

CHAPTER 10

BUILDING MATERIALS FOR THE CONSTRUCTION OF RURAL HOUSES

Rural houses in India are mostly made of non-durable materials taken from the locality. Since India is diverse in her natural resources and geographical conditions, a large number of building materials are obtained from her vegetational and geological sources. These are clay, mud, stones, grasses leaves, bamboo and wood. These materials are used both for the walls and the roofs of the houses. Broadly speaking, all the materials can be divided into two main categories namely the wall-materials and the roof-materials.

Predominant Wall Materials

The great alluvial plains provide various kinds of mud, clay and grasses for poor man's houses. Rich people make houses of bricks. The hilly tracts supply stones and wood of various kinds where both stone and wood are equally important. Both in the west and south various types of marble blocks from Vindhyan or Chitor and blood-stone from Deccan are abundantly available. Jasper from Gwalior is equally important. Limestone from various areas provide cement for construction of rich peoples' houses. In north-eastern region, wood and bamboo are common building materials. In the tropical and sub-tropical regions of grasslands, various types of grasses and reeds are used. In the

Table 14: Distribution of Building Materials used for Walls in the Rural Houses of India, 1971

(in percentage)

State	Mud	Unburnt Bricks	Burnt Bricks	Stone	Total
Andhra Pradesh	53.88	1.31	13.07	19.98	88.24
Assam	0.61	0.01	6.72	0.00	7.34
Bihar	58.35	0.92	16.72	0.26	76.53
Gujarat	39.77	2.71	25.54	19.50	87.52
Haryana	10.60	31.56	51.42	5.89	99.47
Himachal Pradesh	18.42	23.31	3.48	52.93	98.14
Jammu and Kashmir	18.50	19.70	11.31	33.74	73.25
Kerala	19.79	20.32	6.01	36.00	82.12
Madhya Pradesh	65.52	4.16	9.55	9.48	88.71
Maharashtra	29.80	5.56	13.00	33.68	82.94
Manipur	30.75	0.03	0.82	0.16	31.76
Meghalaya	8.17	0.08	0.22	1.33	9.80
Karnataka	37.76	7.54	7.41	39.23	91.94
Nagaland	2.11	0.00	0.18	0.08	-
Orissa	74.22	2.28	9.07	1.71	87.28
Punjab	11.53	36.73	50.77	0.44	99.47
Rajasthan	34.65	19.51	8.62	34.09	96.87
Tamil Nadu	67.66	2.68	19.17	8.89	98.40
Uttar Pradesh	57.07	15.16	19.03	5.48	96.74
West Bengal	69.22	0.34	12.38	0.18	82.12
Andaman and Nicobar Islands	0.08	0.02	0.22	0.51	0.83
Arunachal Pradesh	1.21	0.88	0.05	4.71	6.85
Chandigarh	23.65	3.91	71.83	0.04	99.86
Delhi	2.88	6.74	85.52	3.95	98.59
Goa, Daman, Diu	55.49	0.51	2.59	25.01	83.60
Laccadive, Minicoy and Amindioi	0.00	0.00	0.01	4.63	0.64
Pondicherry	67.73	0.15	26.83	5.35	84.54
India	48.69	8.35	14.16	14.16	86.75

Source : Computed from Census of India, Housing Tables, 1971

Table 15 Percentage Distribution of Rural Households by Roof and Walls in India, 1973
(Percentage to total)

Wall Materials	Roof Materials					
	Straw, grass, bamboo reed and mud	C.I. Sheet asbestos tiles	Cement Concrete	Stone including stone blocks	Not Recorded	Others
Mud, Bamboo reed	48.40	23.85	0.16	0.53	0.02	0.76
Timber, Wood, Col sheet	0.52	0.90	0.05	0.07	0.00	0.07
Brick, Cement Concrete, Stone	5.55	9.23	5.20	2.03	0.01	1.56
Others	0.53	0.27	0.01	0.08	0.00	0.09
N.R	0.02	0.01	0.00	-	0.10	0.00
Total	55.02	34.26	5.42	2.71	0.13	2.46

Source : Sarvekshana, Journal of National Sample Survey, Department of Statistics, Ministry of Planning, Government of India, October (1977). Vol. 2.

Tarai and Bhabar areas, houses are made of reed matting which are plastered with mud. Table 14 shows the statewise distribution of these materials used for wall of rural houses in India.

Predominant Roofing Materials

There is a considerable variety of roofing materials. Tiles, slate, shingles are important roofing materials in Bihar, Gujarat, Madhya Pradesh, Maharashtra, Rajasthan and parts of Haryana. In Andhra Pradesh, Tamil Nadu, Kerala, Orissa and West Bengal thatch, wood or bamboo are most important roofing materials. Jammu and Kashmir have roofs of wood, slate and thatch. In parts of northern plains, the use of semi-circular tiles for roofing is common. Rajasthan being dry has flat roofs made of beaten earth. Pottery clay is used for manufacture of tiles and drain pipes in Raniganj and Jabalpur.

All the building materials used can be put under two main categories. These are building materials derived from (i) geological and (ii) vegetational origin. However, in recent years, new building materials of industrial origin are being introduced. These are galvanized iron sheets, metal sheets, cement concrete, asbestos sheets and factory made tiles. For durability and neat look these materials are preferred by the rich people only and are indicative of the prosperity of the owners.

Distribution Pattern of Rural Houses with
Building Materials from Geological Sources
for Wall

In rural India, the use of building materials of geological origin such as mud, stone, unburnt bricks is very high. When put together, they form 86.75 per cent of all the rural houses. Nearly 78 districts of India have more than 99 per cent rural houses falling in this category. which shows the popularity of these materials. In Purulia district, of West Bengal, 99.85 per cent of houses have mud and bricks for walls out of which 88.70 per cent have mud walls. Midnapur, Bankura and Birbhum have 89 per cent, 89.42 per cent and 92 per cent respectively of rural houses of mud walls. Nearly 79 per cent of the houses in Lahul and Spiti are made of stone and 21 per cent are of mud. PUNCH district in Jammu and Kashmir has 96 per cent houses of stone and 4 per cent of mud. Other districts having more than 90 per cent of walls of houses made of these materials are Cuddapah (99.37 per cent), Patna (99 per cent), Gaya (99.67 per cent), Dhanbad (99.28 per cent), Jamnagar (99.21 per cent), Rajkot (99.80 per cent), Surendranagar (99.65 per cent), Gurgaon (99.44 per cent), Bhavnagar (99.22 per cent), Amreli (99.10 per cent), Karnal (99.55 per cent), Rohtak (99.65 per cent), Hissar (99.67 per cent), Jind (99.75 per cent), Bilaspur (99.09 per cent), Udhampur (99.03 per cent), Rajouri (99.15 per cent), Malappuram (92.90 per cent), Datia (99.24 per cent), Tikamgarh (99.33 per cent), Indore (92.84

per cent), Vidisha (95.39 per cent), Jabalpur (97.16 per cent), Rajgarh (98.20 per cent), Raigarh (96.13 per cent), Jalgaon (92.01 per cent), Bihar (94.43 per cent), Bangalore (99.04 per cent), Balasore (96.45 per cent), Puri (91.21 per cent), Gurdaspur (99.29 per cent), Amritsar (99.77 per cent), Ludhiana (99.79 per cent), Hoshiarpur (98.97 per cent), Ropar (98.37 per cent), Jhunjhunu (99.34 per cent), Alwar (99.70 per cent), Bharatpur (99.61 per cent), Sawai Madhopur (99.60 per cent), Tonk (99.20 per cent), Ajmer (99.43 per cent), Pali (99.22 per cent), Jalor (96.57 per cent), Bhilwara (94.74 per cent), and Jhalawar (98.05 per cent). In Tamil Nadu (98.40 per cent), Chingleput (99.15 per cent), North Arcot (99.70 per cent), South Arcot (99.64 per cent), Dharmपुर (99.19 per cent), Madurai (99.05 per cent), Trichirapalli (99.14 per cent), Thanjavur (96.41 per cent) and Ramanathapuram (97.20 per cent) are the most important districts. Uttar Pradesh has almost all the districts falling in this category. Hamirpur has 99.83 per cent houses falling in this category. In Nainital (75.47 per cent), Kheri (83.60 per cent), Deoria (64.26 per cent), Bahraich (85.28 per cent) and Gonda (89.50 per cent) most of the houses have walls of these materials. Other districts of West Bengal namely Hooghly (95.41 per cent), Burdwan (96.94 per cent), Birbhum (99.66 per cent), Bankura (99.27 per cent), Midnapur (94.15 per cent) have mud houses with thatched roofs.

Mud is most important building material in agriculturally rich areas of northern plains and the delta parts of

the country. Stones are important in hilly mountainous and plateau regions of the country. Stone houses are common in areas where stones are easily available. Being a bulky material its transportation to other areas is difficult and costly.

There are unexhaustible reserves of limestones in Vindhyan rocks. Nearly 4000 thick rocks of building stone is found in an area extending from Dehri-on-Sone to Hoshangabad and from Chitorgarh to Agra and Gwalior. A variety of building stones are available Rewa of Madhya Pradesh, Sambalpur district of Madhya Pradesh, Palnad tract of Andhra Pradesh. The Bijapur district in the Bhima Valley, Bastar and Raipur area between the Godavari and Mahanadi provide excellent stones. The Porbandar slate quarries are important supplies of building materials.

Historically speaking, man in India had been constructing houses of stone for thousands of years. Common man's houses were always simple. In primitive societies, limited technology was applied in house building. In technologically advanced areas social values are given precedence over technological advances. It is only in the construction of temples and monuments high level of skill was employed.

These can be classified as kutchha, pucca and semi-pucca based on the type of materials used. Houses made of non-durable materials are classified as kutchha and those of durable are pucca houses. Some houses are made of mixed materials. Such type of houses are known as semi-pucca.

Table 14 gives statewise distribution of kutchha, pucca and semi-pucca houses and Table 15 gives cross-classification of rural houses by roof and wall types.

Spatial Distribution of Stone Houses

Stones are used both for construction of walls and roofs of the houses. Nearly 14 per cent of rural houses in India have walls made of stone. For roofing only 2.65 per cent of rural houses in India use stones. These figures indicate that stone is more popular as wall material. It ranks next to grasses, leaves, reeds, mud, bamboo, burnt brick and unburnt bricks. Stone as a roofing material ranks fifth whereas as wall material it is third. Most of the stone walled houses do not have roofs made of stone. Many of the stone walled houses have roofs of tiles, iron, zinc, metal sheets, bricks and lime or concrete, cement sheets and asbestos sheets.

Out of about 98 million rural houses in India, about 14 million houses have walls of stone. The highest percentage of stone roofed houses lies in Swai Madhopur where the percentage of such houses is 55 per cent. The highest percentage of stone walled houses can be seen in Punch district of Jammu and Kashmir. Only 2 million houses in India have roofs of this material.

Amongst the States, Himachal Pradesh ranks first having 52.93 per cent houses with walls of stone and only

2.65 per cent roofs of this material. Kulu has maximum (97.5 per cent) of stone walled houses. Kulu houses have walls of alternate layers of wood and stone, while the roofs are of slate, or tiles or shingles. Next is the state of Karnataka where 39 per cent of the houses have walls made of stone. Here only 5.5 per cent roofs of houses are made of stone. In Bijapur, 92 per cent houses have stone walled houses and only 0.98 per cent houses have roofs of this material. Thatched roofs constitute 96 per cent of the rural houses in this district. Gulbarga has 27 per cent rural houses with stone as roofing material and walls having this material account for 91 per cent of the houses. In Bidar, walls of 86 per cent houses are of stone while roofs account for only 7 per cent of the houses. In Kolar, about 30 per cent walls and 31 per cent roofs of the houses are of stone.

Kerala is third in terms of percentage of stone walled houses. In this State, nearly 36 per cent of houses have walls of stone but only 0.01 per cent houses have roofs of this material. Nearly 38 per cent of the houses have roofs of tiles and shingles. Ernakulam district has the highest percentage of stone walled houses which is 62 per cent of the total rural houses. Kozhikode (46 per cent), Kottayam (44 per cent), Trichur (43 per cent) and Quilon (37 per cent) come next. But most of the houses in this State have roofs made of thatch, wood, shingle, tiles, asbestos sheets etc. The houses having roofs of stone account for only less than 1 per cent of rural houses even in the

areas where stone walled houses predominate.

Rajasthan and Jammu and Kashmir have almost same percentages of rural houses having walls of stone. Rajasthan has 34 per cent and Jammu and Kashmir has 33.74 per cent rural houses with walls of stone. The highest percentage of houses with stone walls are found in PUNCH district where 96 per cent of the houses are of stone walls only 0.02 per cent houses have roofs of this material. Nearly 99 per cent houses have grasses, leaves, wood thatch etc. as roofing materials. In Rajasthan, Ajmer has the highest percentage of houses having both roofs and walls of stone. Nearly 59 per cent houses of Ajmer have walls of stone and 43 per cent of roofs are of this material. Next to Ajmer comes Alwar where walls of stone account for 56 per cent and roofs for 35 per cent of rural houses. Swai-Madhopur has more roofs of stone which is 55 per cent, whereas the walls of stone constitute 43 per cent. Excepting Ganganagar, Bikaner, Churu, Tonk, Jaisalmer, Jalor, Pali, Sirohi and Banswara, all other districts of Rajasthan have more than 30 per cent of their houses using stones both for the walls and roofs.

Maharashtra is another important State of India where stone houses are significantly high. Nearly 33.63 per cent of the total houses of this State have walls of stone, and 0.26 per cent houses have roofs of this material. Sholapur district has the highest percentage (83.0 per cent) of houses with stone walls. The stone roofs account for only 0.86 per cent of total houses. The main materials used

for roofing are thatch, grass, leaves etc. which is nearly 70 per cent of total rural houses. Another 26 per cent of the houses have metal sheets, and corrugated iron and zinc sheets as roofing materials. Osmanabad has 82.5 per cent houses having stone as wall material and 57 per cent houses have metal sheets as roofing material. In Kolhapur 55 per cent houses have stone as wall material and nearly 88 per cent have tiles, shingle and slate as roofing materials.

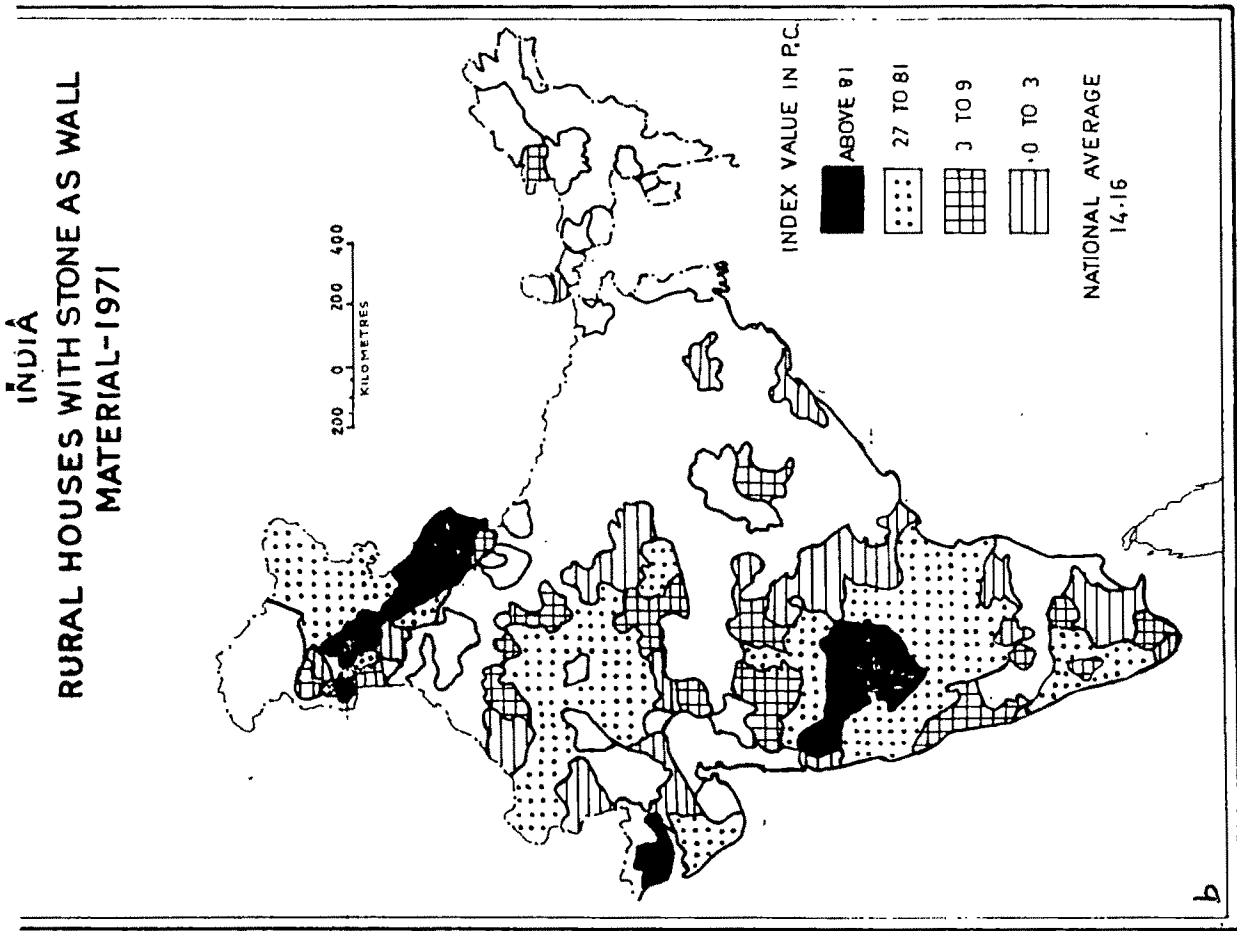
Andhra and Gujarat fall in the same category having 19.98 per cent and 19.50 per cent respectively of their houses with stone as wall material. The highest percentage in Andhra Pradesh occurs in Kurnool district with 80.98 per cent houses having walls of stone. Here only 3 per cent of the roofs are of stone. Kutch in Gujarat has 87 per cent houses with stone walls and only 0.69 per cent roofs of stone. In Gujarat, 71.61 per cent houses have tiles, shingle and slate as roofing material, and 17 per cent have metal sheets.

In Madhya Pradesh, the percentage of houses having walls of stone are 9.48 per cent and nearly 4.49 per cent of houses have roofs of this material. Damoh district has the maximum (50 per cent) percentage of rural houses having walls of stone and only 0.78 per cent of rural houses have roofs of stone. The Shivpuri district of Madhya Pradesh, 48 per cent of the houses have stone walls and nearly 45 per cent houses with roofs of stone. Morena district also has quite high percentages which are 43 per cent for walls and 52 per cent for roofs.

Haryana's average of stone walled houses are nearly 6 per cent of total rural houses and the roofs account for 2.79 per cent of total rural houses. Gurgaon stands out because of the high percentages i.e. 21.63 per cent for walls and nearly 11 per cent for roofs of the rural houses. The State has 76 per cent roofs of thatch and only 4 per cent are of tiles, shingles and slate. The use of cement, concrete and metal sheets is also made in the construction of roofs of stone walled houses.

The number of stone walled houses in Uttar Pradesh is not very high. It is only 5 per cent of the total rural houses, yet in the Himalayan part of UP such as Uttar Kashi, use of stone as wall material is very high. For walls it is 89 per cent and for roofs it is only 10 per cent. The average percentage of stone roofs in the State is only 2.39 per cent. Other places in the UP hills are Tehri Garhwal (99 per cent), Almorah 99 per cent, Chamoli (99 per cent), Pithoragarh (94 per cent). For roofing Almorah has 38 per cent, Garhwal has 28 per cent of their rural houses. Tamil Nadu's average rural houses having stone as wall material is 9 per cent of its total rural houses. Coimbatore has the highest percentage of houses (36.52 per cent) having walls of this material. Only 0.16 per cent of rural houses in Tamil Nadu are having roofs of this material.

The use of stone as building material is more prevalent in the areas where it is available in abundance. The river valleys and the vast Indo-Gangetic plains have no stone



200 km to the north

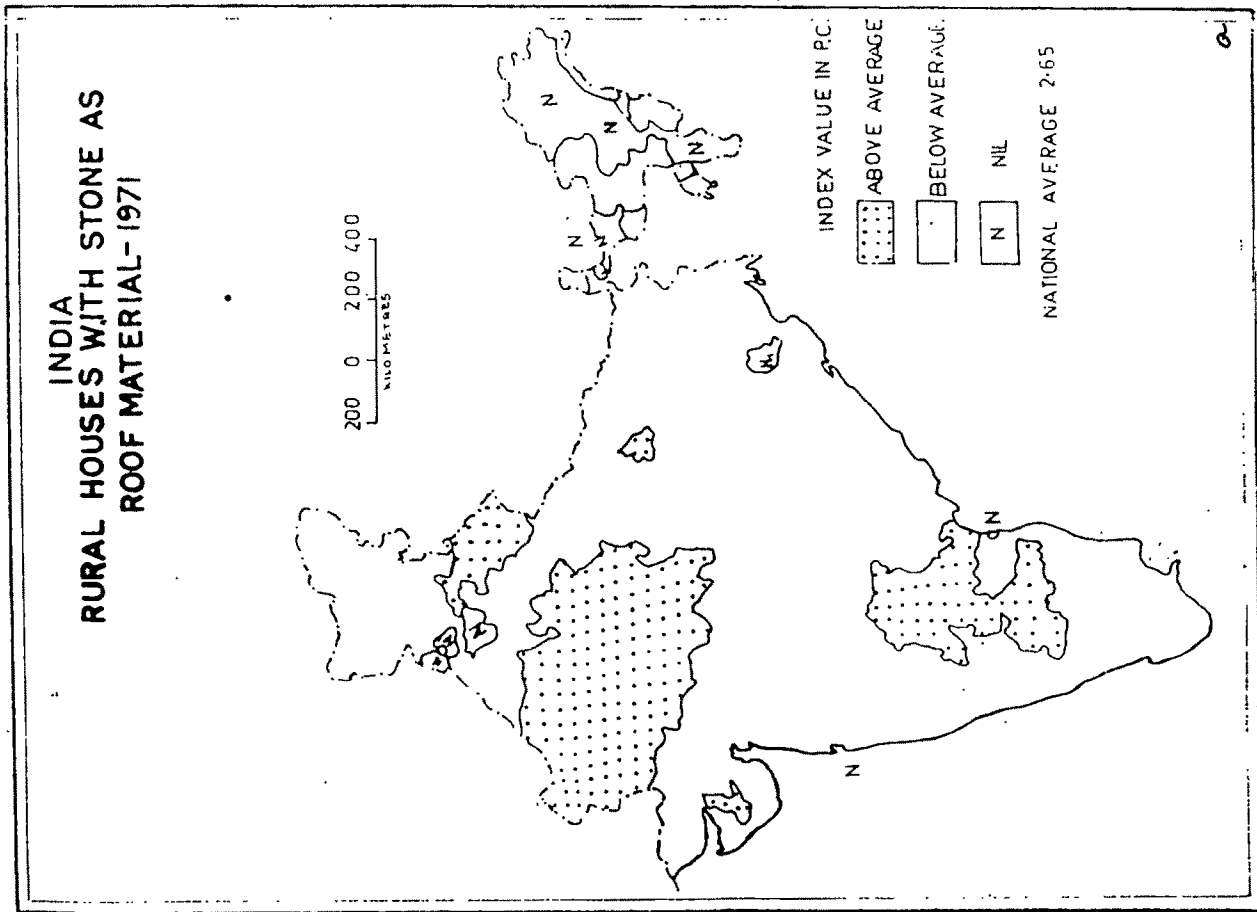


FIG. 44

houses since other building materials can be more easily acquired. Even in the areas of its availability, the uses vary from place to place. The spatial distribution of stone as roofing material is shown in Fig. 44. About 73 districts of India have above average percentage of rural houses of stone roofs. About 30 districts in the eastern plains, there are no stone houses. Eleven districts namely, Tehri Garhwal, Chamoli, Almorah, Kulu, Chamba, Garhwal, Rajouri, Kinnaur, Bijapur, Gulbarga and Diu have above 90 per cent rural houses of stone roofs. There are 109 districts where the stone roofed houses are more than 2.65 % of the total rural houses.

The spatial distribution of stone walled houses is shown in Fig. 44. The map shows four categories of places namely above 81 per cent, between 27 to 81 per cent, between 3 to 9 per cent and 0 to 3 per cent of houses of stone walls. Rest of the places have 9 to 27 per cent of rural houses of stone walls. There are two categories of places having roofs of stone. The third category has no house with stone walls.

Spatial Distribution of Mud Walled Houses

On an average, about 49 per cent of the houses in rural India are made of mud. The frequency graph shows the district-wise distribution of rural houses having mud walls. The percentage ranges between 0 (Pratapgarh), to 95 (Rewa). Nearly 200 districts have more than 30 per cent of rural

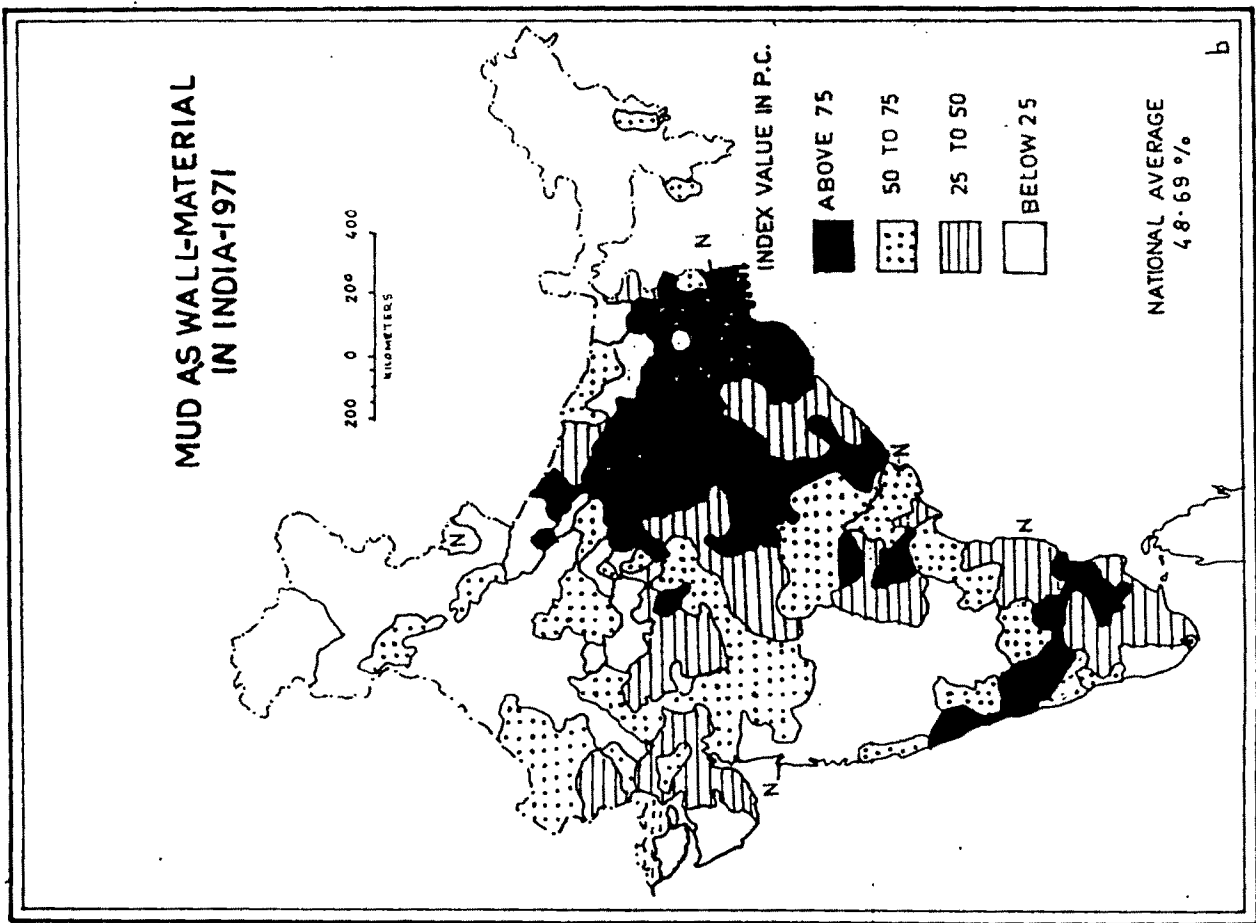
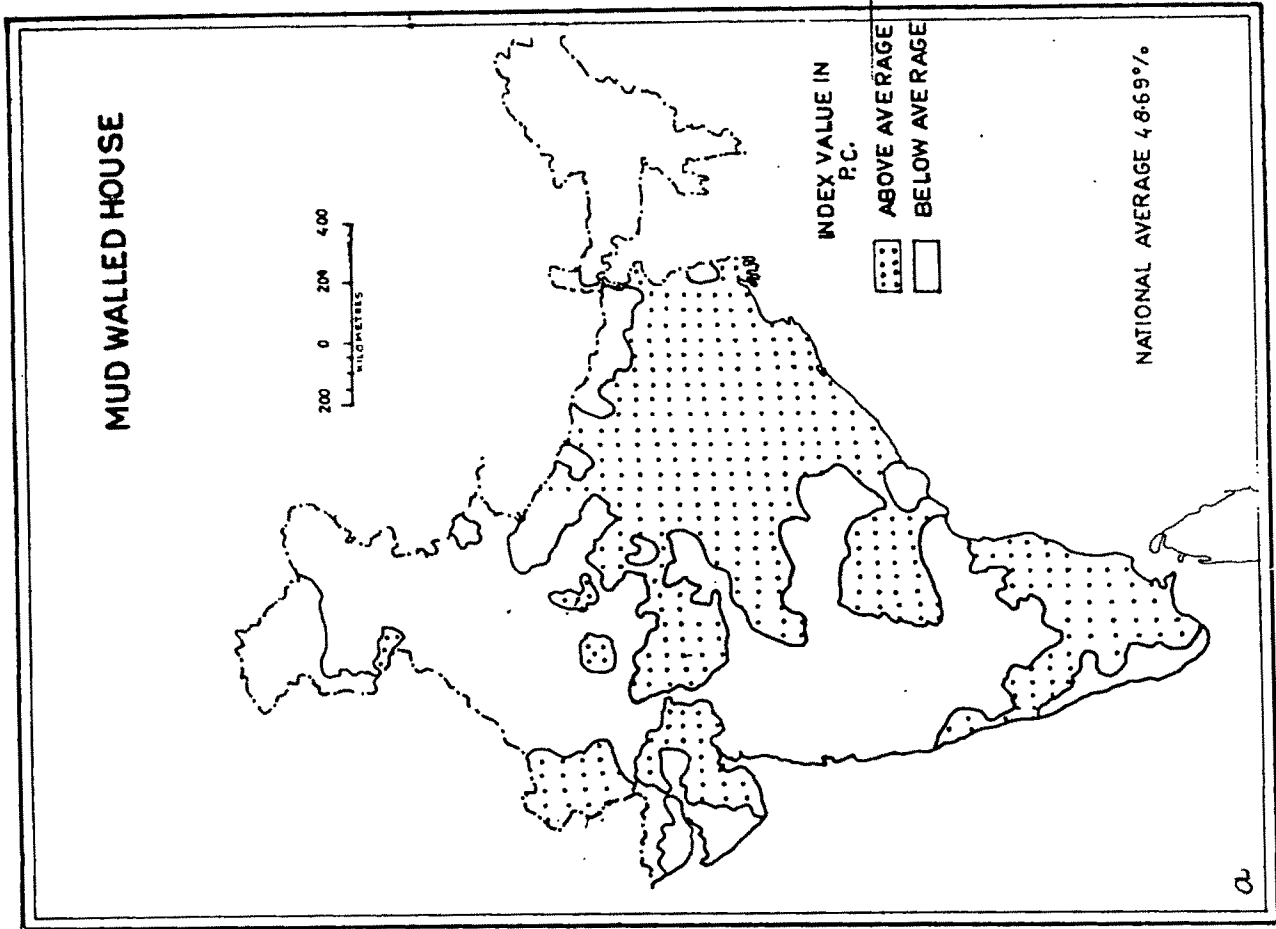


FIG. 46

houses having mud walls. About 100 districts have more than 65 per cent of rural houses with mud walls and about 50 districts have less than 10 per cent mud walled houses (see Graph 45). Since the eastern half of the country in the plains is agriculturally rich, most of the above average percentages of rural houses having mud walls are located in the delta or plain or even in the river valleys. In the hilly parts, mud houses fall in the below average percentages as is shown in Map 46. Walls of mud are not durable. For roofing plenty of mud is used in preparing thatch of grasses, leaves, reeds etc. The mud houses need frequent repairs.

House of Bricks as Building Material in India

Historical Use : It has been deciphered by experts that both the architecture and masonry of Harappa and Mohenjodaro foundations of most of the structures were of burnt and unburnt bricks. These were used in alternate orders (Havell, 1915). In the early Indus civilisation brick houses were common. The bricks were usually made of alluvial soils. Therefore, brick architecture flourished well in the great alluvial plains where clay was easily available and human elements were favourable.

While the brick architecture developed well in construction of edifices such as the Buddhist Chaityas, monasteries, Stupas, Bodhigarahas and later the Brahmanical temples,

the houses of the common man were humble and simple as they are found today in many parts of northern India (Broron, 1965). The brick constructions of Vishnu Temple at Besanagar in Bhopal is an illustration of high quality brick work of 2nd century BC, yet the contemporary literature reveals that common people lived in brick houses which were totally devoid of any ornamental designs on them.

From above it is obvious that technique of using bricks in India had developed in ancient period. To corroborate this point, one comes across frequent references to the use of bricks in the old texts like Sthapatya Brahmana and the Silpa Sutra. In Mahavamsa (LXXXVIII, 106, 107) copious mentions of Ithik Vaddhaki meaning brick architecture or the one who works in bricks are made. Panini refers to Istaka Chita or funeral pyre made of bricks. In support of this one can come across mention of brick constructions in the classical writings of Kautilya and Arian. Mahabharata makes mention of brick alters and Ramayana of sacrificial halls of bricks (Ray, 1964).

According to Imperial Gazetteer of India, the art of constructing substantial edifices of brick masonry was well developed in northern India four or five centuries before christ and was introduced from Babylonia at much earlier date. The skillful handling of bricks today is an indication of its age old use. Brown (1965) places its antiquity somewhere in the period before 300 BC. The oldest use of bricks is traced in the cities of Indus Valley civilization. Excavations

in the Indus Valley reveal a building culture which had many resemblances with Mesopotamians in western Asia in 3rd millennium BC. According to Hamlin (1953), both cultures revealed presence of closely built congested settlements and used bricks to the total exclusion of other materials.

The artistic remains of ancient India upto the beginning of 4th century are mainly Buddhist. During Asoka period as Buddhism spreaded, the use of bricks also expanded with the construction of Stupas and other Buddhist structures and monuments. Unfortunately, the period between the post-Indus Valley civilization and the pre-Mauryan age is the dark age. No significant remains of this period are available. In the beginning of Mauryan period, the mound like structures known as stupas had bricks measuring 40 cm x 25 cm x 8 cm laid in mud (Maisy, 1972 and Mukerjee, 1968). The contemporary literature reveals that most of the secular buildings were of sun-baked bricks. Only the rich and the kings had burnt bricks for construction of their houses. In the south, literary sources reveal that during Chola and early Pallava periods, village shrines were made of bricks. These temples were humble brick structures with no pretensions to be ranked as architecture and were small 'ekatala' (one tier) structures (Subramanyam, 1938). The common dwelling of this period as depicted in the Bharut Sculptures are like the present day sun-baked structures (Havell, 1915).

According to Brown (1965), external influences had been leaving great impact on the Indian style of brick

constructions. It came in the course of centuries with the advent of Mohamadans into the country. They came from a large area consisting of Persia, Arabia and many other neighbouring countries. Since time immemorial, potters were in vogue throughout India, it was not difficult for them to make bricks for their houses. It was first introduced in the Punjab and other areas in western India because of its close contacts with them. Slowly it spreaded into the interior.

The brick architecture seems to have moved towards the east before it spreaded over the south. No kiln of burnt bricks are found in the Gangetic plain prior to the fourth century BC, and became popular only after Asokan period. The unweildly size of bricks used in Mauryan period Magasthene's 'Indica' and kautilyas' Arthsastra also which give information about the use of bricks. The presence of 'Stupas' known as 'topes' all over the country also stand witness to the widespread use of bricks for construction of houses (Jauhari, 1969). During 14th to 17th centuries, the art of brick masnory flourished in India with the spread of Islam religion when throughout the country magnificent mosques and tombs were constructed by the muslim rulers.

Distribution of Unburnt Bricks

Unburnt bricks are used for the construction of walls. The roofs of such houses are either of some durable

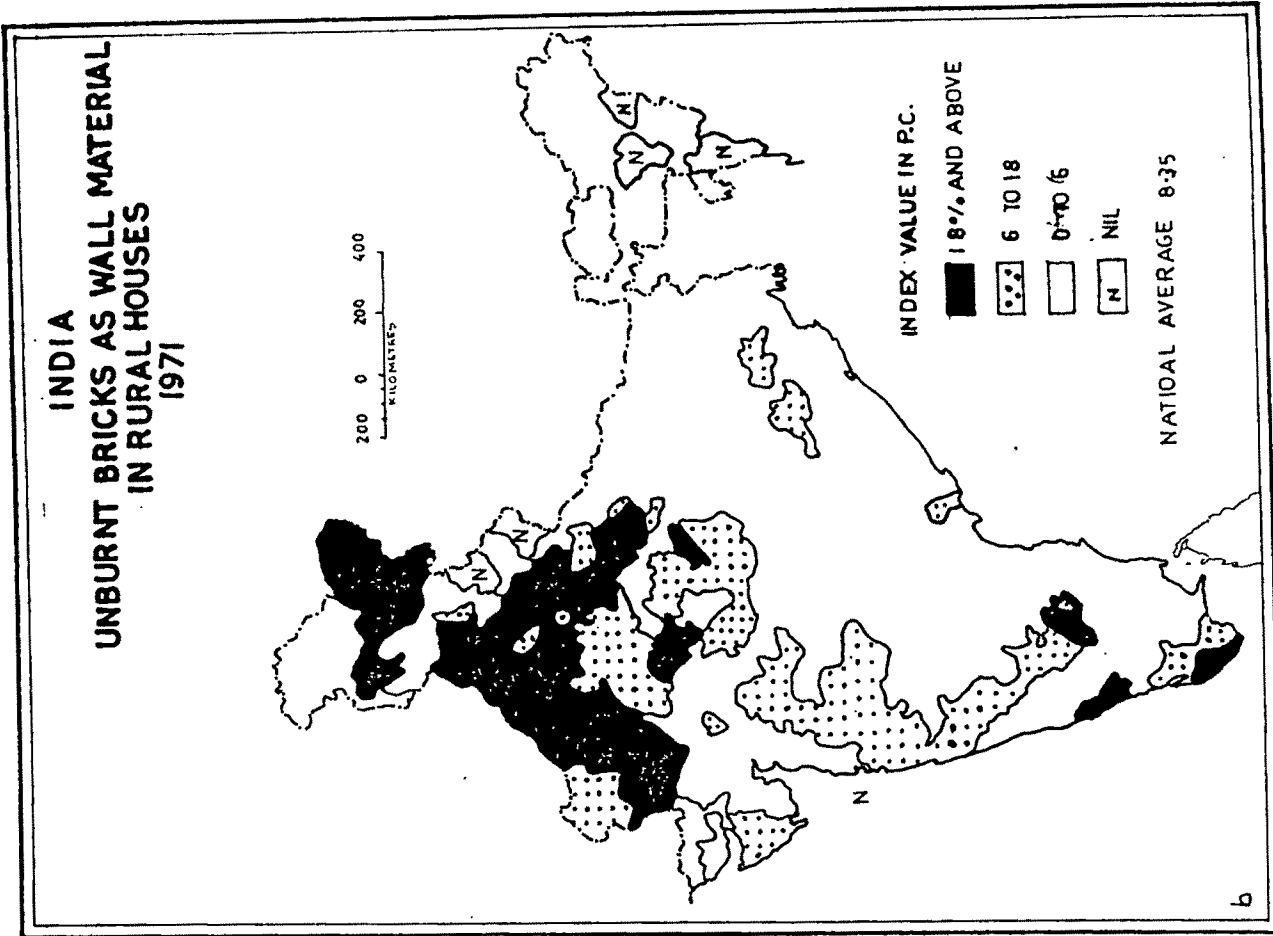
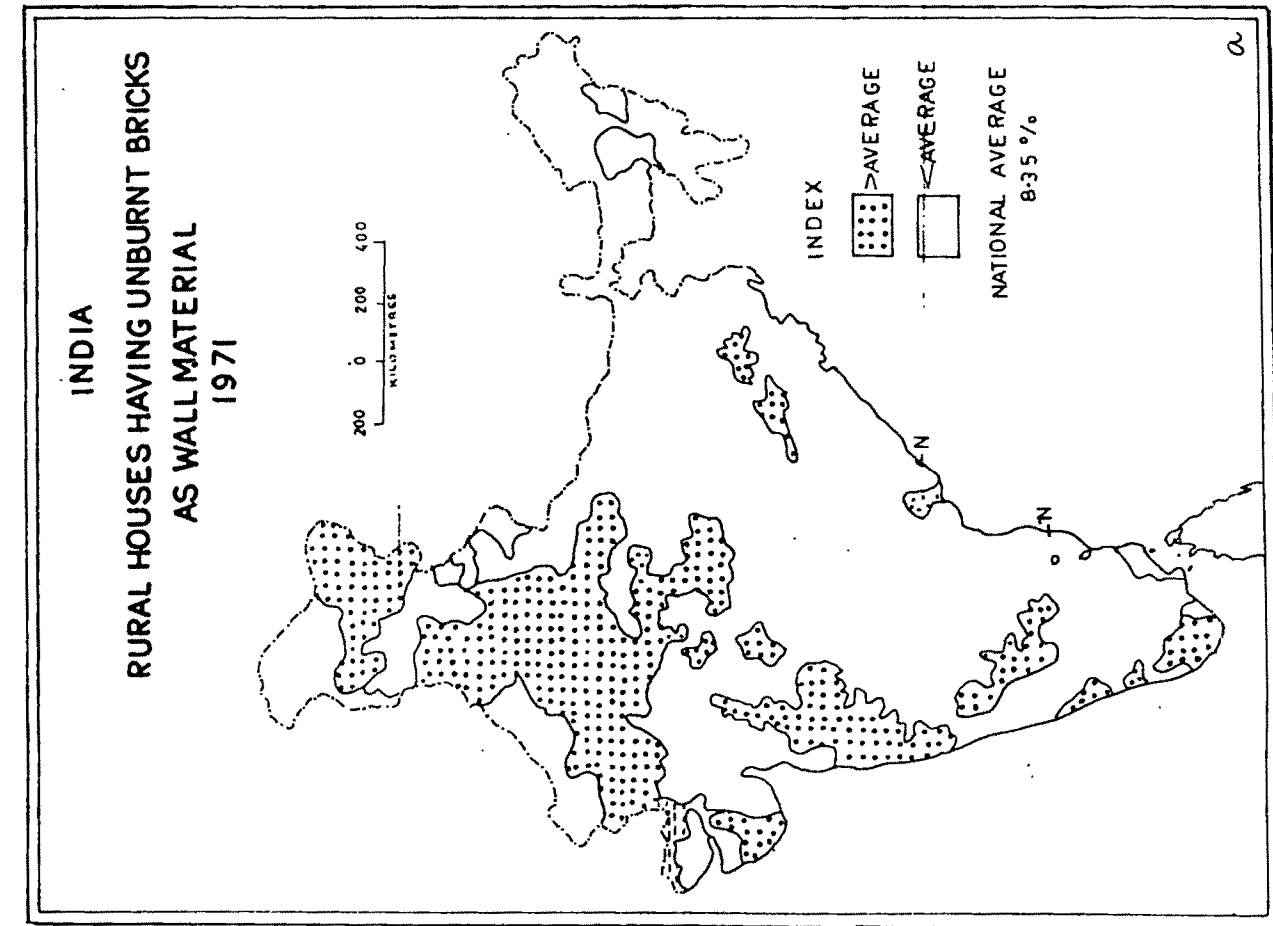


FIG. 47

materials or of thatch. Most of the roofs are made of country made tiles or corrugated iron or metal sheets. In India, unburnt bricks as roofing material has practically no significance. On an average, about 8.35 per cent of rural houses in India have their walls of this material. There are large variations, with its highest percentage in Ganganagar (79.71 per cent) in Rajasthan. On the other hand, district like Tehri Garhwal, Rajouri, Poonch, Mahesu, Goalpara, Kamrup have no houses with unburnt bricks as wall material.

The spatial distribution of unburnt bricks as wall material is closely related to the climate and soils of the country. Due to dry climate and clay mud soils, the western parts of India have more concentration of houses of this type. The dry climate keeps the wall of the houses strong. The mud and clay soils are required for making bricks. The distribution map of India of the use of bricks as wall materials reveals that the country can be divided into four zones (see Fig. 47). The first category has the places with 18. per cent or more of rural houses using unburnt bricks as wall materials. There are 31 districts in this category with most of them in the north-western part of the country. This region comprises of many districts of the Punjab, Haryana, Rajasthan and Gujarat. The highest percentage being in Ganganagar (77.71), being followed by Ferozpur (68.11 per cent), Etawah (64.41 per cent), Manipur (63.02 per cent), Aligarh (58.85 per cent), Jalar (53.18 per cent)

and Muzzafarnagar (51.71 per cent). In Anantnag and Srinagar record 44.04 per cent and 53.61 per cent of their rural houses falling in this category respectively. In the south, two districts of Kerala belong to this category. These are Trivandrum (61.25 per cent) and Cannanore (43.52 per cent). In Himachal Pradesh, Kangra and Bilaspur record 53.95 per cent and 53.64 per cent of their houses having unburnt bricks in the walls.

The second region possess 6 per cent to 18 per cent of houses made of unburnt bricks. The areas within this category are located mostly in the western semi-arid part of the country. The district of Jaisalmer where availability of mud is difficult is excluded. In the second category, there are about 70 districts of India. In Gujarat, Rajkot has 11.74 per cent and Junagarh has 10.60 per cent of their houses falling in this category. The eastward extension of this zone includes some districts in Madhya Pradesh such as Jabalpur (16.24 per cent), Damoh (17.10 per cent), Narsimhpur (14.37 per cent), Sagar (9.33 per cent), Jhabua (13.03 per cent), Khandwa (8.77 per cent), Shajapur (10.53 per cent), Raisen (9.61 per cent), Shivpuri (10.83 per cent) and Tikamgarh (8.21 per cent). The coastal districts of Maharashtra and Karnataka form another zone of this category. There are some isolated pockets of this category in the districts of Singhbhum (8.48 per cent), Sambalpur (17.06 per cent) and West Godavari (11.68 per cent).

The areas falling in the third category are having

less than 6 per cent of their houses with unburnt bricks. There are 231 districts of India which fall mostly in the western half of the country. Their major concentrations are in the western part of Uttar Pradesh, Gujarat, Maharashtra and Kerala. A few scattered areas of this category are found in districts of East Godavari (5.51 per cent), Bolangir (5.90 per cent), and Gorakhpur (5.17 per cent). Most of the areas in western India belonging to this category are close to the areas of first and second categories. The fourth zone records absolutely no houses using bricks as wall materials. In some areas of the eastern region, there is no house having unburnt bricks as wall material. These are Nowgong, Mikir Hills, Mockokchong, Tuensang and Mizoram. Other places having no houses with walls of unburnt bricks are the four highly urbanized areas namely Calcutta, Bombay, Delhi and Madras.

An analysis of the spatial distribution of rural houses having walls of burnt bricks reveals that there is a close relationship between the amount of rainfall and the use of unburnt bricks. The more is the rainfall, the lesser is the use of unburnt bricks and the vice-versa (see Fig. 47). Since the eastern half of the country is less fortunate in the availability of mud, the use of unburnt bricks is not feasible. The availability of mud or clay for manufacturing bricks is another factor in determining its use. In India, the less humid or moderately wet areas having plenty of mud

or clay are highly suitable for its widespread use. Therefore, its concentration is more in the Punjab, Rajasthan, Gujarat and the neighbouring areas. Towards the east the use of unburnt bricks is less due to increase in rainfall and hence the humidity.

Conclusion

The highest use of unbaked bricks is found in Ganganagar district (79.71 per cent). The lowest percentage can be seen in Nagaland, Kamrup, Tehri Garhwal. Nearly 28 districts have 2 to 4 per cent houses of unburnt brick walls and 32 districts have 16 to 32 per cent. Nearly 250 districts of India record below average i.e. 8.35 per cent, rural houses of unburnt bricks as wall material. Most of the areas falling in the above average category lie in the western half of the country. There are a few scattered areas in the eastern and southern parts of India where the percentage of houses of unburnt bricks is high. Looking at State-wise distribution, the Punjab ranks first (36.73 per cent) being followed by Haryana (31.56 per cent) and Himachal Pradesh. Assam has the lowest percentage where only 0.01 per cent of the houses have unburnt bricks as wall material. Nagaland has no house of unburnt bricks. Manipur, Meghalaya, West Bengal, Andaman and Nicobar Islands, Arunachal Pradesh, Goa Daman and Diu, Minicoy and Pondicherry fall in the below 1 per cent category. The houses having unburnt bricks have roofs of thatch, mud or bamboo.

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P.C. OF RURAL HOUSES USING BURNT BRICKS AS WALL MATERIAL

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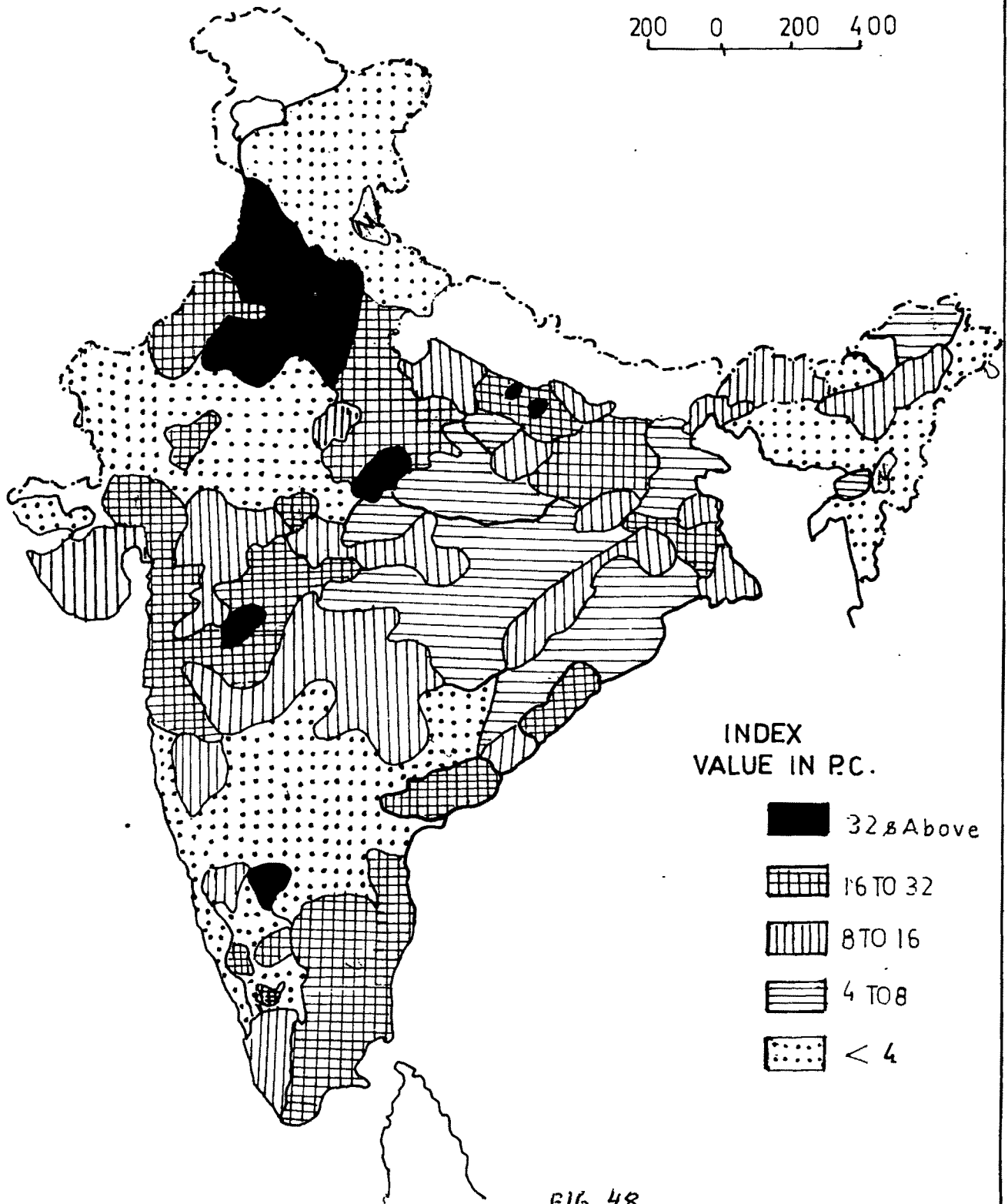


FIG. 48

Distribution of Burnt Bricks

For the construction of rural houses burnt bricks are used both for the walls and roofs. These are generally used without mortar. Only well-to-do people of the village use lime or cement as mortar. But such kind of houses are few. On an average 15.55 per cent of the rural houses have walls of burnt bricks. Their spatial distribution is not uniform. Its predominance is more in the areas where soils are suitable for the manufacture of bricks. In the plateau, hills and mountains, the use of bricks is less, because very few areas have suitable soils. Its major concentration (Fig.48) lies in plains where plenty of mud and clay are available. Based on the use of burnt bricks for walls, the country can be divided into five regions. These are (1) Districts with 32 per cent or more percentage of rural houses having burnt bricks walls; (2) Districts with 16 to 32 per cent houses having burnt brick walls; (3) Districts with 8 to 16 per cent rural houses having burnt brick walls; (4) Districts with 4 to 8 per cent rural houses having burnt brick walls and (5) Districts having less than 4 per cent rural houses with burnt brick walls.

In the first category of places, there are 30 districts most of which fall in the area comprising of the States of Punjab, Rajasthan, Uttar Pradesh, Haryana and Union Territory of Delhi and Chandigarh. The highest percentage is recorded at Jind where 82.33 per cent of the houses have brick walled houses. Other places with high percentage are

Jallandar (66.73 per cent) and Rohtak (66.27 per cent). The highest percentage lies in Delhi Territory where almost every village has at least one brick kiln. The second area falling in this category is in Gujarat covering the districts of Sabarkantha (32.36 per cent), Mahesa (62.62 per cent), Gandhi Nagar (57.82 per cent), Khera (38.12 per cent), and Vadodara (32.74 per cent). In the eastern part of the country, Gorakhpur (32.90 per cent), Bulandshar (36.97 per cent), Muzaffarnagar (39.45 per cent), Saharanpur (25.17 per cent) and Meerut (46.50 per cent) fall in this category. In Madhya Pradesh, Datia (44.04 per cent and Tikamgarh (41.18 per cent) belong to this category. In the south, Nilgiri (51.29 per cent) belongs to this category. In Punjab, Karnal (63.92 per cent), Kapurthala (62.19 per cent), Hoshiarpur (61.17 per cent), Sangrur (58.09 per cent), Ludhiana (56.82 per cent), Patiala (50.24 per cent), Ropar (49.52 per cent), Bhatinda (46.50 per cent) and Gurgaon (32.15 per cent) also belong to the first category.

In the second category of places there are 88 districts where the houses with burnt brick walls range between 16 per cent to 32 per cent of their total rural houses. The main area of this category is covered by a number of districts in the States of Punjab, Haryana, a few scattered districts in Gujarat, Maharashtra and Deccan plateau. Some coastal districts of India also fall in this category. In the central plains and in West Bengal mud and clay are available in abundance. Therefore, brick walled houses are found in

these areas. The most important districts falling in this category are Ambala (30.45 per cent), Mathura (30.40 per cent), Jhansi (30.32 per cent), Ahmedabad (30.16 per cent), North Arcot (30.05 per cent), Hoshangabad (28.28 per cent), Aligarh (29.16 per cent), Banaskantha (27.97 per cent), Daman (27.34 per cent), Coorg (27.03 per cent), Pondicherry (26.56 per cent), Surat (24.25 per cent), Hooghly (23.11 per cent), Rampur (23.08 per cent), Srinagar (21.53 per cent), Madhurai (19.19 per cent), Srikakulam (19.70 per cent), Salem (17.09 per cent), Baramula (16.27 per cent), Alleppey (16.07 per cent) and Khandwa (16.06 per cent). In the coastal areas, there are East Godavari, West Godavari, Krishna and Guntur of this type. All the districts of Tamil Nadu, excepting Coimbatore fall in this category of burnt brick houses. Similarly many districts of Uttar Pradesh and northern districts of Bihar fall in this category. In West Bengal, the districts of Hooghly, Burdwan, Howrah belong to this category.

In the third category of places, the percentage ranges between 8 per cent to 16 per cent. The total number of districts falling in this category is 97. The largest area of this category lies in the central part of the country, viz. at Indore, Gwalior, Buldana, Nellore, Bhagalpur, Unnao, Dhar, Akola etc.. Three districts of Assam namely Darrang, Sibsagar and Lakhampur fall in this category.

In the fourth category there are 56 districts having 4 to 8 per cent of their houses made of burnt brick walls.

The most important districts of this category are Kolhapur (8 per cent), Malda (7.88 per cent), Raisen (7.55 per cent), Bilaspur (7.43 per cent), Allahabad (7.40 per cent), Khammam (7.39 per cent), Bhir (7.38 per cent), Chitradurg (7.29 per cent), Chhatrapur (7.20 per cent), Darjeeling (7.14 per cent) and Yeotmal (7.4 per cent). The districts having less than 7 per cent are Saharsa (6.99 per cent), Ernakulam (6.89 per cent), Kangra (6.87 per cent), Raipur (6.82 per cent), Ratlam (6.71 per cent), Coimbatore (6.50 per cent), Trivandrum (6.48 per cent), Sagar (6.35 per cent). There are six districts namely Dhenkanal, Chindwara, Santal, Parganas, Hassan and Hyderabad which have between 5 per cent to 6 per cent of their rural houses falling in this category. The lowest in the category are Kozhikode (4.5 per cent), Singhbhum (4.16 per cent), Koraput (4.19 per cent), Cachar (4.3 per cent), Satna (4.31 per cent), Guna (4.85 per cent), Pratapgarh (4.90 per cent) and Bunda (4.93 per cent). There are nearly 56 districts which fall in this category.

In the fifth category, there are 95 districts where rural houses having burnt brick walls fall below 4 per cent. Some of them are Cuddapah (3.91 per cent), Purnea (3.88 per cent), Sirmour (3.80 per cent), Trichur (3.80 per cent), Alwar (3.57 per cent), Garhwal (3.22 per cent), Jaipur (2.81 per cent), Mandi (1.79 per cent), Manipur Central (1.2 per cent), Mikir Hills (1 per cent), Chamba (0.12 per cent), Almorah (0.01 per cent), Balasore (2.90 per cent), Sholapur (3.12 per cent), Sirmour (3.80 per cent), Surendra Nagar

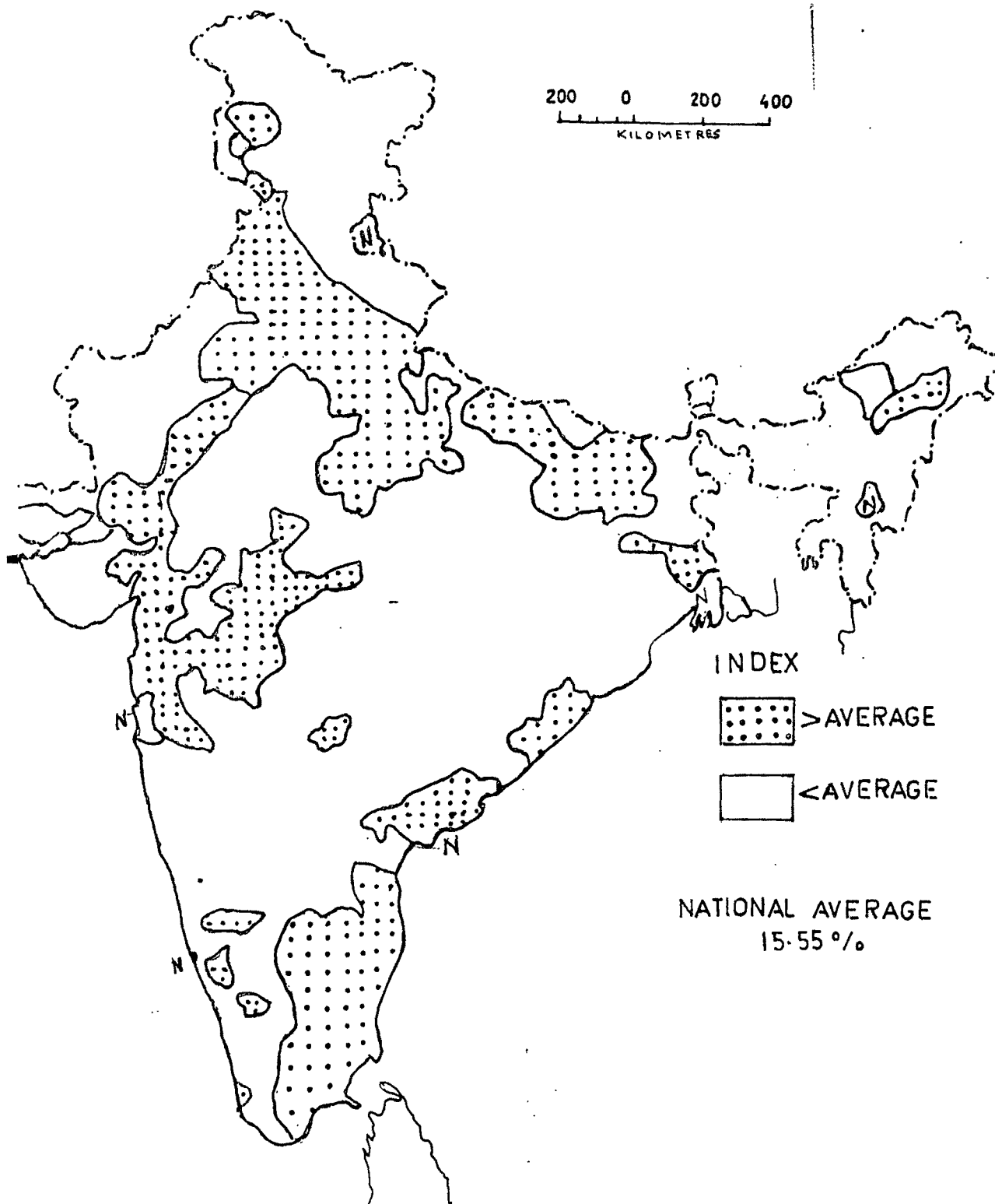
(3.88 per cent), Purnea (3.88 per cent), Trichur (3.80 per cent) and Jodhpur (2.96 per cent), Jaisalmer (1.63 per cent), Medak (1.63 per cent), Sidhi (1.57 per cent), Ajmer (1.52 per cent), Bilaspur (1.35 per cent), Manipur Central, Cooch-Bihar, and Raichur.

Conclusion

In northern plains use of burnt bricks is high, because of the local facilities of the manufacture of bricks with clay and mud. Its position as a building material is second after mud. Amongst the States, Haryana stands high with 51.42 per cent houses having walls of burnt bricks. Next is Punjab (50.77 per cent). Rajasthan has more percentage of unburnt bricks (79.91 per cent) while burnt bricks form only 8.62 per cent. Gujarat and Pondicherry have 26.83 per cent and 25.53 per cent respectively. Uttar Pradesh, Tamil Nadu have 19.03 per cent and 19.17 per cent respectively. Next in the sequence come Andhra Pradesh, Maharashtra, West Bengal and Jammu and Kashmir. All other States of the country have less than 10 per cent of their houses having walls of burnt bricks. Laccadive and Minicoy islands have 0.01 per cent only.

It may be of interest to note that the distribution of its use is uneven. It has more concentration in the western parts of the country. The percentage decrease slowly towards the east.

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Burnt Bricks as Roofing Materials

The burnt bricks with lime are used for the roofs. On an average, only 1.52 per cent of the rural houses have brick and lime as roofing. The maximum incidence of such type of houses occurs at Haryana's Mahendragarh district having 27.46 per cent of rural houses of burnt brick roofs. Next is Gurgaon with 15.12 per cent rural houses using this material. Nearly 80 districts of India fall in the category of above average percentage. The rest of the 243 districts have below average percentage. Compared to other materials, burnt bricks do not seem to be very popular as roofing material in India. The most important districts having more than the average are Jind (13.81 per cent), Bijnor (11.68 per cent), Jullander (4.57 per cent), Ludhiana (10.7 per cent), Ganganagar (5.28 per cent), Jhunjhun (7.61 per cent), Sikar (4.73 per cent) and Delhi (12.94 per cent). Hisar and Rohtak have 9.08 per cent and 9.96 per cent respectively of their rural houses having roofs of burnt bricks and lime.

The spatial distribution of rural houses using lime and burnt bricks as roofing material is shown in Fig. 49. There are three regions viz., the places having above average percentage of rural houses with burnt bricks in the roofs; (ii) places having below average percentages of rural houses with roofs of bricks and (iii) the places having no houses with roofs of bricks.

Use of Vegetational Materials for Construction
of Rural Houses

The vegetations used in rural houses are various types of grasses, straw, reeds, palm leaves and wood. Due to scarcity of wood, its use has declined considerably. Other materials falling in this category are being used widely in various combinations. In some areas plenty of mud is mixed with other materials or is plastered over it. Even today, most of the houses are constructed by using age old techniques and skill which is passed on from one generation to another.

In the past, houses made of grasses were known as 'Kusa Houses'. In Epics, these are known as 'Kutis'. The old texts mention the huts made of bamboo (Vanisaga), straw mats (Kadano), and wooden planks (Ukhanchana) and thatch of grass (Chavana). Such type of houses were known as Dhamija (Ray, 1965) and were white-washed. All the Indian villages, in the past contain huts of vegetation materials. Similar kind of houses were constructed in the third century BC in Nagarjunakunda during Ikshvakas period (Murthy, 1977). Poet Kalidasa also wrote about leaf huts known as Parnasala or Utajas. Utajas were the domical shaped roofs made of palm leaves. Similar kind of houses are depicted on the bas-reliefs of the Buddhists and Jaina monuments (Brown, 1965). Excavations at Kayatha on Choti Kali Sindh river nearly 24 kms east of Ujjain have yielded enough materials to corroborate this point.

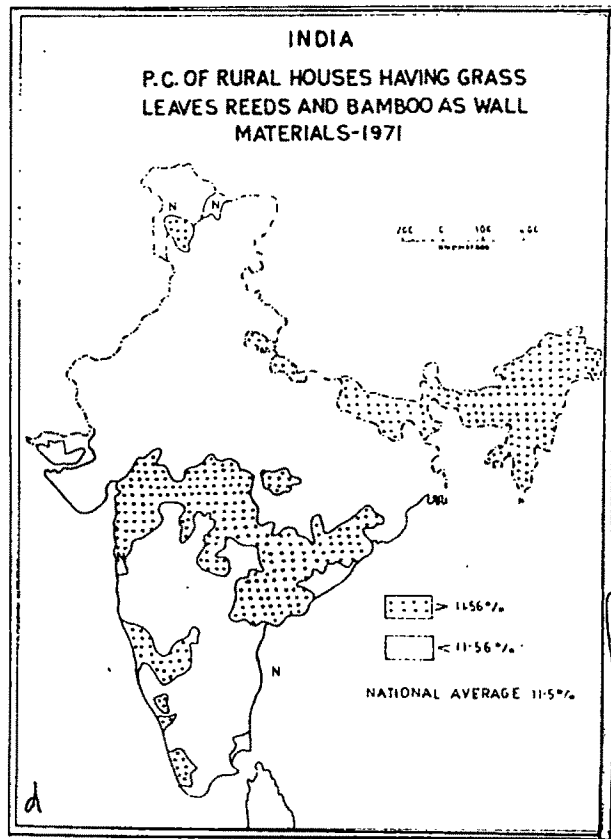
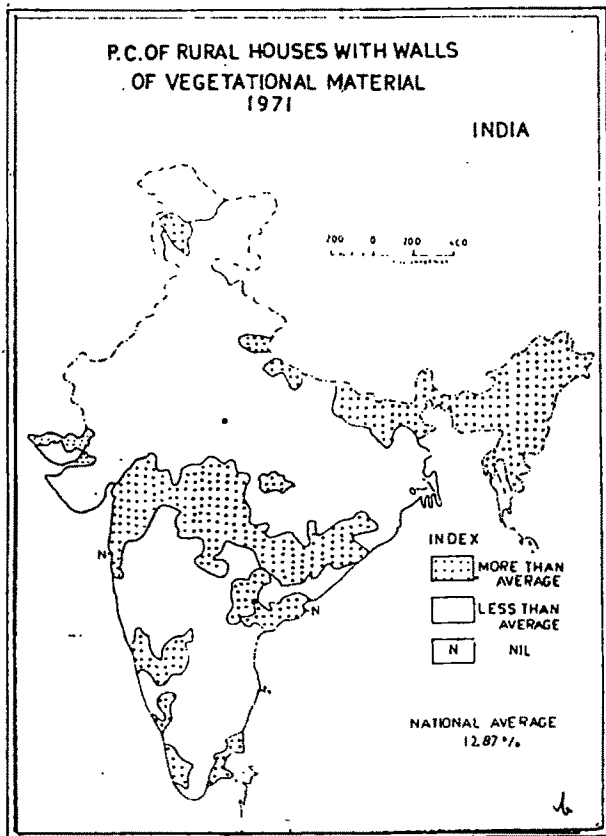
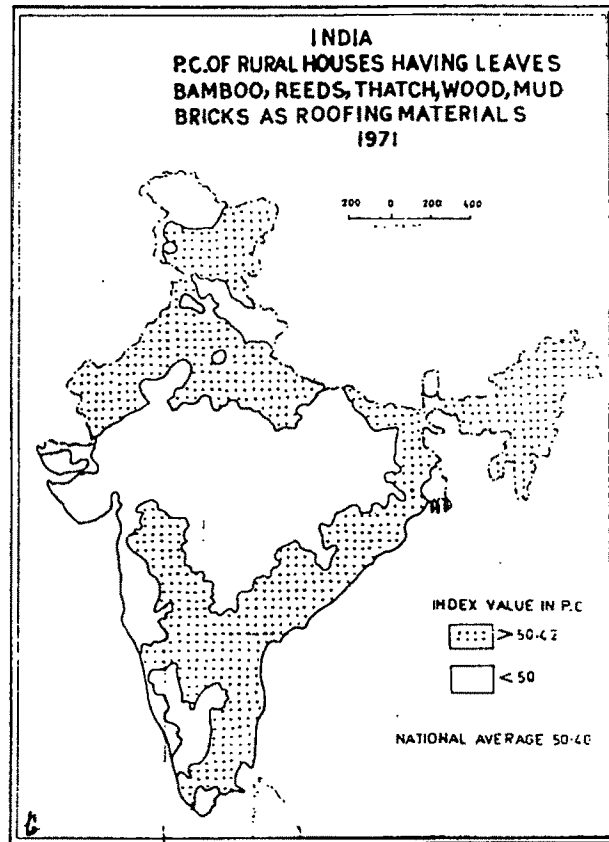
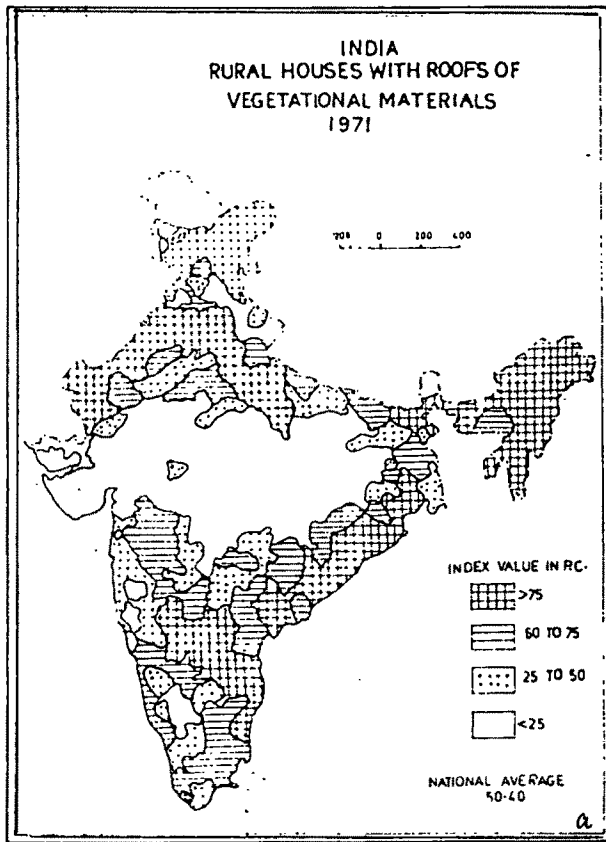


FIG. 50

Since traditions die hard, the Vedic huts described above are still being made in many parts of rural India. The ground plan of such houses may be circular, square or rectangular. The use of these materials for roofing is more popular as compared to the walls. For roofing nearly 50 per cent of rural houses have used these materials. Only 12.87 per cent, rural houses have walls of this category of materials.

Spatial Distribution of Rural Houses using
Vegetation in the Roofs and Walls of the
Households

There are four types of areas (see Fig.50) on the basis of the use of vegetation in rural houses. These are (i) areas having more than 75 per cent roofs of houses made of these materials; (ii) areas having rural houses with roofs of vegetational materials between 50 to 75 per cent; (iii) areas with 25 to 50 per cent of their rural houses having roofs of these materials and (iv) areas with less than 25 per cent rural houses of vegetational roofs.

The first type can be identified in many areas of the country. The whole of Central part of the country belong to the fourth category, below 25 per cent rural houses having roofs and walls of these materials.

The walls of vegetation materials account for only 12.87 per cent of the total houses in rural India. Their spatial distribution record three types viz., (i) areas

having more than 18 per cent of rural houses using of vegetational materials, (ii) areas with 12 to 18 per cent rural houses having wall of these materials, and (iii) areas with 6 to 12 per cent rural houses having walls of these materials and (iv) with less than 6 per cent houses of this type.

The distribution pattern of rural houses using vegetation in their construction records some interesting phenomena. The north-western part of the Himalaya, the desert region and the central part of the country record less than 6 per cent of the rural houses using reeds, bamboo, grasses and leaves in their roofs. In the Himalaya, wood is used and in central part stone is the most important wall material. On an average, only 11.56 per cent houses of India have walls of grasses, leaves, reeds and bamboo. (Fig. 50).

Use of Wood as Building Material

The wood is used as building material in India since ancient time. The wood is one of the premeval material out of which the early man in India is supposed to have made his shelter (Sukla, 1960). Many scholars believe that the first human abode had sprung up from the branches of a tree known as 'sakhas'. These houses were known as 'Sala Houses'. To corroborate this point ample evidences are found in the old texts. Through the display of life style of ancient India, old art galleries also depict a variety of wooden houses. Rg. Veda, Silpa Ratna, Vastu Shastra and a number of Sutras bear the early incidence of the use of wood for

the construction of houses. Many of the 'Manasaras' and 'Samaranganas' have numerous references of the use of wood as a construction material. The 'Griha sutras' have elaborate descriptions of wooden houses and also the techniques employed in their construction. Jataka stories have frequent mention of wooden huts of common man.

The construction techniques mentioned in the old texts reveal that the methods of using wood have not changed over the centuries. Sutra Bhashya has enough information about the use of wooden frames, rafters and posts. To support this point many sculptures at Bharat, Sanchi and Amravati have displayed the wooden houses of common man having thatched roofs and wooden frames and rafters.

Since the timber age in India was a long one, the carpenters remained as architects for a long period of time. The forests used to determine the location of settlements. Most of them were near the forests. The predominance of wooden houses continued upto the extension of the forests. The vast stretches of land of India were under forests till a millennium ago. The Ramayana mentions the existence of large areas under forests. Some of them are Naimi Saindhava, Chitrakoot, Dandakaranya (still under forests) and Panchwati. Valmiki has described the birth place of Lord Krishna in the densely forested area of Brindabans. Pargitar states that forests of Dandakaranaya stretched from Bundelkhand to the Krishna river. There were many natural forests in Madhya Desha during the 6th century. Other forests mentioned in

the classical texts are Kuru jungle, Ajanta Vana at Saketa, and some Mahavanas at Vaishali. The Mahavana at Kapila Vastu stretched right upto the foot of the Himalaya (Law, 1954). Suminivana is said to be located between the Rohini and the Vinjatavi rivers. A very large forest was located near Vindhya. There were very dense forests along the Indus at the time of Alexander's invasion. There were dense forests on the land between Jhelum and Salt Range (Stebbing). The greater part of eastern Indian which was settled by aboriginals was covered with dense forests.

The literary sources reveal that all the aboriginals living in the woods made wooden houses of their own type. Their types and designs depend on available timber and skill of the people. The rich made houses by using wood, while the poor lived in semi-wooden houses having thatched roofs (Barnett, 1964).

The wooden houses of common people were simple. Only the houses of the kings and very rich people were greatly influenced by foreign art of wooden craftsmanship. The style, polish and design of Asoka bell capital which was later used widely in Indian pillars was derived from Archadian constructions (Kosambi, 1965). For illustration, there are remains of palace made of wood located in the south of a road between Bankipur and Patna. The whole structure is similar to that found in Burmese Palace at Mandlay (Imperial Gazetteer of India, 1908). Another example is of square panels carved into diaper pattern found on the gates of

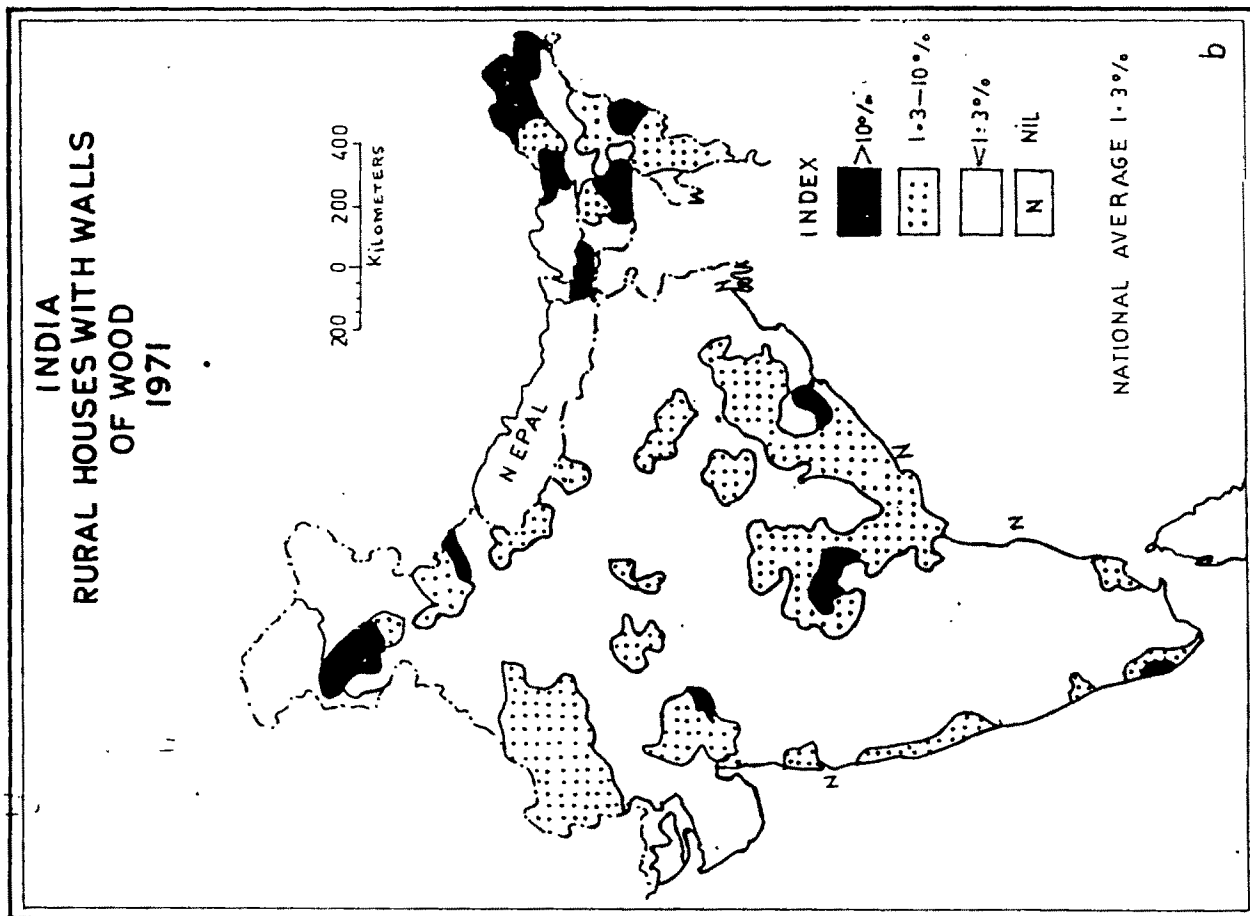
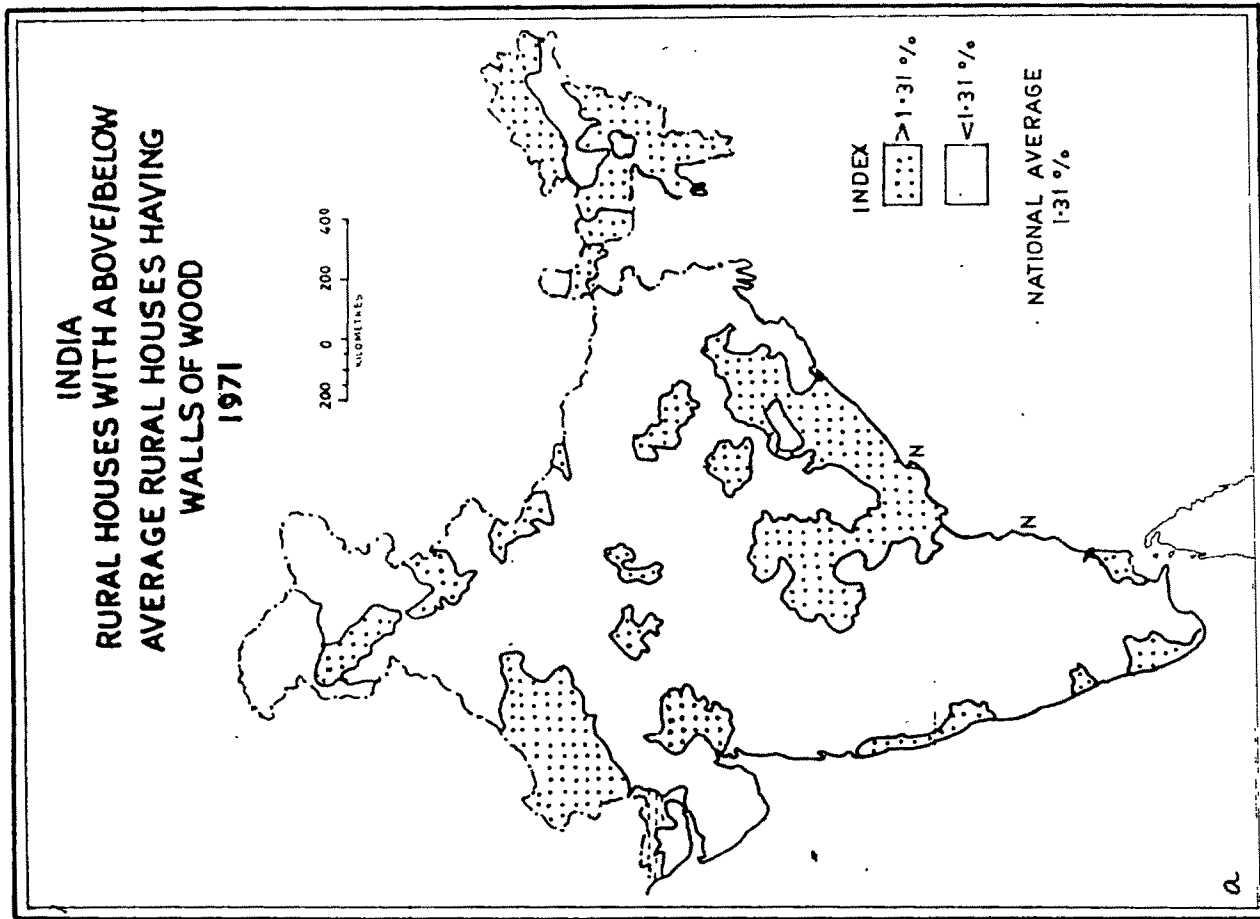


FIG. 51

Somnath now deposited in Agra Fort. It depicts Greek influence. The characteristic Buddhist houses on shrines were originally of wood. Markuta Shrine in Chamba and Hidamba temple in Manali are made of wood. Markuta temple belongs to the fifth century and was reconstructed using same plan in seventh, eleventh, and seventeenth century AD. Many temples in western India were destroyed by invaders which led to the use of stone for their construction (Goet, 1965).

Use of Wood as Building Material

The percentages of wooden houses in rural India vary from place to place between 64 per cent in Manipur to 0 per cent in Gwalior. On an average, 1.31 per cent of the rural houses in India have walls of wood. Above average percentages are found in only 87 districts (see Fig. 51) and the values are not very high in most of them. The sub-classification of these categories reveal that only 22 districts of India have more than 10 per cent of their houses with walls of wood. The next category has between 3 to 10 per cent and the number of places in this category is only 30. Nearly 77 districts of India fall in the category of 10 to 1.31 per cent and 246 districts fall in the category of below 1 per cent. This shows an imbalance in the distribution of rural houses having wooden walls. The places having higher percentage (above 10 per cent) are located in the hilly and forested areas of central India. Most of these areas are inhabited by tribal people. On the eastern hills are the

tribal groups in Manipur East (64.07 per cent), Garo Hills (28.22 per cent), Manipur North (15.52 per cent), Lohit (14.14 per cent), Kameng (12.52 per cent) and Jaintia Hills (11.34 per cent). All these districts form a large region in Eastern India. The second large area of this category lies in the north-western part of the Himalaya in which some districts of Jammu and Kashmir, Himachal Pradesh, and Uttar Pradesh Hills are included. The hilly districts of Baramula (39.36 per cent), Srinagar (25.52 per cent) and Anantanag (30.32 per cent) fall in this category. Uttar Kashi district (10.68 per cent) in Uttar Pradesh Hills form another small pocket of this category.

In the plains and plateau regions, small pockets consisting of Banswara, Adilabad, Thanjavur form other pockets of this category. Other isolated districts of India falling in this category are Bilaspur in Mahanadi Basin, Palamau on Chotanagpur plateau, Jhansi in Bundelkhand uplands, and Kota in Rajasthan. Here the percentages range from 1.37 per cent to 2.17 per cent (see tables in the end).

The decline in the use of wood for construction of houses is obvious which is due to several reasons. There had been a ruthless depletion of forests for domestic fuel as well as for other urban uses. The heavy grazing also caused depletion. After Muslim invasion, the land clearing activities to produce more food and more revenue accelerated the progress in deforestation (Mamoria, 1975). With the advent of the British, there was rapid depletion of forests

due to export of wood to UK and other foreign markets. The manufacture of railway sleepers, paper pulp, ships etc. was another reason for the depletion of timber resources in the middle of 19th century.

A further decline in the availability of forest resources for building materials took place when indirect uses of forests in soil and wild life conservation, and the conservation of forests for supply of raw materials from forests for modern industries was recognised. Loss and damage due to fire, insects and plant diseases also remained unchecked for a long time.

In recent years, many forests loving tribes like the Kols, Bhils, Machis, moved to the neighbouring industrial areas. In Konkon region Kolaba, Thana and Ratnagiri which were originally heavily forested fell victim to the axe of new cultivators. Heavy demand for timber for railway sleepers increased the number of saw mills causing heavy destruction of original forests.

Similarly growth impulses from outside reached the Dandakaranya districts which had been selected for rehabilitation of refugee migrants from East Pakistan. As a result of this, the area had been brought under the influence of people from different cultural milieu which has disturbed the age old tribal ways of life. The mineral wealth of the region has linked this area with Vishakhapatnam. Various tribal development programmes have also brought changes in the tribal ways of life and their house types.

In Deccan trap Vidarbha has lack of water and strong winds tend to spread the fire. Extensive fires occur in summer in hilly terrain and slopes in Melaghat, the fringes of Buldana, Yeotmal, Talegaon-Kondali plateaus at the foothills of the Satpuras and the Chirodi hills. The economy of the areas is poor and frequent famines had caused starvation and death in these areas (Pandhye, 1965). The arable land is less which is only 20 per cent of the total area. The repeated calamities have affected the house types drastically. Most of the villages have experienced depopulation.

The areas of concentration of tribal population in Gujarat are found in Durgapur, Sabarkantha, Panchmahals and Vadodara. Since the large cover of forests in these districts are commercially exploitable, the percentage of wooden houses has dropped considerably. Only the headman and other prosperous villagers have extensive use of wood with carving on them.

In Uttar Pradesh, 40 to 60 per cent of land is under forests, but their concentrations are in difficult location away from transportation arteries on steep slopes or hills. The chief species of timber trees are Sal (*Shorea robusta*), Chir (*Pinus Goxbugbit*), Deodar (*Cadrus Deodara*), Sisoo (*Dalbergia Sissoo*), Babul (*Acacia arabica*), Spruce, Pine and Jamun (*Syzigium Oumimi*). Because of other direct uses the availability of wood for construction is in short supply.

The map showing distribution of rural houses having walls of wood show a very clear picture of two types of

regions where houses with wood walls are predominant. These are : (i) the regions having high percentage of tribal population and (ii) the regions having hills with dense forests.

Those tribes who are in contact with more progressive and economically advanced societies have settled in permanent villages and now practice agriculture. Their houses have undergone many changes in respect of the building materials used. The shape, size and designs of their houses have undergone transformation.

Types of Stone Houses

The stone houses of common man in India represent very distinct architectural style. They are constructed in a variety of places. Their designs depend on the type of stone used and the skill of the people. Most of the stone walled houses have roofs made of shingle and slate or of tiles or thatch. Their predominance is in the States of Himachal Pradesh, Karnataka, Kerala, Rajasthan, Gujarat, Maharashtra, Jammu and Kashmir, and Andhra Pradesh. Madhya Pradesh and Tamil Nadu have also moderate percentage of stone houses. Some examples of the stone houses are given below :

Stone Houses in Himachal Pradesh

Rural houses in Himachal Pradesh are simple structures which give a solid look. These are of three main types :

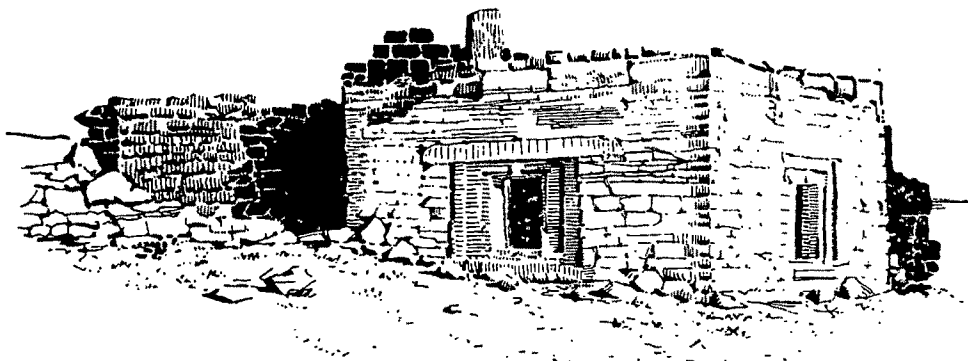
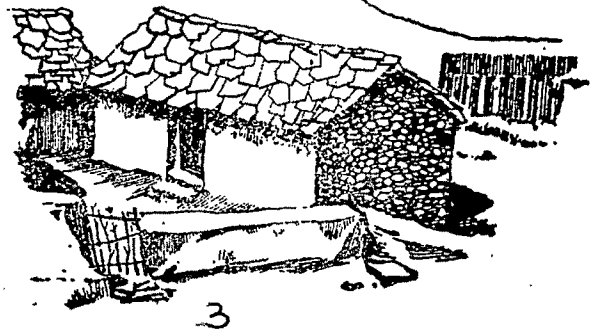


FIG. 52 4

1. Nurpur Houses : These houses are found in the southern and south-western tracts of the State. The houses are single structure having walls of stone and mud. They have flat roofs. The area is agriculturally backward and gives a poor look.

2. Kangra Houses : These are found in valleys and the adjoining hills where precipitation is high. The Kangra houses have high pitched roofs. The plinth of the houses is made of roughly dressed stones taken from the beds of the streams. The walls are made of stone and timber with thatch or slate covering it. Such type of houses are found in the area lying between Dharamsala and Simla (Fig. 52).

3. Kulu Houses : These are found at higher elevation where level land is restricted. The houses are made of timber and stone. Such type of houses are elegant and beautiful which give an appearance of full comfort. The walls of such houses are made of loose stone with wooden courses at interval of about a metre. Some of the houses are massive two to three storied structure. These are mostly found in Kulu and Manali.

Stone Houses in the Uttar Pradesh Himalaya

The average house of this type is an oblong rectangular structure with gable ends having a sloping roof. Walls are made of stones joined ordinarily with clay or burnt lime. In the case of well-to-do people, the walls are

plastered with cement. Floors of these houses are made of cement and concrete. The areas, where slates are not quarried, single roofs are common. Single roof are common in north-Chakrata tahsil where deodar (*Cedrus deodara*) is grown in plenty. The double storied houses in this area are locally known as Dopura Makan. These houses have two-rooms on each floor and each room has a separate . . . The upper floor is used for residential purpose and the lower for housing the cattle. If located in the market, the lower floor is used as a business establishment, such as shop or office.

The well-to-do people in this area have verandah in front of the rooms. The staircase lies inside the building and provides access to the upper storey without entering into the rooms. The staircase is made of stone. Very large stone houses have finely carved pillars in the front of the verandah, and circular arches of the carved wood are added at the upper ends of the posts. This type of house (mansion) is much larger than the average Himalayan houses. In the Himalayan part of Uttar Pradesh, houses of mud are almost unknown. The poor houses have walls of rough hewn stones and roofs of slates. They are generally single storey and are generally found in the north.

The Bhotiya houses in the Bharatiya Valley of Uttarakhand are directly related to their traditions. They have both the summer and winter homes. It is the summer house that is made of stone.

In Uttar Pradesh Himalaya, due to a large variety of climatic and other local conditions, there occurs a large variety of villages with equally diverse types of houses. The houses in the hilly district of Kumaon and Uttarkhand are usually single storied, with slate as roofing materials. These type of houses belong to the poor. The double storey stone houses having a number of wooden pillars and highly ornamental carved wood work belong to the very rich people. The pillars are made of Cedrela toona or some other wood of dark shade. The carving on the circular are of the same kind of wood evinces the skill and ingenuity of the workman.

The Himalaya stone house is par excellence a product of its geographical environment. The geological formation of the area provide ample material for stone walls. The rocks consist of limestones, dolomites, shales and slates which are good enough for the construction of ordinary stone houses. These are found everywhere. Limestone and slate are quarried almost in every inhabited tract of the region. Limestone boulders are found in the river beds.

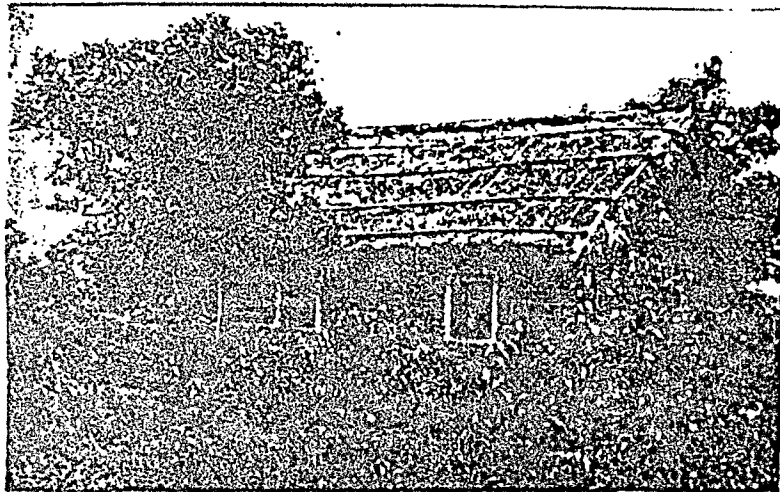
Through the form of the houses, the topography of the area is expressed. The steepness of slopes has limited the ground dimensions of the dwellings. The lack of level ground has been compensated by the vertical construction of the buildings. The absence of 'Angan' is due to want of level land. The cooler climates also obviate the necessity of open space provided by the 'Angan'. In other parts of UP owing to the tedious nature of the cultivation practices,

women are engaged in outdoor activities. The 'purdah system' in the Himalayan region is rare. These factors account for the absence of 'Angan' in the Himalayan houses and distinguish them from the houses in the plains.

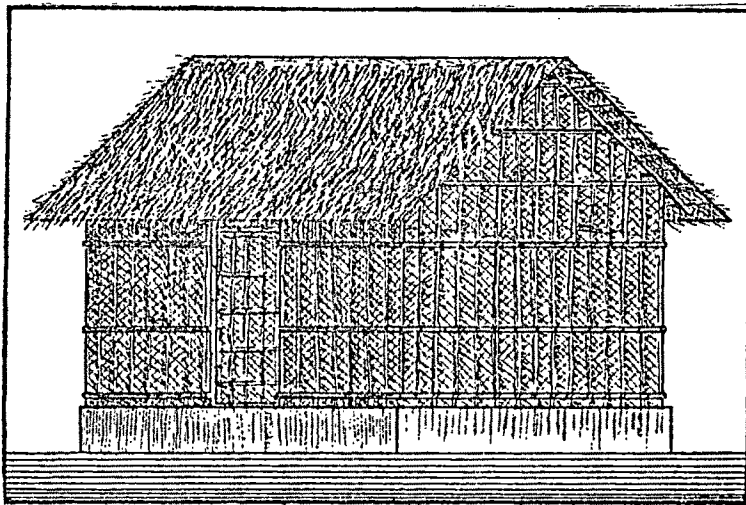
Ubiquity of forests provide timbers in abundance for building purposes. Both the stone and timber are used for construction of houses and are equally important. Chir pine is the most important tree of the area. Good rafters and beams are easily available for the construction of two storied houses. The houses give a solid look. The pitch of the roofs is not very high and is nearly 20° to 25° only. For two storied houses, both wood and stone are available in the area in large quantities (see Fig. 52).

Stone Houses in Lahul and Spiti

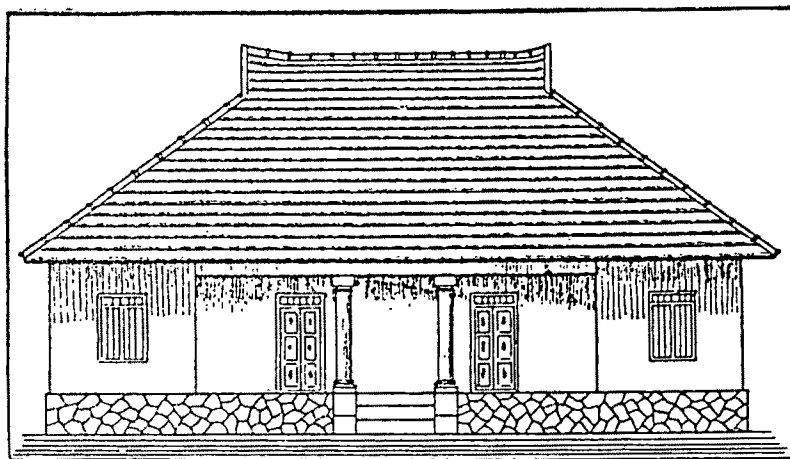
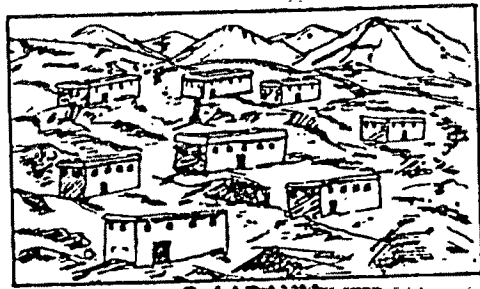
These houses are made of stone laid in mud mortar. The inner side of the walls is plastered. The wooden rafters are laid horizontally on the walls at height intervals of about a metre to impart strength to the walls. The roofs here are made of some non-durable materials. The plinth of the houses is nearly one metre high above the ground (see Fig. 52). Such type of houses are found on the Kulu-Ladakh road. These houses have roughly 2m in height, and have doors but no windows. A hole on the roof for air and light is covered with a slab of stone when it rains. In most of areas in Kangra, Lahul and Spiti, the walls of the houses are of stone and staircase is of wood. The houses have more than one storey.



A Specimen of Laterite Block in Cement Mortar



A POOR CLASS HOUSE WITH PLINTH OF LATERITE STONE



A HIGH CLASS HOUSE


FIG. 53

Each storey is built for different purposes. The ground-floor is constructed to house the cattle. In some villages in Kangra, the courtyard and the streets are also paved with stone (Mitra, 1961).

Stone-Walled Houses in Trans-Jumna

There are two areas in Trans-Jumna tract which are characterized by the stone walled houses. These are : (1) the hilly parts of Mathura and Agra and (2) the southern parts of the hilly tract of Jhansi, Hamirpur, Banda and South Allahabad. The building stone is quarried in the south west of Agra from the Vindhyan Hills. Here the stone houses are common. Even the poor houses are built of stone roughly filed up without any cementing material. Dwellings near the Aravalli outliers in Mathura are of stone walls. The poor houses have thatched roofs (see Fig. 53).

The typical house in this region is made of boulders of stone picked up from the hills. Roughly hewn boulders are used with mud mortar. For the constructions of some houses only the foundations and the lower portion are made of stone. Low pitched tiled roofs and absence of varandahs are the common features of the houses of Bundelkhand plain and are common here also. All the houses can be classified into three broad types viz., the oblong one room hut of the poor often single storey, the square or rectangular enclosure of the average peasant having shingle or tiles as roofing, and the large, often two-storied buildings of the



zamidars. Some houses in the Jhansi area have sandstones from the Vindhyan Hills for roofing purposes. Slabs of sandstone are split into half inch thickness and are used for roofs while the walls are of dressed stones. Even the beams are of stone. Such type of houses belong to the rich class.

Stone Houses in Malabar Coast


In the Malabar Coast, the stone houses of the well-to-do people are beautiful. They are generally rectangular in shape. The structures are built of stones like granite and laterite set in wooden frames and mud. Laterite is used for pillars. All the walls of the houses are plastered with lime. They are white-washed and coloured. Some of the houses have walls covered with bright coloured figures of gods and animals.

The middle class houses in Kerala have rectangular ground plan. The basement is normally constructed of laterite and rarely of granite stone to the height of 2 to 3 feet above ground level. Along the coast, the basement is higher to keep the water out of the rooms. The houses have 200 to 600 sq ft plinth area on which the superstructure is constructed of laterite stone. The walls are often plastered with lime and sand and in some cases with lime and red laterite soils. Unplastered houses are few. The floors are beaten hard after spreading laterite soils and the surface is made smooth. Cow-dung mixed with laterite soil

is coated over it periodically. The front verandah generally serves the purpose of a drawing room. The roofs of middle class houses are generally sloping, having a framework either of wood or of palmyra or coconut palm (Mitra, 1961) (see Fig. 53).

Stone Houses in Andhra Pradesh

A typical house in Anantapur of Andhra Pradesh State has walls of stone covered with mud and palm leaf thatch roof. The houses have stone enclosures (see Fig. 53). The Kurnool district and a portion of Cuddapah district show a distinct type of house quite different from the houses found in the Rayalaseema district. The dry Rayalaseema district of the Andhra Pradesh comprises of Cuddapah, Kurnool, Anantapur and Chittor districts and the houses of this region are entirely different from those found in the coastal districts. One suddenly comes across concentrations of flat roofed houses almost entirely made of stones. The walls are made by packing flat stones one over the other. Sometimes mud or lime mortar is used. The roofs are made of flat sheet stones spread over a wooden frame. The upper portion of the roof is covered with saline clay. The soil though black (cotton soil) on the surface, has a formation of sheets of flaky stone just a few feet below. Their own fields are dug to obtain stone for their construction. In the western part of Hyderabad, houses with walls of limestone and sloping roofs of shingles are predominant features.



Sandstone is quarried in this area which is sent to the Hyderabad city for construction of houses (Mitra, 1961).

Stone Houses in Jammu and Kashmir

In Kathua the houses having stone walls constitute 24.23 per cent of the rural houses. The roofs of the houses are made of durable materials such as corrugated iron sheets. The roofing materials are obtained from outside, because of its nearness to Pathankot railhead. The stone for wall is available in plenty in the local hills. In contrast, the houses in Punch district are still of traditional materials, because of its distance from the plains. In Punch district the walls of the houses are made of stone and the roofs of wood, thatch, reed or bamboo. Such type of rural houses are common in its other districts like Udhampur and Doda. These areas receive heavy snowfall and therefore the thatched roofs give them the comfort required (see Fig. 53).

Stone Houses in Madhya Pradesh

There are two types of stone houses in this State, namely (i) rectangular ground plan with horizontal roof and (ii) rectangular ground plan and inclined roofs. The flat roofed houses are rare. The second type of houses are more common in the areas covered by Morena district, Bhind, Datia, Shivpuri, Guna, Ashok Nagar and Mandsaur districts of Madhya Pradesh. The roofs are horizontal with slight

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inclination on one side. The materials used are slate and slabs of sandstone. The construction of these types of houses is in the areas where these materials are easily available. The rainfall in these areas is low. These inclined roofed houses show one more variation and that is the multiple-roofed houses. Two roofed houses are common in this area, more specially in the Balaghat district (Mitra, 1961) (see Fig. 33).

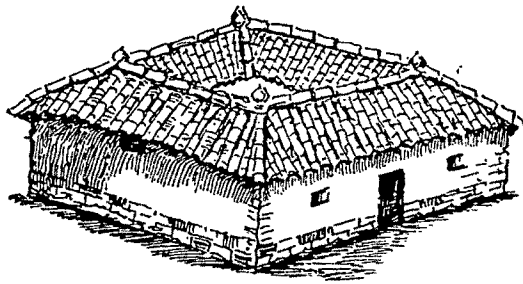
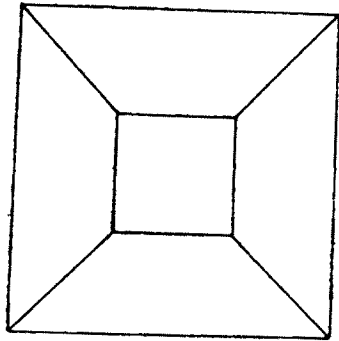
Stone Houses in Maharashtra

Two types of stone houses are found namely, (i) Poona stone houses and (ii) Kolhapur stone houses. Kolhapur stone houses are generally two storied known as 'dumafli'. They are constructed around a quadrangle with stone walls and tile roofs. The houses have verandah, two to three sleeping rooms, central room, a large dining room and kitchen. In the rear of the house is a cattle-shed and a bath room. The fronts of houses are ornamented with carved wood or in bright colours with pictures of Gods, Goddesses, wild beasts or heroes to scare awares, the evil spirits. Such type of houses belong to the rich people.

Poona stone houses are very large mansions and are known as 'Vadas'. These houses are now becoming obsolete and are found only in very large villages. These houses are 'dumajli' which means two storied. Like Kolhapur houses these are also built round a 'chowk' or quadrangle or a central plot. The walls are of stone and roofs are of tiles

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a



b

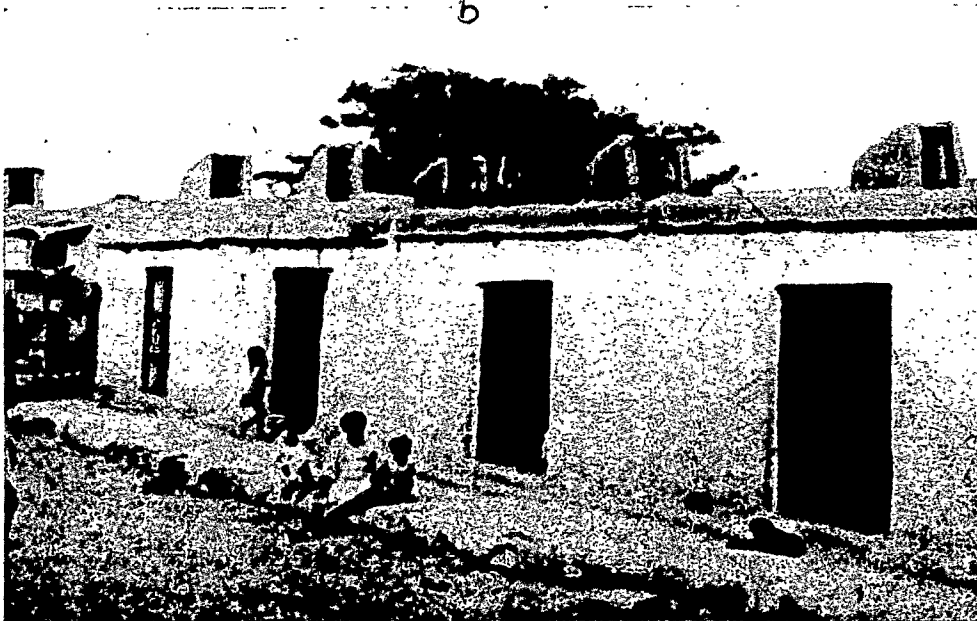


FIG. 54

(see Fig. 54). They have verandahs, and the entry is through a gate somewhere in the outer face of the building. The house is built on a raised plinth (Jote) nearly three or four feet high. The inner courtyard has steps to lead to the 'Verandah' of the building. The verandah is used to receive the strangers, and for the children to play or for women to swing and talk. The ground floor has four to seven rooms, and the upper floor has four rooms.. Such type of houses belong to Jagirdars or other wealthy persons. From architectural point of view, these 'Vedas' are plain having very little ornamental work. They are massive and monotonous. The plinth is of closely joint blocks of polished stone.

The 'Vedas' are now being replaced by modern stone houses having stone walls and tiled roofs. A house of this kind consists of an Osari (front Verandah), majghar (a central room for dining and setting and Devghar (a room for worshipping god), a kitchen and a room to sleep. There is a cattle-shed either in the front or at the back. One storied stone houses belong to economically weak people and have tiled or thatched roofs. They usually belong to the Gujjars who build very large cattle sheds attached to the buildings.

Types of Houses Made of Mud, Grass, Reeds,
Leaves and Bamboo

The tradition of making mud houses in India is very old. Excavations at various places have revealed that mud

houses were in vogue during 200 to 100 BC. Such type of houses had roofs of thatch supported on wooden poles and rafters (Sankalia, 1951). Its popularity as a building material is due to (i) low cost of construction and (ii) its easy availability.

At present, mud houses are par excellence the characteristic features of agricultural landscape. Mud is used as mortar on plaster coating over a frame of wood, bamboo, stone or bricks, which gives protection against fire. In areas where mud is the main building material, it is mixed with local grasses.

The height of mud walled houses varies from place to place and depends on the climatic conditions of the areas. In less humid areas of Ganganagar canal tract, western UP, eastern and southern Punjab, the roof is high and flat (Sharma, 1960). The mud houses are common in the Tapi and the Godavari, Basins and in the rain shadow areas of the Sahyadri south of Konkon and Vidharbha. In Maharashtra, nearly 20 per cent of the houses are of mud and even more in the Krishna and the Godavari plains.

The roofs are made of wood covered with 20 to 40 cm. layer of mud. The mud houses all over the country are mostly made of clay or mud mixed with substances taken from natural vegetation of the areas of their locality. The height of the roofs decrease with the increase in rain. Their shapes vary from place to place depending upon the availability of the type of materials and the cultural background of the

people. They can be circular with conical roof or square or rectangular having flat or gabled roofs.

Houses of mud, grasses, reeds, leaves, bamboo etc. are of many types. These are described below :

Malwa : In Malwa region, the flat roofed mud houses are either built of Gonda clay or sun dried bricks in the plains. The plain lies in between Aravallis and Vindhyan ranges. The roofs are made of a network of beams, wattles or straw covered with mud. The walls and roofs of the houses are of same colour and are plastered with mud, so that they do not become damp in the rainy season. In the plateau region, the thatched roofs are inclined at 60° and the walls are sometimes very low. Due to some superstition the houses face east, more particularly of the Bhils and Kols (Kumar, 1972).

Sunderbans : Nearly 90 per cent of houses in Sunderbans are made of mud mixed with locally available grasses, leaves etc. The roofs of houses are not supported by wooden posts. Therefore, the walls of the houses are low and roofs are hanging close to the ground. The height varies from 1.5 to 2.5 m from the ground. The conical huts made by people represent the cultural heritage of people from Midnapur coastal area. Some fishermen from Bihar also settled down in the reclaimed area. Some cheap labourers from, Ranchi, Santal Parganas and some other districts of Chotanagpur were also brought by the government to develop the area. These people came in contact with the local people, which resulted

in a mixed social and cultural developments of the region. They produced a large variety of houses made of these materials (Chatterjee and Saha, 1965).

Uttar Pradesh : Mud houses with thatched roofs are ubiquitous in many districts of Uttar Pradesh. The thatching materials are abundantly available in the flood plains of the streams and also in low lying areas. The whole of trans-Ghagra Doab, is wet and has luxuriant growth of trees and grasses. The central part of Dun valley, and Saharanpur area have wattle and duab huts all along the irrigation canals. The pitch of the roofs are made as steep as required. The thatch is 50 to 75 cms thick and is nearly 7 to 9 mts high. In North-Eastern Gorakhpur the soils are deposits of the Gandak having an unusual proportion of lime contents. These are friable soils. Therefore, the houses are made of wattle. In the Aran valley of eastern Dun, wattle and duab huts are common features.

Use of Non-traditional Building Materials

A number of non-traditional building materials are being used in the construction of roofs and walls of the rural houses. For roofing cement concrete, cement sheets, asbestos sheets, reinforced brick concrete and for walls cement and concrete, galvanized iron sheets and metal sheets are the new building materials which are used. As compared to the use of traditional building materials, the use of above mentioned building materials is still very low. The

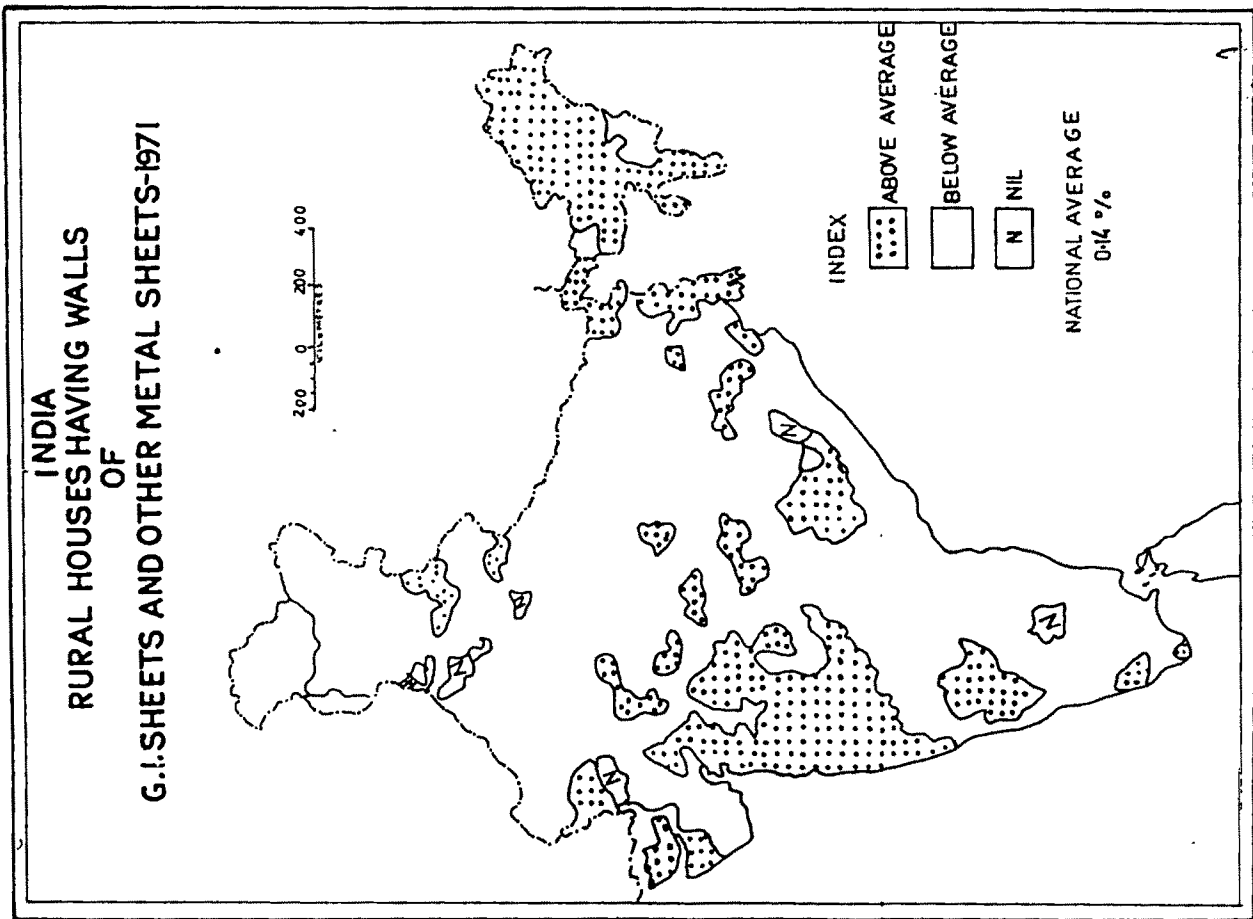
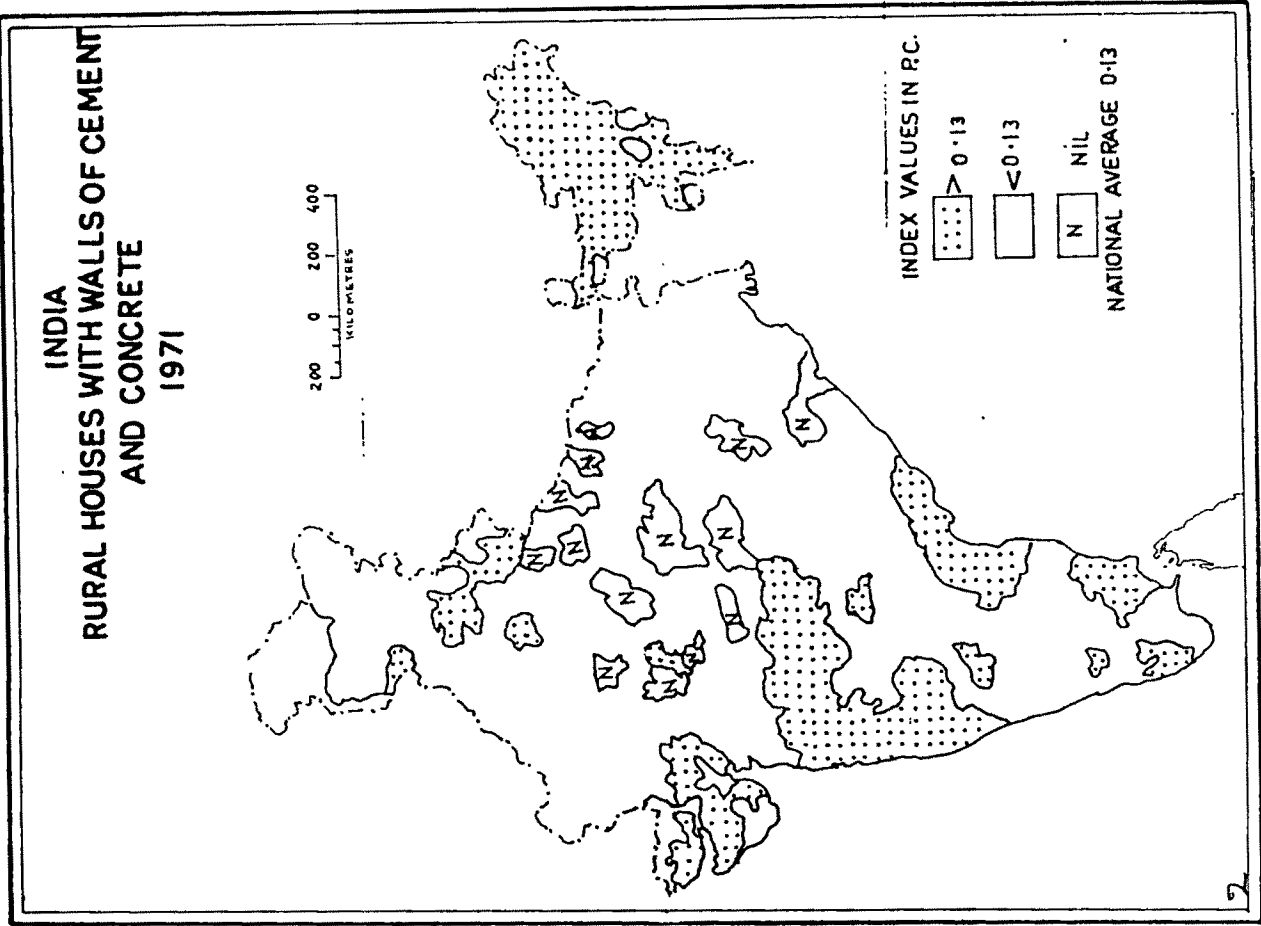


FIG. 55

basic reasons for their low rate of uses are :

1. the non-availability of these materials in the locality. The difficulty faced and cost of transportation of these materials from other areas are other discouraging factors;
2. for the use of these materials skilled labour needs to be hired which makes the construction cost high.

Because of the above mentioned reasons, an average man in the villages cannot afford to use these materials. Therefore, the use of these materials is limited to certain class of people.

The spatial distribution of houses having these materials for walls and roofs differ from place to place which is discussed below.

Use of Non-traditional Building Materials

a. Non-traditional wall materials

1. Galvanized iron sheets and other metal sheets constitute only 0.14 per cent of total rural houses. Map 55 gives the spatial distribution of their use for walls. This map shows two categories of places namely, (1) the places having above average rural percentages, and (2) places having below average percentages of this type houses. Two very

distinct zones of above average category emerge in this map. One is located in North Eastern Hilly states and the other is located in the western part along the coast of Maharashtra. There are some small scattered pocket areas in the Deccan plateau. One large pocket is found in Nilgiri (1.10 per cent). All other areas have below average percentage of rural houses falling in this category.

An analysis of the distributional pattern reveals that United Khasi and Jantia Hills have the highest percent which is 6.77 per cent and Cooch Behar (4.08 per cent) comes next. There are only 16 districts where the percentages of rural houses having walls of these materials are above one per cent. These are Meghalaya (3.89 per cent) , Andaman and Nicobar Islands (3.46 per cent), Darjeeling (2.34 per cent), Jalpaiguri (1.90 per cent), Nadia (1.46 per cent), Surat (1.43 per cent), West Tripura (1.43 per cent), Sirmaur (1.25 per cent), Kameng (1.22 per cent), Tirap (1.17 per cent), Nilgiri (1.10 per cent), Nowgong (1.02 per cent) and Thana and Goalpara (1.01 per cent) each. All other places fall in below 1 per cent category.

2. Cement and concrete as wall material form only 0.13 per cent of total rural houses in India (Fig. 55). The highest percentage is found in Darjeeling (5.59 per cent). Next in this category are Lohit (5.53 per cent) and Kohima (4.54 per cent). Nearly 16 other districts in India have above 1 per cent of rural houses having walls of these

materials. These are North Cachar Hills (2.92 per cent), Nagaland (2.75 per cent), Mokokchung (2.69 per cent), Tirap (2.52 per cent), Jalpaiguri (2.43 per cent), United Khasi and Jantia Hills (2.36 per cent), Arunachal Pradesh (2.25 per cent), Nowgong (2.06 per cent), Meghalaya (2.05 per cent), Garo Hills (1.66 per cent), Mikir Hills (1.66 per cent), Lakhimpur (1.40 per cent), Tnensang (1.22 per cent), Lachar (1.22 per cent), Kamrup (1.14 per cent), Darrang (1.04 per cent), Thana (1.01) and Goalpara (1.00 per cent).

From above, it is evident that these materials are not yet very common in the villages. The map shows two categories of areas namely, (1) the places having above average percentage of houses of this type, and (2) the places having below average percentage of houses having walls of these materials. The above average areas are located in three different regions. The first one is in the North Eastern Hilly states, while the second is in the coastal part of Maharashtra and the third is along the east coastal parts. Other areas falling in this category are scattered small pockets in the northern and western parts of the country.

b. Non-traditional roofing materials

1. Asbesto and cement sheets as roofing materials are used only for 0.40 per cent rural houses of India (Fig. 56). The percentages vary from place to place with its highest in Jalpaiguri (5.81 per cent). Next in this

category are Andaman and Nicobar Islands (4.69 per cent) and Rakhimpur (4.67 per cent) , Nilgiri (3.84 per cent), Dehradun (3.39 per cent) and The Dhangs (3.15 per cent) have between 3 to 4 per cent rural houses falling in this category. The districts having above one per cent and below 3 per cent are Darrang (2.81 per cent), Dadar Nagar Haveli (2.78 per cent), Darjeeling (2.56 per cent), Dhanbad (2.36 per cent), Indore (2.35 per cent), Sibsagar (2.34 per cent), Daman (2.28 per cent), Lacadive and Minicoy (2.00 per cent), Bharuch (1.98 per cent), Sundargarh (1.95 per cent), Mandi (1.89 per cent), Mahesana (1.86 per cent), Sabarkantha (1.79 per cent), Sirmaur (1.79 per cent), Keonjhar (1.53 per cent), Ahmadabad (1.45 per cent), Thana and Delhi (1.43 per cent), Puri (1.41 per cent), Bangalore (1.30 per cent), Valsad (1.16 per cent), Ahmadnagar (1.08 per cent), Baudh Khandmal (1.02 per cent), Koraput (1.02 per cent) and Ganjam (1.01 per cent). All other districts have less than 1 per cent rural houses falling in this category.

2. Reinforced brick cement and reinforced cement concrete are used for roofing of rural houses. On an average only 2.93 per cent (Fig. 56) of the rural houses in India have these materials for roofing with the highest percentage of 15.14 in Mahendragarh. Etah and Dhanbad have 14.68 and 14.45 per cent respectively. The districts having more than 10 per cent are Burdwan (12.67 per cent), Gurgaon (12.46 per cent), Jalaun (11.58 per cent), Etawah (11.25 per cent),

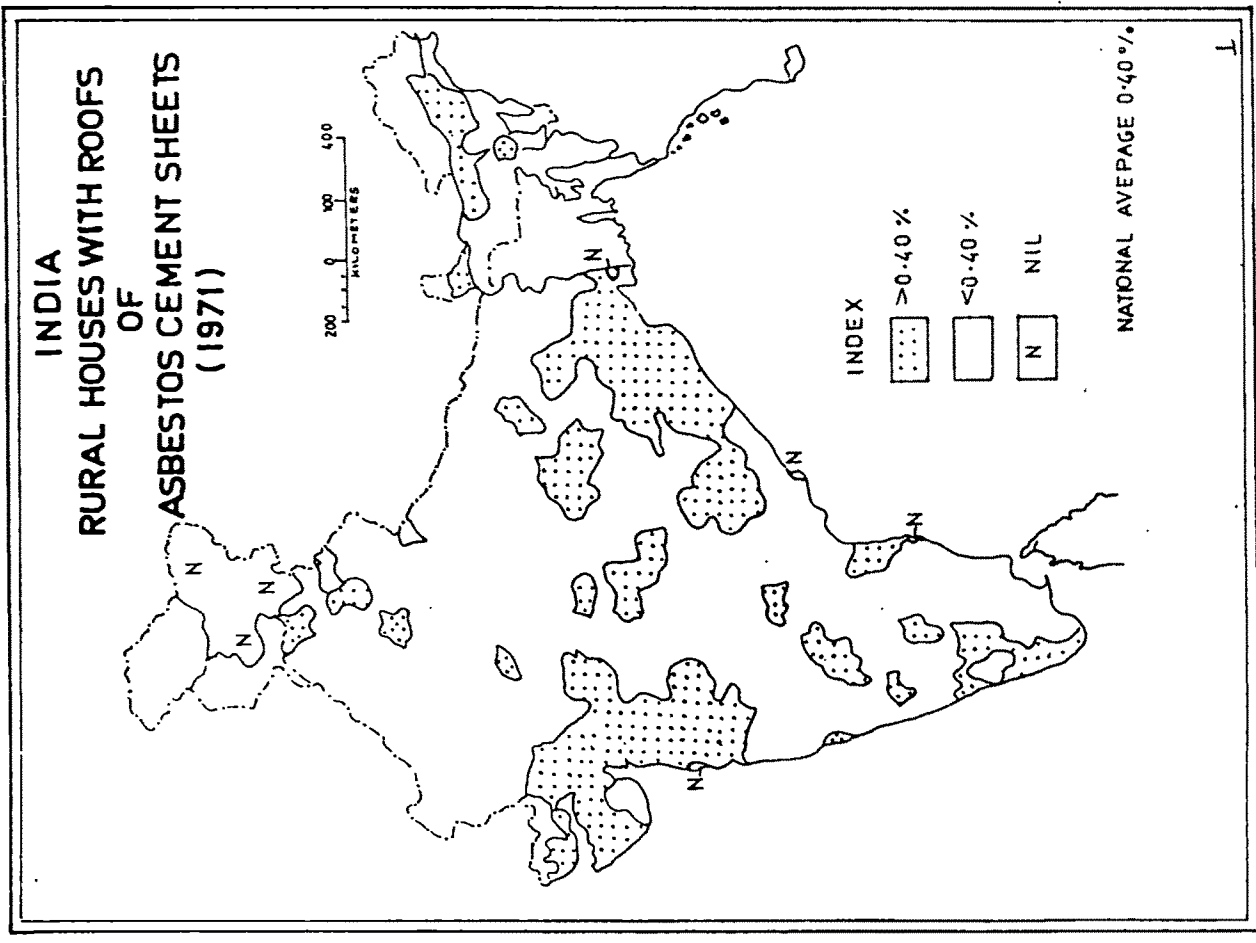
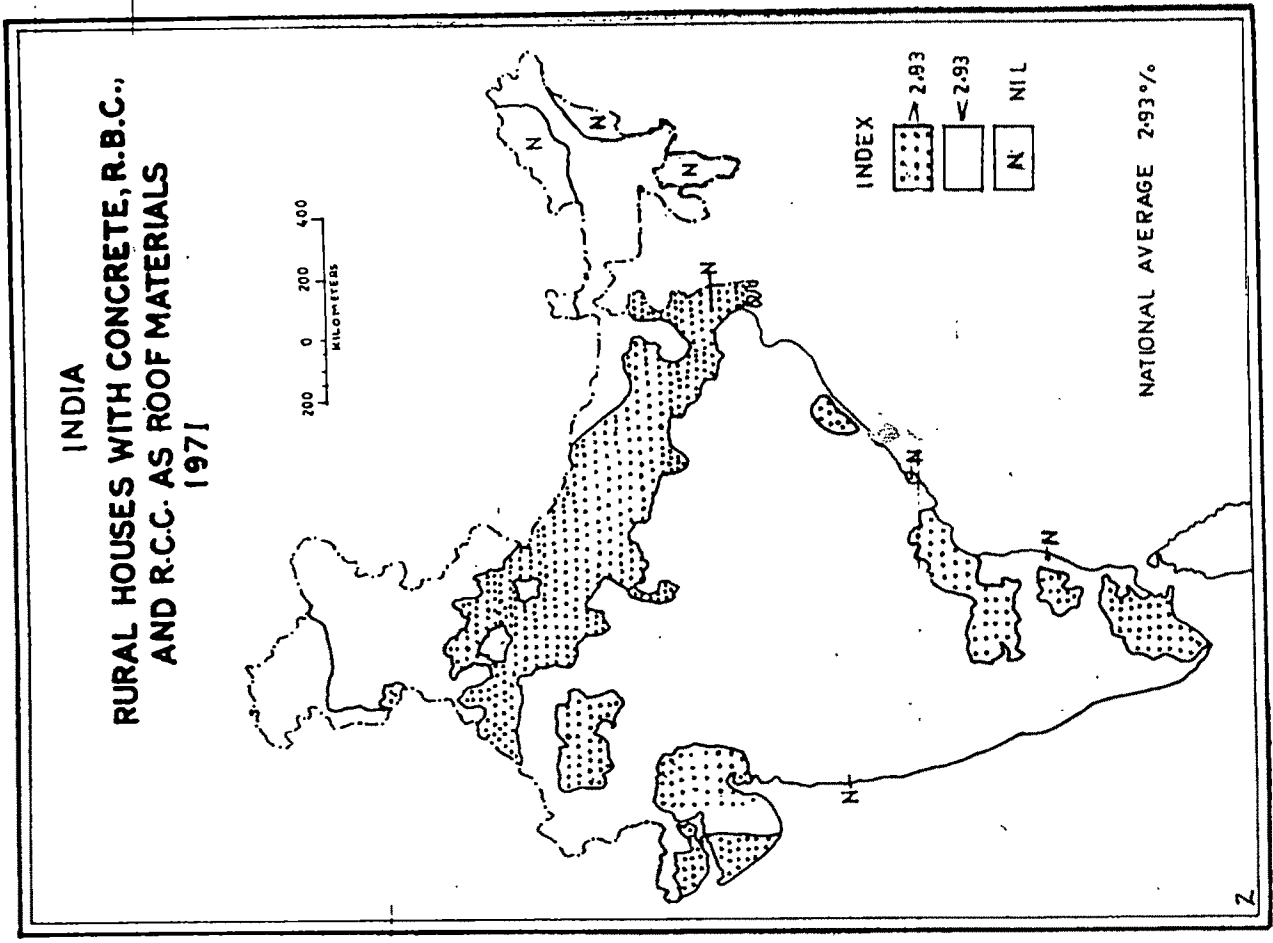


FIG. 56

Mainpuri (10.89 per cent), Dehradun (10.87 per cent) and Khera (10.39 per cent).

The Map 56, shows two categories of places namely above average and below average percentage of houses having roofs of these materials. A large belt of above average category runs from west to east in the northern plains covering vast areas in West Bengal, Bihar, Uttar Pradesh, and parts of Rajasthan. Small pockets are found in Gujarat coastal area and eastern coastal area. Almost whole of central India and western coastal plains fall in below average category.

3. Corrugated iron and metal sheets : These materials are very significant building materials for the construction of roofs of the rural houses. But on an average only 4.88 per cent of the total rural houses have roofs of these materials with its highest is Osmanabad (56.57 per cent). Other districts having more than 50 per cent of their houses of these materials are Parbhani (55.41 per cent) and Vadodara (50.61 per cent). The districts falling in the category of 30 to 50 per cent rural houses are Bhir (42.69 per cent), Akola (41.93 per cent), United Khasi and Jantia Hills (38.87 per cent), Yeotmal (35.14 per cent), Satara (34.38 per cent), Khera (33.78 per cent), Mahesa (33.70 per cent) and Bharuch (30.01 per cent). This districts falling in the category of 20 to 30 per cent are Bidar (29.75 per cent), Andaman and Nicobar Islands (27.47 per cent),

Jalpaiguri (27.20 per cent), Kohima (26.86 per cent), Meghalaya (26.14 per cent), Cooch Behar (25.88 per cent), Poona (24.41 per cent), Thana (23.78 per cent), Dehradun (23.76 per cent). Nearly 24 districts of India fall in the category of 10 to 20 per cent. All other places fall in below 10 per cent category of places.

The Map 57 shows the spatial distribution of such type of houses in two main categories namely (1) above average places and (2) below average places having roofs of zinc corrugated iron and metal sheets. The entire north-eastern hilly region falls in the category of above average percentages. Another area of this category is located in Maharashtra and parts of Gujarat. It is a fairly large area. Bidar in Mysore also falls in this category. All other areas fall in below average category of places.

From above discussions, it seems that new materials have not yet reached to the common village man. These are used by the rich only..

4. Tiles, Slate, Shingle as roof material : On an average 37.14 per cent rural houses have tiles, slate and shingle as roofing material which is quite high as compared to the other new materials. Such type of materials can be used as roofing of the houses having walls of mud, unburnt bricks, burnt bricks and stone. The roofs made of these materials are no doubt very costly, but are preferred by many people in areas where rainfall is moderate to heavy.

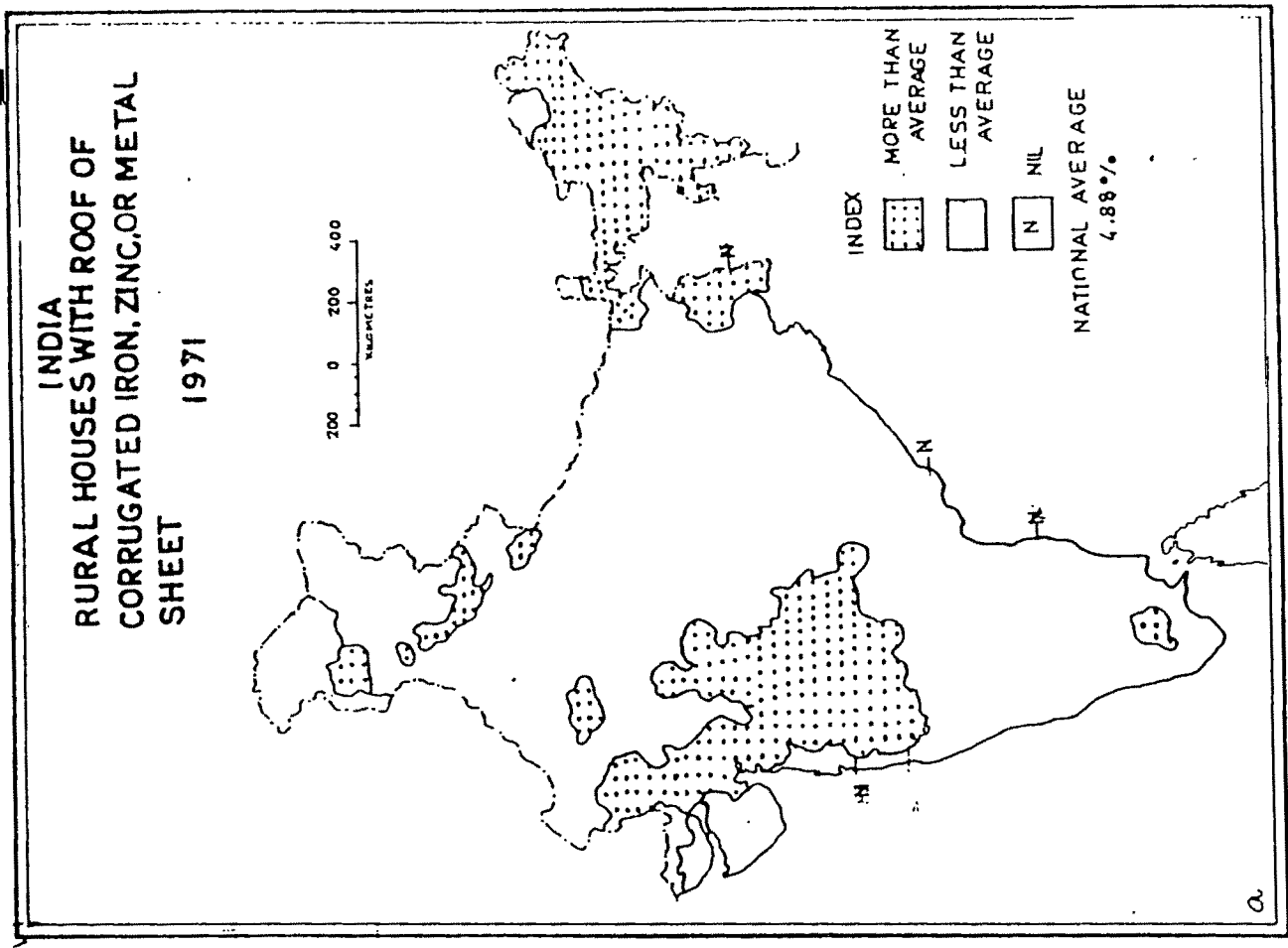
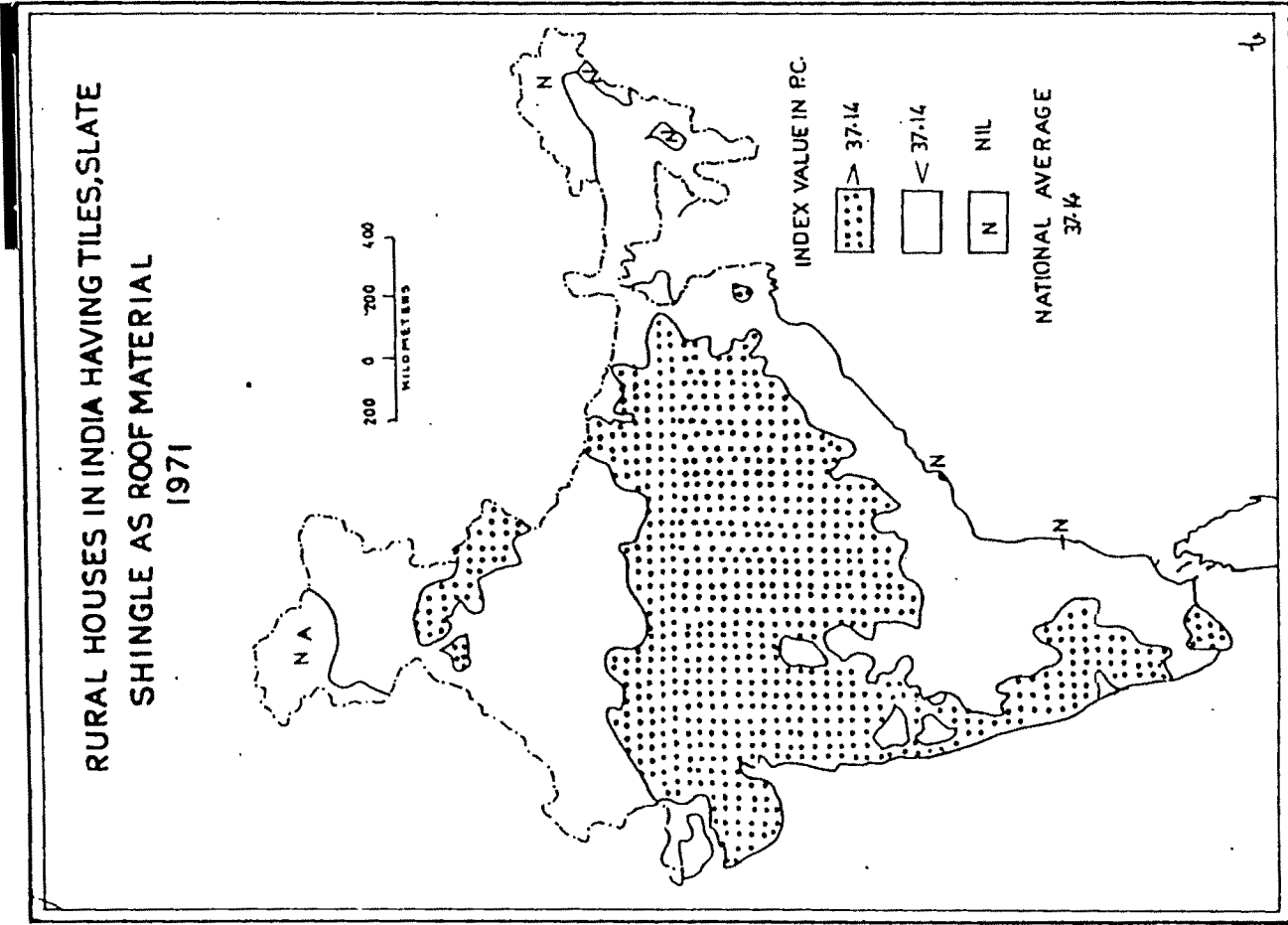


Fig. 57

The Fig. 57 gives the spatial distribution of such kind of materials used as roofing. The areas of its high concentration i.e. above average percentages lies in central part of India. This belt extends towards west along coastal plains of Gujarat and Maharashtra and in south it runs near Kanya Kumari along the west coast. Other areas are scattered and lie both in the north and south.