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Understanding Rural Building Systems in India

Building Practices and Delivery Processes in Rural Bundelkhand

Zeenat Niazi

School of Architecture,
McGill University, Montreal
March, 1995

A Thesis submitted to
The Faculty of Graduate Studies and Research
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the degree of Master of Architecture

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UNDERSTANDING RURAL BUILDING SYSTEMS IN INDIA:
Building Practices and Delivery Processes in Rural Bundelkhand

ABSTRACT

Building practices in rural areas have developed in response to a variety of interrelated factors like climate, local physiography and socio-cultural traditions. The rural house is as much an agrarian product as the crops and livestock depending on a balanced eco-system. It is characterised by a dependence on the immediate natural environment for materials, high labour and low energy inputs in construction. Unfortunately, depletion of natural resources, changes in resource management structures and rapid monetisation of the rural economy have had abrupt and often detrimental effects on the condition of rural shelter.

This research attempts to understand the characteristics of rural building systems in order to identify the nature of interventions required to facilitate the process of shelter upgrading. From a study of six villages in Jhansi district of Bundelkand region, the study demonstrates that indigenous building practices and delivery processes can form effective links in the process mentioned. Local building materials, techniques of construction, service transaction, and methods of skill and information transfer are studied to analyse the factors which influence appropriation of available options by users. The specific character of the rural building system - that of a network is highlighted. The building network is characterised by a high degree of local control on construction and management, incremental upgradability and variety and flexibility in delivery processes

This study indicates that effective and sustainable interventions in resources, technologies and delivery processes in rural India will need to utilise the potential offered by the 'network nature' of rural building systems. Any new or improved systems of construction will have to be supplemented by increasing users' access to them and will need to pass through the tests of:

- Enlarging the range of available options,
- Augmenting (at least not limiting) the variety and flexibility in delivery options and,
- Increasing the level of local control in construction and management.

COMPRENDRE LA CONSTRUCTION RURALE AUX INDES:

Les pratiques de construction et les processus de distribution dans la région de Bundelkhand

RÉSUMÉ

Les pratiques de construction dans les régions rurales se sont développées en réponse à une variété de facteurs tous liés entre eux, comme le climat, l'environnement physique et les traditions socio-culturelles. Comme la moisson et le cheptel, la maison rurale est un produit agraire qui dépend aussi d'un système écologique équilibre. Elle se caractérise par une dépendance de l'environnement naturel immédiat, d'une main-d'œuvre nombreuse et d'une basse consommation énergétique dans la construction. Malheureusement, l'épuisement des ressources naturelles, les changements dans la structure de la gestion des ressources et la rapidité de la monétarisation de l'économie ont eu des effets brutals et néfastes sur la condition de l'habitat rural.

Cette recherche tente de comprendre les différentes caractéristiques des systèmes de constructions rurales, dans le but d'identifier la nature des interventions nécessaires à fournir pour faciliter le processus de restauration de l'habitat rural. L'étude de six villages dans le district Jhansi de la région de Bundelkhand démontre que les pratiques de construction en cours et le processus de leur distribution peuvent contribuer efficacement à la restauration de l'habitat rural. Les techniques et les matériaux locaux de construction, les méthodes des services de transactions et le transfert de l'expérience et des connaissances sont étudiés, pour faire ressortir les facteurs influents dans l'appropriation des options disponibles par les constructeurs-usagers.

Cette étude tente à démontrer que l'utilisation efficace et durable des ressources, des technologies et des moyens de production devront utiliser le potentiel offert par le "réseau des constructions rurales vernaculaire". Tous systèmes nouveaux ou améliorés devra répondre aux exigences suivantes:

- élargir le choix des options disponibles,
- augmenter la variété et la flexibilité des options de distribution et,
- intensifier le degré de control des utilisateurs locaux sur l'exécution et la gestion de la construction.

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The list of people to whom this thesis owes its fulfilment is long and all of them cannot be mentioned by name in the limited space available.

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This thesis has been made possible by the International Development Scholarship received from the Aga Khan Foundation, Canada, for the duration of the Master's programme. The McGill University Humanities Research Committee provided financial assistance to conduct the field survey in Jhansi. I am indebted to them.

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PREFACE

"*Why plant a new tree where an established tree already stands?*" asks the Gaia Atlas of Planet Management Traditional societies are like established trees with their roots deeply anchored in the history and culture of an area. Development proposals produced by remote government officials often ignore these local systems in their attempts to improve and 'develop' them. Remote solutions almost always lead to a mismatch of real needs and solutions. It is only when we truly understand local problems and solve them at local levels, that we will be able to achieve the global goal of sustainable development. Localised action is the key to resolve many global problems and local action can only occur through a holistic understanding of local issues and ways of life

Concerning the study of indigenous built environments, Nezar Alsayyad has remarked: "*we ought to pay more attention to those stories our people tell, the stories that can only be acquired through growing up in a certain culture*". In this spirit, the thesis has been put together by talking to the villagers and people who have and worked in rural areas, and by reading about their life-experiences: both tangible - quantitative and intangible - qualitative.

Before we begin, some comments on the writing-style may be useful as a guide to the reader:

Firstly, local terms have been liberally used to preserve the spirit of the thesis. These are italicised and wherever possible, have been explained in the text. A glossary of terms is provided at the beginning of the document to assist the reader.

Secondly, instead of metric units, lengths and areas are expressed in feet and square feet respectively, this being the commonly used measurement system in the local area studied. In the drawings, East orientation along with the standard North sign is indicated as it represents the local reference for orienting the buildings.

Thirdly, the use of 'hyphens' needs an explanation. Changing techniques and technologies often suggest new word forms to describe them. Until the technical vocabularies have fully adopted the 'neologism', there is a tendency to show their origin by using a hyphen. The hyphen is used of course for some intra-specific distinctions but here also, there are relative degrees of acceptance in different linguistic cultures. Without trying to resolve this, I have mainly tried to be consistent.

Finally, the issue of gender distinction also needs to be brought up. Historically, certain skilled jobs like masonry and stone-carving have been the domain of men. However, women have always been an intrinsic part of the building system with distinct roles and responsibilities. Many established roles are in the process of being transformed but the forms of address will take longer to change. Moreover, the masculine form of addressing a villager in the document is used in a generic manner, without favour or prejudice to any gender.

The thesis concludes with thoughts and reflections entitled 'final remarks', the 'learning' however, continues. This thesis has been more than a mere fulfilment of the requirements of the degree of Master of Architecture, it is the beginning of a process of understanding indigenous processes of development in search for a truly sustainable human co-existence with Gaia: our mother Earth.

- Zeenat

List of Abbreviations

ASAG	Ahemadabad Study Action Group
CAPART	Council for Promotion of People's Action and Rural Technology
CBRI	Central Building Research Institute
CSIR	Centre for Scientific and Industrial Research
CSV	Centre for Science for Villages (Wardha, Maharashtra, India)
DA	Development Alternatives
GRET	Group of Research and Action on Technology
HUDCO	Housing and Urban Development Corporation
HSMI	Human Settlements Management Institute
IYSH, 1987	International Year of Shelter for the Homeless, 1987
NABARD	National Bank for Agriculture and Rural Development
NBO	National Building organisation
NGO	Non-Governmental Organisations
NIC	National Informatics Centre
NREP	National Rural Employment Programme
OLHS	One Lakh Houses Scheme
PWD	Public Works Department
R&D	Research and Development
RBC	Reinforced Brick Concrete
RCC	Reinforced Cement Concrete
RLEGP	Rural Landless Employment Guarantee Programme
TARU	The Action Research Unit
TRYSEM	Training of Rural Youth in Skills for Employment

Glossary of Terms[1]

Abadi	Residential zone in a village
Awaas	Shelter
Basti	Settlement
Beldar	Unskilled labourer; here unskilled construction worker
Brahmin	A member of the traditional priestly class amongst the Hindus
Chabutra	Platform
Chapti	Flat
Chulha	Stove
Diwali	Festival of lights; Diw(y)a = oil lamp,
Einth	Brick; here, the locally manufactured thin fired brick
Farshi	*Farsh* = flat floor; here, flat stone roof, terraced with cement concrete.
Gol	Round
Grahak	Client
Gram-sabha	Village society
Gumma	Modular masonry unit; here, the 9"x4.5"x3" modular fired brick, manufactured locally or imported from distant areas.
Harijan	Children of God - a name given to the lowest caste, supposedly untouchable community amongst Hindus.
Jajmani	Barter based traditional system of service transaction in rural areas.
Jati	Caste
Kanpuri	Belonging to or pertaining to Kanpur (a city in North India).
Katcha	Temporary
Khanda	Regular or modular masonry unit; here used for dressed stone units and concrete blocks.
Khaprel	Clay tile for pitched roofs
Laughariya	Tribal community of blacksmiths
Lipai	Plaster made of a mixture of mud and fresh animal dung, also the act of plastering wall, ceiling and floor surfaces using one's hands.
Madrasi	Belonging to or pertaining to Madras (a city in South India).
Mistri	Artisan - mason
Panchayat	Village assembly
Patti	Patta = flat slab or plank; here stone slab.
Patti-farshi	Same as *farshi* - stone slab roof terraced with concrete.
Pokhar	Water hole; here, a pond
Pucca	Permanent
Raj mistri	Raj(a) = king; here, head, the senior most and/or highly skilled mason.
Sahariya	Tribal community local to Bundelkhand - traditionally hunter-gatherers
Thakur	A member of the traditional warrior class amongst the hindus
Yojna	Scheme

[1] Local Hindi terms are listed here, many of these terms are locale specific and differ from place to place even in the Hindi speaking regions of India.
Local geological terms and names of trees and plants are explained within the text.

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PART 1

CHAPTER I - INTRODUCTION

India is a essentially a rural country. India's population is about 900 million, threatening to touch the one billion mark by the turn of the century. More than 600 million or 75% of this population lives in rural areas,[1] where the main source of livelihood is agriculture or pastoral activities. A majority of the rural population live in small and highly dispersed villages of less than 5000 people. Life in these villages is characterised by illiteracy, ill-health with limited or no access to safe drinking water, sanitary facilities nor electricity. The bulk of rural trade and transaction systems falls outside the formal market systems, making it difficult to break the vicious circle of rising population, increasing poverty and falling standards of living.[2]

As a reaction to the unmanageable urbanisation in India, as in most of the Third World, the attention of professionals dealing with human settlements issues has mainly been concentrated upon problems associated with urban explosion and decay. Rural habitats and their problems have been largely ignored. A deeper study would however indicate, that much of the "urban problématique" is in fact symptomatic of Third World development policies characterised by urban biases and rural neglect.[3] Moreover, trends indicate that, despite the rapid pace of urbanisation, most Asian and African countries shall continue to be largely agrarian and rural in character for several decades[4] - dependent on a "*biomass based (subsistence) economy.*"[5]

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[1] This figure is based on the Census of India projections after the 1991 census. The 1981 census had given the figure of India's rural population as 570 million. [Aromar Revi; Shelter in India (Vikas, New Delhi, 1990), pp. 20, 21].
[2] Revi (1990), p. 16.
[3] Michael P. Todaro and Jerry Stilkind; City Bias and Rural Neglect: The dilemma of Urban Development (New York: Population Council, 1981),
Lester R. Brown and Jodi L. Jacobson; "The Future of Urbanization: Facing the Ecological and Economic Constraints", World Watch Paper, no. 77 (World Watch Institute, May 1987), p. 12,
HH, the Aga Khan, "Opening Remarks: Sixth International Seminar on Architectural Transformations in the Islamic World, October 19 - 22, 1981" in The Changing Rural Habitat, vol. I, The Aga Khan Award for Architecture. (Concept media, 1982), pp. xiv - xvi,
Farokh Afshar; The Political Economy of Technology Choice: Construction and Materials Production in Pakistan (PhD Thesis, Urban and Regional Planning, Massachusetts Institute of Technology, October 1985), p. 257, and Maurice Mitchell and Andy Bevan; Culture, Cash and Housing (VSO/IT, 1992), pp. 4, 5.
[4] ibid. and Farokh Afshar; "Globalization: The Persisting Rural Urban Question and the Response of Planning Education" in Journal of Planning Education and Research, no. 13, 1994. pp. 271 - 283.
[5] Anil Agarwal and Sunita Narain; Towards Green Villages: A strategy for environmentally sound and participatory rural development (CSE, New Delhi, 1989), p.1. Parenthesis added.

The rural house is as much an agrarian product as the crops and livestock which depend on a balanced ecosystem.[6] It is characterised by a dependence on the immediate natural resource base for materials, high labour and low energy inputs in construction. Building practices in rural areas have developed in response to a variety of interrelated factors like climate, local physiography, locally available natural resources, social regulations and cultural traditions. Construction has been traditionally managed through mutual self-help and exchange of services in a barter system; skills were transferred through the spoken word and through practice from father to son or from master to apprentice.

1.1 The Rural Housing Problématique

It has been pointed out that rural housing and habitat issues, have largely been ignored throughout the Third World. The dominant view has been that the housing problem is mainly an urban condition. In rural areas, land and building materials are readily available, hence there the problem is less urgent.[7] In fact, the picture is far from optimistic. Rural people, living in settlements that have evolved slowly over long periods of time, are facing rapid and often critical changes in their habitats.[8] The natural resource base has been disturbed due to short-sighted exploitation for commercial gains, rapid industrialisation and population pressures. The traditional systems of community-based management of resources have broken down in many areas and many indigenous traditional construction skills have disappeared. Dependence on expensive and often inaccessible external resources and skills is leading to a deterioration in housing quality. This has necessitated external intervention in the area of rural shelter upgradation.[9]

In India, rural housing concerns have received low priority in the National Development Plans.[10] Intervention in the area of rural housing and habitat improvement

[6] Mitchell and Bevan (1992), p. 6.
[7] Van Huyck (1977) in Afshar (1989), p.257.
[8] "Complementary Emphasis" in Aga Khan Foundation - International Strategy: 1991 - 1999 (AKF internal document), p. 53.
[9] Revi (1990), p. 18.
[10] A look at the National Development Budget in India from 1950 to 1990 reveals that only 1.9% of the country's total financial outlay was allotted to rural housing in 1950 and this has actually gone down to 1.36% in 1990. [Revi, (1990), p. 17].

has been affected by an inadequate understanding of indigenous rural building and decision-making processes. This is evident in the public sector response to complex problems associated with the provision and improvement of rural shelter. The formal interventions have evolved from a simplistic and massive, but largely ineffectual, land reform movement to the development and introduction of new or improved building materials and technologies.

The primary indicator of the rural housing problem, as understood by the formal sector and reflected in the evaluation of its various housing programmes, is found in the 'housing gap'. Official estimates in 1989 placed the housing gap in rural areas as 19.3 million dwelling units.[11] Despite the enormity of the problem as presented by official statistics, the variety of technical and financial assistance programmes initiated by the formal sector in the four decades since independence, have contributed to less than 3% of the total construction activity in rural areas.[12] The majority of building work is carried out through informal, private means. Government programmes not only contribute a negligible fraction to the total house building activity in rural areas but the housing produced is much more expensive and inappropriate than that built by people themselves.[13]

It is felt that the formal response has disregarded and ignored, to a large extent, the 'variety' and 'flexibility' that exist in indigenous rural building practices, delivery methods and management systems.[14] The specific characteristics of the building sector in rural areas, the attitudes to construction, transaction systems, the transfer and exchange of information, skills and knowledge have not been clearly understood. It is acknowledged that rural shelter processes require 'facilitation' rather than 'provision' of houses but this is rarely reflected in projects on the field. The results of public sector interventions to improve rural housing conditions have naturally been far from satisfactory, both in terms

[11] Housing gap is defined as the difference between the total population and the number of shelterless, it reflects the number of dwelling units required. These figures can be misleading as the criteria is based on perceived degree of permanence of the house and one family to one house, disregarding the joint and extended family system in rural areas. It also does not take into consideration repairs, maintenance and extensions as necessary aspects of housing need. [Revi(1990), pp. 21, 22].

[12] Geeta Vaidyanathan and Zeenat Niazi, "Traditional Building Materials and Construction in Rural Western Uttar Pradesh", paper presented at The National Conference Cost Reduction Techniques and Low Cost Materials for Rural Housing, Gajuraula, January 1993 (Development Alternatives, New Delhi, 1993).

[13] Revi (1990), pp. 76, 77.

[14] Vaidyanathan and Niazi (1993).

of quantity and quality. Moreover, the message sent out by public sector policies and programmes has actually resulted in loss of credibility of indigenous building systems over the more expensive and often inaccessible industrial building materials and techniques.[15]

1.2 The Problem Redefined

There is an urgent need to improve rural habitats and make them desirable places to live in. An integrated study of the rural building environment becomes important, not only because of the immense rural populations and their deteriorating quality of life; but also because a lack of research and inadequate understanding of rural housing processes has resulted in the treatment of these complex issues in a simplistic and fragmented manner. This has led to a spiralling of problems. A careful analysis of local conditions and capabilities and the integration of these into technical, organisational and financial strategies being designed for rural housing programmes is, therefore, necessary.[16]

"*One of the best ways to begin to understand the culture , climate and technology available in a local area is to examine the local building traditions. A study of the local building techniques and indigenous building vocabularies provides an insight into the local building industry. A knowledge of the process of building is also a way of introducing oneself to the cultural significance of building in the area.*"[17] An understanding of indigenous building practices (materials and techniques) and delivery processes (manpower, information and knowledge transfer, markets and transaction systems) in specific areas can assist in the formulation of effective and sustainable enabling strategies to facilitate the process of rural shelter upgrading.

1.3 The New Approach

Current housing policies and programmes in India reflect the need for a new approach to issues of rural habitat in their emphasis on the role of the individual and community, training of local manpower, introduction of improvements in local building

[15] Afshar (1985), p. 181.
[16] AKF (1991 - 1999), p.53.
[17] Mitchell and Bevan (1992), p.72.

materials and techniques and attempts to regenerate the local resource base.[18] This shift in attitudes from a simplistic land-reform or 'technical-fix' of the rural housing and habitat problems to a holistic approach is indeed a welcome step. It recognises that successful field interventions need to pay attention not only to technology, but also to local resources, skills, economy and organisational capabilities. This suggests that sustainable strategies for rural habitat improvement must proceed at the outset with the involvement of villagers and artisans themselves: in essence, through "*building up and building on indigenous skills and knowledge systems in specific areas.*"[19]

1.4 Current Research

In view of the above discussion, it is evident that local building practices and delivery methods can form effective links in the process of rural shelter upgradation. This thesis is built on the premises that:

(i) Rural building systems posses an inherent potential that can facilitate the process of shelter upgrading in an effective and sustainable manner, and,

(ii) Characteristics of rural building systems need to be understood in order to identify the nature of interventions required to facilitate the above process.

The research focuses on:

A study of building materials, techniques and modes of delivery (for roofs and walls), in selected villages of the Bundelkhand region in India, and an analysis of user choice of the same, in order to understand the characteristics of the rural building system.

In essence it attempts to answer the following question:

- How can the knowledge and understanding of rural building systems help facilitate the process of rural housing upgradation in an appropriate and sustainable manner?

[18] This is further discussed in Chapter II, under Initiatives in Rural Housing and Building Systems.

[19] Onju Roy: "The Merging of Traditional and Modern Cultures in Nepal" in Architecture + Design, May - June 1990 (Media Trans-Asia, New Delhi), pp. 73 - 80. The same idea is repeated in Mitchell and Bevan, p. xiii and AKF (1991 - 1999), pp. 53, 54.

This issue raises many other secondary and tertiary questions, some of which are enumerated as follows:

(i) What are the main characteristics of rural building systems in India (Bundelkhand)?

- What are the strengths and weaknesses of the rural building system?
- How are these strenghts and weaknesses used by the rural users to fulfil their aspiration for satisfactory shelter?

(ii) What factors affect user appropriation (choice) of materials, technologies and modes of delivery?

- What are the range of choices available?
- What are the limitations of and/or incentives to choose one option over the other.
- What is being chosen? What is the major trend?
- How are the choices being made? What modes are employed?

(iii) What is the nature of interventions required to facilitate rural housing upgradation?

- What are the implications of current trends in choice of building materials, technology and modes of delivery?
- How can the strengths and potentials of the rural building system facilitate the process of rural housing upgrading in a sustainable manner?

1.4.1 Research Methodology: The research is explorative in nature and utilises the techniques of Rapid Rural Appraisal (RRA). This technique is increasingly being employed in development research and has been found to be very effective in addressing complex and interrelated issues that are characteristic of Third World rural societies. The exploratory and iterative nature of this method and the intensity with which the research is conducted "*enables rapid and progressive learning to take place.*"[20]

Substantial emphasis is placed upon learning about rural conditions, problems and needs directly from rural inhabitants. Semi-structured interviews, participant observation, photography and measured drawings are primary tools used to collect and document information. Statistical information from secondary sources like the census is used only to substantiate and validate the data. The initial hypothesis is treated as a guide and is subject to repeated testing, revisions and refinement through the research process.

[20] Grandstaff and Grandstaff, (1987) in Rapid Rural Appraisal in Northeast Thailand: case studies George Lovelace et al. (eds), (KKU-Ford, Thailand, 1988), pp 7.

"RRA as an art or craft relies heavily upon training, as well as upon practice and experience gained during the conduct of actual studies."[21] Previous experience with RRA techniques in three different studies conducted prior to this research made the choice of this method very appealing.

1.4.2 Scope and Limitations of the Research: The study has been conducted with a broad objective of understanding rural building systems - the physical environment in relation to the socio-economic and natural environments. The construction and delivery processes have been studied with respect to materials, masonry and roofing elements - techniques and technology, skills, local building economy and information networks.

Geographic boundaries of Jhansi uplands in the Bundelkhand region (described in Chapter III) provided the social setting and the resource palette. The administrative confines of six selected villages within the jurisdiction of Jhansi district limited the extent of the actual physical survey. The villages were, however, not studied in isolation but their connection with the nearest urban centre and its impact on the rural building system was also considered.

The limitation of the lack of a 'team' (an important aspect of RRA) to conduct an interdisciplinary study was overcome by engaging in meaningful discussions with professionals from varied backgrounds (at Development Alternatives, New Delhi) and through reviewing earlier studies conducted in this field by sociologists, economists, architects, engineers and development workers.

1.4.3 Choice of Locale: It is important, at the outset, to understand why Bundelkhand and, within it, Jhansi district was chosen for the purpose of this study. Bundelkhand, lying in the centre of the country, is a distinct geographical identity (Figure 3.1) and can be referred to as one region in socio-cultural terms. Micro-level studies conducted in any part of this region can be generalised to a considerable extent for the entire region. Lying in the Hindi heartland, it has many similarities on the cultural, occupational, societal, economic and linguistic levels with most of the Hindi-belt regions[22] that form a large part of North India.

[21] ibid., p. 21

[22] The Hindi-belt comprises of the states of Uttar Pradesh, Madhya Pradesh, Rajasthan and Bihar - the Hindi speaking states of India.

Another important reason for the choice of this particular area lies in the practical post research advantages anticipated with the possibility that the findings of this research would be of immediate practical value to an ongoing shelter programme in this region.

1.4.4 Definition of Terms: Certain specialised expressions have been frequently used in this paper. A brief discussion of these will put them in the proper context of the research.

Building system: The interactive network of building practices and delivery methods which include materials, manpower, energy, information and socio-economic relationships.

Building practice: The techniques of roof and wall construction being utilised in the area studied - includes materials, elements, components and technology.

Building materials and elements: Raw natural or industrial material resources for construction like earth, stones, cement and steel and processed raw materials such as bricks (masonry elements) and stone beams.

Building components: Two specific building components are studied, viz., roofs and walls.

Delivery processes: The processes involved in the transfer of skills and information from one person or region to another, artisanal remuneration systems, local building markets as well as family and community relationships with respect to house construction.

1.4.5 Organisation of the Research Paper: This research paper is organised in three parts:

Part 1 deals with the aspects of rural life in general and the building practice in particular. This section provides a broad overview of rural building practices in India as reviewed from the body of literature available. The formal sector interventions by way of housing plans and policies, new or improved technologies and their delivery are also reviewed briefly.

Part 2 deals with the actual study conducted on the field in the Bundelkhand region of India. A brief introduction to the regional context in **Chapter III** is followed by primary findings presented in **Chapter IV**. **Chapter V** analyses these findings, whereas the final **Chapter VI** highlights important issues emerging from the study and raises questions for further research.

Appendices and bibliographical references are compiled in **Part 3** of the document.

CHAPTER II - RURAL BUILDING SYSTEMS IN INDIA: CURRENT THEORIES AND PRACTICES

There is considerable variation in different village building systems in India. This chapter presents an overview of physical and social structures in Indian villages.[1] Emphasis is laid on social, cultural and physical linkages involved in the process of construction. This is certainly not an exhaustive description and much more information is required to complete the picture. However, from the point of view of this thesis, it is considered sufficient as an introduction to the varied factors that interact during the construction process. A more detailed description is taken up in Chapters III, IV and V when we deal with the particular example of Bundelkhand. The discussion on rural building practices is followed by a brief description of public sector interventions in the field of rural housing improvement. Problems and potentials associated with both indigenous systems and the formal response are then highlighted.

2.1 The Village Structure

2.1.1 Settlement Patterns: A settlement has been defined as a product of adjustment between social forces and physical conditions of the habitat.[2] Sociological studies indicate that cultural, economic, political, historical and physical factors all have a role to play in the development of a settlement pattern. The relationship between these factors is complex and as such not within the scope of this thesis. However, it is reasonable to assert that, within India, two extreme patterns of habitation have been identified, namely;

(i) Nucleated or clustered, with the dwellings grouped together to form a compact habitation area clearly demarcated from the surrounding agricultural fields, mainly a characteristic of the North, and,

(ii) Dispersed or scattered type, where houses are built apart either in small clusters of two or three separately or each in its own farm, as in most of the South.

[1] Here we do not include tribal villages which form a large proportion of rural India. Their village systems and therefore building systems are distinct from those of non tribal settlements. Many scholars have analysed this distinction, refer to Brian J. Murton, "South Asia" in World Systems of Traditional Resource Management, Gary A. Klee (ed.) (Arnold, London, 1980), pp. 71,72.

[2] Mukherjii, (1957:102) in Nature and Structure of Rural Habitations, S.K. Chandhoke, (1990), p. 2.

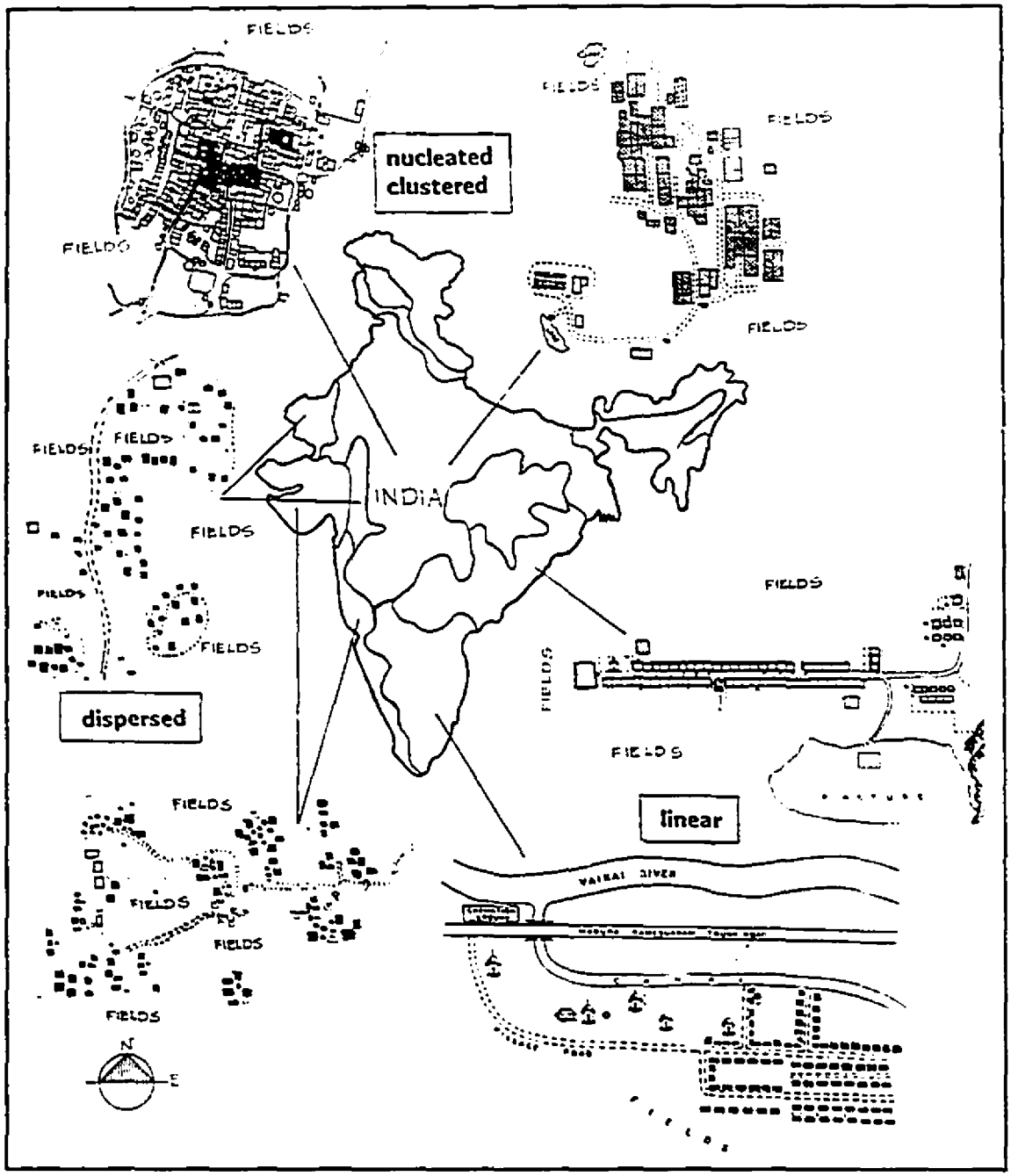

Figure 2.1 **Rural settlement patterns in India.**
After: Peasant Life in India; Anthropological Survey of India (Memoir no. 8, 1961) and Onju Roy: Architecture+Design (May - June, 1990)

A third type of settlement - the linear arrangement is seen along the South-East coast, (Figure 2.1).[3]

Within a habitation, whether dispersed or nucleated, caste divisions[4] and social hierarchy govern the placement of dwellings and their relationship to each other.[5] Social distances are reflected in the physical distances within a settlement and, "*place acquires a prestige and economic value.*"[6]

The pattern of any habitation is very much conditioned by the social life of those inhabiting it, however, once formed, the pattern rarely changes.[7] Thus it is obvious, that the pattern of a settlement only serves to strengthen the social forces that lead to its formation in the first place. This is especially true for Indian villages where caste and social hierarchy determine the dwelling arrangements and these social relationships are made stronger by the physical differentiation of space.

Changes in the economic order, increasing levels of education, and contact with urban life has resulted in some alteration in these social relationships. In some villages, the earlier 'lower castes' have become powerful through economic gains and the settlement structure indicates this change in hierarchy.[8]

2.1.2 *Abadi* and Common Property in a Village: A nucleated village settlement is characterised by an '*abadi*' area, or a region for habitation with common lands and individual fields surrounding it (Figure 2.2). *Abadi* is the densely populated zone of the village. Ownership in the *abadi* has traditionally been in direct proportion to the share in agricultural lands.[9] As most of the higher castes were also the larger landlords, this only made their position within the village more powerful.

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[3] For a detailed study of rural settlement patterns, see M.N.Srinivas (ed.); India's Villages, (1960), and Chandhoke (1990). Also refer, "Peasant Life in India", Anthropological Survey of India, (Memoir no.8, 1961).

[4] Traditional Hindu society is divided into four main and numerous sub -castes on the basis of traditional occupations. These have, over centuries, degenerated into rigid, hierarchical and feudal divisions of the society.

[5] The spatial separation has been defined to emerge from the need for certain occupations to have room for carrying out the different processes needed for their craft. Where this can explain the segregation of the weavers, potters, dyers, brick-makers etc., the main reason for segregation of caste sectors is the ban on contact between castes and solidarity of a sub-caste; Karve (1957), p. 102 and Srinivas (1965), p. 27 in Chandhoke (1990), p. 15.

[6] Chandhoke (1990), pp. 16, 18.

[7] Bracey (1959) and Nicholas (1963), in Chandhoke (1990).

[8] Surender Singh; Some Aspects of Housing Problem in Rural Delhi (Radha Publications, New Delhi, 1989).

[9] Chandhoke (1990).

Pasture lands, forest lots, streams and ponds within the village boundary constitute the village commons or '*gram-sabha* lands'. The commons have traditionally formed important sources of building materials like soil, timber, stone etc. and access to them is crucial for the construction of adequate shelter by the rural poor.

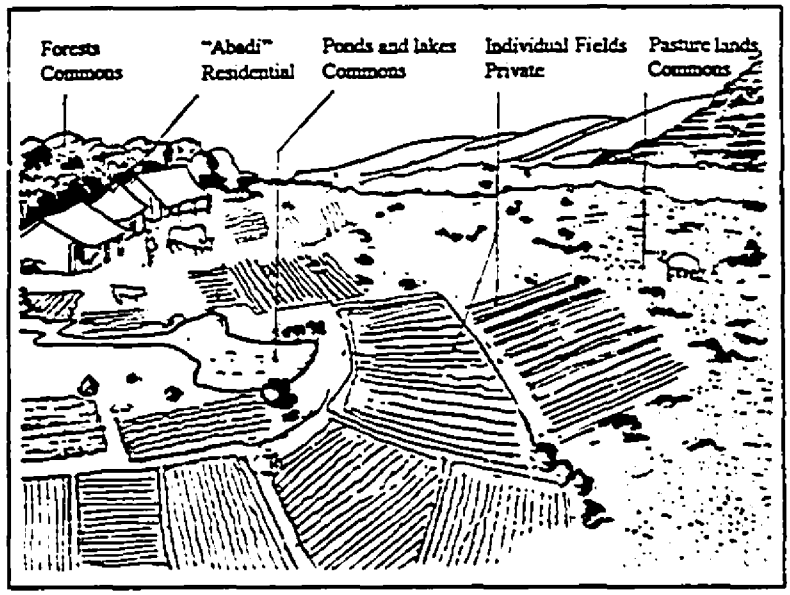

Figure 2.2 Abadi and common property in a village
After: Chris Forsey: Gaia: an Atlas of Planet Management (Gaia Books ltd. 1984) pp.58, 59.

Common lands cannot be divided and are not normally built upon. The level of control over common property resources has been dependent on social hierarchy, however, every one in the village has a share in the common property and a responsibility to maintain it.[10] In recent years, *gram-sabha* lands in many areas have been reduced by granting ownership to specific individuals - legally or through force. Many common property lands appropriated by the government 'for better management', have lapsed into 'free-access situations'.[11] Breakdown of social control, increasing poverty and population pressures have led to the neglect of many of these common property resources.[12]

[10] For details regarding control and authority over village commons refer Chandhoke (1990).
[11] This concept relates to the attitude of 'everybody's property is nobody's property' towards the common property resources. The denudation of common lands initially attributed to lack of single private or state ownership and termed as the 'Tragedy of the Commons' (Hardin,1968), was disputed in the context of many Third World agrarian and tribal communities and redefined as the 'Tragedy of the Free Access' - wherein a shift in management control from the community to the government has resulted in loss in accountability and therefore in attitudes towards responsible management. For details refer to note no. 13.
[12] For details refer Kanchan Chopra et al; Participatory Development - people and common property resources (1990), / Bromley and Cernea The Management of Common Property Natural resources some conceptual and operational fallacies (World Bank Discussion paper no. 57) and Agarwal and Narain (1989).

2.1.3 The House Form: The rural house form has emerged from a complex interaction of various factors. These are macro and micro climatic features, availability and quality of building materials, level of technology and skill possessed by the people to process and utilise the materials and the specific socio-cultural characteristics of the communities. The Anthropological Survey of India[13] has classified the rural house form in three broad categories on the basis of ground plan and roof form (Appendix 2.1):

- rectangular ground plan with horizontal roof,
- rectangular ground plan with inclined roof, and
- circular ground plan with conical roof.

These vary in combination with the height of base or plinth, presence or absence of courtyards and arrangement of covered and semi-covered spaces around the courtyards. Such a description of house type on the basis of shape of hut as 'typical round hut with thatched roof' etc. is rather simplistic and has often been criticised. "*Structural diversity and variation in technique results in significant changes in house form even though 'shape' may generally be the same.*"[14]

In 1961, The Census of India conducted a survey to record rural house forms in India, some of these are presented in Appendix 2.2.

A comprehensive study on the response of rural house forms to macro-climatic conditions has been conducted by Bansal and Minke.[15] They classify rural houses within the six climatic zones of the country.[16] Most rural houses have a large open to covered space ratio, as much of the life is spent out of doors. The courtyard shape and size varies in response to the heat and humidity conditions of different regions. The courtyard in northern India is normally found within the house or surrounded by a boundary wall. In the south and east of the country front and back yards are more common.[17] The variation in form and its relationship to climate will, however, have to be reviewed in the light of introduction of new materials like glass and RCC and the possibility of cost and material optimisation in roof and wall thickness.[18]

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[13] ASI, (Memoir no.8, 1961).
[14] Paul Oliver, Dwellings Across the World (Phaidon, Oxford, 1987), p. 54.
[15] N.K.Bansal and Gernot Minke, Climatic parameters, climatic zones and rural housing in India (1988).
[16] For a detailed discussion of this study, refer, TARU (1992)..
[17] ASI (memoir no. 8, 1961).
[18] Aromar Revi et al (TARU), BMTPC: Technology Action Plan for Rural Housing (1991 - 2001) (TARU, New Delhi, 1992).

2.2 Construction Practices - Materials and Techniques

Locally available natural resources, primarily earth and biomass, form the major part of building materials used for both roof and wall construction in rural India. The National Building Organisation classified rural houses as '*pucca*' (permanent), '*katcha*'(temporary) or 'semi-*pucca*' on the basis of materials used in construction.[19] Earth and biomass are thus considered '*katcha*' even though many of the houses built from these materials have lasted for more than a lifetime, some for more than a hundred years. Such a classification of material and therefore of the quality of a dwelling unit has often been criticised. As early as 1959,[20] we see the definition of *katcha*, *pucca* and dilapidated in the following manner:

- *pucca* - that which has a life of 20 to 30 years with proper maintenance
- *katcha* - life 5 to 10 years with annual or more frequent maintenance and
- dilapidated - of quality which should be demolished and rebuilt if necessary.

This classification in terms of 'life' of a building which includes materials, construction technique and maintenance, and therefore considers a holistic view of the house has been replaced by the quality of material used for construction with no regard to the complete picture. The housing census of 1981 enumerated rural houses on the basis of materials used in roofs and walls, (Appendix 2.3). The results of 1981 census are taken a step further in a study conducted by TARU in 1992. It includes techniques of roof and wall construction using naturally occuring materials.[21] Projections till the year 2001, made in the same study, indicate the major trends of building materials use in rural areas. It is estimated that earth and biomass will continue to be the most popular building materials even though these are being replaced in many regions by fired brick and RCC.

There is a significant variety in construction techniques from one region in the country to another. This is obvious in the variety of building types. Field surveys conducted by Development Alternatives in 1989 and 1992, and by TARU in 1992[22]

[19] Revi (1991) and TARU (1992).
[20] Rene F. Eyheralde; Village Redevelopment Project - A report (Ford Foundation, 1959).
[21] TARU (1992).
[22] Development Alternatives; "Rapid Appraisal of Building Systems in Western Uttar Pradesh." (Development Alternatives, New Delhi, 1989), "Primary Survey and Analysis of Rural Shelter for Selected Districts in Western Uttar Pradesh." (Development Alternatives, unpublished research, New Delhi, 1992), Vaidyanathan and Niazi (1993) and TARU (1992).

provide comprehensive documented information regarding techniques utilised to construct roofs and walls in some rural areas. The studies indicate that presence of a certain material within accessible range and its quality, along with the climatic variable, largely determines the technique to handle the building material. Access to adequate tools and technology to utilise the full potential of a material, however, naturally limits the technical choices available to a community.[23]

Some construction techniques have been analysed with respect to materials used, skills required, performance, embodied energy and direct monetary costs, (Figure 2.3). The roof and wall systems need to be studied further in terms of their sub-systems, i.e., frame, under-structure, insulating layer, water proofing layer etc. This breakdown would yield an understanding of the weakest link in the system in terms of cost, structural stability, linkage with other elements of the system, resource scarcity, environmental threat, possibility of replacement with another material or resource regeneration.

The fastest growing sector in rural areas in terms of wall construction is found to be burnt-brick masonry in mud or cement mortar. The houses with tile roofs on burnt brick walls set in mud mortar are found to be of the relatively high (structural) performance 'intermediate' housing type. Whereas, houses with biomass roofs on bio-mass walls have been described as the most inadequate form of housing, except in disaster prone areas where they provide considerable advantage over 'high mass' buildings.[24]

It has been a matter of concern that the wattle and daub type of walling system has shown an increase in the past 20 years. This has been considered as one of the factors contributing to the "dehousing" phenomenon in rural areas. Reduction in thatch and other biomass roofs without comparable increase in the tile, RCC sector and a growing 'housing gap' has been analysed as an indication of scarcity of the biomass resource and of reduced access of the poor to these resources.[25] However, the impact of increasing poverty on the access to these hitherto 'free' resources and people's aspirations to build '*pucca*', need to be considered in the analysis of housing need.

[23] Oliver (1987), pp. 58, 59.
[24] TARU (1992).
[25] ibid.

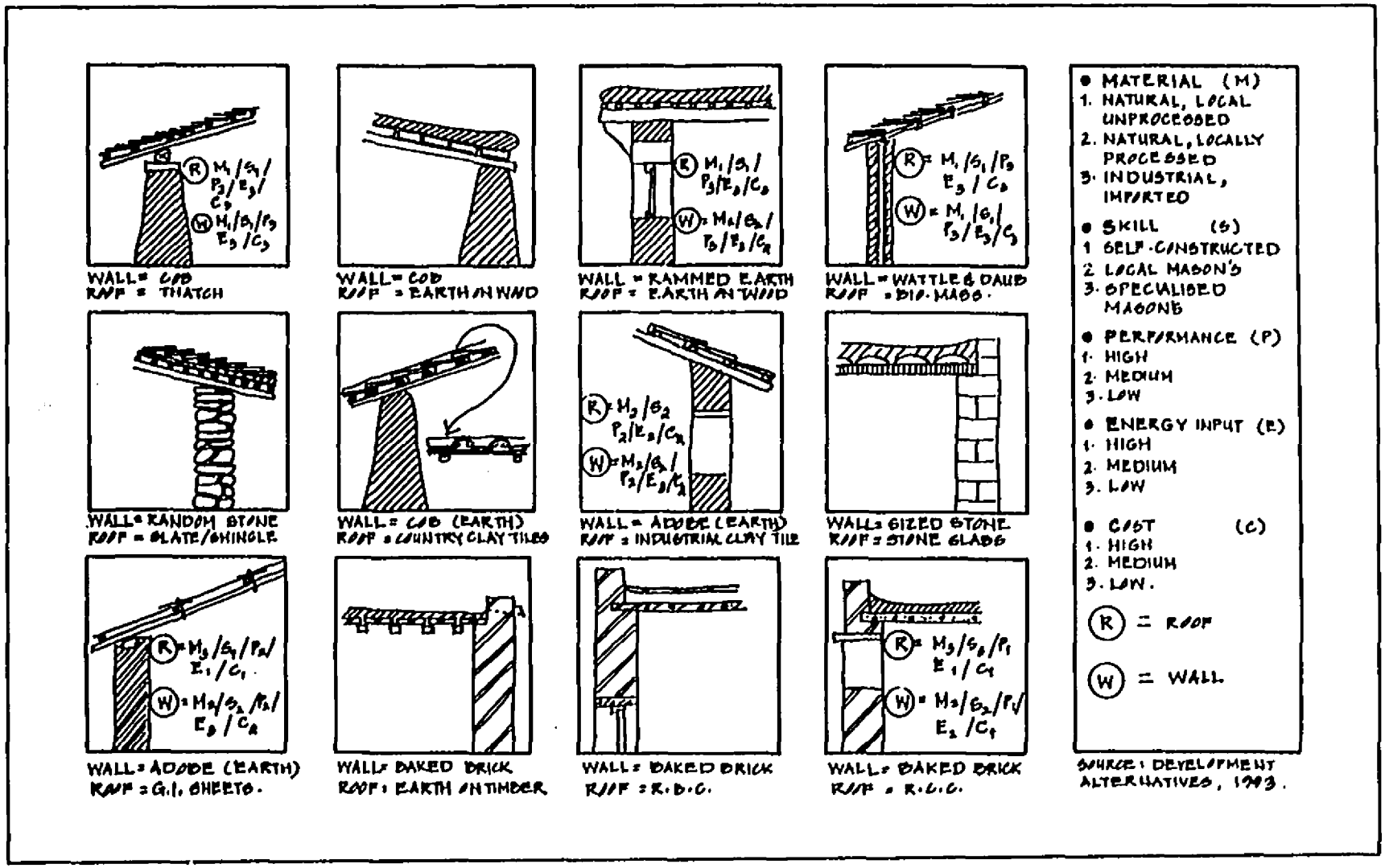

Figure 2.3 **Analysis of roof and wall construction systems**
Source: Development Alternatives (1992).

2.3 Rural Housing as a 'System'- the Process in Construction

The importance of studying the 'process' of dwelling creation as opposed to a mere discussion of construction techniques has been adequately demonstrated by various scholars and researchers.[26] The study of 'the process along with the technique of construction' yields insights into the building practice as a 'system'. Process involves the complex interpersonal relationships as well as the relationships that people share with each other, with their natural environment and with the technology available to them. These relationships, to a large extent, govern what will be built and how. This has much to do with the delivery of the product in its final form, and involves all forces and actors : physical - rational and non-physical -ritualistic, involved in the creation of a dwelling, its subsequent repair, maintenance and extension.

The construction sector has been analysed to operate under four linked environments - the social, technical, economic and managerial environments.[27] These linked environments or relationships form the 'building system' within the village. These relationships are manifested in the rural socio-economic institutions. They not only determine the settlement pattern and house form as has been described earlier, but also, in the context of the Indian village, provide a compelling code of conduct or behaviour in relation to all activities within the village including the act of construction. This includes the role of the various players in the process, the villagers' attitude to building technologies, materials and their uses, artisanal remuneration, the tradition of knowledge and skill transfer from generation to generation and other related aspects.

2.3.1 Social Linkages:

The Caste System and the Process of Construction: The rules and regulations of caste not only determine the position of dwellings within the village as discussed previously, but have also determined the size, level, material and degree of permanence of a house in earlier days. For example, in many regions *Shudras* (lowest-caste, supposedly

[26] John F. C. Turner; "Housing as a Verb" in Freedom to Build, Turner and Fitcher (eds.) (Macmillan, New York, 1972), pp. 148 - 165 and Oliver (1987), pp. 58 - 71 (amongst many others).
[27] T.N.Gupta; " Strengthening Housing Delivery Systems in Developing Situations - Status and Initiatives in India" in Low Cost Housing and Infrastructure (Conference proceedings, March, 28 - 30 1994, INAE, BMTPC New Delhi), pp. 1 - 39.

untouchable) would often not be allowed to build permanent structures because it clashed with caste values.[28] Caste divisions are regarded as permanent, hereditary and hierarchically graded. The institution of caste is pervasive and powerful, but not self-sufficient. Members of different castes have traditionally depended on each other for a variety of necessary activities, including those related to building and construction.[29] The institution is, however, rigid and perpetuated though birthright. It has resulted in the transfer of knowledge regarding specific skills also through birthrights, from father to son. This eventually gave rise to craft-guilds where the techniques and tricks of trade were carefully guarded and protected.[30]

The *Panchayat* as a Local Administrative Institution: The *panchayat* is the smallest level of administration in the country and fuctions at the village level. Every village, however does not necessarily have its own *panchayat*. Depending on population, two or more villages may be grouped under one *panchayat*.[31]

The *panchayat* by definition, is a council of five. Traditionally, it consisted of three to seven senior male members of the village who looked after the day-to-day village administration.[32] The operations of most traditional village *panchayats* have disintegrated due to many complex reasons, including colonisation by the British and current political processes at work in the country. Many of these bodies have unfortunately become appendages to political parties for vote catching and have a tendency to become battle grounds of village factionalism.[33] The new *Panchayati Raj* Act (not yet in operation) aims to provide more powers, both for implementation and of budgetary control to the *panchayats*. It also seeks fair representation of all sections of the village society, especially the backward classes and women.

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[28] Srinivas (1965), p.29 in Chandhoke (1990), p. 18.
[29] Srinivas (1960), p. 6.
[30] Oliver (1987). For a detailed account of the structure and functioning of traditional craft guilds in India, refer, Ananda K. Coomaraswamy; The Indian Craftsman. (Probsthain's Oriental Series, 1909).
[31] The grouping of many villages under one *panchayat*, as a consequence of present political processes, has resulted in the physical distancing of many *panchayat* members from the villages under their jurisdiction. This has been analysed by Agarwal and Narain (1989), as one of the causes of its mal-functioning, especially in relation to management of common property resources.
[32] For details regarding the structure and operation of traditional *panchayats*, refer, Srinivas (1960)
[33] Development Alternatives; "Community Based Resource Management Systems." (Development Alternatives, New Delhi, 1991)

The Rural Building Economy: The economics of house construction within a village are not simply the result of calculating direct material and labour costs. A study conducted in rural Gujarat[34] has revealed two major components of construction cost;

(i) Non-monetised, self-help component - This includes what a family can do itself, which involves unskilled labour, collection of some building materials, rudimentary construction work like cob walls and the like.

(ii) Monetised component - This represents 'cash' that needs to be paid to procure building materials and specialised skills not existing within the family.

Even within these main categories several combinations of cash, grain, service exchange, credit and instalment-based payment exist. The concept of Village Economy Component (VEC), introduced in the above mentioned study, refers to the part of economic transaction (in construction) conducted amongst residents of the same village or village cluster. The VEC is found to be more flexible as compared to non-local transactions in terms of periodicity in payments, informal credits and labour exchanges.

Service was traditionally exchanged through a system of barter called the ***Jajmani*** system. Within this system, artisans such as masons, blacksmiths, carpenters etc., were supported by the primary agricultural producers in return for their services. The *jajmani* system was organised on the basis of occupational castes and was heavily tilted in balance towards the rich land owners who also happened to be the higher caste groups. Coomaraswamy[35] describes the traditional rural craftsman as being under perpetual contract with the agriculturists. Monetary payment was unusual, in fact the amount of money in circulation in a village was negligible; grain and land grants, security and personal services taking precedence. Rapid monetisation of the rural society without sufficient development of rural industry has left many of the earlier craftsmen and service communities without an economic anchor. Two groups who have suffered most with the breakdown of the *jajmani* system are the artisans through the loss of patrons to support their crafts and livelihoods and the poor and lowest castes, who are now unable to procure (purchase) raw materials needed to put up and maintain their shelters.[36]

[34] CSV; "Is There Any Future for Burnt Clay Cottage Industries?" (CSV / GRET, Wardha, 1985).
[35] Coomaraswamy (1909).
[36] Revi (1990) and Srinivas (1960).

The agrarian life-style and the seasonality of agriculture result in cash inflow into the village system at harvest periods once or twice a year depending on single or double cropping systems. This had traditionally resulted in payment schedules (by way of grain or cash) to the artisans at annual or semi-annual intervals. This seasonal aspect of remuneration is no longer practised in many villages; however, studies of rural markets suggest that this characteristic is understood and capitalised upon by local small entrepreneurs and businesses in rural areas.[37]

2.3.2 Environmental Linkages: Rural India, due to its prolonged isolation from urban and industrial processes, developed a dynamic relationship with the eco-system in which it was embedded. Materials for construction, as we have seen, were mainly those that could be obtained from the immediate natural environment or produced through agriculture or from small craft-based industries like pottery and blacksmithy. An understanding of the regenerative capacity of locally available biomass like timber and grasses resulted in the development of regulatory mechanisms in many rural societies for the controlled extraction and management of these resources.[38]

The traditional rural house has been referred to as an agrarian product, similar to crops and livestock, dependent on a balanced eco-system.[39] The existence of village commons (as described in an earlier section), their maintenance and at least some right over this common property on the part of all sections of the society, whether high or low in the caste-pyramid, suggests that the villager understood his dependence on, and the limitations of, the eco-systems's carrying capacity.

The foresight of farmers in the construction of their houses is evident in the fact that very often, "*trees were planted many years in advance within the farms for the next generation to use them in construction*".[40] Whether this eco-sensitivity was imposed by circumstances or is inherent in the rural psyche is not clear. As previously discussed,

[37] Arun Kumar; "Small Enterprises for MCR Production in India - A Case Study" in Basin-News, Issue No. 8, (SKAT, July 1994), pp. 28 - 30.
[38] Refer to note nos. 10, 11 and 12 in this Chapter.
[39] Chapter - I and Mitchell and Bevan (1992), p. 6.
[40] S.M.Amin; "Rural Housing Problems and Role of Self-Help Housing" in Sociological and Economic Aspects of Housing, (NBO, 1969), p. 63

population pressures and decrease of the villagers' control over village commons have led to 'free-access' situations and eventual scarcity of bio-resources. Present day strategies, designed to regulate intensive use of natural resources and their regeneration will need to understand and incorporate traditional resource management know-how.

The Rhythm in Construction: The variety of materials available in different areas and response to diverse climatic conditions has produced tremendous regional variation in construction 'techniques'. The 'process' of construction is, however, unified by the relative regularity of monsoons that strike most of the country within a span of four months from June to September.[41]

This seasonal factor is responsible for the rhythm in house-building activities in rural areas. Construction follows the pattern of agricultural activities that are regulated by the monsoon. Thus, during sowing and harvesting seasons, nearly everybody is at work in the fields. Slack time in between is spent in other activities including that of house building. A whole house is rarely built at one go, but is phased seasonally over a period of two or more years. This characteristic of the rural building practice, enables the villager to invest in small amounts for incremental and piece-meal construction, without requiring a large capital outlay. It also provides a lag period that allows biomass to regenerate for the next cycle.

Murton[42] has described three work environments in the Indian sub-continent on the basis of biological activity depending on the availability and frequency of sunshine and rainfall. These are, the high, low and seasonal work environments. He has found, that contrary to logical expectation, human populations in South Asia have not concentrated in high work environments of tropical rain forest areas. Maximum densities of human populations are found in seasonal environments of the Gangetic plains and the Deccan plateau. This suggests a preference for seasonality and a periodicity that allows, *"a time to plant, a time to cultivate and protect the crops, a time to harvest and a time to rest and prepare for the next cycle."*[43]

[41] Revi (1990).
[42] Murton in Klee (1980), p.71.
[43] ibid.

2.3.3 Technological Linkages: The variety of traditional construction materials and techniques seems to suggest that there are very many ways of building houses. The village mason talks of a range of materials that he can use for building a shelter, but central to the options of materials that he chooses from, is the *"process know-how logic"*[44] of each. For example, walls for single storey light roofed buildings can easily and adequately be constructed with adobe or even cob. It is however crucial to the construction process, that wall height must not be increased by more than 2 feet for cob and 8 to 10 courses of adobe per day.[45] This cannot be compared with a conventional fired brick, cement-sand mortar construction where the mason's productivity per day is much higher because the materials used allow it.

The built environment has been described as situated within the social environment.[46] *"The physical setting provides the possibilities from among which the choices are made. The choices are determined by taboos, customs and traditional ways of culture. Even when the physical possibilities are numerous, the actual choice may be severely limited by the cultural matrix."*[47] For example, the roles of the man and woman in a family during the construction of a simple cob wall are quite distinct.[48] Introduction of a new material or technology may put the process beyond the reach of either one of the partners.[49] This, in some cases, may lead to the improvement of the structural performance of the building while in others it may result in the rejection of the new method which requires a recasting of traditional family roles.

Characteristics of Construction Skills: It is generally believed that every one in a village understands the building process and can therefore construct his or her own dwelling. However, the 'process know-how' of certain specialised techniques may not be simple enough to be understood by all in the village. It therefore takes on ritualistic associations for the average villager. Only the master mason understands the logical reasoning behind

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[44] K.S.Gopal; "Housing for the Rural Poor" in The House that Grows (Proceedings of the International Conference on Rural Low-cost Housing, 1988), p. 28.
[45] ibid.
[46] Chandhoke (1990).
[47] Ogburn and Nimkoff (1956) in Chandhoke (1990).
[48] Tasneem Chowdhury; Women's Domain in Rural Housing in South Asia (M.Arch. thesis, Mcgill University, Montreal, 1992)
[49] K.S. Gopal (1988).

the ritual. Specialisation regarding stone cutting and laying for example, may not be available to every one in the village although every one more or less recognises and identifies with the basic rules. This process has been appropriately compared with a handicraft mode as opposed to the industrial production mode.[50]

The know-how of simple processes, on the other hand, is available to all members of the community. Knowledge is transmitted through collective memory and most simple operations are carried out empirically. As the procedure does not involve any complexity, "*any one can control its 'technology', which further implies more freedom of action and hence less dependence on the external world, thereby reducing the realisation of cost*".[51] This may however, result in the low prestige value that is often accorded to such simple processes.[52]

Collective and specialised skills as described above have been classified as personal skills and local skills.[53] Local skills pertain to area skills - those possessed by a highly paid mason in the area. Many villagers still rely on their own labour (personal skills) to construct simple cob wall - thatch roof houses. A one step upgrading to adobe in their case might put the house out of their reach because it now requires a trowel - a seemingly simple tool, but one which needs skill to use and therefore has related costs. Another step up to fired brick and RCC might even put the regular maintenance and repair out of their control. Thus, although upgrading is desirable, the shift and the degree of shift in the level of process control needs to be examined in the light of affordability.[54]

The skilled mason may use simple tools, however he has complete mastery over their use. In fact the mason relies more on his skill than on the tool. Many tools are self-fabricated or adapted from old ones to suit a special need.[55]

It is generally accepted that traditional skills develop over long periods of trial and error. Fathy however argues, that traditions need not take generations to get established. The solution to a problem innovated by one mason - appreciated, accepted and applied by

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[50] Mohammed El-Bahi; "Traditional dwellings and Spontaneous settlements in North West Tunisia" in Traditional Dwellings and Settlements Working Paper Series, (Traditional Rural Settlements, volume 12, 1989), p. 31
[51] ibid.
[52] Oliver (1987).
[53] K.S.Gopal (1988).
[54] ibid.
[55] Coomaraswamy (1909), pp. 89, 90.

another, marks the beginning of a tradition.[56] Thus, conscious decisions of the builder in the devlopment of vernacular forms and techniques must not be undermined.[57] The mason has been defined as the primary vector in the evolution of the building practice and tradition.[58] It is through him and his understanding of the materials and techniques within the socio-cultural context, that building traditions, informal/popular codes or standards of construction are established, which evolve and adapt to changing circumstances.

The village mason prefers to build with materials that are familiar to him. The familiarity and the concepts of availability, utility, workability, durability, and net-cost along with ideas of prestige and aesthetics (defined in strictly local terms) are important criteria in the acceptance and popularity of materials and techniques.[59]

'Availability', from the view point of the villager corresponds to the ease with which a raw material can be procured with the local modes of transaction and the ability to use prevalent skills to process it.

'Utility' pertains to the rural attitude towards a material possession which serves different needs of prestige, possibility of mortgage, inheritance etc. Sand-stone slabs, columns and fixtures in Rajasthan for example, are not only meant to last till the house as a whole remains in form, but also represent capital assets acquired to out-live future generations.[60] Similarly, tribal populations in Orissa have been found to attach special significance to timber beams, posts, door/ window frames and lintels. These are carried with the community as it moves from one part of the forest to another. Local grasses and soil provide the infill materials, while permanent structural elements are reused for many generations and mortgaged or sold if 'cash' is required at any point. These are family assets and savings.[61]

'Workability', refers to the ease with which a material can be worked upon by local specialists or through the conventional methods. A material which may be processed and shaped for use by a higher level of technology may be recognised as being just as

[56] Hasan Fathy, Architecture for the Poor (University of Chicago, 1973)
[57] Oliver (1987).
[58] Babar Mumtaz; The Changing Rural Habitat, vol. I, Aga Khan Award for Architecture, (Concept, Singapore, 1988).
[59] David Oakley and K. Ramman Unni (eds.); "The Rural Habitat: dimensions of change" in Village Homes and House Groupings (SPA, New Delhi, 1965).
[60] ibid. p. 21
[61] Based on the author's experiences in Phulbani district of Orissa.

workable, but not accepted for popular use unless the mason as well as the villager perceive its grades and qualities.[62] Thus, a study of local materials and techniques within the total context indicates how deeply they are embedded in the socio-cultural milieu, and what could therefore be suitable and acceptable improvements to them.

The above discussion has attempted to build a broad picture of rural building practices and processes in India. Rural life is no longer isolated from urban and external influences. Increased accessibility (roads and railways) and the media (especially television) have brought rural residents into the mainstream of national political and economic processes, affecting and changing long established traditions. Urban construction practices and public sector developmental policies have been identified as major influences on rural building practices. Increased accessibility to urban societies and capitaist market mechanisms by socially and economically ill-equipped villagers have their disadvantages too; as Murton says, "*the average villager, today, is more intimately linked to the outside world and perhaps more vulnerable to it than ever before.*"[63]

2.4 Initiatives in Rural Housing

The rapid and often detrimental changes in rural housing conditions due to resource depletion, population pressures, monetisation of economy and reduced access to resources have necessitated formal interventions into the system. The following section discusses external interventions into the village system, in particular, provisions in the National Development Plans, development of new / improved materials and technologies and attempts to disseminate these by both formal and independent sector organisations.

2.3.1 Housing Plans and Policies: Housing issues have been part of the National Development Plans[64] since independence in 1947. In the specific area of rural housing,

[62] Oakley and Unni (1965).
[63] Murton in Klee (1992), p. 94
[64] India's National Development Plans are formulated at and for five year intervals. Except for a period of three years in early 1960s, when three one year plans were formulated, the five year plans have been a regular benchmark for planning and analysing developmental processes since 1950. Currently the eight five year plan is in operation.

however, major initiatives have only been taken since the 1980s, at the end of the Sixth and the beginning of the Seventh Plan periods.

During the early phases, low quality of housing was attributed to improper settlement planning, unsanitary and ill-ventilated house designs and lack of sewerage and drainage facilities. Landlessness was considered as the single factor responsible for homelessness and land re-allocation and re-distribution were proposed as key solutions. The legislative measures designed to implement this have, however, been more or less ineffective.[65]

Lack of modern industrial materials was considered a problem, during these early phases. Major emphasis was laid on making the country self-sufficient in cement and steel production and large investments were made in establishing industries for the same.[66] At the same time, there was an increased bias of urban housing standards in terms of space design, building materials and construction technologies.[67] The results of R&D efforts to improve traditional building materials and construction technologies carried out by institutions like the Central Building Research Institute (CBRI), National Building Organisation (NBO), Centre for Scientific and Industrial Research (CSIR) etc. were largely ignored. New developments like soil-cement blocks and stabilised mud plasters were characterised by very few field trials and more or less remained at laboratory testing stages due to lack of sposoring agencies and of inadequate delivery mechanisms for their implementation.

In the 1970s, the role of 'people's participation in housing' was emphasised for the first time. The One Lakh Houses Scheme (OLHS) in Kerala was an important step in recognising the potential of local building materials, labour and skill.[68] Rural housing schemes in rest of the country, however, saw the continued imposition of urban and western standards in design and construction. Community buildings in rural areas built with public sector funds eventually became 'symbols of progress' and could all be

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[65] Chandan Sen Gupta; "Social Housing: the policy and the people" in Housing in India: problem, policy and perspectives; Jayaram and Sandhu (eds.) (New Delhi, 1988).
[66] ibid.
[67] Revi (1990).
[68] For details regarding this important step/stage in the development of the approach to rural housing in India read Thomas K. Poulose; Innovative Approaches to Housing the Poor: role of voluntary agencies (C.Mathews, Trivandrum, 1988)

classified under a single heading of 'PWD construction'.[69] They were characterised by a similarity in materials and construction techniques (often also in form) throughout the length and breadth of the country. Impact in terms of numbers was slight, but influence in terms of value judgements of building materials as *katcha* (temporary) and *pucca* (permanent) gained ground. This has done much harm in stereotyping buildings and construction systems. Locally available building materials and indigenous skills lost ground and credibility in the face of these modern symbols of progress.

The later part of the Sixth and Seventh Plan periods, in the eighties, were influenced by the spirit of the International Year of Shelter for the Homeless (IYSH, 1987), and its projected goal of shelter for all by the year 2000 AD.[70] The National Housing Plan was the first step in this direction.[71] Technology was recognised as an important means for problem-solving in the area of rural housing. Many housing schemes utilised the construction techniques developed by CBRI and other research organisations. Credit and financial assistance schemes especially suited to the rural areas were sought to be designed. The setting up of the National Housing Bank and the National Bank for Agriculture and Rural Development (NABARD) were important steps in this direction.

The above phase was also characterised by environmental and resource management considerations in human settlements issues.[72] The relationship of rural housing to rural socio-economic issues was recognised. The activity of housing was related to the poverty alleviation programmes.[73] Under the Integrated Rural Development Programme (IRDP) many rural housing schemes were launched which focused on rural poverty alleviation. Construction skills and building activity were now accepted as part of income generating activities in the villages and were incorporated in programmes like Training of Rural Youth in Skills for EMployment (TRYSEM), the Rural Landless Employment Guarantee Programme (RLEGP) and the National Rural Employment Programme (NREP).[74]

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[69] Public Works Department - the public sector agency for implementing construction works in most of the country.
[70] Chandan Sengupta (1988).
[71] D.R.Veena, Low income Rural Housing: a model for government policy and action, (1985) and K. Thomas Poulose (1988).
[72] Revi (1990).
[73] ibid.
[74] For details refer, Desai, vol. 6, (1988).

An increased emphasis on the use and specification of local building materials and skills in rural housing programmes has been oserved in the period leading up to the nineties. Encouragement to use industrial waste and recyclable materials in construction has been coupled with some flexibility in housing standards and codes. A comprehensive National Building Code that includes low-cost and alternative building materials and practices has been published. Institutions like CBRI, NBO, Human Settlements Management Institute (HSMI), professional NGOs like Development Alternatives, Action in Science and Technology for Rural Advancement (ASTRA), Ahemadabad Study Action Group (ASAG) , Centre of Science for Villages (CSV) and many others are currently conducting intensive research in alternative building materials. The Council for Promotion of People's Action and Rural Technology (CAPART) has been formed as an institution to disseminate technologies for rural development. This has further received a boost by the formulation of the Building and Materials promotion Council (BMTPC), for accertainingthe standard and promotion of alternative building materials and techniques.

The 1990s have seen a critical appraisal of this initial increase in rural housing activity, both in the national and international circles.[75] Criticisms regarding the quality and overall effectiveness of housing programmes that have paid scant attention to ecological and environmental impacts have moved the policy makers to look at local strengths and potentials in specific areas to form region specific housing guidelines. The formulation of a National Action Plan for rural housing which would have guidelines for regional development plans is now underway.[76] This plan recognises the need to understand local and regional building practices in order to formulate effective housing strategies. District action plans are to be formulated on the basis of local conditions and needs.

2.4.2 Technological Interventions - Materials, Techniques and Technologies:

Research carried out over the last 20 years in industrial and building institutions has led to the development of a range of new building materials and techniques which can be

[75] K.Thomas Poulose (1988).

[76] "Project proposal for the preparation of data base for the National Action Plan for Rural Housing," (Development Alternatives, New Delhi, 1993).

produced from local resources, using simple small scale technologies and adapted to local traditions. These include improvements in soil and biomass based building techniques, ferro-cement products, alternative binders and thermo-plastics.

The number and kind of these technological innovations is quite large. Many have been forgotten due to technical failures on the field, or to a lack of promotion due to political, bureaucratic, marketing, or economic reasons. Most have made impact only in research papers and pilot projects. Many have not even reached that stage. The bottlenecks in the dissemination and wide-scale use of these materials and technologies are now being critically analysed; and measures are being taken to promote them.

Intermediate scale "appropriate technologies," which combine the advantages of small scale processes (flexibility in operation, not demanding high initial capital investment or highly skilled labour) have been often demonstrated in many Third World countries, including India. Many of these materials and elements that can be manufactured at small-scale do not find easy acceptance by end-users, nor by regulatory authorities.[77] Small-scale producers and craftsmen face several constraints in upgrading their production facilities and skills to adopt these 'appropriate technologies'. Some of the associated problems are: lack of information, shortage of risk capital, low accessibility to credit facilities, inadequate training and market extensions,[78] while others relate to social and cultural factors.

Biomass has been identified as a major area of research under the Eighth Plan. This is the only resource that can be regenerated and therefore forms a sustainable source of building materials. Biomass-based resources are the predominant materials for roof and wall construction in most rural areas of the country. It is estimated that large quantities of these materials will be required over the 1991-2001 decade not just for re-thatching, repair and maintenance; but for new construction.[79] It is also felt that very little data exists about the various types of biomass used in rural areas. TARU[80] have conducted pioneering

[77] For a critique on government policy concerning the building materials industries in the countries of Asia and Africa read the reference in note no. 89, p. 7. Also refer to an ongoing dialogue on building materials in the III World in Jill Wells (1994) and Robin Spence, "Building Materials for Housing: a Rejoinder" in Habitat Intl. vol. 18, no. 1, (1994), pp. 85 - 86.
[78] "Building Materials for Housing -Report of the Executive Director of UNCHS"; Habitat Intl. vol. 17, no 2, (1993), p.6.
[79] TARU (1992).
[80] ibid.

research in biomass availability, its usage and present and projected demand in the country. They have identified major areas of research and the limitations in present day use and study of bio-mass based materials.

Industrial materials like lime, cement, steel, thermo-plastics, paints, etc. have always been important areas of research and development. The development of small-scale plants for localised production of cement was promoted during the seventies and now over 2500 such plants exist in the country which utilise the vertical shaft process.[81] Many researchers have, however, felt that mini-cement plants are actually a stagnant technology.[82] Efficiency in lime production at local levels is also being looked at, however with much scepticism.[83] There has been considerable research in small-scale production of fired bricks and increasing the fuel efficiency of traditional kilns. However, it has been pointed out that both indirect energy costs and direct cash price of most industrial materials have increased six-fold since 1971. This trend is expected to continue, serious research is therefore required in their efficient use in construction.[84]

2.4.4 Initiatives in Delivery Methods: The credibility of new, improved and "appropriate technologies" has often been a victim of inadequate delivery to target groups. Scholars and field workers alike are now recognising the importance of "appropriation" (verbal noun) as the key to this bottle-neck and a prime indicator of "appropriateness" (an adjectival noun). A product or technology is appropriate only when it is understood, adapted and indigenised, in effect, "appropriated" by the people for whom it is designed.[85] For this to happen, the product and its process not only have to be simple in design, of human scale, utilise local materials and skill and generate wealth in local markets, but they must also 'reach' the target audience. Thus the delivery of the product becomes very important, and must essentially be built into the design process.

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[81] "Building Materials for Housing -Report of the Executive Director of UNCHS"; Habitat Intl. vol. 17, no. 2, (1993),pp 1-20.
[82] Jill Wells; "Building Materials for Housing- Comment on the Report of the Executive Director of UNCHS", Habitat Intl. vol. 17, no. 4, (1993), pp 87-92.
[83] Mohan Rai; "Building Materials in Developing Countries" in Low Cost Housing and Infrastructure (INAE, BMTPC, New Delhi, 1994), pp. 137 - 151.
[84] ibid.
[85] Mitchell and Bevan (1992), Mumtaz (1989) and Afshar (1985).

The failure of past attempts at technology transfer have necessitated an urgent need for innovative modes of technology transfer based on a clear understanding of local needs and abilities. One such model for the diffusion of appropriate technologies to the small-scale building materials producers and craftsmen comes from the **Building Centres Movement**. The building centres aim to provide integrated production and marketing packages, for cost-effective construction, using a mix of traditional and new technologies. They have been described as "*appropriate mechanisms to speed up the pace of house building using local materials and mobilising local initiatives in the spirit of the enabling approach promoted by the Global Strategy for Shelter*".[86]

The *Nirmithi Kendras* as they are known in the South or the *Nirman Kendras* of the North were first established mainly to meet the growing need for building materials.[87] Nearly 200 centres have been set up in various parts of the country, many of these are completely functional, undertaking activities such as training of artisans and other workers in construction related skills, consultancy to local house holders, demonstration and production of cost effective building materials and components. These centres have been described as 'agents of change' and are being seen as 'delivery channels' for transfer of appropriate technology to the grassroots.

In the past decade, the role of the non-governmental **Independent Sector Organisations** in 'research in action' for improving the quality of life in rural areas, especially in the area of shelter, has become prominent. Many of these agencies undertake scientific research and development. They conduct surveys to estimate actual needs of the people. Their contact at the grassroots level gives them better understanding of the problems of rural shelter.

Local **Micro Enterprises** are recognised as effective means of delivering appropriate building technologies. The real builders operate at small-scales and through non-formal institutions. New and improved technologies and construction systems can be successful in wide scale application only if these are profitable to these real builders - the building materials producers and the craftsmen.

[86] "Building Materials for Housing -Report of the Executive Director of UNCHS" in Habitat Intl., vol. 17, no. 2, (1993), p. 13.
[87] K. Thomas Poulose (1988).

Micro or small scale enterprises operate efficiently in rural areas drawing upon the local population as potential markets within the rural economic system. These enterprises work with products, building technologies and designs selected on the basis of determinants that reflect the priorities of local users. They are found to have a high quality-to-input ratio, to be highly participative and to use flexible financing methods.[88]

The above sections have built up a broad picture of the rural building system and its various dynamic linkages. The changes in physical and socio-economic structures of rural life have led to considerable changes in building construction processes, necessitating formal interventions. The public sector has responded with a variety of policies and programmes. The following section presents a summary of the above discussion. It analyses the problems and potentials of indigenous rural building practices and highlights the strengths and weaknesses of the formal response to the problems of rural housing.

2.5 An Analysis of Problems and Potentials

Most rural construction utilises materials that can be collected from the immediate natural environment. These materials are either used in their raw state or processed in a rudimentary manner. Simple tools, high labour and low energy inputs are characteristic of the process. Despite this, the resultant building elements possess a considerable amount of complexity.

The use of mud and biomass, as in traditional construction, call for regular maintenance and care. This was not an overriding problem in earlier days, as such resources were readily available and lifestyles permitted regular maintenance cycles. Today, frequent maintenance will have to be balanced by the opportunity costs of time: regular and self-help maintenance may not really be a solution in many cases. It is, however, clear that rural populations will for a long time continue to depend on locally available natural materials, although industrial materials like cement and steel will be increasingly used as catalytic reinforcing inputs.[89]

[88] Shrastant Patara, "Transfer of Appropriate Technology through Micro-Enterprises", in Low Cost Host Housing and Infrastructure (conference proceedings, INAE, BMTPC, New Delhi, March 28 -30, 1994), p. 659.
[89] Revi (1990).

The recent analysis of rural houses, in terms of construction techniques utilising indigenous materials[90] leads to important changes from simplististic '*katcha*' - '*pucca*' definitions. It provides a much better idea of the house types under consideration and therefore of the minimal and specific interventions that need be made.

In search for low-cost options, building professionals are now looking at indigenous materials and techniques. However, most R&D work in this area is *ad hoc* and fragmented, not keeping 'complete shelter systems or packages' in mind. Marketing and other forms of dissemination are almost always afterthoughts and rarely built into the design and development of a technology package.

Underlying this search for low cost technology is the belief that technology can provide all the answers. Formalisation of the whole process, however, raises the costs of these options beyond affordable limits for the poor. Thus the need to get around this problem: can processes based on indigenous knowledge show us a way?

We have found that any system of construction carries with it a baggage of extremely localised aspects. This not only incorporates techniques of utilising materials, manpower and tools but also a whole network of social and environmental relationships.

The breakdown of the traditional social linkages have had both positive and negative impacts. The *jajmani* system of traditional, personal, exchange relations, based on rigid caste lines, is being replaced by impersonal, contractual relations.[91] Where on one hand, this has apparently liberated a whole section of the population which had been subjugated and dehumanised for centuries, the same people are now left without an anchor. Village 'development' projects have done little for them. The lowest castes, those who are mainly landless labourers, often gain nothing at all from rural development projects. They have nothing to begin with, nothing which can be improved, no means of getting an economic start and so they remain economically as well as socially disadvantaged. The gap between them and the other villagers often widens rather than diminishes as 'development' reaches the village.

[90] TARU (1992).
[91] Revi (1990).

There is today a process of social change within rural areas set in motion by economic and technological developments and political processes in the country. The recent interest to revive and recast community based resource management systems for integrated village development seem to herald this change. The role of independent sector and grass-roots level bodies is being recognised and encouraged. The setting up of Building Centres in peri-urban and urban areas has been an attempt to make region-specific building materials and construction skills available at localised centres, though the impact of these at the village level is not yet effective.

In terms of public sector initiatives, there has been a slow but steady change in the approach to rural housing issues. The uni-dimensional approach which saw housing problems as factors of landlessness, unsanitary conditions and lack of modern building materials has given way to a multi-faceted, integrated view which includes sociological, economic and environmental concerns. The public sector has attempted to move away from the role of 'providers' to that of 'facilitators' and 'enablers'. In this spirit, the public, private and independent sectors have all emerged as partners in progress.

The altered image of public sector approach to the rural housing problems is as yet theoretical and needs to be backed by documentation of implemented housing projects. Empirical data suggest that there is a large gap between the new attitudes in policy-making and actual implementation of housing projects in the field. It is clear, therefore, that facilitation and enablement policies require a holistic understanding of actual ground conditions - local building practices and delivery methods. Comprehensive studies are required at local village, sub-regional and regional levels to highlight specific characteristics and peculiarities of rural building systems. This will provide a much needed database for the formulation of effective local and regional action plans. It will also lend a sensitivity to the developmental interventions that are made in rural areas.

Part 2 of the research paper now deals with one such study conducted in six villages in the Bundelkhand region in Central India.

PART 2

CHAPTER III - THE CONTEXT

The rural area studied for the purpose of this research forms part of the meso-region of Jhansi uplands (District Jhansi in particular) in Bundelkhand region. This section examines the regional context of the study area in terms of its spatial, physiographic, climatic, and cultural characteristics. This is followed by a broad profile of the socio-economic conditions, administrative structure, settlement patterns and house forms observed during the survey.

3.1 The Field Study

3.1.1 Survey Procedure: Field research for the study was carried out in two phases each of ten days duration, with an interval of one month between them. The main purpose of the first phase was to secure a general feel of the area and to establish contact with relevant people. It involved the survey of a much larger area than what was finally decided upon. This facilitated the selection of villages that were later taken up for detailed studyin the second phase.

The preliminary survey plus secondary information regarding the region, provided a guide for the second survey. The first phase had been more general and open-ended, involving a broad spectrum of information like settlement patterns, agriculture, cropping patterns, vegetation, forests and political and class problems within the region. The second phase on the other hand, was more precise. It involved discussions with village house owners, artisans, building material suppliers, shop-keepers and factory owners. Technical discussions with government engineers, officers of the District Rural Development Agency (DRDA) and with the personnel of a major independent sector organisation - Development Alternatives, were also part of this phase of study. District and village level census information was collected and sample houses were measured and photographed.

The first phase of the study was conducted in the month of June before the advent of monsoons. This enabled observing village life during the lag period when most agricultural activities are at a stand-still and house building and maintenance activities are at their peak. The second phase was conducted during the monsoon in the month of July. Many houses had recently been repaired in preparation for the rains and their behaviour could be recorded. This phase also provided a firsthand understanding of seasonal changes in the rhythm of rural life.

3.1.2 Sampling: Study samples within the site were selected though a stratified sampling procedure.[1] Land-holding size formed the main criteria for socio-economic stratification.[2] Three socio-economic levels were identified (Section 3.2.4) using the results of an earlier sociological survey conducted in this region.[3] These were verified during conversations with villagers and the *sarpanchs* (head-men), regarding occupational pattern, land-holdings and dominant castes. A representation from each level was selected for the study. Personal introductions served as a basis for selecting the dwelling units, therefore, 'random' sampling was not always possible. In most cases however, one was made welcome following a request to be allowed into a particular house to study the construction systems and speak with the residents.

Findings of the discussions, measurements and drawings of a small sample of 1.5 to 3%, that is 3 to 5 houses per village, were confirmed though visual observation of a larger sample of approximately 15%. The consistency in observations was further validated by walking through the villages and, in conversations with villagers.

3.1.3 Data collection tools and sources of information: Various methods and sources were used to collect information (triangulation - an important feature of the RRA method)[4] in order to improve the reliability of primary findings. Flexible, unstructured but guided interviews, direct observation, measurements and photographs were primary sources and tools used to collect information during the field survey. A framework for the type of information desired was formulated prior to the commencement of the field survey (Appendix 3.1).

Secondary sources of statistical information used, were district level Primary Census Abstracts, village level primary data collected and compiled by the Jhansi office of the National Informatics Centre (NIC) and previous sociological and technological surveys conducted in Bundelkhand region and in Jhansi district in particular.

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[1] Chowdhury (1992), p.

[2] Development Alternatives, Datia, Madhya Pradesh, India: A Case Study in Sustainable and Manageable Development (Development Alternatives, New Delhi, 1993), Development Alternatives, District Development Strategy, Datia - Part I: Diagnosis and Synthesis of Issues, project report submitted to the Ford Foundation (Development Alternatives, New Delhi, 1992).

[3] Ibid., "District Profile -Jhansi, 1994." Notes received from Development Alternatives based on information from The Census of India, 1991 and Ongoing survey and research at Development Alternatives, New Delhi, July 1994.

[4] Refer Chapter - I for RRA as a research method.

3.1.4 Limitations of the Field Survey: Despite the advantages of language and of previous association with developmental work in rural areas, there were considerable cultural differences between the investigator (a city-bred, formally educated professional), and the rural individuals interviewed. This naturally limited the extent of 'participation' in the phenomena.

Limitations of time and means of travel restricted the selection of villages to those within a 30 km. range. However, villages both near and relatively far from any metalled road were selected. Being a woman and an outsider to the area, one had to be escorted at all times during the survey. This limited the survey to those villages in which one's guide had some sort of credibility and was 'known' or recognised so that one was received in friendship. This yielded reliable as well as detailed information regarding rural life-styles and building systems. Moreover, one was allowed inside village homes without any prejudice of caste or religion.

3.2 Bundelkhand - Land and People

The Bundelkhand region, lying in the folds of the Vindhyan mountains is at present only a 'geographical expression'. Its area is divided into the states of Uttar Pradesh and Madhya Pradesh (Figure 3.1). Historical records of ancient and medieval periods show that its geographical compactness facilitated political and administrative cohesion at various times.[5] The geographical boundaries of the region are well defined by rivers Yamuna, Narbada, Tons and Chambal in the north, south, east and west respectively. Bundelkhand can be said to have a distinct cultural personality. The region gets its name from the *Bundela Thakurs* - a dominant ruling class of this region between the 11th and late 19th centuries.[6] *Bundeli*, a variant of Hindi is the main language spoken here.

3.2.1 Physical Features: Topographically, Bundelkhand is divided into two parts - the south is mountainous while the north (wherein lies the study area) slopes down to the Yamuna. The region sits on one of the most stable land masses in the sub-continent. The terrain is undulating, rugged and rocky. It has been described as *"recognisable by a mass of rounded hills, typical tropical exfoliation weathering the reddish Bundelkhand gneiss, cut across by innumerable white quartzite dykes."*[7]

[5] M.L Nigam; Cultural History of Bundelkhand (Sundeep Prakasam, New Delhi, 1983), p. i (preface).
[6] Kirit K. Shah; Ancient Bundelkhand: Religious History in Socio-Economic Perspective (Gian, New Delhi, 1988), p. 6.
[7] Spate in Nigam (1983), p.4.

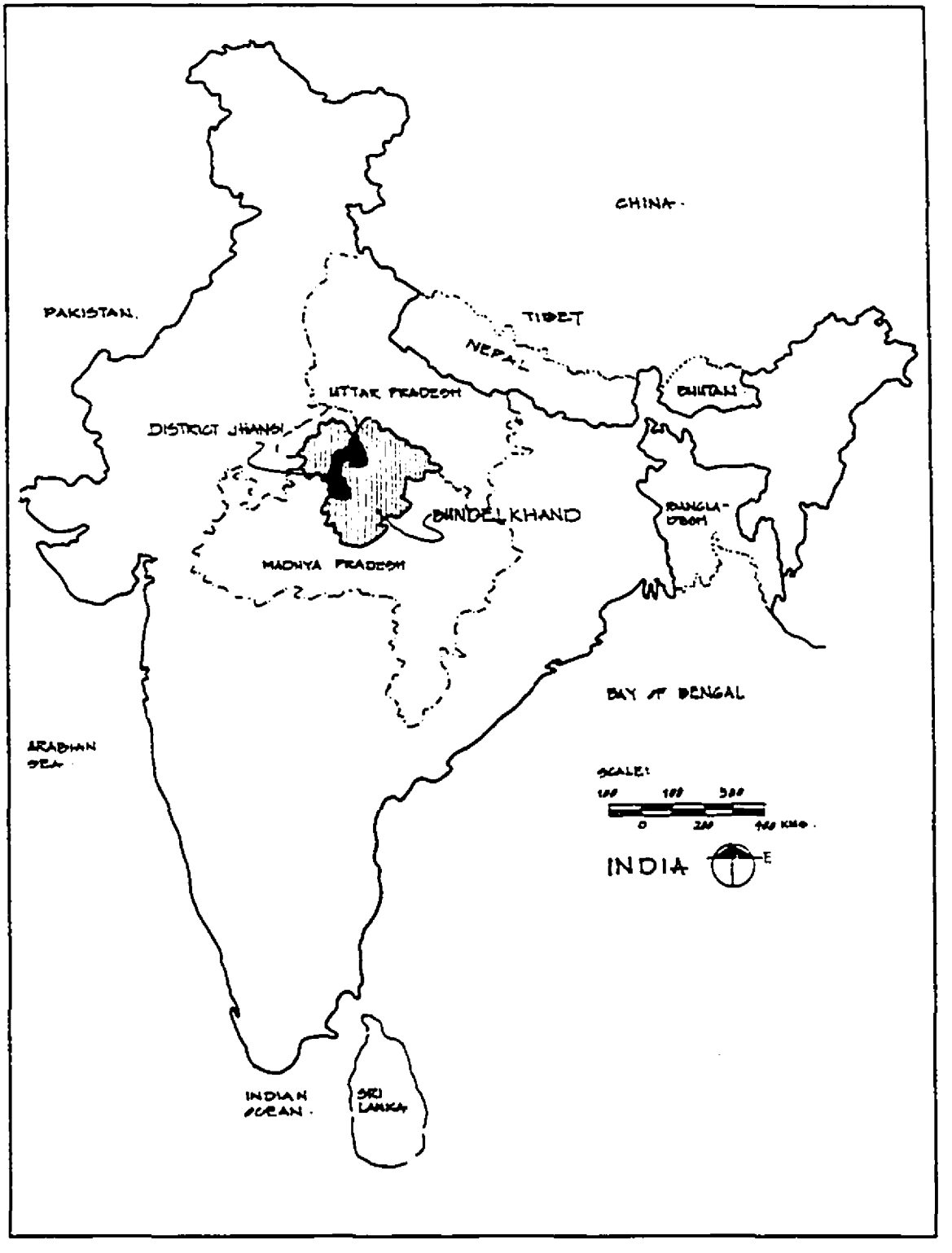


Figure 3.1 **Location of the Bundelkhand region in India**
After: Regional Divisions of India, Census of India, 1981 and Nigam, 1983.

Many large and small streams flow northwards from the hills of Bundelkhand to river Yamuna. Of special significance to this study is the river Betwa - its tributaries forming the drainage and irrigation channels in the rural area under consideration.

3.2.2 Climate: The region has a sub-tropical composite climate divided into three core seasons;

(i) hot-dry summer (March to June),

(ii) monsoon (July to September) and,

(iii) cold and dry winter (November to February).

A significant diurnal range is observed in both the summer and winter seasons. The south-western monsoon brings in ninety percent of the rainfall from July to September. The annual average precipitation for district Jhansi (wherein lies our study area) is 880 mm. There is a short spell of rain during the last week of December and the first week of January.[8]

3.1.2 Soils: Main soils of the region are red, black and mixed reddish brown. The red soils are lateritic in nature and are locally referred to as *Morram* or *Parwa*. These are coarse grained and sandy with little clay content. They drain well and are good for groundnut and oilseed cultivation. The most fertile soils are the reddish brown soils locally called the *Mar* or *Regur* soils; they produce rich crops of wheat and gram. The region also has pockets of black-loamy, fine grained soil with a high clay content and high water retention. At many points along the river Betwa erosion exposed, ravined *Rakar* soils are found which are too weak for cultivation. Large tracts of open land, once fertile, are now denuded and converted into wastelands covered with hard soil called *Kabar*.[9]

3.2.3 Natural Resources: The region has its fair share of resources that can, and are being used for construction purposes. Three forest types are found here, viz;

(i) dry miscellaneous,

(ii) northern thorn forests and,

(iii) dry tropical scrub forests.

[8] Nigam (1983). p.5 and "District Profile - Jhansi, 1994", p. 2.
[9] Nigam (1983) and Census of India: Regional Divisions of India General Note. (Census of India - 1981). p. 521

Most of the ancient forests have been destroyed and replaced by scrub - leading to extensive soil erosion. Marginally dense tree cover is found in reserved forest areas.[10]

The most abundant rock type is the Bundelkhand gneiss- a pink granite without mineral deposits. The Dharwarian and Vindhayan rocks in the region contain minerals and are economically important. High quality sand-stone, shales and lime-stone of uniform fine grain and texture are found here.[11] The rocky nature of land is exploited by the villagers to extract rubble for construction. Larger rock outcrops are often auctioned by the district administration to generate revenue.

3.2.4 Socio-economic pattern: Three distinct economic classes have been identified on the basis of land holding size (refer Appendix3.3 for land holding details in the villages studied):[12]

(i) landless farmers and tribals - scarce to subsistence economies,

(ii) marginal and small farmers with land holdings from 1 to 5 hectares - subsistence economies and,

(iii) medium and large farmers with land holding size from 5 to 15 and 20 to 40 hectares - sufficient to surplus economies.

A wide gap exists amongst the agriculturists with a minority of very large farmers and a majority of marginal farmers who can barely secure their subsistence. About 65% of agricultural families are small and marginal farmers collectively cultivating only 25% of the total agricultural area of the district. 35% of medium size and large-land lords cultivate the remaining 75% of the land.[13] Besides agriculture, animal husbandry occupies an important place in the economy of the district. Livestock are maintained for milk, meat, manure and motive power. It is estimated that the cattle-to-human ratio in the rural areas of Jhansi district today is approximately 1:1.[14] This has increased the pressure on the common pasture and scrub lands. Attempts by the communities or the government to rejuvenate the common *gram-sabha* and the government revenue lands have been few and far between.

[10] ibid., p.522 and Refer to Appendix 4.1 for locally available timber and its use in building.
[11] Nigam (1983), p. 6.
[12] Development Alternatives, ongoing socio-economic survey of Jhansi district,(1994).
[13] District Profile of Jhansi (1994).
[14] Revealed during discussions with AVM (retd.) Sahni, manager, D.A. Jhansi (a national NGO), and confirmed from the preliminary results of ongoing research at D.A. Delhi.

Of the many tribal communities in the region, mainly two reside in the district, near and within the targeted study area. The first group is of the *Laugharias* - a tribe of blacksmiths from Chittor in Rajasthan. They are migrant and do not settle at any specific place. The second group are the *Sahariyas*, traditionally hunter-gatherers in the forests of Bundelkhand. They have had to settle down and seek alternative employment, due to the decline of forest lands and consequent loss of traditional livelihoods. This tribe is being made to settle down in small communities adjunct to some larger villages.

3.3 The Study Area

The study area is administered in the jurisdiction of Jhansi district lying centrally within Bundelkhand (Figure 3.2). It possesses physiographic characteristics typical of the region. The city of Jhansi is the district headquarters and its main urban centre. It was established by Raja Bir Singh Deo in 1613 AD, and is renowned for the valour of its queen Lakshmi Bai during the first major uprising against the British rule in India in 1857 AD. It offers a spinal transport network consisting of a broad gauge railway line, the National and State Highways - NH 25, NH 26, SH 44 and other metalled roads.[15] Orcha, Datia, Shivpuri and Gwaliar are other urban centers to which the study area is connected.

Six villages were selected for detailed study after the preliminary survey. They are Raksa, Dhikoli, Palinda and Kanchanpura situated in block[16] Babina, and Khalilpura and Lidhora in block Gursarain. All these villages fall within the boundaries of the state of Uttar Pradesh. Besides these, Harpalpur at the Uttar Pradesh-Madhya Pradesh border in District Tikamgarh and a *Sahariya basti*[17] at Pura Badhera in Block Babina were studied briefly. Rural housing programmes and projects implemented at Raksa, Dhikoli, Pura Badhera and near Lidhora were also studied. Figure 3.3 below shows the location of the villages in relation to Jhansi city.

[15] "Bundelkhand - Jhansi", tourist brochure (Uttar Pradesh Tourism, 1994), p.1.
[16] Each district is further sub-divided in Community Development Blocks, developmental activities are normally taken up at the block level. Refer figure 3.2 for block delineation in this district.
[17] *Basti* - a settlement, see glossary.

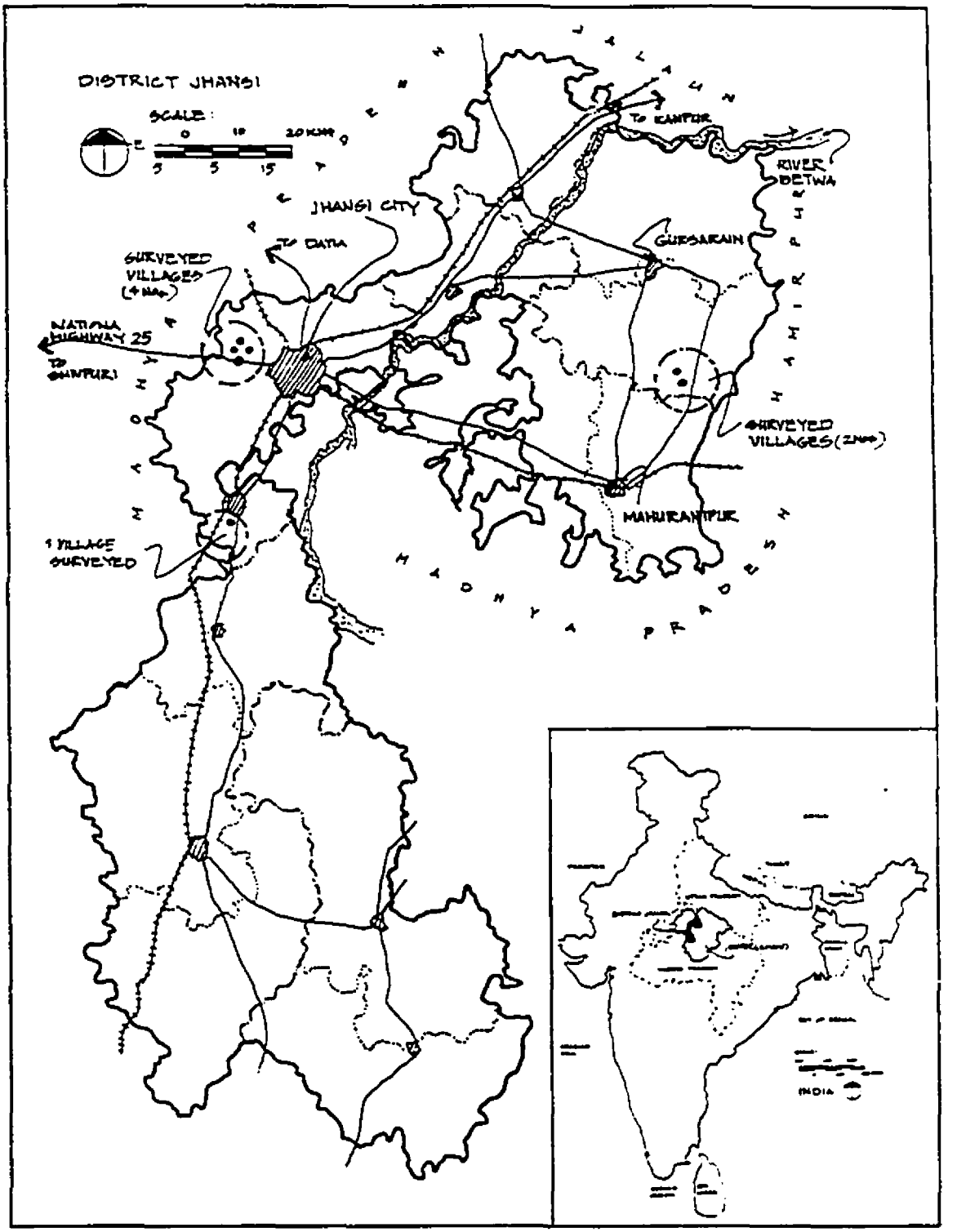


Figure 3.2 **Location of the study area within the Bundelkhand region**
After: District Census - Jhansi and Regional Divisions of India, Census of India, 1981.

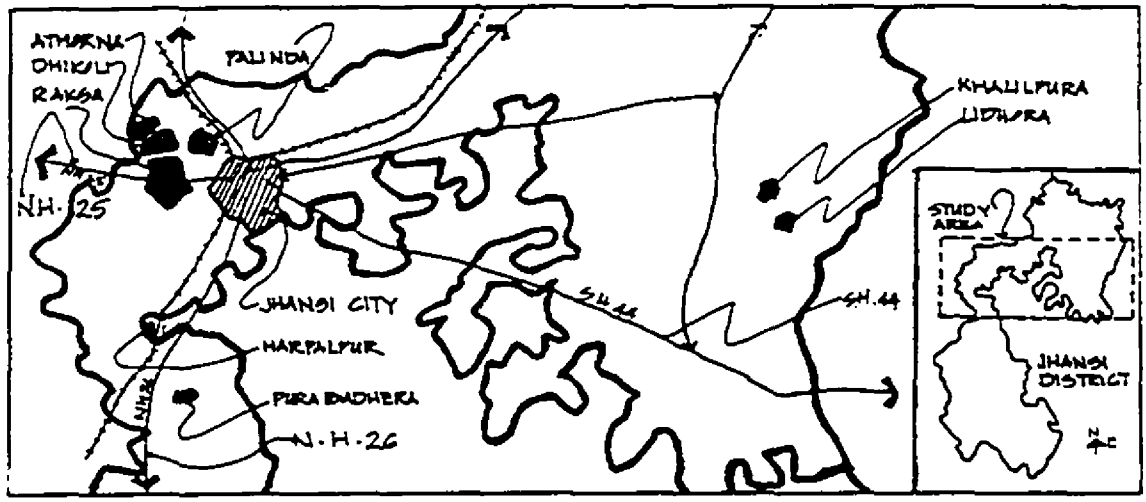


Figure 3.3 **Location of surveyed villages in relation to Jhansi city.**
After: "District Cesus - Jhansi", (Census of India 1981).

3.3.1 General description:[18]. Amongst the six villages studied, Dhikoli is the oldest, about 700 years old with a breakaway *Harijan*[19] settlement of 12 households adjunct to it.

Raksa is about 150 years old. The National Highway 25 (NH 25) cuts through this village dividing it into two parts with a metalled road. Regular truck and bus traffic has prompted the development of shops and small restaurants along the roadside lending it a small town character. It forms the main shopping area for surrounding villages. This village has two separate settlements adjunct to it belonging to the *Harijans* and *Sahariya* tribals respectively.

Palinda, a 400 year old village, has reduced in size from 2,500 households to only 700. at present. It has moved 2 km. south of its original site and now sits at the base of a hillock - the Pali Pahari.

Kanchanpura is the youngest village in the study sample. It was resettled in its present location only 30 years back when its earlier site was taken over by a military firing range. It has a small *Sahariya* settlement adjunct to it.

Lidhora and Khalilpura are situated at a distance of 110 km from Jhansi and about 35 km from Gursarain, the nearest town. Unlike the other four villages, these two villages are subject to very little direct urban influence. During monsoons, the stream separating them from the main road overflows, making movement across it difficult and dangerous.

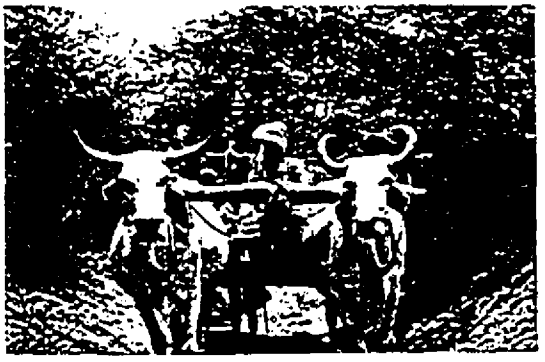
[18] The description is built up following discussions with local villagers during the survey conducted for this research.
[19] *Harijan* - or people of God is the name given by Mahatma Gandhi to the backward classes and the supposedly 'untouchable' lowest castes.

Raksa - view from National Highway 25

Dhikoli - Community open space

Village Dhikoli - side street

Sahariya Basti adjunct to village Raksa



Village road leading to Khalilpura

Lidhora - village entrance

Figure 3.4 Surveyed villages: views

The roads leading into the villages from the main state and national highways are of rammed earth, 2 to 3 metres in width allowing only one bullock cart to pass at a time. During monsoons, these roads become very difficult to traverse as the surface becomes soft and soggy. Bullock carts and tractors with trolleys are the common mode of transport on these roads. The villages studied in Block Babina fall under the jurisdiction of *panchayat* Raksa; Lidhora is administered by *panchayat* Bharkuwan and Khalilpura by *panchayat* Pandwaha in Block Gursarain. Appendix 3.2 summarises the primary census information of the six villages.

3.3.2 Socio-economic Profile: The socio-economic and demographic profiles of the villages are similar to that of the district. Besides small and large agriculturists, a small proportion of service classes like, barbers, carpenters and masons also reside in the villages. Pastoralists form a major community in Khalilpura and Palinda. The *Sahariya* tribals identified in the study are mainly farm and construction labourers. The land provided to them for their rehabilitation is largely rocky and unculturable. They also weave baskets and partition panels from locally available Lantana grass and sell them for a living. Appendix 3.3 describes the major castes and land-holdings in the villages concerned.

3.4 Village Structure and House Form

3.4.1 Settlement Structure: The settlements are nucleated-clustered[20] with well-defined *abadi* areas surrounded by fields and common lands. Within the *abadi*, spatial segregation of castes and sub-caste groups has given rise to distinct neighbourhoods. The *Harijan* quarter in all the villages was found outside the main settlement; except in Dhikoli, where the settlement seems to have grown around it. Structural character of dwelling units has traditionally varied amongst different caste quarters in the villages. Many more of the socially dominant (and richer) castes possess *pucca* houses than the socially depressed castes. This is, however, less obvious in some villages. Many backward class families, with improving incomes, have built up their houses to match those of the dominant *thakurs* and *brahmins*. In Palinda, the growing economic status of the *pals* (pastoralists - backward class) is reflected in the structure of their

[20] Refer Chapter - II.

houses. Similarly, the construction and extension of the houses of *brahmins* in Dhikoli and Palinda indicates their economic decline.

Development of the *abadi* areas is organic in character and well contained within its boundaries. In some places, an intrusion into agricultural areas was observed. This was explained as the need of a *bhumihar* (farmer) to be in proximity to his field for guarding the crop. The congestion within *abadi* areas due to population pressures is taken care of by groups breaking away and settling down in the commons.

Appendix 3.4 describes the settlement plans of the six villages surveyed.

3.4.2 Infrastructure and Community Facilities: All the villages under study, were observed to be partly electrified. Power connections to run irrigation pumps in the fields are preferred over residential use connections.

Drinking water is normally drawn from open wells or from government-installed hand pumps. No direct piped water supply exists in any of the six villages.

The percentage of covered toilets inside the *abadi* area does not exceed more than 5%. The need for individual, covered toilets was expressed by many villagers. Some affluent families have built toilets for themselves, the poorer sections, however still consider this as an added expense - a luxury they can do without. However 'pour flush toilets' - *Sulabh Shauchalayas*[21] provided for the *Sahariyas* in Pura Badhera were left unused.

3.4.3 The Commons: *Gram sabha* lands and village commons constitute important community facilities in the villages.[22] Open ponds, streams, pasture and forest lands all fall in this category. All the villages studied, except Kanchanpura, possess some common lands, although most of it is denuded forest and degraded pasture land - now termed 'wasteland'. It supports a large growth of the *Karondi*[23] bush which comes forth just prior to the monsoon, lending a green cover to an otherwise barren land. This, however, soon gets depleted as cattle take their toll.

[21] For details about this sanitation system, refer, Bindeshwar Pathak; Sulabh Shauchalaya (Hand Flush Water Seal Latrine): A Simple Idiea that Worked (Amola Prakashan, Patna, 1981).
[22] Refer Chapter II
[23] Local name; botanical name = Pongammia pinnata

Most common lands are *de facto gram-sabha*[24] property converted to *de jure* common ownership. Kanchanpura, did not possess any *de facto* commons in this site and was not provided any lands by the district government when the village was located here 30 years ago. The village is proximal to a revenue forest, the products of which are regularly utilised by the villagers, though illegally, for fuel wood, construction timber and fodder.

A small percentage of the common *gram sabha* land is cultivated while some is converted into *abadi* land. The *Indira Awaas Harijan basti* in Dhikoli, the *Harijan* and *Sahariya bastis* in Raksa are built on *gram sabha* lands. The beneficiary families have been provided with *Awasiya Pattas* (ownership certificates for residential use) by the *panchayat*.

A 600 year old *talau* (pond) forms part of the commons in Dhikoli. It has local cultural importance. Clay from here is used to manufacture roofing tiles.

3.3.4 House Form: The typical house form of this area is the courtyard type. The definition of the court depends on the level of consolidation of the house, that is the number of rooms or covered living spaces built around it. The courtyard is conspicuous by its absence in the *Sahariya* houses. They are a tribe people and share many more communal activities than the non-tribal peasant community. A *Sahariya* family is extended to include the whole community. This is reflected in the spatial character of a common open space surrounded by small one-roomed houses.

Generally, houses are one to two storeys high, very rarely going up to three floors. The entrance is normally flanked by a platform or *chabutra* on either side built of brick and mud and plastered with mud and cow dung. In the more affluent house holds, the *chabutra* is often paved with stone slabs. Figure 3.5 describes the typical spatial pattern found here.

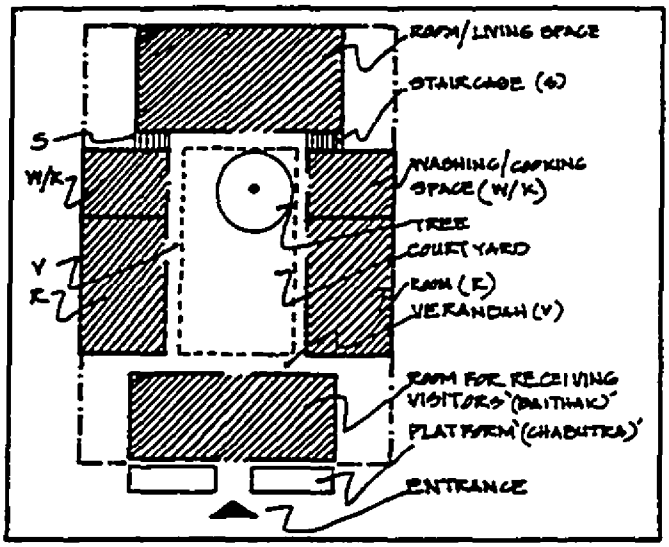


Figure 3.5 Typical spatial pattern of houses in rural Bundelkhand

[24] Refer to Section 2.1.2, Chapter - II and note no. 20, this Chapter.

Spatial development is normally from the back of the plot to the front. The reason lies in the local belief that the front of the house should be lower than its back. Normally, a house is never built all at once. The first act is to provide a boundary of thorn bushes or branches and twigs, with a small gate. The first space is built at the back end of the site and subsequent rooms are added along the boundary and in the front.

Materials and techniques of construction have undergone many changes over the years; but spatial structure based around the courtyard has remained more or less the same. The houses can be classified into three categories:

(i) the traditional house,

(ii) the transformed traditional house, and,

(iii) the government design house.

Table 3.1 below, describes the basic characteristics of these three house-types.

Table 3.1 : House types in the study area

House type	Spatial structure	Wall thickness	Openings
Traditional	Courtyard based	2 to 2.5 feet	None or small windows opening in the court; elaborately arched doorways
Transformed traditional	- do -	14" to 18"	Large window openings with iron grills; doors and windows spanned by flat stone or RBC
Government design	Single room, no courtyard	9"	Two small windows - 18"x18" on opposite walls

It is important to note that in most cases every one of the three types can be found in a single house. A house being a group of covered living spaces clustered around the courtyard and the covered living spaces having emerged at different times in the history of the house; each of the covered spaces might belong to a different typology.

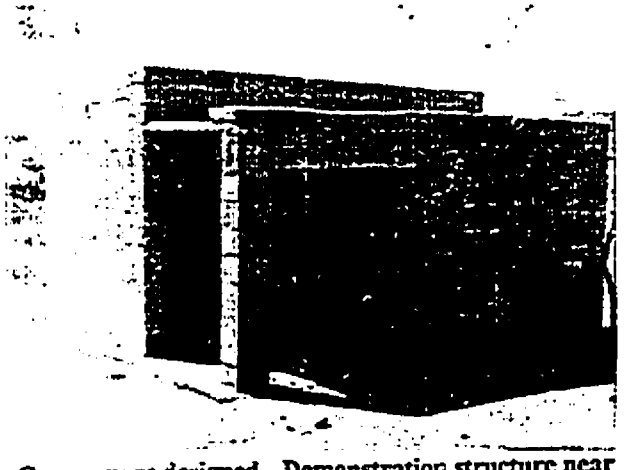
This chapter has attempted to build up a general picture of the study area and placed it in regional context. The following chapter presents the primary findings of the survey and describes the construction practices and methods of delivery in the building system of the six villages.

Traditional - *Sarpanch's* house, Dhikoli

Traditional - Owner unknown, Lidhora

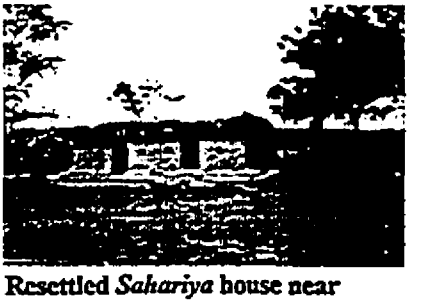
Transformed traditional - Owner unknown, Dhikoli.

Transformed traditional - Harprasad's house, Kanchanpura



Government designed - Demonstration structure near Pura Badhera *(Photo: DRDA, Jhansi District)*

Traditional *Sahariya* houses at check-dam construction site near Raksa



Resettled *Sahariya* house near Kanchanpura

Figure 3.6 House types in the surveyed villages

CHAPTER IV - BUILDING SYSTEMS IN RURAL BUNDELKHAND: FINDINGS OF THE FIELD SURVEY

In the previous chapter we identified three main house types found in the study area and differentiated on the basis of initial observation. In this study, we are primarily concerned with investigating **the building systems** related to the first two locally constructed types: the traditional and the transformed traditional. The third, related to public sector housing programmes is studied with respect to reactions of its residents to materials, technique and construction process.

The building system has been classified into two broad categories - **the building practice** (the what) and **the delivery process** (the how). This chapter deals with findings of the survey regarding the construction (the practice) and delivery (the linkages) of houses studied in the selected group of villages in Jhansi district of the Bundelkhand region. A discussion on changes in construction and delivery processes due to a variety of reasons and the reactions of rural beneficiaries to some public sector housing projects are also presented.

4.1 The Construction Practice

Construction can be broken down into various stages of extraction of material, processing of the raw material into masonry and roof units, transportation to site, assembly of the units into walls and roofs and their subsequent maintenance, repair, extension and renewal. Each of these stages is associated with a number of factors: people, monetary cost, energy, time and opportunity costs and a level of control by the individual concerned individual, family and community over the process.

Walls and roofs form the major proportion of expenditure in material, manpower and time that goes into the construction of a dwelling. A variety of roof and wall components was noted in the villages. This section describes the building materials, their extraction and transportation, the production of masonry and roofing elements, followed by a discussion of the various wall and roof types observed during the survey.

4.1.1 Resources for Construction - Materials and Elements: Most building resources being used are locally available and occur in the natural environment. Thus, earth, stone, timber, sand, aggregates, cow dung, and agro-residues form the bulk of building materials for both walls and roofs. Raw materials are extracted manually using simple hand tools. These are used unprocessed, as in cob walls (earth) and random rubble (stone) masonry in walls; or processed into masonry and roofing elements like fired bricks (*einth/gumma*), dressed stone (*khanda*) and clay tiles (*khaprel*).

Earth and earthen elements: Earth of various types found in the region has been discussed in Chapter - III. Villagers determine the quality of raw earth by its colour and texture, these being representative of the granulometry, presence or absence of humus and mineralogy of clay particles in the sample. The reddish-brown earth - *regur*, is most widely used in construction. In combination with the black clayey soil from ponds, it is used for constructing walls using the cob technique and for mud plaster or *lipai*. The fine grained variety of the reddish brown earth is mixed with black soil to manufacture two types of bricks - (i) *einth* and, (ii) *gumma* and roofing tiles or *khaprel*.

The coarse red earth, or *morram*, being lateritic, has little binding properties and is used for filling and on roads. Some pockets of the black clayey earth have deposits of lime giving them a dull grey to off-white colour. This earth is used for plastering the front platforms and edges of walls for protection against wear and tear. Lumps of lime are also collected and used for 'white-washing' the walls.

Earth is extracted mainly from private fields and common *gram sabha* lands. It is usually free and requires labour (family's / other villagers') and transportation costs. Often earth of good quality is not available freely. It is then 'stolen'[1] from government revenue lands.

The processing of raw earth to manufacture building elements for walls and roofs is often done by house owners themselves. Very little specialisation in brick making exists in these villages. Three types of fired bricks are used in construction: (i) the *einth* (2"x8"x12"), (ii) the local *gumma* (3"x4.5"x9") and (iii) the *gumma* from Kanpur.

Upto five years back, *einth* was the most widely used traditional fired brick of the area. It is now being replaced by the *gumma*, even though the former is considered stronger. Its

[1] Unauthorised collection

smaller depth allows even baking and its larger size provides greater surface area in contact with mortar resulting in stronger walls. Smaller size of the *gumma* allows optimisation in wall thickness and faster construction. It is also lighter, about 2.25 to 2.5 kg in weight as compared with 3 to 3.5 kg of the *einth* thereby making for easy workability. Coal and coal waste is added to the kiln while firing the *gumma*, unlike *einth* which can be easily fired with just the locally available country wood and dung cakes.

The *gumma* from Kanpur is accepted as the most superior masonry unit amongst the three. It is manufactured from very good quality soil from the gangetic plains utilizing a more efficient baking process. It is also much more expensive than the locally manufactured bricks. It is preferred by the district authorities for use in government sponsored housing projects but is rarely used in private construction by villagers themselves.[2]

Local earth is also processed into clay tiles for cladding pitched roofs. Two types of clay tiles for roofs were found in this area, namely, the *chapti khaprel* - flat country tile and the semi-circular tile - the *gol khaprel*. A mixture of fine grained red soil and black *pokhar* (pond) soil is used in a proportion of 1:2 to manufacture flat tiles. Semi-circular roofing tiles are made with greater proprtion of black soil in the mix, the ratio being 1:2.5 or 1:3. The skill to form *chapti khaprel* is widely known in the villages, though not everybody is well versed in its practice. The *gol khaprel*, on the other hand, is manufactured by specialised potters, a large community of whom reside in village Chirgaon east of Jhansi city. Absence of craftsmen and the requirements for special skills has made the latter more expensive in the villages surveyed.

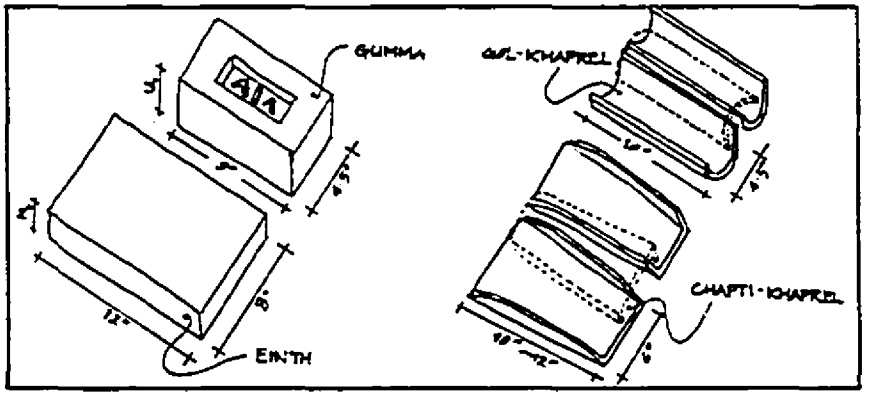


Figure 4.1 A Processed earthen building elements

[2] The transporters from Jhansi carrying stone aggregate from its crushers to Kanpur find it profitable to return back with the *gumma* rather than with empty trucks, the promotion of the *Kanpuri gumma* import in Jhansi is thus motivated by the economics of exporting aggregate from Jhansi.

Biomass, timber and agro-residues: Wooden elements are the most precious of all building elements, competing only with stone. Many families in the new rehabilitated villages of Kanchanpura and Harpalpur had brought all the timber elements that they could carry from their old houses when they were displaced 30 years back.

The use of primary timber in this region has declined over the years. In many old houses, considerable amounts of timber of good quality hardwoods like Teak and *Shisham* (Indian rosewood) has been used for beams, intermediate floors, doors and door-frames.

The popular timber currently in use is from *Neem*, *Mahua*, *Babul*, *Karondi*, and *Dhak* trees.[3] Of these, *Neem* and *Mahua* are the most prized and expensive. *Babul* wood is an important fuel and the *Karondi* bush is used as cattle-feed. Many families grow their own trees for future use. The residents of Kanchanpura were very proud of the line of *Neem* trees planted by them in their village which had matured over 30 years. Some amount of bamboo is also used in construction as described later in Section 4.1.2.

Lantana and Iopmea are two local tree species that grow wild in the region. They are used in the sub-structure of *khaprel* roofs. Ipomea is called *Besharam* or 'shameless' in local parlance. It can grow almost anywhere in extremely difficult conditions and once there, rarely dies. The wood, though not very strong, lasts long and does not get infested with termites. Lantana is woven into baskets, nets, partitions and panels by the *Sahariya* community. Their transitory shelters in the forest, of which very few are left, are made of Lantana and Ipomea branches woven together and bent to provide low shelters. These are covered by *Dhak* leaves and easily last a full season.

A list of the locally available timber and its common uses in construction is given in Appendix 4.1.

Wheat straw, the largest agro-residue of the region, is mainly utilised as fodder for livestock. Some of it, cut into small pieces 5-10 mm in size, is mixed with mud and cow-dung for wall plaster. It is also used to supplement fuel requirement for baking tiles and bricks.

Dung: Animal dung is an important resource with commercial value. Besides its use as manure, fresh dung is used to plaster walls and floors. Dung (as dried cakes) finds its most important use today as fuel, both for cooking and in brick and tile kilns.

[3] Local names, for botanical names refer Appendix 4.1.

Inorganic materials - sands and stones: Sand in construction is used for mortars, concrete and filling; it is of two types - the coarse reddish lateritic sand which is quarried and the fine river sand collected from stream beds and banks.

Stone for construction are both locally available or may be brought from as far as Shivpuri and Sagar via Lalitpur, from a distance of 30 to 150 km.[4] Locally available stones are, the Bundelkhand gneiss, quartzite and granite rocks. These are either used undressed as boulders or are dressed into regular sized *khandas* of 1'x1'x1' or 6"x6"x6". It was revealed, that up to 5 to 8 years back, specialised stone workers from Madras were employed to dress the stone during their seasonal migrations. This skill has now been acquired and perfected by local stone workers from a neighbouring village (Punawli). Boulders may be extracted from fields and commons, while dressed stone has to be procured at the quarries. Rich landlords sometimes employ less affluent farmers or the landless to extract and dress boulders for construction within the village itself.

Flat slabs of sand stone are used for roofs. Two most widely used stones are the pink sand-stone from Shivpuri and the white or grey sand-stone from Lalitpur. These stones are quarried in standard sizes of 10, 12 and 14 feet, 1.5 to 2.5 feet in width and from 0.75 to 4 inches thick. The grey stone is generally considered superior, as it contains fewer faults and is available in longer lengths up to 12 ft. and up to 4 inch thickness. It is preferred when rooms are spanned from wall to wall. The pink stone is used when smaller spans of 8 to 10 feet, or when intermediate beams are being used. The indigenous intermediate support for the stone or *patti-farshi* roof is the stone beam. The stone is bought at the quarry and dressed to size on site. An expert mason spends about 6 hours, in effect a whole day (one working day = 8 hours) to dress and shape one stone beam of approximately 12 feet in length.

Many granite and quartzite rock outcrops lying in government revenue lands, have been auctioned off to contractors for limited time (not limited quantity) extraction. The rock is quarried and crushed in diesel or electric powered crushers to produce stone aggregate of good quality. The aggregates are used mainly in concrete for roof terracing and for RBC slabs. The technology of RCC is not yet popular in this rural region.

[4] The stone quarries in the Jhansi - Shivpuri sector are at Dinara, Amola ghati and Sugaiya, while the ones in the Jhansi - Sagar sector are at Dhaura Dhasan, Asta, Ata and Malthaun. (Source: Transporter in Jhansi).

Stone crushers generate considerable amounts of stone dust which is normally dumped in river beds or used as land fills in low lying areas. The dust is also utilised as coarse sand in construction. It is available free of charge at most places with only transportation costs to be paid. This situation, is however, not expected to last long as the crusher owners have already recognised the monetary potential and market for this material. Concrete block manufacturers in the area have begun to procure large quantities of the dust, thereby making this waste a commercially viable material. The availability of large quantities of aggregate and sand/stone-dust has prompted the establishment of two concrete products' factories here.

The technology of concrete blocks is being promoted by the district authorities in housing projects for the *Sahariya* tribals and the economically backward classes. The block, however, has not found popular use by local rural populace.

Industrial materials - cement and steel: The use of industrial materials like cement and steel is increasing as is evident from census records of 1981 and 1991.[5] Discussions with building material suppliers at Raksa and Jhansi revealed that sale of cement in rural areas has increased substantially in the last five years. Convenience of cement as a binder was expressed by Devki Nandan, an old mason at Dhikoli, as it is now possible to continue construction during the monsoon in the intermediate dry days and the moisture actually helps to cure the cement.

Two medium scale cement plants have been started in the vicinity. However, the cement generally preferred is not from the nearby Diamond cement factory but from the more renowned Rewa Cement Factory at a distance of approximately 1,300 Km. from Jhansi. Cement is bought at building material outlets in Raksa. In Lidhora and Khalilpura, the percentage of cement used is much less than in the four villages studied in block Babina. .

The use of steel is also increasing in the region. The percentage of stone roofs supported by steel beams and T/L sections is 12% in Raksa, 7% in Dhikoli, 6% in Palinda, 2% and 4% in Khalilpura and Lidhora respectively (Appendix 4.2).

Tables 4.1 (A) and (B) summarise the above discussion on extraction of raw material, transportation to the villages and the processing of raw material into masonry and roofing elements.

[5] Refer Appendix 4.4.

Table 4.1 A: Summary of building materials in the surveyed villages

Material	Source Type	Extraction		Transportation		
		Mode	Cost	Distance	Mode	Cost
Earth	Fields / Commons	Manual - self / employed labour	Free / LC	1 - 3 km	(i) Head load (ii) BC	(i) Free only self labour, (ii) Free if owned, cash If hired
	R L	Manual - self / employed labour	Stolen	2 - 6 km	BC / Tractor	Free if owned, cash if hired
	Revenue lands	Manual - contractor	LC	2 - 8 km	- do -	- do -
Bio-mass						
Primary timber	Timber merchants				BC / tractor -own/ hired	Cash
Secondary eg. Mahua	Fields/ commons/R.L.	Manual / self	Cash / free		BC / tractor -own /hired	Cash
Secondary Babul/ Kardhai	Fields/ commons/ RL		Labour - free	2 - 8 km	BC/ tractor - own/ hired	Free
Tertiary - Ipomea, Lantana	Fields/ commons	Manual/self	Free / LC	1 - 3 km	Head load / BC	Free
Agro- residue	Own fields	Manual/self	Free	1 - 3 km	Head load / BC	Free
Cow dung	Own /others cattle	Collection/ self	Free	1 - 3 km	Head load	Free
	Others cattle	Collection - other	cash / barter	1 km	Head load	Free
Sand:						
Coarse	Commons / Quarry	Manual self / contractor	Free / LC -cash	2 - 8 km	BC / tractor -own/hired	Free if owned, cash if hired
Fine	River beds	Manual self / contractor	Free/ LC - cash	2 - 8 km	BC/tractor -own/hired	Free if owned, cash if hired
Stones:						
Boulders	Fields / commons	Manual - self / employed labour	Free/ LC		BC / Tractor	Free if owned, cash if hired
	R L	Manual - contractor	LC / Stolen	2 - 8 km	(i) BC / Tractor (ii) Truck	(i) Free / hired, (ii) cash
Dressed stone	Quarry	Manual - contractor	LC	2 - 8 km	- do -	- do -
Stone slabs	Quarry	Blasting - contractor	C+profit	8 - 35 km	- do -	- do -
Stone dust	Stone crusher Dumps in river beds	Collection/self / contractor	Free / LC - cash	6 - 14 km	BC / tractor -own/hired	Free if owned, cash if hired
Aggregates	Stone crushers	Mechanical/ contractor	cash	6 - 14 km	BC / tractor -own/hired	Free if owned, cash if hired
Lime/ Cement/ Steel	Shop	Factory made	cash	6 - 14 km	BC / tractor -own/hired	Free if owned, cash if hired

Legend:
LC = Labour Cost; BC = Bullock Cart; RL = Revenue land (government land); Self = Indicates unpaid family labour; Babul/ Kardhai/ Ipomea/ Lantana = Local names, for botanical names refer Appendix 4.1.

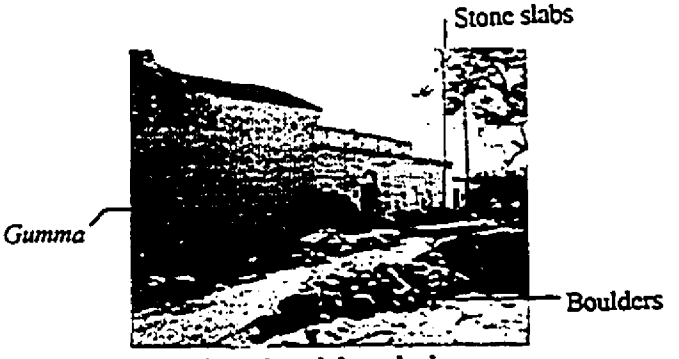
Earth (from demolished old wall) at Lidhora

Bamboo clumps at Kanchanpura

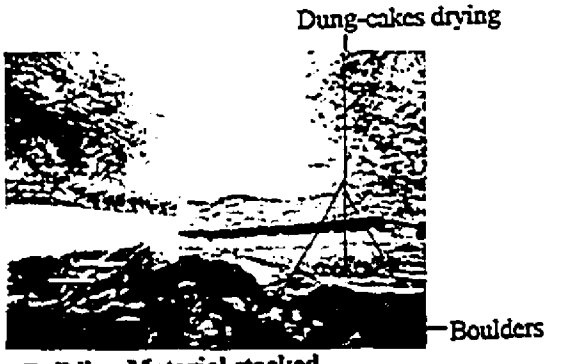
Biomass along NH - 25

Lantana woven into partition panel at *Sahariya* Basti in Raksa

Stone aggregate at crusher along NH - 25



Building Material stacked along village streets, Palinda



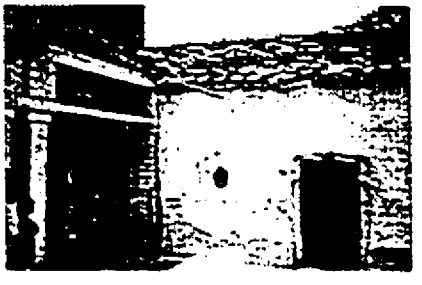
Building Material stacked along village streets, Dhikoli

Figure 4.1 B **Building materials and elements**

Table 4.1 B Summary of processed masonry and roofing elements

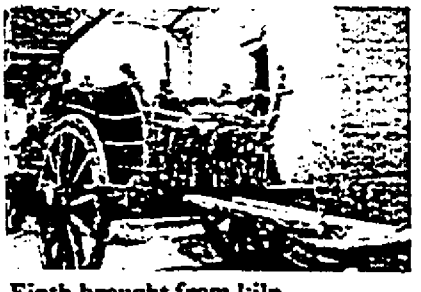
Elements	Raw Material Source	Production		Transportation	
		Process	Cost	Mode	Cost
Masonry Elements:					
Einth	Local / F/ C/ RL	Self / local labour	Free/ cash/ grain/service	Head load/ BC/ tractor	Free if own; cash if hired
Gumma	Local / F/ C/ RL	Self / local labour	Free/ cash/ grain/service	Head load/ BC/ tractor	Free if own/ cash if hired
Kanpuri Gumma	Kanpur	At Kanpur/ from shop	Cash	BC/ tractor	Free if own/ cash if hired
Concrete Block	Quarry + factory	Factory/ from factory	Cash / self labour	BC/ tractor/ on site	Free if own/ cash if hired
Roofing Elements:					
Chapti Khaprel	Local/ F/C/ RL	Self + local semi-skilled labour	Cash + grain	Head load / BC / Tractor	Free if own/ cash if hired
Stone Beam	Quarry	Prepared at site	Cash / grain	BC/tractor	Free if own/ cash if hired
Steel I beam	Factory	Factory/ bought at shop.	Cash	BC/tractor	Free if own/ cash if hired
Wooden Beam	----				

Legend: F = Fields; C = Commons; RL = Revenue Lands; BC = Bullock Cart

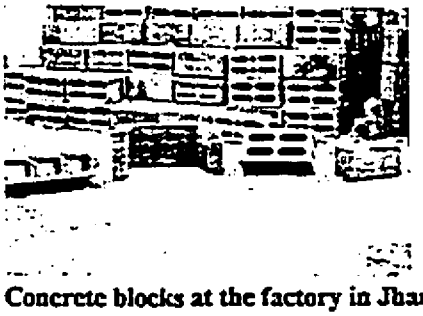


Reinforced Brick Concrete lintel

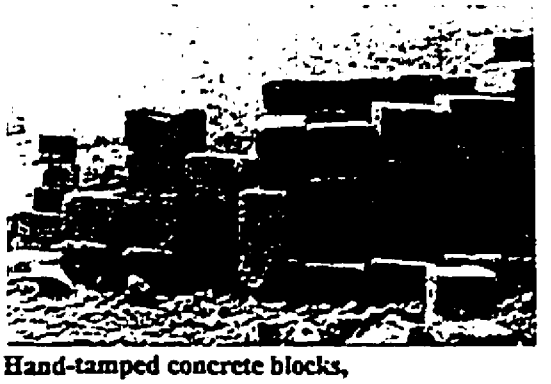
Reinforced Brick Concrete lintel



Einth brought from kiln



Concrete blocks at the factory in Jhansi



Hand-tamped concrete blocks, Pura Badhera

Figure 4.1 C Building materials and elements

4.1.2 Building Components - Walls and Roofs:

Walls: Four main types of walls were observed: (i) earthen walls in cob and adobe, (ii) fired brick masonry walls using two types of locally manufactured bricks - *einth* or *gumma*, (iii) stone masonry walls in random rubble or *khanda* (dressed stone) and, (iv) composite masonry - a combination of fired brick and random rubble in layered courses.

Cob walls in the area range from 2 ft. to 3 ft. thickness, and are not built tapering but in parallel plumb from bottom to top. Adobe construction uses unfired bricks laid in mud mortar, plastered with mud and dung.

Fired brick and stone masonry are usually laid in mud mortar. The wall may be left exposed, the joints grouted and pointed with cement or else the surface is plastered with mud-dung or cement-sand plaster. Most of the older construction has been built with walls 2 ft. thick, while the more recent ones have 18 inch thick walls. Brick masonry walls presently being built are 14.5 inch thick. At one place in Raksa, a new mason has built 9 inch thick walls in his house, but load bearing walls 14.5 or 18 inches thick are the preferred norm. Random rubble masonry walls of about 18 inch and dressed stone masonry 1 ft. thick were observed.

Composite masonry for walls is very popular in this region. Random rubble increases the volume of masonry and a layer or two of fired brick after every 2 to 3 feet 'levels' the wall. The number of bricks that are required for the house is, thus, greatly reduced. A glance at Appendix 4.3 indicates that this type of wall construction is more expensive than others in cash terms, however, as indicated by villagers, economy is achieved due to the utilisation of left-over *einth* from previous construction and freely available boulders.

Roofs: Two predominant roofs found in the study are: (i) double sided pitched roof using locally manufactured clay tiles - the *khaprel*, laid on a country wood under structure, and, (ii) flat *farshi-patti* roof of stone. Commonly observed spans in the region are 10, 12 and 14 feet. Most 10 feet wide rooms are spanned end to end with stone slabs. For longer spans, slabs are laid on intermediate beams of stone or steel. The stone beams come in sizes of 12 and 14 feet. Wooden beams are now rarely used due to their scarcity and high cost.

An interesting system of constructing intermediate floors was observed in Kanchanpura. The residents use a split bamboo mesh over bamboo under-structure, which is plastered with mud and cow-dung on top. The bamboo is locally available and grown by villagers for construction and other purposes. Although clumps of bamboo are found elsewhere too, their utilisation in construction is limited to under-structure for clay tile roofs, as fences and for gates around courtyard and fields.

A small percentage of Reinforced Brick Concrete (RBC) roofs and lintels was observed. The skill needed for reinforcing beams and slabs is not yet well understood by local masons here. One finds *ad hoc* reinforcement where the user is not knowledgeable about the stresses and loads on the beams and roofs. Most masons who do reinforcement work have learnt it either by observation or as apprentices to masons at odd jobs in the city. They use rules of thumb which they change and adapt as they work with the material.

Table 4.2, and Figures 4.2 (A) and (B), summarise various roof and wall types found during the study. The percentage of various roof and wall types observed in the villages is presented in Appendix 4.2. Discussions with artisans and other villagers revealed certain characteristics of the various wall and roof components regarding structural performance, frequency and type of maintenance and type of manpower required in both construction and subsequent repairs. These are summarised in Tables 4.3 (A) and(B).

Construction costs of masonry and roofing elements and building components have been calculated for a standard room of 10ft.x12ft. area presented in Appendices 4.3 and 4.4. Costs are based on local material and labour rates. These however, do not represent actual expenditure made by the villager. Tables 4.4 (A) to (H) present the cost breakdowns into material and labour; monetary and non-monetary components, thus indicating where the villagers economise in construction.

The process of construction can be divided into two broad levels of activity- the pre-site and on-site levels. Each of the these can be further sub-divided. Charts 4.1 (A) to (F) describe the activities at each stage for two types of walls and roofs.

Table 4.2 Combination of roof and wall components

Walls \ Roofs	Khaprel on Acacia/ Ipomea Understructure	Khaprel with Neem Acacia Understructure	Farshi - stone slabs on walls	Farshi - stone slabs on stone beams	Farshi - stone slabs on steel beams	Reinforced Brick Concrete	Reinforced Cement Concrete	Bamboo intermediate floors
Cob		1						
Adobe								
Kinth /Kumma in mud mortar		2		6	5			
Boulder stones in mud mortar								
Composite masonry in mud mortar	3			7				
Dressed stone - *Khanda* cement-sand mortar				8				
Concrete blocks in cement-sand mortar						4		


1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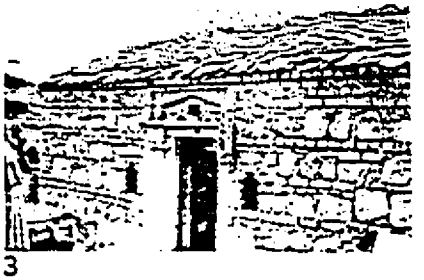
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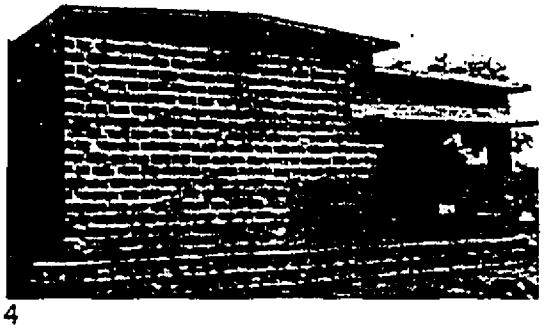
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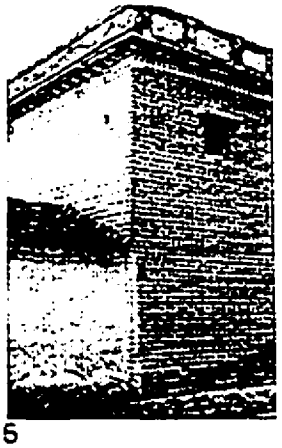
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7


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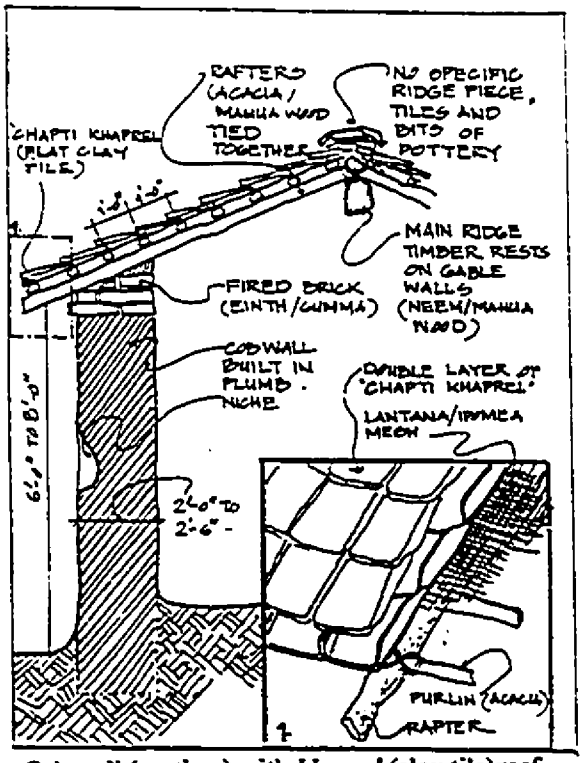
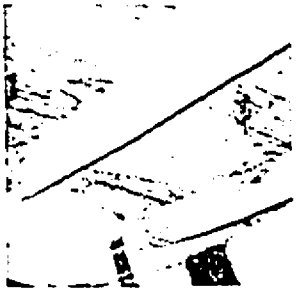
Figure 4.2 A Roof and wall components in the surveyed villages

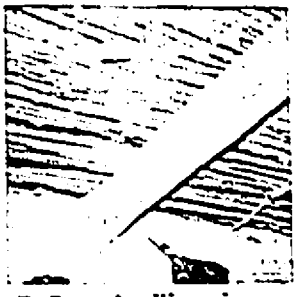


Cob wall (earthen) with *khaprel* (clay tile)roof

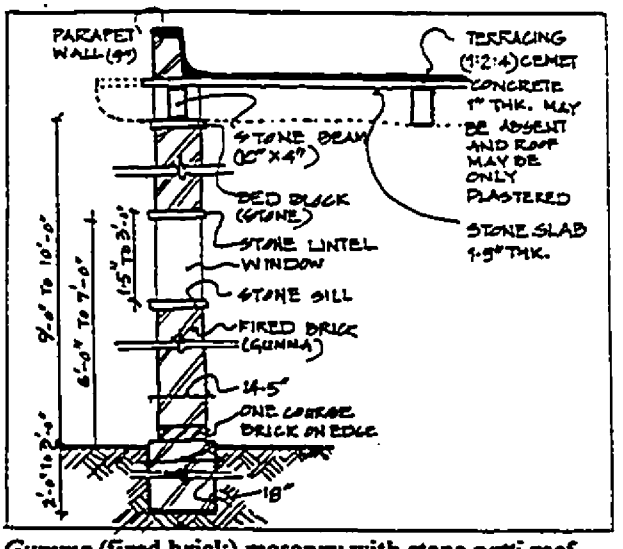
Under-structure of a *khaprel* roof



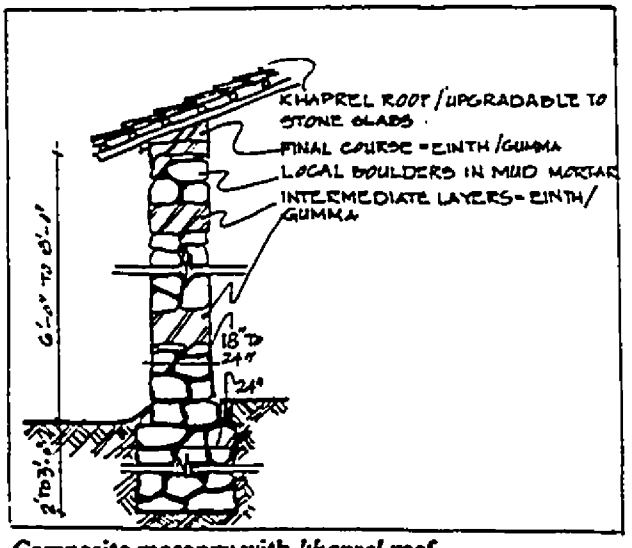
Reflected ceiling view - timber roof



Reflected ceiling view - bamboo intermediate floor



Gumma (fired brick) masonry with stone *patti* roof



Composite masonry with *khaprel* roof

Figure 4.2 B Details of some roof and wall components

Table 4.3 A Performance of walls

Wall Type/ Constructed by	Type of maintenance	Frequency of maintenance	Maintained by	Structural performance	Remarks
Cob Self	Plastering with mud and dung - *lipai*	Monthly to bi-annual	Women of the house mainly, some times the man.	Low load bearing, requires thick walls, normally single storeyed, some double storey houses observed. Problems of water ingress and termites, needs thick lintels.	Easy to maintain and construct, every family member can contribute to its construction and maintenance. Knowledge is local and common.
Adobe - un burnt *einth/gumma* Self+ semi-skilled and skilled input	- do -	Bi-annual to annual	- do -	Single to two storeys, can take heavier roofs like stone. Problems of water ingress. Fast construction may cause shrinkage cracks due to improper drying and settling of mortar.	Regular maintenance costs are offset by cheap and efficient initial construction. A combination of adobe and fired brick observed in Raksa.
***Einth* in mud mortar** Skilled mason + unskilled (self) input	Little maintenance after joints have been grouted with a cement-sand mortar. Lime wash and a plaster coat once.	Plaster once in 10 t7 15 years. Lime wash annually or once in two to three years. Lime based plaster more than 40 years old has not yet needed replacement.	Grouting of joints - self + semi-skilled input. Lime wash done by self or by local labour.	Considered by the local masons as a very strong and efficient wall construction system. Walls 18" thk. The masonry unit is less porous than both the *gumma* and the concrete block of the area. Shrinkage cracks as above.	Lime wash is mainly for aesthetic reasons with or without a coat of cement- sand plaster. In many cases, the wall had been left exposed after grouting the joints for more than 5 monsoons without any adverse affects
***Gumma* in mud/ cement-sand mortar** Skilled mason + unskilled (self) input	- do -	- do -	- do -	Two to four storey load bearing walls. Masonry is even and in plumb, allows thinner - up to 9" walls to be built. Lighter than *einth* allows higher productivity. More porous than the *einth*.	Unplastered walls without grouted joints often show dampness inside after a long stretch of rain.
Boulder stones in mud mortar Skilled mason + unskilled (self) input	Little or no maintenance after joints have been grouted and /or a coat of plaster.	- do -	- do -	Large amounts of mortar required. Walls are very thick due to size of unit. Off-plumb walls observed.	Lime wash for aesthetic reasons was found on almost all boulder stone walls.
Composite masonry in mud mortar Skilled mason + unskilled (self) i	- do -	- do -	- do -	Self construction may lead to off-plumb walls.	A very pupular mode of construction
Dressed stone - *khanda* in cement-sand mortar specialised skilled + unskilled (self) i	Generally trouble free after joints have been grouted.	Little or no maintenance	Lime wash by family	Load bearing walls, 2 to 4 storeys.	Regular coats of lime wash may be done for aesthetic reasons. Expensive, found only in well-off houses.
Concrete blocks in cement-sand mortar specialised skilled + unskilled (self)	Cement-sand plaster and lime wash to prevent moisture seepage.	Plaster once in 10 years, lime wash every second year.	Plaster by mason, lime wash self or local labour.	Improper hand-tamping leads to increased porosity; lean mix makes it low load bearing.	The hand- tamped blocks are used as in fill and not load-bearing masonry units.

Table 4.3 B Performance of roofs

Roof Type/ Constructed by	Type of maintenance	Frequency of maintenance	Maintained by	Structural Performance	Remarks
***Khaprel* on Acacia/ Ipomea under-structure** Self + some semi skilled input sometimes	Replacement of broken tiles, and adjustment in proper position, replacement of under-structure and sub-structure in case of rotting or termite infestation. (Regular smoking during cooking reduces termite attack).	Approx. 10 - 12% tiles need to be replaced annually. At least once before monsoon, tiles are adjusted in place, main under-structure may be replaced once in five years & Ipomea sub-structure in 3 years.	Annual maintenance can be done by most members of the family, although under-structure replacement is done by the men of the family with the women assisting.	Roofs sag due to weak Ipomea branches, and leak if the tiles have not been adjusted well. Tiles break with monkeys jumping on them and fly away in heavy wind. Roofs allow smoke escaping in cooking spaces.	Maintenance though regular, is easy and manageable by the family. Normally a stock of tiles is maintained in the house for annual repairs. The tiles are heavy and the quality of under-structure is a cause of concern. Some cases of fire were reported.
***Khaprel* on *Neem/Mahua* under-structure** Self + sometimes semi skilled input	- do -	As above, except the frequency of main and sub-structure replacement is between 7 to 10 years.	- do -	Roofs fairly even - little sagging observed. Rest, as above	- do -
***Farshi* - stone slabs on walls** Skilled mason + unskilled (self)	Leaking joints need to be plugged, top needs to be plastered.	If the surface is not terraced, the top is plastered once in 2 - 3 years, joints are grouted as often.	Simple grouting done by the house-holder, persistent leaks require a skilled mason.	Commonly available stone sizes permit room spans > 10 feet. Vertical expansion possible	Provides roof space for sleeping and drying clothes, spices and grain etc.
***Farshi* - stone slabs on stone beams** Skilled + semi-skilled + unskilled (self)	- do -	- do -	- do -	Longer spans possible, beam requires careful selection and dressing. Cracks observed under absent/ improperly laid bed-blocks.	As above, but more expensive. Beams extend to form support for overhangs and shading devices.
***Farshi* - stone slabs on steel beams** Skilled + semi-skilled + unskilled (self)	As above, steel beams need to be painted against rusting	As above, repainting of steel beams rarely undertaken.	- do -	Longer spans possible and/or allows use of smaller pieces of stone slabs. Cracks observed under missing/ improperly laid bed blocks.	- do -
Bamboo intermediate floors Semi-skilled + unskilled (self)	Re-plastering the surface. Replacement in case of rot or termite infestation.	Once in 3 to 4 years.	Mostly done by the women of the house.	Easily takes standard live and dead loads. No collapse observed or replacement made in 30 years since construction.	Termite infestation treated with smoke fumigation, no rot observed as it is not exposed to moisture. Only found in Kanchanpura.
Reinforced Brick Concrete (RBC) Local/city based skilled +semi-skilled + unskilled (self)	Re-plastering the surface if un-terraced	Once in 3 to 5 years	Normally a semi-skilled or skilled mason is called.	Dampness may observed due to porosity in bricks and improper concreting.	More preferred for staircase slabs, non-structural lintels than roofing slabs.
Reinforced Cement Concrete (RCC) City based skilled +semi-skilled + unskilled (self)	- do -	- do -	- do -	Inadequate knowledge regarding the technique is evident in the *ad hoc* and wasteful reinforcement.	Very few such roofs seen in the area.

Tables 4. 4 A to H **Building elements and components - break-down of construction costs:**

The following charts break the costs of building elements and components into monetary and non-monetary components. The costs calculated in Appendices 4.3 and 4.4 are taken as base values. The breakdown is at the income level of a landless and/or small farmer with the following parameters:

- Freely available/ collectable materials - zero cash value.
- Contractor controlled materials - full cost as cash value
- Materials bought at shop - full cost as cash value.
- Unskilled labour - self-help with zero cash value.
- Semi-skilled and skilled labour - full cost as cash value.
- Transport costed as part self (25 or 50%) and part cash.

Building elements

A. *Einth* at Lidhora:

Expenditure	Materials		Labour			Transport		Total
	Free	Bought	Un-skilled	Semi-skilled	Skilled	Own	Hired	
Earth	Free							-
Earth digging			14.5%					14.5%
Watering + kneading			4.2%					4.2%
Moulding			8.3%	6.2%				14.5%
Loading kiln			6.2%	3.1%				9.3%
Unloading kiln			4.2%					4.2%
Dung and other fuels	25.8%	25.8%						51.6%
Transport						1.7%		1.7%
Monetary component	-	25.8%	-	9.3%	-	-	-	36.8%
Non-monetary component	25.8%	-	37.4%	-	-	1.7%	-	63.2%

B. *Gumma* at Palinda:

Expenditure	Materials		Labour			Transport		Total
	Free	Bought	Un-skilled	Semi-skilled	Skilled	Own	Hired	
Earth	Free							-
Earth digging			12.5%					12.5%
Watering, kneading & moulding			15%	5%				20%
Loading + unloading kiln			2.5%	7.5%				10%
Dung and other fuels	29%	29%						58%
Transport						2%		2%
Monetary component	-	29%	-	12.5%	-	-	-	41.5%
Non-monetary component	29%	-	27.5%	-	-	2%	-	58.5%

C. *Chapti khaprel* - flat roofing tile:

Expenditure	Materials		Labour			Transport		Total
	Free	Bought	Un-skilled	Semi-skilled	Skilled	Own	Hired	
Earth	Free							-
Earth digging			10.2%					10.2%
Watering + kneading			3.3%					3.3%
Moulding (pulling)			6.2%	6.2%				12.4%
Loading kiln			2.7%	1.7%				4.4%
Unloading kiln			2.7%					2.7%
Dung and other fuels	32.5%	32.5%						65%
Transport						2%		1.7%
Monetary component	-	32.5%	-	7.9%	-	-	-	40.4%
Non-monetary component	32.5%	-	25.1%	-	-	2%	-	59.6%

Building Components
Walls and Roofs:

D. Cob wall construction:

Expenditure	Materials		Labour			Transport		Total
	Free	Bought	Un-skilled	Semi-skilled	Skilled	Own	Hired	
Earth	Free							-
Agro waste	Free							-
Digging			42.6%					42.6%
Laying and finishing			47.2%					47.2%
Transport						8.2%	2%	10.2%
Monetary component	-	-		-	-		2%	2%
Non-monetary component	-	-	89.8%	-	-	8.2%		98%

E. *Einth* masonry in mud mortar:

Expenditure	Materials		Labour			Transport		Total
	Free	Paid	Un-skilled	Semi-skilled	Skilled	Own	Hired	
Einth	33.2%	19.3%						52.5%
Earth digging for mortar			3.2%					3.2%
Masonry work			11.4%	9.6%	13.4%			34.4%
Transport: bullock cart /tractor						1.7%	3.2%	4.9%
Miscellaneous, tools and plants	2.5%	2.5%						5%
Monetary component		21.8%		9.6%	13.4%		3.2%	48%
Non-monetary component	35.7		14.6%		-	1.7%		52%

F. Composite masonry in mud mortar:

Expenditure	Materials		Labour			Transport		Total
	Free	Paid	Un-skilled	Semi-skilled	Skilled	Own	Hired	
Einth	9.6%	5.7%						15.3%
Boulders	14%	15%						29%
Earth digging for mortar			4.5%					4.5%
Masonry work			21.5%	19.3%				40.8%
Transport						2%	3.4%	5.4%
Miscellaneous, tools and plants	2.5%	2.5%						5%
Monetary component		23.2%		19.3%			3.4%	45.9%
Non-monetary component	26.1%		26%		-	2%		54.1%

G. *Chapti Khaprel* - flat clay tile on *Mahua* - *Babul* (acacia) under-structure:

Expenditure	Materials		Labour			Transport		Total
	Free	Paid	Un-skilled	Semi-skilled	Skilled	Own	Hired	
Khaprel tiles	6.2%	3.6%						9.8%
Understructure: rafters -*Mahua*		28.5%						28.5%
Understrucure: purlins - Acacia	48%							48%
Setting up roof			3.6%	2.5%				6.1%
Transport						1.3%	1.3%	2.6%
Miscellaneous, tools and plants	2.5%	2.5%						5%
Monetary component		34.6%		2.5%			1.3%	38.4%
Non-monetary component	56.7%		3.6%		-	1.3%		61.6%

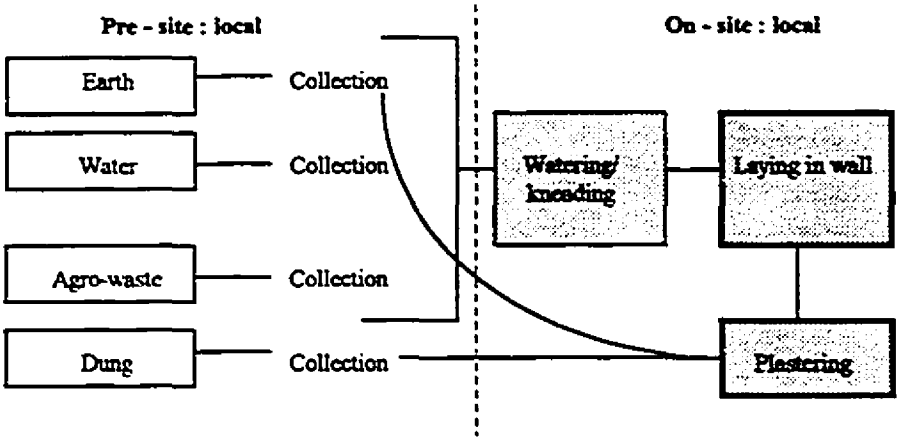
H. *Farshi* - stone slab on stone beams:

Expenditure	Materials		Labour			Transport		Total
	Free	Paid	Un-skilled	Semi-skilled	Skilled	Own	Hired	
Stone slabs and beams		33.7%						33.7%
Cement,aggregates and sand		18%						18%
Laying the roof			11.5%	9.6%	14.3%			35.4%
Transport						4.1%	4.1%	8.2%
Miscellaneous, tools and plants	2.5%	2.5%						5%
Monetary component		54.2%		9.6%	14.3%		4.1%	82.2%
Non-monetary component	2.5%		11.6%			4.1%		18.2%

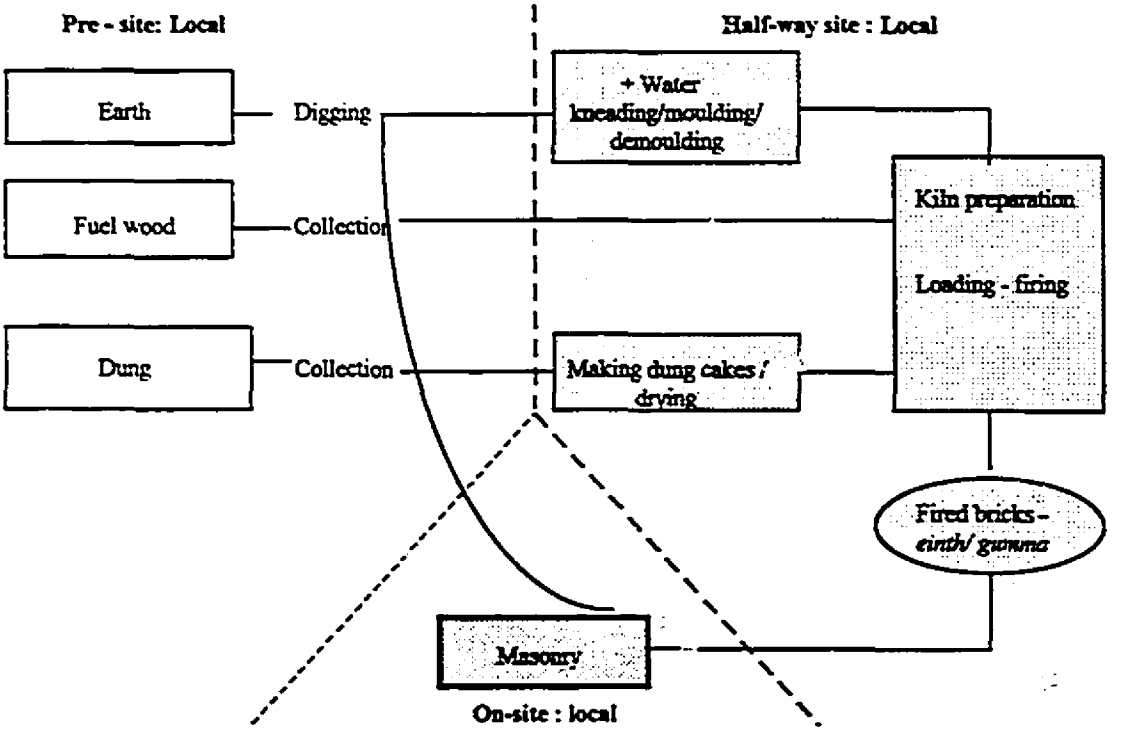
Chart 4.1 Segregation of Construction Activities into pre-site and on-site stages

The following charts present the activities involved in the construction of wall and roof components. The process includes extraction of raw materials and production of building elements. It is indicated 'where' each of the activities take place. A half-way site stage indicates that the activity happens close by but not necessarily on the site of construction. The distance between the half-way site and site is normally 100 m. to 2 km.

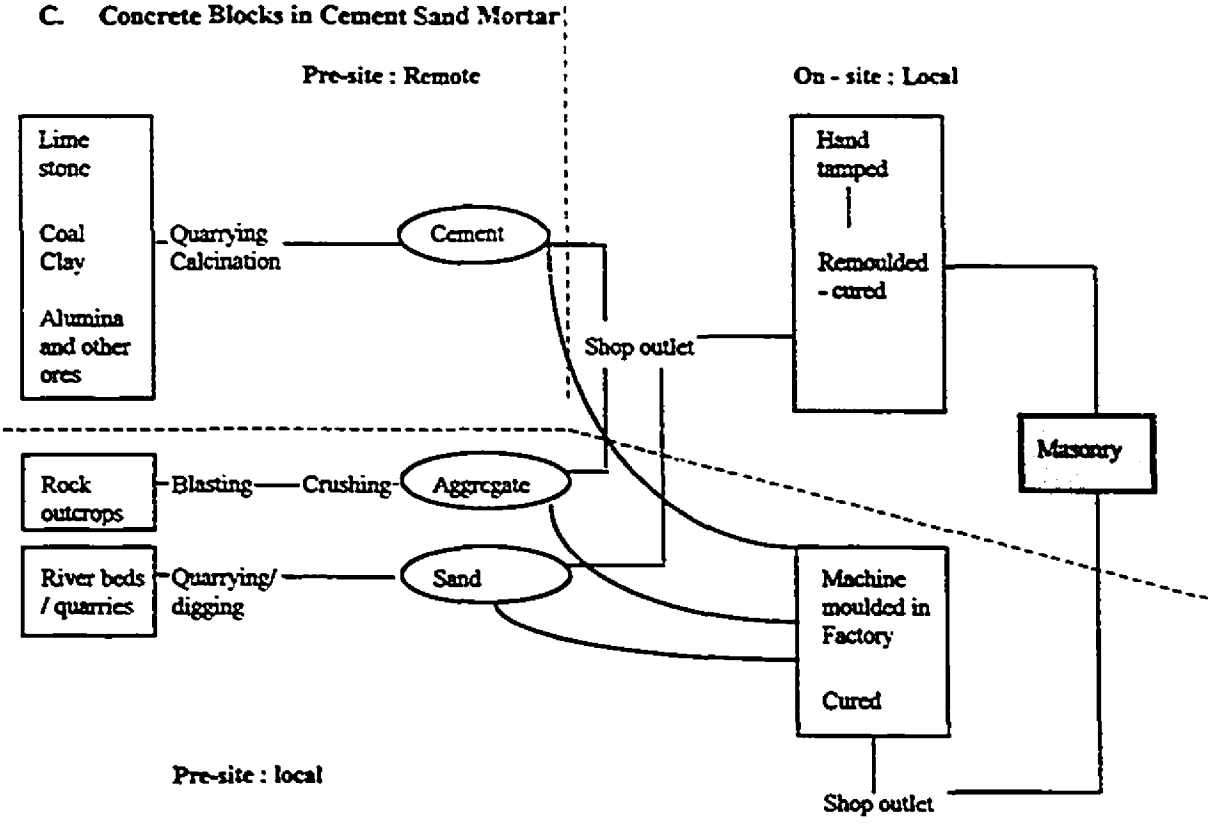
A. Cob wall



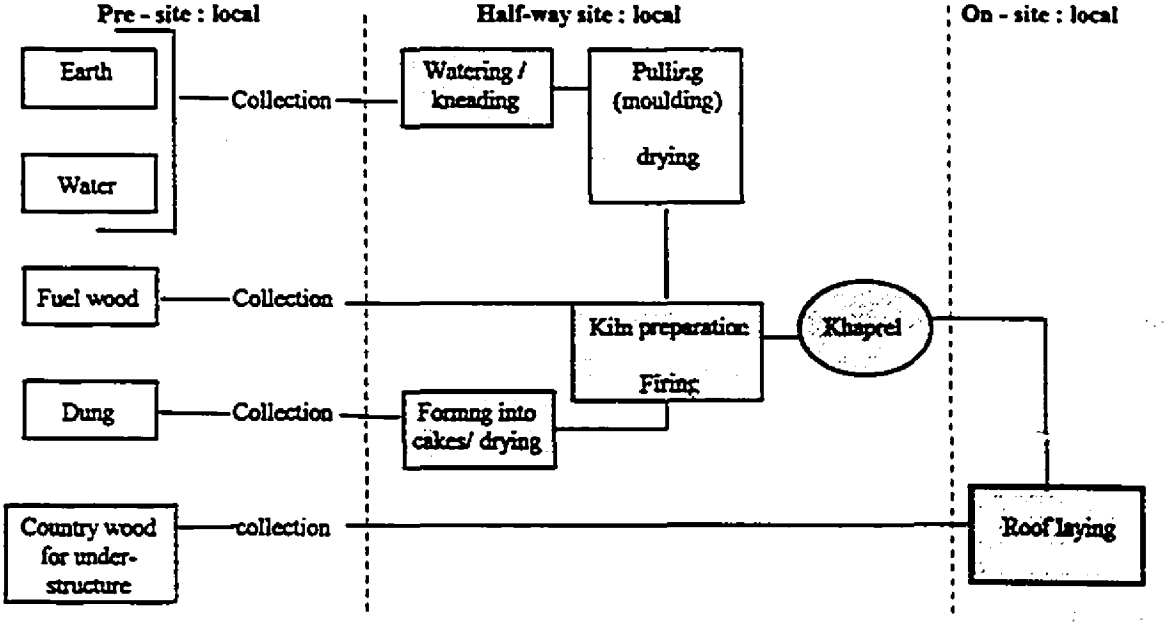
B. Fired Bricks - cinth / gumma in mud mortar



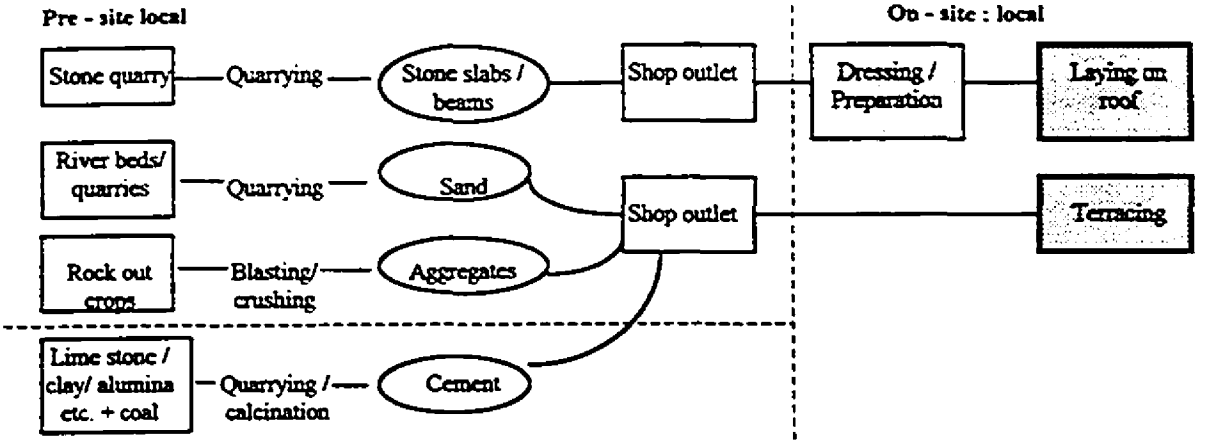
C. Concrete Blocks in Cement Sand Mortar



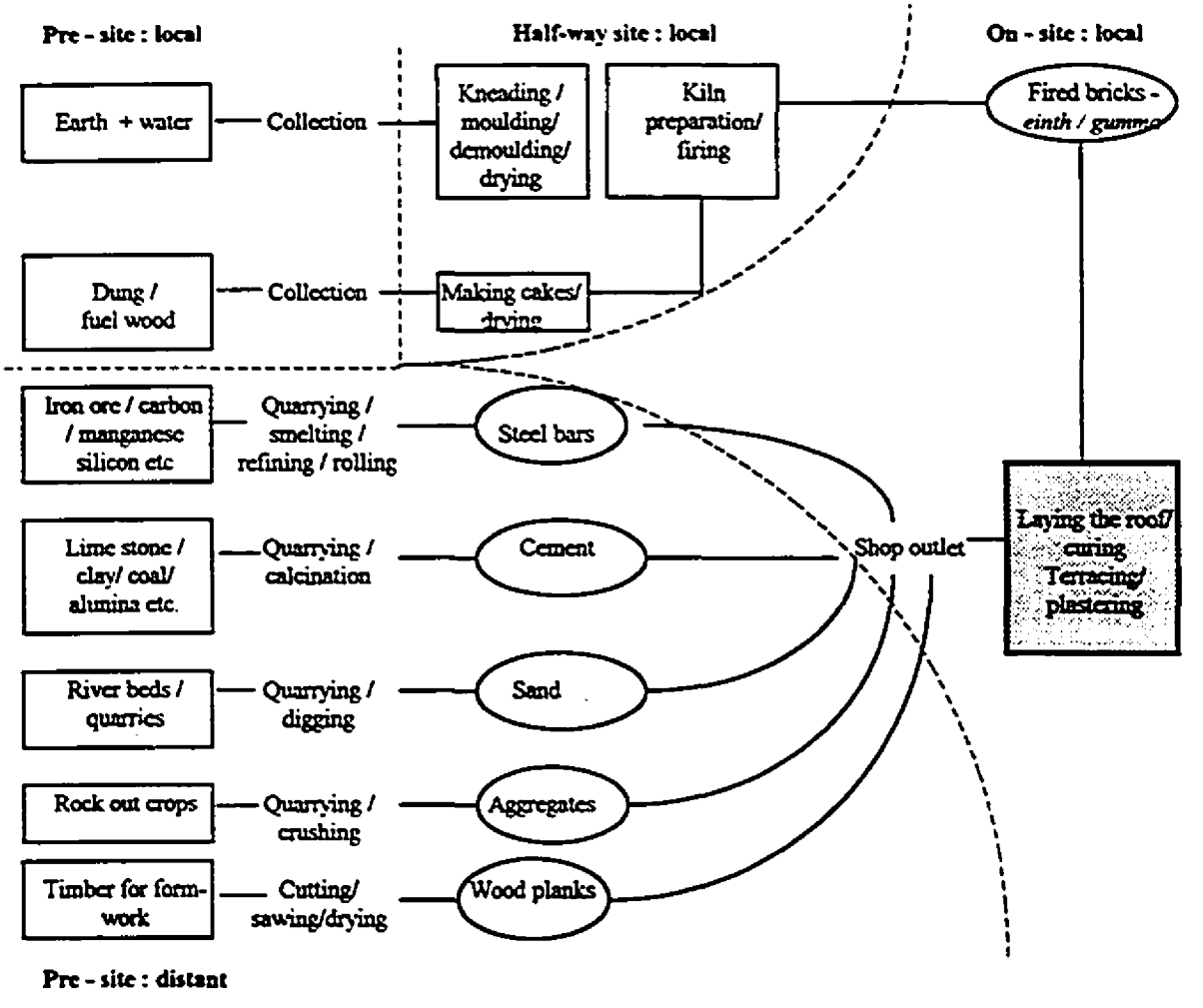
D. Country clay tile - *khaprel* roof on country wood (*mahua/neem/acacia*) under-structure



E. Stone slab roof - *farshi* on stone beams:



F. Reinforced Brick Concrete (RBC) roof



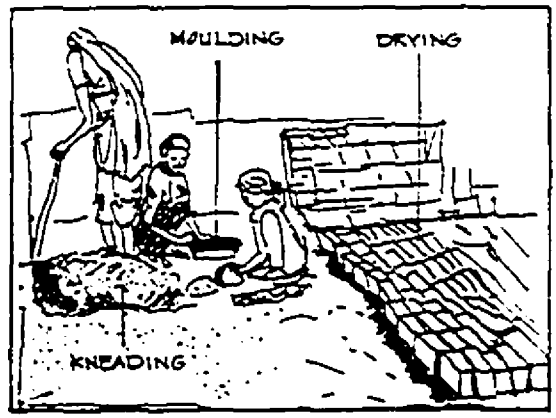
4.2 Delivery Processes - The Linkages

A description of materials and techniques is incomplete if one does not understand the relationship that the various role players share with each other, their resources and technology. These relationships, as discussed in Chapter - II, form important linkages that change and transform the construction practice and are the essence of the housing delivery mechanism. This section describes the building linkages - social, technological and economic, observed in the study area. It deals with the roles of the individual, family and community, significance of the skilled artisan and the role of local markets in the construction of dwellings.

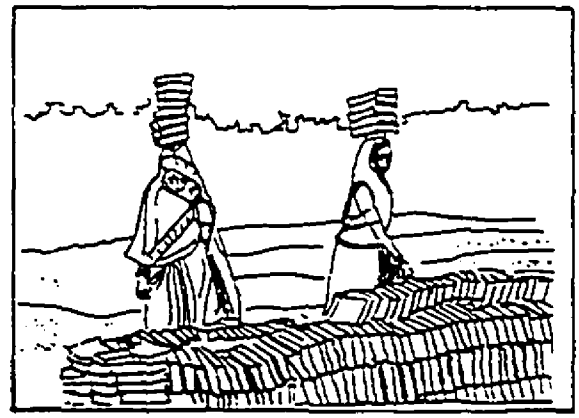
4.2.1 The Individual, Family and Community: Interaction of villagers to each other is at various the levels of family, *jati* (caste group), community, and neighbouring villages and towns. At the family level, interaction is limited to distribution of tasks amongst its members. This translates into occupational specialisation, lending, borrowing and / or hiring equipment, procurement of labour or material resources, information and skill exchange within the village and between different villages and towns.

The family as the smallest unit in society has an important role to play in the building process. In lower income house-holds, most construction is conducted through family labour. Roles of the family members are quite distinct, as for example, in *gumma* or *einth* production. Figure 4.3 describes the roles of family members at each stage of the process. Amongst other activities, digging, breaking boulders and mixing mortar are common. Adult males rarely perform the act of carrying building materials, especially if it has to be done as a head-load. Setting up a kiln, assisting the mason (with the plumb line, mason's string or in laying bricks) are jobs handled by men.

In economically better-off house holds, most building work is contracted to specialists and local unskilled labour. Management and supervision of construction is, however, controlled by the house owner. The role of women in decision making is less obvious in public. The choice of building materials, discussions with the mason or carpenter etc. are conducted by men, at least in public. However, basic maintenance of the house which involves plastering the walls, floors and platforms with mud and cow-dung, preparing dung cakes for fuel etc., are normally done by women whether high or low in income group, caste or class.

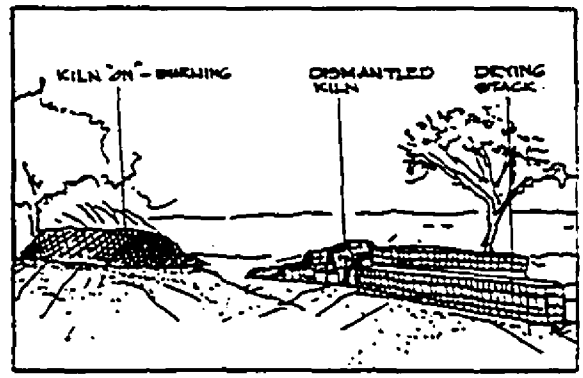


The family moulding *einth*

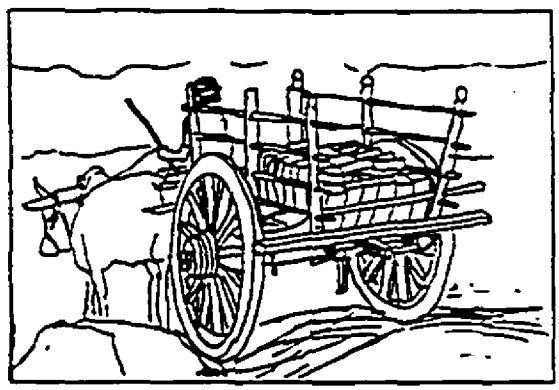


Carrying 'green' *einth* to the kiln

Setting the kiln



***Einth* being baked**



Transporting *einth* by bullock-cart

Stacking *einth* on the *chabutra* in front of the house

Figure 4.3 Process of *Einth* manufacture

It was observed that young male members of a family are frequently pulled into discussions between house-owners and *mistris*. The young men are often more informed, than their parents about new construction methods due to their frequent visits to neighbouring villages and towns. Although the final voice is always that of the family head - the grandfather or father, the views and opinions of these young men are given due consideration. Young women, however, are rarely asked or encouraged to participate in such discussions.

Information network within a village is simple by word of mouth and quick to spread. Who is going to the city today?, where can one find the *mistri* (mason)? or who's house was built by which *mistri*?, what problems were encountered in its construction? and the like. There are some elders 'who know' and people go to them for advice. Most advice is based on precedents, thus their experience gathered over the years is valuable. The elders, like Babaji in Palinda and the previous *sarpanch* of Dhikoli remember problems that were encountered when a new technique was tried or the advantage obtained through a slight change in technique. These stories are discussed intricately by villagers as they sit under the *Neem* tree or other community spaces (apparently at leisure). One was witness to a few such discussions in Dhikoli and Palinda; in fact one's questions and queries often provoked them. The development and change in construction techniques are ongoing processes very much a part of daily conversations. For example, Kaluram Sahu's decision to construct a new room in his house using 14" thick fired brick walls instead of the standard 18", was discussed at length by a large group of concerned villagers in Dhikoli. They had all observed a few such walls built and tempered over a couple of seasons and were interested in the pros and cons of the technique.

4.2.2 The Artisan and Characteristics of Construction Skills: The artisan plays a very important part in the delivery process. His practice establishes the guidelines and therefore the standards for construction. Four types of artisans were found to be involved in the building process in these villages; the mason, the potter the carpenter and the blacksmith.

The mason: At least one mason was found to reside in each of the six villages. In Raksa, Dhikoli, Palinda, Khalilpura and Lidhora, 6, 4, 4, 1 and 2 masons were recorded respectively.[6] In Kanchanpura a community of 8 masons resides.

[6] NIC records, 1994.

A mason normally works in a team consisting of a semi-skilled worker and a group of unskilled workers. Unlike in a city, where either the mason organises his own team or the contractor employs a group of labourers; in a village, this is the house owner's responsibility. As mentioned earlier, rich farmers generally employ the landless or marginal farmers and their families from the village as unskilled workers. On the other hand, small and medium farmers save on construction costs by utilising family labour to provide all or part of the unskilled manpower component. At the time of survey, Sriram and his family at Harpalpur were assisting the mason to construct a room in their courtyard. Sriram, his wife and one of his sons had dug the foundation trench, sized boulders for foundation masonry and were mixing mortar and carrying *gumma* to the mason. The mason only laid-out the trench line for excavation, laid masonry in the foundation and super-structure. The roof under-structure and the *khaprel* would be put-up later by Sriram himself.

This process, while enabling the villager to save on construction costs, provides a familiarity with local building methods and an opportunity to imbibe the skills. Traditionally, masonhood was passed on from father to son and the knowledge remained within the family or community group. This system of knowledge transfer is appearing to break down. Many of *raj-mistri's*[7] helpers and students in Dhikoli do not come from artisan families, while the sons of masons themselves are moving away from their family occupations. Some are turning to agriculture if they have land, others are starting small businesses or finding jobs in the city. The mason's sons, however, have a good handle on local construction practices even if this is not their regular occupation. Devki Nandan's (old mason's) sons in Dhikoli, one, a peon in Jhansi and the other, a shopkeeper, were observed to construct an addition to their house under the verbal guidance of their father during the survey. The father, at 72, does not undertake much construction work any more. The two sons are also asked to assist in other construction jobs in the village.

Training or transfer of skills is almost never initiated by the trainer himself, unless it is within the family. Thus Ramprasad, considered the second best stone worker in Dhikoli, has worked his way up from an unskilled labourer to a semi-skilled assistant of the *raj mistri*. He is

[7] It is difficult to say who designates a mason as a *raj mistri* (head mason). But his skill, workmanship and leadership along with length of experience, cumulatively result in this title being conferred upon him.

now often called over on his own when the *raj mistri* is busy or too expensive for a villager. The transfer of skills from the stone cutters of Madras to the local workers at the quarries happened in the same way. Stone dressing into regular *khandas* is no longer limited to that period of the year when the *Madrasi* stone cutters pass this way.

Young men migrating as construction labourers to Jhansi or other cities often return as masons, bringing with them the knowledge and skill (often incomplete) of construction techniques being used there. For example, Deendayal at Raksa, after having worked with a mason in Jhansi, now claims to be a skilled craftsman. His value in the village, calculated on the basis of daily wage rate is, however, only Rs. 50 per day, that of a semi-skilled worker.

The activities for which the mason is valued are foundation masonry, super-structure masonry in brick, boulder and dressed stone, *farshi-patti* roofs, dressing a stone beam, cement plastering of walls and roofs and laying the RBC roof in increasing order of importance. The mason is also asked to do various types of decorative plaster mouldings or arches in the facade, especially in the doorways - thus emphasising his role as an artisan and a craftsman, rather than a mere technical expert. Rudimentary knowledge of masonry work is known to almost every one and it is often undertaken by oneself (unskilled) or contracted to semi-skilled masons for reasons of economy. This results in poor quality walls that require frequent repair and maintenance. Preparation of under-structure and laying a *khaprel* roof are also activities for which skilled artisans are normally not required or called.

The carpenter: Fabrication of doors and windows is only a small part of the carpenter's job. His main work involves manufacture and repair of agricultural implements and bullock carts. The carpenter's market in building has further declined with the scarcity and rising prices of timber and an increasing popularity of galvanised iron door frames and shutters. Each village, however, does not have a carpenter, and the services are procured from neighbouring villages.

The blacksmith: Like the carpenter, the blacksmith primarily caters to the requirements of agricultural tools and implements. The *Loghariya* tribals from Chittor are the main source of blacksmith jobs during their travels in this region, prior to sowing and harvesting seasons.

The potter: No specialised potter families were found in the six villages surveyed. A large potter community lives east of Jhansi in Chirgaon and Badagaon villages, but their influence is not evident in the use of fired clay products, especially roofing tiles or *khaprel* in these villages.

Self construction - Beldar at Raksa plastering the room

Self Construction - Masonry at Dhikoli

Assisting the mason to lay a stone roof at Dhikoli

Assisting the mason in masonry - Sriram at Harpalpur

Transfer of skills - Raj Mistri and his apprentice at Dhikoli

Devki Nandan's sons - built this new room under father's guidance

Figure 4.4 Delivery Processes

An earlier survey had revealed that the five potter families in Raksa had given up their profession as it was no longer economically viable. A broad community-based knowledge regarding the manufacture of the *chapti khaprel* exists in these villages. Inquiries regarding 'who' specifically manufactures *khaprel* in Dhikoli and Palinda revealed that many villagers 'know how to', but some are better acquainted than others in the skill of 'pulling' (moulding) the clay mix. Many villagers, both young and old, claimed to have manufactured *khaprel* for themselves or for others in the village. They are not professional potters in the traditional sense, but have gained this skill through practice. This issue raises the question of classifying the skill. Is it a 'local area' or a 'personal skill'.[8] The manufacture of *chapti khaprel* in this area seems to fall in between the two and can probably be classified as a 'semi-specialised local craft'. The semi-skilled worker is only called in for 'pulling' the *khaprel*. He charges Rs. 50 per 100 *khaprel* 'pulled' which actually forms only a small percentage of his main income from agricultural or pastoral activities.

Remuneration of the artisan: The traditional system of *jajmani* based remuneration has all but disappeared in this area. Some land-lords still practice it "*in order to keep their hold over artisans and to maintain their superior social status*" (Chattarpal, village Dhikoli, June 1994). Table 4.5 presents remuneration rates for artisans and the unit of work normally charged for. Although the table presents basic monetary rates in cash terms, it was found that cash payment is often discounted in part by grain or service exchange. Thus Rs. 70 per day of the mason or Rs. 50 for *khaprel* pulling is negotiable on the basis of daily food or grain or other goods and services - never totally but often partially compensated.

Table 4.5 Artisans' remuneration rates

Artisan	Unit	Rate/ Unit (Rs.)*	Compensation frequency indicated	Compensated with
Skilled mason	per 8 hour day per item of work	Rs.60 - Rs. 70 per day	Often, but decreasing	Grain, daily food, installment based payment
Semi-skilled mason	per 8 hour day	Rs. 45 - Rs. 50 per day	Sometimes	Daily food, grain
Un-skilled worker	- do -	Rs. 30 - Rs. 35 per day	Sometimes	Daily food, grain
Carpenter	per item of work - door/ window	Rs. 1000 per door, wood included.	Often, but decreasing	Daily food, grain, installment based payment - credit.
Blacksmith	per item of work		Often with iron, sometimes with grain	Old iron, grain
Potter - *Khaprel* maker	per 1000 nos.	Rs. 50 per 1000 (only 'pulling')	Sometimes	Daily food

* *1 Can $ ~ 23 Indian Rupees (Rs.).*

[8] Local area skills versus personal skills are explained in Chapter 2.

Table 4.6 Building activities in the five villages*

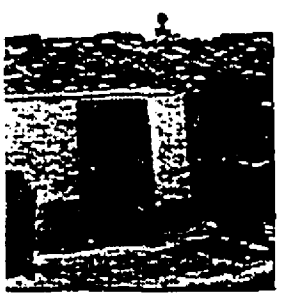
Village	Maintenance& repairs: plaster - *lipai*, painting, replacing broken roof tiles.	Upgrading: changing whole roof or Wall	Extention: adding new rooms in existing courtyard	New houses: completely new houses being constructed
Raksa	40%	25%	25%	approx. 10%
Dhikoli	50%%	22%	25%	approx. 3%
Palinda	55%	18%	25%	approx. 2%
Kanchanpura (new)	35%	10%	50%	approx. 5%
Khalilpura	85%	10%	5%	None observed
Lidhora	75%	15%	8%	less than 2%

** : Percentage is calculated as per observation, validated by the vilagers during survey, an error of +/- 2% is possible. The figures above reflect percentage of total building activity of various types being undertaken during the period of the survey and not the percentage of total houses.*

Collection of building elements for the next season, Harpalpur

Collection of building elements for the next season, Lidhora

Upgrading a wall after demolition - from cob to composite masonry at Lidhora



Repair and Maintenance - Resetting the *khaprel* roof - *Sahariya Basti* at Raksa

Repair and Maintenance - Plastering the Chabutra at Dhikoli

New Construction - Chattarpal's new house at Dhikoli

Figure 4.5 Building activity in the villages

4.2.3 Local Markets and Building Economy: Most housing activity within the villages is related to repair, maintenance and extension (Table 4.6). Much of the repair and maintenance utilises materials like *khaprel* and *gumma*, which are self made or manufactured within the village requiring little external skilled input and country wood collected from the surrounds. Only for items like cement and steel are the material outlets approached. Stone slabs and *khandas* are directly bought at the quarry, while sand is procured from the contractors.

All of the villages studied except Khalilpura and Lidhora are fairly well connected to the main road N.H. 25 leading from Jhansi to Shivpuri. Along this road are various building material outlets, mainly for cement, slaked lime, iron, steel, and *Kanpuri gumma*. Raksa is the main shopping area for Palinda, Dhikoli and Kanchanpura. Transportation is mainly by tractor trolley and bullock carts According to the owners of some of the building material outlets, the number of these shops has increased, though not substantially. The sale and purchase of cement and aggregate is increasing as mentioned before. Majority of their clients or *grahak* are rural, mainly from neighbouring villages that are well connected by road. Business peaks up during summer. Credit is given sometimes, but only to regular or known clients; late or instalment based payment is sometimes accepted. All the building material suppliers in Raksa possess agricultural land and the 'shop' is not their only source of income.

Manpower source in the villages is local and at least one mason was found in every village surveyed.[9] Local masons are kept relatively busy during the construction period i.e., from April to June. In the words of the *raj mistri* at Dhikoli - "*in this season (summer of 1994) I have not had a single day free.*" Increase in brick and stone masonry construction has resulted in an increase in the mason's market. Much of the 'extension work' in Dhikoli is curently done with fired brick, or random rubble masonry and stone or RBC roofs, requiring the services of a skilled workman. Work pressure decreases from July to March. The artisans, however, do not involve themselves in construction all the time. Most of them possess at least 2 to 5 acres of land which are cultivated once or twice a year. Some migrate to the city during periods of low construction activity in the village or work as labour in the fields of larger land-lords.

[9] NIC records, supplemented by information collected or confirmed by the author.

Due to the agrarian nature of economy, incomes are seasonal. At the times of the two harvests, in November and March farmers are flush with monies received from the sale of crops. The mason's market peaks up at this time from May to June. The November harvest heralds repairs and maintenance for the festival of *Diwali*, and for marriages. The pastoralists, on the other hand, have regular incomes. Animal husbandry has been a traditional occupation of this area and has become very lucrative with an increase in the market for milk. This has resulted in better incomes for the cattle herders and is reflected in the building activity within this community as well as an increased demand of the artisans' services.

4.3 Changes in the Building Practice and Delivery Processes

The pattern of change from one system to another is slow but generally uniform in the area and it indicates the trend. It also reflects the status of resource availability, change in socio-economic structures, skills, needs and aspirations. A study of change, by its very nature, involves a study conducted over a period of time. Changes appearing in the construction practice over a period of 10 to 15 years were studied at the time of survey by making inquiries about the materials, techniques and time of construction of different sections of the dwelling units. Discussions with village elders, especially the older artisans, enabled an understanding of how materials, techniques and remuneration systems have transformed over the years.

4.3.1 Spatial and Structural Changes: First impression of the villages, especially Raksa and Dhikoli is the lack of completeness in the built environment. Repair, maintenance and extension are in progress in a majority of houses. Most building activity in the villages is of this type as indicated in Table 4.6. Walls are left with jagged ends to receive a new room or another wall, some mud walls are in the process of being knocked down to be rebuilt in fired brick or stone, while others are being plastered and prepared for the coming monsoon. In most cases, living spaces are extended by building another room within the compound.

Figures, 4.6 (a) - (d), explain graphically how change in construction systems has taken place in a selected sample of 4 households in the study region. Appendix 4.4 presents the change in roof and wall components in the district over a span of 20 years from 1971 to 1991, and shows an increase in fired brick walls and stone roofs.

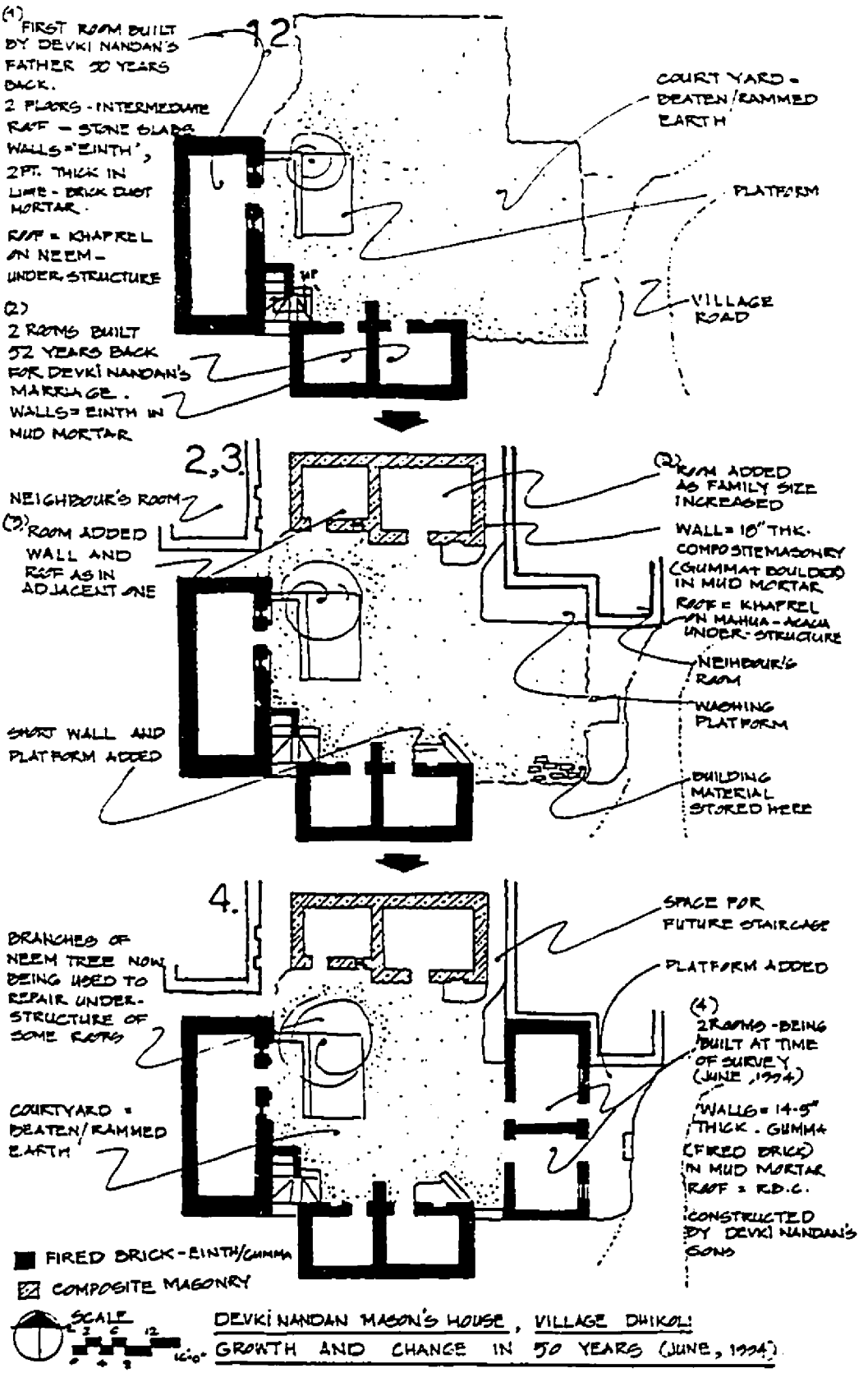


Figure 4.6 A Process of spatial growth and change in the building components

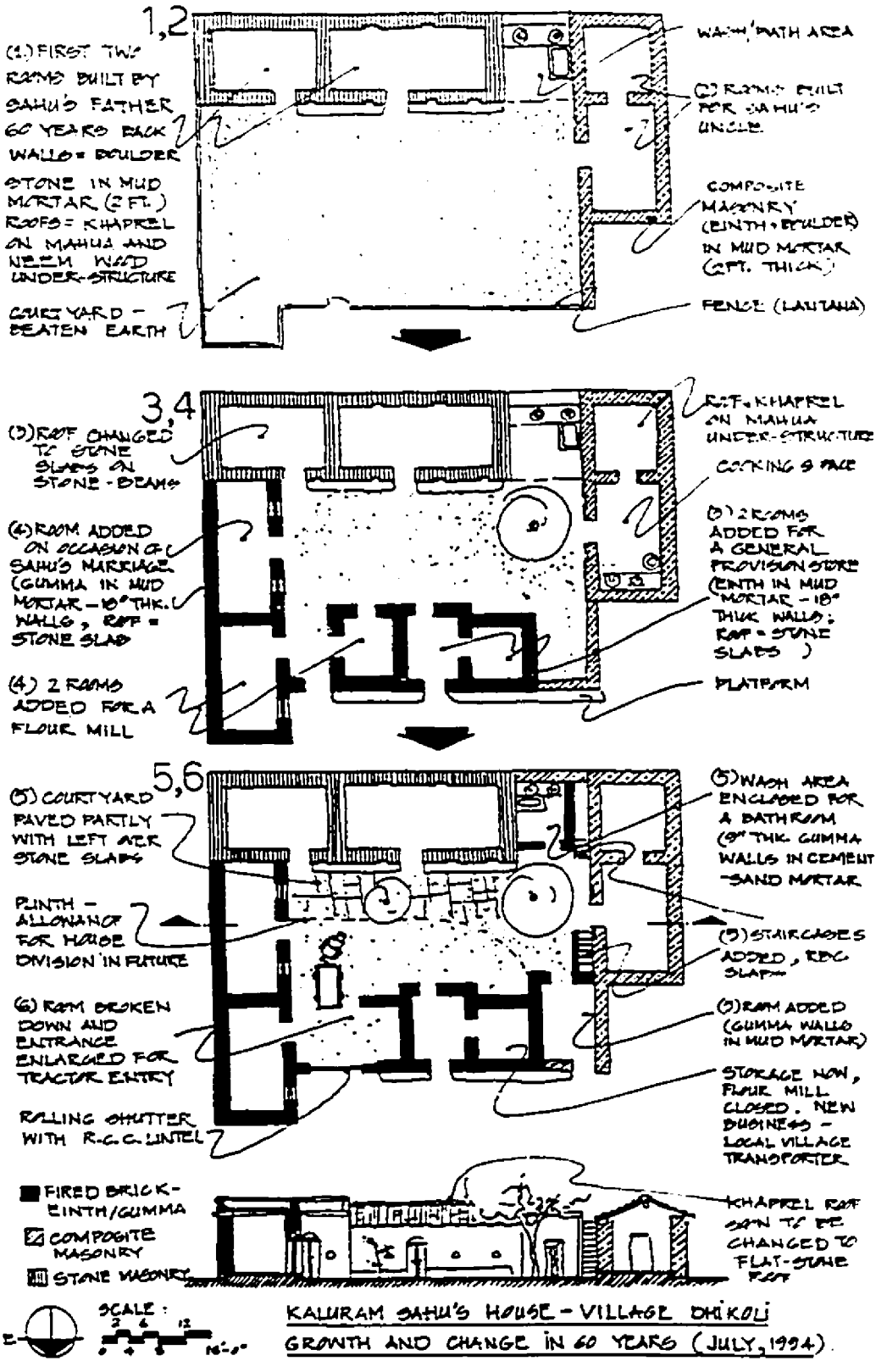


Figure 4.6 B Process of spatial growth and change in the building components

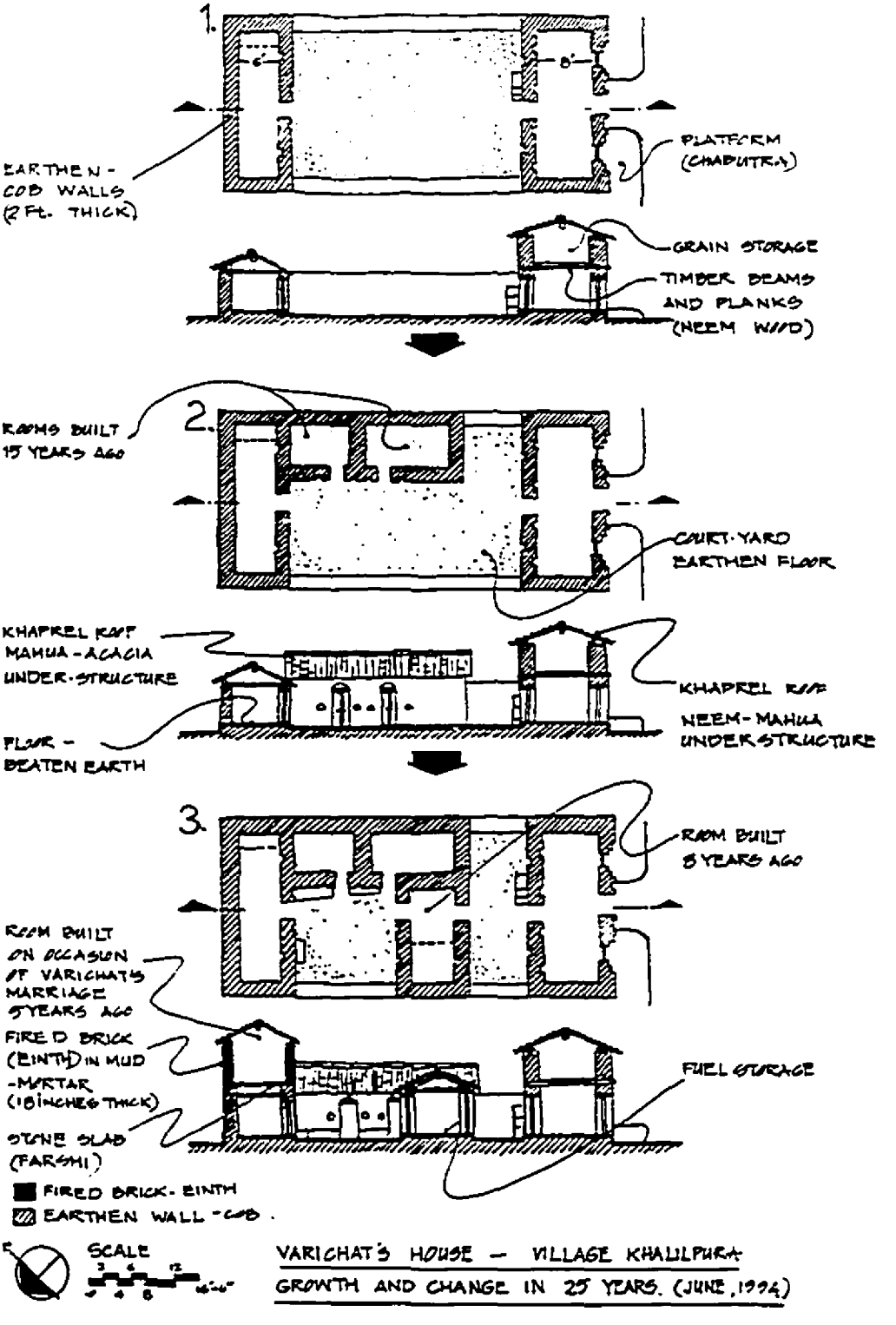


Figure 4.6 C Process of spatial growth and change in the building components

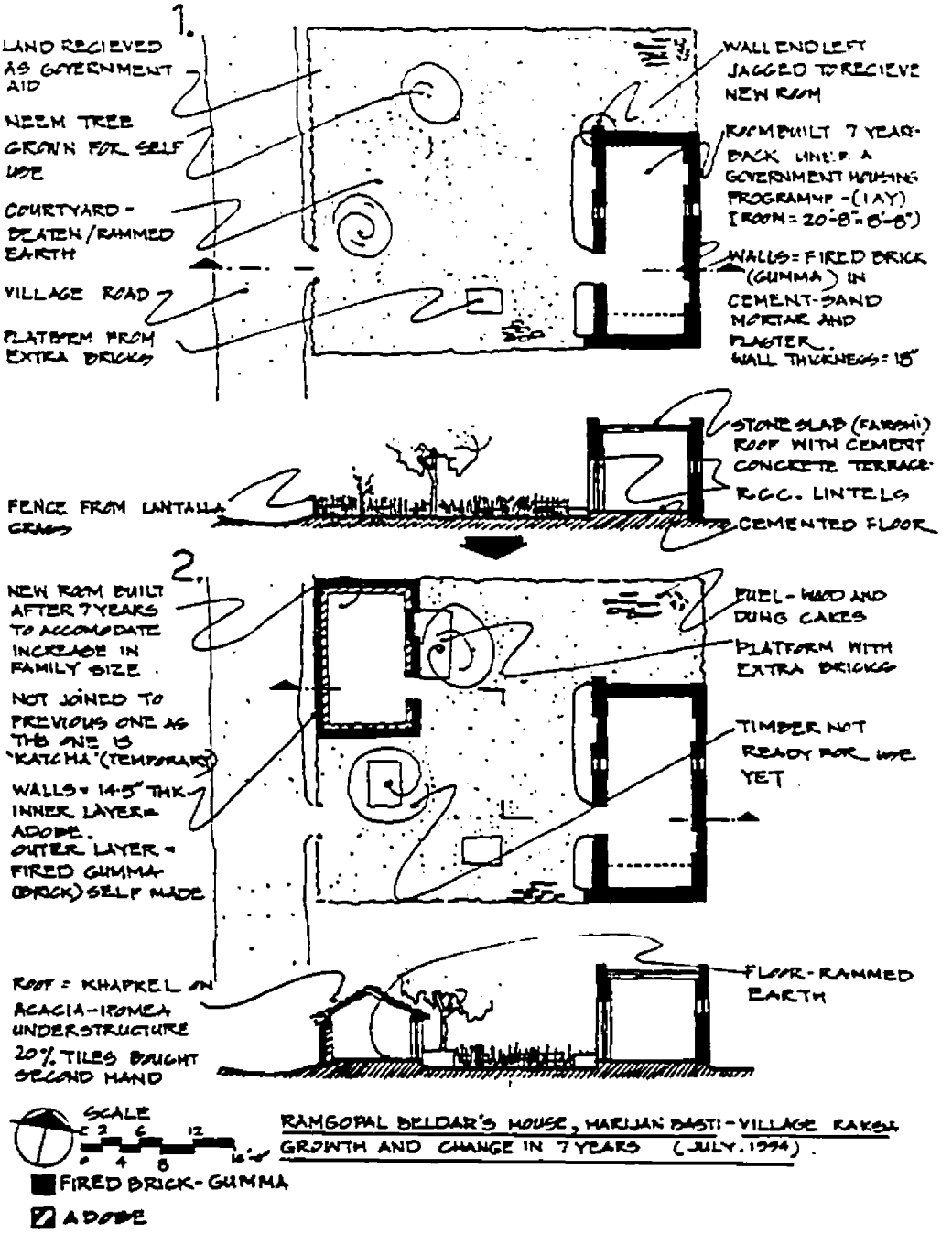


Figure 4.6 D Process of spatial growth and change in the building components

A mud wall or a tile roof is not necessarily replaced by *pucca* fired brick or stone construction, unless it is beyond maintenance or there is surplus cash available. The older room is broken down and rebuilt in fired brick and stone only when it looses its utility value, or when a special occasion demands it. Special occasions like weddings and births and their celebration through house building and upgrading are motivations to save money. Although, normally houses are upgraded / extended utilising household savings only after daily needs have been satisfied, special occasion building may take precedence over priorities like new clothes, education, food quality and health. Two cases (Sriram at Harpalpur and Beldar at Raksa) were observed where the dwellings were being extended despite difficult economic circumstances. The former, to accommodate a new bride and the latter in anticipation of a child.

Many houses were in the process of change of roof from pitched-tiled roofs to flat stone roofs at the time of this survey. The upgrading of walls from cob to fired brick, boulder or composite masonry is a prerequisite for a heavier roof. Inquiries regarding reason for change in structure from earth based to fired brick or stone based, often revealed a need for reduced maintenance of the house, as jobs in the city left little time for this regular activity. Much greater variety in materials and techniques and a mix of natural and industrial materials was found in Raksa and Dhikoli as compared to the relatively remote village of Khalilpura. The former, also had much more new construction and rebuilding after total demolition.

Steel angles for door and window frames were observed in many houses in the villages. RBC and steel girders appear to provide alternatives to stone and timber for roofs and beams. However, this shift is greater in Raksa, Palinda and Kanchanpura as ccompared to Lidora and Khalilpura. Almost 30% houses in the new village of Kanchanpura are roofed with stone slabs on steel beams and 18% by stone beams as compared to Khalilpura which has only 2% and 9% (Appendix 4.2). Wrought iron window grills and cement *jalis* (fenestration) for ventilators are finding popular use for security and aesthetic reasons.

The process of upgrading is slow but steady and piece-meal in most cases and has stabilised for many. This stabilisation, for families who by now posses *pucca* houses, is because of any of the three reasons: (i) their needs are not growing, (ii) there is general satisfaction with the level of technology used, or, (iii) due to technological and economic challenge. For the lower income families, stabilisation at lower levels of technology almost

always seemed to be a result of the lack of financial input and /or the lack of access to more *pucca* (permanent) materials into their system.

4.3.2 Changes in Resource Availability, Accessibility and Costs: Significant changes are observed in the region with respect to availability and accessibility of building materials. There is almost no tree cover left on common lands. Much of the under-structure, especially for *khaprel* roofs now utilises secondary timber like *Babul* and *Mahua*, and at many places, even this is being replaced by Ipomea and Lantana. A general degradation is thus visible, especially in the houses of the poorer section. Upto approximately 18% houses in Raksa, 13% in Dhikoli and 12% in Palinda are roofed with clay tiles supported on Acacia-Ipomea /Lantana under-structure (Appendix 4.2).

Fuel needs can no longer be met by timber, therefore dung, a valuable manure resource is being diverted as fuel for cooking and in kilns for the manufacture of bricks and tiles. Empirical calculations and observations reveal that approximately 1000 to 1500 cakes of dung are required for every 1000 bricks. This is a large amount of manure. Much dung is lost when cattle is sent out to graze.

Many incidents were mentioned of a farmer renting out his agricultural fields and/or using it himself to manufacture bricks in order to pay for an unavoidable expense like a daughter's marriage. This increased use of fertile top soil could lead to reduced soil fertility - a fear expressed by AVM (retd.) Sahni, who is managing a large watershed programme here.

The abundant inorganic resources like sands in the stream beds, boulders and rock outcrops are now controlled by contractors. Contractors obtain permits for extraction and supply of these in return for royalty paid to the district revenue authorities. These contractors are usually the more influential members of the rural society, often absentee landlords.[10] Resources like rocks and soil lying in individual fields and *gram-sabha* lands can be extracted by villagers free of cost but any material from revenue lands and reserved forests has to be bought. In many cases, villagers revealed that such resources were simply removed illegally.

Amongst the resources that have disappeared is lime, as mentioned before. Up to 25 years back lime was being used in this area, in combination with brick dust as a mortar in

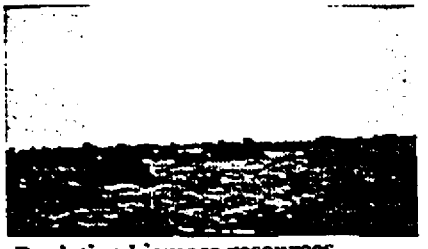
[10] For example, Hemant Kumar Narvariya in Raksa.

masonry. Lime was traditionally manufactured using a laborious and time consuming process of burning lime-stone in kilns and crushing the burnt stone between oxen driven grinding stones. The crushed material was finally slaked in pits dug in the ground. Introduction and popularisation of cement, lack of knowledge regarding simpler and more efficient methods of lime production and a scarcity of timber for burning the limestone have all contributed to the decline in manufacture and use of lime in construction. Now lime is mainly used as a white-wash for walls.

Cement as a binder in mortars and plasters entered the rural building system of this region only about 25 to 30 years back. Although widely used in the city of Jhansi, its use in these villages was limited to government built public buildings like schools, *panchayat* buildings etc. The use of bamboo for intermediate floors is unique to Kanchanpura in this group of villages and is a remnant of construction methods used by this community in their earlier site 30 years back. This system is not known to the neighbouring villages.

4.3.3 Changes in Levels of Skill: A change in resources and socio-economic status (therefore patronage) obviously heralds changes in levels of skill. Certain skills demand a lot of labour input like the elaborate foliate arch. This is a prominent vernacular expression defining the entrances, it is however too expensive now, even for many medium and large farmers. One archway of the type shown in Figure 4.7 can take upto 30 mason days to construct. In cash terms this would mean upto Rs. 2100.00 for skilled labour costs alone.

New needs and aspirations and a new aesthetic influenced from the urban areas is bringing new skills into the village system. Requirements like private toilets ask for space in the house and for methods of constructing soak pits. Acquisition of assets like tractors mean garage spaces or large openings which need to be spanned with steel, RBC or RCC. Reasons of economy have resulted in the optimisation of wall thickness and construction of thinner (14.5 or 9 inch) walls. Urban influence is seen in flat spans for doors and windows, decorative cement *jalis* and concrete beams. Chattarpalji's new house is to be built in an entirely 'modern style' with flat openings and a porch, while Deendayal in Raksa is experimenting with a semicircular arch of 9 inch thick brick work laid in mud mortar without a counter thrust.



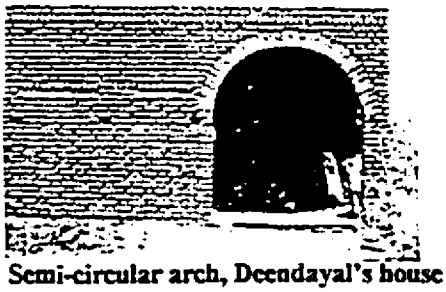
Depleting biomass resources

Deteriorating quality of construction with poor materials

Large openings and flat spans

Large openings and flat spans

The elaborate foliate arch - a disappearing local vernacular



Semi-circular arch, Deendayal's house at Raksa - new forms in the study area

Figure 4.7 Changes in the building system

4.4 Public Sector Housing Programmes in the Area

Two main government housing programmes have been introduced in this region - the Nirbal Awaas Yojna (NAY) and the Indira Awaas Yojna (IAY). The difference between the two is mainly that of the target group and in the mode of financing. The NAY is totally subsidised and is meant for any economically backward family. The IAY has a soft loan component along with partial subsidy and is meant only for Scheduled Caste (SC) and Scheduled Tribe (ST) families. Three such public sector housing schemes were observed in the region studied.

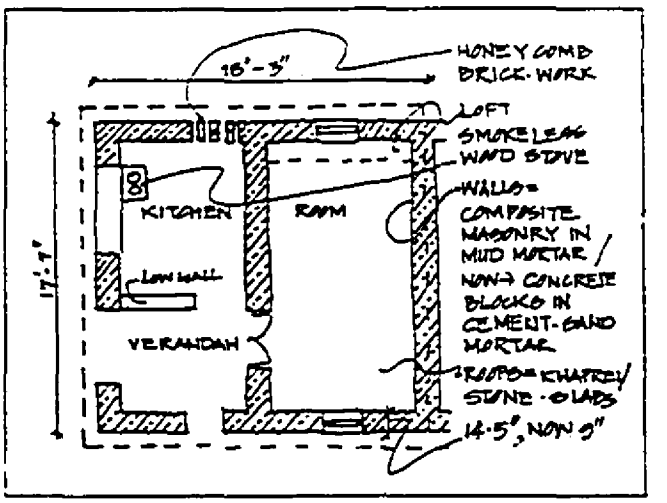


Figure 4.8 A typical Indira Awaas Yojna house

i) NAY adjunct to Dhikoli: At first glance this group of 12 houses does not look very different from the general houses in the main village. On closer look, the identical one-room plans become apparent. These houses were constructed in 1987 for 12 *harijan* families in the village but were occupied only four years back, when congestion in their houses in the village forced the families to break up and move out. Changes, additions and extensions are seen in the roof system - from *gol khaprel* to the *chapti khaprel*, walls have been built up to increase the covered space. The new walls are built with local *gumma* laid in mud mortar. The earlier construction uses *Kanpuri gumma* in mud mortar. One family has constructed an additional room with composite masonry. There are no stone roofs yet - but the residents expressed the aspiration for eventually changing the *khaprel* to *farshi* (stone-slabs).

Figure 4. 9 A Harijan Basti at Dhikoli

ii) **IAY outside Lidhora:** This group of six houses outside village Lidhora and is about three years old. The construction system is fired brick in cement mortar and cement plaster for walls, and RCC for the roofs. The houses are in a state of disrepair and no extensions or changes have been made. Houses have been acquired but not lived in. The beneficiaries of this scheme live just a few metres away in self-made cob wall - *khaprel* roof houses.

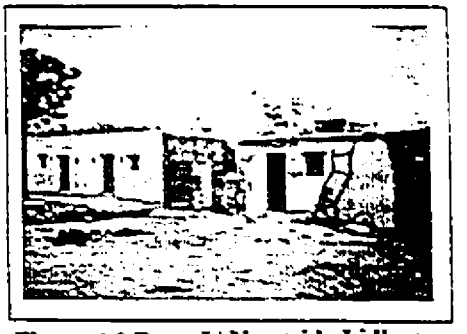


Figure 4.9 B IAY outside Lidhora

iii) **NAY at Pura Badhera:** This group of 104 houses built for a *Sahariya* community was completed in February, 1994. The community's earlier self-built cob-*khaprel* houses were demolished and *pucca* houses of concrete block walls and stone roofs were construced in their place. The concrete blocks were hand moulded on site by a mason employed by the local block office. The moulds are now stored in the block office for other projects. These houses are provided with pour-flush '*sulabh*'[11] toilets and smokeless *chulhas* (stoves) - neither being used. At the time of this survey, the houses were experiencing their first monsoon. Most roofs were leaking and the residents expressed their inability to make necessary repairs in absence of access to both the technology and the material.

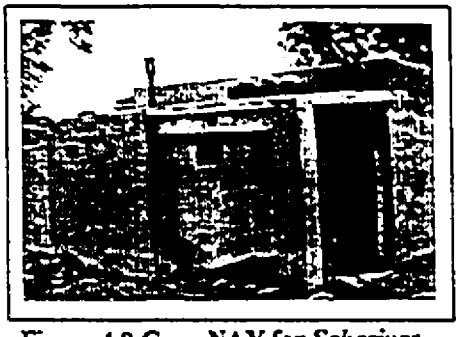


Figure 4.9 C NAY for *Sahariyas*

This chapter has presented construction practice and delivery linkages in a selected sample of villages within Jhansi district in Bundelkhand. An analysis of appropriation of the materials, wall and roof construction techniques, manpower and transaction systems by different socio-economic groups is taken up in the subsequent chapter. This enables an understanding of the 'character' of the rural building system.

[11] Sulabh Shauchalaya (privy) is an innovative pour flush toilet that is cheap to construct and maintain and reduces the quantity of water required for flushing. Refer note no. 22, Chapter - III.

CHAPTER V - APPROPRIATION OF BUILDING SYSTEMS: ANALYSIS OF THE FIELD SURVEY

This chapter builds on the understanding of scholars as researched through literature in Chapter II and builds a framework for the analysis of observations made in the field. It identifies a set of indicators or criteria that determine 'appropriation'[1] of a building system by the villager, thus explaining the pattern of construction processes observed on the field (Chapters III & IV).

It is attempted to link the **building practice (the what)** and the **delivery processes (the how)** to the **criteria of user choice (the why)**. The analysis is qualitative and interpretative in nature, rather than rigorous - quantitative. The analysis is fairly congruent with the considered judgement of many earlier researchers in this subject. In addition, it brings forward certain systemic characteristics of rural building systems. Obviously, studies of more rigorous nature are required to determine its applicability in a wider variety of situations.

5.1 Classification of Construction Systems:

We have seen that various types of roof and wall components exist in the rural building palette. What are the characteristics of each of these construction systems in terms of their material, technology input, delivery process and the quality of the resultant product? It is attempted to classify these systems so as to bring forward their common characteristics. For this purpose, Julian Salas's model of classification of auto-construction methods in Latin America is being used.[2] The systems of roof and wall construction are classified in a generic manner so that they are understood in a wider context. The characteristics of building materials, masonry and roofing elements, technology input, delivery process and the resultant product as derived from the site are enumerated in the following section.

[1] The concept of taking over, adopting and adapting for self utilization - indigenising the technology, product, process or system. Refer Chapter II.

[2] Julian Salas, "An analysis of Latin American Auto-Construction: A plural and mass phenomenon" in Open House International, vol. 13. No. 4,1988, pp. 2-11.

Table 5.1 A Classification of the Building System

1 Materials (m) and elements (e):	2 Technology input:
A. Local, procured-self / others (m):	**A. Rudimentary:**
-Locally available, naturally occurring, organic / inorganic. - Widely available and free. - Renewable, abundant. - Flexible transaction mode.	- Utilises locally available, natural unprocessed or minimally processed materials. - Unskilled/non-prepared labour - usually family-based. - Little difference in pre-site and on-site activities. Minimal tools used. - Few construction guidelines - available as common knowledge. - Low / no monetary component.
B. Local, self procured / stolen (m):	**B. Local craft based/ hand made:**
- Locally available, naturally occurring, organic / inorganic. - Conserved though government order; - managed by and accessible through contractors / illegally removed. - Renewable scarce / non-renewable abundant. - Flexible transaction mode.	- Utilises locally available naturally occurring materials processed little. - Self-unskilled/semi-skilled manpower input. - Locally understood common knowledge construction guidelines. - Some distinction in pre-site and on-site activities. - Permits horizontal growth, vertical growth sometimes possible. - Part monetised; option of transaction in service exchange or credit possible.
C. Quasi-local, bought (m):	**C. Local specialised:**
- Locally available, natural inorganic. - Contractor controlled - bought at quarry. - Used semi-processed, processed by self / village craftsmen. - Widely available. - Limited flexibility in transaction.	- Utilises locally available material processed by local craftsmen. - Requires skilled local artisanal labour. Family as unskilled component. - Specific tools used. - Relies on artisanal judgement for structural performance. - Proportion of monetised cost greater in labour input. - Identified as the local vernacular.
D. Imported / Industrial (m):	**D. Industrial / locally understood:**
- Industrially processed / produced - Raw material - non-renewable, available enough / scarce - Bought at shops - cash transaction, credit rarely accepted..	- Utilises industrially produced/manufactured materials and elements. - Requires special skills that have been introduced into the village system. - Skill absorption through observation & use, mainly in the cities. - Complex pre-site activities, distant from user. - High monetary component.
E. Fabricated self / + local help (e):	**E. Industrial, specialised:**
- Uses A / B material type above. - M4 type used in case of govt. projects. - Processing knowledge - semi skilled type. - Transaction mode free / flexible.	- Utilises industrial materials and elements, not widely available. - Requires specialised skills unknown to local artisans. - Contractor built, normally provided for by the public sector. - Little or no local control over process. High monetary component.
F. Fabricated by local craftsmen (e):	
- Uses A / B/ C material type above. - Processing process specialised village craft. - Flexible transaction mode.	
G. Factory manufactured (e):	
- Industrially processed. - Procured at shop, cash transaction only.	

Table 5.1B Classification of the Building System

3 Delivery Process:	4 Resultant product:
A. Self-Constructed:	**A. Rudimentary - stable:**
- Construction of own dwelling. - Assisted by family and close relatives with local artisans! advice. - Technology type (2A) or (2B). - Piece-meal/ incremental. - Non-monetary in character.	- Technology type (2A). - Usually single or two rooms. - Has not been upgraded for a period of 5 - 7 years. Particular socio-economic, locational & other prevailing constraints under status quo condition render upgradation unlikely in the near future.
B. Self + local semi- skilled labour:	**B. Rudimentary - growing:**
- Construction of own dwelling. - Family + local semi-skilled labour. - Normally uses local craft based (2B) technology. - Incremental. - Partly monetary; possibility of exchange of service and goods.	- Technology type (2A). - Shows evidence of upgradation and change in construction system, or spatial extensions in the past 5 to 7 years. - Particular socio-economic conditions, under status quo permit an upward mobility.
C. Self-managed, self unskilled + skilled labour input:	**C. Intermediate - stable:**
- Construction of own dwelling . - Own and family labour as unskilled component - self managed. - Uses (2B), (2C) or (2D) type of technology. - Material Collection may be piece-meal, construction at one time. - Partly monetised, possibility of material / service exchange.	- Technology type (2B). - Has not been upgraded for a period of 5 to 7 years and particular socio-economic, locational and other factors indicate low probability of upgradation in the near future.
D. Self managed - local unskilled + skilled labour:	**D. Intermediate - growing:**
- Construction of own dwelling. - Uses 2C or 2D type of technology input. - Spatially incremental, each space a one time construction. - Delivery process totally monetised.	- Uses technology type (2B) / (2C) but not considered as entirely *pucca*. - Particular socio-economic conditions, under status quo permit an upward mobility.
E. Self-managed - specialised skill + local labour:	**E. Finished -stable:**
- Construction of own dwelling. - Uses 2D type of technology input. - Special city mason + local labour input. - Involves introduction of new skills and techniques into the village. - Spatially incremental. - Delivery process totally monetised.	- The industrial or local materials and techniques used reflect a high prestige value amongst currently available options. - Construction conforms with the resident's mental image of a finished product - Needs are not growing and current status of house, in the opinion of the owner does not require any upgradation in the near future.
F. Contractor / local government built & managed:	**F. Finished -growing:**
- Construction by an outside agent for a beneficiary. - Technology input (2E). - Delivery process monetised - requires beneficiary input. - Financed by Government as aid or part loan.	- Needs may grow, however, new spatial requirements are expected to be met with materials and techniques similar to the ones used in the current house.

5.2 Factors affecting User Appropriation of Building Systems

Chapter II portrayed the inter-relatedness of construction activities within a village The common thread running across building systems in rural areas was identified as dependence on locally available natural materials, high labour input (usually self or local village based), seasonality and piece-meal nature of construction. It was indicated that the physical environment provides possibilities from which choices are made. Choices are determined by taboos, customs and traditional ways of culture and even though physical choices may be numerous, the actual choice is often limited by the cultural matrix.[3]

We find, that although social taboos of caste no longer dictate construction modes, their role in the creation of today's economic classes is undeniable. Problems associated with the availability of and accessibility to materials, manpower and technology coupled with the monetisation of village economy increasingly affect the choices that are made. These practical limitations are now stronger determinants of choice of building systems. The socio-economic considerations necessitate a review of the 'linkages' and therefore of the process as a whole.

Three distinct socio-economic groups were identified on the field (Chapter III): (i) the landless and *Sahariya* tribals, (ii) marginal and small farmers and (iii) medium and large farmers. The preferences and priorities of each of these groups varies due to different socio-economic constraints imposed upon them.. A marginal farmer on the cross roads of change from a mud to fired brick wall may ask himself the following questions:

- Is there soil available nearby to manufacture bricks, is it free for collection or do I have to pay the revenue authorities; so, should I take it in any case (steal / remove illegally)?
- Can I manufacture bricks on my own; do I need help from the neighbour; do I have enough fuel for burning the bricks or do I need to buy dung cakes?
- Should I compromise my daily wage in order to spend time on brick manufacturing?
- Can I lay the bricks on my own or do I have to call a mason? How will he get paid?

At the other end of the economic ladder, a large farmer raises questions such as, whether it is better to buy steel girders or is a stone beam cheaper? Does the local mason know how to construct an RBC roof or should he go in for a stone roof? With less economic but more social/ prestige constraints, he fulfils his aspirations through other economic routes.

[3] Chandhoke (1990), Refer Chapter II

Four factors are identified that have a direct bearing on the choice of a construction system. These are: (i) availability and accessibility to materials, manpower and technology, (ii) affordability, (iii) new needs and aspirations and, (iv) intra-systemic factors.

5.2.1 Availability and Accessibility: Availability pertains to presence of a material, element, skill and technology in the vicinity and within acquirable/procurable distance. The issue of availability is, however, incomplete without considering the aspect of accessibility. Accessibility defines physical, social and economic reach to materials, elements, technology, skill, information and knowledge systems associated with a construction system.[4]

Changes in the natural resource base have made certain materials unavailable to the villagers. Scarcity of good quality timber has resulted in a change over to stone (on stone or steel) and/or RBC roofing systems. For the lower income groups it has meant using secondary and even tertiary timber like Ipomea and Lantana resulting in inferior quality *khaprel* roofs. Lack of external technological input regarding simpler and more efficient methods of lime production with simultaneous influx of cement has resulted in the disappearance of local production and use of lime. The stone is now mined to manufacture cement.

Sand, rock outcrops like granites, and gneiss have become inaccessible to the poorer sections of the village society simply due to a change in management structure from community based to government and contractor controlled. A change in transaction systems from *jajmani* and exchange based to monetary has reduced or altered conditions of accessibility to local skills, crafts and locally produced materials and elements. Informal payments - credit and instalment based, do exist but cash transactions are preferred instead of the traditional exchange of grain and services. This has meant a shift from artisanal to self dependent construction - many now make their own *gumma* and *khaprel*.

Location plays an important role in accessing materials and technology. Dhikoli, Palinda and Kanchanpura, connected by fair weather roads to NH 25, and Raksa through which this highway passes, are easily able to access industrial materials like cement and steel. Transportation of material upto the village is rarely a problem. Frequent and regular contact with city markets and seasonal out-migration have contributed to information and influence of

[4] Oakley and Unni (1965).

'city type' construction seen in grills, *jalis*, 9" thick walls etc. Lidhora and Khalilpura, on the other hand, being remote and relatively cut off, especially during monsoons, have less contact with, and therefore reduced access to, information, skills and materials from a city or town.

Access to reliable information is an important factor in the choice of a building material or technique. The information net-work is relatively strong between the city and the village (most information flowing one way). Within the rural area, however, the net is strong only between older and well settled villages, where social and economic ties have developed over generations. Thus, very little is known in Palinda, Raksa or Dhikoli about Kanchanpura. The special skills regarding bamboo construction for intermediate floors possessed by the residents of this village are not known to other villages although almost every village has some information regarding possible use of RBC, RCC.

The *Sahariya* community, adjunct to Kanchanpura, identified economic inaccessibility to tools, techniques, materials and skill regarding the concrete block masonry system as the main constraint to extend and repair their houses. Whereas, this can be explained as a lack of responsibility towards maintenance and upkeep of a 'gifted item'[5], it does not justify the reaction of *Harijans* at Dhikoli, also 'provided' with government built housing. The latter were able to utilise their limited access to materials, techniques, and skills, to incrementally upgrade their *gumma-khaprel* houses. Similarly, non availability of *gol khaprel* (semi-circular tile), a lack of skill to manufacture it and economic inability to procure it from Chirgaon are probably the reasons why most *khaprel* roofs in Raksa, Dhikoli, Palinda and Kanchanpura are clad with the *chapti khaprel* (flat tile). For the same reason *Harijans* at Dhikoli are slowly replacing *gol khaprel* in their IAY houses with the cheaper and more accessible *chapti khaprel*.

Social inaccessibility to a mason's skill has been one of the reasons that the *Sahariya* community (even those who are relatively well off) choose a self-build option.

5.2.2 Affordability: Affordability of a rural family has greater connotations than simple purchasing power determined by available surplus cash. The factor of cost encompasses aspects of direct monetary cost, initial expenditure required, recurring maintenance cost, possibility of credit or service exchange and time and opportunity cost.

[5] One which has been acquired without monetary or labour input on their part

In an agricultural economy surplus cash is limited. Aspiration to a decent and acceptable shelter is a driving force for household saving. However, 'cash' is not the only route adopted to achieve the final aspiration, even in an increasingly monetised economy.

We find a considerable input of family labour in construction, especially in lower income households. The non-monetised component, thus, contributes significantly to economy in total construction cost. The piece-meal nature of construction further helps get the otherwise expensive materials within a villager's limited budget. For example, unlike popular belief, changing from a *katcha*, mud house to a *pucca* fired brick or stone house does not necessarily entail a large one-time investment. Most materials are collected over a period of two to three years and stored in the courtyard. A little surplus cash at this time enables the farmer to employ a skilled workman and upgrade the dwelling or add another room.

Recurring maintenance costs have to be balanced by time and opportunity costs. Whether the farmer is compromising on a potential income generating opportunity in order to invest time in recurring maintenance costs, manufacture bricks etc. is an important factor that determines the technique and process adopted. If the family income is totally land dependent, then they really have no other employment opportunity during lag periods of agricultural activity. However, in case of available options to work as a wage labourers in the city, in village or town based industries, at construction sites or at shops the value of opportunity cost increases. As accessibility to urban centres increases, opportunities for off-land employment also increase. Off-land employment opportunities during lag periods of agricultural work result in higher incomes and reduced time available for repairs and maintenance of the dwelling unit. This results in the shift from a self-constructed to a self-managed process.

5.2.3 New Needs and Aspirations: The pattern of change in building systems within a village indicates that, changes in economic structure (as the hitherto poor and socially backward pastoralists (*gwalas* of *pal* caste) become prosperous), occupation, and influence of urban construction systems (as more and more landless migrate to the city for work) result in a change in aspirations and prestige value of elements, and of the house as a whole. The shift from personal skills (self done) to local area skills (of a local skilled mason) signifies upward mobility and therefore provides a prestige value to the house and owner.

Industrial materials and urban systems of construction have associated with them concepts of modernity and of reduced maintenance. These associations, along with the scarcity and lack of good quality indigenous raw material resulting in comparable monetary costs of industrial materials makes them a preference of those who can afford them. The prestige value of the new industrial materials is clearly reflected in the desire to build a city-type house by Chattarpal, who can otherwise afford to pay in cash for the skill of the local *raj mistri* and scarce materials like good quality primary timber. The adoption of a city type house by the headman's brother (Chattarpal), further reinforces this prestige value. Similarly, a change-over to flat spanned openings from the elaborate foliate arch, a direct consequence of high labour requirements and lack of patronage, is now prestigious and modern and therefore sought after. The new aesthetic (without, however, the requisite knowledge and skills) is also reflected in the construction of a semi-circular arched opening by Deendayal at Raksa, which is maintained in appearance despite its structural failure (Figure 4.7).

The acquisition of new assets like the tractors, a desire for personal toilets *"in the village, (as in the city)"* (Dubeji, village Palinda, July 1994), large windows which require grills and different spanning elements are needs that are being met with the easiest and most convenient mode possible by the different socio-economic groups.

5.2.4 Intra-Systemic and Structural Factors: Modes of material procurement, transportation, manufacturing processes and structural aspects influence the adoption of and change of construction systems.

The material and technique of wall construction is linked to the roof component adopted. For example, change of a cob wall to fired brick or stone masonry is a prerequisite to the change of roof from *khaprel* to stone or RBC. Size of the spanning member available limits room spans, and need for larger rooms is met by utilizing seel and RBC beams as intermediate supports. The system of cooking over wood or dung stoves requires openings in the roof to let the smoke out. This has resulted in all cooking spaces to be covered by *khaprel* roofs. The sizes of which are limited by the timber lengths for under-structure available and accessible.

The size of transportation vehicle limits quantity of material that can be brought from a distance. The farmers who do not possess either a bullock cart or a tractor and have to hire the

same at a 'cost', need to balance out what they have to cart from a distance and how many trips they can afford to make with what is possible through individual head-loading.

Knowledge of the soil, soil-water proportions and burning process, locally popular kiln type and fuel used for baking tiles and bricks results in the specific quality of local fired clay products. The appreciation of this quality in comparison to a stronger *Kanpuri gumma*, boulder or *khanda* determines the choice of one above the other.

Using the classification arrived at in Section 5.1, choices made by the different socio-economic groups are indicated in Table 5.2 below:

Table 5.2: Choice of Building Systems

Options	Characteristic	Landless and *Saharlya* Tribals	Small and Marginal Farmers	Medium and Large Farmers
Raw material	Local - self collected/ collected by others	Most	Most	Some
	Local - self collected / stolen	Most	Most	None or very few
	Quasi-local - procured at quarry / shop	None or very few	Some	Some
	Imported/ industrial	None or very few	Some	Some
Element	Self produced	Most	Most	None or very few
	Self + local labour / Local labour	Some	Most	Some
	Bought at quarry/ shop/ factory	None or very few	Some	Some
Technology input	Rudimentary	Most	Some	None or very few
	Village cottage based / Locally specialised	None or very few	Most	Most
	Industrial/locally known	None or very few	Some	Some
	Industrial/specialised	None or very few	None or very few	None or very few
Delivery process	Self constructed	Most	Most	None or very few
	Self + local semi-skilled labour	None or very few	Most	Some
	Self + skilled labour	None or very few	Some	Some
	Self managed - Local skilled + unskilled labour	None or very few	Some	Some
	Contractor built / Public-sector provided	None or very few	None or very few	None or very few
Resultant product	Rudimentary/ stable	Most	None or very few	None or very few
	Rudimentary/growing	Some	None or very few	None or very few
	Intermediate/stable	Some	Some	None or very few
	Inter-mediate/ growing	Some	Most	Some
	Finished/ stable	None or very few	Some	Some
	Finished/ growing	None or very few	Some	Most

Most Some None or very few

Provided under government programme

5.3 Characteristics of Building System Options:

Analysing the variety of techniques of construction and their delivery within the village system we find three basic common characteristics emerging. The technology input, delivery processes and therefore the resultant product possess:

(i) a high degree of local control,

(ii) incremental upgradability and,

(iii) variety and flexibility in the delivery process.

5.3.1 The Aspect of Local Control: At the lowest rung of the economic ladder, most activities are self-done. Collection of raw material, transportation, manufacture of building elements and their assimilation or construction is an individual's or a family activity, confirming that, "*Subsistence economies rarely permit the emergence of full time building specialists*"[6]

Those higher up on the socio-economic ladder opt for construction systems with more sophisticated technology input. Pre-site participation in the process decreases considerably, while on-site options and options for delivery get limited and more dependent on direct cash transactions. The degree of participation in the act of construction itself decreases as specialists and skilled workmen are called in, but management control remains more-or-less the same. The monetary aspect of the building system in this case also goes up (Table 4.4, Chart 4.1).

The level of local control in actual construction or its management is an important characteristic of the building systems chosen. The unfamiliar skills of concrete block production reduced the *Sahariya's* control over the construction process and was a limitation of the IAY houses provided to them. Introduction of a technology that is industrial and monetary in character into a scarce economy reduces the beneficiaries' access to even the self-help component of their housing process.

5.3.2 The Aspect of Incremental Upgradability: We found a tremendous amount of building activity in the villages of Raksa, Dhikoli, Palinda and Kanchanpura in decreasing order of intensity. In Khalilpura and Lidhora most building activity was limited to repair and maintenance (Table 4.6, Section 4.3.1).

[6] Colin Duly, The Houses of Mankind, (Thames and Hudson, London, 1979). p. 13

The trend clearly indicates that, wherever possible, people are upgrading from *katcha* - earthen houses and intermediate constructions to *pucca* houses. Most of this upgrading is piece-meal. Materials are collected over one or two seasons, and the house is upgraded item by item. The courtyard nature of the house allows spaces to be added incrementally without much disturbance to household activities. This characteristic of the rural building system fits well with the seasonality of agricultural activities. Most agriculture is rain dependent, and the limited irrigation facilities available are unable to provide water during the hottest months of May and June. This time of the year is reserved for upgrading, repair and extension of houses; in the words of Murton, "*A time to rest and prepare for the next cycle*"[7]

In the period just after the harvest (summer), the farmer is flush with monies received from the sale of crop. He is most likely to spend for construction or house building at this time - a fact confirmed by building material suppliers, who find most building material purchases undertaken in this period. The incrementality and seasonality of construction, is therefore a resultant of and reinforces the rural agricultural lifestyle.

5.3.3 Flexibility and Variety in the Delivery Process: We have seen that the general trend within the villages is a move away from the earth based cob construction to fired brick and stone. Roofs show a slower but definite move to *farshi* and RBC from *khaprel*. A variety of intermediate combinations are being adopted. Characteristics of the end product being aspired for have changed from the more traditional - local vernacular to a house with an urban character using modern industrial materials.

The availability of a variety of routes means that similar levels of satisfaction can be achieved at each socio-economic level in varying spans of time. Using the CSV/GRET[8] model, the factor of cost in a rural building system is broken into monetary and non-monetary components (Section 4.2.2 and Appendices 4.3, 4.4). Depending on surplus cash available, the economic route taken by a villager to reach his aspiration is determined by his ability to pay in part or full or complete dependence on self labour.

[7] Refer Chapter II; also Murton in Klee (1992)
[8] Refer Chapter - II

The reactions of the beneficiaries to the public sector low-cost housing projects clearly indicate that whenever flexibility in construction technique or process is available, the residents make maximum use of it to improve and upgrade their shelters. The *Harijan* beneficiaries at Dhikoli could thus take advantage of the flexibility allowed by the *khaprel* roof and *gumma* construction to repair, change and extend their houses incrementally within their economic means. The *Sahariyas* at Pura Badhera, on the other hand, expressed inability to do so because the technology provided to them was way out of their current social and economic means. The beneficiaries at Lidhora, by moving away and back into cob and *khaprel* houses, rejected the rigid linear improvement of the shelters provided to them.

The aspect of variety is an important feature of the village building system. The variety in options of technique and technology available and in the delivery processes gives rise to various levels of user control of the process and the product. This allows a maximum 'stretch' of the constraints imposed by particular socio-economic conditions within available technological options.

5.4 Analysis of a Selected Sample of Case Houses:

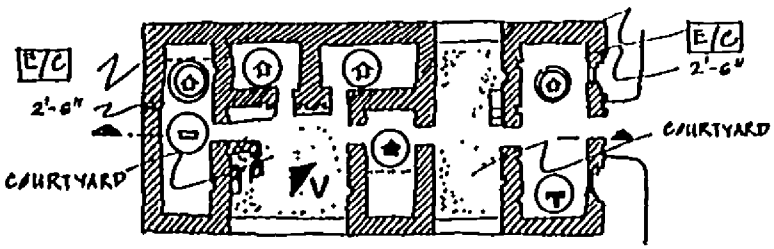
Twelve houses are selected from the six villages surveyed. The owners represent a fair cross-section of the three socio-economic classes. Making use of the classification of materials, technology input and delivery processes (Section 5.1), the options of roof and wall construction and the resultant product - the house are analysed [Figures 5.1 (a) to 5.1 (l)]. The materials and technique in construction and the quality of roof (*khaprel*) are indicated in the figures using the legend on the next page.

This chapter has analysed the choices of materials, element technology and delivery modes being made by the villagers and has attempted to understand villagers' criteria for choice. What do these choices imply and how best can the process of shelter upgrading be facilitated? The following chapter concludes this research paper by identifying implications of user choice on the character of the building system and suggests the 'nature and attributes' of interventions required to facilitate the process of rural shelter upgrading in this region.

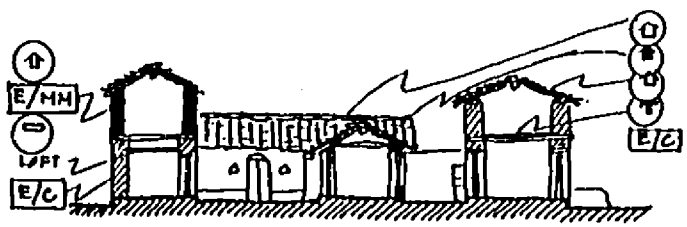
5.4 Analysis of Case Houses:

Legend: The following figures analyse dwellings in the villages studied. Materials and construction techniques used in walls and roofs are indicated in the following legend.

Symbol	Legend
Walls	
E / C	Earthen - Cob
E / A	Earthen - Adobe
E / MM	*Einth* in mud mortar
G / MM	*Gumma* in mud mortar
E / LM	*Einth* in lime mortar
G / C-SM	*Gumma* in cement-sand mortar
	Stone masonry
C/ MM	Composite masonry (boulders + *einth / gumma*) in mud mortar
C / LM	Composite masonry in lime mortar
Roofs	
	First floor ceiling (intermediate roof)
	Second floor roof
	Khaprel of acceptable quality
	Khaprel in poor structural condition (on Acacia/ Ipomea/ Lantana under-structure).
	Wooden planks on stone beams
	Intermediate floor - bamboo
	Stone roof spanned wall to wall
	Stone slabs on stone beams (*patti -farshi*)
	Stone slabs on steel beams
	Reinforced Brick Concrete (RBC) slab
	Reinforced Cement Concrete (RCC) slab)
Analysis	
W	Walls
R	Roofs
PT	Product type (dwelling unit - overall)
T	Technology input
D	Delivery process adopted
VEC	Village Economy Component



PLAN

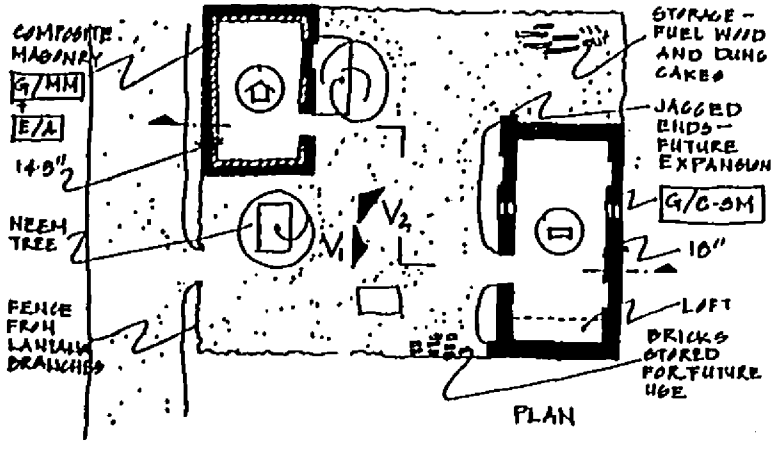


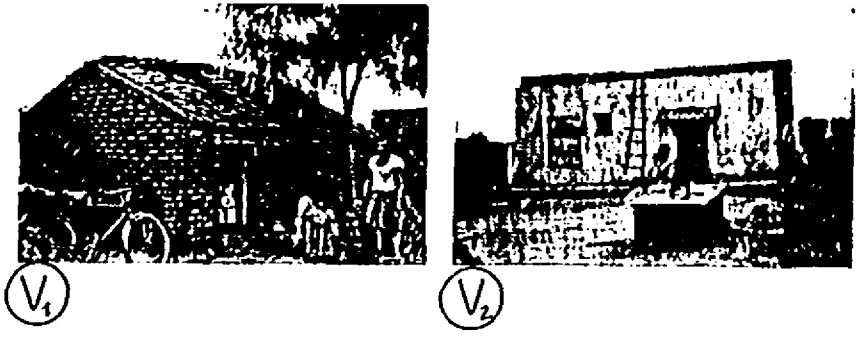
SECTION

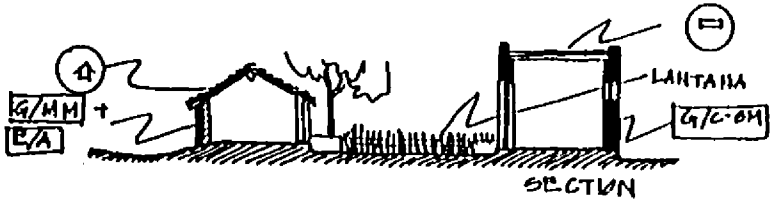
Socio-economic status: Landless, pastoralist, farm labourer family; stable but subsistence level economy. Family size: Two adult males, two adult females, 4 children	
	Earthen - cob; new room - *einth* in mud mortar
	Khaprel on country wood (*mahua, neem, jamun*) under-structure, stone-slabs (*farshi*)
	T= Rudimentary D= Self constructed
	T = Village cottage based D= Self constructed
	PT= Intermediate / stable

Control = High
Incrementality = Medium
Flexibility = Medium
VEC= High

Figure 5.1(a): Analysis Varichat's House, Village - Khalilpura







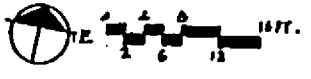
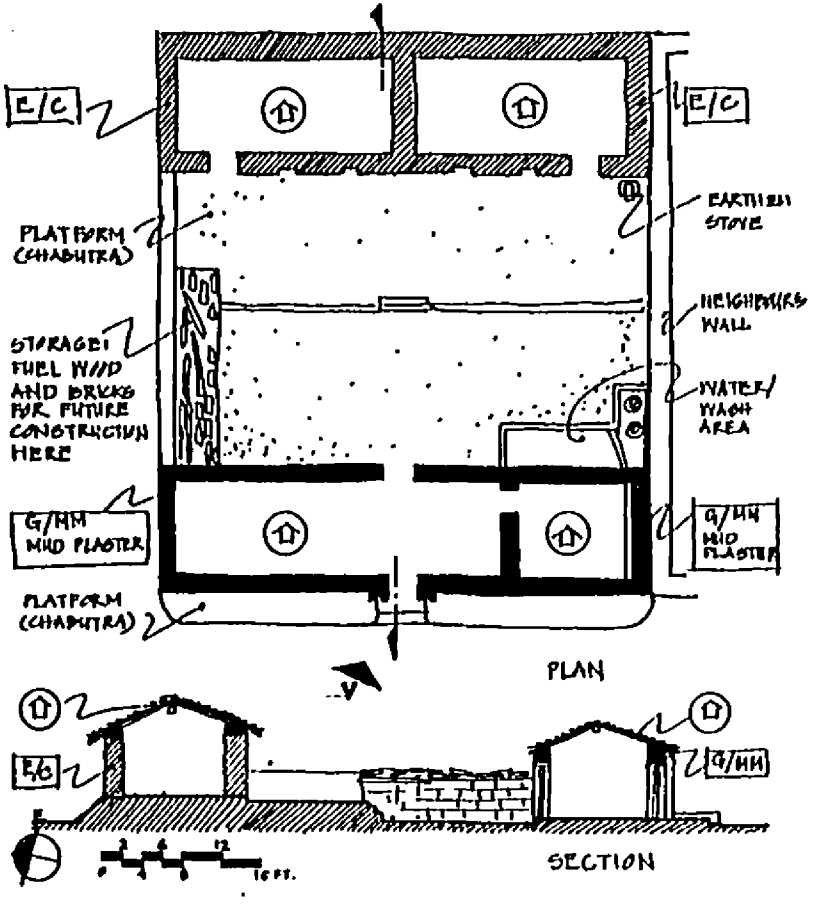


Figure 5.1(b): Analysis Ramgopal Beldar's House, Village - Raksa

Socio-economic status: Marginal farmer, construction labourer in the city; subsistence level economy. Family size: One adult male, one adult female, 2 children	
	Fired brick (*gumma*) in cement sand mortar. New room - *gumma* + adobe combination
	Stone slab (*farshi*); *Khaprel* on country wood (*mahua, acacia*) under-structure.
	T= Local cottage based D= Self + skilled assistance / Self constructed
	T = Village cottage based D= Self constructed
	PT= Intermediate / growing

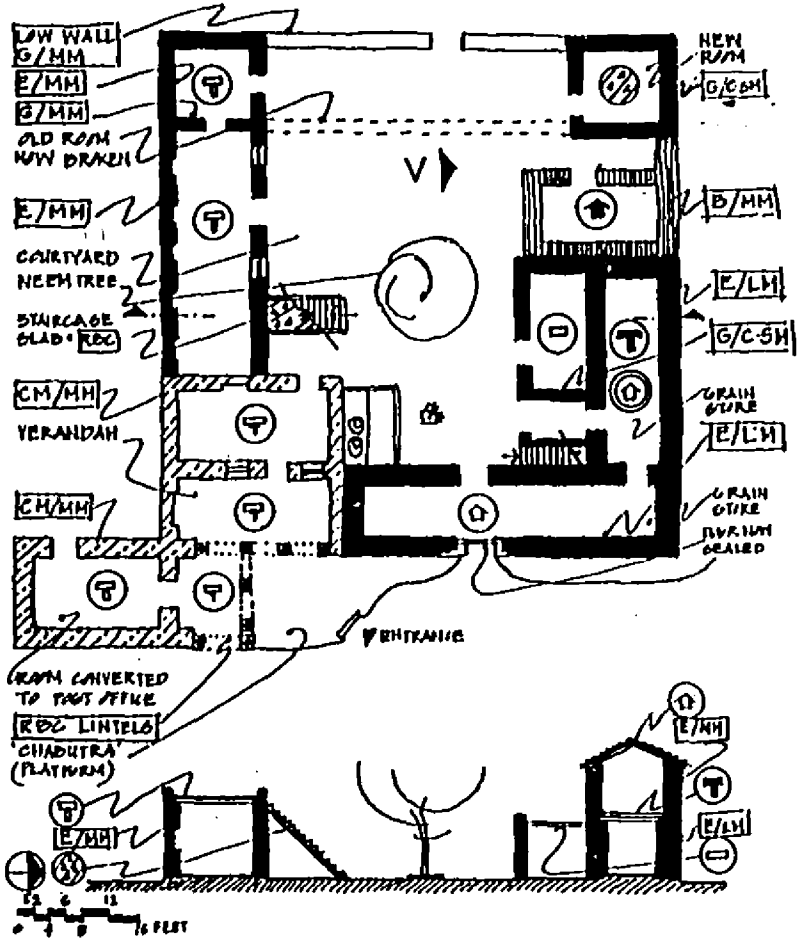
Control = High
Incrementality = Medium
Flexibility = High
VEC= Medium to high

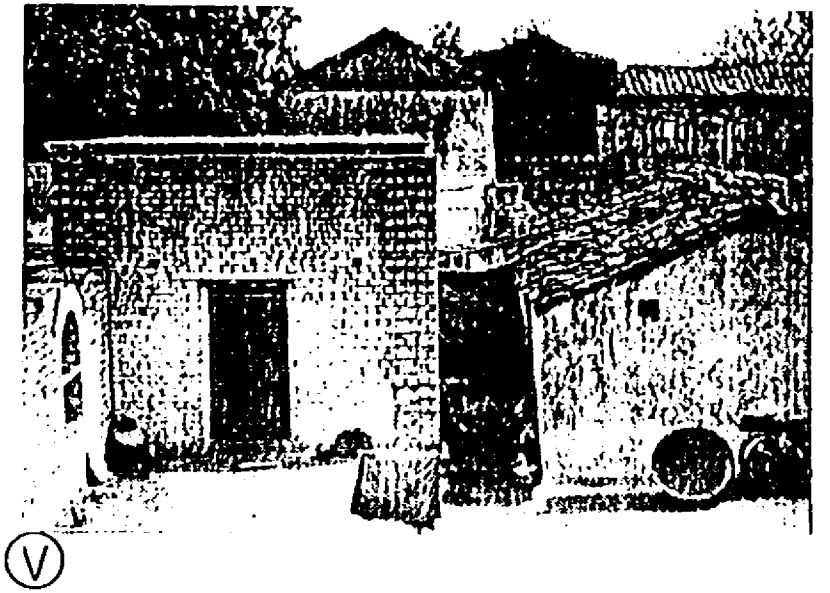


Socio-economic status: Small farmer, sufficient level economy; saving for house building. Family size: 3 adult males, 3 adult females, 4 children.	
	Earthen- Cob; Fired brick (*gumma*) in mud mortar. More *gumma* being collected for an extension
	Khaprel on country wood (*mahua, acacia*) under-structure.
	T= Local cottage based D= Self constructed/ Self + skilled assistance.
	T = Village cottage based D= Self constructed
	PT= Intermediate / growing

Control = High
Incrementality = High
Flexibility = Medium
VEC= High

Figure 5.1(c): Analysis Mataji and Lachu Kushwaha's House, Village - Palinda



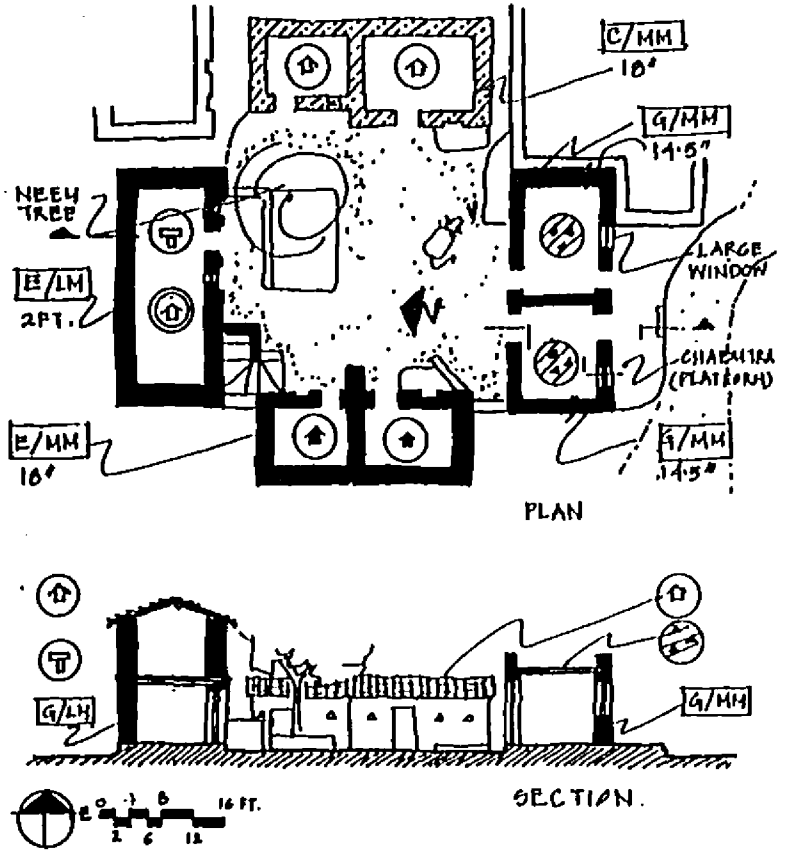


Socio-economic status: Large farmer, dominant caste, owns almost 35% of the *abadi* and 30% of the village agricultural lands; sufficient to surplus economy.
Family size: 4 adult males, 3 adult females, 6 children

	Eimh, boulder, composite masonry in mud mortar, RBC staircases
	Stone slabs *(farshi)* on stone beams and steel beams

	T= village cottage based, locally specialised, industrial /locally known. D= Self managed, local skilled + unskilled labour, *Jajmani* exchange	Control = High
		Incrementality = High
		Flexibility = High
	PT= Finished / growing	VEC= Medium to high

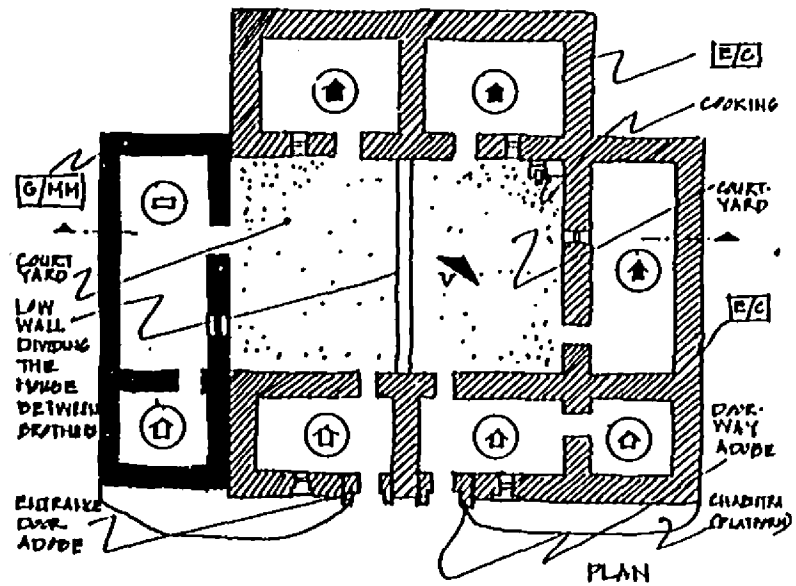
Figure 5.1(d): Analysis Sarpanch's House, Village - Dhikoli



(V)

Socio-economic status: Mason, small agricultural fields, both sons working in the city; sufficient economy, slowly growing. **Family size:** 3 adult males, two adult females, 3 children.	
	Composite masonry, *einth* in mud mortar, new rooms : *gumma* in mud mortar
	Stone slab *(farshi)* on stone beams, *khaprel* on country wood *(mahua, neem, jamun)* under-structure, new rooms: RBC
	T= Village craft based, locally specialised D= Self (skilled) constructed
	T = Village cottage based, Industrial /locally known D= Self (skilled) constructed
	PT= Intermediate / growing
	Control = High
	Incrementality= Medium
	Flexibility = Medium
	VEC= Medium to high

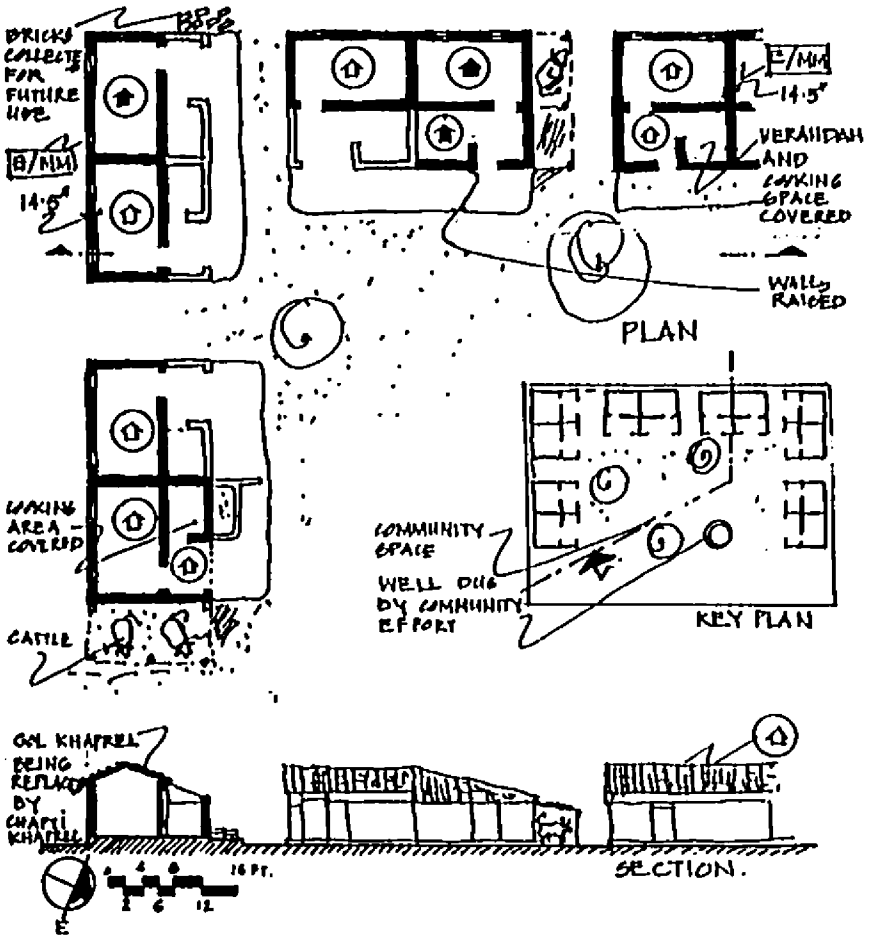
Figure 5.1(e): Analysis Devki Nandan mason's House, Village - Dhikoli

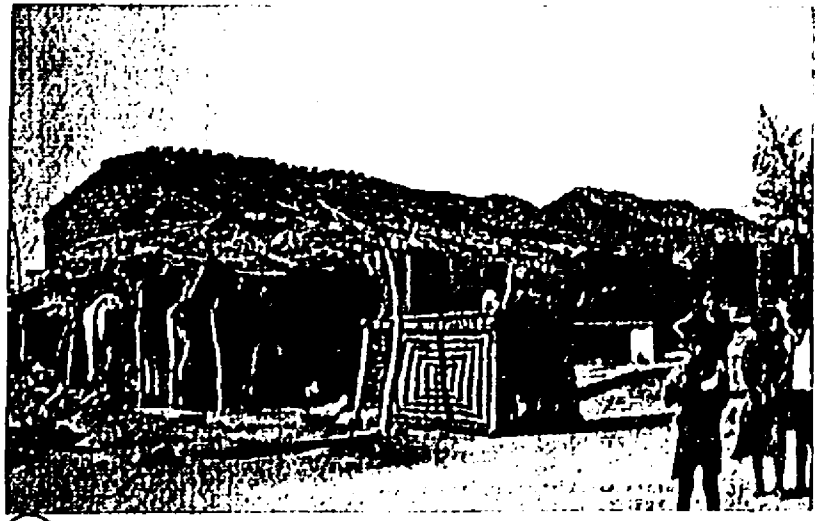


Socio-economic status: Small farmer Off-land income in the city; stable but subsistence level economy/ household divided between brothers Family size: Two adult males, 3 adult females, 5 children.	
	Earthen - cob; new room in brother's part: *gumma* in mud mortar
	Khaprel on country wood (*mahua, neem, jamun*) under-structure, brother's new room : stone-slabs (*farshi*)
	T= Rudimentary D= Self constructed
	T = Village cottage based D= Self constructed
	PT= Intermediate / stable

Control = High
Incrementality = Medium
Flexibility = Medium
VEC= High

Figure 5.1(f): Analysis Lachuram Nai's House, Village- Dhikoli

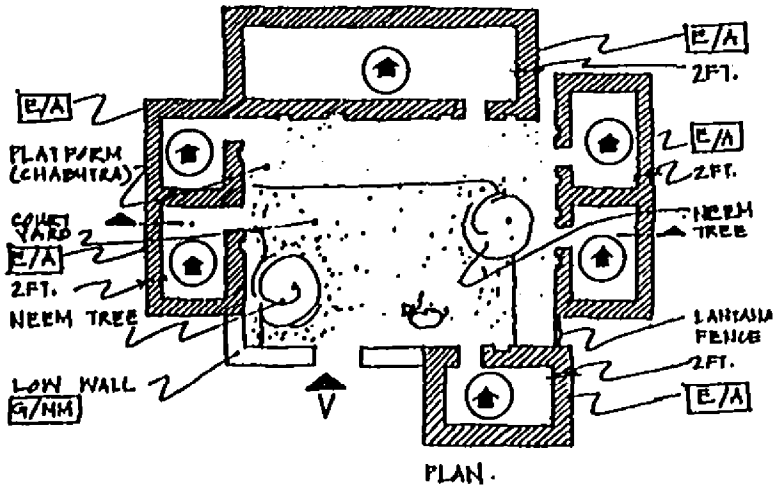


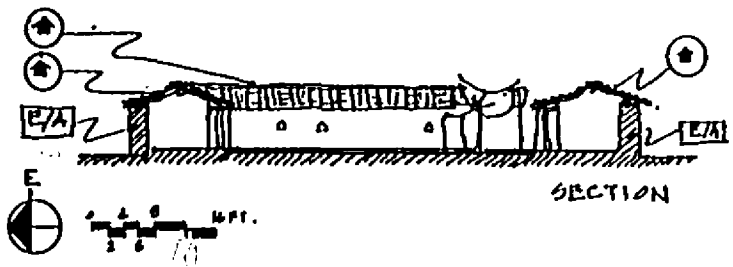


(V)

Socio-economic status: Small and landless farmers; subsistence level economy Family size: An average of 6 members per family.	
	Gumma in mud mortar
	Gol khaprel on country wood (*mahua, neem, jamun*) under-structure, now being replaced by *Chapti khaprel.*
T= Village cottage based D= Contractor built/ through government housing project (IAY), extensions and changes being made by the beneficiaries. PT= Intermediate / slowly growing	Control = Low when constructed, now high Incrementality = Medium Flexibility = Medium VEC= High

Figure 5.1(g): Analysis *Harijan Basti*, Village - Dhikoli

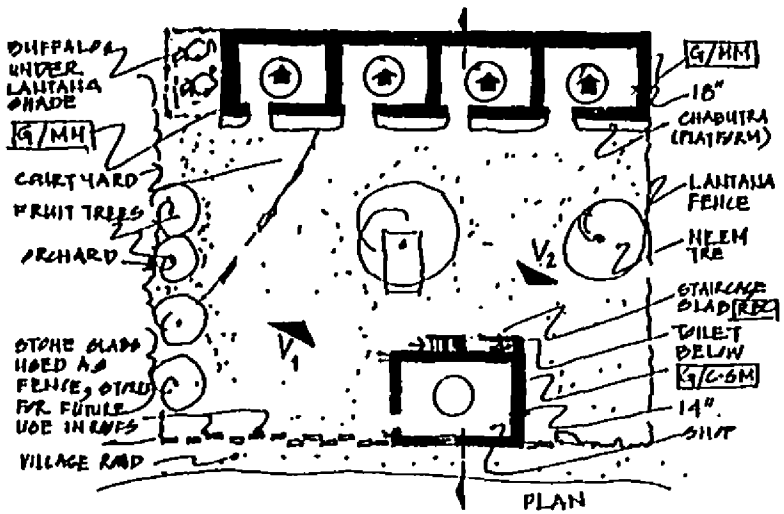


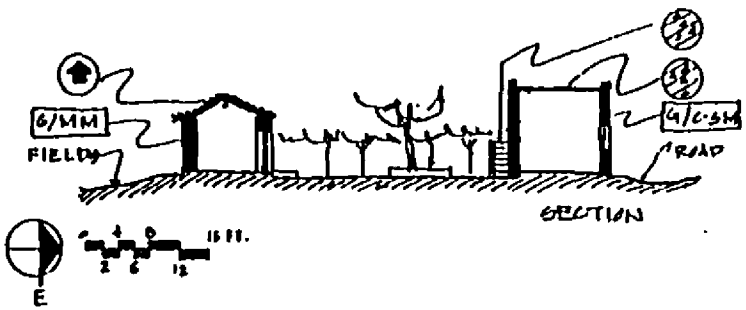


Socio-economic status: Landless farm labourer, backward class; scarce economy. *Family size:* Three adult males, Two adult females, 4 children.	
	Earthen - Adobe
	Khaprel on country wood (*acacia, ipomea*) under-structure (poor quality).

	T= Rudimentary D= Self constructed	Control = High
	T = Village cottage based D = Self constructed	Incrementality = Low
	PT= Rudimentary to Intermediate / stable	Flexibility = Low
		VEC= High

Figure 5.1(h): Analysis Kori family's House, Village - Palinda

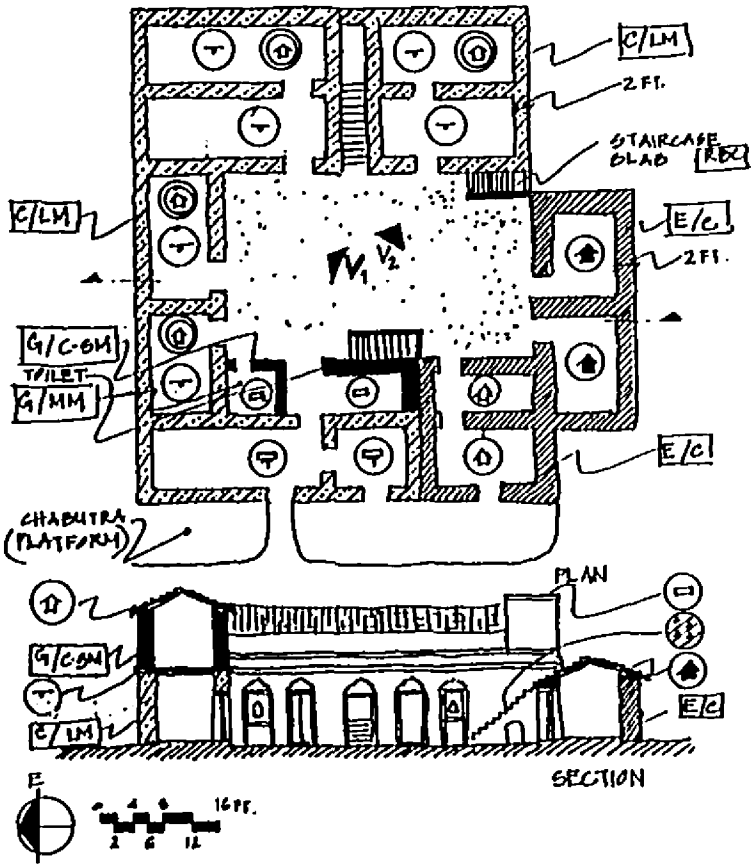




Socio-economic status: Medium farmer, diversifying into petty tradesman (general grocery); sufficient but growing economy. **Family size:** One adult male, Two adult females, 5 children.	
	Gumma in mud mortar, new room: *gumma* in cement-sand mortar, plastered
	Khaprel on country wood (*acacia, ipomea*) under-structure (poor quality), new room: RBC, staircase slab: RBC.
	T= Village cottage based D= Self constructed, self + skilled input
	T = Village cottage based, industrial/ locally known D= old rooms: Self constructed, new room : local skilled input/ self managed
	PT= New room: Finished / growing

Control = High
Incrementality = High
Flexibility = Medium
VEC= High

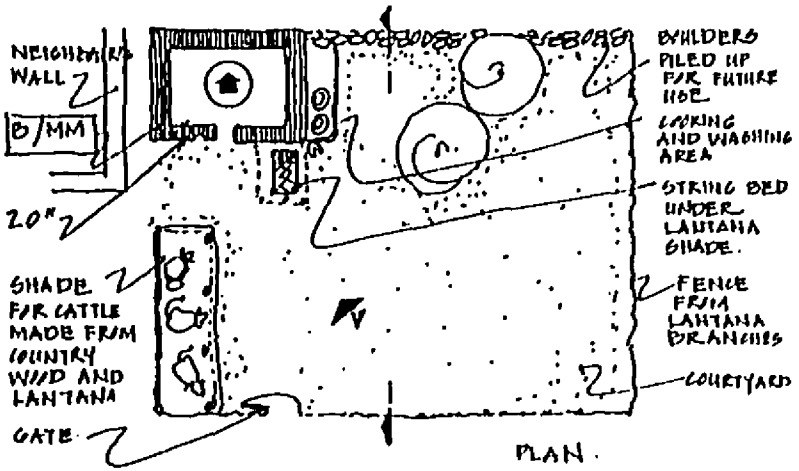
Figure 5.1(i): Analysis Shri Kesar Prasad Dube's House, Village - Palinda

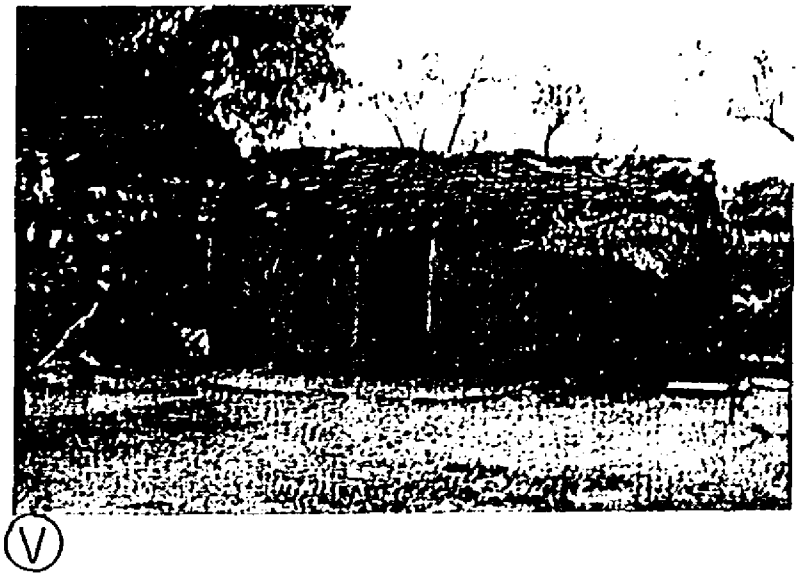


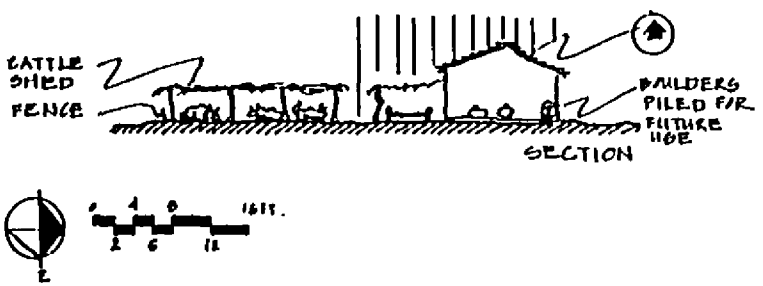
Socio-economic status: Small farmer, double / triple crops, one member mason; sufficient but growing economy. **Family size:** 3 adult males, 3 adult females, 5 children.	
	Composite masonry in lime/ cement-sand mortar, Earthen - cob
	Khaprel on country wood (*mahua, neem, jamun*) under-structure, stone-slabs (*farshi*), bamboo intermediate floors.
	T= Local craft based D= Self (skilled) constructed
	T = Village cottage based D= Self (skilled) constructed
	PT= Finished/ growing

Control = High
Incrementality = High
Flexibility = High
VEC= High to medium

Figure 5.1(J): Analysis Harprasad's House, Village - Kanchanpura

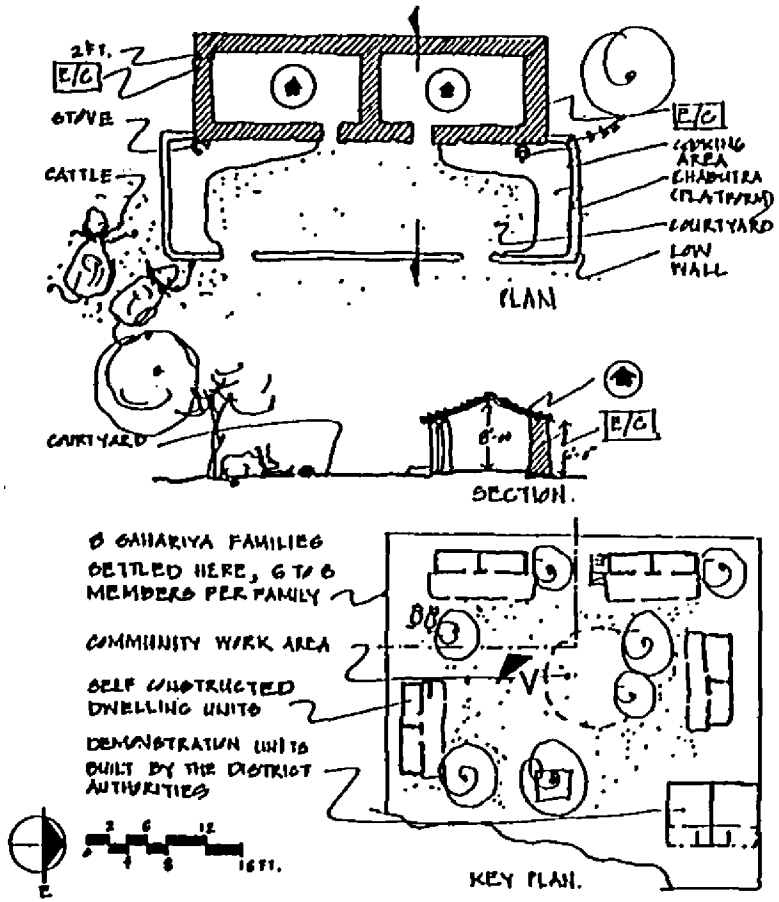






Socio-economic status: Small farmer; scarce economy. Family size: One adult male, 2 small children, 3 daughters married	
	Boulders in mud mortar
	Khaprel on country wood (*acacia, ipomea, lantana*) under-structure
T= Local craft based D= Self constructed	Control = High
T = Village cottage based D= Self constructed	Incrementality = Low
PT= Intermediate/ stable, poor quality construction	Healbility = Low
	VEC= High

Figure 5.1 (k): Analysis Kriparam's House, Village - Kanchanpura



V

Socio-economic status: Landless farmers, construction labourers, small scale income generating activity of basket and partition weaving from lantana branches; scarce economy. Family size: An average of 6 members per family.	
	Earthen - cob
	Khaprel on country wood (*acacia, Ipomea, lantana*) under-structure
	T= Rudimentary D= Self constructed
	T = Village cottage based D= Self constructed
	PT= Rudimentary/ stable,

Control = High
Incrementality = Low
Flexibility = Low
VEC= High

Figure 5.1 (i): Analysis ***Saharia Basti*, Village - Kanchanpura**

CHAPTER VI - CONCLUSIONS AND FINAL REMARKS

This chapter looks back at observations made on the field (Chapter IV) and the understanding of the characteristics of rural building systems (Chapter V), within the framework of literature reviewed (Chapter II). The 'network' quality of rural building systems is highlighted while indicating how the user choice affects the nature and operations of the network. Certain technological, resource and management-based limitations are immediately obvious. They present impediments to the progressive upgrading of the building system. The locale and the field, however, offer possibilities that need to be further studied and built upon to facilitate the housing process. The chapter concludes by indentifying these possibilities and suggests the 'attributes' of interventions that may be made to facilitate rural shelter upgrading.

6.1 A Summary of Findings and Analysis:

A wide variety of materials and elements are being used for both roof and wall construction. An individual's choice of materials, elements, technology for roof and wall components and their combinations is guided by the degree of availability and accessibility, levels of affordability, growing requirements and commonly accepted symbols of prestige.

We find that most construction activity, even in Raksa and Dhikoli (where the highest building activity was observed in the sample), is mainly that of repair, maintenance, extension and upgrading. About 10 % of the ongoing construction was seen to be rebuilding after demolition and addition of new rooms, while less than 5% of construction could be categorised as completely new houses, as in the case of rehabilitation (*Sahariyas*) or decongestion (*Harijans* moving out, families breaking up).

There is a move away from unprocessed earth (cob) construction to stone (boulder) and fired brick (*einth / gumma*) construction. *Khaprel* roofs are slowly being replaced by *patti - farshi* roofs. The current trend can be described as a move towards partially industrialised intermediate technology,[1] which in itself may be a positive phenomenon (Figure 6.1).

[1] Terner and Turner's model, described by Ian Donald Terner in "Technology and Autonomy," in Freedom to Build., Turner & Fichter (eds.) (Macmillan, 1972), pp. 214, 215.

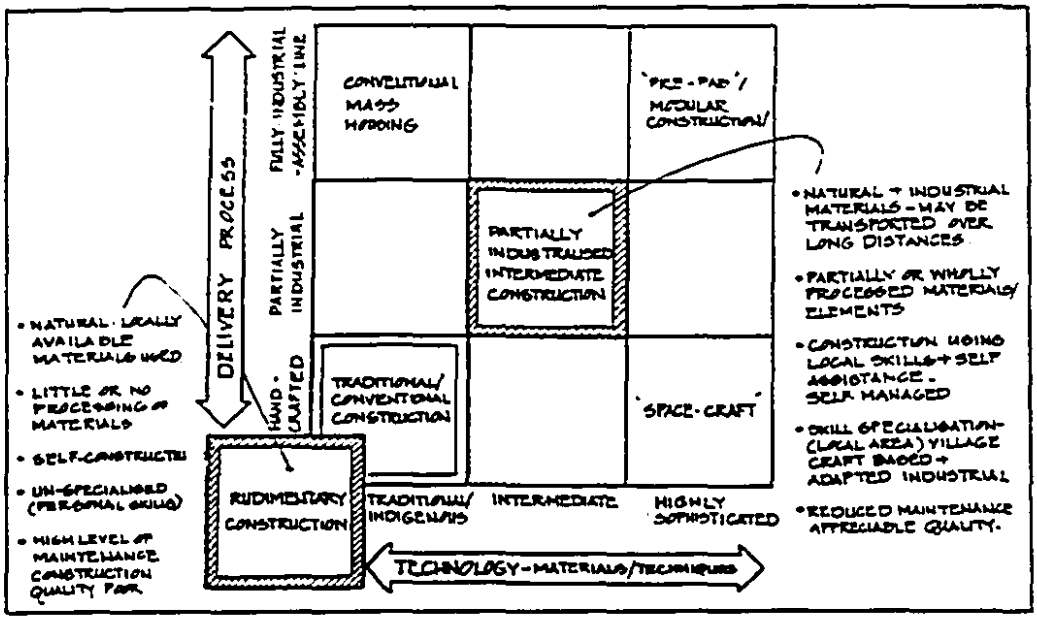


Figure 6.1 The current trend of change *(AfterTerner, 1972, p. 214)*

Although the 'pattern of upgrading' indicates this shift from *katcha* to *pucca* and from self-built to self-managed construction, this is not the only pattern of change. There is, at the same time, a stabilisation or stagnation in the process of upgrading and a deterioration in the structural quality of dwellings as inferior quality materials are being used.

The stagnation may be analysed as a result of current stabilisation of needs like the *sarpanchs'* (head men's) houses at Dhikoli and Palinda. However, for most lower income villagers, (especially in remote locations like Khalilpura and Lidhora) this probably stems from a lack of technological, financial and resource-based inputs into the system. For the *Sahariyas* (at Kanchanpura), this may be a consequence of economic inability to enter the building cycle. Technological and skill-based limitations, for example, mean that small and heavy *khaprel* requiring large amounts of timber for under-structure are being used. A shift from *Neem* (primary timber)to *Babul* (secondary)and to Ipomea (tertiary) for roof under-structure reflects a scarcity of bio-mass. Use of poor quality timber causes the roofs to sag and increases the frequency of maintenance.

Changes in management control of common property resources resulting in reduced access to them have especially affected the ability of the poorest to acquire and upgrade their own shelter. By monetising many of the hitherto 'free' resources, the poor are left with little option but to 'steal' these from revenue lands and reserved forest areas. This illegal

procurement of resources indicates a need for a serious review of current resource management and conservation policies.

Compared to intra-rural communication, information flow from Jhansi city to the villages is effective, depending on location and accessibility. It takes a long time (sometimes never) for indigenous rural innovations and ideas to reach a wider rural public (eg. Bamboo intermediate floors in Kanchanpura and adobe-*gumma* combination masonry in Beldar's house at Raksa). Better rural-rural links, therefore, need to be established. Location with respect to Jhansi city provides the villagers with off-land income generating opportunities, accessibility to industrial materials and techniques and a chance to observe and judge the performance of these materials and techniques. Urban - industrial systems of construction form the role models or symbols of progress.

The cost of construction is a mix and match of monetary and non-monetary components and each socio-economic group combines these two in proportions most affordable to it. The seasonal life style supports the piecemeal nature of construction and aids economic flexibility. A high degree of local control over practice and process fosters significant user participation in construction and management. Thus, despite increasing monetisation, a variety of routes are available to achieve desired levels of aspiration.

There have been changes in the traditional linkages of people to people, environment and technology. Traditional occupations no longer determine the occupational structure of the younger generation. The age-old caste system has resulted in forming distinct economic classes, however, some breakdown in the economic stratification is being observed. Contact with the city, education and diversification of occupations influence the current trends in the choice of materials and technologies.

The traditional view of the villager living in harmony with his natural environment seems a distant and romantic picture in these villages.[2] The commons are wastelands with free-access to all without any organised management of resources. The watershed development and afforestation programme initiated by the district authorities and being undertaken by a local NGO indicates a revival of some sort of a community based resource management system in

[2] This may be an overriding problem in most of India, however, as pointed out by Agarwal and Narain (1989), there are many rural communities in India which still manage their natural environments in a sustainable manner.

Dhikoli and, the common predicament of displacement and resettling event in Kanchanpura has initiated a degree of community cohesion. However, people's conscious awareness of the development potential through co-operative efforts is not apparent.

6.2 The Building Net:

The rural building system can be described as a network.[3] *"The essential quality of a network is the multiplicity of routes it provides to the same end. The economies achieved by people while building for themselves are mainly due to their ability to move through the network and access information and resources through multiple economic routes"*[4] - free/collected, free/stolen, part cash/part grain payment, informal credits, instalments and the like. A network is also characterised by inter-linked reciprocal relationships. Thus every aspect of rural life has an impact on and is affected by the process of shelter acquisition and upgrading.

A motley of building practices and delivery methods exist simultaneously in the rural building net. Villagers utilise different transaction systems of cash, barter, informal credits and their combinations to build, repair, extend and upgrade their dwellings. This gives rise to various house types as we have seen which range from old traditional dwellings to the more modern city-style houses. The practice and delivery process (especially the transaction system) pre-dominantly being used reflect the current local vernacular and become visible as the dominant building pattern in the village. The pattern transforms as the operating-environment of material-resource status, socio-economic conditions and skill-base changes.

The operating-environment determines which delivery process is used most. The delivery process adopted can be called the network-path, It strengthens as its use increases and atrophies through disuse. We as professionals concerned with the facilitation of the process of rural shelter upgrading, have to determine which are the 'key' strands of the network and what are its weakest links.

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[3] Robert Fichter et al; "The necessity of networks" in Turner & Fichter (1972), p. 250
[4] J.F.C. Turner, "The meaning of Autonomy" in Turner & Fichter (1972), p. 251.
Also, Revi, Shelter in India, (Development Alternatives, 1990).

6.3 Implications of User Choice:

The dynamic operating environment of the changing rural socio-economic scenario, status of resource availability and accessibility and greater communication with the outside (the city/ industry) result in construction choices that significantly modify the character of the net. What implications do the choices being made have on the resource base, the villagers' level of control over the process and the flexibility of the network?

6.3.1 Ecological and Environmental Implications: Reduction in the resource base is leading to fewer options. Thus, a farmer who can not yet afford a *farshi* roof, and whose *khaprel* roof needs repairs, has no options to an alternative and affordable under-structure. The scarcity of timber and bio-mass has hit many aspects of local building such as, the fuel for kilns and therefore, tile and brick quality, spanning members for roofs and openings and the like. This has made the otherwise expensive (if total energy costs are accounted for) steel and concrete construction comparable in direct monetary costs at the local level. Thus, not only does a deficient resource base lead to a reduction in the range of options, it also propels the choices towards more energy consuming and less self-reliant materials and processes.

The fulfilment of one basic need (shelter) is challenging another (food production). The use of surface soils for brick manufacture creates competition with agricultural land. Increasing quantities of good and scarce agricultural soil are being burnt to produce building materials. More and more farmers now rent out their fields for brick making in order to supplement their incomes. The situation has not yet reached crisis proportions (as in many areas of West Uttar Pradesh and Tamil Nadu),[5] but may soon do so if proper management of this resource is not undertaken. Soil digging sites would have to be identified as in ponds or *nallahs* (natural drainage channels) and given into the management of communities.

Similar is the case with stone extraction and aggregates. Although, small scale extraction /removal of boulders is beneficial to the farmer; the large scale unchecked quarrying as is currently being done can result in the denudation of vast tracts of hill-sides, thereby

[5] It has been found that in many parts of western Uttar Pradesh and Tamil Nadu, where commercial brick manufacturing is being undertaken at a large scale both formally and informally, agricultural fields have been dug upto 5 to 6 feet in depth with serious negative impact on the soil fertility and crop production (Author's experience during earlier surveys in these areas). In Egypt, the use of Nile silt for brick production has had to be banned because of conflict with agricultural needs ("Building Materials for Housing"; report of the executive director, UNCHS, Habitat International, vol. 17, no. 2, 1993. pp 1-20).

altering natural ecology and micro-climates.[6] The current system of auctioning rock outcrops for a limited time is a futile attempt by district authorities to regulate stone quarrying. The auctionee is not limited by the quantities he is allowed to extract, while the political set-up provides him the cover he needs for the extraction process and for the amount he plunders to be sold at regulated(?) rates. The current process of crushing the rocks to make stone aggregate, results in serious dust pollution arising from suspended particles, pointing to a need for efficient and less polluting production processes.

6.3.2 Implications on Level of Local Control and Village Economy Component: As construction advances in technology, complexity in the activities at each stage increases. At the most rudimentary level, technological input is negligible, if not non-existent. At the level of industrial materials and construction systems, on-site operations are relatively simple but the linkages between materials processing and element production are extremely complex and out of the user's control.

The trend towards greater dependence on non-local systems of construction results in loss of local variety in process control. The system enlarges and its complexity increases as the hinterland depends more and more on the industrial products here before available only at the urban level. The locale may have increased to include the urban fringes within the country side - however, changes/fluctuations in this enlarged locale are neither predictable nor controllable by village residents. The village economy component, on the other hand, decreases as an increased market for urban industrial materialsand skills funnels local wealth out of the village.[7] This becomes obvious when one compares the district authority's preference for the industrially produced *Kanpuri gumma* or the concrete block products manufactured in Jhansi, over the locally produced *gumma* and the greater preferance by the villagers for city-type skills instead of the indigenous skills and crafts.

[6] Development Alternatives; "Research Programme on Energy in Building materials", interim report, (Development Alternatives, New Delhi. June 1994).

[7] Afshar has suggested the need to consider small towns as part of the rural service sector, thus increasing the radius of the rural region. 'Local' in this sense would mean the 'greater rural region' that may include a cluster of villages with their small town service centres. He further introduces the concept of "*rurbanisation*" as greater interaction between the city and rural areas, with mutual give and take (Afshar (1989), Farokh Afshar; "Globalization: The Persisting Rural Urban Question and the Response of Planning Education", in Journal of Planning Education and Research no. 13 pp. 271 - 283.

The introduction of a totally new technology, that is industrial and monetary in character, into a scarce economy, reduces the beneficiaries' access to even the self-help component of their housing process. At the same time, a move towards partially industriaiised intermediate technology (Section 6.1), if not supplemented by an overall increase in economic capacities and/or by support and encouragement of flexibility in economic transactions can considerably reduce control over the process of construction. The 'apparent control', fostered by higher economies in absence of informed knowledge regarding new skills and technologies, however, results in wastage and the production of structurally questionable construction (as seen in *ad hoc* roofing slab reinforcement in Dubeji's house in Palinda and arched openings in Deendayal's house in Raksa).

6.3.3 Implications on the Flexibility of the Delivery Process: A choice of material and technology cascades into the selection of a particular delivery process. Although, a variety of delivery processes are found in the village system, not all of them can be utilised by everyone. The poorest are constrained by their economic conditions while the rich by social constraints of prestige. A wide variety of delivery options, however, permits at least one affordable route to every economic class, within the available range of material resource options.

The flexibility in the routes is enabled by flexibility in transaction systems. The transaction systems associated with most industrial products unfortunately limit this variety and flexibility. Within the scale of a village, transactions of a flexible nature - credit, instalments, and barter still exist, but as dependence on building material outlets of the city and factory increases this flexibility decreases. This operational flexibility[8] which forms an important feature of the rural building system is threatened by urban market mechanisms that are increasingly influencing rural economy.

Seasonality of construction as observed in the village building system may disappear as off-land income generating opportunities become available during the summer months. This naturally leads to a dependence on specialists for construction - self construction giving way to self-managed construction. This in itself, is a positive outcome as it results in more work

[8] Ashok Khosla; "Alternative strategies for developing and delivering low cost shelter technologies", (Development Alternatives, New Delhi, 1988), Revi (1990).

opportunities for artisans, refinement of their skills and an improvement in the overall structural condition of shelter. It becomes more feasible then to introduce new techniques and technologies to increase the range of available options. As the market for the masons' skills increases, it becomes economically viable for him to adopt new techniques and systems; together with the flexibility in transaction systems, this enables greater numbers to avail of the mason's skills through the economic means available to them.

The reduction in seasonality must, however, be viewed in light of possible losses and changes in socio-cultural and environmental relationships: this feature may not be clearly apparent from the limited perspective of shelter upgrading alone.

6.4 Possibilities Offered by the Locale and Issues Emerging for Further Research:

"It would be useful to know what natural resources are at hand, what is being done that could be profitable, and what is not. ... And before any formal intervention is embarked upon, one will need to understand the social and cultural practice regarding work ..., how they organize and their attitudes to co-operation."[9]

The present research can be called a preliminary study to enable design of locale-specific action plans for the region. It brings forward certain technological, management and institutional possibilities as highlighted in the following section. These, however, need to be studied in greater detail so that their complete potential can be exploited to facilitate the process of shelter upgrading.

6.4.1 Technological Possibilities: In the face of scarcity in resources leading to poor quality of shelter, both a regeneration of the depleting resource base and increased efficiencies in the use of currently available resources is required.[10] The role of improved technology has thus becomes important. Can technological inputs mitigate problems associated with shelter upgrading and what aspects within the locale need that input?

The following can be highlighted:

[9] Nabeel Hamdi, Housing without Houses, (MIT press, USA, 1992), p. 100.
[10] Chapter II, UNCHS (1993), Wells (1993), Spence (1993).

(i) The problem associated with heavy and small *khaprel*, requiring considerable amounts of wood for under-structure and the lack of good quality timber to provide it.

(ii) Inefficiency of fuel consumption in kilns and the shortage of fuel resulting in the diversion of large quantities of dung from manure to fuel.

(iii) Potential of alternative fuels from locally available tertiary timber.

(iv) Potential of substantive regeneration of the biomass for both fuel and building needs.[11]

(v) Potential of large quantities of stone dust that can be utilised in construction.

Many technological options exist as pointed out in Chapter II, however, very little research has gone into effective mechanisms for transferring these to the field. Any technological input will have to carefully weigh in and utilise local systems of delivery and transfer of technology, skills and information.

6.4.2 Delivery possibilities: We have found that a variety of options of what to do (the practice) and how to do it (the delivery) exist in the rural building system. As significant as the 'range of material and technical alternatives' available, is the 'variety in the possible routes' to reach the desired levels of shelter. It is the permissibility of this range which makes the process dynamic, resulting in generating satisfaction with the outcomes at each level, however rudimentary they may appear.

One common aspect of any formal intervention to improve or upgrade rural housing conditions has been the presence of an external change agent or a delivery agency bringing to the villager 'a better way of doing things'. This study shows that effective delivery agents - the masons, the influential members of the rural society and local markets exist within the rural society itself. Effective and sustainable improvement can be promoted through these agents. Who are the real builders in a rural area?, who should receive specialised training? and under what conditions will increased levels of skill result in economic returns? These are questions that have to be asked before any interventions in rural housing. The answers are available in the existing rural building network. These networks, form efficient conduits for information and knowledge transfer. Although everyone has basic information regarding simple construction, special skills are available with the mason only. New technologies and improved

[11] The ongoing watershed development programme here suggests this.

techniques can be delivered through him, provided he has a market for these skills. A mason's market may increase as levels of affordability rise. Affordability, we have found, is a result of many interacting conditions, not the least of them is the flexibility in transaction systems.

For appropriate and efficient technologies to be accepted, an understanding of popular aspirations and symbols of prestige is necessary. The choices made by the leaders in rural society (as Chattarpal and the *sarpanch*) influence the formation of status symbols, thus affecting villagers' choices for materials and technologies.

It has been suggested that local micro-enterprises are effective means to deliver a range of options in materials and techniques.[12] These function with increased user participation in construction and management within flexible transaction systems. The potential advantage that local entrepreneurs possess over conventional distribution systems is that, they identify with the users' specific priorities, thereby allowing incremental, piecemeal and seasonal growth.[13]

These potential entrepreneurs in the studied local area are those who can afford a certain amount of risk taking. The entrepreneurs may well be from the traditional upper caste groups who still dominate the rural economic scene: they are definitely those who are oriented towards popular participation and indicate a move away from or diversification of their traditional occupations in agriculture and livestock management.

The Housing and Urban Development Corporation (HUDCO) has proposed to set up a Building Centre in Jhansi. The network of building centres is visualised as a regional supermarket of building materials, elements, manpower, skills, training, equipment, information, advice etc.[14] A building centre can make more technological choices available to the rural populace but its success will depend on its operational variety and flexibility. A rural building centre, as opposed to its urban counterpart, may have to accommodate many different transaction methods - monetary, barter, credit, etc. What will be the character of such a facility? Can it arise as a consequence of an artisan or local entrepreneur co-operative? Are there any role models for such a facility? These issues need to be explored.[15]

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[12] Chapter II

[13] Shrashtant Patara, "Transfer of Appropriate Building Technology Through Micro-enterprises" in Low Cost Housing and Infrastructure, conference proceedings, (INAE, BMTPC, New Delhi, 1993) pp. 659 - 664. and Arun Kumar, (1994).

[14] T.N. Gupta (1993).

[15] It may be useful to study the operations of the Bangladesh Rural Advancement Committee as a successful example of rural financing system (see references at the end of this document).

The rural economy, we find, is variable and seasonal. Its transactions are piecemeal with a mix of monetary and non-monetary components. It is inequitable and the current socio-political environment promotes its segmental and divisive character. Sustainable delivery of technological interventions will need to incorporate these features in its basic design.

6.4.3 Management and Organisational Possibilities: The success of any local level action plan will depend on its capacity to build upon local organisational potentials and capabilities. A need for augmenting the resource base, especially the biomass base, demands local community based systems of management. The feudal character of the villages and the highly politicised caste divisions have been found to be great inhibitors to the development of community groups or co-operatives. (Chapter II).

In counterpoint, Kanchanpura, the new village consolidated within a short span of 30 years, provided some interesting insights:

The predicament of displacement and rehabilitation binding the village together to a common fate has actually opened up avenues for development. The community, though not 'mono-caste', is cohesive and realises the need for a co-operative management of its resources, although they are at a disadvantage of not being endowed with any common lands and forests. Individually within houses and inside the village, they have planted *Neem* trees used as a resource-base. They brought with them the skill of manufacturing intermediate floors from bamboo and cultivate small clumps of the grass around their fields for this purpose. If this indicates that disaster brings people together, it also provides a hope that an awareness of imminent disaster (no resources, increasing wastelands etc.) would bring rural folk together.

This particular awareness was also observed in Dhikoli. The advantages of the ongoing water-shed and afforestation programmes are clearly visible to the villagers who are coming forward to participate in its management. The risk of involving only the *sarpanch* and his brethren in the development of the bio-resource base (as is happening now), is that management and control may get concentrated in the hands of one powerful group within the village further marginalising the lower income and less powerful groups. The particular advantage that Dhikoli has is the progressive bent of mind of its *Sarpanch* and local leaders, a feature which needs to be analysed and fostered in other villages too.

6.5 Final Remarks - Characteristics of the Required Interventions

We started with the premise that rural building systems possess an inherent potential, an understanding of which can assist in the formulation of effective and sustainable strategies to facilitate the process of rural shelter improvement.

The transition from a simplistic "*number of dwelling units to be provided*"[16] approach to the "*facilitation of housing process*"[17] requires an analysis of the **characteristics** of any interventions that are proposed. The particular characteristics of rural building systems require that successful interventions in practice and delivery must:

- respond to the seasonality in labour, material and finance availability,
- function through flexible financing methods, and,
- provide a continuity with existing practices and change to new methods and concepts.[18]

It has been noted earlier that sophisticated industrial technology often limits operational flexibility, especially among the lowest income groups. We need better and more efficient technology **coupled with** the operational flexibility - clearly the greatest potential in a rural building system.

'Appropriate' interventions will have to compete with established role models of progress. Thus it is essential to create alternatives or a range of options whose performance is 'technically' **and** 'symbolically' at par with currently accepted prestigious systems. The former is a technical design exercise, while the latter is a socio-cultural and economic issue associated with symbols of progress and with the ability to access the options.

Turner has suggested that "*access*" to network systems enables people to solve their housing problems by providing them the "*freedom to build*". Such systems provide users with adequate resources, as well as adequate access to resources. However, "*Networks fail or cannot come into existence when there is a grave scarcity of resources or when access to sufficient resources is restricted.*"[19] Thus, increasing both the range of options and the access to this range is of paramount importance.

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[16] S.K. Chandhoke (ed.); Human Habitation - Culture - Environment Interface, (Vikas, New Delhi, 1991), p. 214
[17] Ibid.
[18] AshokKhosla; "Alternative Strategies for Developing and Delivering Low-Cost Shelter Technologies" (Development Alternatives, New Delhi, 1988).
[19] Turner in Turner and Fichter (1972), pp. 205

We have noted earlier that network-paths or delivery processes represent the local building pattern which becomes dominant and strengthens through increased use. The choice of one network-path or delivery process (especially the transaction system) over another, is determined by the operating environment described earlier (Section 6.2). The network nature, however, permits catalytic inputs (suitable interventions) in the operating environment to increase the use of certain pathways thereby strengthening them.

The rural house is very much an agrarian product and depends on a balanced operating environment that includes the natural eco-system and social, economic and management structures. A network operating in an optimally balanced environment would possess significant variety and operational flexibility while allowing all the users, maximum access to material resources, technology and skills In the current situation, therefore, any intervention in resources, technology or delivery processes will therefore, have to pass through the tests of:

(i) enlarging the range of availa:le options

(ii) augmenting (at least not limiting) the variety and flexibility of delivery options, and.,

(iii) increasing the level of local control in construction and resource management.

This will be able to best utilise and enhance the potential of the **rural building network**.

PART 3

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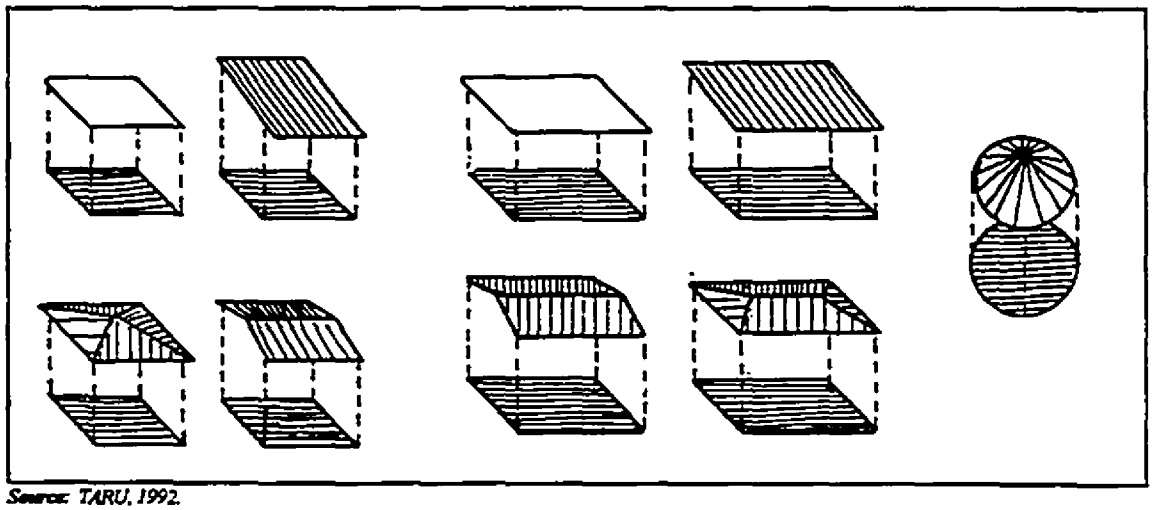
Appendix 2.1

Classification of rural house form by ground plan and roof form

House plan	Roof slope and direction			
	Negligible	One - way	Two - way	Four - way
Rectangular	Flat	Pitched; lean-to	Pitched; gabled	Pitched; hipped
Square	Flat	Pitched; lean-to	Pitched; gabled	Pitched; hipped
Circular				Pitched; conical

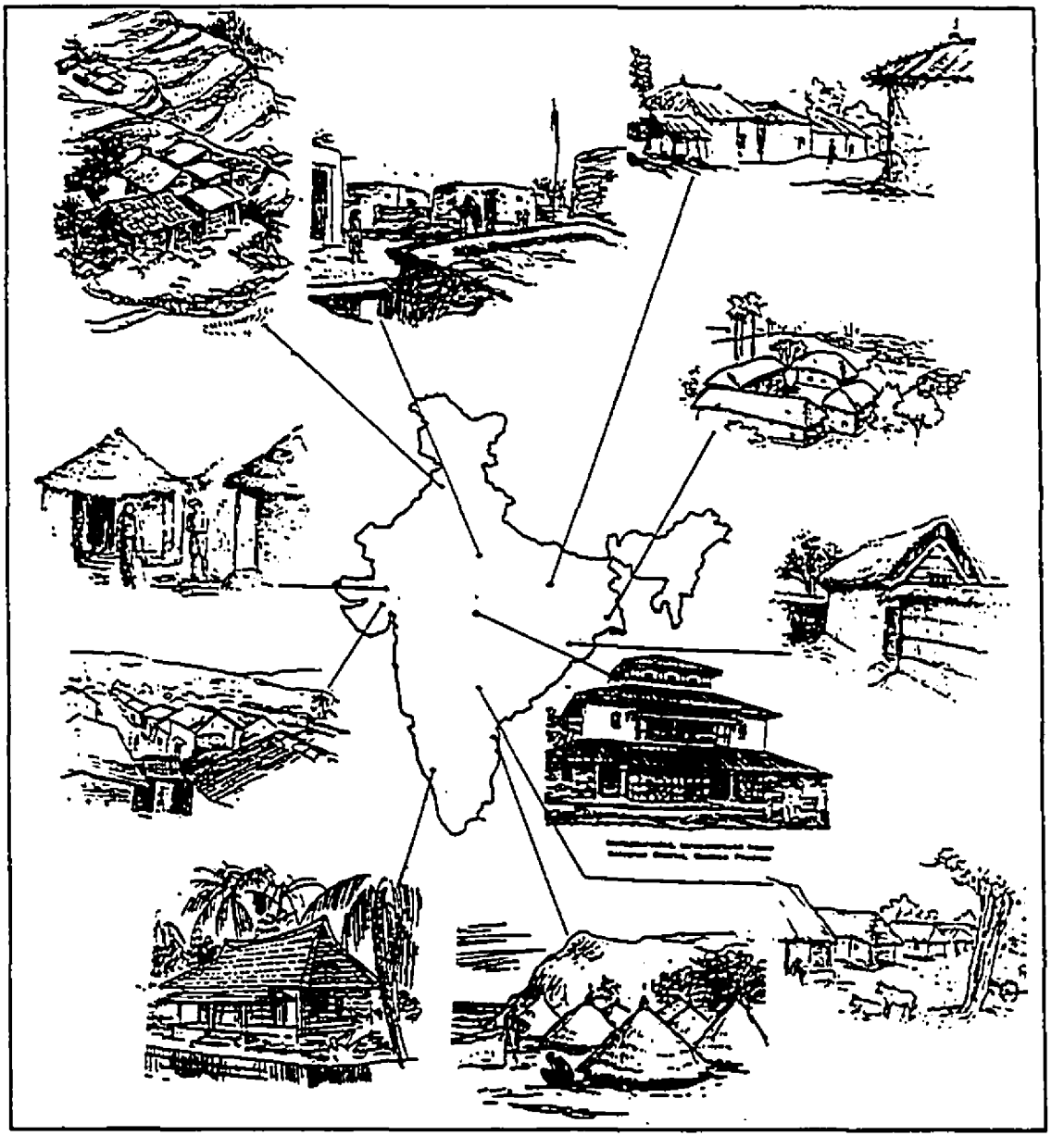
Source: Census Atlas, Census of India, New Delhi, 1961 - 1981



Source: TARU, 1992.

Apppendix 2.2

House form in rural India



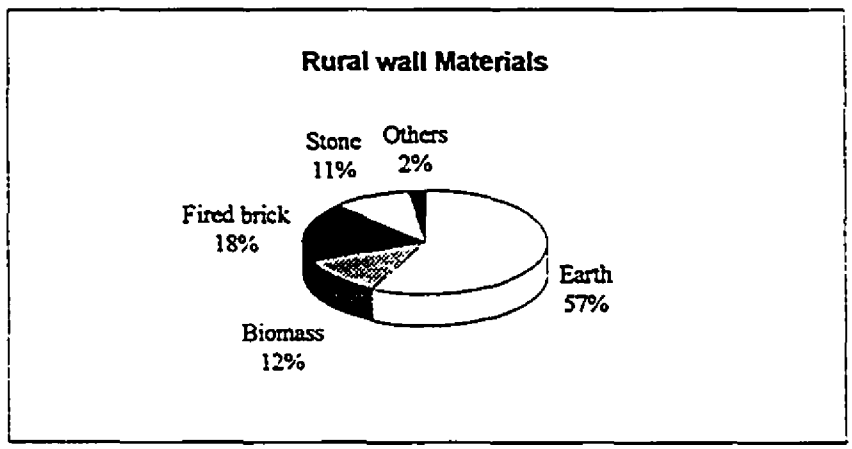
Source: Housing Census of India, 1961

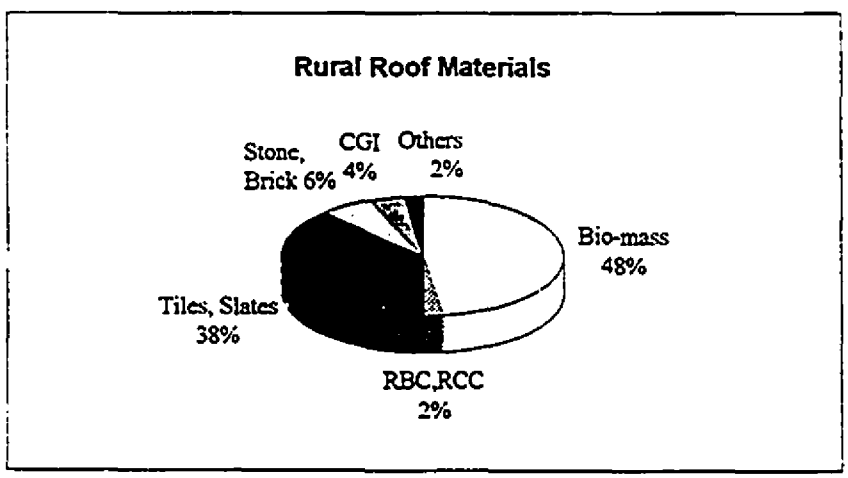
Appendix 2.3

Classification of rural houses in India by materials used in of roof and wall construction (% of total)

Wall Material	Roof Material						
	Biomass, earth	Tiles, shingles & slate	CGI sheets	All Metal sheets	Brick, stone & lime	RBC & RCC	Total
Bio-mass	10.1%		0.5%				10.6%
Earth	28.3%	26.5%	1.5%	0.7%	0.1%	0.2%	57.3%
Timber	0.4%	0.3%	0.2%				0.9%
Burnt bricks	3.1%	7.2%	0.9%	0.5%	4.3%	1.5%	17.5%
Stone	3.3%	4.4%	0.6%	0.1%	2.0%	0.2%	10.6%
Total	45.2%	38.4%	3.7%	0.7%	6.4%	1.9%	96.9%

Source: Census of India, Table H/I - VII, 1981





Source: Rev. 1990; TARU. 1993

Appendix 3.1

Framework / Information guide for the field survey:

The field study was conducted in two phases: (i) a preliminary survey, with the purpose to get a general feel of the area and to establish contact with the relevant people, and , (ii) a focused secondary survey in specific selected villages. During the second phase six villages were the focus of concentrated study, while some settlements around like the IAY settlement at Pura Badhera and village Harpalpur in Tikamgarh district were studied briefly.

The survey was conducted through observation, photographs, measured drawings, census data and informal discussions with villagers, government officials and development workers. Information regarding the study area was sought from the following category of people:

(a) Villagers of various economic levels - residents, house-owners -builders, village head-men and artisans.
(b) Building material suppliers in the local area - shop-keepers.
(c) Managers of building material factories in the target area.
(d) Local building contractors - owners of stone crushers, stone suppliers etc.
(e) Engineers of the District Rural Development Agency.
(f) The Chief Development officer (CDO) of the region.
(g) Development workers of the local office of Development Alternatives (Jhansi) - the only major NGO operating in this region.
(h) Professionals from other organisations working in the area of Rural Development - TARU, New Delhi, DA, New Delhi and CSE, New Delhi.

A broad framework regarding **"Type of Information Sought"** was formulated prior to conducting the survey. This framework was modified after the preliminary survey. Even though a prior list of information required had been prepared, this was constantly added upon, modified and changed though-out the survey. A lot of the useful information gathered during the long drawn conversations with village residents was in fact not even part of the framework, this indicates a strong point in favour of guided but unstructured interviews. The information was sought in seven broad heads, which often over-lapped.. The "Type of Information Sought" as per the last modification made, is presented below.

Type of Information sought:

A. Settlement pattern and house form:
- clustering of residential area;
- relationship of '*Abadi*' to common *gram sabha* lands and individual fields;
- ownership in the *abadi* and agricultural lands;
- status of common lands - environmental condition, responsibility of maintenance, access to various villagers;
- typical house form and utilisation of various open and covered spaces;
- spatial development - sequence of construction of the various covered spaces.

B Village socio-economic structure:
- primary occupations;
- income levels;
- agricultural land ownership and production;
- annual cropping frequencies;
- caste groups and relationship amongst different castes;
- off-land occupations and incomes;
- occupational diversification from traditional occupations;
- typical family sizes, family structure - joint or nuclear.

C **Administrative and organisational structure:**
- *panchayat* structure and duties - resource management, land distribution, role in public sector development projects, others ;
- impact on local building practices;
- management of public sector housing schemes - beneficiary / target group selection, funding and fund release criteria, implementation, management, beneficiary participation.

D **Construction methods - walls and roofs:**
- **materials in construction :**
- used for roof or wall;
- natural, industrial, processed, unprocessed;
- bought (from whom) or collected (from where, and by whom);
- extraction process, extracted by whom and from where
- distance transported, mode of transportation, cost of transportation;
- cost of materials on site, unit of transaction;
- handled by whom;
- quality discernment, local standards of quality;
- availability and accessibility to materials;
- what natural bio-mass products are used in construction;
- local grasses - cultivated and wild;
- tree/ forest cover - growth and usage;
- frequency of extraction of timber, soil, stone and local country woods;
- fuel requirement fro processing materials and type of fuel;
- water requirements in construction and procurement;

- **roof and wall construction techniques:**
- types and nomenclature;
- typical spans, wall to roof heights, roof slopes, wall thickness etc.;
- materials used in each;
- technique of construction;
- type and quantity of manpower input;
- manpower costs;
- comments on structural and thermal performances;
- frequency and type of repair and maintenance;
- element/ component requiring maximum maintenance;
- maintained by whom;
- costs of maintenance.

D **Delivery methods:**
- **delivery of materials:**
- from where;
- how (transport);
- cost (material + transport);
- extracted / grown where;
- managed / controlled by whom;
- processed by whom and where;
- frequency of availability / seasonality;

- **delivery of skills:**
- who's skills (mason, personal skills, semi-skilled work);
- level of skill required for each type of work, level of skill available;
- seasonal availability of skilled workers;
- remuneration method, transaction units, any informal payment systems;
- transfer of skills - within family, within community, from outsiders - city based masons etc.;

- introduction of new skills from whom and how;
- status of and economics of older traditional skills;
- economic returns - market for skills, skilled workmen required for what type of jobs;

- institutions:
- local markets (bazaars) what building materials, elements and skills are procured from here;
- what building material and skilled manpower goes out from the villages to the nearest urban areas;
- family roles in building - who does what;
- any artisan guilds/ communities;
- village institutions controlling resource extraction - management of common property resources by whom and what are the conditions;
- what are the public sector institutions for development of construction skills / housing improvement or provision;
- who organises construction of community buildings like *panchayat ghar*, schools etc. in the village, who puts in the labour, how is it paid for.

E **Changes in A, B, C and D above over a period of 15 to 20 years:**
- new materials;
- new techniques;
- reduced use of/ disappearance of any older materials, techniques, skills in construction and why;
- who is able to afford (access) the various materials and skills now and what was the situation 15 to 20 years back;
- new needs, changes in lifestyle, in income levels, in occupations, literacy levels;
- what is the trend of social mobility amongst castes - do the masons build for the so called *shudras*;
- new status symbols, fashions in house types - who is adopting them and what is the trend.

F Relationship with the nearest urban centre:
- migration pattern - daily, seasonal, long duration;
- procurement of materials, skills from and provision to the city;
- influence in terms of status, fashion, efficiency in construction etc.

G Public sector housing activities in the area:
- housing projects;
- targets and target groups;
- selection of beneficiaries;
- monetary assistance;
- construction materials, techniques, specifications used;
- construction through what agency - level of beneficiary participation.

Appendix 3.2

Surveyed villages - primary census data:

Village	Age (yrs.)	Area (acres)	Population* (households)	Distance from Jhansi	Accessibility
Raksa	250	2142	784+245 HH; 970 houses +14 adjunct	10 km.	Metalled road
Dhikoli	700	857	125 HH + 12 HH adjuct	13 km.	3 km. earthen road from NH 25
Palinda	400	721	700 HH	15 km	3.5 km earthen road from NH 25
Kancharpura	30	871	349 HH; 344 houses**	14 km	2 km earthen road from NH 25
Lidhora	600	809	171 HH	110 km	6 km. earthen road from the metalled road, one stream in between.
Khalilpura	120	409	26 HH + 63 HH	110 km	- do -

Source: Primary Census Abstracts, census of India: 1991 / Field survey conducted for this study, June - July, 1994.

** In case of house less families, no. of houses differ from total house holds (census), however, more than one family occupies a house.*

'+' indicates an adjunct harijan or tribal settlement.

*** the survey revealed a discrepancy with the census information, total number of households found were 250 + 18 HH of Saharyas.*

Appendix 3.3

Surveyed villages - socio-economic structure:

Village	Social structure	Primary occupation	Economic class
Raksa	Thakurs & Brahmins - 5%	Agriculture	Medium & large farmers
	Kayastha - 18%	Shops, agriculture	Small & medium farmers
	Lodi - 37%	Agriculture, farm labour	Small & Marginal farmers
	Chamar - 28%	- do -	- do -
	Lohar, koli, Gadhariya - 7%	Agriculture, labour, livestock	Marginal farmers
	Sahariya tribals - 5%	Farm & construction labour	Landless
Dhikoli	Brahmins - 16%	Agriculture	Small & medium farmers
	Thakurs - 9%	- do -	Medium & large farmers
	Lodi, Teli, Nai - 40%	Agriculture, shops, farm labour	Small & marginal farmers
	Chamar, Kurmi - 23%	Agriculture, farm labour	- do -
	Khangar - 12%	Farm & construction labour	Landless
Palinda	Brahmin - 8%	Agriculture	Medium farmers
	Thakur - 16%	- do -	Large & medium farmers
	Pal - 17%	Livestock, agriculture	marginal farmers
	Lodhi - 35%	Agriculture, farm labour	Small & marginal farmers
	Chamar, Kurmi - 24%	- do -	- do -
Kanchanpur	Brahmin - 10%	Agriculture	Small & medium farmers
	Thakur - 30%	- do -	- do -
	Yadav - 15%	Livestock, agriculture	- do -
	Chamar, Kurmi - 40%	Agriculture, farm labour	- do -
	Sahariya tribals - 5%	Reed baskets & mat manufacture, labour	Landless
Lidhora	Brahmin -	Agriculture	Large & medium farmers
	Thakur -	- do -	- do -
	Pal -	Livestock, farm labour	Landless
	Kurmi -	Agriculture, farm labour	Small & marginal farmers
Khalilpura	Brahmin - 48%	Agriculture	Medium farmers
	Thakur - 22%	- do -	- do -
	Gadhariya - 30%	Livestock, farm labour	Landless

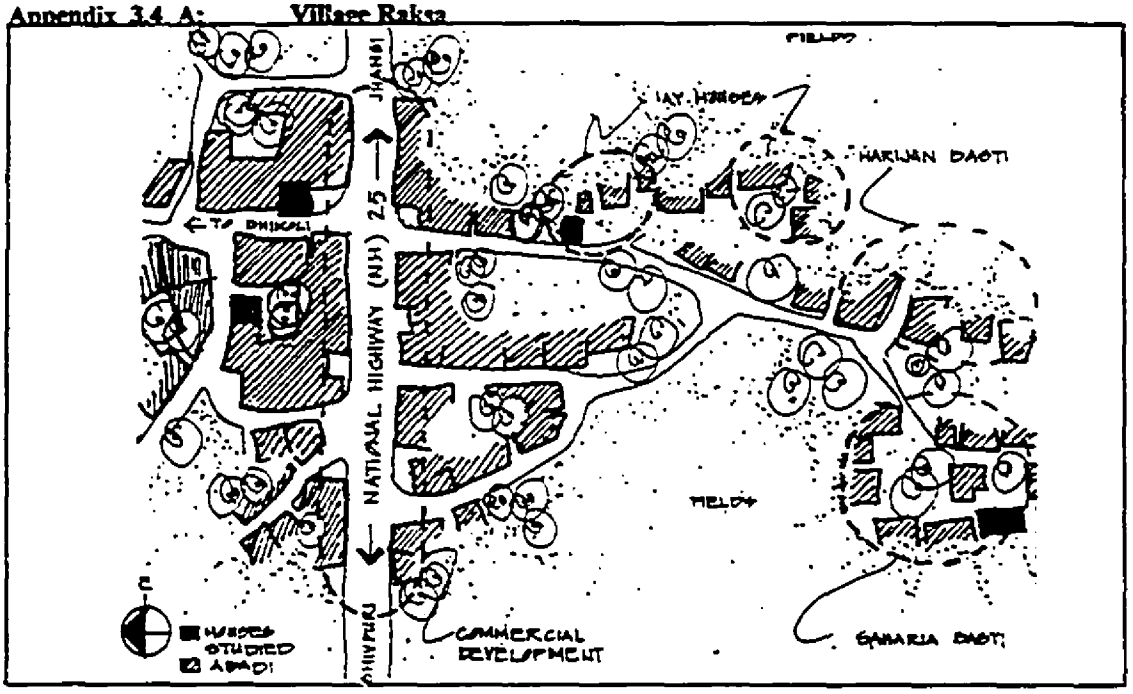
Source: Primary Census Abstracts, Census of India, 1991/ Field survey conducted for this study, June - July 1994.

Appendix 3.4

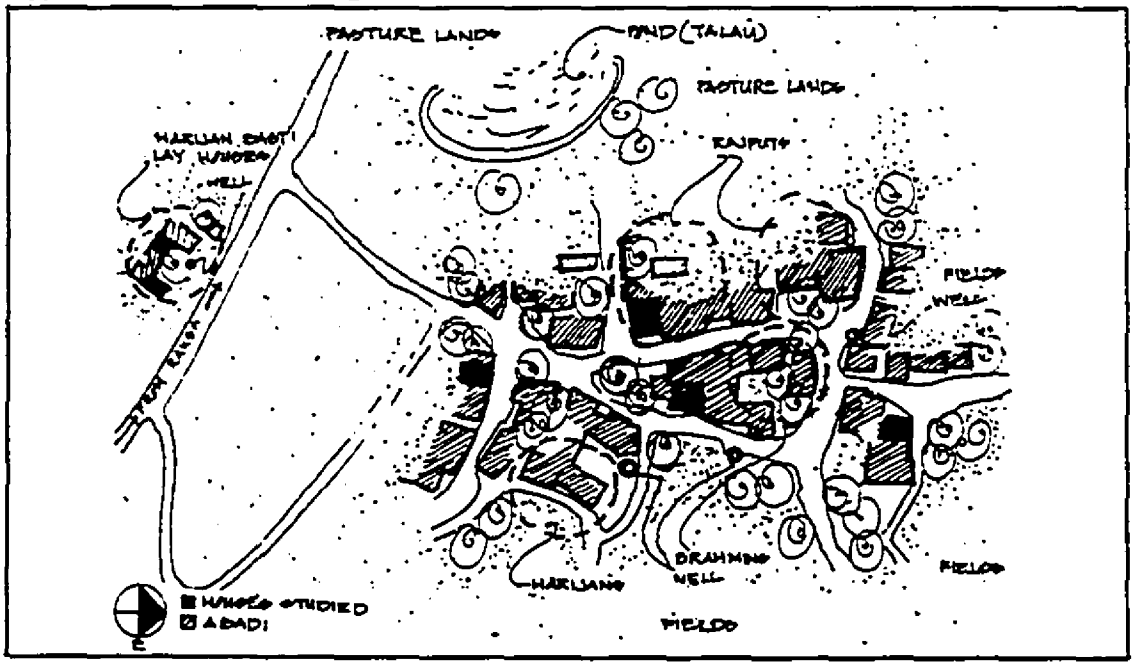
Surveyed villages - settlement patterns:

The following drawings present the settlement pattern of the six villages that were studied in detail. The drawings have been developed by walking through the villages and recording information. They are not to scale and are indicative only. Villagers relate to the aspect of 'orientation' with respect to east - where the sun rises from. The following drawings therefore mark East as per the local system of indicating orientation as well as North according to the formal architectural indication style.

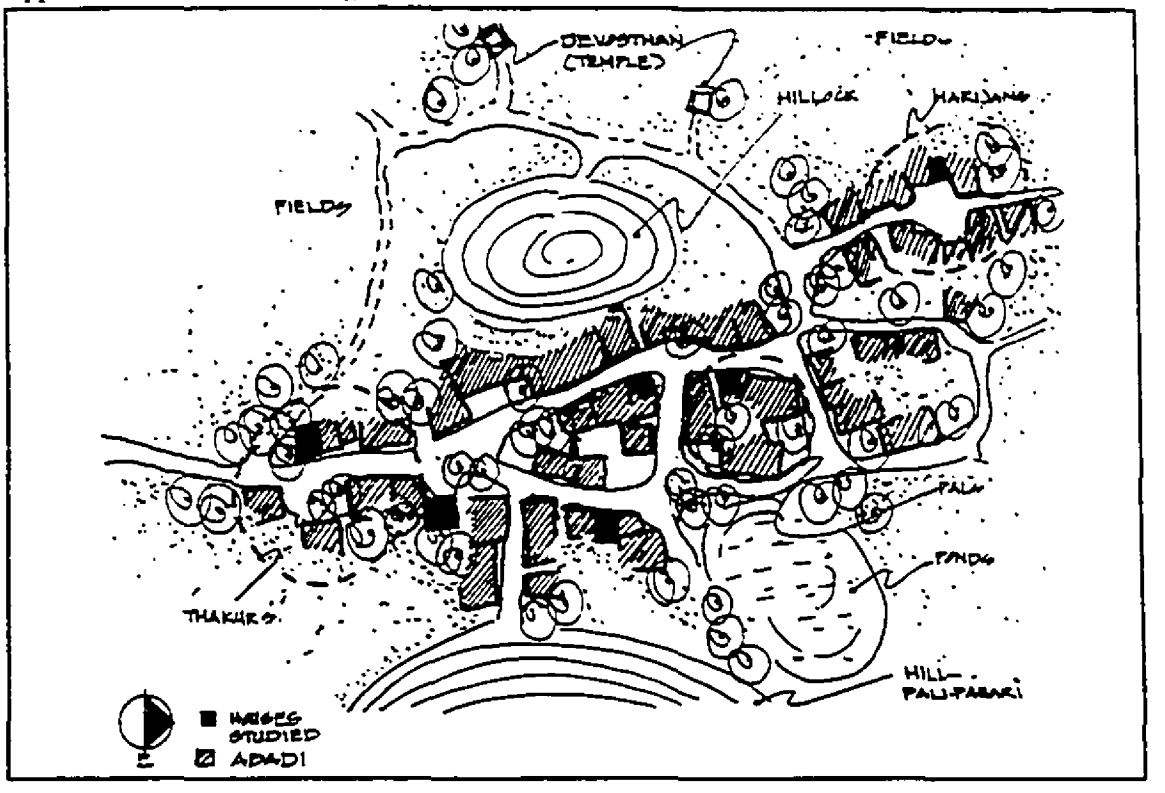
Appendix 3.4 A: Village Raksa



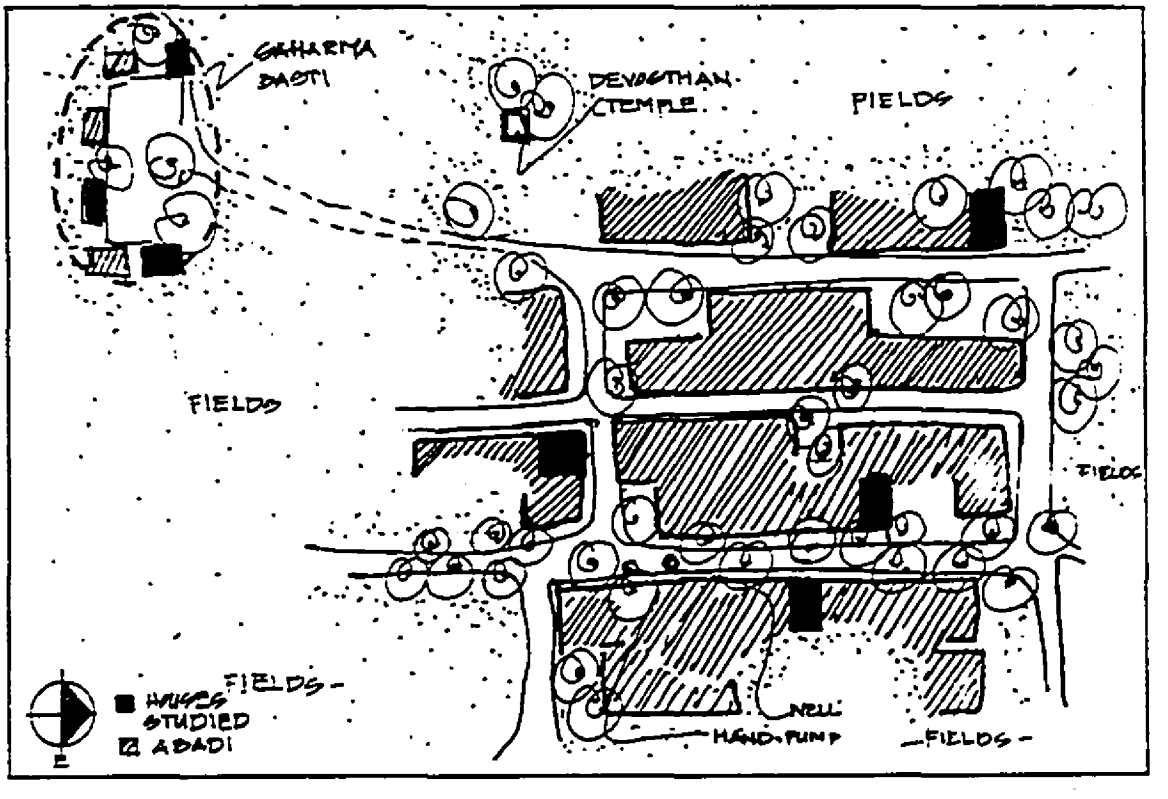
Appendix 3.4 B: Village Dhikoli



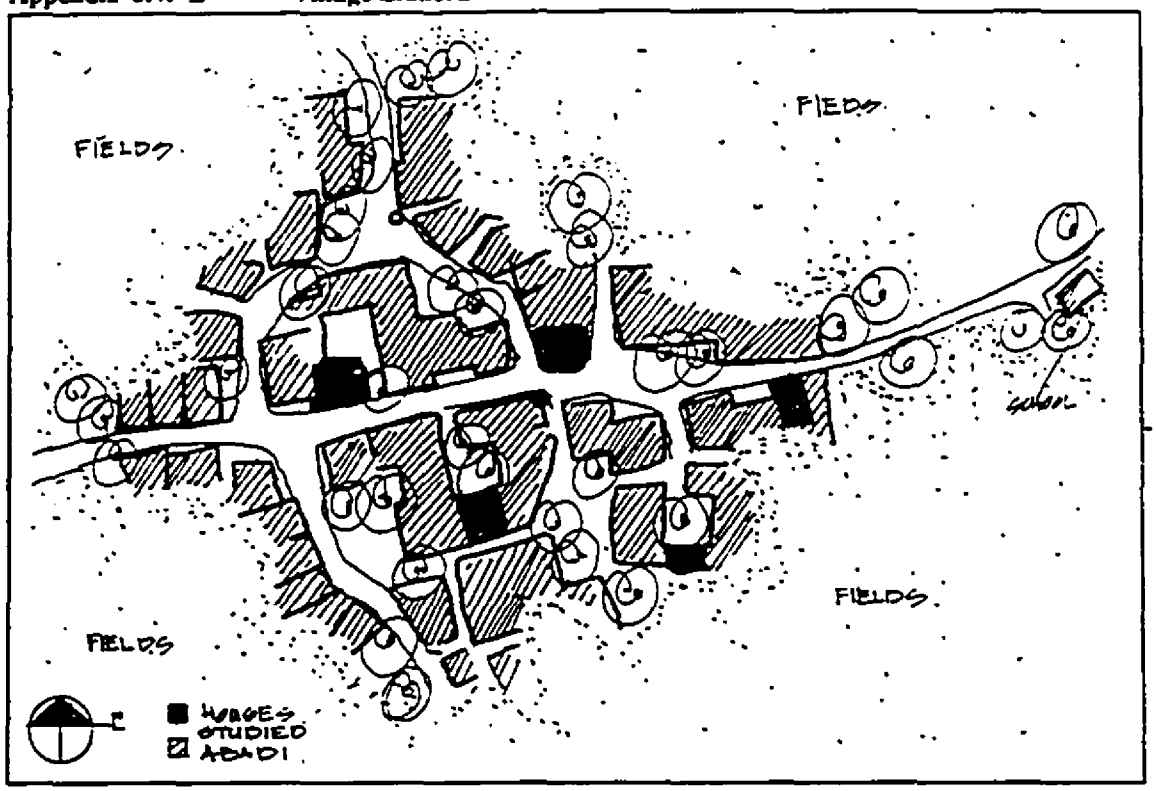
Appendix 3.4 C: Village Palinda



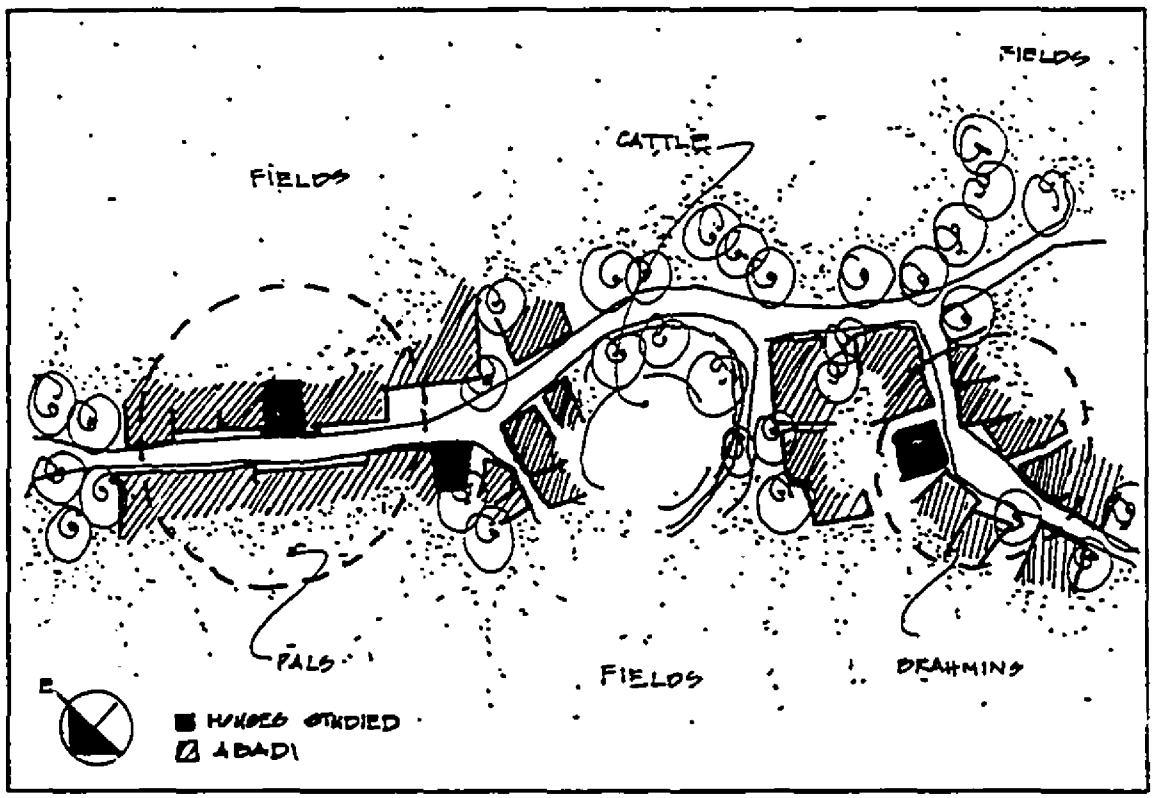
Appendix 3.4 D: Village Kanchanpura



Appendix 3.4: E Village Lidhora



Appendix 3.4 F: Khalilpura



Appendix 4.1

Locally available timber and its use in building

S.No.	Species	Local name	Nature	Size	Category	Utilization	Availability
1	Acacia catechu	Khair	D	M	Secondary	FW,T,	High
2	Acacia nilotica	Babul/kikar	D	M	Secondary	FE,FW,	High
3	Acacia tortilis	Israeli babul	D	M	Tertiary	B	Medium
4	Aegle marmelos	Bael	D	S-M	Tertiary	FW	low
5	Anogeissus pendula	Kardhai	D	S	Tertiary	FW,T,	Medium
6	Azadiracta indica	Neem	D	L	Primary	FW,B,T,IR,AGI	Medium
7	Bauhinia variegata	Kachnar	D	L	Secondary	B,FW,T	Low
8	Bombak ceiba	Semal	D	M	Secondary	FW,T	Low
9	Buchnania latifolia	Chironji	D	M	Secondary	FW	Medium
10	Butea monosperma	Dhak	D	M	Secondary	FW,B,T,AGI	High
11	Cassia fistula	Amaltas	D	S-M	Secondary	FW,B,T	Low
12	Dalbergia sissoo	Shisham	D	M-L	primary	B,T,FW	V Low
13	Dendrocalamus strictus	bans (bamboo)	E	M-L	Primary	T,FR,AGI,B	Low
14	Diospyros melanoxylon	Tendu	E	M	Secondary	FW,T	Low
15	Eucalyptus tereticornis	Safeda	E	L	Secondary	FW,T,FR	Medium
16	Leucaena leucocephala	Subabul	E	L	Secondary	FW,T	High
17	Madhuca indica	Mahua	D	L	Secondary	FW,T	Medium
18	Mangifera indica	Aam (mango)	E	L	Primary	T,FR,AGI	Low
19	Pongammia pinnata *	Karondi	P	S - M	Tertiary	FR, FW, FO	Seasonal
20	Prosopis juliflora	Mesquite	D	S-M	Tertiary	B,T	High
21	Tamarindus indica	Imli	E	L	Secondary	FW,B,	Low
22	Tectona grandis	Teak	D	L	Primary	FW,T,FR	V Low
23	Zizyphus mauritiana	Ber	D	S	Tertiary	FW,T,	Medium
24	Ipomea	Besharam	E	S-M	Tertiary	FW,T,	High
24	-	Lantana	D/grass	S	Tertiary	B,T,Part,Mesh	High

Legend:
D= Deciduous; E = Evergreen; P = Perennial; S=Small; M= Medium; L = Large
FW = Fire wood; FR = Furniture; T = Timber for doors,windows, spanning and support memebers; B = Wind-break, ornamental; FE = Fibre, rope; AGI = Agricultural implements; IR = Insect repellent; Part = Partitions., FO = Fodder

** Not used in building, however, mentioned here as it is an important ground cover.*

Appendix 4.2 Roof and Wall Components in the Surveyed Villages

The percentages are based on observation made while walking through the villages and during discussions with village residents.

A. -Raksa

Walls \ Roofs	Khaprel on Acacia/ Ipomea Understructure	Khaprel with Neem Acacia Understructure	Farshi - stone slabs on walls	Farshi - stone slabs on stone beams	Farshi - stone slabs on steel beams	Reinforced Brick Concrete	Reinforced Cement Concrete
Cob	6%	6%					
Adobe	4%	3%					
Einth/Gumma in mud mortar	2%	12%	8%	8%	8%	5%	2%
Boulder stones in mud mortar		2%		2%			
Layered masonry in mud mortar	4%	4%	6%	8%	4%		
Dressed stone - *Khanda in* cement-sand mortar			2%	2%		1%	1%
Concrete blocks in cement-sand mortar							

B. - Dhikoli

Walls \ Roofs	Khaprel on Acacia/ Ipomea Understructure	Khaprel with Neem Acacia Understructure	Farshi - stone slabs on walls	Farshi - stone slabs on stone beams	Farshi - stone slabs on steel beams	Reinforced Brick Concrete	Reinforced Cement Concrete
Cob	4%	6%					
Adobe	3%	5%					
Einth/Gumma in mud mortar	2%	8%	10%	8%	4%	1%	
Boulder stones in mud mortar	2%	4%	6%	5%			
Layered masonry in mud mortar	2%	8%	10%	8%	2%		
Dressed stone - *Khanda in* cement-sand mortar			1%	2%	1%		
Concrete blocks in cement-sand mortar							

C. -Palinda

Walls \ Roofs	Khaprel on Acacia/ Ipomea Understructure	Khaprel with Neem Acacia Understructure	Farshi - stone slabs on walls	Farshi - stone slabs on stone beams	Farshi - stone slabs on steel beams	Reinforced Brick Concrete	Reinforced Cement Concrete
Cob	4%	5%					
Adobe	3%	5%	1%				
Eirth/Gumma in mud mortar	2%	14%	10%	6%	4%	2%	
Boulder stones in mud mortar	1%	6%	6%	3%			
Layered masonry in mud mortar	2%	10%	6%	8%	2%		
Dressed stone - *Khanda in* cement-sand mortar							
Concrete blocks in cement-sand mortar							

D. - Kanchanpura

Walls \ Roofs	Khaprel on Acacia/ Ipomea Understructure	Khaprel with Neem Acacia Understructure	Farshi - stone slabs on walls	Farshi - stone slabs on stone beams	Farshi - stone slabs on steel beams	Reinforced Brick Concrete	Reinforced Cement Concrete	Bamboo intermediate ceiling
Cob	2%	6%						
Adobe	2%	3%						
Eirth/Gumma in mud mortar	2%	10%	12%	10%	12%	2%	1%	2%
Boulder stones in mud mortar		1%	1%		2%			
Layered masonry in mud mortar	2%	6%	6%	6%	8%	1%		2%
Dressed stone - *Khanda in* cement-sand mortar			1%	2%	2%	1%		1%
Concrete blocks in cement-sand mortar								

E. - Khalilpura

Walls \ Roofs	Khaprel on Acacia/ Ipomea Understructure	Khaprel with Neem Acacia Understructure	Farshi - stone slabs on walls	Farshi - stone slabs on stone beams	Farshi - stone slabs on steel beams	Reinforced Brick Concrete	Reinforced Cement Concrete
Cob	6%	25%					
Adobe	4%	15%					
Eirth/Gumma in mud mortar	2%	15%	6%	5%	1%		
Boulder stones in mud mortar		5%	2%	1%			
Layered masonry in mud mortar	1%	5%	3%	2%	1%		
Dressed stone - *Khanda in* cement-sand mortar				1%			
Concrete blocks in cement-sand mortar							

F. -Lidhora

Walls \ Roofs	Khaprel on Acacia/ Ipomea Understructure	Khaprel with Neem Acacia Understructure	Farshi - stone slabs on walls	Farshi - stone slabs on stone beams	Farshi - stone slabs on steel beams	Reinforced Brick Concrete	Reinforced Cement Concrete
Cob	4%	10%					
Adobe	3%	4%					
Eirth/Gumma in mud mortar	2%	12%	12%	8%	2%	1%	1%
Boulder stones in mud mortar	1%	4%	5%	3%			
Layered masonry in mud mortar	2%	10%	8%	5%	1%		
Dressed stone - *Khanda in* cement-sand mortar				1%	1%	1%	
Concrete blocks in cement-sand mortar							

Appendix 4.3

Cost calculations of building elements:

The building elements - fired bricks (*einth and gumma*), clay tile (*khaprel*), stone beam and concrete block are costed below. The calculations are based on local material and labour rates and labour productivity as informed by masons and villagers during the survey. At places certain lump-sum rates have been established as in the case of *gumma* cost in Palinda. The accuracy of the calculations is within +/-5% the variation due to fluctuating material and labour rates in time and location of different villages, especially between the remote and well-accessed villages, and also to varying methods of calculations and to economy parameters established in different villages.

The system of measurement is F.P.S. as followed in the villages. Conversions for the convenience of the reader are roughly: 3 ft. ~ 1 m.; 10 sq.ft. ~ 1 sq.m.; 35 cft. ~ .1 cu.m.
Can $ 1.^{00} ~ Rs. 23.00 (July, 1994).

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1) *Einth* (for 5000 units): Masonary element - size = 12"x8"x2".

(i) At Lidhora

a) Material:	
Earth= 5000 x .11 cft. -	free
Water =	free
Dung and other fuels = 5000x0.15 =	Rs. 750.00**
b) Labour:	
Earth digging = 7x30* =	Rs. 210.00*
Watering and kneading = 2x30 =	Rs. 60.00
Moulding = (2x30 + 1x45) =	Rs. 210.00
Loading the kiln = (1x45 + 3x30) =	Rs. 135.00
Unloading the kiln = (2x30) =	Rs. 60.00
c) Transport =	Rs. 25.00
Total =	Rs.1450.00

Cost of one fired *einth* = Rs. 0.29 ~ Rs.0.30 per piece.
Cost of one unfired *einth* (adobe) = Rs. 0.10

* *one worker can dig approx. 50 cft. of earth (non rocky) per day. May be free if done byself.*
** *dung may be free or only partially so, if own cattle do not produce enough.*

(ii) At Dhikoli

a) Material:	
Earth= 5000 x .11 cft. -	free
Water =	free
Dung and other fuels = 5000x0.25 =	Rs.1250.00**
b) Labour:	
Earth digging = 7x35* =	Rs. 245.00
Watering and kneading = 2x35 =	Rs. 70.00
Moulding = (2x35 + 1x50) =	Rs. 240.00
Loading the kiln = (1x50 + 3x35) =	Rs. 155.00
Unloading the kiln = (2x35) =	Rs. 70.00
c) Transport =	Rs. 50.00
Total =	Rs.2080.00

Cost of one fired *einth* = Rs. 0.42 ~ Rs.0.45 per piece***
Cost of one unfired *einth* (adobe) = Rs. 0.12 ~ Rs.0.15 per piece***

* *Labour costs are higher here.*
** *Dung may be free orpartly free from own cattle or may be provided by the buyer.*
*** *Sold at Rs. 0.45 and 0.15 per piece respectively within the village.*

2) ***Gumma*** (for 1000 units): Masonary element - size = 9"x4.5"x3".

At Palinda (lump sum prices established here)

Digging =	Rs. 50.00
Watering, kneading & moulding =	Rs. 100.00
Loading and unloading on kiln =	Rs. 50.00
fuel cost (dung)+ addition of =	Rs. 300.00
Transport at own cost	
Total =	Rs. 500.00

Cost of one fired *gumma* =	Rs. 0.50
Cost of one unfired *gumma* (adobe)=	Rs. 0.25

3) **Dressed stone - *Khanda*:**

(i) Masonry element - size = 1'x1'x1'.: At Dhikoli and Palinda (done by local villagers)**

Extraction and dessing =	Rs. 3.50 per piece
Transportation = (upto 100m) =	Rs. 1.00 per piece
Total =	Rs. 4.50 per piece*

(ii) Masonry element - size = 6"x6"x6". At Dhikoli and Palinda (done by local villagers)

Extraction and dessing =	Rs. 1.00 per piece
Transportation = (up to 100m) =	Rs. 0.50 per piece
Total =	Rs. 1.50 per piece*

* *Sold for Rs.5.00 to Rs.7.00 and rs.2.00 at the quarry respectively*
** *At the quarry, 'local villagers' are from the neighbouring village Punawli.*

4) **Boulder stone for random rubble masonry:** Masonry unit in varying sizes - 0.2 to 1.0 cft. in volume.

Extraction and breaking =	Rs. 2.00 per cft.
Transportation at own cost	

5) Concrete block (per piece): Masonry unit - size 8"x8"x16"

(i) Cost at the factory =	Rs. 7.80
Transport (up to 25 km) =	Rs. 1.00
Total =	Rs. 8.80
(ii) Manufactured on site by Sahariya beneficiaries =	Rs. 5.20*

** As calculated by engineers at the Community Block office.*

6) *Chapti khaprel* - clay tile (for 500 units): Roof cladding element - size = 1.5'x1'x1"

a) Material:	
Earth (black and red)= 5000 x .125 cft.=	Rs. 100.00*
Water - free	
Dung and other fuels = 7500x0.25 =	Rs.1875.00**
b) Labour:	
Earth digging = 7x30 =	Rs. 210.00***
Watering and kneading = 2x30 =	Rs. 60.00***
Pulling - moulding = 3x50 =	Rs. 150.00
Loading the kiln = (1x45 + 2x35) =	Rs. 115.00***
Unloading the kiln = (2x35) =	Rs. 70.00***
c) Transport =	Rs. 25.00
Total =	Rs.2605.00

Cost of one khaprel tile = Rs. 0..52/pc ~ Rs.1.20 per pair.
Normal cost after economising -only 50% fuel,
Earth, moulding & transport costs = Rs. 0.24/pc ~ Rs. 0.50 per pair

** Rs. 100 is paid is earth if collected from revenue lands. It is free if the collection is from own fields or common gram sabha lands.*
*** Dung may be free or only some of it bough.*
**** This is normally done by the house owner himself.*

7) Stone Beam: Roof spanning member - 12'-14'x1.5'x3"

Cost at quarry =	Rs.140.00 - 160.00
Transportation =	Rs. 20.00*
Dressing (1x70x1day) =	Rs. 70.00
Total =	Rs. 230.00 - 250.00 per beam

** Transportation costs are approximate sinceother items are purchased and transported along with it, thus distributing transport costs over a number of building materials and supplies.*

Appendix 4.4

Cost calculations of wall and roof construction systems:

Costs of the various wall and roof construction systems are calculated below. Costs are based on local material and element costs as calculated in Appendix 4.3 above, local labour rates and productivity as found out during the survey. The calculations are made for walls and roof of a room 10 ft.x12 ft. in size, with two windows and a door. The walls for cob and *einth* in mud mortar are calculated as roofed with pitched roof of *khaprel* with average height of 9 ft., while the wall systems are calculated for flat roof systems with average wall height of 10ft.. The accuracy of calculation within a range of +/- 5%.

The standard manpower productivity and quantity estimation is based on discussions with local masons and with the help of guidelines from The Instruction Manual for Appropriate Building Systems; (Development Alternatives and BMTPC, New Delhi, 1993). The system of measurement is F.P.S. as followed in the villages. Conversions for the convenience of the reader areapproximately 3 ft. ~ 1 m.; 10 sq.ft. ~ 1 sq.m.; 35 cft. ~ 1 cu.m. Can $ 1.^{00} ~ Rs. 23.00 (July 1995).

Wall Systems:

1) Cob wall (2 ft. Thick, 2 windows - 1x1.5 sq.ft. each, 1 door - 3x6 sq.ft.)
masonry volume ~ 728 cft. Including wastage (10%).

a) Materials:		
Earth =	free or	Rs. 100.00*
Water =	free	
Agro-waste =	free	
b) Labour*:**		
Digging = (14.5x35) =		Rs. 507.50**
Laying = (2x35x6 days) =		Rs. 420.00
Finishing, plastering = (4x35) =		Rs. 140.00
c) Transport =		Rs. 25.00
Total =		Rs. 1185.50

Cost per cft. ~ Rs. 1.63/ cft.. or Rs.54.25/cum.

* *Rs.100.00 has to be paid in case earth is being dug from another person's field or bought from revenue authorities.*
** *Digging costs @ 50 cft. per labour per day.*
*** *Self labour, normally costed as free by owners.*

2) *Einth* in mud mortar at Ludhora (wall height= 9 ft., wall thickness = 18ft., 2 windows - 1.5x2 sq.ft., 1 door - 3x6 sq.ft.) - masonry volume ~ 560cft.

a) Materials:	
Einth (5500 nos. Including wastage @ Rs. 0.30each) =	Rs. 1650.00
Earth for mortar (0.3cft/cft of masonary ~ 170 cft digging costs only @ Rs. 0.6/cft =	Rs. 102.00
Labour:	
1 mason + 1 helper team can do approx. 100cft per day	
total team days required = 6; cost (70 +50)x 6 +	Rs. 720.00
Labourers (2x6)= 12labour days @ Rs. 30.00/ LD=	Rs. 360.00

c) **Transport** , approx.	Rs. 150.00
Total	Rs. 2982.00
Miscellaneous and tools and plants approx. 5%=	Rs. 149.10
Grand Total =	Rs. 3131.10, say Rs. 3131.00

Cost per cft. = Rs. 5.6 per cft. or Rs. 186.66 per cum.

3) ***Einth*** **in mud mortar at Dhikoli** (wall height= 9 ft., wall thickness = 18ft., door and windows as above) -masonry volume = 560 cft..

a) Materials:	
Einth (5500 nos. Including wastage @ Rs. 0.45/pc) =	Rs. 2475.00
Earth for mortar (0.3cft/cft of masonary) ~170 cft digging costs only @ Rs. 0.7/cft =	Rs. 119.00
b) Labour:	
1 mason + 1 helper team can do approx. 100cft per day	
total team days required = 6; cost (70=50)x6=	Rs. 720.00
Labourers (2x6)= 12 labour days @ Rs. 35.00/ LD=	Rs. 420.00
c) **Transport** , approx.	Rs. 200.00
Total	Rs. 3934.00
Miscellaneous and tools and plants approx. 5%=	Rs. 196.70
Grand Total=	Rs. 4130.70, say Rs. 4131.00

Cost per cft. ~ Rs. 7.40 per cft. or Rs. 246.66 per cum.

4) ***Gumma*** **in mud mortar** (wall height, average = 9 ft., wall thickness = 14.5inches, 2 windows - 1.5x2.5 sq.ft each , 1 door -3x6 sq.ft.) - masonry volume = 447.7 cft.

a) Materials:	
Gumma (7000 nos including wastage) @ Rs. 0.50each =	Rs. 3500.00
Earth for mortar (0.30cft/ cft. of masonry) ~ 140cft.	
Digging cost @ Rs. 0.70/ cft.=	Rs. 98.00
b) Labour:	
1 mason + 1 helper team can do approx. 100cft per day	
total team days required= 4.5, say 5 days; cost =(70+50)x5=	Rs. 600.00
Labourers (2x35)x5=	Rs. 350.00
c) **Transport**, approx.	Rs. 200.00
Total	Rs. 4748.00
Miscellaneous and tools and plants approx. 5%=	Rs. 237.40
Grand total=	Rs. 4985.40, say Rs. 4986.00

Cost per cft.~ Rs. 11.13/cft. or 371/cum.

5) **Boulders in mud mortar** (wall height = 10 ft., wall thickness = 2 ft., 2 windows - 1.5x2.5 sq.ft each , 1 door -3x6 sq.ft.) - masonry volume = 832 cft.

a) Materials:	
Boulder stones = 900 cft. (including wastage) @ Rs. 2.00/cft. =	Rs. 1800.00
Earth for mortar (0.40cft. per cft. masonry ~ 350cft.)	
digging costs @ Rs. 0.70/cft.=	Rs. 245.00
b) Labour:	
1 mason + 1 helper team can do approx. 110cft per day	
total team days required= 8=(70+50)x8=	Rs. 960.00
Labourers (4x35)x8=	Rs. 1120.00
c) **Transport**, approx. =	Rs. 300.00
Total=	Rs. 4425.00
Miscellaneous and tools and plants approx. 5%=	Rs. 221.25
Grand total =	Rs. 4646.25.
say Rs. 4647.00	

Cost per cft.~ Rs. 5.6/cft. or 186.66/cum.

6) **Layered (combination) masonry in mud mortar:** (wall height = 10 ft., wall thickness = 18inches, 2 windows - 1.5x2.5 sq.ft each , 1 door -3x6 sq.ft) - masonry volume = 625 cft.

Boulder = 80% ~ 500 cft.
Einth = 20% ~ 125 cft.

a) Materials:	
Boulders = 500cft. @ Rs. 2.00/ cft.=	Rs. 1100.00
Einth = 1250 nos. Including wastage @ Rs. 0.45each =	Rs. 562.50
Earth for mortar =(0.4x625 = 250cft.) @ Rs.0.70/cft. =	Rs. 175.00
b) Labour:	
1 mason + 1 helper team can do approx. 110cft per day	
total team days required= 6=(70+50)x6=	Rs. 720.00
Labourers (4x35)x6=	Rs. 840.00
c) **Transport**, approx. =	Rs. 250.00
Total =	Rs. 3547.50
Miscellaneous and tools and plants approx. 5%=	Rs. 177.40
Grand total=	Rs. 3724.90,
say Rs. 3725.00	
Cost per cft.~Rs. 5.9 /cft. or 196.66/cum.	

7) **Concrete blocks in 1:6 cement sand mortar** (wall height, average = 10 ft., wall thickness = 8 inches, 2 windows - 1.5x2.5 sq.ft each , 1 door -3x6 sq.ft) - masonry volume = 283.33 cft.

a) Materials:	
Concrete blocks (525 nos including wastage) @ Rs. 5.20each	
(as manufactured on site by the Sahariya tribals) =	Rs. 2730.00
Mortar : (0.36cft. mortar per 1 cft. of masonry) ~ 102 cft.	
Cement = [(0.36x1)/ (1+6)]x102 = 5.24cft. ~ 213.15 kg	
(One bag ~ 48 kg; required ~4.4, say 5 bags @Rs.103.00/ bag=	Rs. 515.00
Sand = {0.36x6)/(1+6)}x 102 ~ 32 cft. @ Rs. 2 per cft. =	Rs. 64.00

b) Labour:

1 mason + 1 helper team can do approx. 100cft per day	
total team days required= 4.78, say 5 days; cost =(70+50)x5 =	Rs. 600.00
Labourers (2x35)x5=	Rs. 350.00
Transport, approx. =	Rs. 100.00
Total =	Rs. 4359.00
Miscellaneous and tools and plants approx. 5%=	Rs. 217.95
Grand total =	Rs. 4612.95,
say Rs. 4613.00	

Cost per cft.~ Rs. 16.3/cft. or 543.33/cum.

Roof Systems:

8) *Chapti khaprel* - Flat clay tile on *Mahua-Babul* understructure:

Plan area = 10 ft.x 10 ft.; Total roof area = 13.34x12 = 160 sq. ft.

a) Materials:

Tiles required = (1 tile covers approx. 0.25 sq.ft. area), 640 nos.,	
say 700 including wastage @ Rs. .24 per peice=	Rs. 168.00
Understructure - Approximately Rs. 2500.00 if all wood is bought	
Normally, Rs. 1500.00 as some wood may be collected by self =	Rs. 1500.00*

b) Labour:

1 semi-skilled worker for one day =	Rs. 50.00
2 skilled workers forone day = 2x35 =	Rs. 70.00
c) Transport, approx. =	Rs. 50.00
Total =	Rs. 1838.00
Miscellaneous and tools and plants approx. 5%=	Rs. 91.90
Grand total=	Rs. 1929.90,
say Rs. 1930.00	

Cost per sq.ft.= Rs. 12.06/sq.ft. or Rs. 134.02/ sq.m

** Depending on the type wood being used, understructure cost may be quite low. Acacia or Babul is collected free of cost, Ipomea and Lantana are abundant and picked free. Some villagers grow their own trees forconstruction timber.*

9) *Farshi* - stone slab on stone beam roof - plan area = 120 sq. ft.; roof area = 143 sq. ft.

a) Materials:

Stone slabs= 143 sq.ft. (14 pcs. 1.5 ft. X4.5 ft.) @ Rs. 6.0/Sq.ft.=	Rs. 858.00
Stone beams= 2 nos. (3"X1.5'x12') @ Rs. 160/Beam =	Rs. 320.00
Bed blocks= 3 sq.ft. @ Rs. 6/Sq.ft.=	Rs. 18.00
Mortar and terracing -Cement ~ 4 bags (~48 kg/bag)@ Rs. 103/Bag=	Rs. 412.00
Sand= 15 cft. @ Rs. 2.0/ cft.=	Rs. 30.00
Aggregate= 15 cft. @Rs. 12/ cft=	Rs. 180.00

b) Labour:

Beam dressing = 1 mason day/beam= Rs. 70x 2=	Rs. 140.00
Stone slab dressing= 1 mason + 1 helperx 3 days=	Rs. 360.00

Roof laying= 1mason + 1 helper +4 labourersx 1.5 days	
= [(Rs70+Rs. 50) +(Rs.35x4)]x1.5 =	Rs. 390.00
Grouting joints and terracing = 1 mason+1 helper + 2 labourers	
take 2.5 days+ [(Rs.70 + Rs.50)+ (Rs.35x2)]x2.5=	Rs. 475.00
c) **Transport**, approx.=	Rs. 300.00
Total =	Rs. 3483.00
Miscellaneous and tools and plants approx. 5%=	Rs. 174.15
Grand total =	Rs. 3657.15.
say Rs. 3660.00	

Cost per sq.ft.= Rs. 25.6/sq.ft. or Rs. 284.44/ sq.m.

10) Stone slabs on steel undertstructure:

Cost of steel girders = Rs. 30 - 60 per ft length. Taking Rs. 50.00 per foot length,
Total beam required = 12x 2 = 24 feet = Rs. 1200.00.
Replacing this with the cost of procuring and preparing stone beams, we get Rs. 4400.00,
or Rs. 27.50 per sq.ft. or Rs. 305.55 per sq.m.

11) Reinforced Brick Concrete Roof:

Cost of construction = Rs. 144.35 per sq.m or Rs. 13 per sq.ft. as calculated by the U.P. State Schedule of Rates for Building Works, Jhansi District. The materials used are first class bricks (compressive strenght > 50 kg/cm^2), ordinary portland cement and *murram* sand in the ratio of 1:3. This does not include the cost of steel reinforcement nor the terracing on the slab. (Cost of steel = Rs. 1100 per quintal).

Appendix 4.5:

Change in Roof and Wall components from 1971 to 1991

A. Predominant material of wall in Jhansi District - Rural areas - 1971 to 1991

	A. Grass, leaves, reeds or Bamboo	B. Earth	C. Unburnt bricks	D. Wood	E. Burnt Bricks	F. G.I sheets of other metal sheets	G. Stone	H. Cement concrete	I. Others
1971	0.20%	55.00%	9.80%	1.40%	30.30%	0.08%	3.1	0.02%	.08%
1991	0.12%	50.7%	5.15%	0.37%	40.9%	0.85%	1.04%	0.12%	0.03%

Source: Table H-II, Housing Tables, District Census Records, Census of India, 1971 & Table H-II, Housing Tables, District Census Records, Census of India, 1991

B. Predominant material of roof in Jhansi District - Rural areas - 1971 to 1991

	1. Grass,leaves, reeds, thatch, mud, unburnt bricks or bamboo	2. Tiles, slates, shingles	3. Corgated Iron, Zinc or other metal sheets	4. Aesbestos Cement Sheets	5. Brick and Lime	6. Stone	7. Concrete: RBC/ RCC	8. Others
1971	2.0%	88.0%	0.4%	0.1%	0.7%	4.0%	4.60%	0.2%
1991	1.4%	77.34%	0.3%	0.53%	8.13%	4.76%	7.21%	0.33%

Source: Table H-II, Housing Tables, District Census Records, Census of India, 1971 & Table H-II, Housing Tables, District Census Records, Census of India, 1991

C. Distribution of Census houses by predominant material of wall and roof - Cross Tabulated data - Uttar Pradesh - Rural Areas- 1971

1971	1	2, 3, 4, 5,6,7	8
A, B, C, D	4.8%	29.6%	0.018%
E, F, G, H	5.75%	16.26%	0.018%
I	0.007%	0.003%	0.02%

Source: Table H-II, Housing Tables, District Census Records, Census of India, 1971

Cross Tabulated data - Jhansi district, Uttar Pradesh - Rural Areas- 1991.

1991	1	2	3	4	5	6	7	8
A	0.07%	0%	0.002%	0.002%	0%	0%	0%	.05%
B	0.84%	49.75%	0.04%	0.004%	0%	0%	0%	0.055%
C	0.055%	5.08%	0.006%	0.004%	0.035%	0.015%	0.05%	0%
D	0.25%	0.06%	0.013%	0.03%	0%	0%	0%	0.008%
E	0 13%	21.56%	0.22%	0.35%	8.0%	4.4%	6.1%	0.18%
F	0.015%	0.02%	0.02%	0%	0%	0.011%	0.006%	0%
G	0.012%	0.9%	0.002%	0%	0.008%	0.07%	0.04%	0%
H	0.002%	0.044%	0.004%	0.14%	0.09%	0.3%	1.017%	0.004%
I	0%	0.013%	0%	0%	0%	0.004%	0%	0.002%
J	0%	0.004%	0%	0%	0%	0%	0%	0.03%

Source: Table H-II, Housing Tables, District Census Records, Census of India, 1991

REFERENCES

- Achwal, M.B.; Laurie Baker: The Master Craftsman. UNICEF, 1979 and HUDCO, New Delhi, 1988.
- Afshar, Farokh; The Political Economy of Technology Choice ; Construction and Materials Production in Pakistan. Ph.D. Thesis, Urban and Regional Planning, Massachusettes Institute of Technology, October 1985.
- ————; "Globalization: The Persisting Rural - Urban Question and the Response of Planning Education." Journal of Planning Education and Research, no. 13, 1994. pp. 271 - 283.
- Aga Khan Foundation; "Aga Khan Foundation International Strategy: 1991 - 1999." AKF - internal document, 1991.
- Agarwal, Anil and Narain, Sunita; Towards Green Villages: A strategy for environmetally sound and participatory rural development. CSE, New Delhi, 1989.
- Amin, S.M.; "Rural Housing Problems and Role of Self Help Housing." Sociological and Economic Aspects of Housing. Selected papers from the training course organised by National Building Organization, Govt. of India and UN regional centre ESCAFE, 1969.
- Angel, Shlomo and Benjamin, Stan; "Seventeen reasons why the squatter problem can't be solved." Ekistics, no. 242, January 1976. pp. 20-26.
- Anthropological Survey of India, Kirmal Kumar Bose (ed.); Peasant Life in India - a study in Indian unity & diversity. Memoir no.8. ASI, Calcutta, 1961.
- Bansal, N.K. and Minke, Gernot (eds.); Climatic parameters, climatic zones and rural housing in India. Part I of the Indo-German project on Passive Space Conditioning. KFA, Julich, 1988.
- Bijlani, H.U.; "Rural Housing in India." Habitat Intl., vol. .6, no. 4, 1982. pp. 513-525.
- Bourdier, Jean-Paul and Alsayyad, Nezar (eds.); Dwellings, settlements and tradition: cross-cultural perspectives. University Press of America, IASTE, 1989.
- BRAC; Peasant Perceptions - Famine, Credit Needs, Sanitation. BRAC Prokashana, Dhaka, 1984a.
- ———; Landless in Bangladesh - Realities and Constraints. BRAC Prokashana, Dhaka, 1984b.
- ——; Who gets What and Why. BRAC Prokashana, Dhaka, 1986.
- Bromley, Daniel W. and Cernea, Michael M.; "The Management of Common Property Resources - Some Conceptual and Operational Fallacies." World Bank Discussion Paper, no. 57, The World Bank, 1989.
- Brown, Lester R. and Jacobson, Jodi L.; "The Future of Urbanisation: Facing the Ecological and Economic Constraints." Worldwatch Paper, no.77. May, 1987. Worldwatch Institute, 1987.
- Cabral, Sina del Rosario; Garbage Housing in Informal Settlements. M.Arch. Thesis, McGill University, 1990.
- Cain, Allan et al; "Indigenous Building and the Third World." Ekistics, no. 242, January 1976. pp. 29-32.
- Census of India; "Housing Tables - Jhansi District, District Census Records." Census of India, 1971.

- ———: "Housing Tables - Jhansi District, District Census Records." Census of India, 1991.
- ———: "Primary Census Abstracts - District Jhansi." Census of India, 1991.
- ———: Regional Divisions of India - A Cartographic Analysis (General Note). Census of India 1981.
- Chandhoke, S.K.; Nature and Structure of Rural Habitations. Concept and School of Planning and Architecture, New Delhi, 1990.
- ——— (ed.); Human Habitation - Culture - Environment Interface. Vikas, New Delhi, 1991.
- Chandhoke, S.K. and Singh, K.B.; "Village Housing Conditions in the Bharatpur region, Eastern Rajasthan, India." Ekistics, no. 224, July 1974. pp. 67-72.
- Chopra, Kanchan et al; Participatory Development: People and Common Property Resources. Sage, New Delhi, 1990.
- Chowdhury, Tasneem A.; Women's Domain in Rural Housing in South Asia. M. Arch. Thesis, McGill University, 1992.
- Coomaraswamy, Ananda K.; The Indian Craftsman. Probsthain & Co., London, 1909.
- "CUSO Asia." GATE, 2/87. p. 36.
- CSV; "Is There Any Future for Burnt Clay Cottage Industries?" CSV / GRET, Wardha, 1985.
- Danby, Miles; "Building and the Environment." Overseas Building Notes, no.165, ODA, December 1975.
- Das, R.N.; "Palm and bamboo for roofing supports." Appropriate Technology, vol.16, no.3, December 1989. pp. 27-31.
- Davis, Howard, et al; "The Village Meets the City." Architecture + Design, March-April 1993, Media-Transasia, New Delhi. pp. 51-57.
- Desai, Vasant; Rural Development, vol. IV: Rural Development in the Seventh Plan. Himalaya Publishing House, Bombay, 1988.
- Development Alternatives; "A Delivery System for Appropriate Technologies." Marketing Group, Development Alternatives, New Delhi, 1986.
- ———; "Building a House: the rural dimension to housing." Shelter Group, Development Alternatives, New Delhi, 1987.
- ———; "Community Based Management of Natural Resources". Report Submitted to USAID, Development Alternatives, New Delhi, 1991.
- ———; "Datia, Madhya Pradesh, India: A Study in Sustainable and Manageable Development." Development Alternatives, New Delhi, 1993.
- ———; "District Development Strategy, Datia - Part I: Diagnosis and Synthesis of Issues." Project Report prepared for the Ford Foundation, New Delhi, 1992.
- ———; "Feasibility Study for the Facility of a Hand-Made Paper Plant in Jhansi." Ongoing research, Development Alternatives, New Delhi, 1994.

- ————; Instruction Manual for Appropriate Building Systems. Shelter Group, Development Alternatives and BMTPC, New Delhi, 1993.

- ————; "National Action Plan for Rural Housing." Project Proposal for Preparation of Data base and District Action plans in the States of Maharashtra, Rajasthan, Madhya Pradesh and West Bengal. Shelter Group, Development Alternatives, New Delhi, February, 1993.

- ————; "Need Identification survey of village potters and concept testing of fired clay products in Bareilly, Badaun and Jhansi, U.P." Shelter Group, Development Alternatives, 1989.

- ————; "Tree species of Bundelkhand region." Ongoing research, Development Alternatives, Jhansi, 1994.

- ————; "Primary Survey and Analysis of Rural Shelter for Selected Districts in Western Uttar Pradesh." Unpublished research, Development Alternatives, New Delhi, 1992.

- ————; "Rapid Rural Appraisal for Building Systems in Rural Western Uttar Pradesh." Project report prepared for DST. Development Alternatives, New Delhi, 1989.

- ————; "Research Programme on Energy in Building Materials," Interim Report. Development Alternatives, New Delhi, June 1994.

- ————; "Shelter in Rural India - the role of appropriate technologies and local enterprise." Shelter Group, Development Alternatives, New Delhi, 1986.

- Diacon, Diane; "Innovative and successful solutions to global housing problems". Ekistics, no. 346, January/February 1991, no. 347 March/April 1991. pp. 4-17.

- "District Profile -Jhansi, 1994." Notes received from Development Alternatives based on information from The Census of India, 1991.

- Duly, Colin; The Houses of Mankind. Thames and Hudson, London, 1979.

- El-Bahi, Mohammed; "Traditional Dwellings and Spontaneous Settlements in Northwest Tunisia". Traditional Rural Settlements, Traditional Dwellings and Settlements - working paper series, vol.12. Nezar Alsayyad and Jean-Paul Bourdier (eds.). IASTE, CEDR, University of California at Berkley. 1989.

- Eyheralde, Rene F.; Village Redevelopment Project - a report (Khanjarpur Village). University of Roorkee and Ford Foundation, 1959.

- Fathy, Hassan; Architecture for the Poor. Chicago University Press, 1973.

- Fielding, Nigel G. and Fielding, Jane L.; Linking Data. Sage publications, Inc., USA, 1986.

- Gangrade, K.D.; "Rural Sociology in Relation to Housing." Sociological and Economic Aspects of Housing: Selected papers from the training course organised by National Building Organization, Govt. of India and UN regional centre ESCAFE, 1969.

- Ghai, Dharam and Vivian,Jessica M.(eds.); Grassroots Environmental Action: People's Participation in Environmental Action. Routledge, 1992.

- Ghosh, Subrata; "The Bengal Home". Architecture + Design, May - June 1988. Media-Transasia, New Delhi. pp. 81-85.

- Gilman, Diane and Robert (eds.); Eco-Villages and Sustainable Communities. A report prepared for the Gaia Trust by Context Institute. Context Institute, WA, USA, 1991.

- Gopal, K.S.; "Housing for the Rural Poor". The House that Grows. Proceedings of the International Conference on Rural Low-Cost Housing, Lilongwe, Malawi, 1st - 16th August, 1988.

- Government of Uttar Pradesh; "PWD Schedule of Rates - Building Construction, Jhansi, 1991." 35th Circle, Jhansi. Lok Nirman Vibhag, Uttar Pradesh.

- ———; "Instruction Booklet for the construction of Residential Buildings under the RLEGP scheme." (Hindi), Rural Development Wing, Uttar Pradesh, 1985.

- Guillaud, Hubert et al; "Is Mayotte a Model for Development?" GATE 1/92. pp. 11-16.

- Hall, Nick; "Has Thatch a Future?" Appropriate Technology, vol. 8, no.3, December 1981. pp. 7-9.

- Hamdi, Nabeel; Housing Without Houses. MIT press, 1992

- Harris, Cyril, M. (ed.); Dictionary of Architecture and Construction. McGraw Hill Inc. NY, 1975.

- IERD; The Overview. Voices of Rural practioners Series, IERD, 1984.

- INAE; Low Cost Housng and Infrastructure. Conference proceedings, International Seminar on Low-Cost Housing and Infrastructure held in New Delhi, March 28 - 30, 1994. INAE, BMTPC, New Delhi, 1994.

- India Development Service (IDS); Rural Development in India: Theory and Practice. Proceedings of the conference held on October 19, 1985, at the International House of the University of Chicago, USA. IDS, 1985.

- Intisful, George W.K.; Rural Housing Improvement in Ghana. M. Arch Thesis, McGill University, 1984.

- Iyengar, B.R. Narayana; "Rural Research-cum-Training Centres in India - Their functions, working and Progress." Sociological and Economic Aspects of Housing. Selected papers from the training course organised by National Building Organization, Govt. of India and Un regional centre ESCAFE, 1969.

- Jain, Kulbhushan; "Form - a Consequence of Context." Indigenous Settlements in Southwest Asia. Process: Architecture, vol. 15. Tokyo, May,1980. pp. 17-34.

- Jayaram, Narayana and Sandhu, Ravinder Singh; Housing in India. New Delhi, 1988.

- Jedlicka, Allen; "Delivery Systems for Rural Development: or, After You've Searched Your Soul for an Appropriate Technology, How Do You Get People to Use It?" Paper for symposium on Appropriate Technology: Panacea for Developing Countries?. AAAS National Meeting, DC, February, 1978.

- Jodha, N.S.; "Common Property Resources: A Missing Dimension of Development Strategies." World Bank Discussion Paper, no. 169. The World Bank. Washington, 1992.

- John, J.P. and Sridharan, N. (eds); Shelter for the Rural Poor. Ashish, New Delhi, 1992.

- Kemeny, Jim; "Community-Based Home and Neighbourhood Building: an Interview with John Turner." Scandinavian Housing & Planning Research, no. 6 1989. pp. 157 - 164.

- Khosla, Ashok; "Alternatives strategies for developing and delivering low cost shelter technologies." Development Alternatives, New Delhi, 1988.

- ———; "The Architect and Sustainable Development." Development Alternatives, New Delhi, (undated).

- Klee, Gary A. (ed.): World Systems of Traditional Resource Management. V.H. Winston and Sons, 1980.

- Kumar, Arun; "Small Enterprises for MCR Production - A Case Study." Basin-News, Issue no.8, July 1994. SKAT. pp. 28 - 30.

- Kumar, Jyoti; Integrated Rural Development: Perspectives and Prospects (1952-82). Mittal, New Delhi, 1987.

- Lovelace, George et al. (eds.); Rapid Rural Appraisal in Northeast Thailand: case studies. KKU - Ford Rural Systems Research Project, Khon Kaen University, Thailand, 1988.

- Madhava Rao, A.G. and Murthy, D.S.R.; "Applications of Ferrocement for Low-Cost Housing in India." Appropriate Building Materials for Low-Cost Housing (African Region). Proceedings of International Symposium, Nairobi. UNESCO, London, 1983.

- Mathur, G.C.; Low-Cost housing in Developing Countries. Centre for Science & Technology of the Non-Aligned and other Developing Countries. Oxford & IBH, 1993.

- Mishra, R.P. and Sundaram, K.V.; Rural Development Alternatives. Synthesis of a Research Project on Regional Development Alternatives in Predominantly Rural Societies. United Nations Centre for Regional Development, Japan. Concept, New Delhi, 1987.

- Mitchell, Maurice and Bevan, Andy; Culture, Cash and Housing. VSO/IT Publications, VSO, 1992.

- Mumtaz, Babar and Hopper, Emma; "Rural Development Policies: Settlements and Shelter." The Changing Rural Habitat, vol.II : Background Papers. The Aga Khan Award for Architecture. Concept Media Ltd. Singapore. 1982. pp. 11 - 26

- Mumtaz, Kamil Khan; "Mistree Haji Ghulam Hussain : A conversation with a traditional building craftsman." Mimar, no10, October - December, 1983, pp. 8 - 13.

- Murison, Hamish S. and Lea, John P.(eds); Housing in Third World Countries : Perspectives on Policy and Practice. Proceedings of the International Workshop on Housing in Third World Countries held in Sydney, Canberra and Brisbane in 1978. St. Martin's Press, New York, 1979

- Myres, Norman (ed.): Gaia: An Atlas of Planet Management. Gaia Books Limited, 1984.

- Naik, Hemant; "Tribal Communities in India." Indigenous Settlements in Southwest Asia. Process: Architecture, vol.15. Tokyo, May, 1980. pp. 35-48.

- Niazi, Zeenat; "Soil-Based Plasters: low-cost option for protection of earth walls." Development Alternatives Newsletter, vol. 2, no. 12, Nov-Dec 1992. pp. 4-5.

- NIC; Village Level Primary Census Data." Collected and compiled by the district office of NIC, Jhansi District. Government of India, 1994.

- Nigam, M.L.; Cultural History of Bundelkhand (3rd B.C. to A.D. 650). Sundeep Prakashan, Delhi, 1983.

- Nwanodi, Oroma B.A.; "Hausa Compounds: Products of Cultural, Economic, Social and Political Systems." Habitat Intl. vol.13, no. 4, 1989. pp. 83-97.

- Oakley, David and Unni, K.Ramman (eds); The Rural Habitat, Dimensions of Change in Homes and House Groupings. School of Planning and Architecture, New Delhi, 1965.

- Oliver, Paul; Dwellings: The House across the World. Phaidon Press Ltd., Oxford, 1987.

- Parvathamma, C. and Satyanarayana; Housing, Rural Poor and their Living Conditions. Gram, Delhi, 1987.

- Patara, Shrastant; "Rural Shelter: An Approach to Technological Change". Development Alternatives Newsletter, vol. 3, no. 4, April 1993. Development Alternatives, New Delhi. pp. 4-5.

- Pathak, Bindeshwar; Sulabh Shauchalaya (Hand Flush water Seal laterine): A Simple Idea that Worked. Amola Prakashan, Patna, 1981.

- Pathak, Ram Chandra; Bhargava's Standard Dictionary of the Hindi Language. Hindi - English edition. Bhargava Book depot, Benares, 1969.

- Peyzieu, Jean; "Village Architecture: appropriate technology at the service of tradition." Techniques in Architecture: Architecture in India., Aug.-Sept. 1985. pp. 152-155.

- Poulose, K. Thomas; Innovative Approaches to Housing the Poor - Role of Voluntary Agencies (A success story - India). C. Mathews, Trivandrum, 1988.

- Rapoport, Amos; House, Form and Culture. Foundation of Cultural Geography Series, Prentice Hall, NJ, 1969.

- Ray, C.N.; "Planning Issues in Rural Housing." Journal of Rural Development, vol.10(6), 1991. NIRD, Hyderabad, India. pp. 831-837.

- Revi, Aromar; Shelter in India. Sustainable Development Series, Society for Development Alternatives. Vikas, New Delhi, 1990.

- Revi, Aromar et al; "Technology Action Plan for Rural Housing (1991-2000)." Report prepared for BMTPC. TARU, New Delhi, 1992.

- Roy, Onju; "The Merging of Traditional and Modern Cultures in Nepal." Architecture + Design, May-June 1990. Media-Transasia, New Delhi. pp. 73-80.

- Rybczynski, Witold; "Technological Alternatives Please; Alternative Technology, No Thank You." Open House International, vol.10, no.1, 1985. pp. 43-45.

- Salas, Julian; "An Analysis of Latin American Auto-Construction: A Plural and Mass Phenomenon." Open House International, vol.13, no.4, 1988. pp. 2-11.

- Schilderman, Theo; "Housing Standards: can they be made appropriate?" Appropriate Technology, vol.19, no.1, June 1992. pp. ??

- School of Architecture, McGill University; "Tora Village, Uttar Pradesh: a case study of a traditional Indian village." Patterns of Living - Architural Research in India, vol. 2. McGill University, CIDA Youth programme, July 1994.

- Schreckenbach, Hannah; "The Global strategy for Shelter: What it means for a Technical Agency." GATE, 1/92. pp. 3-6.

- Shah, Kirit K.; Ancient Bundelkhand: Religious History in Socio-Economic Perspective. Gian Publishing House. New Delhi, 1988.

- Shah, Mayank; "Nomadic Movements and Settlements of the Rabaris of Kutch." Indigenous Settlements in Southwest Asia. Process: Architecture, vol.15, May,1980. Tokyo. pp. 49-67.

- Sharma, M.L., Vermani, Savitha and Kaur, Parveen; "Some Aspects of Rural Housing." Housing in India: Problems, Policy and Perspectives; N.Jayaram and R.S. Sandhu (eds). B.R. Pub. Corp., New Delhi, 1988.

- "Shelter for the Poor, Report and Case studies". Proceedings of the NGO Workshop held in February 1993. Development Promotion Group, Madras, 1993.

- Singh, R.L. and Singh, Rana P.B. (eds); Transformation of Rural Habitat in Indian Perspective, A Geographic Dimension. International Centre for Rural habitat Studies, Res. Pub. no.1 and The National Geographical Society of India, Res. Pub. no. 19, 1978.

- Singh, Surender; Some Aspects of Housing Problem in Rural Delhi. Radha Publications, New Delhi, 1989.

- Skinner, R.J. and Rodell, M.J.(eds); People, Poverty and Shelter:Problems of self-help housing in the third world. Metheun, London and New York,1983.

- Soysa, Chandra; "Rural Housing." Housing Asia's Millions: Problems, policies and prospects for low-cost housing in South Asia; Stephan H.K.Yeh, and A.A.Laquian.(eds.). IDRC, 19..

- Spence, Robin; "Building Materials for Housing - A rejoinder." Habitat Intl. vol. 18, no. 1, 1994. pp. 85, 86.

- Spence, Robin et al; Jobs from Housing: employment, building materials and enabling strategies for urban development. Overseas Development Administration, U.K.,1993.

- Srinivas, M.N. (ed.); India's Villages. Asia Publishing House, London, 1960.

- Sriraman, V. and Kumar, Arun; "Shelter innovations: Building Technologies, Materials & Industrial Waste." Development Alternatives Newsletter (Shelter Special), vol.4, no.1, Jan. 1994. pp. 7.

- Stulz, Roland and Mukerji, Kiran; Appropriate Building Materials: A Catalogue of Potential Solutions. Revised, enlarged edition. SKAT, IT, GATE, 1988.

- Syagga, Paul M.; "Promoting the Use of Appropriate Building Materials in Shelter Provision in Kenya." Habitat Intl., vol.17, no.3, 1993. pp. 125-136.

- The Aga Khan Award for Architecture; The Changing Rural Habitat, vol.I, Case Studies. Concept, Singapore, 1988.

- Todaro, Michae P. and Stilkind, Jerry; City Bias and Rural Neglect; The Dilemma of Urban Development. New York Population Council, 1981.

- Turner, John F.C.; "Approaches to government-sponsored housing." Ekistics, no. 242, January 1976. pp. 4-7.

- Turner, John F.C. and Fitcher, Robert (eds.); Freedom to Build. Macmillan, 1972.

- UNCHS; "Building Materials for Housing: Report of the Executive Director, United Nations Commission on Human Settlements." Habitat Intl., vol. 17, no. 2, 1993. pp. 1-20.

- United Nations; "The Improvement of rural housing in Asia and the Pacific." Human Settlements, vol, IV, no.4, December 1974. pp. 8-23.

- Uttar Pradesh Tourism; "Bundelkhand - Jhansi. Tourist Brochure." UP Tourism, 1994.

- Vaidyanathan, Geeta and Niazi, Zeenat; "Traditional Building Materials and Construction in Rural Western Uttar Pradesh." Paper presented at the State Level Workshop for Western Uttar Pradesh on Cost Reduction Techniques and Low Cost Materials for Rural Housing. Development Alternatives, New Delhi, 1993.

- Veena, D.R.; Low-Income Rural Housing: a model for government policy and action. Ashish, New Delhi, 1989.

- Wells, Jill; "Building materials for Housing - Comment on the Report of the Executive Director of UNCHS." Habitat Intl., vol.17, no.4, 1993. pp. 89-92.

- Yagi, Koji; "Human Environment." Indigenous Settlements in Southwest Asia. Process: Architecture, vol.15, May, 1980, Tokyo. pp. 13-16.

- Yuan, Lim Jee; "Traditional housing: A Solution to Homelessness in the Third World - The Malasian Example." The Ecologist, vol.18, no.1, 1988. pp. 16-23.