Developing Lexico-Semantic Relations of Saraiki Nouns: A Corpus-Based Study

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Article Info	Abstract
	Abstract Saraiki, being the fourth most widely spoken language in Pakistan and being used in some parts of India and Afghanistan, is of significant geographical, historical, and cultural importance. However, it remains neglected in terms of proper documentation and identification of its unique linguistic features. The current study is centered on identifying the lexico-semantic categories of Saraiki nouns and then developing their hierarchical relationships (Miller et al., 1993). This quantitative research is designed to contribute to the process of developing Saraiki WordNet and is related to Natural Language Processing (NLP). A corpus of 3 million words was developed on the basis of data collected from different genres of the Saraiki language, including newspapers, academic essays, literary texts, and religious books. Both expansion and merge approaches were used to analyze the data. A wordlist of 1500 most occurring nouns was extracted from the corpus using Antconc 3.4.4.0, followed by manual tagging in Microsoft Excel 2010. Resultantly, 39 most occurring nouns from the wordlist were used to develop 173 related synsets, and lexico-semantic relationships among these nouns were identified with the help of 30 hierarchies (Miller et al., 1993). This study is limited to areas like Bahawalpur, Multan, and Muzaffarabad. It would be a milestone for Saraiki language learners, SWN development, Saraiki lexical resources, online SL dictionaries, and a guide for researchers.

1. Introduction

Saraiki is one of Pakistan's regional languages. Saraiki language has a concrete similarity with some other languages in Pakistan, such as Punjabi and Sindhi. Moreover, the Saraiki language is spoken in both southern and Northern areas of Pakistan (Asghar, 2021). It has passed through many developmental phases to reach its current version. Saraiki language is the representation of definite culture that is the combination of some other cultures such as Indus Valley culture, Persian culture, and Muslim culture. Therefore, the Saraiki language based on its unique ethnicity demanded its independent lingual identity in Pakistan during the 1960s (Hashmi and Majeed, 2014). It is also pertinent to mention that the Saraiki movement started years ago has been gaining momentum and appears quite successful in achieving some of its core objectives. It led to the acknowledgment of Saraiki as a separate language and culture (Mushtaq and Shaheen, 2017).

In Pakistan, Saraiki is spoken by 25 million people, and almost one million people speak this language in India (Alam et al., 2023), but in computational linguistics and online linguistic resources, it is greatly neglected. Hence, the current study serves to bridge this gap by working on the Saraiki lexicon, specifically nouns. This study is designed

to develop nominal synsets and identify lexico-semantic relations among nouns of Saraiki lexicon. This is highly specified investigation as it is focused on Saraiki used in central Punjab-specific regions such as Bahawalpur, Multan, and Muzaffarabad. To accomplish research objectives, the researcher will consult different texts such as books on language and literature, newspapers, and article-type material because of the authentic usage of vocabulary in the mentioned areas.

WordNet is a lexical database that organizes words and their meanings into a semantic network. It achieves this by grouping words into sets of synonyms called "synsets." Each synset represents a distinct concept or meaning, and words that are synonymous in a given context are linked to the same synset. For instance, in WordNet, both "automobile" and "car" are associated with the synset that represents the concept of a motor vehicle.

1.1.1. Synset Creation

WordNet organizes words into sets of synonyms called "synsets." A synset is a collection of words that share the same meaning or concept (Miller et al., 1993). For example, the synset for "vehicle" might include words like "car," "automobile," and "truck." Synsets are created by grouping words with the same sense tag.

1.1.2. Gloss

Gloss is specifically used to describe the concepts. It is divided into two parts:
- Text Definition (explains concepts)
- Example Sentence (tells usage in the sentence)

1.1.3. Lexico-semantic Relationships

WordNet includes complex or in-depth lexico-semantic relationships, which are the type of relationships or links that bind two or more words based on their meanings (Miller et al., 1993). Lexico-semantic relationships play a significant role in synset formation as identifying multiple senses. WordNet defines several semantic relationships that connect synsets. These relationships may exist mainly among parts of speech, such as nouns, verbs, adverbs, and adjectives. The relationships that exist among different words based on their meanings are synonymy, antonymy, meronymy, holonymy, hyponymy, hypernymy, troponymy, and entailment (Miller et al., 1993).

1.1.3.1. Hyponymy/Hypernymy

Hypernymy is a relationship where a word is a more general term that encompasses the meaning of more specific words (Miller et al., 1993). For example, "Nabi" (prophet) and "Paghamber" (messenger) are hyponyms of the hypernym "Rasool" (divine messenger). Moreover, "Hajj" is a hyponym of the hypernym "Ibadah" (worship), indicating a specific type of worship in Islam.

1.1.3.2. Synonymy

Synonymy exists when two or more words have similar meanings. In this context, there might not be direct synonyms for specific religious terms like "Allah" (God) or "Hajj" (Islamic pilgrimage), but there can be synonyms for general terms like "Nabi" and "Rasool."

1.1.3.3. Meronymy/Holonymy

Meronymy is a relationship where one word refers to a part of something, while holonymy refers to the whole (Miller et al., 1993). For instance, "Maseet" (mosque) is a meronym of "Islam" because it is a part of Islamic religious practice. Similarly, "Zakat" (obligatory charity) is a meronym of the holonym "Sadaqah" (charitable giving) in the context of Islamic financial practices.

1.1.3.4. Antonymy

Antonymy refers to words that have opposite meanings (Miller et al., 1993). For example, "Neiki" (goodness) and "Gunah" (sin) are antonyms.

1.1.3.5. Troponymy

Troponymy is a relationship where one verb describes a manner of doing something related to another verb (Miller et al., 1993). For example, "Tarbi" (education/upbringing) could be a troponym of "Amal" (deeds/actions) if it implies a specific way of performing actions based on upbringing.

1.2. Objectives

The objective of the undertaken study is to;
- to identify the lexico-semantic categories of Saraiki nouns and then to develop their hierarchical relationships.

1.3. Questions

This research deals with the following research questions:
1. How many categories of nouns are there in general in Saraiki Language?

2.   What processes are involved in synset creation?

3.   How many lexico-semantic relations are there in nouns of the Saraiki Language?

It would contribute to computational research on Saraiki Language, specifically Natural Language Processing (NLP). It would enhance and elaborate the meaning of words in the Saraiki Language by synonymy, variety of senses, gloss, and relevant examples. This research will be of great use to Saraiki language learners, teachers, SWN development, Saraiki lexical resources, and online SL dictionaries.

2.   Literature Review

WordNet development process involves word selection that is succeeded by sense identification, which consequently results in their usage documentation (Zafar et al., 2012). WordNet lacks etymological information about words; it also includes all words irrespective of their offensive meanings. Moreover, it lacks pronunciation of words and domain-specific words/terminologies (Devopedia, 2020). Usually, WordNet of any language can be developed either manually or by automated methods. Suppose both methods of WordNet development are compared. In that case, the manual method is considered more accurate despite being a time-demanding and labor-demanding procedure, while the automated method is comparatively less accurate and requires expertise in technology.

WordNets are lexical structures developed by synset creation and lexical-semantic relations (Malotra, 2018). Synsets are the building blocks of wordnet, Which are the sense-based relationships among words that assist with gloss formation. A synset is best formulated considering three basic principles of semantic relations i.e., the principle of coverage, the principle of minimality, and the principle of replaceability. Some synsets are developed by either expansion or merge approach, whereas some are developed by hybrid approach (Gull, 2019; Asghar, 2021).

In the Expansion approach, there are two groups of languages i.e. target language (TL) and source language (SL). This approach utilizes an already established functional language WordNet as its source (Desai et al., 2010) which is also called source language (SL). The constructed wordnet is related to the target language (TL) means the language under processing while the source language assists TL in WordNet construction by providing synsets of SL. These already-developed SL systems are translated and used by TL. The expansion approach is highly significant as the resultant WordNet becomes the part of *Interlingual Index* (ILI) which assists multilingual applications by providing similarity of concepts among various languages (Asghar, 2021). Therefore, it can be said that the synsets of TL are developed with the assistance of SL. This is because SL presents already developed synsets and related glosses for referential support to TL.

The merge approach is relatively different than the expansion approach as it lacks the requirement of some source language but works solely on the target language. It is purely a principle-based approach as it emphasizes the strict following of all three principles of synset creation i.e., coverage, minimility and replacability (Asghar, 2021). This approach needs a wide collection of dictionaries and language for which Wordnet is being created. This wordnet would act as a base Wordnet for future research. The synset creation is not affected by the influence of any source or neighboring language as the synsets are based only on the information provided by the dictionaries and contextual information about the target language.

A WordNet provides different senses and inter-relationship of words based on their meanings within a particular language. Miller stated that based on semantics certain lexical relations may be found in any WordNet i.e., synonyms (similar meanings), antonyms (opposite meanings), hypernymy and hyponymy (dependent & independent), meronymy (meanings as part of some other meaning), holonymy (whole meanings), troponymy (meanings in manner) and entailment (implied or deduced meanings).

Table 2.1

Representation of Lexico-semantic Relations in WordNet. (Miller et al. as cited in Asghar, 2021).

Relations	Syntactic Category	Examples
Synonymy (similar)	N, Adj, V, Adv	flat, apartment fair, just melt, dissolve hardly, barely
Antonymy (opposite)	Adj, Adv, (N, V)	good, bad,harmful, harmless,hardly, softly, quickly, slowly
Hyponymy/ Hypernymy (subordinate and superordinate)	N	cricket, sport, wheat, crop, shirt, clothing

Meronymy/ Holonymy (part- whole)	N	car, wheel, house, room, hand, finger
Troponomy (manner)	V	communication, talk, speech, talk
Entailment	V	snore, sleep

N= noun V= verb	Adj= adjective	Adv= adverb

In Pakistan, researchers have started to explore the semantic, syntactic, and morphological aspects of neglected languages like Saraiki and Punjabi. In this regard, a recent contribution is of M.F. Arslan et. al. (2023) in which they provided the morphological description of nouns in Shahmukhi Punjabi. Whereas, Saraiki language is totally deprived of any corpus study for WordNet as a group of researchers has initiated this task to develop Saraiki WordNet (Gull, 2020; Asghar, 2021). Therefore, this research would be economic contribution in this regard.

3.   Research Methodology

Current study follows a triangular approach as it aims to identify lexico-semantic relationships and hierarchical representation of these relationships among Saraiki Nouns

The whole procedure could be categorized into four phases such as data collection i.e. corpus development of Saraiki. The second phase involves the POS tagging of the corpus which is followed by the third phase is the categorization of nouns i.e. types, morphology (suffixes), and lexico-semantic relations. Afterward, in the fourth phase, synsets of Saraiki nouns were developed, followed by hierarchy formation to represent lexico-semantic relationships. Nouns of the Saraiki language were categorized according to two frameworks, the first framework from *A Descriptive Grammar of Hindko, Panjabi, and Saraiki* specifically the portion of nouns, whereas the second framework for the current study was Wren & Martin's High School Grammar & Composition.

Table 3.1*Disciplines used in Corpus Formation*

Serial No.	Disciplines used in the study
1.	Religion (Translation of Holy Qoran)
2.	Prose (Autobiographies, essays, diary, geography, general knowledge, magazines, and personalities)
3.	Fiction
4.	Poetry
5.	News or media
6.	Saraiki Linguistic books (Zuban or lisaniat)

3.1 De Gruyter Mouton's Framework of Saraiki Nouns

Bashir et al. (2019) gave a multidimensional description of Saraiki nouns, but due the time constraints current study was limited to De Gruyter Mouton's framework of Saraiki Nouns. It focused on morphological indicators such as suffixes to identify different categories of nouns such as common, proper, abstract, and gender of nouns including animate and inanimate (as a whole due to this framework current dissertation contained a detailed discussion on different classes of gender).

3.2 Semantic Categorization

Semantic categorization was the first step after the creation of a noun list, where nouns were directly placed or manually randomly added from the corpus. Semantic categorization is the step where these nouns are arranged and grouped according to certain nominal classes known as nominal or semantic categories. For example, nouns or lexical itemsدماغ، زبان، لہو، گیچی were placed in a single class/category (جُسےدے حصے). This semantic categorization was effective in two ways, first in synset formation and second in developing lexical relations for the hierarchal representation. The summary of lexico-semantic categories of nouns is given in Table 3.2;

Table 3.2*List of semantic categories of Saraiki Nouns*

Sr. No.	Semantic Category	Total Nouns	Sr. No.	Semantic Category	Total Nouns
1	زؤرات (Jewels)	22	18	فصل(Crop)	15
2	مشروبات (Drinks)	14	19	کیڑے (Insects)	16
3	جُتی (Shoes)	10	20	سنگھار (Makeup)	9

4	زانوراں دیاں بیماریاں ('Animals' Diseases)	6	**21**	درخت (Tree)	14
5	سکے /ٹبر (Family /Relations)	63	**22**	دین (Religion)	31
6	موسیقی (Music)	7	**23**	سفر (Transport)	8
7	سمتاں (Directions)	7	**24**	رسماں (Rites/ Ceremonies)	16
8	احساسات (Emotions)	4	**25**	ذاتاں (Casts)	19
9	پیشے (Professions/ Occupation)	14	**26**	سکول (Education, School)	20
10	انسانان دیاں بیماریاں (Human's Diseases)	20	**27**	لباس دے حصّے/ کپڑیاں (Dress Parts)	31
11	کھانڑے (Meals)	14	**28**	چیزاں/استعمال دیاں شیواں (daily use objects)	23
12	رنگ (Colors)	13	**29**	زانور (Animals)	20
13	پھل (Fruits)	11	**30**	ویلا (Time)	25
14	خُشِک مسالے (Dried spices)	12	**31**	گھاء، گھا دیاں قِسماں، سبزہ (Grass/weeds, and its types)	17
15	خطاب (Addressing Titles)	10	**32**	جُسے دے حصے (Body Parts)	58
16	اسمان (Sky)	15	**33**	لیدر دیاں چیزاں (leather objects)	7
17	جاہ (Place)	29	**34**	موہنہ (Mouth)	21

Synset creation was made possible with the assistance of two approaches i.e. expansion approach and merge approach. In the expansion approach, the senses from the source language (i.e. Punjabi) were borrowed and translated into the target language (i.e. Saraiki) because of the similarity between these two. On the other hand, in the merge approach senses of Saraiki were created first with the help of contextual information i.e. Saraiki Dictionaries and these senses were used for synset formation.

4.   Results and Discussion

4.1. Process involved in Synset Creation

Synsets formulation involves seven steps such as semantic category determination, selection of noun from relevant semantic category, mentioning its multiple senses, synsets or declaration of possible senses of the selected noun or lexical item, gloss (definition of each synset or sense), and lastly followed by appropriate example (Miller et al., 1993). The following diagram can visualize this process of synset creation:
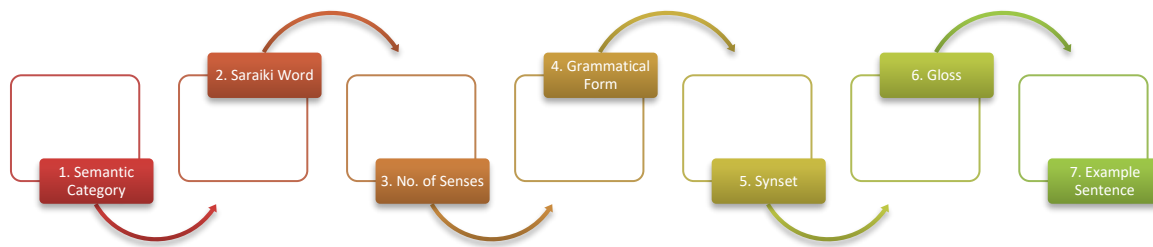

Figure 4.1 Stages involved in Synset Formation of Saraiki Nouns

Table 4.1 *Synsets of Saraiki Noun* پیر */peir/*

Semantic Category	Sr. No.	Saraiki Word	No. of Senses	Grammatical Form	Synset	Gloss	Example sentence
جسے دے حصے /Jusy dy hissy/	2	پیر /peir/	Sense 1	Noun	سہارا	سہارا جیندے دم توں بندہ جیندا اے	"پُتر تے پیو دے پیر ہوندے ہین۔"
			Sense 2	Noun	پیر	لت دے تھلویں حصے، اعضاء جنہاں نال تُر سگیندائے	"اندھے دے پیرتلے پتیرا آگئے۔"
			Sense 3	Noun	پکے پیر	پکّے پیر، زخم، پھٹ	"پکے پیراں کوں ہرکئی وٹے مریندے۔"
			Sense 4	Noun	سر پیر	گالھ دا مکمل ہوݨ	نیڑی اس گالھ دا سر پیر تا کائی نئیں وت میں کیویں من لواں۔"
			Sense 5	Noun	ہتھ پیر	پراݨ، تُرݨ پھرݨ، کم کاج دی قوت	"جیکر بندے ہتھ پیر سلامت ہوون کسے دی مُتھاجی کیوں لئیے۔"

The word پیر */peir/* in table 4.1, has been taken from the semantic category of جسے دے حصے /*Jusy dy hissy*/. The word پیر */peir/* is common or shared word and is found in Urdu, Punjabi, and sariki language. This word shared total five senses. It is a polysemous word as it contains multiple senses such as *shara, peir, sar peir, pakky peir, and hath peir* (Gull, 2019; Asghar, 2021). Here it can also be noted that the word پیر */peir/* when is combined with some other noun or adjective, results in compound noun. In table, 4.1 examples of compound noun are *sar-peir, pakky-peir, and hath-peir* . These are justified further with the contextual information provided in gloss column and successively assisted with certain examples. The approach used to develop these synsets was expansion approach as context of word پیر */peir/* was similar to Punjabi.

3.2 Lexico-semantic Relations

Semantic relations are the link or connection that binds synsets with each other. Lexico-semantic relationship means different senses and inter-relationship of words based on their meanings within particular language. Semantic relations may also be defined as the relationship between two or more synsets based primarily on their meanings. As described earlier in chapter 2. various lexico-semantic relations occur specific parts of speech such as noun, pronoun, adjective, verb, and adverb. The relationships which exist among words are synonyms (similar), antonyms(opposite), hypernymy and hyponymy(dependent & independent), meronymy (part), holonymy (whole), troponymy (manner) and entailment(deduced or implied meanings) (Miller et al., 1993).

As current study deals only with nouns, found in saraiki corpus therefore lexico-semantic relationships among various noun synsets are studies. Prominent semantic relationships occuring among noun synsets or senses are hypernyms i.e.Y is a hypernym of X if X is a (kind of) Y; hyponyms i.e. Y is a hyponym of X if Y is a (kind of) X; meronym i.e. Y is a meronym of X if Y is a part of X; and holonym i.e. Y is a holonym of X if X is a part of Y(Miller et al., 1993). Following are the figures reflecting lexico-semantic relations within each semantic category;
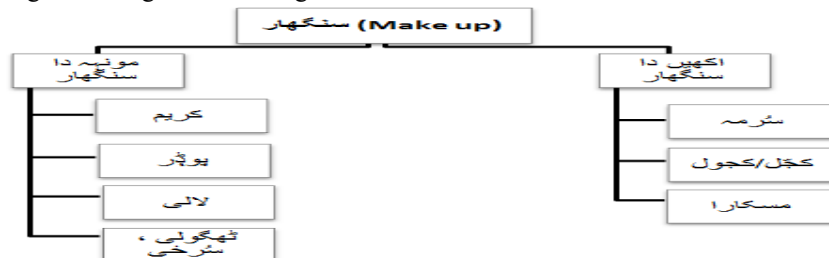
Figure 4.2. Semantic Relations of Word "سنگھار (jewelry)"

Figure 4.2 indicated that '*akhyn da singhar*' and '*mouh da singhar*' are the hyponyms of '*singhar*'. The noun '*mouhdasinghar*' is hypernym ofnouns like '*cream*', '*poder*', '*lali*', and '*thagoli/surkhi*'. Simlarly, the noun '*akhyn da singhar,* is the hypernym of nouns like '*surma*', '*kajul/kajal*', and '*maskara*' (Miller et al., 1993).
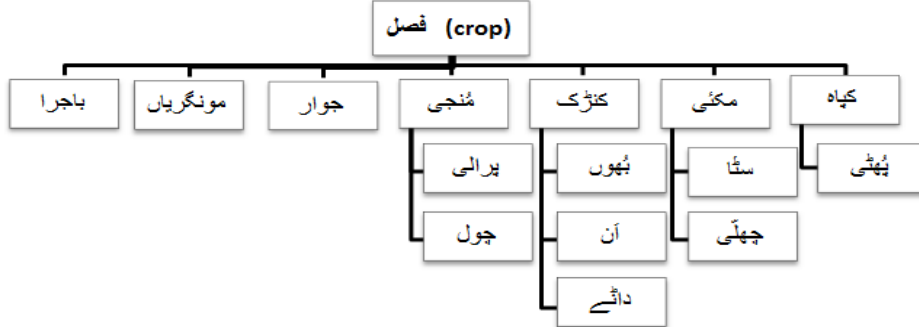

Figure 4.3 Semantic Relations of word "فصل (crop)"

Figure 4.3 shows that the nouns like '*bajra*', '*mongrian*', '*jwaar*', '*munji*', '*kanak*', '*makai*', and '*kapah*' are the hyponyms of noun '*fasal*'. Here noun '*munji*' is the hypernym of nouns like '*prali*', and '*chol*'. Similarly, nouns '*bhoon*', '*ann*', and '*dana*' are the hyponyms of noun '*kanak*'. Furthermore, nouns '*sitta*, and '*challi*' are interlinked by synonymybut both thesenouns are aslo the hyponyms of noun '*makai*'. Lastly, the noun '*kapah*' is the hypernym of noun '*phutti*'; both nouns are also linked via synonymy (Miller et al., 1993).
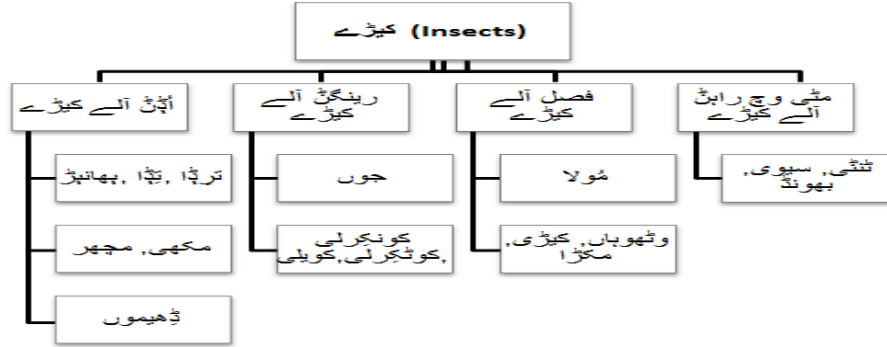
Figure 4.4 Semantic Relations of Word "کیڑے   (Insects)"

According to figure 4.4 the nouns '*udan alay keeray* ', '*reengan alay keeray* ', *'mitti wich rahanalay keeray'* and *'fasal dy keeray'* are hyponyms of noun '*keeray*'. Here noun '*udan alay keeray*' is the hypernym of '*tanani*', '*bhanbhar*', '*dheemonh*', '*tidda*', '*tridda*', '*makkhi*', and '*machar*'. Moreover, noun '*reengan alay keeray*' is also the hypernym of nouns like '*konkirli/kotkirli*', '*joonh*', and '*kueli*'. On the other hand, the noun *'fasal dy keeray'* is hypernym of nouns like '*keeri*', '*makra*', '*wathoha*', and '*mula*'. Lastly, '*tinni*', '*sevi*', and '*bhond*' are the hyponyms of '*mitti wich rahawan aly keeray'* (Miller et al., 1993).
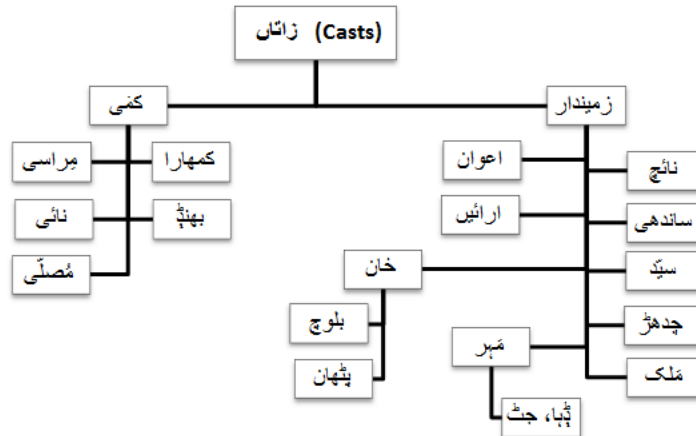
Figure 4.5 Semantic Relations of word "زاتاں (Casts)"

In given figure 4.5, the nouns '*kammi*', and '*zameendar*' are the hyponyms of noun '*zataan*'. Similarly, the noun '*kami*' is the hypernym of '*mirasi*', '*nai*', '*musalli*', '*khumhara*', and '*bhand*'. Whereas, the noun '*zameendar*' is the hypernym of '*awan*', '*arain*', '*naich*', '*sandhi*', '*syed*', '*chahdar*', '*malak*', '*mahr*', '*khan*', and '*patwar*'. The noun '*khan*' is the hypernym of '*pathan*', and '*baloch*'. Similarly, the noun '*Daha/Jutt*' is the hyponym of noun '*mahr*'(Miller et al., 1993).
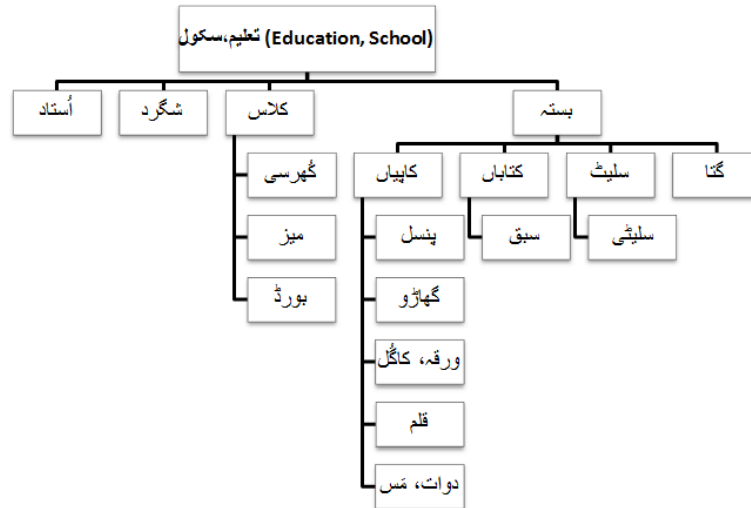
Figure 4.6 *Semantic Relations of word "تعلیم،سکول (Education, School)"*

Figure 4.6 indicates that words '*ustaad*', '*shagirad*', '*class*', and '*basta*' are the hyponyms of word '*taleem/skool*'. The word '*class*' is the hypernym of words like '*khursi*', '*maiz*', and '*board*'. The word '*basta*' is the hypernym of words like '*kapian*', '*kitaban*', '*salait*', and '*gatta*'. Here, few words play the role of hypernym as '*salait*' is the hypernym of '*salaiti*'; word '*kitab*' act as hypernym of word '*sabaq*'. Lastly, it is also noticed that words like '*pinsal*', '*gharu*', '*warqa/ kagul*', '*kalum*' and '*dawat/ mass*' are the hyponyms of word '*kapian*'.
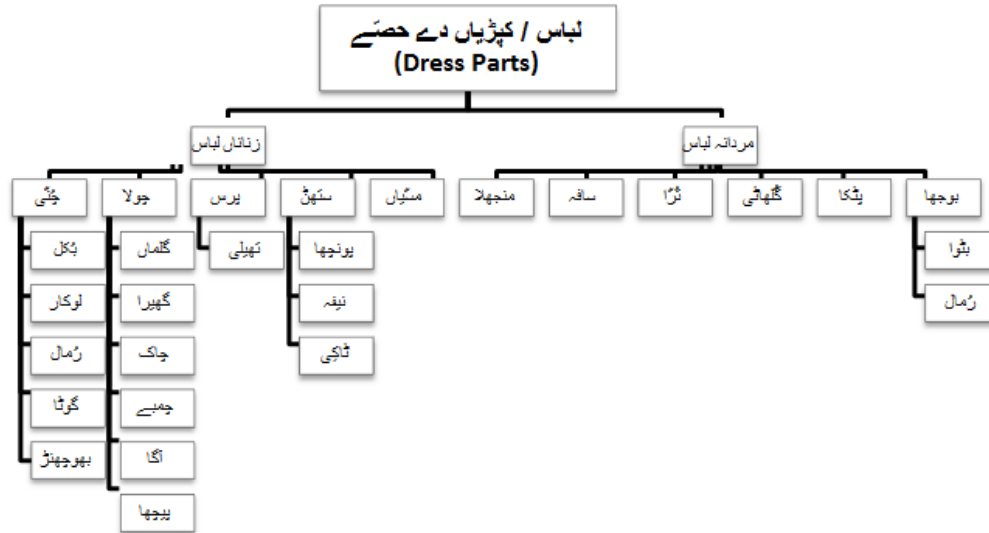
Figure 4.7 *Semantic Relations of word "لباس / کپڑیاں دے حصّے (Dress Parts)"*

Figure 4.7 shows that noun '*mardana libaas*' and '*zanana libas*' are the hyponyms of '*libas/ kapria dy hissy*'. Subsequently, words '*zanana libas*' act as hypernyms of nouns like '*chamby*', '*chunni*', '*chola*', '*paras*', '*suthan*', and '*massian*'. Similarly, word '*mardana libaas*' acts as hypernym of nouns like '*manjhla*', '*safa*', '*turrah*', '*gulati*', '*patka*', and '*bojha*'. Here, words like '*bukal*', '*lukaarr*', '*rumaal*', '*gotta*', and '*bhochan*' are the hyponyms of word '*chunni*'. Moreover, words like '*galman*', '*gheera*', '*chaak*', '*chambay*', '*aaga*', and '*pecha*' are the hyponyms of

'chola' while 'paras' is the hypernym of noun 'thaili'. The word 'suthan' is the hypernym of words 'poncha', 'naifa', and 'takki' while another word 'bojha' is also the hypenym of 'batwa' and 'rumal'(Miller et al., 1993).
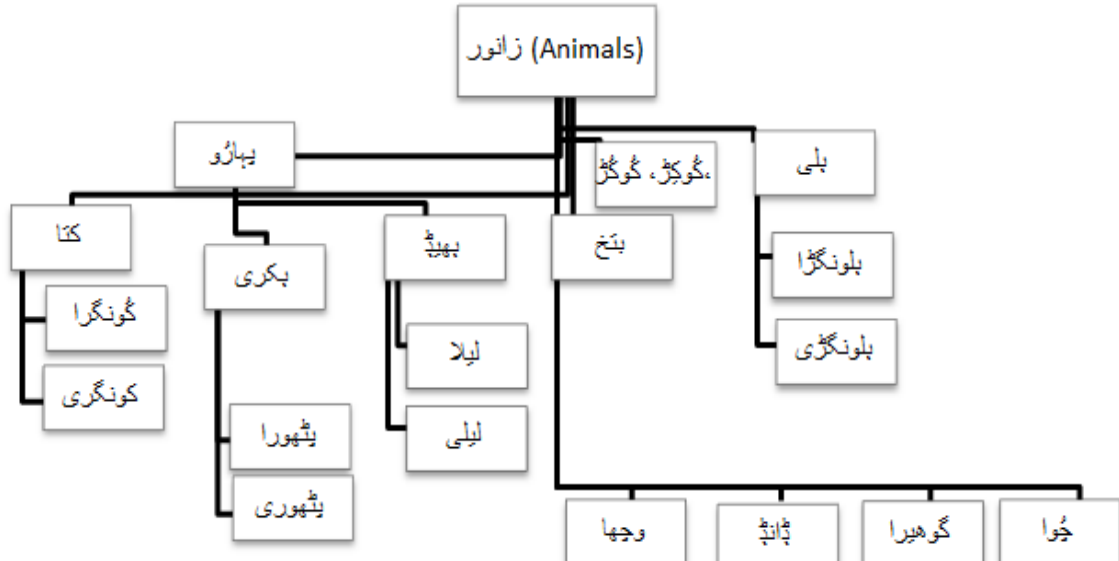

Figure 4.8 *Semantic Relations of word "*زانور *(Animals)"*

As Figure 4.8 indicates, the words *'pharu', 'kutta', 'billi', 'kokar/ kokir', 'batakh', 'wacha', 'dand', 'gohera',* and *'chuwa'* are the hyponyms of word 'zanwar'. The word 'paharu' is basically the hypernym of words like 'bakri' and 'bhaed'(Miller et al., 1993). Furthermore, it can be noticed tht the word 'kutta' is the hypernym of words like 'kungra' and 'kungri'. Moreover, 'kongra', 'kongri', and kutta are also having synonymous relations. Another noun is 'bakri' and it is the hypernym of nouns 'pathora', and 'pathori' while 'bhaed' is the hypernym of nouns 'laila' and 'laili'. Lastly, the nouns 'balongra' and 'balongri' are the hyponyms of noun 'billi'.
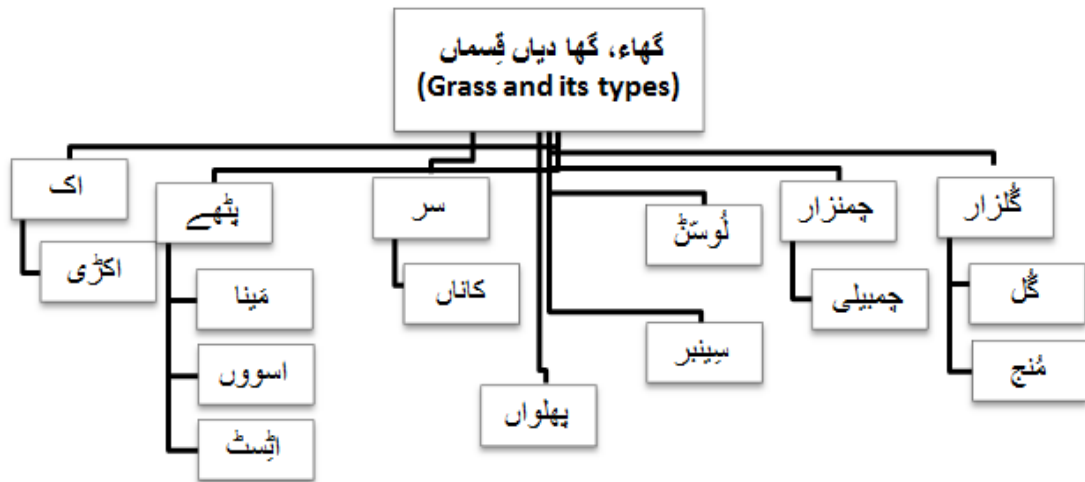
Figure 4.9 *Semantic Relations of word "*گھاء، گھا دیاں قسماں *(Grass and its types)"*

Figure 4.9 shows that words like *'akk', 'pathay', 'sar', 'phalwan', 'seenber', 'loosein', 'chamanzaar',* and *'gulzaar'* are the hyponyms of word 'gha/ gha dia kisman'. Word 'patthay' is the hypernym of nouns like 'maina', 'asooson', and 'attisit' whereas the word 'akk' is the hypernym of 'akri'(Miller et al., 1993). Moreover, word 'kaana' is the hyponym of word 'sar', and word 'gulzar' as well as 'chamanzar' are the hypernyms of 'gul', 'munjh', and 'chamaili' respectively.
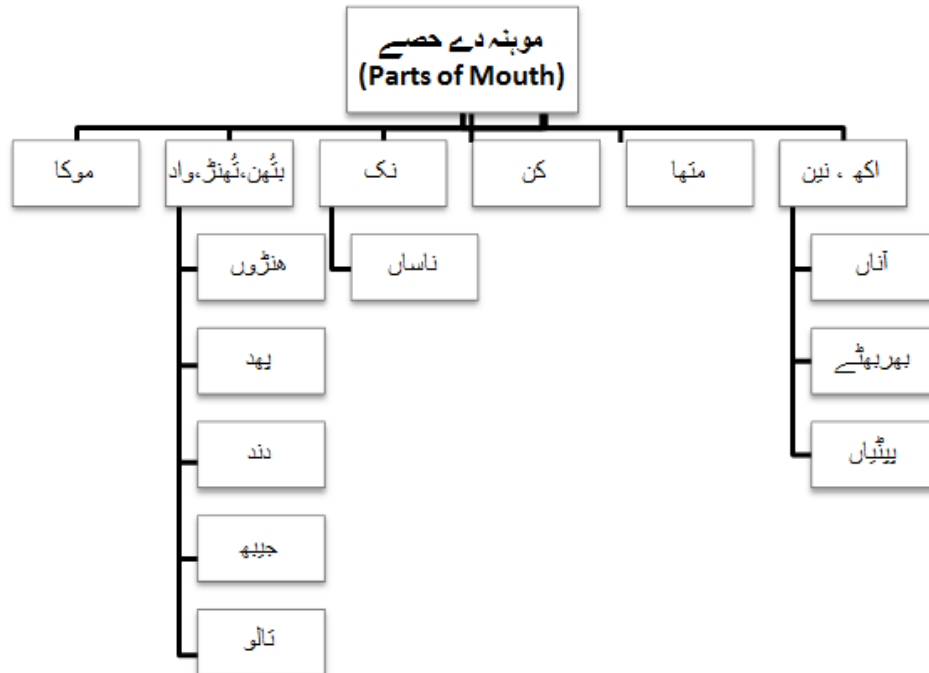
Figure 4.10 *Semantic Relations of word "*موہنہ حصے دے *(Parts of Mouth)"*

Figure 4.10 shows that words like *'moka', 'thunn/ waad', 'nak', 'kann', 'matha',* and *'akh/ nain'* are the hyponyms of 'muhn dy hissy'. Here, the word '*thunn/ waad*' is hypernym of nouns such as '*hannu', 'phad', 'dand', 'jeabh' and 'talu'*. Similarly, words like '*ana*', '*bharbhittay*', and '*pipnia*' are the hyponyms of word '*akh*'. Lastly, word '*nasan*' is hyponym of word '*nak*'.
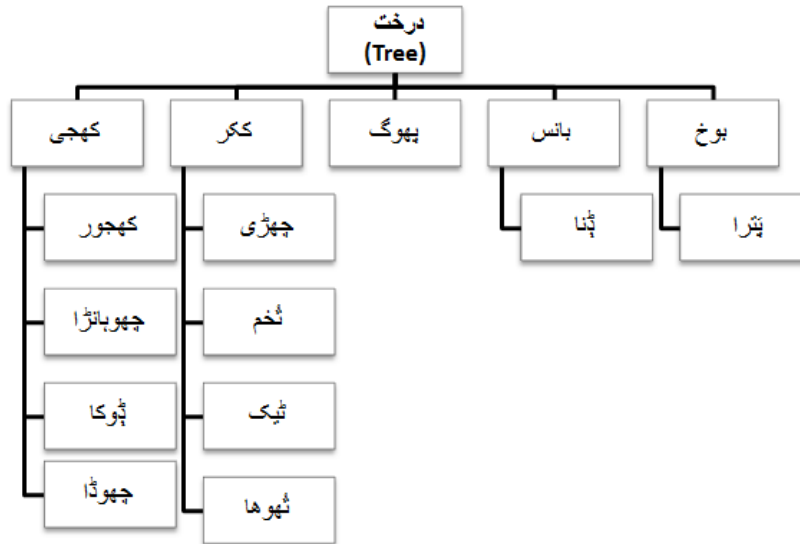
Figure 4.11 *Semantic Relations of word "*درخت *(Tree)"*

Figure 4.11 shows that words like '*khaji', 'kikar', 'phogh', 'bance',* and *'boakh'* are the hyponyms of word 'darakhat'. Here, word 'khaji' is the hypernym of words like '*khajoor', 'chohara',* and *'choda'* while the words *'khajoor', 'doka',* and *'chohara'* are linked with each other via synonymy. Similarly word '*kikar*' is the hypernym as well as holonym of words '*charri', 'tukham', 'taike', and 'thuha'*. Whereas, word '*bance*' is the hypernym as well as holonym of word '*danna*'; and word '*boakh*' is the hypernym as well as holonym of word '*patra*' (Miller et al., 1993).
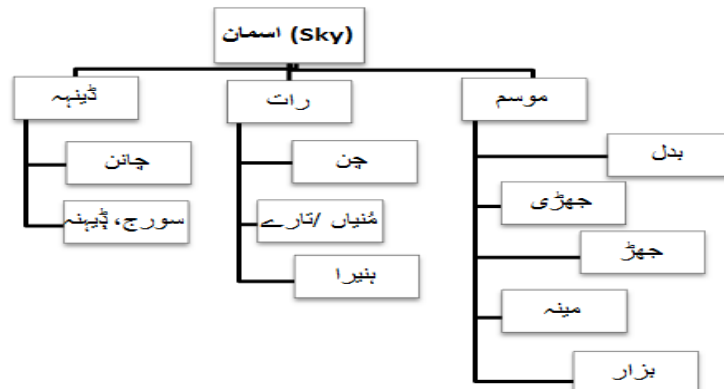
Figure 4.12 *Semantic Relations of word* "اسمان *(Sky)*"

Figure 4.12 shows that the words like '*raat*', '*dehn*', and '*mosam*' are the hyponyms of word/ noun '*asman*'. Here, word '*dehn*' is a hypernym of words like '*chanan*', and '*suraj/ dehn*'. Similarly, '*raat*' is the hypernym of nouns like '*chan*', '*munian/ taray*', and '*haneera*'. It can also be seen fron the above given figure that words like '*badul*', '*mehein*', '*jharri*', '*jhar*', and '*bzaar*' are the hyponyms of word '*mosam*'(Miller et al., 1993).
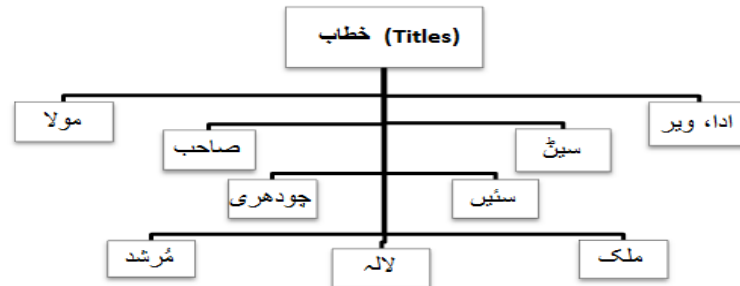
Figure 4.13 *Semantic Relations of word* "خطاب   *(Titles)*"

Figure 4.13 shows that the words like '*mola*', '*ada/ veer*', '*sahab*', '*syan*', '*chohadri*', '*saain*', '*murshid*', '*lala*', and '*malak*' are the hyponyms as well as meronyms of word '*khitab*'. On the other hand, words like '*syan*' and '*saain*' are synonyms; and words like '*mola*' and '*murshid*' are also synonyms. Similarly, words like '*chohadri*', '*sahab*', and '*malak*' are linked to each other through synonymy (Miller et al., 1993).
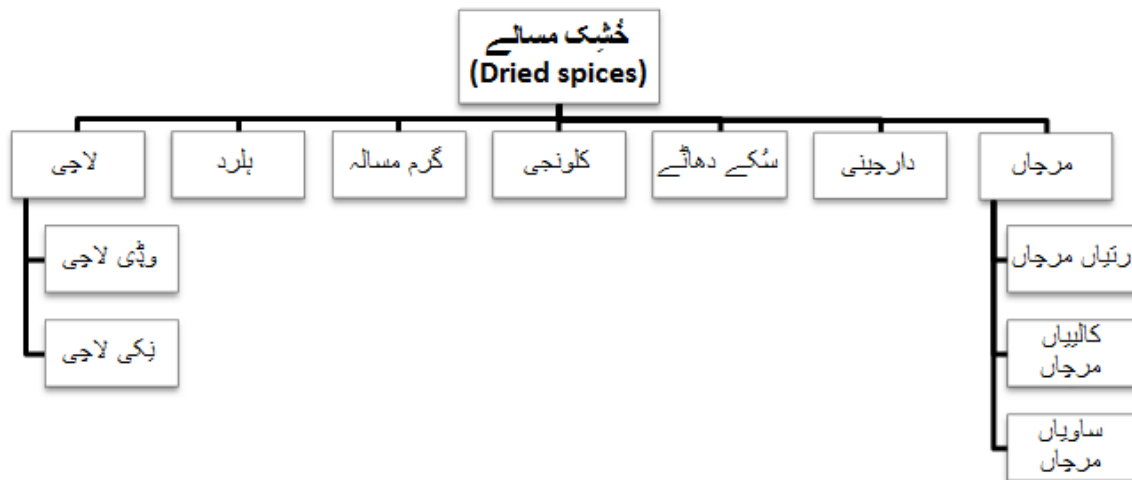

Figure 4.14 *Semantic Relations of word* "خُشِک مسالے *(Dried spices)*"

Figure 4.14 shows that the words like '*lachi*', '*halard*', '*darchini*', '*garam masala*','*kalwanji*', '*sukkay dhanay*', '*darchenni*' and '*marchan*' are the meronyms as well as hyponyms of '*khushiq misalay*'. Here, words like '*wadi lachi*' and '*niki lachi*' are the meronyms of word '*lachi*' while '*wadi lachi*' and '*niki lachi*' share a relationship

of synonymy with each other (Miller et al., 1993). Furthermore, word '*marchan*' is the hyponym as well as holonym of words '*kali mirchan*', '*rattimarchan*', and '*sawian marchan*'.
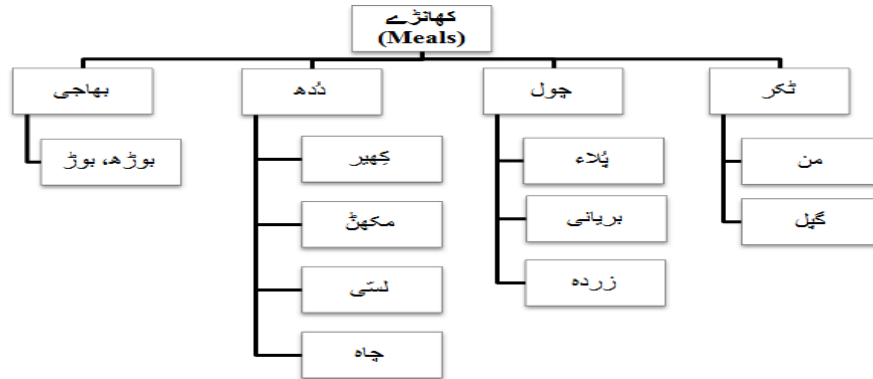

Figure 4.15 *Semantic Relations of word "*کھانڑے* (Meals)"*

Figure 4.15 shows that the words '*bhaji*', '*dudh*', '*chol*', and '*tukar/ roti*', act as meronyms and holonyms of '*khanay*'. Here, words like '*bhaji*'and '*Borh/ borr*' share the relationship of synonymy. Similarly, word '*dudh*' is the hypernym as well as holonym of words like *'kheer (dish)', 'makhan', 'lassi',* and *'chah'*. It is also notable that there also exists relationship of synonymy among words '*dudh*' and '*kheer* (milk)' (Miller et al., 1993). Furthermore, the word '*chol*' is the hypernym as well as holonym of words like '*pulahh*', '*baryani*', and '*zardah*'. Lastly, the words '*tukkar/ roti*', '*mann*', and '*gappal*' are the synonyms.
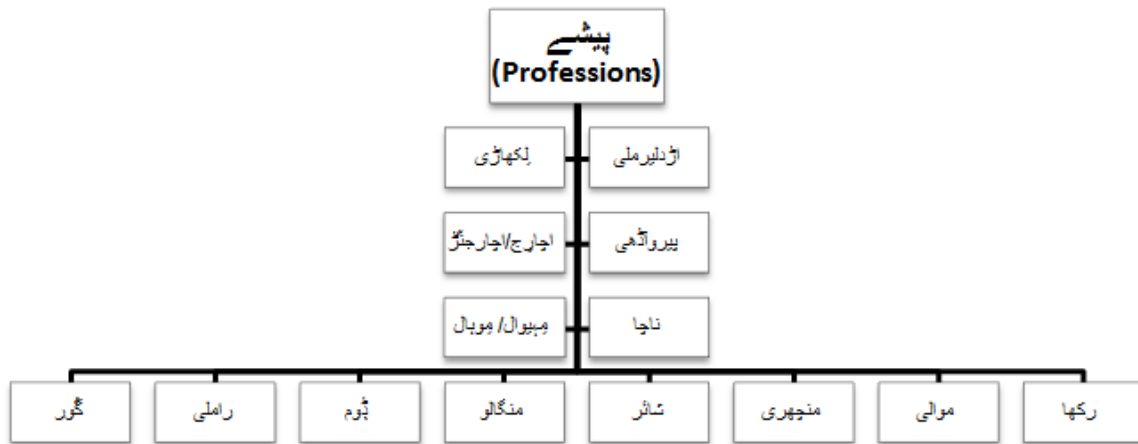

Figure 4.16 *Semantic Relations of Word "*پیشے* (Professions)"*

As figure 4.16 indicates that the nouns *'Dwom', 'Ramli', 'Gor', 'Acharij/Acharjan',* 'Piro' 'Adhi', 'Shair', and '*Mangalo*' are the hyponyms as well as meronyms of word '*paishay*'. Similarly, word such as '*paishay*' is a hypernym as well as holonym of words like '*Manchhri*', '*Likhari*', '*Mawali*', '*Mihewal/Mohal*', '*Nacha*', '*Urdleer Mili*', and '*Rakha*'.
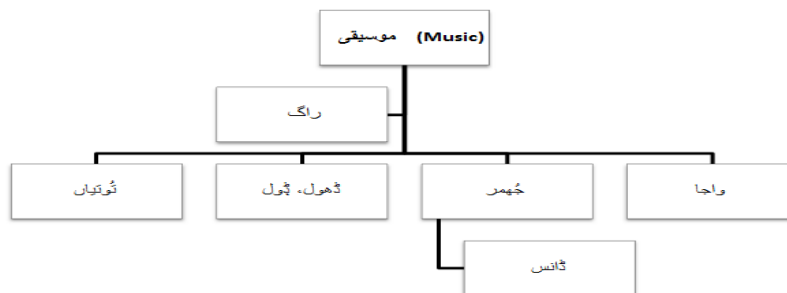

Figure 4.17 *Semantic Relations of word "*موسیقی* (Music)"*

Figure 4.17 shows that nouns like *'raag', 'tootiyan', 'dhol', 'jhumar',* and *'waja'* are the hyponyms as well as meronyms of word '*moseeqi'*. Furthemor, there exists a relationship of synonymy between words like '*jhumar'* and '*dance'*.
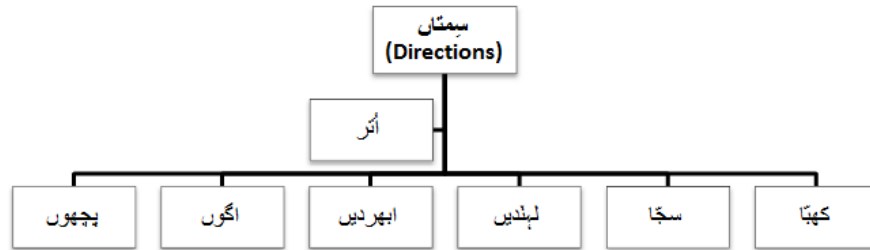
سِمتّاں
(Directions)

اُتر

پچھوں | اگوں | ابھرديں | لہنديں | سجّا | کھبّا

Figure 4.18 *Semantic Relations of word "سِمتاں (Directions)"*

Figure 4.18 indicates that words like *'utar', 'ubharden', 'lahandi', 'sajja', 'khubba', 'agun',* and '*pichon'* are the hyponyms of word '*simatan'*. Similarly it can also be said that word '*simatan'* is the holonym of words like *'ubharden', 'lahandi', 'sajja', 'khubba', 'agun', and 'pichon'*.
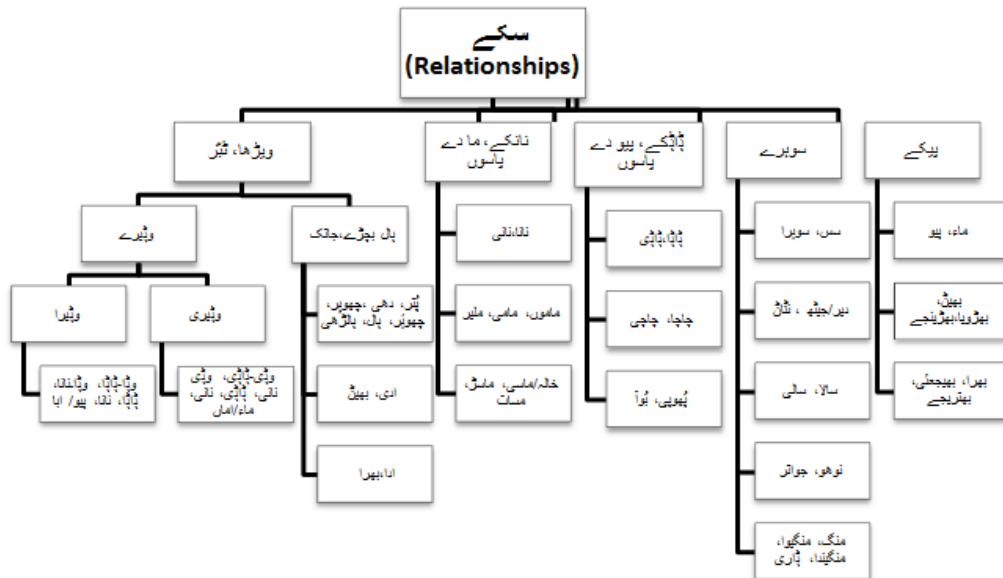
سکّے
(Relationships)

Figure 4.19 *Semantic Relations of Word "سکّے (Relationships)"*

As figure 4.19 shows that the word '*sakkay'* is the holonym as well as hypernym of words '*wherrah'*, 'tabbar' (a relationship of synonymy is shared by '*wherrah'* and '*tabbar'*), *'nankay/ maa dy pasu', 'dadakay/ pio dy pasu', 'sohary',* and '*paikay'*. Here, words 'Wadayre' and *'bal, bachray, jatuq'* are the meronyms as well as hyponyms of '*wherrah/ tabbar'* whereas there also is antonymic relationship between 'Wadayre' and 'bal, bachray, jatuq'. Similarly, words like '*wadaira'* and *'wadairi'* are the hyponyms of '*wadayre'* while words like '*putar/ dhee, chohar/ chohir, bal/ balharri', 'adi, bhaen',* and *'ada, bhira'* are the hyponyms/meronyms of *'bal, bachray, jatuq'*. Afterwards, table 4.18 shows that word '*wadaira'* is the synonym of words like '*wada-dada'*, '*wada-nana'*, '*dada'*, '*nana'*, '*pio/ abba'*. Similarly, word '*wadairi'* is the synonym of words like '*wadi-dadi'*, '*wadi-nani'*, '*dadi'*, '*nani'*, '*maa/ amma'*.

The words '*nana, nani'*, '*mamu, mami, malair',* and *'khala/ masi, masar, masaat'* are the hyponynms/meronyms of *"nankay/ maa dy pasu'*. Similarly, words like '*dada, dadi'*, '*chacha, chachi',* and '*phuphi/ boa'* are the hyponyms/meronyms of '*dadakay/ pio dy pasu'*. Futhermore, word 'sohary' is the hypernym/holonym of words like *'sass, sohara', 'deer/ jeith, ninaan', 'sala, Sali', 'noohn, jawatar',* and '*mang, mangeewa, mangendi/mangenda, dari'*. Lastly, words like '*maa, pio'*, '*bhaen, bhanrwaya, bharenjay',* and *'ada/bhira, bhajai, bhatreejay'* are the hyponyms as well as meronyms of '*paikay'*.
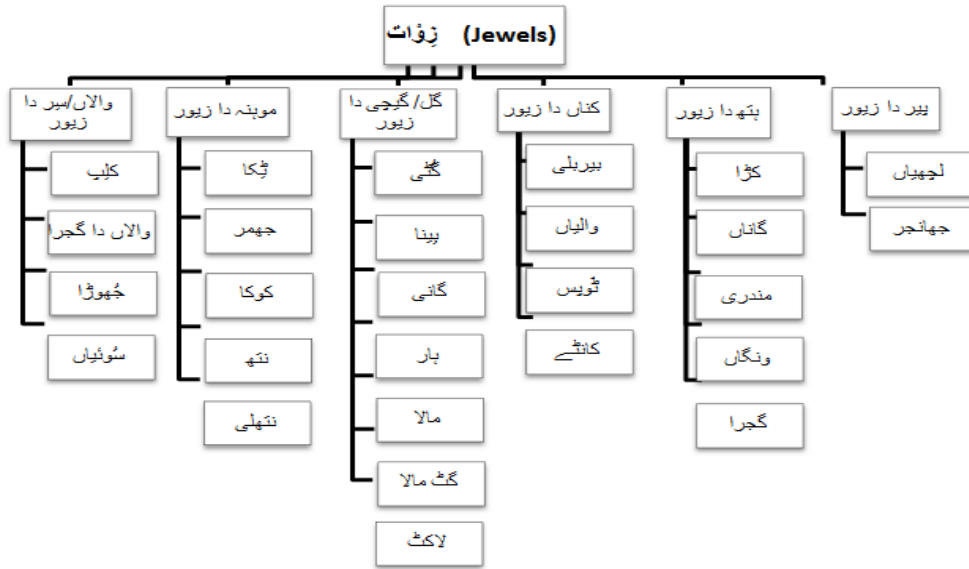
Figure 4.20 *Semantic Relations of Word* "زیورات (Jewels)"

Figure 4.20 shows that word '*zewraat*' is the holonym as well as hypernym of *'wala/ sir da zewar', 'muh da zewar', 'gal/ ghechi da zewar', 'kanah da zewar', 'hath da zewar'*, and *'peir da zewar'*. Here, words like *'kalip', 'wala ala gajra', 'jhura',* and *'suian'* are the hyponyms/ meronyms of '*wala/ sir da zewar'*. Similarly, words like *'tikka', 'jhummar', 'koka', 'nath'*, and *'nathli'* are the hyponyms/ meronyms of '*muh da zewar'*. The words like '*gal/ ghechi da zewar'* are the hypernym as well as holonym of words *'gutti', 'baina', 'ganni', 'har', 'mala', 'gut-mala',* and *'lakut'*. Furthermore, words like *'bairbili', 'walia', 'topus',* and *'kantay'* are the hyponyms/ meronyms of *'kanah da zewar'*. Similarly, words like '*karra', 'gannah', 'mundri', 'wangan',* and *'gajra'* are the hyponyms as well as meronyms of *'hath da zewar'*. Lastly, *'peir da zewar'* acts as hypernym or holonym of '*lachian'* and *'jhanjar'*.
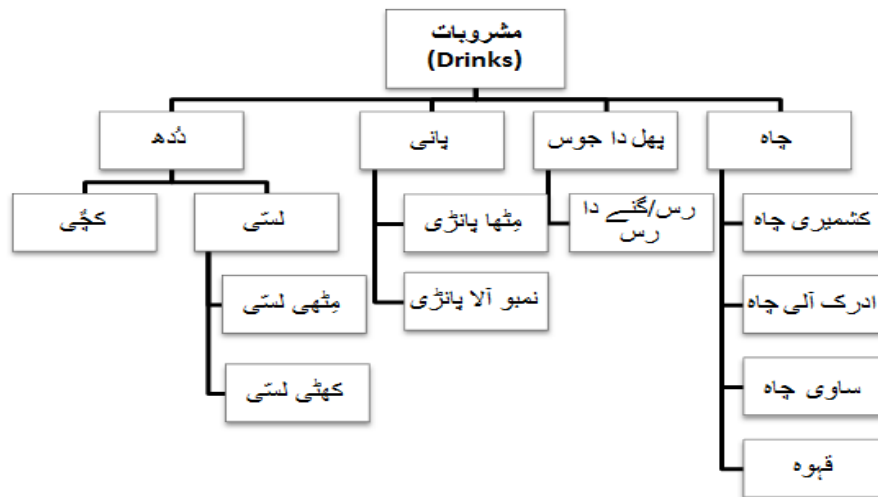

Figure 4.21 *Semantic Relations of word* "مشروبات (Drinks)"

Figure 4.21 indicates that words like '*dudh', 'pani', 'phal da juice',* and '*chah'* are the hyponyms as well as meronyms of word '*mashrubaat'*. The word '*dudh'* is the hypernym/ holonym of '*kacchi'* and '*lassi'* whereas '*lassi'* is the hypernym of '*mitthi lassi'* and '*khati lassi'*. Similarly, word '*pani'* is the hypernym or holonym of both '*mittha pani'* and '*nimbu ala pani'*. Another word '*phal da juice'* is the hypernym as well as holonym of word '*rass/ gannay da rass'* while words like '*kashmiri chah', 'adraq ali chah', 'sawi chah'*, and '*qawa'* are the hyponyms as well as meronyms of word '*chah'*.
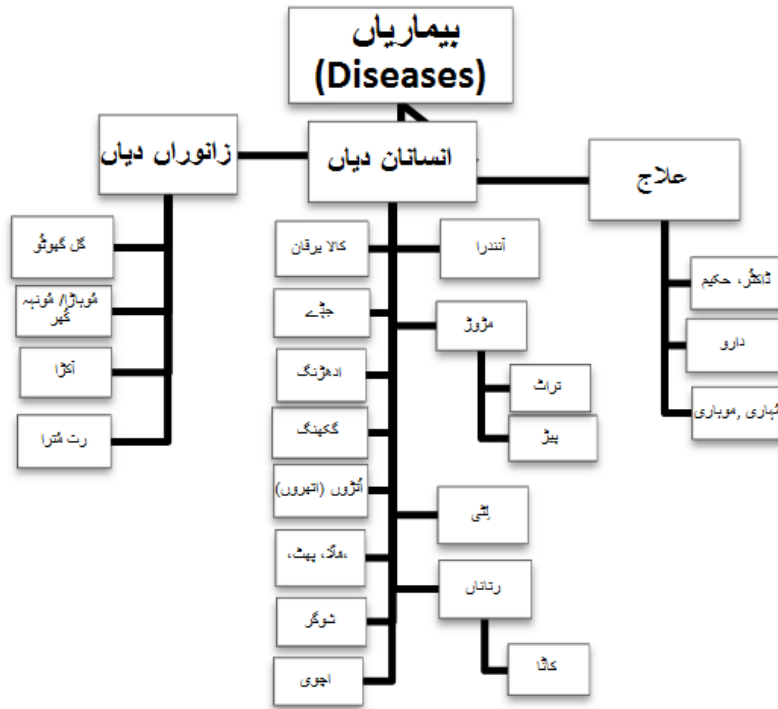
Figure 4.22 *Semantic Relations of word " بیماریاں (Diseases)"*

Figure 4.22 indicated that the word '*bemarian*' is the hypernym as well as holonym of '*zanwara dia bemaria*', '*insana dia bemaria*', and '*ilaj*'. Here '*zanwara dia bemaria*' acts as holonym or hypernym of words '*gal ghoto*', '*mohada/ munh khor*', '*aakra*', and '*rat mutra*'. Similarly, '*insana dia bemaria*' acts a holonym as well as hypernym of words like '*kala yarqan*', '*anandra*', '*jady*', '*maror*', '*adhrang*', '*khang*', '*uthron (athron)*', '*malla*', '*phat*', '*sugar*', '*achvi*', '*litti*', and '*ratana*'(Miller et al., 1993). Furthermore, words like '*daktur*', '*haqeem*' (both these words are synonyms), '*daru*', and '*mohari*' are the hyponyms as well as meronyms of word '*ilaj*'.
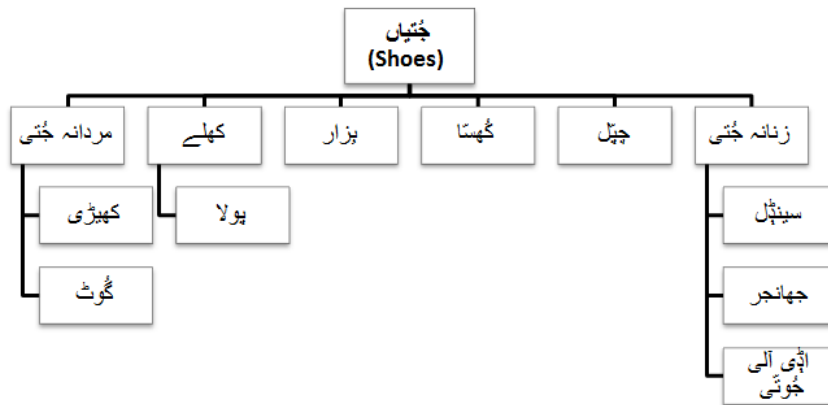

Figure 4.23 *Semantic Relations of word " جُتیاں (Shoes)"*

Figure 4.23 depicts that word '*jutia*' act as both hypernym and holonym of words like '*mardana jutti*', '*zanana jutti*', '*khallay*', '*bizar*', '*khussa*', and '*chappal*'. Here '*mardana jutti*' is the holonymy as well as hypernym of word '*khaerri*' and '*goot*' while '*zanana jutti*' is the holonym as well as hypernym of words like '*sandal*', '*jhanjar*', and '*addi ali jutti*'. Similarly, all words also share a relationship based on synonymy as words '*khallay*' and '*pola*' are synonyms.
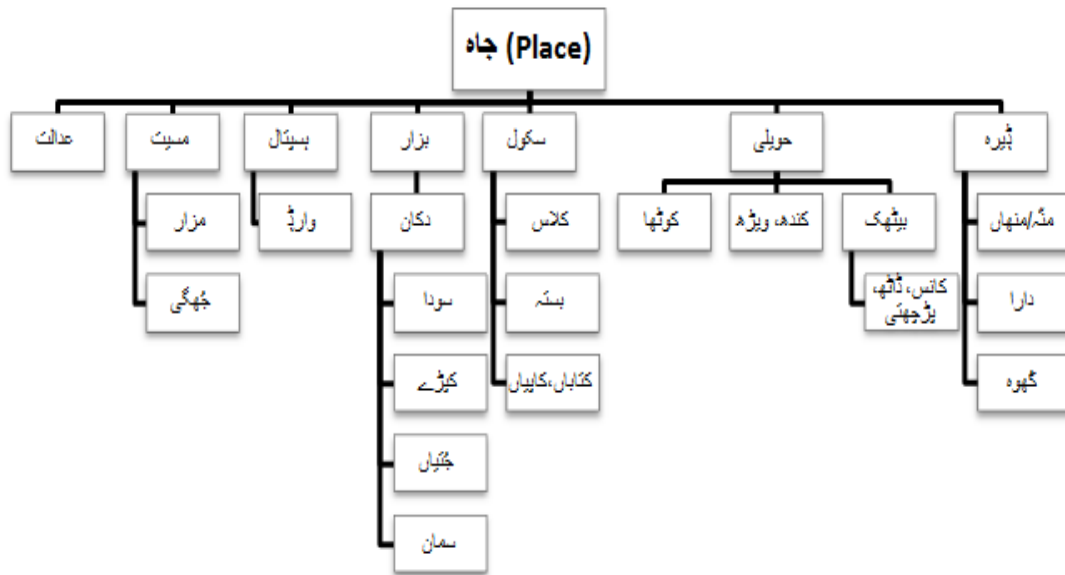
Figure 4.24 *Semantic Relations of word "جاہ (Place)"*

Figure 4.24 represents that word 'jah' is the hypernym as well as holonym of words such as *'adalat', 'maseet', 'hasptaal', 'bazaar', 'skool', 'hawaili',* and *'dairah'*. The word *'maseet'* is linked with words like *'mazar'* and *'jhugi'* through hyponymy and hypernymy. Word *'hasptaal'* is heyper as well as holonym of *'ward'* while bazar is the hypernym (holonym) of *'dukan'*. Similarly, words like *'kitaba', 'basta', 'kapia',* and *'kitaba'* are the hyponyms as well as holonyms of word *'skool'*. Furthermore, word *'hawaili'* is the hypernym (holonym) of words *'kotha', 'kandh', 'werah',* and *'baithak'*. Moreover, word *'dairah'* is the hypernym as well as holonym of *'munnah', 'dara'*, and *'khuh'*. Words like *'soda', 'kapray', 'jutia',* and *'saman'* are the hyponyms as well as meronyms of word *'dukan'*. Similarly, word *'baithak'* is the hypernym (holonym) of words *'kans', 'dath',* and *'parchatti'* (Asghar, 2021).
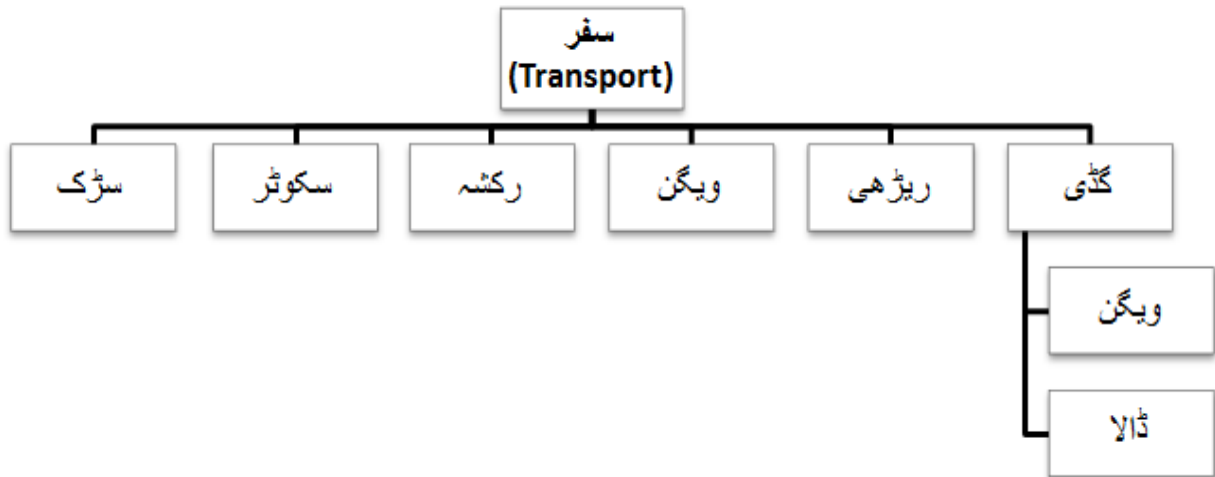

Figure 4.25 *Semantic Relations of word "سفر (Transport)"*

As the above figure 4.25 indicates words like *'gadi', 'dala', 'rehrhi', 'sarak', 'raksha',* and *'sakutar'* are the hyponyms as well as meronyms of word *'safar'*. Similarly, the word *'gadi'* is the hypernym and holonym of words *'wagon'* and *'dala'*.
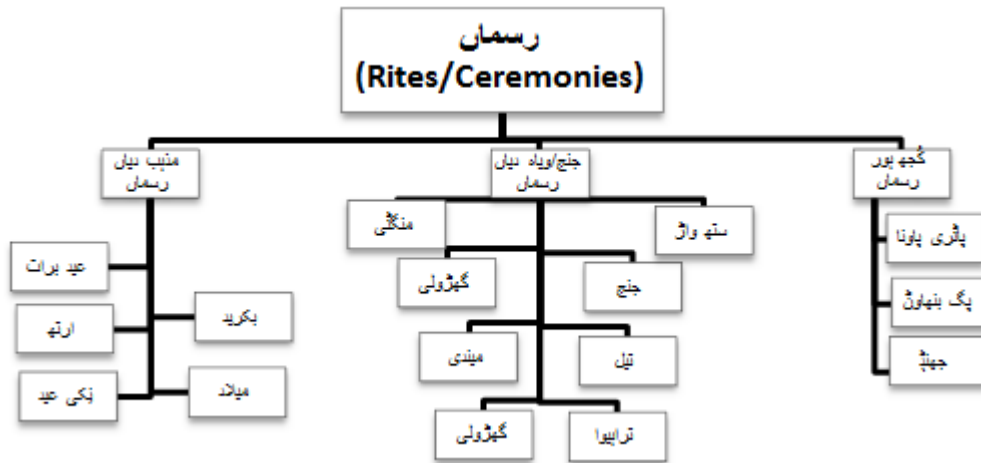
Figure 4.26 *Semantic Relations of word "رسماں (Rites/ Ceremonies)"*

Figure 4.26 show that word '*rasma*' is the hypernym as well as holonym of '*mazhab diarasma', 'janj/ wiya/ shadi dia rasma*', and '*kujh hor rasma*'. Here, '*mazhab dia rasma*' is the holonym as well as hypernym of '*eid barat*', '*meelad*', '*nikki eid*', '*bakreed*', *and* '*arath*'. Similarly, 'janj/ wiya/ shadi dia rasma' is the hypernym and holonym of '*mangni*', '*gahrohli*', '*meendi*', '*ghrolhi*', '*trahewa*', '*tail*', '*janj*', and '*sathwaar*'. Furthermore, words like '*Pani Pawna*', '*Pug Banhawan*', and '*Jhand*' are the hyponyms and meronyms of '*kujh hor rasma*'.
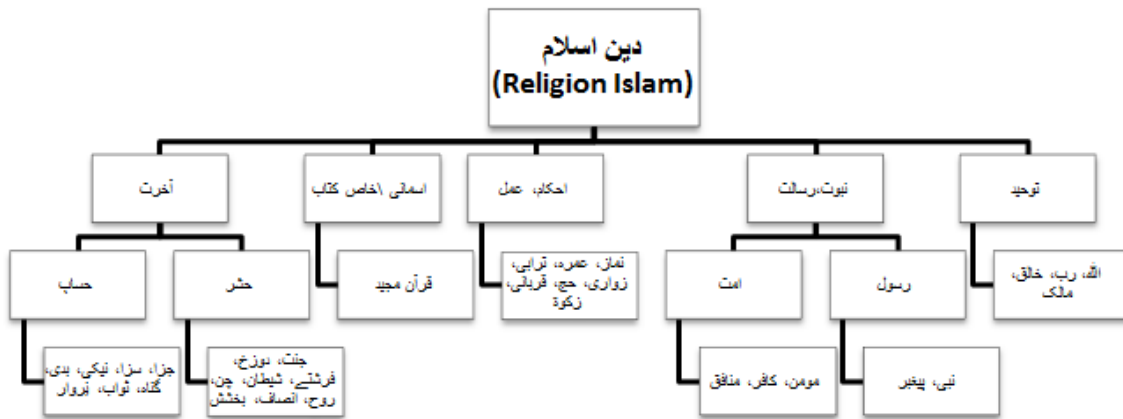

Figure 4.27 *Semantic Relations of Word "دین اسلام (Religion Islam)"*

Figure 4.27 indicates that the words '*toheed', 'nabowat/ risalat', 'ahkam/ amal', 'asmani/ khas kitab',* and '*akhrat*' are the hyponyms as well as meronyms of '*deen Islam*'. The word '*toheed*' is the hypernym as well as holonym of words '*Allah*', '*Rab*', '*Khaliq*', and '*Maliq*'. The word '*nabowat/ risalat*' is the hypernym as well as holonym of words '*Rasool*' and '*ummat*' whereas '*Rasool*' is the hypernym as well as holonym of '*Nabi*' and '*Paighambar*'. Similarly, words like '*moman', 'kafir', and 'munafiq*' are the holonyms as well as meronyms of '*ummat*'. Furthermore, the words '*nimaz', 'umrah', 'tarabi', 'zawari', 'hajj', 'qurbani*', and '*zaqat*' are the hyponyms as well as meronyms of word 'ahkam/ aal'. Here it can also be noticed that words like '*asmani kitab', 'khas kitab*' and '*Quran majeed*' share synonymous relationship where '*Quran majeed*' is the hyponym of other two words. The word '*akhrat*' is the hypernym as well as holonym of words '*hisaab*' and '*hashar*'. It can be noticed that word 'hisaab' acts as holonym or hypernym of '*jza', 'sza', 'neiki', 'badi', 'gunah', 'swab',* and '*nirwar*'. Lastly, words like '*jannat', 'dozakh', 'farishtay', 'shaitaan', 'jin', 'ruh', 'insaaf*', and '*bakhshash*' are hyponyms as well as meronyms of word '*hisaab*'.

چیزاں/استعمال دیاں شیواں (Daily-use Objects)

کُجھ ہور چیزاں | لکڑدی بنی | لوہے دی بنی | کھیتی باڑھی

ڈیوا، تسُر، ڈرم، بلف، ٹنگڑی، ترانکل

گھڑونجی

کُنجی، جندرا، ترکڑی، ٹوکرا، صندوق، صندوقڑی

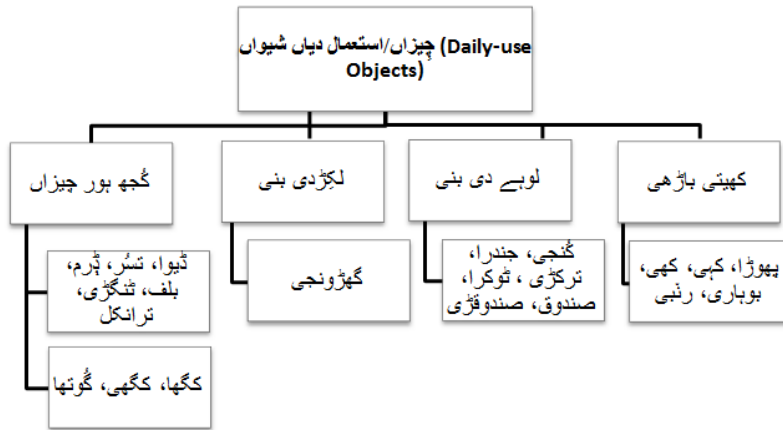پھوڑا، کہی، کھی، بوہاری، رنبی

کنگھا، کنگھی، گُوتھا

Figure 4.28 *Semantic Relations of word "*چیزاں/استعمال دیاں شیواں* (daily use objects)"*

Figure 4.28 indicated that the words like *'kheiti barhi', 'lohay di bani chezan', 'lakri di bani chezan',* and *'kujh hor chezan'* are the hyponyms as well as meronyms of *'cheezan/ istemaal dia shewan'*. Similarly, word *'kheti barhi'* acts as holonym as well as hypernym of words like *'phora', 'khahi', 'bohari'*, and *'ranbi'* whereas *'lohay di bani cheezan'* is the hypernym as well as holonym of words like *'kunji', 'jandra', 'tarakri', 'tokra', 'sandooq'*, and *'sandooqri'*. Furthermore, the word *'gharwanji'* is the hyponym as well as meronym of *'lakri di bani cheeezan'*. There are certain other words which also have hyponymic and meronymic relationship with *'kujh hor cheezan'* these are *'dewa', 'tasur', 'drum', 'baluf', 'tangni', 'trankal', 'kagha', 'kaghi'*, and *'gutha'*(Miller et al., 1993).

ویلا (Time)

ڈیہنہ | عمردا ویلا | ورہیں

سویل، فجر | ڈیگر | پیشی | نمِاشاں، شاماں | رات

پیر، سرگی

روٹی ویلا

اگلا پوہر

ادھ پوہر

پچھلا پوہر

ادھ رات

نِکا ویلا

چھوکراینا، چھوہرپ

بڈھیپا
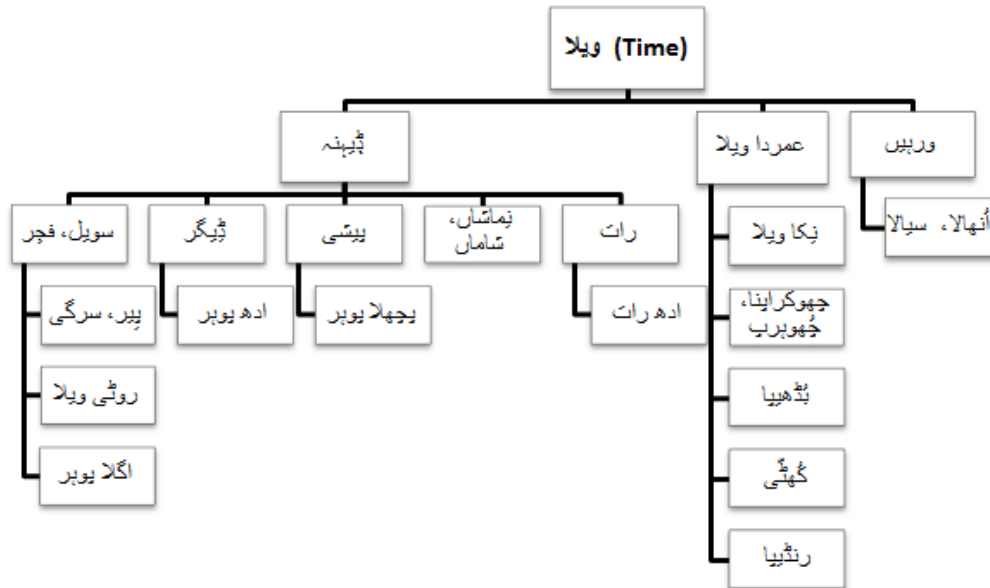
کُھٹی

رنڈیپا

اُنھالا، سیالا

Figure 4.29 *Semantic Relations of word "*ویلا* (Time)"*

Figure 4.29 represents that the words like *'deinhn', 'umar da wela',* and *'warhyn'* are the hyponyms as well as meronyms of word *'wela'*. It can also be noticed that word *'deinhn'* is the hypernym as well as holonym of words like *'sweil/ fajir', 'digar', 'peshi', 'nimashan, /shaman',* and *'raat'*. Moreover, word *'warhyn'* is the hypernym as well as holonym of words *'unhala'* and *'siala'*; word *'deiger'* is hypernym of *'adh pahr'*; word *'peishi'* is hypernym of *'pichla pohar'*; and word *'raat'* is hypernym of word *'adh raat'*. Here, word *'sweil/ fajir'* is the hypernym of words like *'peer/ sargi', 'roti-wela',* and *'agla-pohar'*. Lastly, the words *'nika-wela', 'chokarappana/ chorap', 'budheipa', 'khuthi'*, and *'randeipa'* are the hyponyms of word *'umarda wela'*.
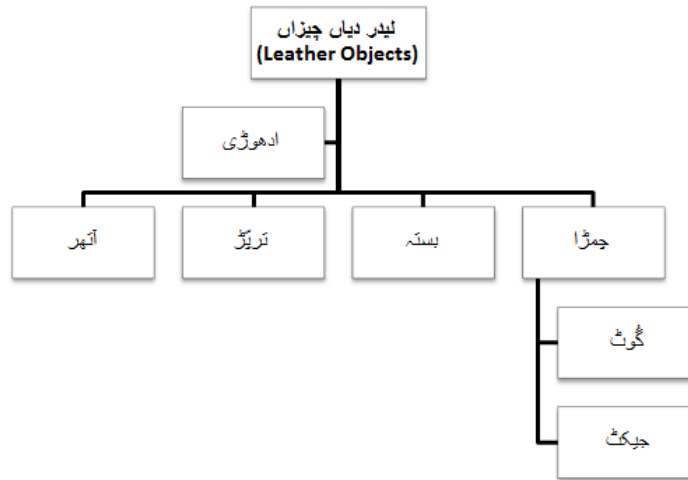
Figure 4.30.*Semantic Relations of word "*لیدر دیاں چیزاں* (Leather Objects)"*

Figure 4.30 indicates that words *'adhori', 'aathar', 'taraparr', 'basta',* and *'chamra'* are the hyponyms as well as meronyms of word *'leather di bania cheezan'*. Furthermore, the word *'chamra'* acts as hypernym as well as holonym of words *'goot'* and *'jaket'*.
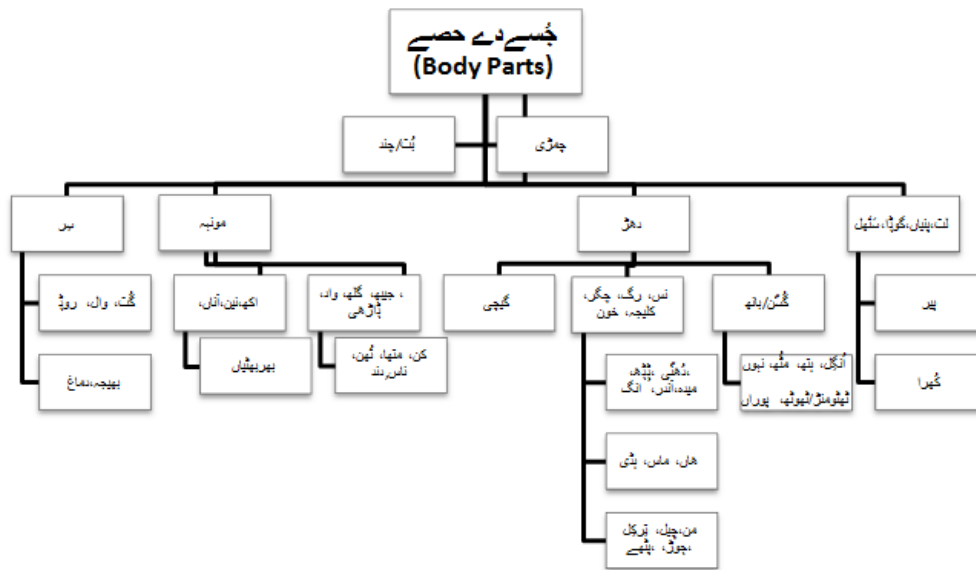

Figure 4.31 *Semantic Relations of word "*جُسّے دے حصّے* (Body Parts)"*

Figure 4.31 indicates that the words like *'buot'*, *'chamri'*, *'sir'*, *'mouh'*, *'dhar'*, *'latt'*, *'piniah'*, 'sathal', and *'goda'* are the hyponyms as well as meronyms of *'jussay dy hissay'*. Similarly, word *'sir'* is the hypernym as well as holonym of words *'gut, waal, road'*, *'bhaija/*, and *dimagh'*. The words *'akh'*, *'nain'*, *'ana' 'jhebh'*, *'gal'*, *'waad'*, *'bharbhatiyan'*, *'darrhi'*, *'kann'*, *'matha' 'thun'*, *'naas'* and *'dand'* are the meronyms of word *'mouh'*. The words like *'geetchi'*, *'nas'*, *'rag'*, *'jigar'*, *'kalia'*, and *'khoon'* are the hyponyms as well as holonyms of word *'dharr'* whereas, words like *'haan', 'maas', 'haddi', 'dhunni', 'dhidh', 'maidah', 'andar', 'ang' 'mann', 'cheel', 'trikkil', 'jor',* and *'pathe'* are the hyponyms as well as meronyms of *'dhar'*. Similarly, words like *'ghasun'*, and *'hath'* are the hyponyms and meronyms of *'dhar'* whereas words like *'ungill', 'hath', 'muth', 'nahu', 'tathumar/ thuth',* and *'pran'* are the hyponyms of *'hath'*. The word *'khura'* is hyponym as well as meronym of *'peer'* whereas *'peer'* is hyponym of *'latt'*.

5. Conclusion

The undertaken study aimed to develop lexico-semantic relations of Saraiki nouns by using Saraiki corpus. A wordlist consisting of 1500 nouns was extracted from the available corpus, out of which 338 nouns were categorized according to frameworks, i.e., Wren and Martin's *High School English Grammar* (overall noun categorization) and

De Gruyter Mouton's framework for the Saraiki nouns in *A Descriptive Grammar of Hindko, Panjabi, and Saraiki* (2019). All the objectives were successfully achieved as the researcher, using a hybrid approach (i.e., expansion and merge approaches), developed 173 synsets of 39 nouns and 30 noun hierarchies of lexico-semantic relationships among nouns. Saraiki language is blessed with unique lexical wealth; hence, it would be economical for researchers who are anxious to explore languages, as this language is rich in idiomatic phrases and surplus wisdom.

Saraiki nouns show remarkable synset ability and can be effective in WordNet formation. Nouns were linked to each other via holonymy, meronymy, hypernymy, hyponymy, synonymy, and antonymy (Fee. This helped identify relationships among various Saraiki nouns. In a nutshell, it can be stated that the Saraiki language, being a powerful language of Pakistan, needs proper recognition and contribution to AI and NLP via WordNet development. It is because, like other languages, it also has lexical wealth and would be effective if this lexical information is used in modern-day technology.

5. 1. Recommendations and Suggestions

It has been observed that developing countries show immense negligence, especially towards the minority languages, while developed countries, after working on their languages, are now moving towards the languages of underdeveloped countries to preserve the essence and cultural heritage linked with each language to retain the linguistic variety and beauty over the surface of the earth. Hence, these countries are improving AI and NLP according to the requirements of the advancing era. Therefore, it is the responsibility of researchers to explore, highlight, improve, and make some contributions to oriental languages, especially Saraiki. Saraiki language needs more intensive work so that tasks like WordNet formation could be made possible. Furthermore, there must be some incentives and encouragement for those who aim to work in such an area.

Another suggestion is that there must be a proper setup for corpus-related studies, especially if there is a proper lab or some similar medium that may act as a guide for researchers working in such domains.

5. 2. Limitations of Study

The undertaken study is limited to the Saraiki language, and the areas in which it is used are also specified. Furthermore, specific genres are worked upon, i.e., religious text, fiction, poetry, prose, media or news, Saraiki linguistics, and dictionaries '*lughat.*' It is also limited as it focuses on noun synset formation; even in noun formation, a limited range of nouns was selected.

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