and *kheyot*. *Bara* was the central part of the settlement with most fertile soils dominated by vegetable fields and cattle sheds. *Bara* was encircled by a circular road known as *phirni*. Adjacent to the *bara* beyond the *phirni* lied the *nyayee*. *Nyayee* means new land that is renewed in fertility by the continuous addition of human and animal excreta and household waste known as *roori*. *Nyayee* fields were usually small in size due to their greater degree of sub-divisions. *Nyayee* fields had largest concentration of wells irrigation and were used mainly for the cultivation of vegetables and fodder. *Nyayee* fields were not used for grazing cattle. Beyond *Nyayee* lied *kheyot* which means periphery. Ishida has further sub-divided the *kheyot* into inner and outer zones. The inner zone of *kheyot* was having more fertility than the outer zone. More profitable crops like sugarcane, cotton and wheat were grown in the inner zone and less profitable crops like grams, *bajra* and *jowar*, were grown in the outer zone and was also used for cattle grazing cattle.

These traditional zonal structures of the village territory were transformed after the adoption of process of consolidation in Punjab plains after 1950s due to the conversion of unproductive lands into agriculture lands (Figure 5.70).

DIAGRAMMATIC MODEL OF EXISTING FIELD PATTERNS IN PUNJAB PLAINS

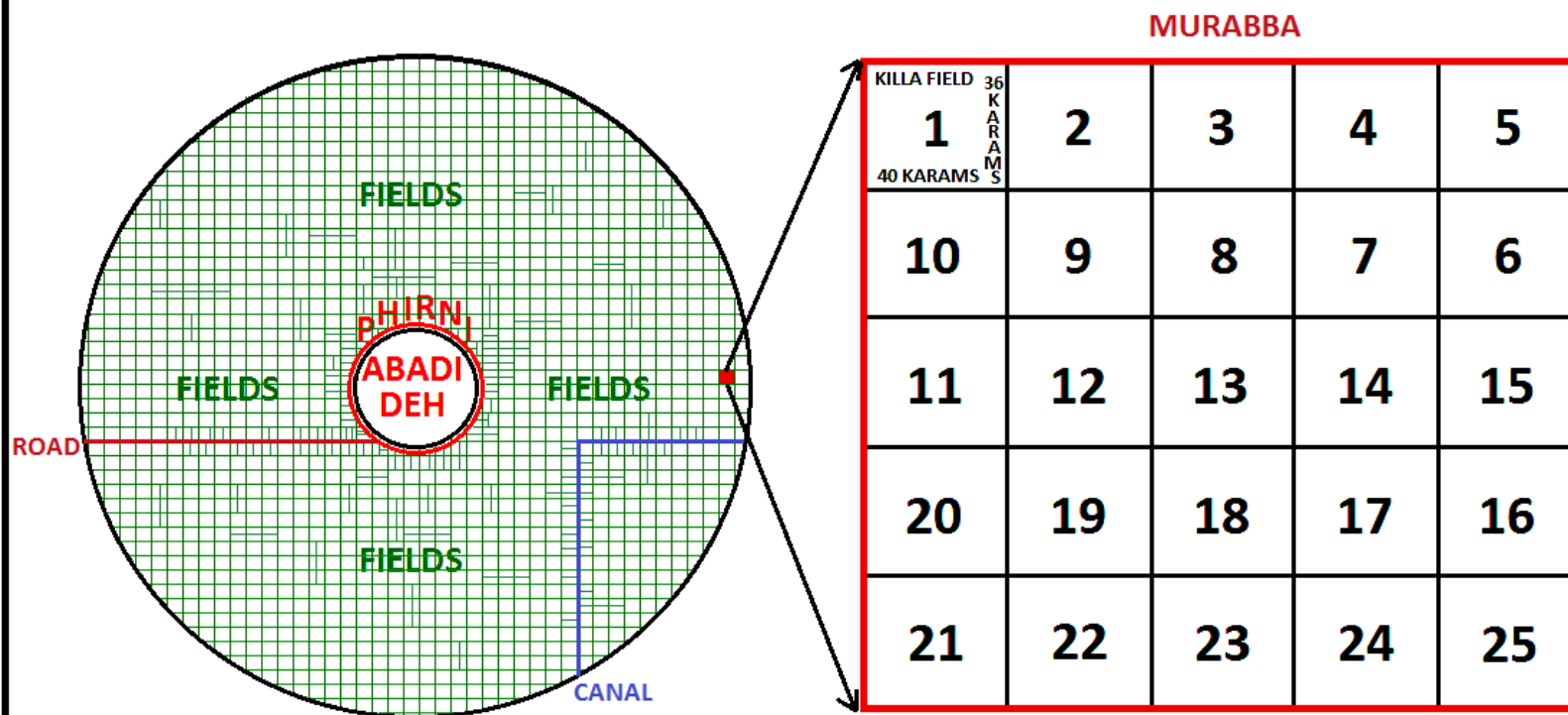


Figure 5.71

Area under poor land type *kheyot* was mostly converted in to *awal* (first rate) land type due to better management of land through the provision of more irrigation facilities and by laying of new roads for increased accessibility to the fields.

Intensive commercial agriculture is practiced at present in the villages of Punjab plains. The productivity and fertility of all the fields are maintained by the universal use of chemical fertilizers with assured irrigation, irrespective of their distance from the *abadi-deh* (settlement). Therefore, *nyayee* and *kheyot* rings suggested by Ishida have lost their relevance in the villages of Punjab plains in the existing scenario. The practice of cattle grazing in the fields has also been abandoned due to settled dairy farming. Therefore, pasture zone mentioned by Ishida in his diagrammatic model of a Punjab village territory, is not found any more in the villages of Punjab plains at present times. Therefore, the traditional three-fold ring-shaped structure of a village territory in Punjab has been replaced by two blocks in the existing village territory (Figure 5.70). The main settlement block (*abadi-deh*) is comprised of houses enclosed by a ring road known as *phirni* and the second block is comprised of agricultural fields situated outside the *phirni* extending up to the village boundary. There is no difference in the productivity and fertility of soils in the entire village territory in the Punjab plains due to the use of chemical fertilizers and irrigation facilities in all the fields. Road facing fields are encroached upon more by the new settlements in the existing village maps. Therefore, a new diagrammatic model of existing village territory is proposed, which is applicable to the villages situated in Punjab plains spreading over more than 97 per cent area of the state (Figure 5.70).

Though three-fold ring-shaped structure in recent times has lost its significance in the villages of Punjab plains, it still has relevance in some villages situated in the active flood plains not protected by *dhusi bandhs* (embankments) and the Shiwalik hills situated in north-east Punjab covering less than three per cent of the geographical area of the state. The three-fold ring-shaped structure has little significance in terms of functional pattern approach. It has importance only in the light of cultural-historical approach relating to origin and evolution of village territory and field patterns.

Majority of the fields in Punjab plains covering more than 97 per cent geographical area of the state are rectangular in shape with uniform size of one *Killa* (one acre) each. Twenty-five such *killa* fields constitute a *Murabba* (25 acres). Any one holding

may cut across different blocks of a *killa* or a *murabba*. The process of consolidation of *killa* fields is called *Killabandi* and consolidation of *murabba* blocks is known as *Murabbabandi*. Existing field patterns in the villages of Punjab plains are dominated by such rectangular blocks due to the adoption of *Murabbabandi* (Figure 5.71). One *Killa* field block is comprised of an area of 36 *karams* x 40 *karams* or 198 feet x 220 feet or 8 *kanals* (160 *merlas* or 600 yards) equivalent to an acre. *Merla* is a unit of land measurement comprising an area of about 30 square yards. The field patterns have been created on the basis of the measurement of land; *Merla-Kanal-Killa-Murabba* are found everywhere in Punjab plains (Figure 5.71). This diagrammatic model of field patterns is applicable to the villages situated in Punjab plains barring Shiwalik hills and some flood prone areas, where process of consolidation was not implemented.

It is important to examine the relationship between the area of a field and work potentiality based on the use of particular implements and technology. Area of one *Killa* field is what one farmer can conveniently plough and prepare for sowing in a day using a tractor. It is interesting to note that a field is temporarily partitioned into small *kyaris* which in many cases cover one *Kanal* area by means of *wats* (embankments) for the purpose of irrigating the fields. The strip pattern fields are seen in many areas as a result of sub-divisions of original rectangular block fields, due to increase in the number of owners affected by the law of inheritance from generation to generation. Such strip pattern fields are distributed more near the *abadi-deh* (settlement), along roads and canals due to their more economic attraction (Figure 5.71). These sub-divisions of fields will further intensify in future leading to more strip pattern small size fields owing to continuous increase in the number of owners. The rectangular shape fields are dominant and irregular shaped fields are scarcely seen in all the villages situated in Punjab plains. Though, rectangular shape fields are very common today, irregular shaped fields were widespread before the implementation of process of consolidation. The village *hadbast* (boundary) is generally marked by the stone pillar known as *Saheda* usually put at the boundary meeting point of three villages. Majority of the fields are approachable by footpaths and roads. This diagrammatic model of field patterns is applicable to the villages situated in Punjab plains in present times

MAIN FINDINGS AND CONCLUSIONS

Detailed elaboration and illustrated descriptions of existing field patterns in the selected villages have brought the following main findings and conclusions:

- ❖ Field patterns have experienced further changes from post-consolidation phase to the existing field patterns phase of 2016 in all the villages. This change was more pronounced in the villages which are situated in the close vicinity of big cities. Many fields were encroached by the fast expanding settlements in the village Dhanowali situated very close to Jalandhar city and in village Bath situated near Bathinda city. The fact that field pattern is a cumulative result of phases of settling which have operated through time, is proved through the changes observed in study of field patterns from 1880s, pre and post-consolidation phase to the existing field patterns phase of 2016 in all the villages.
- ❖ Diverse field patterns have evolved in the study villages in response to different landform regions of upland plains, upland plains with sand dunes, piedmont plains, flood plains and Shiwalik hills. Field patterns in a village belonging to the Shiwalik hills landform region are different than the field patterns of any other landform regions due to its unique physiography and vice-versa. Therefore, it is proved again in this chapter that diverse field patterns have evolved in the study villages in response to different landform regions.
- ❖ It is evident from the study of existing field patterns that land types have improved to maximum extent in the villages situated in upland plains and upland plains with sand dunes due to universal availability of irrigation facilities. The *chahi* (tube-well irrigated) land type cover both big as well as small size fields in the village Dhanowali and *nahari* (canal irrigated) land type cover big as well as small size fields in the village Bath. Majority of the fields in the villages pertaining to Shiwalik hills and flood plains landform regions belong to *barani* (non-irrigated, rain-fed) land types due to physiographic barriers. The size of the fields is comparatively smaller in *barani awal* and it becomes larger in *barani daum* and the largest in *barani saum* land type in all the study villages. The fields belonging to *banjar kadim* land type are also very large in size in these villages belonging to the flood plains and Shiwalik hills landform regions. Majority of the fields have been converted from *barani* to *nahari* land type in the village Pathan Chak belonging to piedmont landform region. The fields are comparatively larger in

size and irregular in shape in poor land types and smaller as well as larger in size in better land types in all the study villages. Relationship between the land types and field patterns has faded in the villages, where entire cultivated area has been brought under irrigation, like village Dhanowali located in the upland plains and village Bath located in the upland plains with sand dunes.

- ❖ The size of the fields in terms of increasing distance from the *abadi-deh* (settlement) is found to vary in the existing field maps. The size of the fields is comparatively smaller near the *abadi-deh* (settlement) in all the sample villages. Large fields are situated away from the settlement proper in the outfield areas. These fields are larger than the infields situated near the *abadi-deh* (the settlement) because the heirs are not keen in dividing intensively the outfield, rather they prefer to have a full unit in a distant part, but they certainly want a share from every field near the settlement (infield) due to their more economic value, because of their relative nearness to the *abadi-deh* (settlement) and scope for future house construction.
- ❖ The impact of sub-divisions of fields is clearly visible on road facing fields. The road facing fields are smaller in size, elongated in shape, parallel to each other and perpendicular to the road than the fields, which are situated away from the roads in all the villages. The road facing fields have greater commercial value and therefore every member of the family wants to have an access to the road. Road facing fields are encroached upon more by the new settlements in the existing village maps.
- ❖ Rectangular shape and uniform size fields made possible due to the implementation of process of consolidation in 1950s are visible in the existing field maps also. The only difference visible is an increase in the number of fields and reduction in their size due to continuous sub-divisions of the existing fields. Due to continuous sub-divisions of existing fields and land holdings resulting from the laws of inheritance and equitable distribution of benefits and handicaps the benefits of consolidation process have been minimized. The per-capita number of fields and size of land holdings are declining fast due to continuous increase in the number of owners. Due to this fact, problems related to fragmentation of land holdings, which were eliminated by the adoption of consolidation have again cropped up. The form of agricultural landscape has remained more or less the same from 1884 to 2016, where process of consolidation was not implemented

like in village Khera Bagh in flood plains and village Rohg Teeka Khakhoh in the Shiwalik hills landform regions, because of difficult terrain. The cultivated land is continuously shrinking due to encroachment by the fast expanding settlements in recent years.

- ❖ It is also found that the size and shape of the fields vary under different crops grown in the study villages. Commercial grain farming dominated by winter wheat and summer rice is universal in most of the villages in Punjab. The fields are larger in size and regular in shape in commercial grain farming villages situated in the upland plains, upland plains with sand dunes and in piedmont plains, whereas in the flood plains and the Shiwalik hills villages traditional subsistence farming is practiced in irregular shape fields and traditional crops are grown according to the available favorable geographical conditions. Fields in these villages tend to be intermediate in size and irregular in shape distributed in different parts of the village. Maize and pulses are grown generally in the *barani* land type fields in the villages of Shiwalik hills and flood plains. An analysis of existing cropping pattern in the study villages situated in upland plains, upland plains with sand dunes and in piedmont plains reveal that there exists no relationship between cropping pattern and infield and outfield area situated near and away from the *abadi-deh* (settlement). The intensive subsistence cum commercial farming is practised both near and away from the *abadi-deh* (settlement). Distance from the *abadi-deh* (settlement) does not appear to have any relationship with the types of crops grown and the resultant field patterns. Fodder is grown relatively near the *abadi-deh* (settlement) to meet the daily requirements of cattle, as cattle are kept in the *abadi-deh* (settlement) site. *Ekfasli* (one crop) fields exist nowhere. Farmers grow at least two or more crops in a year both in infield and outfield areas. The *teenfasli* (three crops) fields are found more in the villages belonging to upland plains, upland plains with sand dunes and in piedmont plains. Early maturing high yielding variety seeds are used in these fields. After the harvesting of one crop, new crop is immediately grown without wasting time. Mechanized farming along with intensive irrigation and use of fertilizers, insecticides and pesticides help the crops to grow early. The *teenfasli* fields are relatively larger than the *dofasli* fields. It is observed that farmers decide to allocate fields under different crops not in terms of their size or shape but in terms of price of crops, yield, ripening period and market demands. Cropping

pattern has shifted from low value traditional crops to economically more remunerative crops. The fields are covered more by commercial crops. These crops have affected the field patterns to only some extent only. The rice grown fields are divided relatively in to smaller sections. Water should remain standing in the paddy fields almost for first three months. Water can be kept in small sections of fields with ease. All other crops are found in all the fields irrespective of their shape and size. A few small *kyaris* (cultivation units) are created near the tube-well for growing vegetables. Vegetables growing fields are generally smaller in size. The cropping pattern has shifted from traditional and subsistence types to non-traditional commercial crops due to the adoption of Green Revolution technology in Punjab plains. On the whole the type of crops grown does not seem to have affected the field pattern to a large extent in all the study villages. Crops are grown in the fields irrespective of their size, shape and distance from the *abadi-deh* (settlement) in all the study villages with commercial as well as subsistence type of agriculture.

- ❖ It is observed that the amount of land owned by different castes display different field patterns in the study villages. In general, fields and holdings of high castes are larger than those of the lower castes. This fact is proved by the *Jat Randhawas* in village Dhanowali, *Jat Baths* in village Bath, *Sainis* in Pathan Chak and *Thakur Khakhohs* in village Rohg Teeka Khakhoh. All the study villages except Khera Bagh started as uni-religious, uni-clan and uni-caste settlements and later on turned into multi-religious, multi-caste and multi-clan villages but the dominance of people belonging to initial caste was not effected as they remained largest land owners in all the phases from past to present. Obviously the fields and holdings owned by them at present are larger than other castes. The fields belonging to people of high castes are located in the better land types. The fields of different castes were found intermingled in the entire village territory in all the study villages. High caste groups in general have large size fields and land holdings. The village Khera Bagh is inhabited by people of different castes from old times. Therefore, people belonging to all castes have small as well as large land holdings. The economic conditions of different land-owning castes also have a great bearing on field patterns. The rich farmers belonging to all castes have big land holdings, large and regular rectangular fields and practise mechanized

farming. The holdings and fields of poor farmers are small irrespective of their castes.

- ❖ Tube-wells, submersible pumps and canals are the main sources of irrigation prevalent in the state of Punjab. Village Rohg Teeka Khakhoh situated in the Shiwalik hills does not have any source of irrigation. Only three percent of the cultivated area is under chah (well) irrigation in village Khera Bagh situated in flood plains surrounded by the Shiwaliks. The cultivated fields are *barani* (rain-fed) in Khera Bagh and Rohg Teeka Khakhoh villages and fields of all sizes and shapes are found here. Canal water introduced in 1960s, is the chief source of irrigation in village Bath situated in the upland plains with sand dunes and it has indepth relationship with field patterns. *Choes*, *khals* and *kuhals* are the chief sources of irrigation in village Pathan Chak situated in piedmont plains also affected the field patterns. The fields irrigated by canal, khals and *kuhals* are strip in shape to have access to water in village Bath and Pathan Chak. Tube-wells and submersible pumps are used as sources of irrigation in the village Dhanowali situated in the upland plains. In village Dhanowali, most of the old wells have been converted into electric or engine tube-wells after the adoption of Green Revolution technology in late 1960s and due to continuous fall in underground water level, farmers are compelled to go for submersible pumps in their fields. Tube-well is located mostly either in the centre of the holding or near the road. It may be located anywhere within a field. All the fields of a holding do not necessarily touch one or more sides of a tube-well. Water of tube-well can be brought through *arr* (drain) to all the fields with a great ease in plain areas. The field, in which tube-well is dug, mostly becomes hexagon in shape. Otherwise, fields of all shapes and sizes are found near the tube-well. The size and shape of the fields do not seem to have any relationship with the tube-well as source of irrigation. The fields of different size and shape are irrigated with the help of tube-wells. It is inferred that irrigation has affected the cropping patterns. The farmers have started growing non-traditional crops, rice and vegetables in irrigated fields. The distance of fields from the *abadi-deh* (settlement) is no more a prime determinant of land quality after the availability of irrigation facilities in all parts of the villages. Therefore, there exists no relationship between the distance from the *abadi-deh* and productivity and fertility of land due to the universal use of irrigation facilities.

- ❖ The kind of ploughing implement determines the size and shape of a field to some extent only in the study villages. There is a universal use of tractors in Punjab to plough the fields irrespective of their size and shape. In the village Rohg Teeka Khakhoh large fields and holdings are ploughed by small sized tractors, because of hilly topography. Bullock drawn fields which were universal prior to the introduction of Green Revolution technology are completely replaced by tractors in present times. The fields ploughed by bullocks prior to the introduction of Green Revolution technology were small to medium in size. At present ploughing implement does not seem to have relationship with the field patterns in the study villages. All fields irrespective of their size and shape are being ploughed by tractors in all the villages. A farmer who does not own tractor prefers to hire a tractor for ploughing his fields. The small *kyaris* (cultivation units), where farmer grows vegetables are generally ploughed by farmer himself using traditional small size farm implements.

CHAPTER-6

CONCLUSIONS AND SUGGESTIONS

Rural Settlement Geography concerns primarily with the phases of settling in an area and the results of these phases of settling, which suggest the processes of exploitation of natural resources of an area by human beings to fulfill their needs. The people settled in different areas have differences in physical and human environment and therefore have differences in rural landscapes. The house types and field patterns are the most important and outstanding visible components of rural landscape. Through practicing agriculture, the farming people establish a permanent relationship with land and in this process create field patterns. Thus, Geography of Field Patterns may be defined as the study of the spatial structure of agricultural fields created through interplay of nature and man.

In the present study field patterns have been geographically analysed within the framework of an interacting system of elements of physical and human environment. The important physical and human factors, which affected the field patterns in the study area are geology, relief, climate, soil, slope of the land on which these fields lie, drainage system, land types, population, level of agriculture, systems of land division, rights of ownership of land, land tenure systems, size of land holdings, irrigation sources, crops grown, distance from the *abadi-deh* (settlement), means of transport, market demand factors, technology used and methods of cultivation. Apart from these, caste, government policies, social customs and cultural practices such as the effect of operation of Hindu law of inheritance, principle of equitable distribution of benefits and handicaps, principle of compensation also play their role in shaping the field patterns. These factors individually as well as in combination played their important role in the origin, evolution, arrangement, form and function of fields. The study involved the field patterns and their essential attributes: shape, size, boundaries, distribution, scattering and their combinational arrangements.

OBJECTIVES OF THE STUDY

The objectives of the present study were:

1. To describe and analyse the effects of time and space on the field patterns in their phases of settling.

2. To undertake a geographical analysis of field patterns of the villages selected from different landform regions of Punjab.
3. To study the relationship between the elements of field patterns and distance from the settlement proper (*abadi-deh*), land types, consolidation of land holdings, cropping patterns, land-owning castes, sources of irrigation and ploughing implements used.
4. To suggest measures to save existing fields and to improve their efficiency.

HYPOTHESES PROPOSED AND TESTED

Based upon our research objectives following hypotheses were proposed and investigated.

1. A field pattern is a cumulative result of phases of settling which have operated through time in an area.
2. Diverse field patterns evolve in response to different landform regions.
3. In the irrigated land types the size of the fields is small and in the rain-fed land types the size of the fields is large.
4. Large fields are situated far from the *abadi-deh* (settlement proper).
5. The fields facing roads are small in size and elongated in shape.
6. In the villages where consolidation of holdings has taken place the fields are large in size and regular in shape, whereas in unconsolidated villages the fields are small, inconveniently large and irregular in shape.
7. In commercial grain farming areas, the fields are large and regular, whereas in vegetable and subsistence farming areas fields are intermediate in size and irregular in shape.
8. High caste groups have large land holdings, whereas low castes possess small land holdings.
9. Field patterns are different in areas having different modes of irrigation.
10. Tractor ploughed fields are accentuated rectangular in shape and large in size, whereas bullock ploughed fields are small in size.

SOURCES OF DATA AND METHOD OF STUDY

The study was founded mainly on the primary data derived from extensive field work of the sample villages selected from the state of Punjab. The data was obtained from *Patwari* (village level government revenue official), *Kanungo* (tehsil level

government official in revenue department) at the district revenue offices of Punjab and from the office of the Director Land Records, Punjab. The thematic maps on different aspects of field patterns in this study were drawn by the researcher on the basis of data obtained from these sources. This was accompanied by the detailed observations and photographs on the shape and size of the fields, field boundaries, field paths and means of irrigation. Information was also obtained through enquiries and interviews with the farmers. Index of Scattering and Index of Scattering in terms of Distance were used for calculating scattering of sites of fields of a farmer during pre and post consolidation phases. The available data on land types, shape, size, field boundaries, crops grown, per capita number of fields and size of land holdings were tabulated and maps were drawn and used as tools to test the hypotheses for different phases in temporally designed chapter scheme to derive the conclusions.

THE STUDY AREA

The study area Punjab was divided into five landform regions on the basis of geo-physical characteristics on the lines with the schematic division followed by Punjab Remote Sensing Centre, Ludhiana. These landform regions are upland plains, upland plains with sand dunes, piedmont plains, flood plains and Shiwalik hills. One village each was selected from these landform regions for a detailed spatio-temporal analysis of its field patterns. The villages selected for case studies were Dhanowali from upland plains, Bath from upland plains with sand dunes, Pathan Chak from piedmont plains, Khera Bagh from flood plains and Rohg Teeka Khakhoh from the Shiwalik hills.

The study was confined itself to the time period from 1884 to 2016. This period of study was selected due to limitations of data sources, as data for most of the villages was available from 1884 onward only in the state of Punjab. The chapter scheme was ordered in temporal sequence to test the hypotheses during initial phase (1880's), pre-consolidation phase (1910's), post-consolidation phase (1950's) and in existing phase (2016).

RATIONALE FOR THE STUDY OF FIELD PATTERNS IN PUNJAB

For this study of field patterns, Punjab was chosen as the study area, because it is agriculturally most dynamic and one of the most intensively farmed areas in the world with deep agricultural roots. Geographers nearly ignored the study of the phenomenon of field pattern in the rural settlement geography of the state. No comprehensive study

on field patterns covering all the landform regions of the state of Punjab, for time periods 1884 to 2016 existed in the state. This left a scope for such a meaningful study in the agriculturally developed state of Punjab. The present study has tried to fill this research gap. This study on field patterns in Punjab has not only enhanced the existing literature, but it has also created a new knowledge with a sound social applicability. It is expected that the study will draw the attention of researchers to this very important dimension of field patterns, which has not properly been addressed so far. The findings of this research would arouse interest and can be usefully adopted as a model by geographers, anthropologists, sociologists, rural development planners and experts from land records in the state of Punjab as well as other parts of India and the developing countries with similar socio-cultural backgrounds.

(A) CONCLUSIONS

In line with the objectives of the study and proposed hypotheses following conclusions are drawn in the present study:

1. Evolution of Field Patterns

To test the evolution of field patterns, it was hypothesized that: A field pattern is a cumulative result of phases of settling which have operated through time in an area.

Through the study of effect of time and space on the evolution of field patterns from 1884 to 2016 period, for the sample villages selected from all the landform regions of Punjab, it has been found that field pattern is a cumulative result of phases of settling which have operated through time. Most of the villages began as a uni-religious, uni-caste and uni-clan settlement and slowly turned into multi-religious multi-caste and multi-clan inhabited villages in Punjab.

The early settlers acquired the village territory by removing forests and divided cultivated land equally among them. The village territory belonged to all these early settling families. The boundaries of the villages were marked by forests, uneven *tibbas* (sand ridges), *choes* and other physiographic features.

Table 6.1**Validation of Hypothesis on Phases of Settling**

Name of the Village and Landform Region	1881-90	1911-20	1951-60/1986	2016
Dhanowali (Upland Plains)	Valid	Valid	Valid	Valid
Bath (Upland Plains with Sand Dunes)	Valid	Valid	Valid	Valid
Pathan Chak (Piedmont Plains)	Valid	Valid	Valid	Valid
Khera Bagh (Flood Plains)	Valid	Valid	Valid	Valid
Rohg Teeka Khakhoh (Shiwalik Hills)	Valid	Valid	Valid	Valid

Source: Data analysis.

The initial division of cultivated land led to the emergence of the initial field patterns. The land was abundant, but with poor inherent productivity and fertility. Because of abundance of land in the beginning, each family may have as much land (*thula*) as it could manage. The initial *thulawand* division of the village land among the founder families may have been effected by the limited size of levelled land free from physiographic drawbacks. After *thulawand* the *thulas* were sub-divided into lineage families as *dheris* known as *dheriwand*. *Dheris* were further sub-divided into individual family *khatas* (fields) of unequal size on the basis of laws of inheritance, principle of equitable distribution of benefits and handicaps as per the generalized scheme of land division among multi-clan and multi-caste inhabitants. These were the *bhaichara* (joint) villages and clan families from the very beginning lived under their elders in groups of equal rights (Baden,1972).

The entire areas of the villages were slowly converted into agricultural fields through different phases. Generally, land near the *abadi-deh* (settlement) was the first to be brought under cultivation due to its nearness, even though it was not enough productive and fertile. Due to the expansion of families, people living in a village

increased the cultivated land towards village territory according to their needs. This expansion of cultivated land would have been continued till the Britishers defined the actual fields and village boundaries in 1846 and prepared the map showing field and village boundaries in between 1846 and 1890 after conducting actual field surveys.

The earliest available field maps of the sample villages reveal that the fields near the *abadi-deh* (settlement) were relatively smaller due to their higher frequency of subdivision in response to the desire of every member of the family to have a share in this land, not so much due to its productivity and fertility but due to its nearness and the scope for building a house in future. This trend continues in all the villages from 1880s to 2016.

The fields in early phase were mostly large ranging from blocks to elongated strips. The holding of a farmer was comprised of several strips scattered in the entire village territory. The elongated strip shape of the fields at that stage would have been determined by micro-topography, uneven *tibbas* (sandy tracks), poor land types, sources of irrigation, use of poor farming implements, bullock plough, subsistence nature of agriculture, poor management of fields due to small family size and very big holdings scattered at different sites and the orientation of all the fields comprising the original property of a farmer to the field roads or village roads. The fields were elongated rectangular and strips in shape also as a result of the ancient notion that the field should be of such a size that one plough team of farmer's family would plough the field in one day. This was essentially related to the use of the wooden ard plough suited to a long furrow so that there would be no wastage of time in turning the plough too frequently (Mukerji, 1961).

In the subsequent stages of evolution of field patterns, fields are continuously subdivided due to increase in the number of male members of different families from generation to generation related to the operation of the law of inheritance. The law of inheritance in the study area was such that all the sons of a father would share equally in his land, regardless of their age, after his death. Each son is given a share in every type of land suggested by the operation of the principle of equitable distribution of benefits and handicaps. It has resulted in the fragmentation of holdings and subdivision of fields. At some places the principle of compensation operates, whereby the proportion of land owned by different sons varies in different land types. He who

wants to have maximum land in the best land types is offered fewer fields which are also small and those with a limited share in the best land may have several fields of large size in poor land types.

The same principle was adopted by the consolidation officials at the time of consolidation of land holdings in the villages of Punjab plains and continues to operate more in the study villages. The consolidation of land holdings in Punjab plains villages in 1960s has disrupted the historical evolution of field patterns. The majority of the fields have become uniform of 8 *kanals* in size and rectangular in shape in the villages, where consolidation of land holdings was implemented.

Due to the increasing population pressure and the entrance of female land owners made possible by the amendment of Hindu Act, which lays down that the daughters are entitled to share equally in their parents property, the number of per capita fields and size of holding has been continuously decreasing. Joint family holdings are breaking up due to family quarrels over land, economic hardships and wish of an individual to migrate to urban areas mainly in search for employment.

The cultivated fields near the *abadi-deh* (settlement) and roads are being continuously encroached upon by expanding settlements. All this has resulted in the reduction of the size of the fields due to sub-divisions of fields and fragmentation of the holdings. The number of cultivated fields is reducing due to continuous encroachment of cultivated land by expanding settlement and other *gairmumkin* (uncultivable) land uses. The average size of the land holding has declined to critical levels. Sub-divisions of existing fields as a result of the increase in the number of owners in the genealogical tree of all the families has been the basic governing process in the evolution of field patterns in all the sample villages of Punjab selected from different landform regions. The hypothesis is found validated for all the selected villages in all time periods.

2. Landform Regions and Field Patterns

To assess the relationship between landform regions and field patterns, it was hypothesized that: Diverse field patterns evolve in response to different landform regions.

Table 6.2**Validation of Hypothesis on Landform Regions and Field Patterns**

Name of the Village and Landform Region	1881-90	1911-20	1951-60/1986	2016
Dhanowali (Upland Plains)	Valid	Valid	Valid	Valid
Bath (Upland Plains with Sand Dunes)	Valid	Valid	Valid	Valid
Pathan Chak (Piedmont Plains)	Valid	Valid	Valid	Valid
Khera Bagh (Flood Plains)	Valid	Valid	Valid	Valid
Rohg Teeka Khakhoh (Shivalik Hills)	Valid	Valid	Valid	Valid

Source: Data analysis.

Landform provides the stage on which human beings create fields for agriculture. Diverse field patterns evolve in response to different landform regions. To prove this, one village each was selected from all the landform regions of Punjab, on the basis of geo-physical characteristics in line with the scheme provided by the Punjab Remote Sensing Centre, Ludhiana. It is witnessed that each landform region has influenced the evolution, size, shape, distribution, land types, field boundaries, sources of irrigation, ploughing implement, cropping patterns and the resultant field patterns of its selected village. Therefore, diverse field patterns have evolved in all the villages in response to their respective landforms. In all the cases, hypothesis proved to be valid for all the time periods.

3. Land Types

To test the size of fields with respect to land types, it was hypothesized that: In the irrigated land types the size of the fields is small and in the rain-fed land types the size of the fields is large.

Land types influence field patterns. In the earliest available land types and field patterns maps of the study villages land types and field patterns were found to be

intimately related to each other. The early phases were dominated more by poor quality rain-fed land types with large size fields scattered all over in the village territories. The fields were smaller in size in the irrigated land types situated more near the *abadi-deh* (settlement)

Table 6.3
Validation of Hypothesis on Land Types

Name of Village and Landform Region	1881-90	1911-20	1951-60/1986	2016
Dhanowali (Upland Plains)	Valid	Valid	Valid	Invalid
Bath (Upland Plains with Sand Dunes)	Valid	Valid	Valid	Invalid
Pathan Chak (Piedmont)	Valid	Valid	Valid	Valid
Khera Bagh (Flood Plains)	Valid	Valid	Valid	Valid
Rohg Teeka Khakhoh (Shiwalik Hills)	Valid	Valid	Valid	Valid

Source: Data analysis.

It is noted that, land types and field patterns have experienced a big change in the post-consolidation phases in the study villages due to increase in the area under irrigation and better management of fields with the adoption of Green Revolution technology. The analysis of land types of the sample villages belonging to different phases reveal that the *chahi* (tube-well irrigated) and *nahari* (canal irrigated) fields are smaller than the *barani* (rain-fed) and other poor land type fields. This relationship has faded away due to assured irrigation supply in all land types in village Dhanowali situated in upland plains and village Bath in upland plains with sand dunes. Presently, there exists no relationship between the distance from the *abadi-deh* (settlement) and productivity and fertility of land, due to use of irrigation and chemical fertilizers. Nearly all the cultivated fields have been brought under *chahi* and *nahari* land types with the help of tube-wells and canals in the village Dhanowali and village Bath respectively. The fields of different sizes and

shapes are found near the source of irrigation and in different parts of the village territory irrespective of their land types in these villages.

Land types have improved in village Pathan Chak, but still nearly one fourth of the fields belong to *barani* (rain-fed) land types. The irrigated land type fields are smaller in size than the *barani* (rain-fed) fields in all the phases from 1890 to 2016 in village Pathan Chak due to their more sub-divisions.

In village Khera Bagh only three per cent of the fields belong to *chahi* (tube-well irrigated) and remaining fields belong to *barani* and *banjar kadim* (fields left without cultivation for more than eight cropping seasons) land types in almost equal share. The agriculture is not dependent on irrigation because of good amount of rainfall well distributed throughout the year and availability of moisture to the soils due to nearness of river Satluj. There is a problem of water-logging due to which many of the *banjar kadim* fields along the boundary of the village with river Satluj are abandoned in village Khera Bagh. The fields are smaller in size in *chahi* (tube-well irrigated) good land types and larger in *barani* and *banjar kadim* poor land types in village Khera Bagh in all the phases from 1884 to 2016 period.

Village Rohg Teeka Khakhoh has experienced improvement in land types to considerable extent from 1884 to 2016, in spite of its physiographic limitations as the village is located in the Shiwalik hills. The hilly relief of the village does not favour digging tube-wells and laying canals in the village. Therefore, none of the fields was under irrigation from 1884 to 2016 period. The *barani* (rain-fed) agriculture is practiced here. Many of the previous *barani saum* and *barani daum* land types have been converted into *barani awal* land type by the efforts of the farmers. The good quality *barani awal* land type fields are smaller than the poor quality *barani saum*, *barani daum* and *banjar kadim* land type fields.

Land types have improved in all the villages though at different rates and have affected the field patterns accordingly in all the study villages. The size of the fields is comparatively smaller in irrigated land types than the *barani* land types.

4. Distance from the *Abadi-deh* (Settlement)

To assess the relationship of field patterns with the distance from the *Abadi-deh* (Settlement), it was hypothesized that: Large fields are situated far from the *abadi-deh* (settlement proper).

Table 6.4
Validation of Hypothesis on Distance from *Abadi-deh* (Settlement)

Name of Village and Landform Region	1881-90	1911-20	1951-60/1986	2016
Dhanowali (Upland Plains)	Valid	Valid	Valid	Valid
Bath (Upland Plains with Sand Dunes)	Valid	Valid	Valid	Valid
Pathan Chak (Piedmont Plains)	Valid	Valid	Valid	Valid
Khera Bagh (Flood Plains)	Valid	Valid	Valid	Valid
Rohg Teeka Khakhoh (Shiwalik Hills)	Valid	Valid	Valid	Valid

Source: Data analysis.

The fields situated near *abadi-deh* (settlement) in all the sample villages were found to be smaller than the fields situated away from the *abadi-deh* (settlement). The large fields are situated in the outfield (peripheral) areas of the village and farmers pay less attention to these fields. These fields are larger than the infields (near the settlement), because the heirs are not keen in dividing intensively the outfield, rather they prefer to have a full unit in a distant part, but they certainly want a share from every field near the settlement (infield) due to their more economic value and relative nearness. This hypothesis has been found valid in all the five villages in all the time periods as near the *abadi-deh* (settlement) more sub divisions of land holdings and fields took place.

5. Road Facing Land

To test the size and shape of fields with respect to road connectivity, it was hypothesised that: The fields facing roads are small in size and elongated in shape.

Table 6.5

Validation of Hypothesis on Road Facing Land

Name of Village and Landform Region	1881-90	1911-20	1951-60/1986	2016
Dhanowali (Upland Plains)	Valid	Valid	Valid	Valid
Bath (Upland Plains with Sand Dunes)	Valid	Valid	Valid	Valid
Pathan Chak (Piedmont Plains)	Valid	Valid	Valid	Valid
Khera Bagh (Flood Plains)	Valid	Valid	Valid	Valid
Rohg Teeka Khakhoh (Shiwalik Hills)	Valid	Valid	Valid	Valid

Source: Data analysis.

The main road facing fields have small size and elongated shapes in different parts of the village territory in all the villages. These fields have greater commercial value and therefore every land owner wants to have an access to the road. Greater number of sub-divisions of these fields has given them elongated strip shapes. Such fields are encroached more by *gairmumkin* (uncultivable) land uses especially construction of houses. Thus, this hypothesis also found validated in all the villages in all the periods.

6. Consolidation of Land Holdings

To assess the impact of consolidation of land holdings on field patterns, it was also hypothesized that: In the villages where consolidation of holdings has taken place the fields are large in size and regular in shape, whereas in unconsolidated villages the fields are small, inconveniently large and irregular in shape.

Table 6.6**Validation of Hypothesis on Consolidation of Land Holdings**

Name of Village and Landform Region	Pre-Consolidation Phase 1911-20	Post-Consolidation Phase 1951-60/1986
Dhanowali (Upland Plains)	Valid	Valid
Bath (Upland Plains with Sand Dunes)	Valid	Valid
Pathan Chak (Piedmont Plains)	Valid	Valid
Khera Bagh (Flood Plains)	Valid	Valid
Rohg Teeka Khakhoh (Shivalik Hills)	Valid	Valid

Source: Data analysis.

The consolidation of land holdings in the study villages, namely Dhanowali situated in the flat upland plains, Bath situated in the upland plains with sand dunes and Pathan Chak situated in the piedmont plains, has disrupted the historical evolution of field patterns. It has greatly influenced the size and shape of the fields. The scattering of sites of fields has been minimized by consolidating the irregular, small and inconveniently very large fields into compact blocks of rectangular fields of uniform size of one *killa* (8 *kanals* or 198 feet by 220 feet) each. On the whole, due to the process of consolidation, fields have become regular, rectangular, compact and more accessible. This has helped the farmers to manage their fields more efficiently and has provided the foundation for the adoption of Green Revolution technology in Punjab.

The study reveals that in the pre-consolidation phase, the fields of farmers were fragmented, irregular, small and inconveniently large scattered in different parts of the study villages leading to their inefficient management, low production, disputes and clashes over field boundaries, poverty and many other problems. The procedure of consolidation was successfully adopted in the study villages in the decade 1950-60 like many other villages of Punjab plains by which the scattering of fields has been

minimized by consolidating the fields into compact blocks of rectangular fields of uniform size of one *kill*a (one acre) each. Scattering in terms of distance from the *abadi-deh* (settlement) of the village has also reduced.

Construction of *phirni* (circular road around the *abadi-deh*, settlement) at the time of implementation of consolidation has given a regular geometrical shape to the *abadi-deh* (settlement). The adoption of consolidation has helped in the introduction of canal irrigation facilities in village Bath and further enhanced the irrigation facilities in village Pathan Chak. The field boundaries became straight after the adoption of process of consolidation which facilitated the laying of *khals* (irrigation water channels) along the fields. The area under cultivated land in the study villages Dhanowali, Bath and Pathan Chak was reduced due to the implementation of process of consolidation because the cultivated land was encroached upon by the construction of new roads, houses, *khals* (irrigation channels) and other *gairmumkin* (uncultivable) land uses. The cultivated land is continuously shrinking due to encroachment by the fast expanding settlements in recent years. Many new houses have been constructed outside the *phirni* (circular road around the *abadi-deh*, settlement) and along the roads in all the villages and there is a continuous threat of encroachment in future also.

Due to continuous sub-divisions of existing fields and land holdings resulting from the laws of inheritance and equitable distribution of benefits and handicaps the benefits of consolidation process have been minimized. The per-capita number of fields and size of land holdings are declining fast due to continuous increase in the number of owners. Problems related to fragmentation of landholdings which were eliminated by the adoption of consolidation in 1950s have again cropped up due to the breakup of earlier joint families and continuous increase in the number of owners due to increase in the family size. The hypothesis found validated for all the villages in pre and post consolidation phases

7. Cropping Pattern

To assess the field patterns with respect to their cropping patterns, it has been hypothesized that: In commercial grain farming areas, the fields are large and regular, whereas in vegetable and subsistence farming areas fields are intermediate in size and irregular in shape.

Table 6.7**Validation of Hypothesis on Cropping Patterns**

Name of Village and Landform Region	1881-90	1911-20	1951-60/1986	2016
Dhanowali (Upland Plains)	Data Not Available	Data Not Available	Data Not Available	Valid
Bath (Upland Plains with Sand Dunes)	Data Not Available	Data Not Available	Data Not Available	Valid
Pathan Chak (Piedmont Plains)	Data Not Available	Data Not Available	Data Not Available	Valid
Khera Bagh (Flood Plains)	Data Not Available	Data Not Available	Data Not Available	Valid
Rohg Teeka Khakhoh (Shiwalik Hills)	Data Not Available	Data Not Available	Data Not Available	Valid

Source: Data analysis.

Only current data is available on field-wise crops grown as there is a practice of keeping record of crops grown recorded in *Khasra Gardavari* for five years from the current year. Therefore, study on relationship of crops grown pertains to current data only for year 2016.

Intensive commercial grain farming is practiced in village Dhanowali, Bath and Pathan Chak, therefore fields in these villages are medium to large in size and regular in shape. Subsistence type farming is done in village Khera Bagh and Rohg Teeka Khakhoh in medium to small size and irregular shape fields. Vegetable fields are relatively smaller in size. A few small *kyaris* (cultivation units) are created near the tube-well for growing vegetables. The field pattern is not affected much by the types of crops grown. Wheat is the chief crop of Punjab grown in all the villages irrespective of size and shape of the fields in all landform regions. Distance from the *abadi-deh* (settlement) in the form of infields and outfields have a little influence on the types of crops grown and the resultant field patterns. Fodder crop is grown more in the infields near the *abadi-deh* (settlement). Wheat and paddy crops are grown both in infield and outfield area in all the villages. *Ekfasli* (one crop in a year) fields exists nowhere in any

village. Farmers grow at least two or more crops in a year both in infield and outfield areas.

Rohg Teeka Khakhoh village situated in the Shiwalik hills and Khera Bagh situated in the flood plains have traditional cropping patterns dominated by cultivation of wheat, maize and maah daal (black pulse) suitable to local geographical conditions. Maah daal (black pulse) is grown more in large size fields in *barani* (rain-fed) land type fields. Orchards and other tree plantations are also found in Rohg Teeka Khakhoh and other hilly villages on large size sloping fields. Village Dhanowali situated in the upland plains, Bath situated in the upland plains with sand dunes and Pathan Chak situated in piedmont plains have either *dofasli* (two crops; *rabi/harri* and *kharif/saoni*) or *teenfasli* (three crops: *rabi/ harri*, *kharif/ Saoni* and *zaid*) fields distributed uniformly in the entire village territory both in infield and outfield areas due to the adoption of Green Revolution technology. Early maturing high yielding variety seeds are used in the fields. After the harvesting of one crop, new crop is immediately grown without wasting time. Mechanized farming along with intensive irrigation and use of fertilizers, insecticides and pesticides help the crops to grow early. The *teenfasli* fields are relatively larger than the *dofasli* fields.

Cropping pattern has shifted from low value traditional crops to economically more remunerative crops in village Dhanowali, Bath and Pathan Chak irrespective of their size and shape. The implementation of consolidation of land holdings, provision of tube-well and canal irrigation and the subsequent adoption of Green Revolution technology in these villages transformed the agricultural landscape and the resultant cropping patterns of the village.

The fields are covered by wheat, potato, fodder (barseem and jawien), maize, sarson and vegetables in the *rabi/harri* season and paddy, fodder (*bajra* and *chari*), maize, sugarcane, cotton, *guar*, *haldi*, *maah daal*, *til* and vegetables in the *kharif/saoni* season in different landform regions according to the suitable geographical conditions. Vegetables and summer season fruits are grown in the *zaid* season. Potato is the chief vegetable crop grown at commercial level in village Dhanowali in upland plains and many other villages situated in other parts of the state. *Narma* (American high quality cotton) is grown in village Bath and many other villages situated in the

upland plains with sand dunes due to favourable climate. *Maah daal* (black pulse) and til (oilseed) are grown in Rohg Teeka Khakhoh and other villages situated in the Shiwalik hills due to absence of sources of irrigation in hilly topography. Relationship between crops grown and the field patterns is governed by many factors in recent times. Farmers decide to allocate fields under different crops not in terms of their size or shape but in terms of price of crops, yield, maturing time and market demands. Wheat and paddy are grown intensively because government provides MSP (Minimum Support Price) and guaranteed procurement on lucrative prices. The mono cropping patterns of paddy has resulted in the use of water beyond its sustainability in many parts of Punjab.

8. Land-owning Castes

For testing the association between the size of land holdings with respect to land owning castes, it was hypothesized that: High caste groups have large land holdings, whereas low castes possess small land holdings.

This research does not find complex caste systems and related field patterns in the study villages. *Jat* is the dominant land-owning caste in the Punjab plains. *Jat Randhawa* in upland plain village, *Jat Bath* in upland plain with sand dune village, *Saini* in *choe* infested foothill plains village and *Thakur* in the hilly village are the dominant land-owning castes. They have big land-holdings with large and rectangular fields. All the study villages except Khera Bagh began as uni-caste and uni-clan settlements and slowly turned into multi-caste and multi-clan inhabited villages.

The village Khera Bagh was a multi-caste village right from the beginning, where people from different castes own cultivated land. People from low castes own more land and fields because the village was not attracted by *Jats*, the dominating high caste involved in agriculture in Punjab, due to its poor land types and remote location. The fields and holdings of the rich families are larger than the poor families irrespective of their caste. No difference is found in terms of shape of fields, source of irrigation, crops grown and field boundaries of different castes. Except village Khera Bagh, hypothesis is found validated in all other villages in all time periods.

Table 6.8**Validation of Hypothesis on Land-owning Castes**

Name of Village and Landform Region	1881-90	1911-20	1951-60/1986	2016
Dhanowali (Upland Plains)	Valid	Valid	Valid	Valid
Bath (Upland Plains with Sand Dunes)	Valid	Valid	Valid	Valid
Pathan Chak (Piedmont Plains)	Valid	Valid	Valid	Valid
Khera Bagh (Flood Plains)	Invalid	Invalid	Invalid	Invalid
Rohg Teeka Khakhoh (Shivalik Hills)	Valid	Valid	Valid	Valid

Source: Data analysis.

9. Source of Irrigation

To assess the field patterns with respect to source of irrigation, it has been hypothesized that: Field patterns are different in areas having different modes of irrigation.

Every land owner wants to have an access to the source of irrigation. Shape of majority the fields in the earlier field maps are elongated rectangles and accentuated strips to have access to water from *choes*, *khals* and *kuhals* in village Pathan Chak situated in piedmont plains. The shape and size of fields corresponded with the shape and size of the sand dunes in Village Bath situated in the upland plains with sand dunes in the absence of any source of irrigation up to the pre-consolidation phase. But shape and size of the fields transformed completely after the adoption of process of consolidation and the subsequent laying of khals (irrigation channels) along the straight boundaries of the fields. The fields are elongated rectangles and strips in shape to have access to water from the *khals* in village Bath.

Table 6.9**Validation of Hypothesis on Sources of Irrigation**

Name of Village and Landform Region	1881-90	1911-20	1951-60/1986	2016
Dhanowali (Upland Plains)	Invalid	Invalid	Invalid	Invalid
Bath (Upland Plains with Sand Dunes)	No Irrigation	No Irrigation	Valid	Valid
Pathan Chak (Piedmont Plains)	Valid	Valid	Valid	Valid
Khera Bagh (Flood Plains)	Invalid	Invalid	Invalid	Invalid
Rohg Teeka Khakhoh (Shiwalik Hills)	No Irrigation	No Irrigation	No Irrigation	No Irrigation

Source: Data analysis.

Village Rohg Teeka Khakhoh situated in hilly topography do not have any source of irrigation and water of the *nala* (stream) flowing in the village could not be used for irrigation due to unfavorable topography. Village Khera Bagh also has only negligible area under tube-well irrigation due to physiographic limitations. Tube-wells are not used much for irrigation because the village gets good amount of rainfall. Soils have good amount of moisture due to situation of the village in flood plains near river Satluj.

Underground water continued to be the major source of irrigation in the study village Dhanowali like many villages situated in the upland plains in central Punjab. Most of the *Persian Wheel* run wells common in the past were converted into electric or engine tube-wells after the construction of Bhakra Dam and the adoption of Green Revolution technology in late 1960s in the upland plains of Punjab. Tube-wells are located mostly either in the centre of the holding or near the roads. It may located anywhere within a field. All the fields of a holding do not necessarily touch one or more sides of tube-well for irrigation. Water is easily brought to all the fields through *arrs* (water drains) due to uniform gentle slopes from the tube-well. The big size fields are divided into small *kyaris* to water the crops

with ease. Field patterns and tube-well as source of irrigation do not depict any relationship except the fact that the field in which tube-well is dug tend to be hexagonal in shape. Fields of all shapes and sizes are found near the tube-well. Introduction of paddy cultivation has led to drastic fall in underground water levels in many parts of Punjab plains due to which many tube-wells have been replaced by the submersible pumps in recent past. The small size fields are found more near these sources of irrigation because of their more sub-divisions as every person wants to have access to water to irrigate his fields. There is a complete transformation of land types and field patterns due to the introduction of tube-well and canal irrigation in the Punjab plains. This type of irrigational revolution in Punjab has provided numerous economic gains to the state and the country in the form of increase in agricultural production and much needed food security. This hypothesis is found validated in village Pathan Chak only and invalid in case of Dhanowali and Khera Bagh. It could not be assessed in village Rohg Teeka Khakhoh as it has no source of irrigation available and in case of village Bath no source of irrigation was available prior to 1960's period.

10. Ploughing Implements Used

To assess the field patterns viz a viz ploughing implement used, it was hypothesized that: Tractor ploughed fields are accentuated rectangular in shape and large in size whereas bullock plough fields are small in size.

The input of technology used in fields has increased many folds after the introduction of Green Revolution Technology in Punjab. Discussions with the farmers of study villages revealed that bullocks were commonly used to plough the fields prior to the adoption of Green Revolution Technology irrespective of the shape and size of the fields in the absence of tractors. Today, bullock ploughed fields have been completely replaced by the tractor ploughed fields in the study villages. During a short phase of shifting of technology from bullocks to tractors in the initial years of adoption of Green Revolution technology, small sized fields and holdings owned by poor farmers were ploughed by the bullocks.

Table 6.10
Validation of Hypothesis on Ploughing Implements Used

Name of Village and Landform Region	1881-90	1911-20	1951-60/1986	2016
Dhanowali (Upland Plains)	Invalid	Invalid	Invalid	Invalid
Bath (Upland Plains with Sand Dunes)	Invalid	Invalid	Invalid	Invalid
Pathan Chak (Piedmont Plains)	Invalid	Invalid	Invalid	Invalid
Khera Bagh (Flood Plains)	Invalid	Invalid	Invalid	Invalid
Rohg Teeka Khakhoh (Shiwalik Hills)	Invalid	Invalid	Invalid	Invalid

Source: Data analysis.

Today all the fields irrespective of their shape and size are ploughed by the tractors. A farmer who does not own tractor, plough his fields by a rented tractor. Small sized tractors are used in the hilly villages in comparison to the large size tractors used in the villages situated in plain areas of Punjab. Ploughing implement has not affected the field patterns in Punjab. Thus, this hypothesis have found invalid in all the cases.

11. Size of the Fields

Fields vary considerably in size within a single village and in different landform regions. The size of the fields change with the change in the distance from the *abadi-deh* (settlement), slope of the land, effect of consolidation, effect of operation of Hindu law of inheritance, principle of equitable distribution of benefits and handicaps, principle of compensation on the sub-divisions of holdings and fields. Majority of the fields in village Dhanowali located in upland plains belonging to medium size (1 to 4 *kanals*) in the pre-consolidation phases were converted into large size fields in the post consolidation phase by the implementation of process of consolidation. Due to continuous sub-divisions the large size fields have become medium in size in recent phase in Dhanowali village.

Table 6.11
Dominant Size Category of Fields

Name of Village and Landform Region	1881-90	1911-20	1951-60/1986	2016
Dhanowali (Upland Plains)	Medium	Medium	Large	Medium
Bath (Upland Plains with Sand Dunes)	Very Large	Very Large	Large	Large
Pathan Chak (Piedmont Plains)	Large	Large	Large	Large
Khera Bagh (Flood Plains)	Medium	Medium	Medium	Medium
Rohg Teeka Khakhoh (Shivalik Hills)	Medium	Medium	Medium	Medium and Small

Source: Data analysis.

The size of majority of the fields in village Bath situated in the upland plains with sand dunes were very large (above 8 kanals) because of sand dune topography and less number of owners. Fields were converted into large size of 8 *kanals* each for their better management. Existing field size of majority of the fields in village Bath belongs to large size due to less pressure of owners.

The majority of the fields in village Pathan Chak continue to fall in the category of large size due to less increase in the number of owners. Similarly, size of majority of the fields in village Khera Bagh situated in the flood plains continues to fall in the category of medium size (1 to 4 kanals) fields owing to non-implementation of consolidation and less pressure of owners. The size of the majority of fields in village Rohg Teeka Khakhoh in Shivalik hills is turning from medium size (1 to 4 kanals) to small size (below 1 *kanal*) due to improvement in their land types for their better management. The number of fields is continuously increasing from the year 1884 to 2016 in all the study villages due to sub-division of fields because of increase in the number of owners by the expansion in the size of families from generation to generation. This has affected the size of the fields.

The *gairmumkin* (uncultivable) land uses like expanding settlements have continuously encroaching the cultivated fields has also resulted in reduction of the size of fields.

Small fields are found more near the *abadi-deh* and village roads due to their more economic value and future scope for construction of houses resulting in to their numerous sub-divisions. Medium (1 *kanals* to 4 *kanals*) and large (4 *kanals* to 8 *kanals*) size fields are found more in majority of the study villages like Dhanowali, Bath and Pathan Chak in good land types, whereas large (4 *kanals* to 8 *kanals*) to very large (above 8 *kanals*) fields are found more in village Khera Bagh in flood plains and Rohg Teeka Khakhoh in Shiwalik hills, mostly in poor land types situated away from the *abadi-deh* (settlement) in the village territory. The size of the fields is declining continuously in all the study villages due to increase in the number of owners from generation to generation. The fields may become further smaller due to breaking of joint ownerships in future.

12. Shape of the Fields

The most characteristic feature of the shape of the fields in the village Khera Bagh and Rohg Teeka Khakhoh are their evolved uniformity from the past to present. The process of consolidation was not implemented in these villages like many other villages due to physiographic limitations. The naturally evolved centuries old field landscape in these villages is intact even today with minor changes in the shape of the fields due to their sub-divisions. The shape of majority of the fields in these villages is irregular four sided quadrilaterals and six sided hexagons due to uneven slopes.

The most characteristic feature of existing field landscape in Punjab plains is its total regularity and uniformity in the shape of field. Most of the fields have attained four sided geometrical regular rectangular shapes in the upland plains, upland plains with sand dunes and piedmont plains, where process of consolidation of land-holdings was adopted. In village Khera Bagh situated in the flood plains and village Rohg Teeka Khakhoh situated in the Shiwalik hills, most of the fields have four sided irregular quadrilateral shape of fields due to presence of uneven topography.

Table 6.12
Dominant Shape of Fields

Name of Village and Landform Region	1881-90	1911-20	1951-60/1986	2016
Dhanowali (Upland Plains)	Quadrilateral	Quadrilateral	Rectangular	Rectangular
Bath (Upland Plains with Sand Dunes)	Quadrilateral	Quadrilateral	Rectangular	Rectangular
Pathan Chak (Piedmont Plains)	Quadrilateral	Quadrilateral	Rectangular	Rectangular
Khera Bagh (Flood Plains)	Quadrilateral	Quadrilateral	Quadrilateral	Quadrilateral
Rohg Teeka Khakhoh (Shiwalik Hills)	Quadrilateral	Quadrilateral	Quadrilateral	Quadrilateral

Source: Data analysis.

13. Field Boundaries

The *wats* (low mud dikes), *arrs* (water drains), *warr of kande* (fence of thorny bushes), trees and wires and brick walls serve as field boundaries in different parts of all the villages of Punjab. The *wats* (low mud dikes) act as embankments to retain water within the fields. The low mud dikes are similar in appearance everywhere and give an open aspect to the landscape (Mukerji, 1926).

The mud dikes are generally one foot high and run enormous in length. The mud dikes run straight because of rectangular field patterns resulted from consolidation of land holdings. Irregular fields resulted from uneven slopes, presence of *choes*, outcrop of a rock and wastelands have irregular mud dikes as field boundaries. Mud dikes are generally made up of easily available wet soils and mud taken out from the fields. At some places these mud dikes are also reinforced with bricks and stones. The field boundaries also serve as paths for the movement of human beings, cattle and to take farm vehicles and other machinery to the fields.

Table 6.13
Dominant Field Boundary Category

Name of Village and Landform Region	1881-90	1911-20	1951-60/1986	2016
Dhanowali (Upland Plains)	Four Sided	Four Sided	Four Sided	Four Sided
Bath (Upland Plains with Sand Dunes)	Four Sided	Four Sided	Four Sided	Four Sided
Pathan Chak (Piedmont Plains)	Four Sided	Four Sided	Four Sided	Four Sided
Khera Bagh (Flood Plains)	Four Sided	Four Sided	Four Sided	Four Sided
Rohg Teeka Khakhoh (Shivalik Hills)	Four Sided	Four Sided	Four Sided	Four Sided

Source: Data analysis.

Field boundaries made up of *warr of kande* (fence of thorny bushes) are found more in hilly areas to protect the maize, wheat and sugarcane crops standing in the fields from the stray and wild animals near the settlement. In the past the practice of raising *warr* along fields was very common. It is commonly said '*Jithe Gujar uthe kande, jithe Jat uthe danday*'. It means that wherever *Gujars* (a transhumance practicing ethnic group in the piedmont plains of Punjab) live, the use of *kande* (thorny bushes) for making *war* is most common and wherever *Jats* (a peasant community practicing settled agriculture in North-West India) live, they guard the fields by the force of *danda* (wooden sticks). The fields near the *abadi-deh* (settlement), roads and railway lines are protected more by such field boundaries.

Field boundaries play an important role in improving the ecological and aesthetic qualities of the fields. In addition to protection of fields, these boundaries help in controlling soil erosion and flood control and regulate traffic systems and landuse of the area.

(B) SUGGESTIONS FOR POLICY IMPLICATIONS

On the basis of major findings and conclusions following suggestions are forwarded to save existing fields and to improve their efficiency.

1. Suggestions to Save Fields from Encroachment

The encroachment of fields by the expanding settlements is the major problem of majority of the villages. Village Rohg Teeka Khakhoh and village Khera Bagh are situated at a greater distance from the urban centres and therefore, the fields of these villages are under less threat of encroachment by the people from urban areas. This problem is more severe in the villages which are situated near the periphery of the urban centre like study village Dhanowali situated at the periphery of Jalandhar city and study village Bath situated near Bathinda city. Due to more pressure of population in the core of an urban centre people prefer to have a house in the villages situated near the periphery of an urban centre, due to less cost of living and better living environment. The number of fields and area under cultivation are declining fast more in the study villages which are situated near the big cities due to encroachments by fast expanding settlements, owing to internal as well as external pressure of population. This will eliminate the centuries old rural cultural landscape of agricultural fields with precious fertile irrigated land types of such villages in future. Following measures are suggested to save agricultural fields from future encroachments:

- i. The fertile cultivated fields should not be permitted to be used for *gairmumkin* (uncultivable) land uses such as houses, farm houses, palaces, workshops, factories and shops. Vacant *panchayat* lands, wastelands and other poor land types may be used for such activities.
- ii. Dense and high rise buildings should be allowed in the villages to reduce pressure on agricultural land.
- iii. The future requirement of housing provisions should be dominated by small housing units to save precious agricultural land.
- iv. Minimum land should be allowed to be used as a farm house and no other activity should be permitted in fields except agriculture.
- v. Agricultural land situated outside *phirni* (a circular road around *abadi-deh*, settlement) should be declared as no-construction zone. Agriculture related land uses should only be allowed in the village territory.

- vi. Separate zonal plans for villages should be made to save agricultural lands.
- vii. Efficient use of vacant government lands within the municipal limits of cities will lower down the pressure on agricultural land of villages situated on their peripheries.
- viii. A re-development strategy to accommodate more population within the city limits should be framed.
- ix. The master plans of the city areas must give due recognition to rural areas to save agricultural fields.

2. Suggestions to Control Fragmentation of Land Holdings

Problems related to fragmentation of land holdings, which were eliminated by the adoption of consolidation have again cropped up due to increase in the number of owners leading to sub-divisions of land holdings and fields. Due to continuous sub-divisions of existing fields and land holdings resulting from the laws of inheritance and equitable distribution of benefits and handicaps, the benefits of consolidation process have been minimized. The per-capita number of fields and size of land-holdings is declining fast due to continuous increase in the number of owners. Following measures may control the problems related to fragmentation of land holdings and fields:

- i. There is a need for reconsolidation of land-holdings to provide a solid foundation for sustainable agriculture.
- ii. In the unconsolidated villages, the pockets of plain areas within the villages where consolidation process was not implemented should be brought under the process of consolidation and scattered fields of farmers should also be grouped into less number of sites.
- iii. Small family size should be promoted by controlling fast growing population.
- iv. Availability of more jobs outside agriculture can also lower the pressure on agricultural fields.
- v. Co-operative farming should be introduced by clubbing the uneconomic small land holdings and fields.
- vi. To avoid the ill-effects of law of inheritance in which the land holding is equally divided among all the members of a family, the exchange of holding is proposed. Exchange of holding here means that the entire holding may be exchanged and rotated within the members of the family on year to year basis

to give large number of fields to an individual farmer for profitable commercial farming.

3. Suggestions on Irrigation in the Fields

Irrigation has brought farmers the most important input for increasing agricultural production. There is a need to provide sustainable irrigation facilities in the study villages without adverse effects of over-irrigation. The excessive tube-well irrigation in the upland plains villages like the study village Dhanowali has led to the fall in underground water at an alarming rate after the adoption of Green Revolution Technology and the introduction of paddy cultivation. Excessive canal irrigation in the absence of proper drainage system can prove to be a serious environmental threat. Canal irrigation has transformed the land types and field patterns and brought prosperity in the study village Bath situated in upland plains with sand dunes. But canal irrigation has not been proved as a blessing to all the villages in Punjab. It also has the potential to turn green fields into *seim* (water-logged) fields. The canal irrigated areas are often flat and poorly drained. The continuous supply of canal water to such poorly drained fields may result in water-logging over a period of time. Poor water management in some villages of south-west Punjab has led to land degradation in irrigated areas through water-logging and salinity. Due to the unplanned canal irrigation, inadequate drainage system and over-irrigation and seepage, the problem of water-logging has become an important issue in the different parts of Punjab (Singh, 2013). The level of ground water rises due to water-logging. This water reaches to the crop root and damages it. Crop productivity is affected making the land totally unproductive and the cultivated land turns into a 'wet desert'. Water-logging not only adversely affect the crops, soil productivity and fertility, but it also affects roads, buildings and other structures. Following measures are suggested with regard to use of irrigation in the fields:

- i. All precautionary measures should be taken to keep the agricultural landscape of the village free from adverse effects of over-irrigation.
- ii. Planned canal irrigation system through proper water management and cropping patterns must be adopted.
- iii. Paddy cultivation introduced in the study villages like many other villages of Punjab, should be minimized, if can not be stopped.

- iv. Seepage from the canals should not be allowed. Cemented water channels will not allow the water to seep and will protect the fields from water-logging.
- v. Water supply to the fields through pipelines instead of open drains will not only save water from wastage in the passage, but it will also avoid water-logging.
- vi. The mixed use of canal and ground water can be adopted on the well drained soils of the village for salt tolerant crops.
- vii. The crops consuming less quantity of water should be grown in place of paddy cultivation.
- viii. Sprinkle and drip irrigation techniques not only save water but also save the fields from water-logging. The government should promote and subsidize these techniques
- ix. Laser levelling of fields can also save water by avoiding flooding in the fields.
- x. There is a need to introduce irrigation facilities in the village Rohg Teeka Khakhoh and other such villages situated in the Shiwalik hills and villages like Pathan Chak situated in piedmont plains through lift irrigation, sprinkle irrigation and by other suitable methods.
- xi. Similarly, irrigation facilities should also be extended in the villages like Khera Bagh, situated in the flood plains surrounded by the hills by storing the rain water and providing to dry areas through lift irrigation and sprinkle irrigation techniques, wherever suitable.
- xii. The rational use of irrigation facilities for cultivation of crops in the fields should be promoted for sustainable water resource management.

4. Suggestions on Improvement of Land Types of the Fields

Land types have improved to the maximum extent due to the introduction of irrigation facilities and use of chemical fertilizer after the adoption of Green Revolution Technology in village Dhanowali situated in upland plains and village Bath situated in the upland plains with sand dunes. Land types in other study villages need improvements. Following measures are suggested to improve land types of the fields in the study villages and elsewhere:

- i. *Barani* (rain-fed) land type fields which account for nearly one fifth in the total number of fields and one fourth in total cultivated area in village Pathan Chak can be converted into *chahi* land type by extending irrigation facilities to

these fields from the *choes*, *khals* and *kuhals*. Lift irrigation and sprinkle irrigation techniques are suggested for use in piedmont areas.

- ii. *Barani* (rain-fed) land type fields covering 61 per cent in total number of fields in village Khera Bagh situated in flood plains surrounded by the Shiwalik hills can be improved through rain water harvesting because of favourable *Doon* (valley) type terrain of the village and such other areas.
- iii. Nearly 35 per cent of the fields and half of the area of the village Khera Bagh has *banjar kadim* (fields left without growing crops for more than eight cropping seasons) land types due to threat of alluviation by presence of river Satluj in its eastern and south-eastern boundary. These fields can be improved by constructing an embankment along river Satluj to save the fields from water-logging and seasonal flooding.
- iv. More than half of the area of the village Rohg Teeka Khakhoh is occupied by *pahar* (hills). The convenient slopes here may be converted into terraced fields. The inconvenient slopes may be brought under farm forestry, herbal forestry and orchards to further improve and strengthen the ecology of the village. Such measures may also be adopted in other Shiwalik hills villages.
- v. Excessive use of irrigation facilities and chemicals in the fields in the upland plains, upland plains with sand dunes and piedmont plains should be controlled and minimized to avoid turning of good land type fields into poisonous soils and poor land type fields.

5. Suggestions on Crops Grown in the Fields

There is a lot of pressure on the soils and water after the introduction of intensive commercial agriculture due to the adoption of Green Revolution Technology in Punjab plains. Most of the fields which were once *ekfasli* (one crop in a year) and *dofasli* (two crops in a year) are now used as *teenfasli* (three crops in a year). After harvesting of one crop, new crop is immediately sown without wasting time. The cropping pattern has shifted from traditional low value subsistence types to economically more remunerative non-traditional commercial crops. The double mono cropping patterns of winter wheat and summer rice introduced in recent decades has resulted in the use of water beyond its sustainability. Paddy has replaced the traditional low water requiring crops like maize, cotton, pulses and grams. Underground water has gone down in most parts of Punjab to critical levels due to

excessive pumping of water after the introduction of paddy cultivation. Excessive use of canal irrigation in the absence of effective drainage system is proving to be a serious environmental problem in the form of water-logging. Following measures are suggested to improve cropping patterns:

- i. The double mono cropping patterns of wheat and rice need to be rectified as early as possible. Paddy cultivation introduced in the study villages should either be stopped or minimized to save Punjab from turning into an ecological desert.
- ii. The crops consuming less quantity of water should be promoted. Due weightage should be given to local vegetables, fruits, herbs, oilseeds, grams, pulses and spices crops suitable to small size fields and land holdings.
- iii. Fields should be left without crops for some time after every crop harvest to maintain natural fertility and productivity of the soils and to lessen over-dependence on chemical fertilizers.
- iv. Eco-friendly remunerative mixed cropping patterns based on local agro-climatic conditions suitable for small sized land holdings and fields should be adopted for sustainable agriculture.

We must save our agriculture fields to meet our basic needs of food and food security. Field patterns also form historic, scenic and ecologically useful landscapes. The original age-old field patterns are found even today in the most beautiful and scenic Shiwalik hills and other parts of north-east Punjab. The most regular field patterns are found in the Punjab plains which act as food basket of the country, with highly commercialized intensive agriculture.

These fields have the potential to generate more income to the farmers, beside their productive agricultural values. Their use in addition to agricultural production should also be oriented towards agricultural tourism, ecological and cultural heritage tourism, rural tourism and all other forms of personal and family recreation due to their diverse aesthetic features.

Thus, it has become evident from the geographical analysis of field patterns in Punjab that field pattern is not a static phenomenon. Diverse field patterns are created in response to different landform regions, through an inter-play of nature, man and culture. The existing field patterns have undergone various evolutionary stages and provide a link and a key in the understanding of the phases of settling in an area.

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The research papers, books, monographs, occasional papers, review papers and other such documents are arranged alphabetically by the surname of the author/s. In addition to the references incorporated in the present thesis, other relevant readings related to the theme are also listed. The Chicago Manual of Style as adopted by the Association of American Geographers has been adopted for referencing.

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APPENDICES

GLOSSARY OF VERNACULAR TERMS USED

Abadi: Population.

Abadi-deh: Settlement.

Acre: A unit of land measurement comprising an area of 198'x220', equivalent to a *killa* or 8 *kanals*.

Arr: A narrow water channel for taking water to the field.

Bains: A *gotra* (clan) of the *Jat* caste.

Bajra: A fodder crop.

Balotrey: A *gotra* (clan) of *Rajput* caste.

Bandh: An embankment.

Banjar Kadim: Land which has not been cultivated for more than eight cropping seasons.

Banjar Jadid: The land which has been left without cultivation for three cropping seasons.

Barani Awal: Superior, first ranking *barani* land adjacent to the *abadi-deh* (settlement).

Barani Daum: Inferior, second ranking *barani* land away from the *abadi-deh* (settlement).

Barani Saum: The most inferior, third ranking *barani* land near the village territory.

Barani: Non-irrigated rain-fed land.

Bari Doab: Land situated between the rivers Beas and Ravi.

Barseem: A fodder crop grown in *Rabi/Harri* season.

Basta: A bundle containing revenue record books and maps of a particular village available in the District Revenue Office.

Batai: Division of produce between cultivator and the state in Sikh Rule.

Bath: A *gotra* (clan) of *Jat* caste.

Be-abad: Uninhabited settlement.

Beas: A perennial river dividing *Majha* and *Doaba* regions in Punjab.

Bechirag: Abandoned village.

Bet: Flood plain. Also known as *mand*, *talla*, *bela* or *doon*.

Bhabhar: A variety of grass grown widely along the *choes* and wetlands.

Bhaichara: A joint village system in terms of castes and their clans.

Bhangar: Old alluvium.

Bhanguri: A *gotra* (clan) of *Saini* caste.

Bhullar: A *gotra* (clan) of *Jat* caste.

Bir: A natural ecosystem dominated by trees.

Bist Doab: Land situated between the rivers Beas and Sutlej in Punjab.

Bhardwaj: A *gotra* (clan) of *Brahaman* caste.

Brahaman: A caste.

Chah: A well or tube-well.

Chahi: Land irrigated by *chah* (well or tube-well).

Chakla: An administrative unit.

Chammar: A caste.

Chardi Tarf: The Sunrise side.

Charri: A fodder crop.

Chhole: Grams crop.

Choe: A small seasonal stream.

Deh: A hamlet.

Dhaiya: Steep cliff.

Dheriwand: Division of large chunks of land into smaller sections.

Doab: Land situated between two rivers.

Doaba: A cultural region situated between the river Beas and Satluj in Punjab. Also known as *Bist Doab*.

Dofasali: Two crops grown in a year.

Dun: A valley. Also known as *Doon*.

Ekfasali: One crop grown in a year.

Gairmumkin: uncultivable land.

Ghaggar: A seasonal river in south-east Punjab.

Ghuman: A *gotra* (clan) of *Jat* caste.

Gill: A *gotra* (clan) of *Jat* caste.

Gotra: A clan of a caste.

Guar: Beans crop.

Gujars: A caste.

Hadbast: Boundary.

Jagirs: An assessment of land revenue in lieu of salary.

Jamabandi: A book of land property records. Also known as *Misalhakiat* or *Lal Kitab*.

Jat: A yeoman, peasant community of north-west India.

Jawien: A fodder crop.

Jhona: A fodder crop.

Jhona: Paddy (rice) crop. Also known as *Munji* or *Dhan*.

Johal: A *gotra* (clan) of *Jat* caste.

Kahlon: A *gotra* (clan) of *Jat* caste.

Kaler: A *gotra* (clan) of *Jat* caste.

Kanal: A unit of land measurement, comprising an area of 600 yards.

Kande: Thorn.

Kandi: Foot- hill land. Also known as *Ghar* or *Changar*.

Kanungo: Tehsil level government official in Revenue Department.

Khad: A stream or a valley.

Khadar: New alluvium, flood plain soil.

Khakhoh: A *gotra* (clan) of *Thakur* caste.

Khakhoh: A *gotra* (clan) of *Thakur* caste.

Khal: A seasonal stream.

Kharif: Summer season crops, also known as *Saoni*.

Kharkana: Wild bushes.

Khasra Gardavari: Crop harvest inspection book.

Khasra Number: Identification Number.

Khatawand: Division of *dheris* into family fields.

Khatri: A caste.

Khera bagh: Human settlement in a garden.

Khet: A field. Also known as *Khata*.

Kikar: A thorny tree.

Killa: A unit of land measurement comprising an area of 198 feet x 220 feet or 8 *kanals*, equivalent to acre.

Killabandi: Consolidation of *killa* fields.

Kuhals: Man-made water channels.

Kursinama: A genealogical tree. Also known as *Shajra Nasab* or *Vanshavali*.

Kyari: A small cultivation unit.

Lambardar: Leading man of the village community.

Lehndi Taraf: The Sunset side.

Luhar: An iron-smith caste.

Maah: A black pulse.

Mahli: A *gotra* (clan) of *Jat* caste.

Majha: A cultural region situated between the rivers Beas and Ravi in Punjab. Also known as *BARI Doab*.

Makki: Maize.

Malik: Owner.

Malikana: Ownership.

Malik-i-Qubza: Proprietary right acquired by long possession.

Malkiyat: Ownership.

Malwa: A cultural region situated between the rivers Satluj and Ghaggar in Punjab.

Mamla: Revenue.

Mander: A *gotra* (clan) of the *Ramgarhia* caste.

Mansabdar: The holder of a rank carrying certain fixed remuneration and obligations.

Maru: A land affected by sand- dunes.

Mauza: A revenue circuit of an estate. Also known as *tappa* or *chakla*.

Meera Chahi: *Chah* (well or tube-well) irrigated land generally found away from the *abadi-deh* (settlement).

Merla: A unit of land measurement comprising an area of about 30 square yards.

Murabba: A unit of land measurement comprising an area of 25 acres.

Murabbabandi: Consolidation of *murabba* blocks.

Nagra: A *gotra* (clan) of *Jat* caste.

Nahari: Canal irrigated.

Nala: A Stream.

Narma: American high yielding variety cotton.

Nyayi: The best quality highly manured land situated in the close proximity to the *abadi- deh* (settlement).

Nyayi Chahi: *Chah* (well or tube-well) irrigated land adjacent to the *abadi-deh* (settlement).

Pahar: Hills

Pahbe: A *gotra* (clan) of *Saini* caste.

Panchayat: Village level elected government.

Pathania: A *gotra* (clan) of *Rajput* caste.

Patta: A deed of grants.

Patti: The internal division of a village territory on the basis of *gotra* (clan) or caste of the initial settlers. Also known as *Taraf*.

Patwari: Village level government official.

Phirni: A circular road around *abadi-deh* (the main settlement).

Pind: A village inclusive of *abadi-deh*, surrounding fields, land covers and land uses. Also known as *Gaon*.

Punjab: The land of five rivers, an Indian state.

Qabza: Possession.

Rabi: Winter season crops, also known as *Harri*.

Raj: Kingdom.

Raja: King.

Rajput: A caste.

Ramgarhia: Craftsman caste.

Randhawa: A *gotra* (clan) of the *Jat* caste.

Ravi: A perennial river forming international boundary between India and Pakistan.

Riwaj-i-Am: Traditions and customs regarding rules of division of property in an area.

Roori: Manure made from animal waste. Also known as *Dher*.

Shahtut: A mulberry tree.

Saini: A caste.

Sapta Sindhu: Land of seven rivers of the ancient Indus river system.

Sarasvati: An ancient river of India.

Sarkar: The primary division of a province under the Mughals.

Sarson: An edible oil-seed.

Satluj: The largest perennial river of Punjab dividing *Doaba* and *Malwa* regions.

Seikhon: A *gotra* (clan) of *Jat* caste.

Seim: Water-logging.

Shajra Kishtawar: Village map showing the fields and their boundaries with *khasra* (identification) numbers. Also known as *Massavi* or *Lattha*.

Shajra Nasab: Genealogical tree of owners of the land. Also known as *Vanshavali* or *Kursinama*.

Shamlat: Village common land.

Sheet Lehar: Cold winds.

Shiwalik: Name of the hills found in north-east Punjab.

Sidhu: A *gotra* (clan) of *Jat* caste.

Sobhreyae: A *gotra* (clan) of *Rajput* caste.

Suba: A province or a primary division of an Empire.

Sunnar: Goldsmith caste.

Tappa: The sub-division of the *Talluqa* or the *Pargana* (administrative unit next to province used in Sikh Rule) containing a varying number of villages.

Tarkhan: A carpenter caste.

Taroti: A *gotra* (clan) of *Saini* caste.

Teenfasali: Three crops in a year.

Thakur Dwara: A temple.

Thakur: A caste.

Thulla: Land.

Thullawand: Division of land in large chunks.

Tibba: An irregular sandy land through which water percolates very fast.

Til: An oil seed crop.

Vadder: A *gotra* (clan) of the *Ramgarhia* caste.

Vans: Jungles.

Vanshawali: *Genealogical* tree of owners of the land. Also known as *Shajra Nasab* or *Kursinama*.

Wajib-ul-Arj: Traditions and customs of a village.

Waris: A proprietor or an heir.

Warisi: Inheritance, hereditary right to hold and cultivate land.

Warr: A fence or hedge.

Wat: A low mud dike which separates two fields or property units.

Watbandi: Raised dikes along the boundaries of a field.

Zamindar: Possessor of land, also a peasant proprietor.

Zulaha: A caste.

TERMINOLOGY USED

Accentuated Rectangular Field: Rectangular field with enormous length.

Closed fields: Fields enclosed with boundaries.

Field pattern: Arrangement of fields in terms of shape, size, distribution, boundaries, scattering and their combinational arrangements.

Index of Scattering in terms of Distance: It is an improved method which also considers the cumulative distance of all sites of fields from the *abadi-deh* (settlement) with the help of a formula ($I_{SD} = I_s / \sum D_{SF}$, where: I_{SD} is the Index of Scattering in terms of Distance, I_s is the value of Index of Scattering in per cent and $\sum D_{SF}$ is the sum total of distance of sites of fields from the *abadi-deh* (settlement) comprising a land holding).

Index of Scattering: It is a method to know the level of scattering of fields of a farmer at different sites with the help of a formula ($I_s = X/Y \times 100$, where: I_s is the Index of Scattering, X is the number of sites and Y is the number of fields).

Infields: Fields situated near the *abadi-deh* (settlement).

Law of inheritance: The traditional rule of division of property of parents among the members of a family.

Micro-topography: Relative local relief.

Open fields: Fields without boundaries.

Outfields: Fields situated away from the settlement or near the periphery of the village.

Phases of settling: Periods of inhabitation.

Principle of compensation: A traditional rule of division of property in which a member is given more land or large number of fields in poor quality land types and vice-versa.

Principle of equitable distribution of benefits and handicaps: The traditional rule in which each member of the family is given an equal share in all land type fields.

Processes of settling: Procedures of inhabitation.

Scattering of fields: It refers to a condition in which the holding of a farmer consists of a large number of fields located at various sites and in different directions in the village territory.

Spatial structure: Pattern in relation to space (area/place).

Spatio-temporal: Relating to space (area/place) and time.