Chapter II: Research Methodology

The focus of this chapter is to define the methodologies used for the collection of data and their analysis for the research. Based on exploratory surveys, new sites belonging to different cultural periods were discovered in the research area. The shortcoming in the interpretation of the existing data for reconstructing the complex adaptive strategies is one of the major reasons for undertaking the current surveys. The data from these sites when analysed helped in the understanding of the approaches considered by the people at different periods in the past from a settlement pattern perspective. The explorations resulting in the discovery of sites can also be used for the reconstruction of environmental, cultural, and ecological preferences by the early settlers. These aspects play a key role in defining the features of settlement pattern in a region. The reconnaissance surveys are also helpful in unravelling general characters of the settlements in the varied landscape of the region by helping to understand the nature of the site, its functional dimension, chronological sequence, the inter and intra site interactions etc. The above information was recorded on the field and visually presented using Earth observatory data, primarily Google Earth.

From these explored sites, material culture in the form of artifacts was recovered. Material culture is an umbrella term including objects that can be utilitarian or with aesthetic value (Patnaik, 1995). From the research area however, artifacts included antiquities and ceramics. The former category as such can vaguely be assigned to any specific cultural period essentially when explored from the surface. On the other hand, pottery, even if retrieved from explored context is invaluable in assigning chronological frame to the site. Therefore, the methods adopted to classify and analyse ceramic data is also part of the methodological framework.

The comparative analysis of the explored pottery was initially done using intra site comparative method i.e., with the excavated sites of the area. However, owing to the lack of published data from the excavation in the region for comparative analysis and ambiguity in defining the periods based on ceramic terminology, the method of inter site comparative study was thought to be relevant for the current investigations. Hence, detailed examination of the material excavated from close-by sites of Sanghol and Ropar became important. In addition, scraping the sections from two sites of the research area – Biyan Tibba and Satowali, was another method employed for ascertaining the stratigraphic context of artefacts and their cultural and chronological sequence. This became crucial for understanding the spatial and temporal development of the settlements in the area.

Application of the scientific techniques like XRF, SEM and ICPMS in analysis of specific artefacts like pottery is also one of methodologies adopted for this research. Primarily targeted to understand the cultural position of glazed ware in the research area including its provenance, these scientific analyses, on a broader level, highlighted the cultural interactions and material acquisition processes within the research area (Appendix I). This resulted in the development of understanding regarding the basic strategies adopted by the people inhabiting the area for the procurement of essential commodities for the day-to-day activities. In addition, the networking of different sites explored in different ecological niches for the appropriation of resources was also understood to a certain extent thereby helping to understand the settlement strategies more clearly.

Ethnoarchaeology as a helping aid of the current research is also probed into. It indeed helped in untangling the complex yet simple logical patterns (e.g., certain apparent stylised operations in pottery manufacturing techniques strictly taken as decorative patterns) which could be reinterpreted only when

ethnoarchaeology is taken into consideration. Ethnographic data when seen in conjunction with scientific data helped to understand the general pattern of resources procurement niches in the plains of Jammu and Punjab. This is discussed in Appendix II.

II.1 Exploration

The district of Jammu, as discussed in the previous chapter, comprises of four tehsils – Jammu, Bishnah, R.S Pura and Akhnoor (Fig. II.1). The former two, owing to urbanised landscape and time limitation, weren't thoroughly explored. However, the two potential pockets of Jammu district, i.e., tehsil of Ranbir Singh Pura (RS Pura) and Akhnoor, were surveyed. These two areas essentially had been subjected to investigation by the Archaeological survey of India and documented in various IAR reports from 1961 onwards.

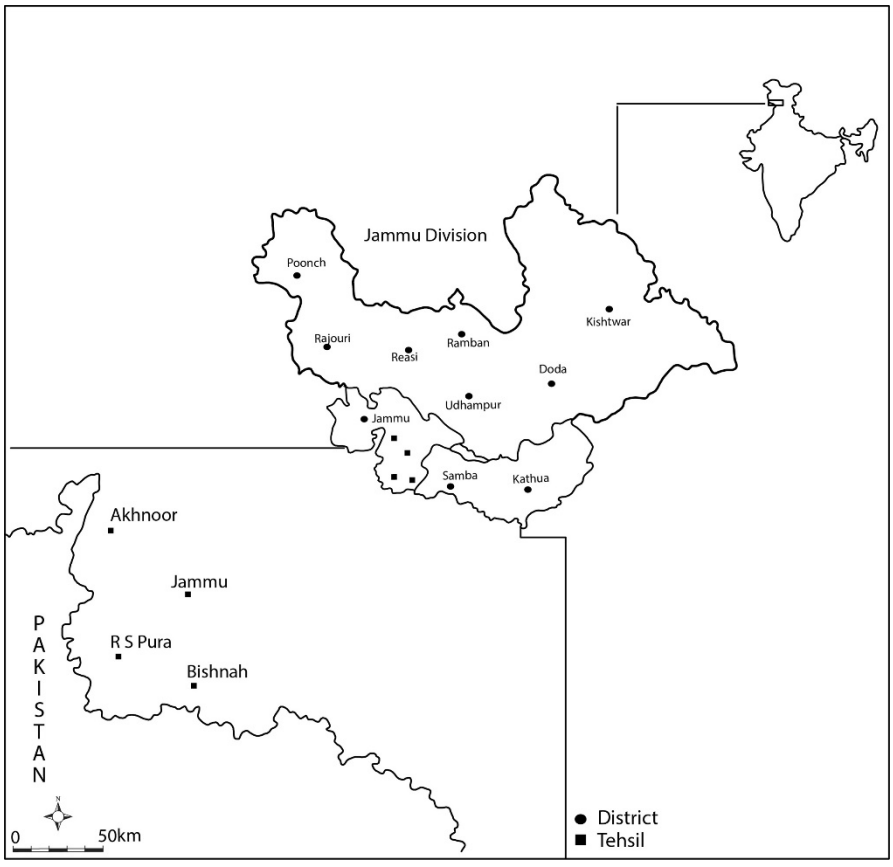

Figure II.1: Location of Jammu district and its Tehsils

However, the archaeological potentiality of some of these documented sites was further explored by the researcher after revisiting them. These sites were redocumented taking attributes like geographical settings, proximity from the nearest water source, size of the site etc. into consideration (Fig. II.2).

Archaeological Exploration in Outer Plains of Jammu

Date:	**Site Data**
Form No.:	**Recorder:**
Site No.:	**Photo No.:**
1. Site Name:	**2. Abbreviation of Site:**
3. Co-ordinates:	**LAT: LONG:**
4. Exact location of the site:	**5. Toposheet No.:**
6. Taluka: District:	**7. Number of Mounds:**
8. Nature of the site:	
9. Extent of the site:	**E-W: N-S:**
10. Thickness of the mound:	**11. Shape of the mound:**
12. Name of the River	
Tributary:	
Lake:	
Meander:	
Others:	
Left Bank:	
Right Bank:	
Distance of the site from the riverbank:	
13. Ownership of the site:	**14. State of site preservation:**
15. Surface Observation:	
16. Surface Finds:Pottery: Bag No.:	
Other finds:	
17. Ceramics Identifiable:	**18. Probable Chronology:**
19. Ethnographic data if any:	**20. Local Informer:**
21. Other details (later additions):	

Figure II.2: Field documentation form used for the sites visited by the researcher

Additionally, with the help of survey of India maps, Google Earth images and the existing archaeological data, the areas with the probability of an archaeological potentiality were shortlisted, and then explored by the traditional village to village foot survey. Since the plains of Jammu follows both Kharif and Rabi cropping patterns, the months of October to November, and May to June were chosen for surveys as the land is kept fallow during these months.

Some areas of RS Pura and a few of Akhnoor gave evidence of a number of visible mounds with scattered artifacts all over. Defining a site in this case was relatively easy, but in mound-less agricultural areas, less pottery in term of quantity but indicative of a particular period was encountered. Therefore, defining a site in such cases became difficult. A similar case study was observed in the hinterlands of Rakhigarhi (Green et al., 2019: 10) where an archaeological site was defined "as a minimum of two artifacts or features of verifiable antiquity within five metres of one another". Hence sites in the research area where there are no archaeological mounds, were defined by the presence of identifiable cultural material of quantifiable amount. The existence of a site in such areas was also confirmed through the villagers especially the old generation who would have the record of such mounds in their distant memories. Multiple localities of the same site were defined when the concentration of artifacts was found to be reasonable moderate at different spots. The pottery belonging to the period from Harappan (?) to CE 10-12th century and other artefacts were collected. Harappan period is questionable owing to the meagre amount of material culture explored from the research area.

Collection of data was based on random sampling method in the initial phase, followed by selective sampling method. Selective sampling method was followed primarily for pottery collection to highlight major trends in the area e.g., impetus of trade in Jammu during the early historic period, spatial distribution of sites belonging to different cultural periods etc.

The diagnostic sherds (rim/base sherds, painted sherds, and other decorated sherds) along with the antiquities were collected and were subjected to further analysis.

The explored data by the researcher and the ceramic data documented in IAR reports when combined produced a dataset which was effectively used to build

up the settlement pattern and chronology of the area. These potsherds, as Shepard (1956) aptly observes, are abundantly found, and have varied variables which can be justly used for setting up relative chronology. The sherds were attributed different cultural periods based on inter-regional comparative analysis, index site referencing, comparison with the pottery from two scraped sections and cross regional analysis.

II.1.1 Intra-regional Analysis

For intra-regional comparisons, pottery housed in the Akhnoor Fort and the ASI regional office Jammu was accessed, and observations on chronological time frame were made. There were, however, challenges in using this as reference material, as has been already mentioned. Due to the lack of published reports of these sites, photo documentation or drawings of the pottery was not allowed. In the absence of regional comparable dataset, the adjoining sites of Ropar and Sanghol were chosen as index sites for artifact analysis.

II.1.2 Index Site Referencing

The sites of Ropar and Sanghol in Punjab were taken as index sites for fixing the chronological framework of the research area. Even though these sites do not fall within the present research region, the study has to depend on these two sites because of the absence of published report of the excavated sites from Jammu. The brief reports of excavations and explorations published in IAR the annual journal of the Archaeological Survey of India is inadequate and unclear for a comparative study of cultural sequence. Thus, these two sites lying in the vicinity of the research area were taken, mainly because of their relatively well described and illustrated stratigraphic sequence and the similarity of their overall cultural assemblage with the sites in the research area. The excavated materials from these two sites now stored in Safdarjung tomb, Purana Qila, Ropar Museum, Sanghol Museum, Directorate office Chandigarh, and Qila

Mubarakh Patiala were studied and were photo documented for preparing the reference data.

II.1.3 Section Scraping

To ascertain the stratigraphic sequence of the area and to check the classification of the pottery from the explored sites in the proper chronological context, two sites were shortlisted for section scraping. The sites of Biyan Tibba and Satowali were chosen essentially because of the promising material culture found from the surface, and due to the digging activities by the locals at these two sites.

The method was helpful as it gave a proper stratigraphic distinction between the pottery belonging to different periods. Scraping of the section was helpful in sequencing the chronological framework of the research area. With the help of the new data, the ill-defined/unclear terminologies used in the earlier excavations were verified and the cultural chronological position of the newly explored sites were integrated into a framework for holistic development of cultures in the area.

The charcoal samples found from these sections proved to be of utmost importance as it gave a scientific background to the relative chronology based on the pottery. Three samples giving two specific dates of 4th-3rd century BCE and 1st century BCE – 1st century CE were particularly helpful in defining specific pottery vessel forms corresponding to these timeframes.

II.1.4 Cross Regional Analysis

In addition to the above methods, the analysis of the artifacts for chronological sequencing of the site was further done by comparing them with the excavated material from adjoining areas of erstwhile Punjab, Haryana, Rajasthan, Gujarat and the Gangetic Plains. The colour of the pottery, colour of the slip and painting were documented using Munsell soil colour chart. On the basis on

fabric, texture, shape, firing and decorative patterns, it was attributed to different cultural periods. Pottery and other artefacts were documented through photographs and drawing. Selected potteries and artefacts were drawn for highlighting their distinct features and digitally documented using Adobe illustrator and Adobe Photoshop.

II.2 Scientific Analysis

Different methods of scientific analyses such as SEM, XRF and ICPMS are used in the study of pottery specially to address specific issues related to local vs non-local production, inter-regional interaction etc.

The relevance of these scientific methods in the research area was found to be useful when investigation the following research problem.

One of the distinctive and rare pottery found during the exploration in the research area was the glazed ware. Being rare, the question of whether this pottery was indigenously made or imported from somewhere outside therefore became important to probe into. For this objective, the scientific techniques of XRF and ICPMS were performed. In addition to get the high-resolution images of the glazed pottery and for its elemental identification along with its composition analysis, SEM with EDX was done.

The ceramic assemblage comprising of red ware (crude ware, Black on red ware and un-slipped red ware) and grey ware, collected from two areas – Akhnoor and R.S Pura, were elementally compared with glazed ware. The red ware is the product of local manufacturing process and therefore provided an index material to compare the glazed ware with local clay. Apart from sites in Jammu, pottery from Bara and Sanghol from Punjab were also subjected to analysis to check their elemental composition. In addition, XRF analysis already done on the ceramic assemblage of Sanghol, Punjab (Kumar et al., 2006) was used for the current study to see if there is any deviation in the elemental composition

of the pottery from the peripheries of Punjab (i.e., Jammu) and mainland Punjab (Sanghol). The data for the analysis is provided in Appendix I.

II.2.1 XRF

The technique of XRF (X-Ray Fluorescence) as an aid to archaeology is helpful for ascertaining the provenance of the artifact. The artifact under investigation was the glazed ware and the local red ware was taken as a comparative dataset. The red ware sherds from the sites of Punjab were included primarily to compare the result of the analysis of glazed ware from Jammu with the pottery of the geographically similar area of Punjab. Total of 32 samples were taken for the XRF from 7 sites (5 Sites from Jammu and 2 sites from Punjab) from explored sites as well as from the sections exposed in the section scraping. In the case of glazed ware, the glazing from both the sides was removed using 180 and 400 grit size sandpaper.

These samples were further divided into 8 groups, A to H, based on the context, ware and area (Appendix I).

Small samples were cut using a carbide saw from the big sherds. For eliminating any residue, the samples were washed with distilled water, and further cleaned in a sonicator (ultrasonic bath sonicator) for about 20 minutes and dried in Sadko Oven at 70℃ for about 3 hours.

The samples were then finely powdered to the Mohs hardness scale of 1 using Ball Mill (Retsch Planetary Ball Mill PM 100). The samples were ground for approximately 40 minutes.

After the powdering, an amount of 5gms of sample was taken and mixed with 2gms of binder (wax). A homogeneous mixture was prepared with the help of agate mortar and pestle. This mixture was then filled in aluminium cups, already filled with a layer of binder in an approximate proportion of 7:3 (70% binder and 30% sample). This is essentially done to concentrate the penetration

depth of X- Rays to the sample. The aluminium holders were then subjected under the pressure of 150 kilo newton by using a hydraulic press for about 2 minutes. The resultant pellets were subjected to WDXRF for the analysis.

The standard used to check the reproducibility was USGS SDO 1. The result of the analysis is given in Appendix I.

II.2.2 ICPMS

The ICPMS analysis was done to measure the rare earth elements, which are also helpful in identifying different provenance patterns. Nine powdered samples, out of the earlier 32 XRF samples were selected for the ICPMS analysis. These samples were put in an oven at 80 ℃ for about one hour and thirty minutes for any moisture to evaporate. The samples were weighed 50 mg each. After weighing, the samples were treated with 2 ml solution of hydrofluoric acid (HF), and Nitric acid (HNO_3) mixed in the ratio of 1:2 respectively. The mixture was then put in an ultrasonicator for about one hour to essentially separate independent grains from each other for the acid to react properly. The samples were then transferred to the hot plate to dry. After the complete drying of the mixture, which took approximately six hours, the samples were again treated with 8% HNO_3 solution (at least treated twice) and left for drying. After this, the solution was treated with 2 ml aqua regia (0.5 ml HCl+1.5 ml HNO_3). The solution was again kept on the hot plate to dry for approximately six hours. After this, the sample was treated with 2% normal HNO_3 solution again and centrifuged for five minutes.

The desired sample thus obtained was transferred in a 50 ml centrifuge tube and make up till 50 ml with 2% HNO_3. Finally, 1 ml of sample was taken with the help of a pipette and make up till 10 ml with 2% HNO_3. The samples thus obtained was run for ICPMS analysis. The standard used is BHVO (Basalt Hawaiian Standard). The data of the analysis is given in Appendix I.

II.2.3 SEM-EDX

For high resolution images, along with the compositional information of the material under investigation, the method of SEM-EDX was used for the glazed ware. Two sherds of glazed ware were subjected to investigation for SEM-EDX. The samples were cut from the sherds using diamond coated saw and were cleaned by using deionized water and alcohol. Both the surfaces of the sherds were coated with 40nm thick gold film for examination under a scanning electron microscope.

The SEM (JSM IT-300LV Joel Machine) coupled with an Oxford-Link Germanium ISIS energy- dispersive spectrometer (EDS) was used for this analysis. The operating conditions for the SEM were 15 KeV accelerating potential, 600 pA probe current, 2500 cps as average count on the whole spectrum, count time 100s. The X-Ray intensities were converted to wt.% oxides by- ZAF4/FLS qualitative analyses software support provided by Oxford-Link Analytical (UK). Multiple points and area of around 50 μm were analysed. The result of the analysis is summed up in Appendix I.

These three different methods, therefore provided a wide range resolution of elemental data, which proved to be helpful in provenance study of pottery of the research area.

II.3 Ethnoarchaeology

Ethnoarchaeology is an extremely powerful tool when the archaeological patterns become unclear to break down. These patterns in archaeological context are important in reconstructing the social dimension of the cultures in question.

The objective of ethnographic documentation of the potter community in the research area was essentially to understand the social context of the pottery production and use. The study of the present-day practices of the population

residing in the outer plains of Jammu helped in understanding the archaeological patterns of the past. The study of the traditional pottery making in the research area was carried out to understand the stages and techniques of ceramic production and to document markers of specific technique and their social context. In addition, the question of functionality of certain elements in the explored pottery e.g., application of mica on some portions of certain sherds and some of the base sherds with metallic intrusion were answered solely with the help of ethnoarchaeology. This is discussed in Appendix II.

Villages in RS Pura and Akhnoor were chosen for documentation. The community of potters live in vicinity to each other, and the shapes and designs made by one house in the village are like all the other potters. Hence, the samples were randomly selected and recordings about the entire process of pottery making was carried out. A questionnaire was prepared which is as follows:

Questionnaire for the ethnographic survey of the pottery manufacturing techniques in Jammu

1. What kind of soil is used for the manufacturing of pottery? What are its characteristics?
2. How is the soil obtained? What is the depth from where it is taken out?
3. How is the soil transported? What is the cost of the soil?
4. What kind of soil is used as slip? What is its cost and what is the source from where it is got?
5. What are the different decorations on the pottery? Are those all patterns decorative or are some of them functional as well?
6. Is there any substitute for the soil used as slip?
7. What is the process of making the pottery?
8. What are the other instruments used in the process of pottery making?

9. How many kinds of kilns are there? What is the raw material used as fuel in the kiln?
10. How many vessels can a kiln hold?
11. How many times in a year is the kiln active?
12. What are the types of vessels made?
13. How is the pottery transferred to the market?
14. Is there any specific caste of the potters?
15. Are the vessels used for any special function e.g., marriage, death etc.? Are the pots worshipped?
16. Is there any other occupation that the potters follow?
17. What is their average earning from pottery making?

These adopted methodologies for the current research proved to be helpful in addressing the research objectives. The results obtained because of the application of these methodologies therefore was useful in generating the complete picture of the settlement patterning, chronological cultural adaptative strategies and inter/intra site exchanging phenomenon of the region of Jammu through the length of the time.