# DESIGNING AND IMPLEMENTATION OF INDIGENOUS KNOWLEDGE MANAGEMENT FRAMEWORK FOR GUMAA IN OROMO GADAA SYSTEM (IN CASE OF SIKO MANDO)

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## Abstract

*Oromo society, like many African societies, is rich in IK (Gadaa system) that is used for conflict resolution, food preparation, marriage system, sheltering, and clothing in all aspects of the Ethiopian nations in general and the Oromia regional state in particular. Furthermore, Oromo Gadaa system (OGS) is a traditional governance system, which includes various assets that helps Oromo society living in different areas of Ethiopia and other nations. Among those assets OGS, Gumaa institution is one of the multitude IK institutions of OGS used for conflict resolution that have been traditionally employed to settle blood feuds or compensate those who have been victimized. Despite its wider use and multidisciplinary in nature, psychosocial analysis of this IK of Gumaa in OGS is not fully utilized and preserved by the community due to its tacit knowledge and not supported by technology and there is no framework and implementation for this IK. Therefore, by considering this indigenousness and its importance in conflict resolution mechanism in different social activities, the aim of this study is to introduce suitable KM approaches that can support how to manage and develop framework for IK management of Gumaa in OGS. To assess and design a framework for the IK of Gumaa all the necessary data were collected from **Siko Mando** (Arsi and Bale) Oromo community using **cluster-sampling techniques** and will be analyze using SPSS version 26 and Prolog programming language was used to develop a functional prototype for implementation of the desired framework for easily managing and capturing IK of Gumaa in Oromo Gadaa system. According to this research finding, the Current Status of KM process is very low in IKM task. Hence, the desired framework and prototype was designed and developed to increase performance of IKM processes. Then, the developed prototype performance was tested and evaluated by experts and users using the standard criteria (ISO-9126) for evaluation like attractiveness, simplicity, efficiency, deliverability, portability, usability, functionality and maintainability. Based on their evaluation the results were 80%, 60%, 65%, 70%, 75%, 85%, 65%, and 50% respectively. Therefore, as the result shows, the proposed IKM framework is promising as solution for IKM processes, specifically for GUMAA in OGS conflict resolution.*

*Keyword: Gadaa System, Conflict Resolution, Knowledge Management, Indigenous knowledge management, Knowledge Base, AI*

## Chapter One

### 1. Introduction

#### 1.1. Background of the Study

Knowledge management (KM) is a multidisciplinary approach to attaining organizational goals and handling information within the organization and individuals by increasing the use of data. As a result, all aspects of KM process like Acquiring, capturing, storing, sharing, utilizing, and preserving knowledge, and as well as the cultural and technical frameworks that support the community, are included in knowledge management [1]. Therefore, KM classifies the knowledge into two categories in the field of artificial intelligence (AI): tacit and explicit knowledge. Where tacit knowledge is the Knowledge embedded in the human's mind, context-specific, and difficult to express and formalize. While explicit knowledge is codified knowledge that is simple to transfer or disseminate to knowledge seekers because it is stored and embedded in physical formats such as journal

articles, books, conference proceedings, databases, and electronic media, and it is simple to acquire, capture, represent, store, share, utilize, and preserve it [2].

Such essential information will be organized, managed and utilized with the help of KM approaches in order to improve the knowledge of individuals, organizations, and experts effectively and efficiently. As discussed, [3], the KM approach is the heart of the organization to utilize knowledge and increasing competitiveness in related working areas. Therefore, as discussed [4], the main goals of KM are to enhance and improve knowledge assets in order to increase performance of organizations and individual knowledge for better decision-making process. In addition, KM has also a higher measurable value in terms of increasing the utilization and preservation of indigenous Knowledge (IK); that the communities use in various areas to solve the problems they have. Indigenous Knowledge (IK) is a comprehensive body of knowledge (knowhow), traditional cultures, beliefs, values, and practices that are unique to a particular society and are transferred from generation to generation [5].

As a result, Oromo are a northern African indigenous people who speak Afaan Oromo and the single most dominant and largest ethnic group in Ethiopia. Moreover, the Oromo people of Ethiopia, like other Ethiopian peoples and other nations, have various tangible and intangible IK and heritages that have evolved over generations because of people's interaction with natural and social settings and serve as reflections of their identity.

What distinguishes the region even more, as discussed [6], is that these cultural and natural resources have been managed with an ancient traditional governance or doctrine system known as the **Gadaa system.** Therefore, Oromo Gadaa system (OGS) is a true forerunner of modern democratic principles and rich in different IK institutions that serve the community in various social aspects. This is because, in OGS, elected officials such as the Abba Gadaa (President of the Gadaa system), the Abbaa Duulaa (Commander of the army), the Abbaa Horii (Chief of the Treasury), and nine Hayyuu (nine intellectual) peacefully transfer power for non-renewable terms of 8 years.

The OGS assets can be shared and practiced with others Ethiopian nationalities such as Sidama, konso, gedeo, etc., in their socio-economic activities. The IK of OGS that helps the communities in various socio-political activities such as conflict resolution, marriage system, food preparation, clothing, sheltering etc. are an example of an African IK institution relevant to the current state of Africa in general and the Oromo society in particular. In OGS, the most common and well-known IK assets are conflict resolution mechanism which contains different institutions such as Gumaa, Siiqqee/Ateetee, Jaarsummaa, and Qaalluu etc. Among those, IK of conflict resolutions Gumaa (reparation) is multitude IK institution existed in OGS and help the communities during blood price, a ritual of reparation, and purification after some wrongdoing actions. In some areas of Oromia, IK of Gumaa is used as compensation for wrongdoing, while in other areas; it used as revenge (Punishment). In other places, it used to reintegration of people who have separated by an incident of wrongdoing, such as killing/murdering, injuring parts of somebody, insulting sacred respect persons. Therefore, in OGS Gumaa does not apply to every situation but it only applies to things, which have already chosen to be included in the Gumaa system. The of IK Gumaa institutions makes every effort to convey peace and justice by compromising conflicting parties in all aspects of their movements, including socially, politically, economically, and psychologically [7]. During conflict resolution process, mediators or negotiators were participated in order to reintegrate and build a peace between conflicted clans under the sycamore tree (Odaa) as shown in figure 1.1.

*Figure 1. 1: Mediators are involved in conflict resolution* [8]

In this study, the researchers addressed and identified the Strength, Weakness, Opportunities, and Threats (SWOT) analysis on Knowledge management (KM) application particularly on indigenous knowledge (IK) of Gumaa institutions in the Oromo Gadaa system (OGS) that the community uses to solve the problems they have. As a result, the researchers identify the application of KM approach as a strength in supporting knowledge holders or professionals of traditional knowledge during knowledge dissemination and preservation process. However, the current use of knowledge management systems (KMS) in OGS for assisting and managing IK exists as a drawback/limitation of domain area as a weakness. Furthermore, in terms of opportunities, this research study has the potential to solve the degree of IK acquisition, capturing, sharing, utilizing, and preserving by help of technology for better decision-making. Finally, the threat of using a knowledge management approach in the Current Status of IK of Gumaa in the OGS is in the utilization and preservation.

Therefore, various IK assets in Ethiopia needs KM approaches to simplify ways of knowledge dissemination and preservation. Then the Oromo Gadaa system (OGS) is one of those essential IK assets that the Oromo communities are using for many years, and it is practicing up to date. Therefore, due to its importance in every aspect of social life, it is critical to apply KM approach for easily manage, use, and preserve this IK asset of Oromo Gadaa system.

### 1.2. Motivation of the Study

Currently, knowledge management (KM) is a systematic and competitive approach for achieving the organizational goal by improving KM process (acquisition, capturing, representing, storing, sharing, utilizing and preserving) of an organizations or individuals [9]. As stated by [5] some indigenous knowledge systems (IKS) need KM approach, in order to sustain and use IKM more efficiently and technologically supported manner. As a result, the IK of Gumaa in OGS is the Oromo community's sociopolitical ideology, as well as psychological treatment, which comprises a variety of actions that result in the settlement of blood feuds or the payment of reparation for wrongdoing. This IK is very important and it is still existed in the Oromo Gadaa system (OGS) and practicing by the Oromo community living in different countries and shared with other nations in various socio-political activities. However, due to lack of a technology solution to assist and enhance it, IK of Gumaa in the Oromo community has not fully managed, captured, represented, shared, utilized and preserved for the next generations. In this study, the researchers have motivated to explore, design a framework and develop a prototype for IK of Gumaa in OGS for further sharing and preservation.

### 1.3. Statement of the Problems

Today, Indigenous knowledge (IK) institutions in the Oromo Gadaa system is serving the Oromo community in sociopolitical activities, and it has played a significant role in day-to-day activities such as conflict resolution, food preparation, sheltering, clothing, marriage, and power transfer systems in Oromo communities. Among those IK institutions of OGS the most common and well known is IK of conflict resolution mechanisms (Jaarsummaa, siiqqee, Gumaa, Qaalluu etc…). Moreover, from IK of conflict resolution Gumaa is a multitude IK institution that requires further investigation and need KM approaches.

However, there are several gaps, particularly in how to apply KM process (acquire, capture, access, share, utilize/apply, and preserve) on the IK of Gumaa for easily disseminate to the next generations. This is due to lack

of technology support, written documents and as well as due to oral teaching and dissemination of IK of OGS from Gadaa system leaders, local elders and other OGS intellectuals. Furthermore, experiences on IK gained through elders to solve community's problems are disappearing on a regular basis due to a lack of written documents, the death of local elders (Jaarsa Biyyaa), migration of people, urbanization, and expansion of foreign cultures [10].   With this in mind, the researchers were motivated to introduce suitable KM approaches to design IKMF, and develop a prototype for functional implementation of IK of Gumaa in order to increase the degree of capturing and preservation of this IK.

A thorough review of the literatures, particularly in the context of the Oromo Gadaa system, revealed that there is insufficient of research studies focused on managing IK of OGS in conflict resolution. Furthermore, the application of the KM approach for designing the framework to support the Oromo Gadaa system for easily handling and improving the usability of the IKM has not been explored. According to a review of previous research and observations, IK management in OGS for conflict resolution remains poor, particularly in terms of IK acquisition, capture, representation, share, utilization and preservation.

### 1.4. Research Questions

In order to solve the problem mentioned in the statements of problem this study is attempt to explore and answer the following Questions:

**RQ1**. What is the Current Status of Gumaa (indigenous knowledge management) in OGS?
**RQ2.** How computing technology support IKM for preservation of Gumaa in OGS?
**RQ3.** How to design and develop the IKM framework for Gumaa institution in OGS?

### 1.5. Objectives of the Study

#### 1.5.1.     General Objective

The general objective of this research is to explore and design the IKM framework for Gumaa in the Oromo Gadaa system for easily utilizing and preserving.

#### 1.5.2.     Specific Objectives

To achieve the general objective, this study addressed the following specific objectives to: -

- Identify and analyze the current status of Gumaa institutions for conflict resolution in Oromo community
- Categorize the major types of the wrongdoing activities and its rules that resulted to Gumaa (compensation) with scale of compensation.
- Investigate the technological barriers that hinder the effective management of IK of traditional conflict resolution practices in the community.
- Investigate and analyze the appropriate KM processes (acquisition, capturing, representing, sharing and utilizing/applying) and models to design and develop IKMF of OGS.
- Design and develop the proposed IKMF and prototype for functional implementation of designed IKMF.
- Evaluate the applicability of the designed IKMF using (ISO- 9126) standard.

### 1.6. Significant of the Study

The purpose of this study is to present a suitable knowledge management approach and knowledge management model for exploring and designing a framework for Gumaa IK in OGS in order to improve degree of IKM in acquisition, capturing, sharing, organization, utilization, preservation and dissemination.

The significance of the research study is to: -

- Simplify and increase teaching and transferring process of IK from Abbaa Gadaa or local elders to the community by reducing communication barrier.
- Increase the degree of acquisitions, capturing, sharing, utilization, and preservation process of IK existed in Oromo community.
- Support and create clear collaboration of Ethiopian nations in general and Oromia regional state in particular to access and use this IK.
- Saves time and budget for Oromia and Ethiopian judicial office.
- Provide input to the Oromia and Ethiopian culture and tourism bureaus in order to assist their communities in social and cultural interaction.
- Provide a baseline for future researchers in the domain of knowledge management.

### 1.7. Scope and Limitation of the Study

#### 1.7.1.    Scope of the study

The aim of this research study is to design a framework for the IKM of Gumaa in OGS to increase the degree of KM process like acquisition, capturing, representing, sharing, and utilization and preservation of IK exist in the Oromo Gadaa system in resolving conflict. Even though the aim of this study to design IKMF of Gumaa in OGS by collecting and analyzing primary and secondary data, this study is focused to IK of Gumaa Namaa (compensation paid for injured human beings). Additionally, functional prototype has developed using rule-based knowledge representation (KR) techniques. In addition, Siko Mando (collection name of Arsi and Bale) Oromo Gadaa system especially West Arsi and Bale zone were clustery selected for data collection, because Oromia regional state is very broad and contains more than 20 zones, which is difficult to collect a data from every zone due to time and economic feasibility.

Moreover, there are insufficient research done especially on IK of OGS used for conflict resolution like Gumaa and siiqqee. Therefore, the main reason behind choosing West Arsi Oromo Gadaa system is that, there are un-touched traditional knowledge that are used for conflict resolution particularly on IK of Gumaa and siiqqee institution.

#### 1.7.2.    Limitation of the Study

The limitation of this study is that data collection is limited to Siko Mando or Arsi and Bale Oromo Gadaa system since the Oromia regional state cover a large area and it takes more time and budget to collect data from every zone of Oromia regional state. Another limitation of this study is interviewing Abbaa Gadaa/elders at any time and everywhere were difficult; because they are orally teaching and assisting communities on various issues, and there is shortage of security and supports to them.

### 1.8. Deliverable/Outcome of the research study

This study was accomplished by investigating and designing a framework for IK of Gumaa institution in the Oromo Gadaa system that help the community in various social issues. As a result, this framework supports the users for easily acquiring, capturing, sharing, utilizing, disseminating and preserving the IK existed in OGS.

### 1.9. Organization/Structure of the Study

This research study has organized into six-chapter. The first chapter contains an introduction part, which emphasizes the background of the study, motivation, and statement of the problem, objective of the study, significant, scope and limitation. The second chapter includes a conceptual and related review literatures and a discussion of the research gap/ ability. The third chapter covers research design and methodology. The fourth chapter includes the result analysis of both primary and secondary data collected using surveys questionnaires, structured and unstructured interviews, and technical observation and as well as analysis different explicit knowledge of IK of OGS related to IK of Gumaa institutions for conflict resolutions were explored in this chapter. The fifth chapter focuses on designing a framework and developing a prototype for IKMF of Gumaa institutions for conflict resolution.  Evaluation and discussion of the proposed IKMF of Gumaa in Oromo Gadaa system is also the main deal of this chapter. The final chapter covers the conclusion and recommendations for the future work direction.

## Chapter Two

## 2.  *Literature Review*

### 2.1. Overview

It is necessary to review numerous types of literatures that have been accompanied in the area by different researchers in order to gain a better understanding of the research study's problem and to discover the knowledge gap. As a result, various concepts and related literatures such as unpublished document, books, articles, proceeding papers, journals, and other sources retrieved from the internet were reviewed to comprehend domain knowledge, concepts, principles, Current Status, and methods that are necessary for designing and developing Indigenous knowledge management (IKM) framework. As a result, there are two parts of the literature review: I) review of Scientific Concepts) and II) discussion of Related work.

### 2.2. Review of scientific concept literature

The fundamental notion of some scientific definitions of common terminology such as knowledge, knowledge management (KM), Indigenous knowledge (IK), KM model, KM process, KM system, Knowledge base system (KBS), and KM framework must be examined in order to arrange and organize the research study. Because it is

crucial to understand the domain and IK in the Oromo Gadaa system (OGS), especially to identify multitudinous of IK of Gumaa in conflict resolution process. As a result, the following parts will focus on exploring these topics from current literature.

### 2.2.1.    Knowledge

Different scholars describe knowledge in a variety of ways. According to [11] Knowledge is a collection of experiences, relevant information and wisdom that serves as a foundation for estimating and integrating new data and experiences for the development of organization. As discussed, [2], there are various types of knowledge but the most common are **tacit** and **explicit** knowledge. Tacit knowledge is involving personal views, values, intuition, insight, and embedded in the minds of individuals, whereas explicit knowledge conveyed in symbols and it is existed in the form of words, sentences, documents, processed data, computer application programs, and other forms.

### 2.2.2.    Knowledge Management (KM)

The concept of Knowledge management (KM) is defined differently by different researchers in different aspects. According [9] [12] [13], KM is the process by which organizations create, discover, share, utilize, preserve and manage the information to develop their cultures and values from intellectual and knowledge-based assets. The information then stored, disseminated, and evaluated using predetermined methods to support the members of the organizations.

### 2.2.3.    Indigenous Knowledge (IK)

Indigenous knowledge (IK) can be explained in a variety of ways. As discussed, [5], Indigenous knowledge (IK) refers to a broad body of knowledge, knowhow that can be transfer from generation to generation, typically through word of mouth and cultural ceremonies. Therefore, according to [14], IK is the result of community centric by practical experience and trial-and-error that is usually unwritten and having a strong link to the land, locale, and community.

### 2.2.4.    Role of IK in conflict resolution

Traditional African cultures are deeply embedded in minds of elders in which the elders have significant role in resolving problems that the society have. As discussed, [15], indigenous knowledge used for conflict resolution is playing an increasingly crucial role in resolving conflicts and supporting community in building peace and stability between them. As a result, the Oromo community, like many African societies, has its own traditional indigenous institutions for conflict resolution, known as the Gadaa system, which distinguishes the nation from others and it includes various assets. Therefore, among the IK of Oromo Gadaa system Gumaa, Siqqee and Jaarsumaa are the most commonly practiced and now practicing in OGS for resolving conflict in Oromo communities.

### 2.2.5.    Knowledge Management Model

Different knowledge management (KM) models like, SECI KM, WIIGS KM and Boisot I-Space model have been reviewed to determine which knowledge management model is suitable for designing a framework for indigenous knowledge management of Gumaa in the Oromo Gadaa system. Accordingly, the SECI KM is selected for designing and developing a framework for IK of Gumaa in Oromo Gadaa system; because the Nonaka model (SECI) were mainly focus on the tacit and explicit types of knowledge and discussed in the following section.

#### 2.2.5.1.    SECI KM Model

As discussed, [16], introduced the SECI model, which has since become a foundation of knowledge discovery and conversion theory. The SECI model were focus on the two types of knowledge, tacit and explicit, depicts that there are four approaches (Socialization–externalization–combination–internalization) conversion process and transferring from one type of knowledge to another. Therefore, in the SECI model, **socialization** (tacit to tacit) is the process of obtaining tacit knowledge from other tacit information through the sharing of experiences among many individuals of the organization. **Externalization** (tacit to explicit) is the process of converting tacit knowledge into explicit, knowledge. **Combination** (Explicit to explicit) is the most basic form of knowledge creation, in which codified information sources are joined to produce new knowledge. **Internalization** (Explicit to tacit), when explicit knowledge sources are, become used and learned, the knowledge is going internalized. Figure 2.1 shows SECI model of Nonaka and Takeuchi
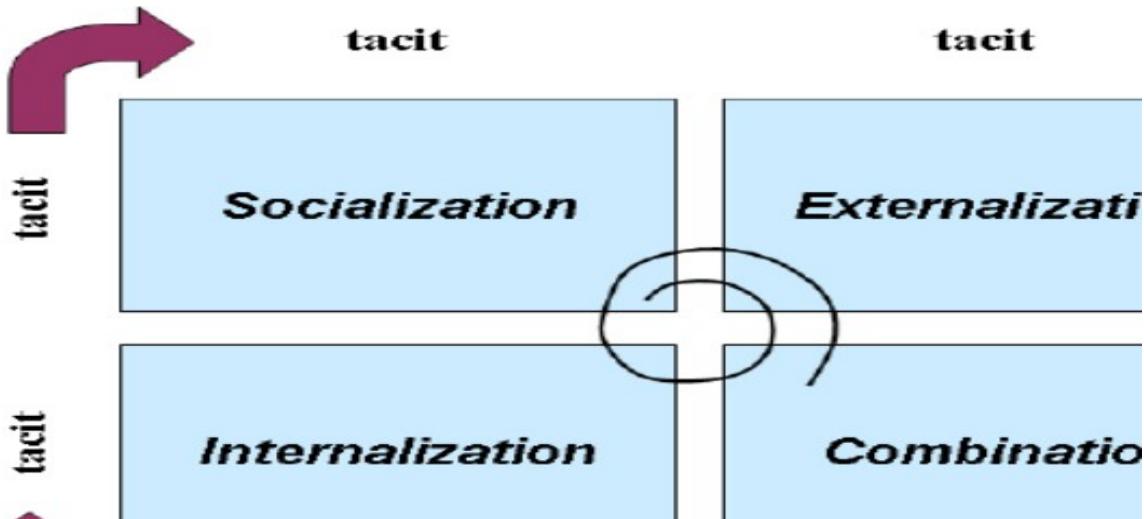
*Figure 2. 1: SECI KM Model* [16]

The researchers used this model as the Knowledge base during the development of the proposed IKM framework because the Nonaka and Takeuchi model has been based on tacit and explicit types of knowledge, which is the KM domain and it continues to be applied in a variety of settings.

### 2.2.6.        Knowledge management process

Knowledge management processes are a set of activities that organizations use during knowledge transfer process like knowledge acquiring, capturing, representing, storing, sharing, utilizing/applying and preserving knowledge easier [17]. Therefore, as explained [18], process of transforming one type of knowledge into another is referred to as knowledge management (KM) process.

### 2.2.6.1.        Knowledge Acquisition

Knowledge acquisition is a KM process that involves implementing novel/new knowledge or replacing existing content in explicit (codified) and tacit (uncodified) knowledge  through creating and discovering innovative information both within and outside of the organizations [19] [18]. Therefore, this process of KM is very essential for new generations to obtain and use IK institution in the Oromo Gadaa system particularly for conflict resolution (Gumaa).

### 2.2.6.2.        Knowledge capturing

Knowledge capture is an important aspect of the KM process in knowledge-based organization, this is due to capturing methodologies involve technology for easing the generation for efficiently collecting knowledge in an organization [18]. In this study, the researchers try to link knowledge capturing strategies to IK exist in OGS (Gumaa).

### 2.2.6.3.        Knowledge Representation

Knowledge representation as discussed [20] is under the umbrella of Artificial Intelligence (AI), which is concerned with the understanding, development, and use of methods for expressing information in computer systems using logic and ontology. There are many different ways to express knowledge, and some of them are mentioned and described here.

### I)        Rule-Based KR

The most frequent type of KR technique is rule-based in which knowledge is represented as a condition and action (IF-THEN) statement to determine the outcome [21]. As a result, rule-based knowledge representation is always written in the following format: IF (premise condition) THEN (conclusion). In this study, the researchers used rule-based KR techniques since the IK in OGS for conflict resolution (Gumaa) is based on predefined rules and facts.

### II)        Logical Representation

It is a branch of mathematics that can be utilized in a variety of ways to justify the correctness of computational representation and inference [22] [20]. Therefore, IK existed in OGS is a logic knowledge embedded in minds of elders so it is important to represent it mathematically using computer system.

### III)        Semantic Net KR

Semantic Net is a KR technique that focuses on the relationship between multiple ideas for knowledge gathered from domain knowledge to represent it as a network rather than data format. The associations among the

identified nodes are connected by two most common links/arcs such as IS_A and HAS_A [23] [20]. Therefore, the researchers address this concepts during knowledge representation process.

## IV)    Frame based KR

The frame is another KR method that employs a data structure and contains all information about a specific object and inference capability [24] [20]. As a result, researchers use this frame-based knowledge representation during modeling IK of Gumaa namaa (compensation for injured human beings) and its attributes.

## V)    Case based KR

Knowledge representation through case based is the type of KR approach used to resolving new difficulties depending on the resolution from previous problems [20] [25]. In this study, the researchers used the concept of case based in order to identify either the wrongdoing activities are occurred intentionally or accidentally or the category of Gumaa institutions.

### 2.2.6.4.    Knowledge storage

 After the obtained knowledge is represented, the next process is the adequate storage (libraries) for later access and preserve [1] [19]. As a result, rather than orally teaching this crucial knowledge of OGS the common platform is required to easily accessing and utilizing.

### 2.2.6.5.    Knowledge sharing

Knowledge sharing procedures relate to the dissemination of knowledge from one to another in order to improve KM process and simplifying decision-making processes [26].  On the other hand it is the process through which tacit or explicit knowledge is communicated and exchange of employee's knowledge to knowledge seekers [18] [1] [19]. As a result, IK embedded in humans' mind such as OGS institution for conflict resolution (Gumaa), follows the same approach for knowledge sharing process as other organizations.

### 2.2.6.6.    Knowledge Application/ utilization

Once available knowledge has been stored and shared among individuals in organizations, it should be effectively utilized and applied for the preservation of IK. As a result, if IK of OGS (Gumaa) is supported by technology it is easy to utilize and apply [1] [26].

### 2.2.6.7.    Knowledge preservations

Knowledge preservation entails identifying, capturing, validating, and formatting steps of wisdom in order to utilize and preserve critical knowledge (know how) and scale up successful solutions [27] [1].  As a result, the IK of OGS that is used for conflict resolution must be preserved for future use and continuity since it helps the community in social, economic and political aspects of everyday life.

### 2.2.7.    Knowledge Management System (KMS)

Knowledge management systems (KMS) have been defined by various scholars in various dimensions. However, the most common and scientific definition of KMS is a tool or information and communication technologies (ICTs) that can be used to capture, store, represent, disseminate, collaborate, and identify knowledge sources in order to support the generation and use of knowledge by individuals, organizations, and nations as a whole [12] [18]. As a result, this study examines how knowledge management systems (KMS) is applied on IK of conflict resolution in Oromo Gadaa system (Gumaa) to manage and preserve it within the community

### 2.2.8.    Knowledge Based Systems (KBS)

Knowledge-based systems is similar to KMS, which is classified in the field of Artificial Intelligence (AI) and used to improve the performance of knowledge sharing and preservation in a certain organization by creating a repository for knowledge [1] [18]. Therefore, IK institutions for conflict resolution in OGS needs knowledge base since it is a crucial and serving the community for various social issues.

### 2.2.9.    Knowledge management Framework (KMF)

Knowledge acquisition, capture, sharing, distribution, utilization, and preservation are all aided by a knowledge management (KM) framework. As well as helping individuals or organizations to sustain their development by allowing effective and successful deployment of their knowledge management system [24] [28]. The over-all knowledge management framework, as shown in figure 2.2, is developed based on a combination of frameworks to identify the factors that improve components level framework through analysis of relevant literature [29].
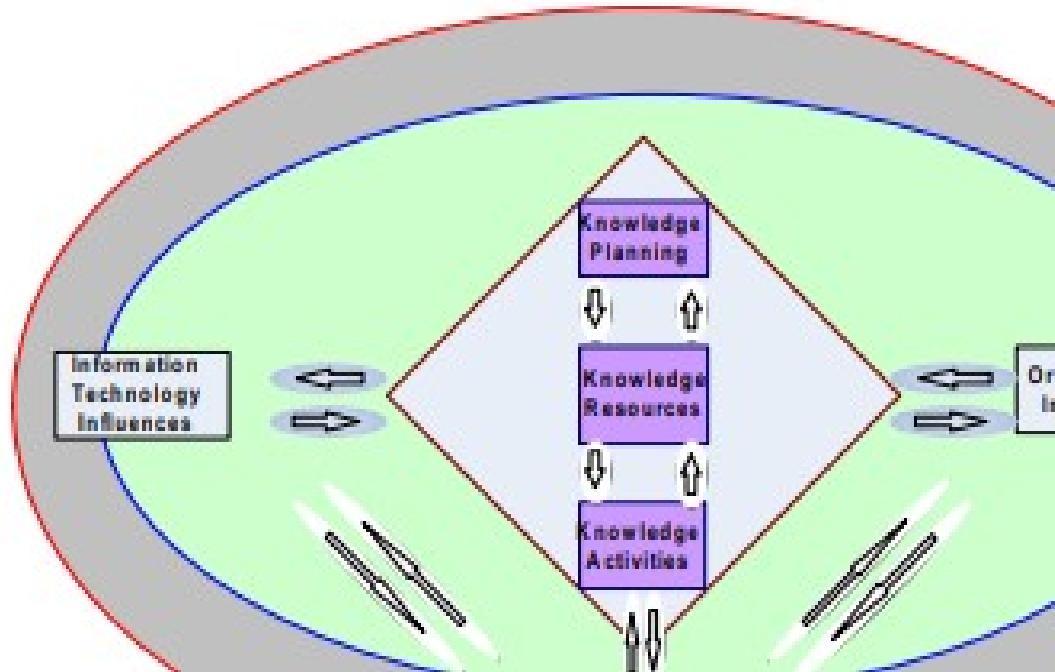
Figure 2. 2:  The Overall Knowledge management framework [28]

In this study, the researcher reviewed different KMF that are developed by different scholars in order to design and develop a framework for IKM of Gumaa in OGS.

### 2.3. Review of related research works

Different research articles are reviewed and cited in this review of relevant research work in order to grasp the research ability and identify the research problem. Accordingly, there are insufficient research studies in the Oromo Gadaa system especially on IK of conflict resolution techniques (Gumaa).  As well as there is no technology enabled management of IK of Oromo Gadaa system

According to [30] investigate a Knowledge Management approach for sharing and acquiring IK of traditional healthcare practices in local communities in Ethiopia's Horro Guduru Wollega zone. The major objective of this study was to examine the KM approaches and develop a framework for sharing and acquiring IK of traditional healthcare practices. The researcher applied Nonaka's SECI model of knowledge creation and sharing in this investigation. (SECI stands for "Socialization (S)," "Externalization (E)," "Combination (C)," and "Internalization (I)"). However, this study did not incorporate all knowledge management process rather than sharing and acquisition process for traditional healthcare practices and as well as this study did not clearly address the methodology; they use to develop this framework.

 As discussed [31], the application of knowledge management (KM) methodologies in the domain of coffee production is to manage and share indigenous knowledge among various stakeholders. The main objectives of this research study were to identify the sources of indigenous knowledge and to assess the existing knowledge sharing culture among various stakeholders in the coffee industry. The researcher used Nonaka and Takeuchi's SECI model to develop a KM model for rural areas in this study. However, the proposed IKMF is limited only to the IK acquisitions and sharing process of coffee production; henceforth it is vital to extend this study includes other process of knowledge management.

As discussed [26], the assessment of knowledge sharing practices in higher learning institutions assess and explore new exploratory framework. The objective of this study is to explore the existing knowledge sharing practices among the staff of the academic institutions/universities and identifies the level of KS practices, prevailing barriers that hinder knowledge sharing practices and technologies that facilitate sharing of knowledge. However, they focus only on the knowledge sharing process. It gives sense and full understanding if it include all KM process like knowledge Acquisition, capture, and utilization and preservation.  After analysis of the related study, the researchers observed that there is no integrated Knowledge management process, which supports the community for easily managing and utilizing their traditional cultures and believes. Therefore  the researchers found that gap and proposed to design and develop IKMF of Gumaa institutions in the Oromo Gadaa system that is used for conflict resolution and incorporates almost all KM process ( Acquisitions, capture, share,

utilize, and preservation) by applying KM approaches (computing technology). As discussed [32] the designed Indigenous Knowledge Management (IKM) model for whole Gadaa System by analyzing and identifying the current status of indigenous knowledge (IK) in Gadaa System in Oromo as general and Guji Oromo Community in specific. In addition, indicating the way of forwarding IKM process to the next generation with the help of technology.  However, the researchers found the gap that this study mainly focused on the whole Oromo Gadaa system. That means the study did not address any asset that existed in the Oromo Gadaa system like conflict resolution and the prototype was focused only on the Gadaa grading system.  Table 2.1 covers some relevant related research works with critical review remarks of the researchers and the objective of the study to find out a knowledge gap in previously done researches.

*Table 2. 1: Summary of litrueture review*

| No | Title | Authors | Objectives of the study | Contributions &conclusion | Critical Remarks/research gap |
|---|---|---|---|---|---|
| 1. | [24] | Christopher k. filson Mr & Paulina Afful Arthur Mrs. (2016) *Library Philosophy and Practice (e-journal)* | The objective of the study is to determine the existing state of indigenous medicine preservation and dissemination, if any, as well as the expected involvement of Ghanaian university libraries in maintaining and distributing the information involved. | Contributed to find out the current way of preserving and disseminating information on indigenous medicine in Ghanaian university libraries. | Even though, researcher used KM approach to manage IK of medicine, they did not incorporate other KM process rather than preservation and disseminations. In addition, other weakness of this study is that they did not develop any framework that shows the conceptual model for IKM of medicine. |
| 2. | [26] | Amin Tuni Gure and Durga Prased Sharma(2019) *The IUP journal of Knowledge management* | The aim of this study is to assess and explore the existing KS practices among the staff of the academic institutions and  identifies the level of KS practices, existing barriers that hinder KS practices and technologies that facilitate KS | The contribution this study is mainly focus on KS and how the barriers of sharing process may varies from individual to individuals  or  from one organization to others especially in higher learning institutions. Finally, the framework for KS developed for it. | Researcher contribute by developing knowledge sharing framework. However, they focus only on the knowledge sharing process among knowledge management process. It gives sense and full understanding if it include all KM process like knowledge Acquisition, capture, and utilization |
| 3. | [10] | Hambisa Mitiku, Worku Jimma & Chala Diriba (2016) *Article in European Academic Research · April 2016* | The goal of this study was to examine into a KM approach for sharing and acquiring IK of traditional healthcare practices in local communities in Ethiopia's Horro Guduru Wollega zone. | In this study, the researchers especially focused on how to use KM approach to manage IK, to identify factors affecting the acquisition and transmission of IK and develop framework for acquisition and transmission of traditional healthcare practices at Horro Guduru Wollega Zone | The researchers develop a framework for acquisition and transmission of traditional healthcare practices at specified area. However, the researcher did not explain how preserve the acquired and shared IK of traditional healthcare as well as this study did not clearly address the methodology they use develop his framework. |

| 4. | [5] | Saeed Lodhi,Peter Mikulecky (2014)<br><br>*Communication and Management in Technological Innovation and Academic Globalization* | The main objective of this study is on indigenous KM, with a special emphasis on the status and requirements of developing countries. | In this research paper the researcher aims to address the importance of IK and its management as one of the developing factors in developing countries. In addition, explain how ICT can play major roles in improving the availability and manageability of IK systems. | The researcher try to address how IK can be managed among developing country and how ICT support for easily capturing in IK, But the researcher did not Identifying and testing instruments for capture and dissemination of IK and as well as there is no framework developed for this IKM of developing country |
|---|---|---|---|---|---|
| 5. | [31] | Tewodros Genanaw & Workset Lamenew (2014)<br><br>*Ee-JRIF Ethiopian e-journal For research and innovation Foresight* | The study identifies where the IK resides and examines the current knowledge sharing culture between different stakeholders in relation to coffee production; then design an Indigenous Knowledge Management Framework (IKMF) tailored to Ethiopian context. | The study identifies the sources where the indigenous knowledge resides and examines the current knowledge sharing culture between different stakeholders in relation to coffee production in Ethiopia and design KM Framework for Sharing and Acquisition IK. | In this research paper, the researcher try to design Indigenous Knowledge Management Framework for Coffee Production in Ethiopia however the proposed IKMF is limited to the scope of coffee production; henceforth it is vital to extend this research to develop an integrated IKMF for the whole agriculture sector and other indigenous institutions for conflict resolution in Oromo Gadaa system. |
| 6. | [12] | Aregash Adugna1 , Worku Jimma2* and Chala Diriba2<br>*January 2020 A Bilingual Journal of the Institute of Oromo Studies (IOS) Jimma University* | The main objective of this study is to design a framework for crop production by applying a KM approach to the IK of crop production. In addition it identify how IK of crop production applied in agricultural sectors | The researchers design Framework for KM Approach in Managing IK of Crop Production that helps to direct how the KM approach is applied in rural community in order to make effective management of IK of crop production | In this research paper, the researchers design Framework for Knowledge Management Approach in Managing Indigenous Knowledge of Crop Production but the study does not specify which model used to design the framework and there is no computing solution for the proposed study. |
| 7. | [9] | Varsha Deb, Vasudha Vashisht, Nidhi Arora(2019)<br><br>*International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878, Volume-8, Issue-2 S7, July 2019* | The main aim of this study is semantic based structure for IT service management processes to design and maintain ITIL processes for end to end knowledge creation, knowledge retrieval and knowledge updating | The researchers of this paper presents semantic based structure for IT service management processes to design and maintain ITIL processes for end to end knowledge management cycle consisting of knowledge creation, knowledge retrieval and knowledge updating | In this study final outcome of the researcher is does not specified because the tools and techniques used is un-clear. In addition the study does not address, how IT service and products are support knowledge management for easily retrieval of the information. |

| 8. | [15] | Saide , Winda Hafiza<br><br>*2017 2nd International Conference on Knowledge Engineering and Applications* | The goal of this research is to look into the effects of individual and technical factors on knowledge sharing activities. It is also aimed to identify the most influential characteristics so that they may be used as a guide to help universities maximize knowledge sharing efforts. | The major contribution of this study is to analyze individual and technological factors on knowledge sharing activities by identify the most influential characteristics so that they may be used as a guide to help universities maximize knowledge sharing efforts. | The researchers try to identify the technological factors on knowledge sharing activities. However, the study did not develop framework that indicates how individual and technology factors affect knowledge sharing within the given organization. |

### 2.4. Related Research Works Summary

After reviewed of the related research study, the researchers found that KM approach are widely used by different researchers in various areas to manage knowledge within certain organizations by developing a conceptual framework. However, there is a knowledge gap and insufficient study on IK institutions, exist in the Oromo Gadaa system for conflict resolution (Gumaa) particularly in application of KM approaches to manage and preserve it.  In this research study the researchers address the observed gaps by injecting different activities of KM process (acquiring, capturing, representing, sharing, utilizing, and preserving) to organize the activities in the right categorization in order to design the IKMF of Gumaa institutions to manage, and increases the degree of utilization and preservation of this IK in the OGS.

In the Oromo Gadaa system, there are different IK institutions, which are totally embedded in human's mind. Among those IK, the IK of conflict resolution is the most important and widely used by the community in everyday life. Therefore, this study focused on IK of conflict resolution (Gumaa) in OGS that plays a great role in peacebuilding and justice administration among the Oromo community.  Moreover, at the end of accomplishment of this research study, exploring and designing a framework with the prototype for IK of the Gumaa institutions for conflict resolution is a contribution of this study.

## Chapter Three

### 3.   Research Design and Methodology

Research methodologies is used to support and conduct the study by identifying the methodology or philosophy to answer research questions, design, and implement conceptual framework in order to achieve the objective of this study [33].  As a result, this section mainly incorporates study area/catchment area, research design, research approach, data sources, data collection methods sample size and sample size determination, and tools used for the development of this study. Therefore, the knowledge engineering research design and methodology were adopted in order to design the framework of indigenous knowledge of OGS used for conflict resolution (Gumaa) to solve the problem mentioned in the problem domain using primary and secondary sources of data.

### 3.1. Research Design

After rigorous review of literature, this research study used a knowledge engineering research design methodology (KERDM), because knowledge engineering (KE) identify knowledge management tools and techniques to convert engineering knowledge into knowledge model for supporting the development of an artifact for IKM process and designing conceptual framework and demonstration [34]. Finally, this research study has resulted in an effort to design an IKM framework for IK of Gumaa in OGS to improve the degree of IK utilization and preservation. Therefore, in this research study  KE research design were used, which includes sections like understanding the domain of the problem, problem identification, solution object, design and development, demonstration, and evaluation [35] [36] which is shown in figure 3.1.
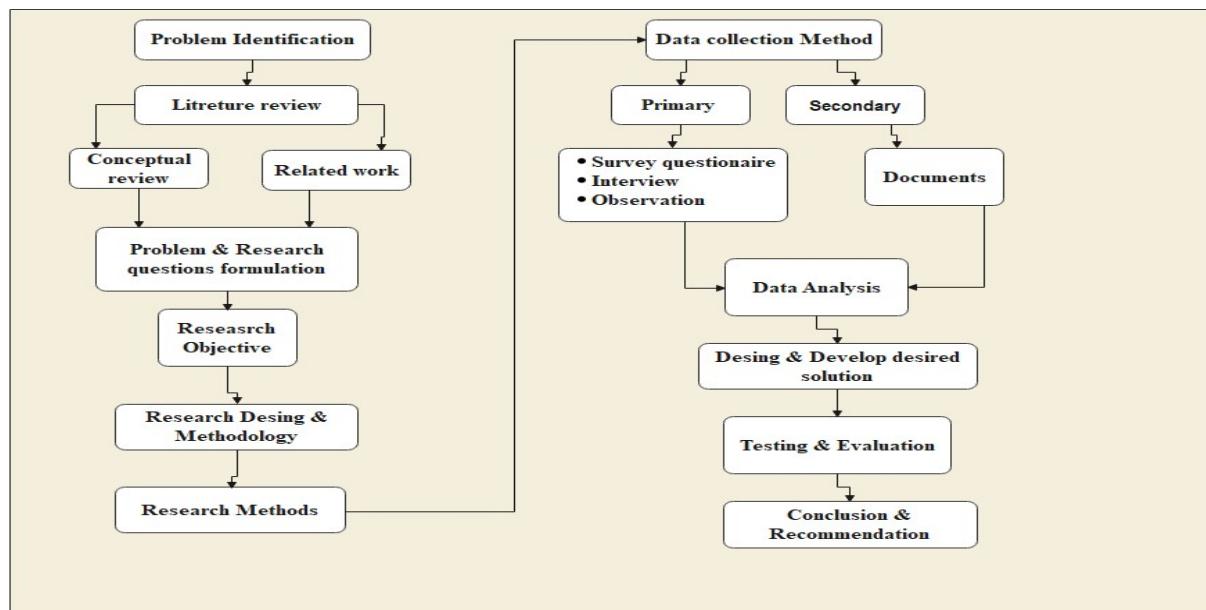
Figure 3. 1: Knowledge engineering research design methodology [35]

### 3.2. Catchment Area

The overall catchment area of this research study is Siko Mando Oromo (Arsi and Bale). As discussed [37] by different researchers and history founders the Siko Mando Oromo is the collection name of Arsi and Bale, were the Siko has five sub-moieties collectively called Shanan Siko (the five ones of Siko). They are Bullallaa, Wacaalee, Jaawii, Waajii and Ilaannii. The Mando has seven sub-moieties collectively called Torban Mando (the seven ones of Mando). They are Raayyaa, Kajawaa, Hawaxaa, Utaa, Waayyuu, Harawaa and Biiltuu [33]. The Siko Mando Oromo community are, West Arsi Zone, East Arsi zone, Bale zone, and East Bale zone. The administrative city of West Arsi and East Arsi is Shashemene and Asella respectively whereas the administrative city of Bale zone and east Bale zone is Robe and Ginir respectively. As a result, this research study will mainly focuses West Arsi zone and Bale zone; since Oromo community of Siko Mando particularly Bale zone and West Arsi zone have various tangible and intangible indigenous Knowledge which have been practice and practicing for long time  like conflict resolution, food preparation, clothing system, sheltering, marriage system, culture of farming. The west Arsi zone town called Shashemene far (240km) from capital city of Ethiopia (Addis Ababa) it has altitude of $7^0$ 12' north and longitude of $38^0$ 36' east.  In Shashemene, the weather is the wet season is comfortable and mostly cloudy and the dry season is warm and partly cloudy. Over the course of the year, the temperatures typically vary from $54^0$F to $82^0$F and rarely below $49^0$F   or above $87^0$F. The town is also known as Rastafarian community since Jamaica people inhabit the city starting from emperor Haile sillase [38]. This zone covers an area of 11,776.72 km2, divided into 12 districts (weredas). The total populations of West Arsi zone was officially estimated at 2,929,894 in mid-2022 [38].  The administrative center of this zone is Shashamane, with an estimated 208,368 inhabitants in mid-2022. Other towns in this zone include Arsi Negele (98,114) in Arsi Negele District, Dodola (43,186) in Dodola District, Asassa (42,867) in Gedeb Asasa District, Kofele (27,948) in Kofele District, and Adaba (25,098) in Adaba District [38].  Bale Zone (Oromo: Aaana Baalee) is a zone in Oromia Region of Ethiopia. Bale is bordered on the south by the Ganale Dorya River which separates it from Guji Zone, on the west by the West Arsi Zone, on the north by Arsi Zone, on the northeast by the Shebelle River which separates it from West Hararghe Zone and East Hararghe Zone, and on the east by the Somali Region. The zone is connected with Finfinne via Robe highway. The economy of the zone is mainly dominated by agriculture. The zone is for coffee and wheat production. Points of interest in the Zone include Sheikh Hussein—named for the tomb of a Muslim saint—the Bale Mountains National Park, and the Sof Omar Caves. Recently Bale is divided in to bale zone and east bale zone. The administrative city of bale zone is robe with population of 244,937 in mid-2022 [38]. Others woredas like Goba, dinsho, agarfa, gasara, goro, harana buluq and dallo mana are also found in Bale zone. In mid-2022, the population size of the Bale zone is approximately 1.5 million [38].

### 3.3. Research Approach

As a matter of facts, a research approach aids in the identification and pursuit of various new facts to address the identified problem in a certain domain [39]. Hence, this research study was required to gather data and information from different sources through survey questionnaire, interviewing, and technical observation and the Mixed (Quantitative and Qualitative) research approach was used.

### 3.4. Source of Data

In order to achieve the objective of this research study, the researchers were use both primary and secondary source of data. Primary source of data will be collected from Siko Mando Oromo community particularly specifically form Abbaa Gadaa, Haadha Siiqqee, local elders, local community and experts of West Arsi and Bale zone culture and tourism bureau through structured and unstructured interview, survey questionnaire and technical observation and focus group discussion (FGD).   While secondary data was collected from published and unpublished materials through rigorous reviews of the conceptual and related documents.

### 3.5. Sampling Design

The sampling design covers calculating the size of the study's sample and the technique for picking these samples from the target area [40].

**Total population: -** This study was conducted at the West Arsi zone and Bale zone, which is found in Oromia regional state. In addition, the total populations of this two area is more than **4 million**. However, among those populations of West Arsi Zone and Bale zone some of them are other ethnic group(clans), some didn't know about IK of Oromo Gadaa system, some are children who didn't learn more about traditional governance of Oromo Community (Gadaa system). Therefore, in order to determine the sample size of this study area, the researchers used **Raosoft** sample size calculator software, which determine the recommended sample size based on the margin error, confidence level and response distribution in which real population of the study area is unknown [41].

**Sampling Technique: -** In this research study, researchers were used **clustering sampling** technique that involves West Arsi zone and Bale zone Abbaa Gadaa, Haadha Siiqqee, local elders, local Oromo community and domain experts of culture and tourism bureau of  these two catchment area of Madda Walabu university based on their role and experiences in IK of OGS (Gumaa) [42].

**Sampling size determination**: -The researchers were determine the sample size by using **Raosoft** method to calculate the recommended sample size of the populations as shown in figure 3.1. Then duplicate and distribute hard copies of Survey questionnaires to the respondent and will made interview, Focus group discussion and technical observation for the respondents based on the selected parameters as stated and attached questionnaire at the end of this proposal.
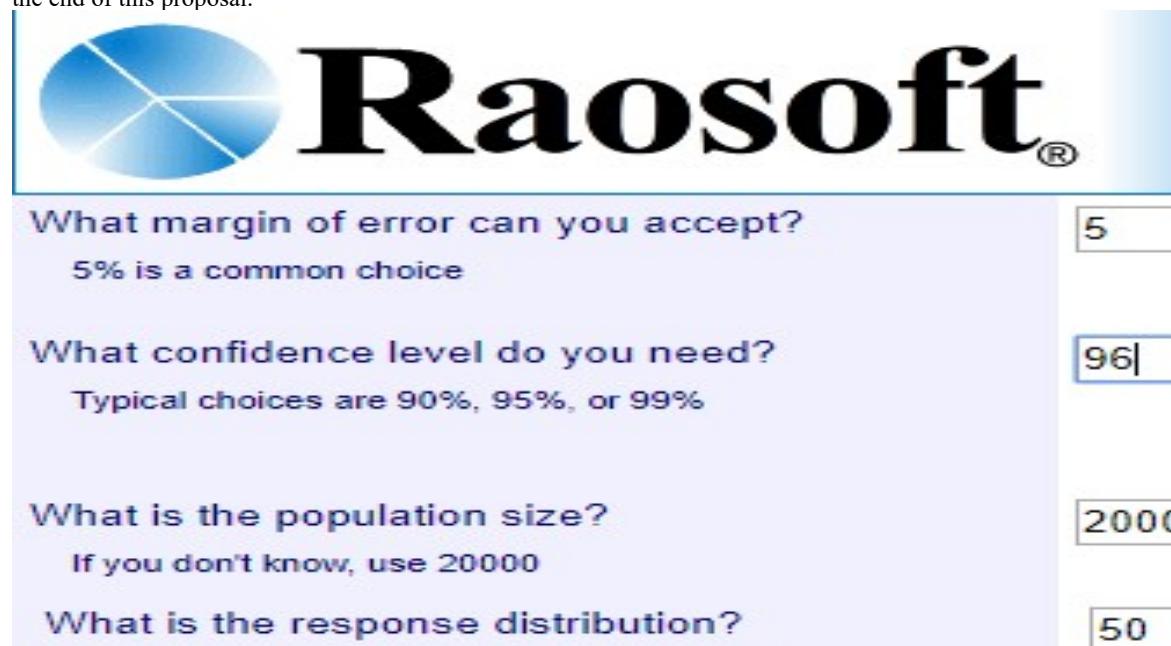


*Figure 3. 2: Sample size deteminationa using Raosoft* **[43]**

As illustrated in figure 3.1, the recommended sample size of this study is about four hundred and twenty two **(422)**. Therefore, the researchers were conduct to collect data from this (422) recommended sample size through survey questionnaire, interviews, FGD and technical observations based on the level of experiences they have on indigenous knowledge of Oromo Gadaa system particularly in conflict resolution.

**Study Area and population: -** This study was conducted at the West Arsi zone culture and tourism bureau, which is found in Oromia regional state, Shashemene town. The total target population of this study area was unknown. Therefore, the researchers were used Raosoft sample size calculation method, which states that if you do not know the population size leave the default value, as it is (20,000) [44].

**Target populations: -** The target population of this research study was Abbaa Gadaa, Haadha Siiqqee, local elders (jaarsa biyyaa), Local Oromo Communities, and experts of culture and tourism bureau in West Arsi zone and Bale. Therefore, from two selected zones, the researchers were decided to select three woreda from Bale zone (sinana, Dinsho and agarfa**)** and three-woreda form west Arsi zone (Shashemene, kofale and dodola).  The reason behind selecting those woredas are that the selected woredas were untouched IK of Oromo Gadaa system like conflict resolution mechanisms, married system, clothing, food preparation and so on and  commonly practice the IK of Oromo Gadaa system for long time and still using the traditional way of conflict resolution mechanisms. Therefore, the researchers were extract basic tacit knowledge from Abbaa Gadaa, haadha siiqqee, local elders, local communities and experts of cultures and tourism bureau of these selected woredas using cluster-sampling techniques. Accordingly, from **422**-sample size, **200** respondents were selected from Bale of selected woredas and **222** respondents from West Arsi zone of selected woredas based on the cluster sampling techniques. Because in this study the cluster sampling technique is used to cluster/ group the respondents under Abbaa Gadaa, Haadha siiqqee, Local elders, Experts of culture and tourism bureau and local Oromo community of Bale and West Arsi zone based on their experience on IK of OGS.  From bale of selected woredas out of 200 key respondents, 5 Abbaa Gadaa, 5 Haadha siiqqee and 10 experts of culture and tourism bureau were selected and the remaining 180 respondents were from local elders and local communities of Bale of selected woredas. In addition, from 222 key respondents of West Arsi zone of selected woredas 6 Abbaa Gadaa, 6 Haadha siiqqee and 10 experts of culture and tourism bureau were selected and the remaining 200 respondents were from local elders and local communities based on the knowledge they have on IK of conflict resolution (Gumaa) in OGS.

**Sampling size:-**The researchers were distributed questionnaires to 422 target populations that were selected from Bale and west Arsi zone of selected woredas. As a result, from those two selected zones, the researchers were conducted to collect data from Abbaa Gadaa (11), Haadha siiqqee (11) local elders and local communities (380) and experts of culture and tourism bureau (20). Accordingly, from 422 total target populations 395(93.6%) were responded. Among 395(93.6%) participants, 385 (91.2%) respondents were filled the required information and successfully responded. However, only 10 (2.4%) respondents were not appropriately filled and answered the required information and it is invalid data ; since they did not understand the way of responding system and about IK of Oromo Gadaa system for conflict resolutions, so the researchers discarded it.  As a result, this research study is more scientifically exploratory, so the sample size of 385 (91.2%) is sufficient for generalization.

### 3.6. Data Collection methods

Data collection is a vital part of any research activity, but it takes on a different meaning when it comes to answer specific research questions. For this research study, the primary and secondary data sources were collected using different data collection tools. Accordingly, for primary data sources structured and unstructured interviews and survey questionnaires were used. In addition, for secondary data collection recorded document analysis and different research papers were reviewed [45], as depicted in the Figure 3.2.
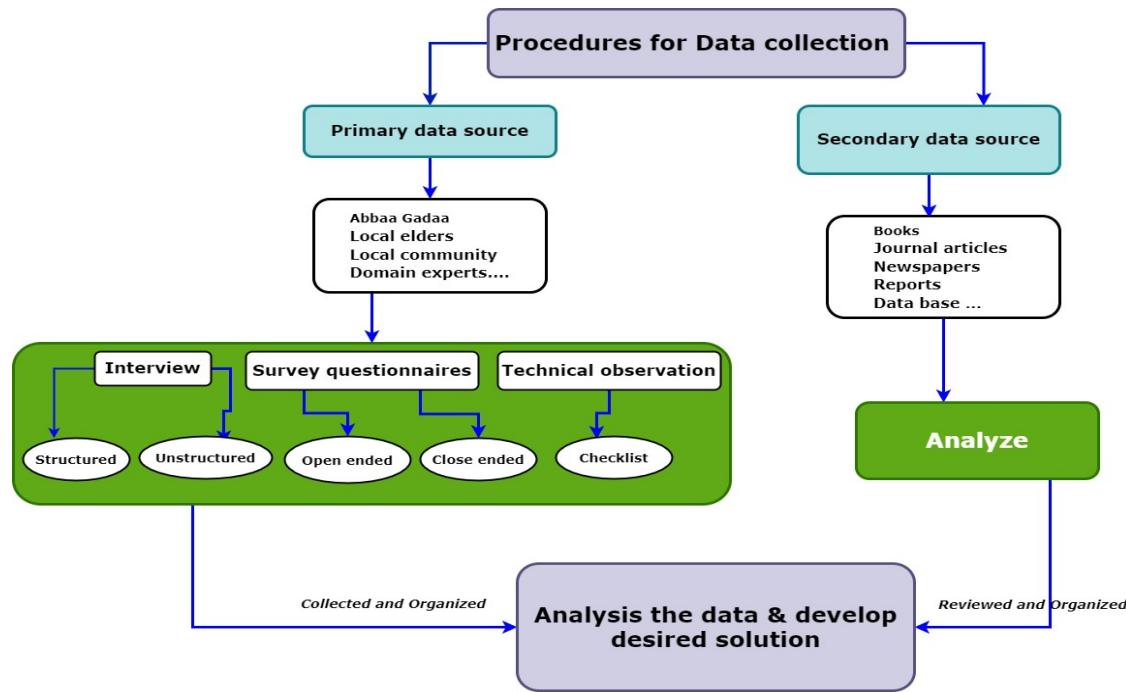
Figure 3. 3 : Data collection Methods [45]

This study used both primary and secondary data collection methods, as shown in figure 3.2, and the procedures are explained below.

A. **Interview:**   Interviewing is the most common data collection method, which entails asking questions depending on the parameters chosen for the research question and receiving answers from study contributors or participants. In this research study, individual face-to-face and group face-to-face interviews were applied [39] by using structured and unstructured interviews. Therefore, eight (8) Abba Gadaa, eight (8) Haadha siiqqee and twenty (20) key experts were interviewed and detail information of IK of Gumaa in Oromo Gadaa system were collected and analyzed.

B. **Survey questionnaire:** A questionnaire is a type of primary data collection method that consists of a series of questions intended to gather information in order to answer all of the research questions raised in the proposed study. In order to acquire responses to the study's problem, the researchers duplicate a paper (hard copy) questionnaire and distributes it to 422 respondents. Accordingly, from the 422 respondents 395 (93.6%) were returned the responses and only 10(2.4%) were invalid data and discarded. Therefore, 385 (91.2 %) respondents were successfully responded and accepted for data analysis.

C. **Technical Observation:**   The researchers were gathered significant data or information regarding the IK for conflict resolution (Gumaa) through technical observation (checklist) and proposed to develop a framework for IK of Gumaa institutions in OGS [39].

D. **Documents Analysis**:   The researchers were reviewed various published and unpublished   document for secondary data collection method in which relevant and necessary data or information about IK of Oromo Gadaa system of Conflict resolution is obtained by analyzing different documents such as books, journals articles, internet, report, magazine, newspaper [39].

### 3.7. Tool Selection

#### 3.7.1.   Software Tools

In this research study the researchers were compared and analyzed the various types of software tools and technologies using different selection parameters (Openness, simplicity, functionality, platform, interactive, pattern matching, literacy, etc…) as shown in Figure 3.3. As a result, SPSS for data analysis, E-draw Max (Draw.io) for designing conceptual diagram and desired IKMF, and SWI PROLOG to develop a functional prototype for the proposed IKMF of Gumaa institutions in OGS were selected
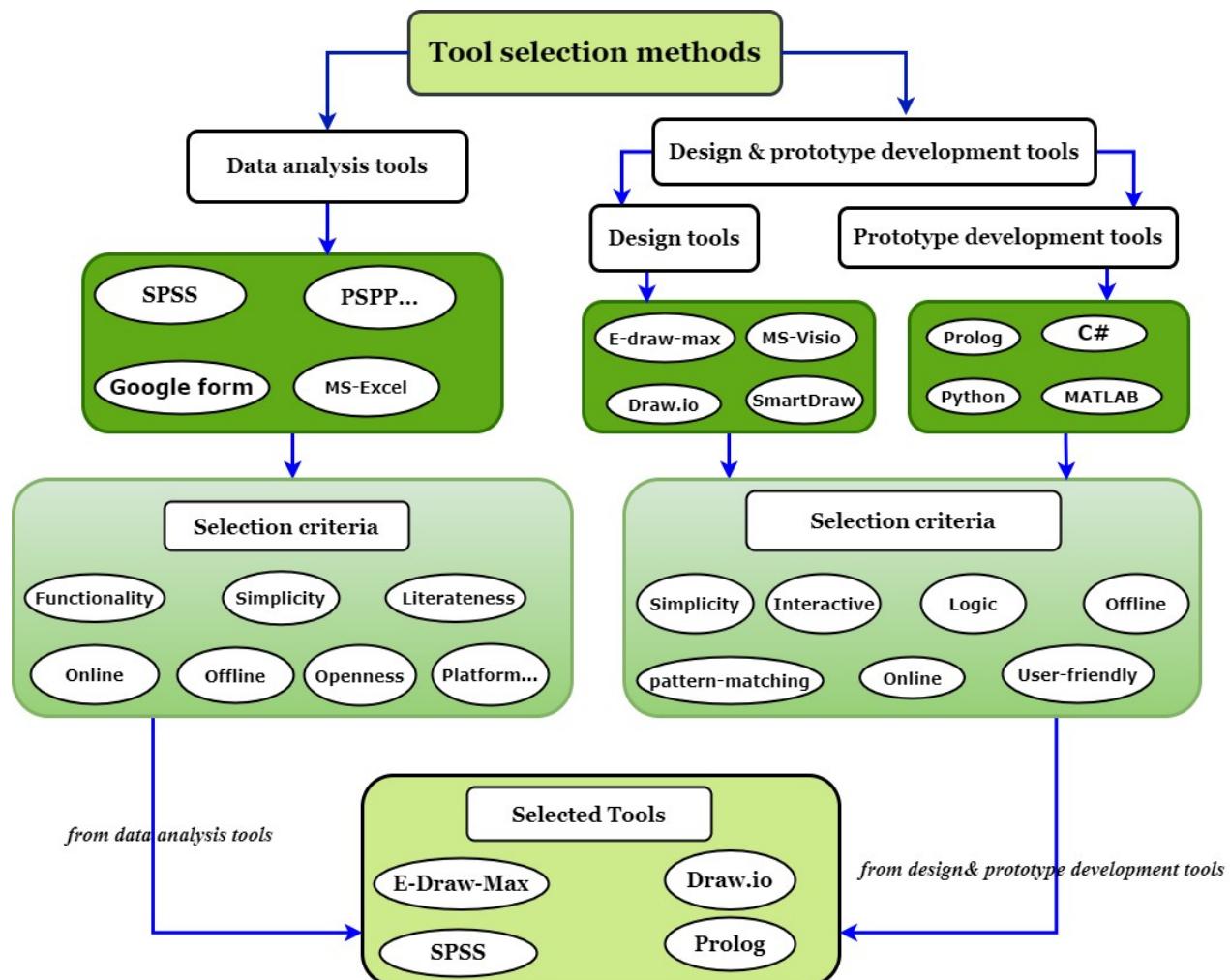
Figure 3. 4: Tool selection methods [45]

This study proceeds with critical comparison and analysis of various software tools as illustrated in figure 3.3, and SPSS, E-Draw-max/Draw.io, and SWI-Prolog were selected for data analysis, designing conceptual diagrams and desired framework, and develop a functional prototype respectively. These tools were selected based on the suitability assessment for the most-fit selection criteria for accomplishing the task and some parameters like simplicity, cross-platform, comfortability, pattern-matching, interactive, openness, literateness, user friendly, easiness of implementation, power full in logic programming, and etc. were used as tool selection criteria for this study.

**E-Draw-Max: -** This is the most essential open-source tool for designing conceptual diagrams and the desired IKMF of Gumaa institutions in OGS.

**Draw.io:** is an online versatile software, with more powerful features that make it perfect for sketching a professional-looking diagram. The reason behind selecting this tool is, it has more functionality and features like drag and drop, ease of use beautiful templates, and other facilities like multiple import and export, than other tools like E-draw Max, Microsoft Visio.

**SPSS: -** SPSS (Statistical Package for the Social Sciences) is a flexible data analysis software that is used by a wide range of researchers to analyze complex statistical data analysis [46]. In this study, SPSS has been selected for analyzing data. The reason behind choosing SPSS for data analysis is that, most of the intellectual of OGS are unfamiliar with Google product. Therefore, researchers were prepared and distributed survey questionnaires (in hard copy) to respondents, and analyzed the data using SPSS.

**Prolog: -** Prolog is primarily intended as a declarative (rule-based) programming language and described in terms of relations, which are represented as facts and rules. Unlike other software, it has key features like built-in, logical facts, rule-based, and simple but sophisticated data structure manipulation [47]. Therefore, in this

study prolog is selected be used to develop a functional prototype in order to test the designed IKMF of Gumaa institutions in OGS because the IK of conflict resolution (Gumaa) is based on predefined rules and facts.

## Chapter Four

### 4. Data Analysis and Discussion

#### 4.1. Primary data and secondary data analysis

In this research study, both primary and secondary data were collected from different sources using survey and interview questionnaires. In addition, the technical observations (Check List) is done to verify the collected data and interview results were matched or not.  As a result, the collected data from all sources were analyzed and discussed based on the selected parameters.

#### 4.2. Indigenous Knowledge management (IKM) process

##### 4.2.1. Knowledge Acquisition (KA)

Knowledge acquisition (KA) is a KM process in which novice knowledge is obtained from a variety of sources, including domain experts, books, videos, and databases to enhance and managed knowledge within an individual, group and organization [48]. Therefore, knowledge acquisition process is applied in this study to identify all current IK of Gumaa in OGS.

##### 4.2.2. Knowledge capturing (KC)

Knowledge capture (KC) is the process of gathering information that is used to maintain, express, encourage, and improve social performance as well as domain activity [48].  Accordingly, KC have been applied on IK of Gumaa institution to capture essential information about assets of Oromo Gadaa system used for resolving conflict and promoting peace between societies. Therefore, as the collected data shows Bale and west Arsi Oromo Gadaa system has a number of IK institutions for dispute resolution (Gumaa), as well as a number of additional IK that tied to Gumaa were explored in this study as follows.

**A.   Shanacha( five intellectual members)**

In Oromo Gadaa system, the collective name called Shanacha derives from the Afaan Oromo word "Shan," which means "five". As a result, Shanacha (five intellectual member) were the first stage of the conflict resolution process in Gumaa and other disagreements between the Oromo communities.  However, if the conflict is not resolved, it will go to the saglan gosaa (nine intellectual members), and again if it is not solved, it will proceed to the Gumii/caffee the last stage, which is the highest position for resolving a conflict.

**B.   Bokkuu (symbol for power and peace)**

In the OGS, the term Bokkuu has no exact meaning, but it literally means, "Stick made of selected tree" and is a symbol for power and peace in the Oromo Gadaa system. The Oromo community beliefs that Bokkuu is made up of metals and given to the Oromo people by Waaqa (God) and it is an important character in OGS, especially when it comes to resolving conflict and building peace, as well as protecting their country against the enemy. Furthermore, Abbaa Gadaa seeks to declare and announce the judiciary when Abbaa Bokkuu is present and this IK were captured during data collection process as illustrated in figure 4.1 [49].
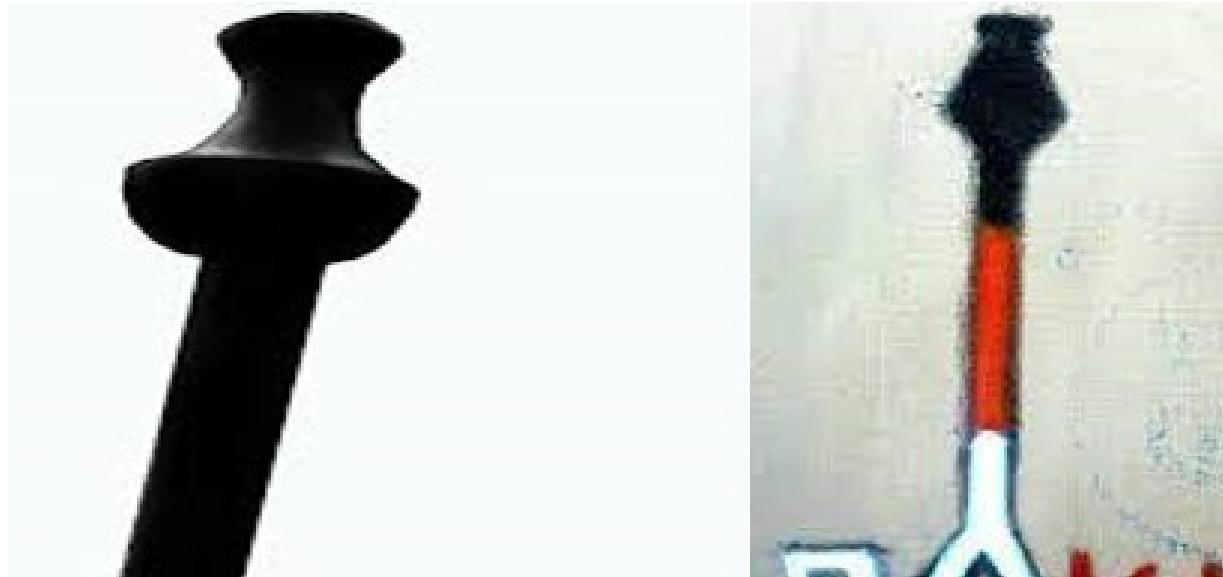
Figure 4. 1: Bokkuu (symbol for power and peace) [49]

## C.  Kallacha( symbol for antecedent and peace for male)

Kallacha (symbol for president and peace for male) , like Bokkuu, is made of metal or thrown with tendon (bakakkaa) is allowed only for male and used for a numbers of issues in OGS such as resolving conflicts, praying to God during a drought, and other societal difficulties as illustrated in figure 4.2 [49]. Therefore, the researchers captured this IK during data collection process.



Figure 4. 2: Kallacha (symbol for antecedent and peace) [49]

## D.  Caaccuu ( symbol for president of female)

The other symbol is for female president called Caaccuu that is a symbol for antecedent and peace for females, made of heifer's leather (kal'ee goromsaa) and ornament (Elellaa). Females with Caaccuu, like males with Bokkuu, are capable of resolving conflicts as well as praying to God for rain, reproduction, drought, and other social issues were the captured IK during data collection process and it is indicated in figure [49].

*Figure 4. 3: Caaccuu (symbol for antecedent and peace for female)* [49]

### E.   Safuu( Norm)

According to the OGS, safuu (Norm) is what Oromo community uphold in his culture and encompasses in all aspects of social life that demonstrate ways of coexistence with one another. Therefore, the IK of norm in OGS can be disseminate and apply in the ways of what to do or not do in the OGS, particularly in the Gumaa institution for conflict resolution. Furthermore, safuu (Norm) is a captured indigenous knowledge of norm during data collection process [50].

### F.   Sirna fuudhaa fi Heerumaa ( Marriage system)

According to [51], Marriage is the foundation and building block of all human beings in our world in which man and a woman can combine as husband and wife in a relationship oriented to the formation of new life. In addition, the Oromo society, like other societies, has a marriage system that is practiced and preserved under the Gadaa system, with numerous forms and distinctions from one Abbaa Gadaa zone to another. Particularly, in Arsi Oromo Gadaa System, for example, Aseennaa, Hawwii, Gabbara, Walgaraa, Meembetoo (Wanbeetoo), Buttaa are the most common marriage system [52]. Therefore, in this study the IK of marriage system is captured during data collection and correlated with IK of conflict resolution (Gumaa) [52].



*Figure 4. 4:  Sirna fuudhaa fi heeruma fi Gabbara*  [52]

### G.   Moggaasa( Naturalization)

In OGS, humanitarian IK used by the Oromo community, which is very beautiful culture for integrating and accommodating diverse non-Oromo peoples, is known as Moggaasa (naturalization). As result, the conquered clans are treated as family. Therefore, the researchers captured the IK of Gumaa institutions for conflict resolution is serving both naturalized group and Oromo community in the same way [53].

### H.  Guddifachaa( Adoption)

In the OGS, Guddifachaa (Adoption) is one of the most popular practices of accommodation of Oromo or non-Oromo male or female individuals, usually at a younger age. Therefore, the adopted children would have the same rights and privileges as biological children in Guddifachaa IK [53]. In this research study, the researchers were captured the role of IK of Gumaa for the adopted individuals and analyzed in this study.

### I.  Namummaa (Humanness)

According to Oromo philosophy, namummaa (humanness) describes what makes a person human being, such as thinking, speaking, and performing a relationship with the human community as a whole, as well as a relationship with Waaqa uumaa (God the Creator) [50]. Therefore researcher identify and captured that murdering/killing human beings is a violation of this namummaa (humanness), which can be leads to Gumaa in OGS.

### J.  Dhibaayyuu (libation)

In OGS, the Oromo society believe that dhibaayyuu is an ancient Waaqeffannaa spiritual community type of prayer in which drinkable fluids known as mijuu/ Guutuu  offering to the Creator (God) in the sacred libation ritual. Therefore, the concept of dhibaayyuu (libation) is a ritual of pouring a liquid as an offering or returning to Waaqaa (God) as a sacred offering and it is used at the end of the reconciliation process. In this study, the researchers captured dhibaayyuu (libation) with the roles and functionality of IK of conflict resolution in the OGS (Gumaa) [54].

### K.  Wayyuu(sacred respect )

In the OGS, wayyuu is an IK that depicts someone or something in the community who is held in high respects [55], such as Waaqa (God the creator), dachee (earth or land), Soddaa (male in law), Soddaatii (female in law), Abbaa fi haadha (father and mother), etc. If someone does not respect wayyuu (sacred respect), they have to punished according to the Gadaa system's rules and regulation.  Therefore, the researchers captured the concept of this wayyuu and its relations to the IK of Gumaa for conflict resolutions.

### L.  Waaqeffannaa (Oromo traditional religion)

The Oromo communities who are governed under Gadaa system have their own traditional religion, called Waaqeffannaa. In the waaqeffannaa religion the believer belief in a one God, (Waaqa tokkicha) who created the entire universe. When a problem arises between an individual, a clan, or a group in the community, they ask the help of their Waaqaa (God) before proceeding to the resolution process, since they respect the Waaqa uumaa (God the creator). As a result, Waaqa and the Oromo community have a strong bond. To extract IK of waaqeffannaa and how it is linked to IK of conflict resolution in OGS (Gumaa), the researchers collected all the necessary data and information from the knowledge holders.

### M.  Irreecha(Thanks giving to God)

In the OGS, the Irreecha is the ceremony that Oromo community holds twice a year (in the autumn and spring) to give gratitude to their God. This Irreechaa ceremony brings the Oromo people together, regardless of their religious affiliations (Muslim, orthodox, protestant, etc.). If there is significant information to be transferred to the Oromo community at the Irreechaa ritual, it will be transferred from the Abbaa Gadaa or Abbaa Bokkuu to the peoples on this ceremony [56]. In addition to the celebration, if there is any previous conflict in the society, it is resolved on this day using IK of the Gumaa system. Therefore, the purpose of capturing IK of irreecha is better to know how Oromo community respect each other and Gadaa system leaders as indicated in figure 4.5.

Figure 4. 5: Irreecha (thanks giving to God) [56]

### N. Araara( reconciliation)

In OGS, the concept of Araara (reconciliation) is the most IK institutions practicing in Oromo society, for conflict resolutions which involves local elders (Jaarsa Biyaa), Gadaa system leader (Abbaa Gadaa), and haadholii siiqqee (mothers of the siiqqee) [57] and so on.  Therefore, the researchers captured IK of reconciliation and the role of IK of Gumaa institutions in reconciliation process.

### O. Qaalluu/Abbaa Muudaa (spiritual leader)

In OGS, a qaalluu (spiritual leader) is an Original Oromo religious leader who has had the moral authority and social obligation to praise God and support popular Oromo Gadaa leaders based on the principles of safuu (norm) and Waaqaa uumaa (God the creator) [58] [55]. The researchers captured this IK of qaalluu institution during data collection process because it is also tied with IK conflict resolution.

### P. Siiqqee (Women's right)

In the OGS, Siiqqee (women's right) is the weapon in which Oromo women struggle for their rights and it is made up of a thin stick called ulee from selected trees like harooressa, and given to every married woman by her mother at the time of her wedding in Oromo culture [7] [57].  Therefore, the researcher captured how the IK of the Siiqqee institution functions in conflict resolution among individuals, groups, or clans in the Oromo society with comparison of IK of Gumaa institutions. Figure 4.5 shows the interviews from Haadha siiqqee and Abbaa Gadaa during data collection.



Figure 4. 6: Sample Interview made to collect data from Abbaa Gadaa and Hadha Siiqqee

### Q. Jaarsummaa(mediation)

The IK institution of mediation is a significant practice in Oromo society, involving a group of Jaarsa biyyaa (local elders) in conflict resolution process [7] [57]. In the Arsi Oromo community, the process of Jaarsummaa began with koottu-dhufee (come and am here) from both side to identify the source of problem. This IK of Jaarsummaa and its functionality in today's Oromo community were collected during data collection process.

*Figure 4. 7: Jaarsa biyyaa during jaarsummaa for conflict resolution*

### R. Gumaa( compensation)

In the Oromo society, Gumaa institution is the assets of OGS used for conflict resolution, that stands for a variety of wrongdoing activities and compensate for those wrongdoing actions in order to reintegrate the conflicted parts. Therefore, in the Gumaa system the well-known wrongdoing activities that pertinent to Gumaa includes Gumaa Namaa (compensations for injured human beings), damage someone's properties, cutting tree, killing animals and disrespecting some sacred.

In this research study, the researchers focused on Gumaa Namaa (compensation paid for injured human beings) to design a desired IKMF and develop a prototype for IK of Gumaa for easily sharing and disseminating. Therefore, the researchers captured and discussed categories and types of wrongdoing activities under IK of Gumaa namaa (compensation for injured human beings) as follows.

### i.   Gumaa Lubbuu (compensation for killing someone)

In the OGS, Gumaa lubbuu (compensation for killing someone) is the most serious wrongdoing actions that violates the human right and its compensation is very high depending on its occurrence (intentional and un-intentional). Therefore, Abbaa Gadaa and local elders follow the case in order to establish peace between two parties without any differentiation.

The process and compensation scale for murder is different from one zone of Abbaa Gadaa to another. As a result, in Arsi Oromo Gadaa system, the mediators who are involved in the case have to get all information about the action from both sides by koottu (come) and dhufee (I am here) process by saying "Amantu dhibbaan koottu, Waakkattu jilbaan koottu." If you accept to do so, bring 100(dhibba dhiiguu) cattle; else, bring defensive rules". This indicates that most popular and widely used kind of compensation in the Oromia region in general and Arsi Oromo community in particular is cattle, and the scale of compensation is also varies depending on intentional and un-intentional injuries. However, the most common for murdering human being is 100 cattle and can be reduced depending on intentional and un-intentional injuries and as well as it can be considered if there is a relationship between slain and slayers. In this study, the researchers identified and captured the IK of Gumaa lubbuu and the related rules and regulation during data gathering process.

### Gumaa ijaa (compensation for human eyes)

In the OGS, the IK of Gumaa institutions play a significant role in resolving conflicts between two people, clans, or group of clans. As a result, if someone gouged out someone's eyes, the Gadaa system leader and local elders would act as mediators, helping the situation to be resolved peacefully according to Gadaa rules (Seera Gadaa). They determine whether the problem was caused intentionally or not, and punish the wrongdoer accordingly. Nonetheless, the punishments varies from one Oromia zone to another. However, the most common and standard punishment is 50 cattle, which is reduced to 25 cattle if both clans were from the same family (worrooma) and

in-laws (soddooma). Therefore, the IK of Gumaa ijaa practices were also captured by the researchers form the knowledge holders during data collection process.

### i.        Gumaa ilkaanii( compensation for human teeth)

In the Oromo society, braking someone's teeth is wrongdoing activities that pertinent to Gumaa and needs compensation depending on type of injuries and part of the teeth. Therefore, the mediators also identify whether the injury was caused on purpose or by accident and which parts of the teeth were injured. As a result, for different parts of human teeth, there is different compensation scale are paid, for example for front teeth (ilkaan duraa) five (5) cattle and for background teeth (ilkaan qarriffaa) tent (10) cattle and it can be reduced based on relationship. This IK were also captured during data collection process.

### ii.       Gumaa gurraa (compensation for human ears)

In the Oromo community, when somebody cut someone' ears intentionally or un-intentionally there is a punishment for such wrongdoing action. However the compensation scale is vary from parts of the ears (earring part more compensation).  As a result the compensation scale for such action is from 25- 50. The researchers captured the rules and regulations about IK of Gumaa gurraa during data collection.

### iii.      Gumaa harkaa( compensation for human hands)

According to Gadaa system rule, who cuts off another person's hand must recompense, accordingly and the amount of compensation varies based on the occurrence of the injury, but it is usually between 25 and 30 cattle. As a result, the compensation for the left hand is 30 cattle, while the compensation for the right hand is 25 cattle. This indicates that left hand is high values especially in making love and defending against enemy according to belief of Oromo community.

### iv.      Gumaa lukaa (compensations for human legs)

In OGS, Compensation is paid for injured human legs when someone cuts off another person's legs, either intentionally or unintentionally, similar to other wrongdoing activities. The scale of compensation for injured human legs varies from 50 cattle depending on whether the injury was intentional or accidental, and whether the victims were from the same family and as well as it various from left leg to the right leg (50 cattle for left and intentional injure, <50 cattle for right and un-intentional injure)

### v.       Gumaa qubaa (compensation for human fingers)

In Gadaa system, Gumaa qubaa (compensation for human fingers) is also included under the Gumaa namaa, which states that when a human finger is cut off by another person, the doer has to compensate in order to reintegrate with the injured clan. Compensation for injured human fingers varies depending on which of the five parts of human fingers is injured. As a result, compensation for thumbnail (Abbuudduu), milking finger (Elemtuu), tirsee, mirsoo, nyaallee is 15, 6,3,4,2 cattle respectively.

### vi.      Gumaa Gudeeddii (compensation for raped female)

In the Oromo Gadaa system, raping female violate the norm (safuu) of the Oromo communities. As a result, if such kind of wrongdoing action is occurred without her interest the doer have to compensate according to Gadaa rules. Therefore, compensation for raping virgin female, female  who has husband, and females who has not virgin and husband (previously lose her virgin) is 5,9, 3 cattle respectively. There may be no compensation if females make a comfort for such an action (tan afte, tan rafte). The Oromo culture and norm did not respect raping a female, and if someone kills another person while his or her family is raped, the compensation is a **male donkey;** this indicates how Oromo community disrespect raping females.

### vii.     Gumaa qaama hormaata dhiiraa (compensation for men's reproductive organ)

In Oromo community, traditional culture and beliefs, forbids cutting male's reproductive body (qaama hormaata dhiiraa). However if this injury is occurred either intentionally or accidentally, doer have to compensate yearly for who are harmed up to his/her life.

### viii.    Gumaa Hubama xixiqqoo ( compensation for simple injury)

The Oromo have their own system of norms, morality and fundamental values for some sacred respects like Abbaa Gadaa, local elders, mother, etc. As a result insulting and disrespecting those sacred respects also need compensation in OGS rule. Another simple injury that needs compensation includes blooding human body and braking someone bone. The compensation for such simple injuries is first treating and then dressing a traditional blanket made of cattle's leather (Huccuu kal'ee irraa tolfame), feeding injured person etc. The researcher identified the source of knowledge and brief expression of the captured IK as depicted in figure 4.5.
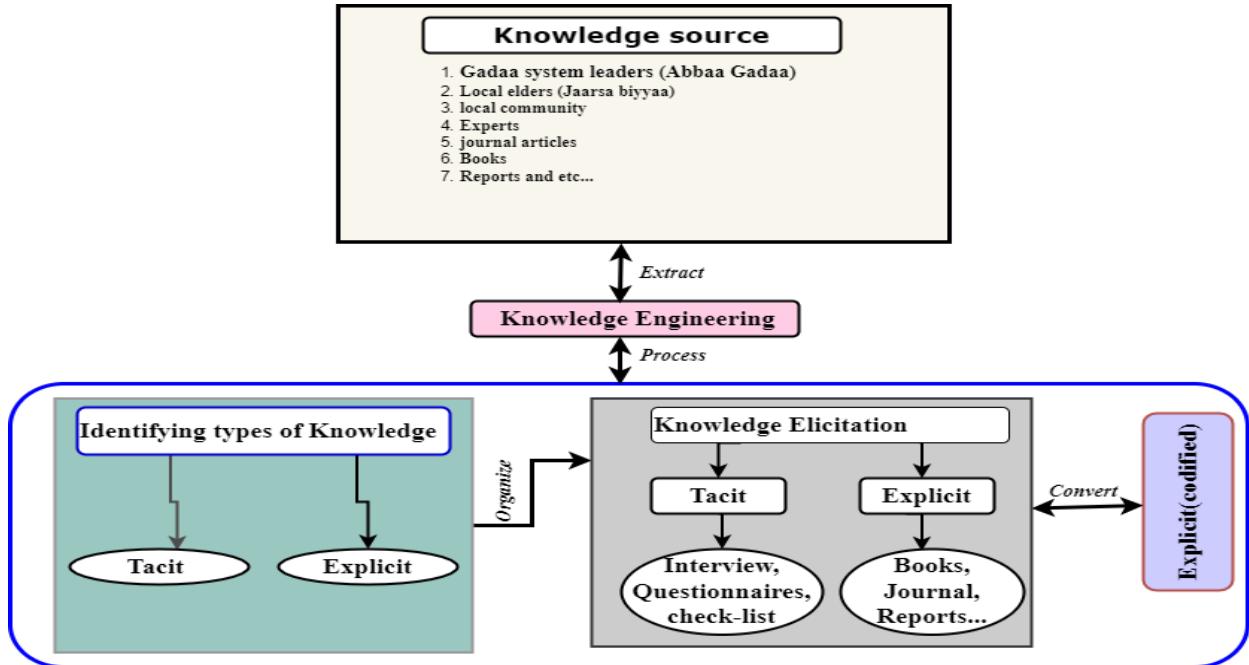
Figure 4.8: Knowledge capturing components [48]

**4.2.2.1.** Knowledge Sources

As its name indicates, knowledge source is repository or storage of information from which the desired knowledge is obtained based on the users requirement [59].  Therefore, in this study the researchers captured vital data and information from a variety of sources, including Gadaa system leaders, local elders, and the Oromo community, experts and as well as reviewing different documents. As a result, the captured knowledge were focused on IK of OGS used for conflict resolution from West Arsi Oromo community through interview, questionnaire and technical observations and as well as analyzing various documents, to design IKMF for Gumaa and develop the prototypical representation of IK institutions of conflict resolution in Oromo Gadaa system (Gumaa).


**4.2.2.2.** Knowledge Engineering (KE)

As illustrated in KC process, Knowledge engineering is an artificial intelligence (AI) discipline that focuses on knowledge elicitation, modeling, representation, filtering, implementation, testing, and evaluation using a knowledge-based system (KBS) in order to solve specific problems within or outside of organizations [60]. In this study, the researchers used Gadaa system intellectuals and experts from West Arsi zone cultural and tourism bureau as knowledge engineers to extract IK of conflict resolution in OGS in order to design the proposed framework and prototype development.


**4.2.2.3.** Identifying types of knowledge

After a knowledge is extracted from its source, the knowledge engineers identify types of knowledge (tacit or explicit) for further process. In this study, both tacit and explicit knowledge about IK of Gumaa institution in OGS is captured from its sources and organized for elicitation process [14] [61].

**4.2.2.4.** Knowledge elicitation

As shown in figure 4.1, after identifying the types of knowledge the next stage is eliciting the appropriate knowledge through by comprising knowledge extraction methods and tools from a specific area or domain expert [62]. In this study the researcher, elicit tacit knowledge of the IK of Gumaa for conflict resolution from Arsi Oromo Gadaa system leaders, local elders, Oromo community through interviews, survey questionnaires, technical observation, and eliciting explicit knowledge by analyzing different documents like books, journal articles, reports and etc.

**4.2.2.5.** Knowledge conversion

 Knowledge can be discovered and exchanged from one form to another form in the four-spiral of Nonaka and Takeuchi (SECI) model [16] [63].  As a result, the IK institutions in OGS that is used for conflict resolution is totally embedded in human's mind and it needs knowledge transformation techniques. The researchers in this

study used the concepts of the Nonaka (SECI) model to transform tacit IK for conflict resolution in the OGS (Gumaa) to explicit knowledge.

### 4.2.3.    Knowledge Representation (KR)

Knowledge representation is the technique by which elicited knowledge is modeled, codified, evaluated, filtered and stored in a knowledge base (KB) in a computer system for solving specific social problem [64] [63]. There are various knowledge representations techniques such as logical, rule-base, frame, networked, case-based etc. Therefore, in this study, the researcher used The production rule model (IF-THEN-rule) to model, codify, filter evaluate, and storing IK in OGS used for conflict resolution (Gumaa), because IK of conflict resolution(Gumaa) embedded in the human mind is produced as a structure of rules and facts that the Oromo community using during peace building process.

#### 4.2.3.1.    Knowledge modeling

Knowledge modeling is process of organizing/structuring the explicit knowledge in order to formalize the desired knowledge and strong it into computer system to simplify the dissemination and transformation of knowledge from knowledge holders to knowledge seekers [64].  In this study, the researchers organize and model the IKMF for conflict resolution in the Oromo Gadaa system (Gumaa) using the production rule (IF-THEN-rule)

#### 4.2.3.2.    Knowledge codifications

The knowledge codification is the process of arranging and formalizing the extracted knowledge using KR techniques (IF-THEN-rule) and storing it to knowledge base (KB) [16]. In this study, the researchers chose a production rule to codify IK in the Oromo Gadaa system (Gumaa) which incorporates a variety of rules and facts, such as categories of wrongdoing, scale of compensation, types of injuries, obligation and right of both slain and slayers

#### 4.2.3.3.    Knowledge filtering

Knowledge filtering is an important component of the knowledge representation in which the codified knowledge is classified, categorized, and organized in appropriate manner to simplify decision-making. Therefore, in this study the researchers captured IK institutions for conflict resolution (Gumaa) exited in OGS and compared and filtered them according to their multitudinous, functionality and recognitions level of IK [65].

#### 4.2.3.4.    Knowledge Evaluation

In the knowledge representation process, evaluating the filtered and organized knowledge is the procedure of measuring appropriateness, completeness, and relevance of the captured knowledge before it is stored into KB [63] [66]. In this study, the researchers focused mostly on IK institutions for conflict resolution OGS (Gumaa namaa) and finally stored IK of Gumaa namaa into KB for easily utilizing and preserving it.

#### 4.2.3.5.    Knowledge base (KB) /repository

The last and most crucial step in representing the filtered and evaluated knowledge is to store it into a knowledge base (KB), which allows the knowledge seeker for later use [67] [66] [63].

In this study, the researchers collected data and information regarding IK institutions for conflict resolution in OGS (Gumaa) from Abbaa Gadaa, local elders, experts, and the local community of West Arsi Oromo, and represented IK of Gumaa institutions for conflict resolutions into the KB for further use and dissemination.

### 4.2.4.    Knowledge Sharing (KS)

Knowledge sharing (KS) is a sequence of knowledge capturing and representation procedures in which the acquired, captured, and represented knowledge in the knowledge base (KB) is distributed or transferred to the knowledge seekers in order to solve a social problem [19] [26].

In this study, IK institution for conflict resolution in OGS (Gumaa), and its rules and facts in punishing wrongdoers, as well as the amount of punishment, right and obligation of both party were stored in the knowledge base (KB) for better decision-making and easy dissemination of IK as illustrated in figure 4.6.
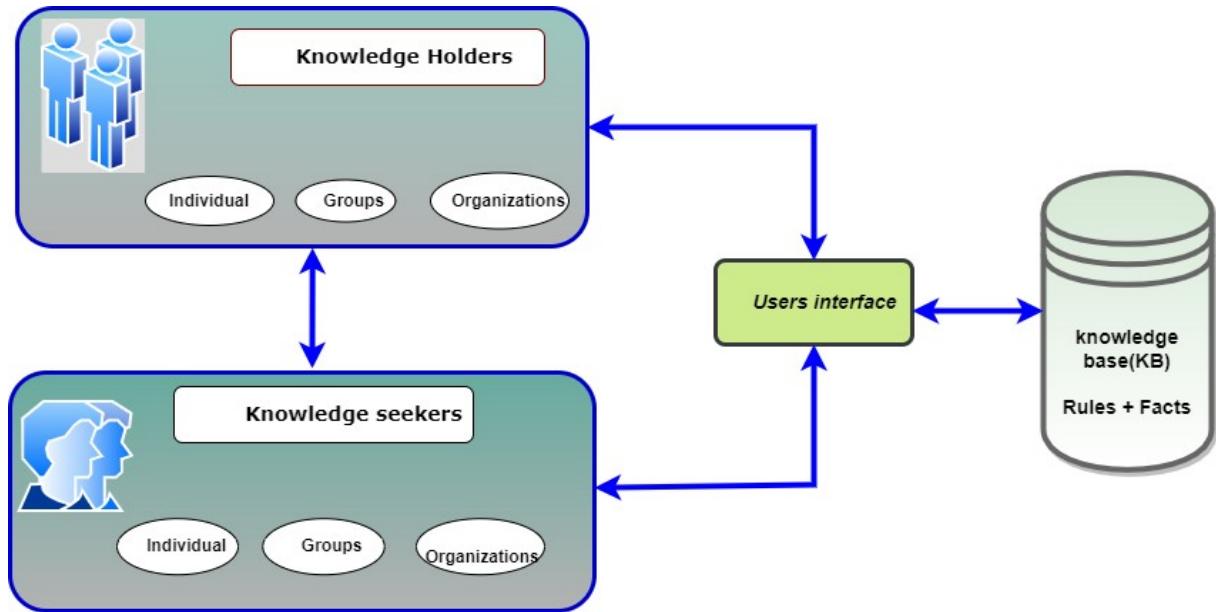
Figure 4. 9: knowledge sharing components [26]

#### 4.2.4.1.        Knowledge holders

Individuals, groups, or organizations that hold the knowledge and share it with knowledge seekers are known as knowledge holders [19]. In this study, the researchers collected data and information regarding IK institutions of dispute resolution in the Oromo Gadaa system from various knowledge holders such Abbaa Gadaa, local elders, local community and as domain experts who has base knowledge about IK of OGS and as well reviewing different documents (like journal articles, reports, books, etc...).

#### 4.2.4.2.        Knowledge seekers

Knowledge seekers are similar to knowledge holders in that they include individuals, groups, or organizations who are looking for knowledge from the knowledge holders or knowledge base (KB) [19]. Therefore, in this study Knowledge seekers are those who are unaware of or have forgotten IK exist in OGS (Gumaa) because of urbanization and migration.

#### 4.2.4.3.        Users interface

The user interface is a critical component of the knowledge sharing process, as it allows knowledge holders and seekers to interact with the knowledge base system (KBS) to enable knowledge exploration, access, and editing [26].  In this study, the researchers used SWI version 8.4.0 prolog to develop the prototype for the user interface,

#### 4.2.5.        Knowledge Application/utilization (KU)

Knowledge utilization (KU) is KM process in which the stored and shared information is accurately disseminated and applied knowledge seekers in order to solve a specific problem [68].  Therefore, in this study the researchers extracted domain knowledge from West Arsi zone around Shashemene town through survey questionnaires, interview, and technical observation and then formalize the IK of Gumaa namaa, and store it into KB for later use as depicted in figure 4.7.
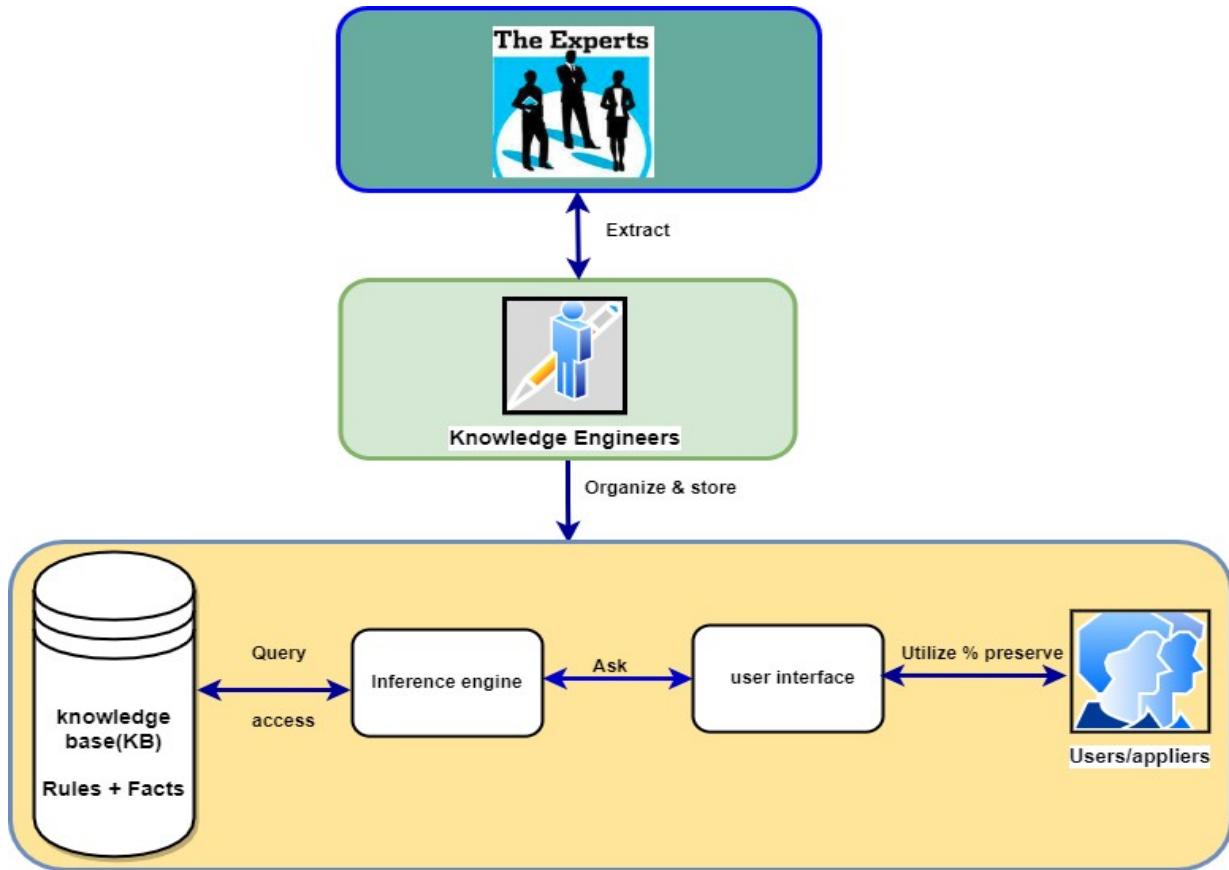
Figure 4. 10: knowledge application/utilization components [66]

### 4.2.5.1.        Domain experts

As shown in figure 4.7, domain experts are first components of knowledge application process those who has awareness of sharing knowledge based on the KEs or users query [68].  As a result, in this study domain experts include those who work in the West Arsi zone culture and tourism bureau and are familiar with the Oromo Gadaa system on the IK institution for conflict resolution (Gumaa).

### 4.2.5.2.        Knowledge engineers (KEs)

The second knowledge application component is Knowledge engineers (KEs) who use a knowledge engineering mechanism to demonstrate where, when, and how to use certain knowledge to solving specific domains of problems [61]. Therefore, the researchers or other intellectual experts who has seeking for IK of OGS for conflict resolution can be KEs.

### 4.2.5.3.        Knowledge base

A knowledge base or repository is a part of knowledge representation that stores elicited, extracted, filtered, and evaluated knowledge for later use [68] [63]. In this study, the researcher collected relevant data and information about IK institutions for conflict resolution in OGS (Gumaa) from Abbaa Gadaa, local elders, experts, and the local community in west Arsi Oromo, and represented IK in a knowledge base for future use and preservation.

### 4.2.5.4.        Inference engine

In the knowledge application process, an inference engine is a field of AI and a component of an expert system in which users communicate with a knowledge base by forming a link in a computer system and applying logical rules known as rule-based (IF-THEN-rule) to access knowledge from a knowledge base system [69]. In this study, the process of IK Application used for conflict resolution would iterate as each new fact and rules in the KB could elicit and requested in the inference engine.

### 4.2.5.5.        User interfere

 The most significant component of knowledge application the user Interface, which deals with human-computer interactions that describe users' problems based on their queries [26].  In this study, researchers used prolog-programming language to develop the user interface, since the IK exits in OGS for conflict resolution includes different  logic, facts, rules, regulations, norms, and values that are still practicing in the Oromo community in everyday life.

**4.2.5.6.** Users

End users are individuals or groups who engage with KB through a user interface to perform and apply knowledge in their daily activities, primarily during the decision-making process. In this study, Oromo community and any interested knowledge seekers are the end users in this study, since the IK institutions for conflict resolution assist the Oromo and non-Oromo communities in socio-cultural, political, psychological, and other daily activities.

**4.2.6.** Knowledge preservations (KP)

Knowledge preservation (KP) entails identifying, capturing, validating, and formatting steps of wisdom in order to preserve critical knowledge (know how) and scale up successful solutions [70]. As a result, the IK of OGS that is used for conflict resolution must be preserved for future use and continuity since it helps the community in social, economic, political aspects of everyday life.

**4.3.** Data analysis

**4.3.1.** Available IK existed in OGS for conflict resolution

The researchers were identify the well-known and multitude IK institutions in the OGS for conflict resolution through survey questionnaire, structured interview and technical observation. The result of the comparison are taken from the SPSS after analysis and shown in the table 4.1.

Table 4. 1: comparison of available IK existed in OGS for conflict resolution

| RQ#20. What are the most common and multitude IK institutions are available in the OGS for conflict resolution that needs KM process (Acquiring, capturing, representing, sharing, utilizing, and preservation)? | | |
|---|---|---|
| IK in OGS for conflict resolution | No. of respondents(Frequency) | Percent (100%) |
| Gumaa | 195 | 50.64% |
| Siiqqee | 125 | 32.46% |
| Jaarsummaa | 55 | 14.28% |
| Qaalluu | 15 | 3.89% |
| Total | 385 | 100% |

According to the result of data responded from the respondents for the survey questionnaires, structured interviews, and personal observation, the researchers found the diverse set of IK that can support the community during conflict resolution. As it is shown in table 4.1, from the total sample size of 422 respondents, 395 (93.6%) respondents were responded for the prepared questionnaires and only ten (2.36%) were not filled properly. Therefore, 385 (91.23%) were successfully filled and responded. Therefore, the sample size taken for this research study was 385 and the researchers used this data for analysis. Accordingly, the respondents responded for the question "**What are the most common and multitude of IK institutions are  available in the OGS for conflict resolution that needs KM process**" were 50.64% were said that Gumaa, 32.46% were said that Siiqqee, 14.28 % were said Jaarsummaa and only 3.89% were said that Qaalluu. Therefore, according to these results Gumaa and Siiqqee has a great role in the conflict resolution respectively in Oromo Gadaa System as shown in figure 4.9.
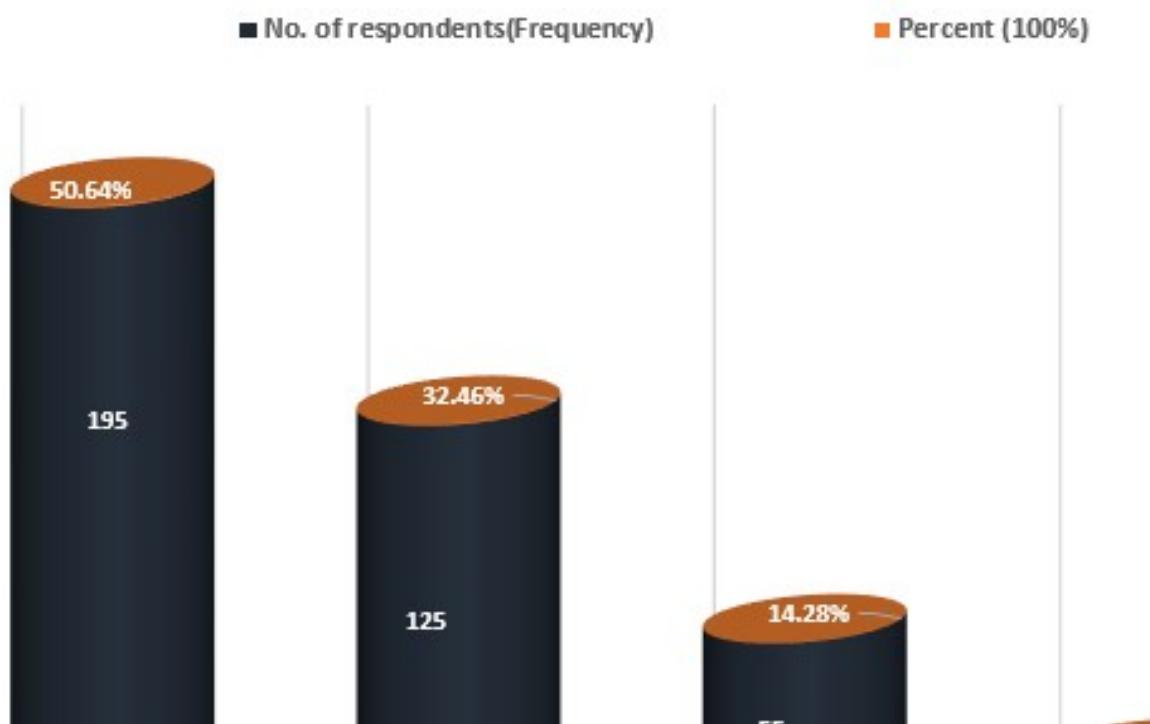
Figure 4. 11  visualization of comparison of available IK existed in OGS for conflict resolution

**4.3.2.**        Role of IK of Gumaa in OGS for Selected Assessments

The researchers collected data about role of IK of Gumaa institutions in OGS from the Abbaa Gadaa (Gadaa system leaders), Jaarsa biyyaa (local elders), local community, and experts of culture and tourism bureau in the West Arsi Zone and then data were analyzed and discussed as follows which represented in the table 4.2.

*Table 4. 2:  Analysis of Role of IK of Gumaa in OGS*

| RQ#24. What degree of utilization of the IK of Gumaa institution and in what situations it is used in OGS? | | | | | | |
|---|---|---|---|---|---|---|
| **Assessments** | | **Uses of IK of Gumaa selected Assessments** | | | | |
| s.no. | **Selected Assessments** | Yes | | No | | Idon.t Know |  |
| | | Respondents | % | Respondents | % | Respondents | % |
| **1** | Araara (Reconciliation) | 96 | 24.9% | 3 | 0.78% | 1 | 0.26% |
| **2** | Jaarsummaa(mediation) | 80 | 20.78% | 3 | 0.78% | 1 | 0.26% |
| **3** | Namummaa(humanness) | 50 | 12.98% | 1 | 0.26% | 1 | 0.26% |
| **4** | Mirga dubartii(women's right)) | 37 | 9.6% | 2 | 0.52% | 1 | 0.26% |
| **5** | Irreecha(thanks giving to God) | 31 | 8.05% | 1 | 0.26% | 1 | 0.26% |
| **6** | Dhibaayyuu (libation) | 21 | 5.45% | 1 | 0.26% | 1 | 0.26% |
| **7** | Safuu(Norm) | 12 | 3.11% | 1 | 0.26% | 1 | 0.26% |
| **8** | Fuudhaa fi Heeruma(Marriage system | 10 | 2.6% | 1 | 0.26% | 1 | 0.26% |
| **9** | Guddifachaa (Adoption) | 16 | 4.2% | 1 | 0.26% | 1 | 0.26% |
| **10** | Wayyuu(secret respect) | 7 | 1.82% | 1 | 0.26% | 1 | 0.26% |
| **Sub total** | | **360** | 93.5% | **15** | 3.9% | **10** | 2.6% |
| **Total** | | **385** | | | | 100% | |

According to the result from SPSS of data responded from the respondents, the researchers found that the IK of Gumaa institutions used for conflict resolution were used in diverse set of indigenous knowledge exited in OGS as shown in table 4.2. However, the utilization each assets of IK were varies from one IK institution to the others. Accordingly, for the questionnaire ''**What degree of utilization of the IK of Gumaa institution and in what situations it is used in OGS?''**, from 385(91.2 %) of the respondents 24.9% were stated that IK of Gumaa was widely used in Araara (reconciliation) and, 20.78% was in Jaarsummaa (mediation), 12.98% was in Namummaa (humanness), 9.6% was in  Mirga dubarti (Women's right), 8.05 was in Irreechaa (Thanks giving to God), 5.45% was in  Dhibaayyuu(libation ), 3.11% was in Safuu (norm),  2.6% was in Fuudhaa fi Heerumaa (marriedge system), 4.2% was in Guddifachaa (adoption),  1.82% were in wayyuu( sacred respect).

Therefore, as the result indicates IK of Gumaa institution for conflict resolution is mostly used in the Araara (conflict resolution) mechanism in OGS and it is visualized in figure 4.9.
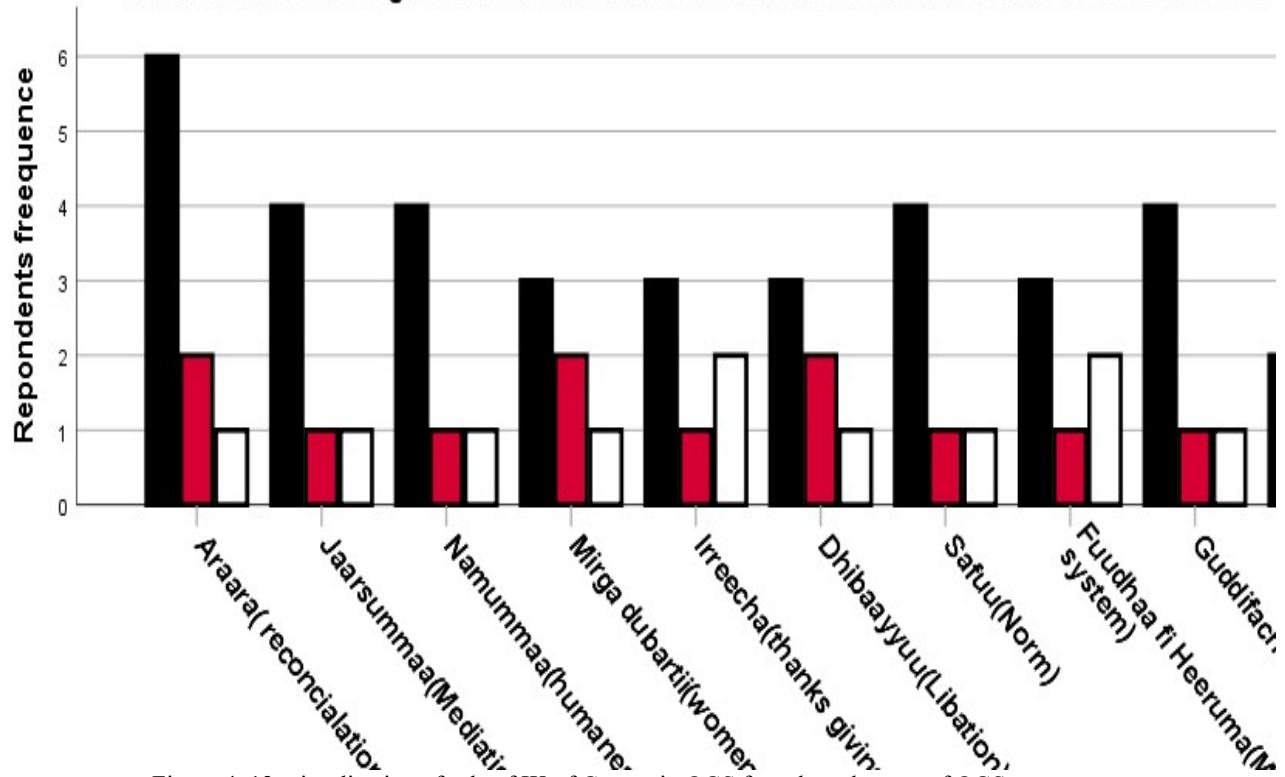


Figure 4. 12: visualization of role of IK of Gumaa in OGS for selected assets of OGS

**4.3.3.**        Comparison of the most serious wrongdoing activities

In Oromo Gadaa system (OGS), not every wrongdoing activities are included under Gumaa system, thus the researchers were able to capture and identify the most serious wrongdoing activities that leads to Gumaa and compare them in table 4.3.

Table 4.3: Comparison of the serious wrongdoing activities (Gumaa namaa and Gumaa Qabeenyaa)

| RQ#9 In OGS, not all wrongdoing activities can be included in the Gumaa system for settling blood feuds; thus, what are the most serious wrongdoing activities that should be included under Gumaa system and needs preservation? | | |
|---|---|---|
| Wrongdoing activities that leads to Gumaa institution | No. of respondents(Frequency) | Percent (100%) |
| 1  Gumaa Namaa ( compensation for injured human beings) | 260 | 67.5% |
| 2  Gumaa Qabeenyaa ( compensation for damaged propertie) | 125 | 32.5%% |
| Total | 385 | 100% |

According to the result of data responded from the respondents for the survey questionnaires, structured interviews, and personal observation, the researchers found that there were two most common and serious wrongdoing activities that are included under Gumaa and needs compensation according to OGS rule as shown in table 4.3.  However, the seriousness and scale of compensation were varies from one injuries to another. As a result, in response to being asked "**In OGS, not all wrongdoing activities can be included in the Gumaa**

**system for settling blood feuds; thus, what are the most serious wrongdoing activities that should be leads to Gumaa system and need preservation"?** Among the 385 (91.2%) respondents, 260 (67.5%) of the respondents were stated that Gumaa Namaa (compensation for injured human beings) was the most serious and needed more compensation wrongdoing activity, while 125 (32.5%) of the respondents were stated that Gumaa Qabeenyaa (compensation for damaged properties) was the next serious and needed more compensation wrongdoing activity. Therefore, as the result shows Gumaa namaa (compensation for injured human beings) is the most common and serious wrongdoing activities that leads to Gumaa and needs more compensation. As a result, the researchers were mainly focus on IK of Gumaa Namaa or compensation paid for injured human beings and then Gumaa namaa (compensation for injured human beings) was used in the prototype development for sample functional implementation of the proposed IKMF of Gumaa institutions in OGS as shown in the figure 4.11.
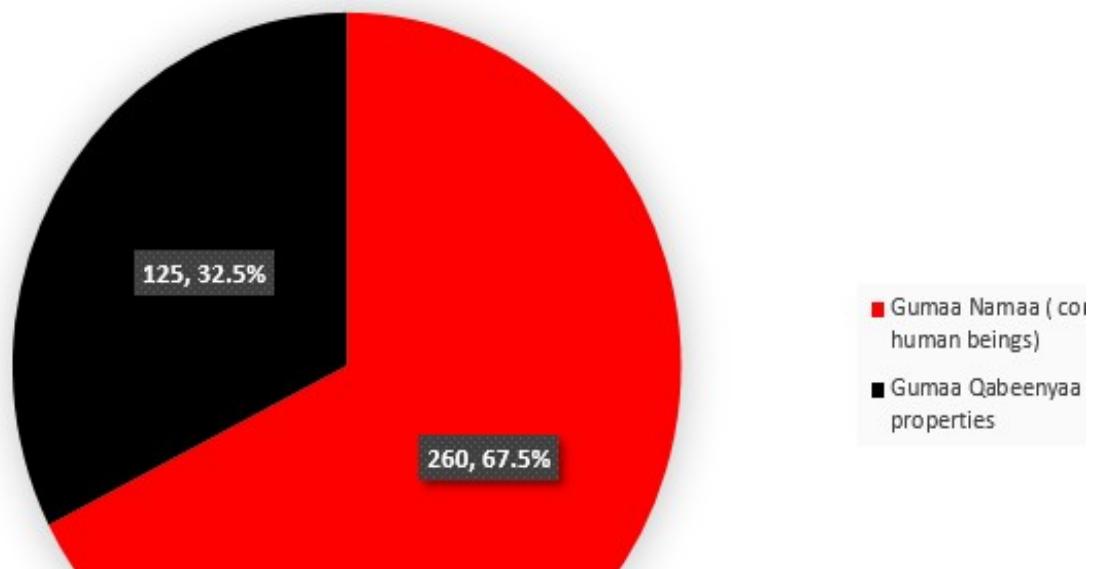


Figure 4.13: Visualization of the comparison of wrongdoing activities leads to Gumaa

**4.3.4.        Attributes for modeling IK of Gumaa Namaa in OGS**

In OGS, there are varieties of wrongdoing activities that leads to Gumaa system, which needs compensation for purifying the doers. As the gathered and analyzed data shows among those wrongdoing activities, Gumaa namaa (compensation for injured human beings) is the most serious and needs high punishment.

As a result, the researchers model a decision tree for those wrongdoing activities of Gumaa Namaa using different attributes such as categories of wrongdoing action, types of injuries (intentional or un-intentional), scale of compensation, and as well as the rights and obligations of both the injure and the victim clan as depicted in figure 4.12.
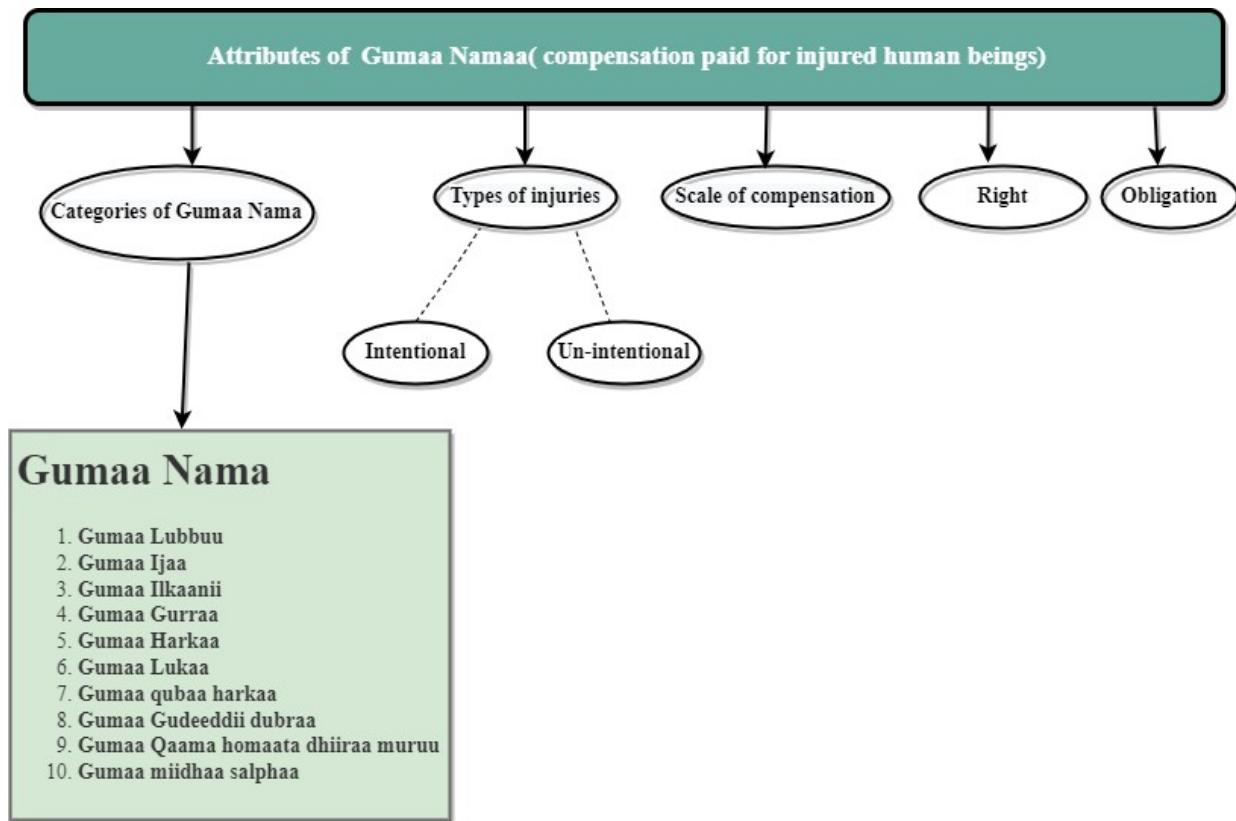
Figure 4. 14: *Attributes of Gumaa Namaa (compensation paid for injured human being)*

**4.3.5.**    Modeling IK of Gumaa Namaa for conflict resolution in OGS

In the OGS, the IK of Gumaa is mostly used during compensation payments for wrongdoing activities such as damaged property, cutting green tree, animals and compensation for injured human beings (Gumaa Nama). In this study, the researchers focused on Gumaa namaa (compensation for injured human beings), which consists of ten (10) different categories of wrongdoing activities and include different rules and facts represented using a decision tree based selected attributes to develop the prototype. The selected attributes were used to distinguish the categories of wrongdoing activities and types of injuries (intentional or un-intentional) and amount of compensation for each wrongdoing actions.

In order to model a decision tree for each IK of Gumaa Namaa, the researchers used abbreviation for some words, because of the limited space to create a clear knowledge model. Therefore, the researchers were used O1, O2…, R1, R2…to show a list of obligations and right for both slain (injured clan) and slayers (killers) respectively.  And as well as the terms "intent" and "un-intent" refer to the intentional and unintentional occurrence of wrongdoing acts and "scale of compensation" refers to the compensation scale for each wrongdoing activities based on Gadaa rules as shown in figure 4.12.
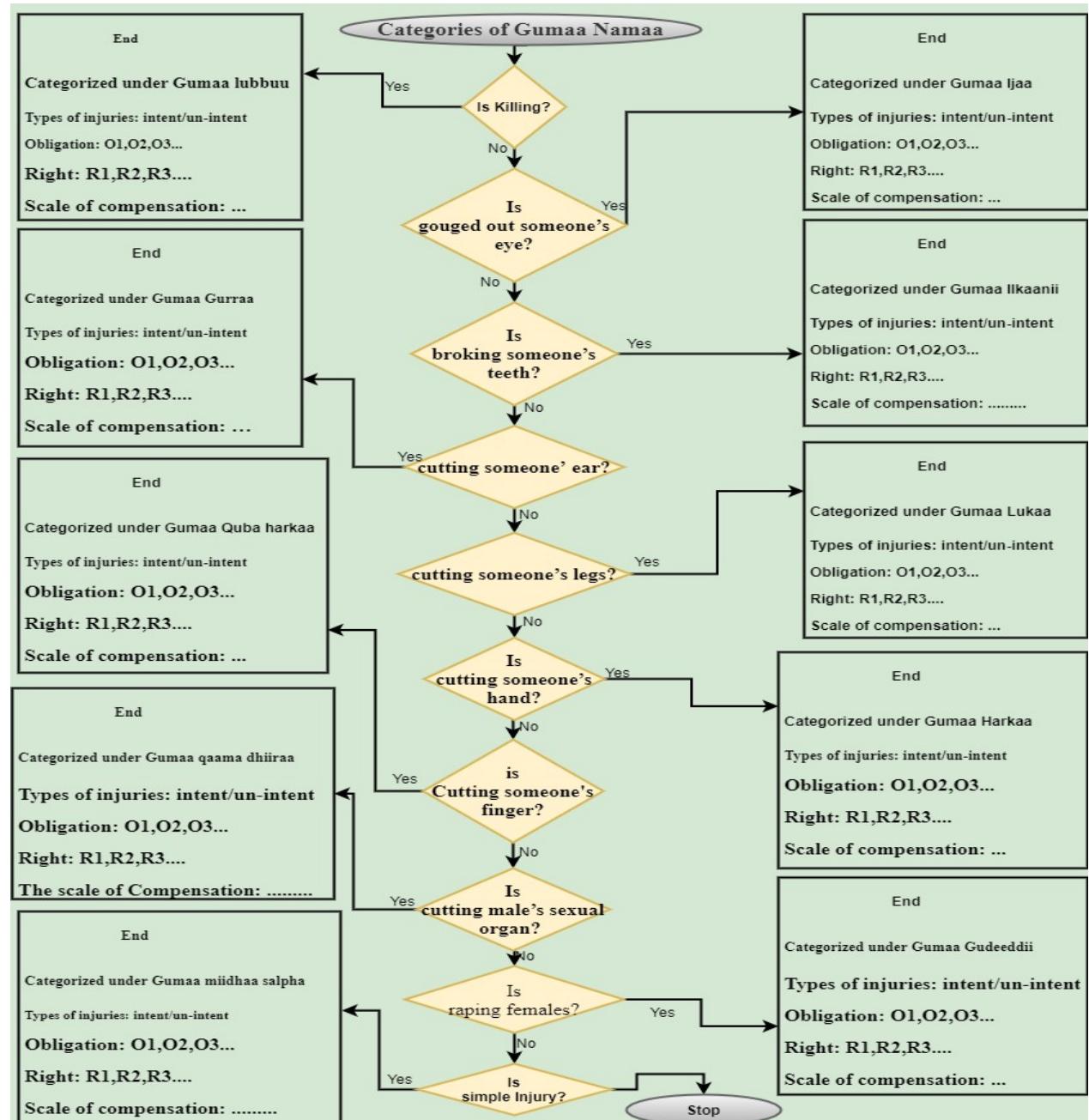
Figure 4. 15: Model for IK of Gumaa Namaa for conflict resolution

**4.3.6.**        Formalization of Gumaa Namaa for conflict resolution in OGS rule

In this study, the researchers captured and represent the IK of Gumaa Namaa (compensation paid for injured human beings) using rule based (IF-THEN-rule)  for easily utilization and preservation of IK institutions used for conflict resolution. Finally, the Prolog programming language (SWI prolog version 8.4.0) is used to store the expressed rule in to knowledge base (KB).

🔸   **Rule 1:**

**IF** wrongdoing activity is killing/murdering human being

   **AND** Types of injury="Intentional"

      **THEN**

   ➢   The wrongdoing activity is categorized under **Gumaa lubbuu namaa**
   ➢   The doer has the responsibility to inform his/her family and the family interns inform the Abbaa Gadaa or Jaarsa biyyaa

➢ The injured clan does not go for revenge but accepts what Abbaa Gadaa says.
➢ The doer has to compensate with 100 cattle/dhibba dhiiguu, but reduced if they are from one family.
➢ The injured clan have to receive the compensation after Abbaa Gadaa/elders decided it

**IF** wrongdoing activity is killing human being
   **AND** types of injury is ="Un-intentional"
            **THEN**
➢ The wrongdoing activity is categorized under **Gumaa lubbuu namaa**
➢ The doer has the responsibility to inform his/her family and the family interns inform the Abbaa Gadaa or Jaarsa biyyaa
➢ The injured clan does not go for revenge but accepts what Abbaa Gadaa says.
➢ The doer has to compensate with <100 cattle based on the situations, but reduced if are from one family.
➢ The injured clan have to receive the compensation after Abbaa Gadaa/elders decided it

🔸 **Rule 2:**

**IF** the wrongdoing activity is gouged out someone's eye
      **AND** type of injury is ="Intentional"
               **THEN**
➢ The wrongdoing activity is categorized under **Gumaa Ijaa**
➢ The doer has the responsibility to inform his family and the family interns inform the Abbaa Gadaa or Jaarsa biyyaa
➢ The injured clan does not go for revenge but accepts what Abbaa Gadaa says.
➢ The doer has to compensate with 50 cattle, but reduced if are from one family.

**IF** the wrongdoing activity is gouged out someone's eye
   **AND** type of injury is="Un-intentional"
               **THEN**
➢ The wrongdoing activity is categorized under Gumaa Ijaa
➢ The doer has the responsibility to inform his family and the family interns inform the Abbaa Gadaa or Jaarsa biyyaa
➢ The injured clan does not go for revenge but accepts what Abbaa Gadaa says.
➢ The doer has to compensate with less than 25 cattle, but reduced if are from one family.

🔸 **Rule 3:**

**IF** the wrongdoing activity is broking someone's teeth
      **AND** types of injury is ="intentional"
      **AND** teeth is ="ilkaan duraa/front teeth"
         **THEN**
➢ Then wrongdoing activity is categorized under **Gumaa ilkaanii**
➢ The doer has the responsibility to inform his family and the family interns inform the Abbaa Gadaa or Jaarsa Biyyaa
➢ The injured clan does not go for revenge but accepts what Abbaa Gadaa says.
➢ The doer has to compensate with 5 cattle, but it is reduced if there is a relationship and type of injury is un-intentional.

**IF** the wrongdoing activity is broking someone's teeth
   **AND** types of injury is ="intentional"
      **AND** teeth="ilkaan qarriffaa"
            **THEN**
➢ Then wrongdoing activity is categorized under Gumaa ilkaanii
➢ The doer has the responsibility to inform his family and the family interns inform the Abbaa Gadaa or Jaarsa Biyyaa
➢ The injured clan does not go for revenge but accepts what Abbaa Gadaa says.
➢ The doer has to compensate with 10 cattle, but it is reduced if there is a relationship and the type of injury is un-intentional.

🔸 **Rule 4:**

**IF** the wrongdoing activity is cutting someone' ear
   **AND** types of injury is ="intentional"

**AND** part of the ear is=" ear-ring "
- ✓ The wrongdoing activity is categorized under **Gumaa gurraa**
- ✓ The doer have the responsibility to inform to his family and the family interns inform to the Abbaa Gadaa or Jaarsa Biyyaa
- ✓ The injured clan do not go for revenge, but accept what Abbaa Gadaa says.
- ✓ The doer have to compensate with 25-50 cattle, but reduced if there is a relationship.

**IF** the wrongdoing activity is cutting someone's ear
  **AND** types of the injury is ="Un-intentional"
          **THEN**
- ✓ The doer have the responsibility to inform to his family and the family interns inform to the Abbaa Gadaa or Jaarsa Biyyaa
- ✓ The injured clan do not go for revenge, but accept what Abbaa Gadaa says.
- ✓ The doer have to compensate with <25 cattle, but reduced if there is relationship.

🔸 **Rule 5:**

**IF** the wrongdoing activity is cutting someone's legs
    **AND** types of the injury is ="intentional"
      **AND** the part of the leg is =" right"
          **THEN**
- ➢ The wrongdoing activity is categorized under **Gumaa lukaa**
- ➢ The doer has the responsibility to inform his family and the family interns inform the Abbaa Gadaa or Jaarsa Biyyaa
- ➢ The injured clan does not go for revenge but accepts what Abbaa Gadaa says.
- ➢ The doer has to compensate with 25 cattle, but it is reduced if there is a relationship.
- ➢ The injured clan have to receive the compensation after Abbaa Gadaa/elders decided it

**IF** the wrongdoing activity is cutting someone's legs
  **AND** types of the injury is ="Un-intentional"
**AND** part of the leg is ="right"
        **THEN**
- ➢ The wrongdoing activity is categorized under **Gumaa lukaa**
- ➢ The doer has the responsibility to inform his family and the family interns inform the Abbaa Gadaa or Jaarsa Biyyaa
- ➢ The injured clan does not go for revenge but accepts what Abbaa Gadaa says.
- ➢ The doer has to compensate with <25 cattle, but it is reduced if there is a relationship.
- ➢ The injured clan have to receive the compensation after Abbaa Gadaa/elders decided it.

**IF** the wrongdoing activity is cutting someone's legs
    **AND** types of the injury is ="intentional"
      **AND** the part of the leg is =" left"
          **THEN**
- ➢ The wrongdoing activity is categorized under **Gumaa lukaa**
- ➢ The doer has the responsibility to inform his family and the family interns inform the Abbaa Gadaa or Jaarsa Biyyaa
- ➢ The injured clan does not go for revenge but accepts what Abbaa Gadaa says.
- ➢ The doer has to compensate with 25 cattle, but it is reduced if there is a relationship.
- ➢ The injured clan have to receive the compensation after Abbaa Gadaa/elders decided it.

**IF** the wrongdoing activity is cutting someone's legs
  **AND** types of the injury is ="Un-intentional"
**AND** part of the leg is ="left"
        **THEN**
- ➢ The wrongdoing activity is categorized under **Gumaa lukaa**
- ➢ The doer has the responsibility to inform his family and the family interns inform the Abbaa Gadaa or Jaarsa Biyyaa
- ➢ The injured clan does not go for revenge but accepts what Abbaa Gadaa says.
- ➢ The doer has to compensate with <25 cattle, but it is reduced if there is a relationship.
- ➢ The injured clan have to receive the compensation after Abbaa Gadaa/elders decided it.

### ⬇ Rule 6:

**IF** the wrongdoing activity is cutting someone's hand
    **AND** types of the injury is ="intentional"
      **AND** the part of the hand is =" right"
        **THEN**
➢ The wrongdoing activity is categorized under **Gumaa harkaa**
➢ The doer have the responsibility to inform to his family and the family interns inform to the Abbaa Gadaa or Jaarsa Biyyaa
➢ The injured clan do not go for revenge, but accept what Abbaa Gadaa says.
➢ The doer have to compensate with 25 cattle, but reduced if there is a relationship.
➢ The injured clan have to receive the compensation after Abbaa Gadaa/elders decided it

**IF** the wrongdoing activity is cutting someone's hand
  **AND** types of the injury is ="Un-intentional"
**AND** part of the hand is ="right"
      **THEN**
➢ The doer has the responsibility to inform his family and the family interns inform the Abbaa Gadaa or Jaarsa Biyyaa
➢ The injured clan does not go for revenge but accepts what Abbaa Gadaa says.
➢ The doer has to compensate with <25 cattle for the left hand and reduce if there is a relationship.
➢ The injured clan have to receive the compensation after Abbaa Gadaa/elders decided it

**IF** the wrongdoing activity is cutting someone's hand
    **AND** types of the injury is ="intentional"
      **AND** the part of the hand is =" left"
        **THEN**
➢ The doer has the responsibility to inform his family and the family interns inform the Abbaa Gadaa or Jaarsa Biyyaa
➢ The injured clan does not go for revenge but accepts what Abbaa Gadaa says.
➢ The doer has to compensate with 30 cattle for the left hand and reduce if there is a relationship.
➢ The injured clan have to receive the compensation after Abbaa Gadaa/elders decided it.

**IF** the wrongdoing activity is cutting someone's hand
  **AND** types of the injury is ="Un-intentional"
**AND** part of the hand is ="left"
      **THEN**
➢ The doer has the responsibility to inform his family and the family interns inform the Abbaa Gadaa or Jaarsa Biyyaa
➢ The injured clan does not go for revenge but accepts what Abbaa Gadaa says.
➢ The doer has to compensate with <25 cattle for the left hand and reduce if there is a relationship.
➢ The injured clan have to receive the compensation after Abbaa Gadaa/elders decided it

### ⬇ Rule 7

**IF** the wrongdoing activity cutting male's sexual organ/pines
    **AND** types of injury is="Intentional"
➢ The wrongdoing activity is categorized under **Gumaa qaama saala dhiiraa muruu**
➢ The doer has the responsibility to inform his family and the family interns inform the Abbaa Gadaa or Jaarsa biyyaa
➢ The injured clan does not go for revenge but accepts what Abbaa Gadaa says.
➢ The doer has to compensate up to the life of an injured person.
➢ The injured clan have to receive the compensation after Abbaa Gadaa/elders decided it

**IF** the wrongdoing activity cutting male's sexual organ/pines
    **AND** types of injury is="Un-intentional"
      **THEN**
➢ The wrongdoing activity is categorized under **Gumaa qaama saala dhiiraa muruu**
➢ The doer has the responsibility to inform his family and the family interns inform the Abbaa Gadaa or Jaarsa biyyaa
➢ The injured clan does not go for revenge but accepts what Abbaa Gadaa says.

➢ The doer has to compensate up to the life of an injured person but it can be reduce if there is relationship.

➢ The injured clan have to receive the compensation after Abbaa Gadaa/elders decided it

🔸 **Rule 8**

**IF** the wrongdoing activity is cutting someone's fingers

  **AND** types of injury is ="intentional"

      **AND** name of finger is="thumbnail/ (Abbuudduu)"

      **AND** name of finger is=" milking (Elemtuu)"

      **AND** name of finger is=" (Tirsee)"

      **AND** name of finger is=" (mirsoo)"

      **AND** name of finger is=" (nyaallee)"

**THEN**

➢ The wrongdoing activity is categorized under **Gumaa Qubaa**

➢ The doer has the responsibility to inform his family and the family interns inform the Abbaa Gadaa or Jaarsa biyyaa

➢ The injured person does not go for revenge but accepts what Abbaa Gadaa says.

➢ The doer has to compensate with 15, 6,3,4,2 cattle respectively

➢ The injured clan have to receive the compensation after Abbaa Gadaa/elders decided it

**IF** the wrongdoing activity is cutting someone's fingers

  **AND** types of injury is ="un-intentional"

      **AND** name of finger is="thumbnail/ (Abbuudduu)"

      **AND** name of finger is=" milking (Elemtuu)"

      **AND** name of finger is=" (Tirsee)"

      **AND** name of finger is=" (mirsoo)"

      **AND** name of finger is=" (nyaallee)"

**THEN**

➢ The wrongdoing activity is categorized under **Gumaa Qubaa**

➢ The doer has the responsibility to inform his family and the family interns inform the Abbaa Gadaa or Jaarsa biyyaa

➢ The injured person does not go for revenge but accepts what Abbaa Gadaa says.

➢ The doer has to compensate with less than 15, 6,3,4,2 cattle respectively

➢ The injured clan have to receive the compensation after Abbaa Gadaa/elders decided it

🔸 **Rule 9:**

**IF** the wrongdoing activity is raping females

  **AND** the raped female is =" virgin"

➢ The wrongdoing activity is categorized under **Gumaa Gudeeddii**

➢ The doer has the responsibility to tell to his family without any lie and the family interns inform the Abbaa Gadaa or Jaarsa biyyaa

➢ The injured person does not go for revenge but accepts what Abbaa Gadaa says.

➢ The doer has to compensate with 5-9 cattle based on its occurrence, but if the doer dies during raping female, the compensation is a **male donkey**.

➢ The injured clan have to receive the compensation after Abbaa Gadaa/elders decided it

**IF** the wrongdoing activity is raping females

   **AND t**he raped female is="has husband"

➢ The wrongdoing activity is categorized under **Gumaa Gudeeddii**

➢ The doer has the responsibility to tell his family and the family interns inform the Abbaa Gadaa or Jaarsa biyyaa

➢ The injured person does not go for revenge but accepts what Abbaa Gadaa says.

➢ The doer has to compensate with 5 cattle based on its occurrence, but if the doer dies during raping female, the compensation is a **male donkey**.

➢ The injured clan have to receive the compensation after Abbaa Gadaa/elders decided it

**IF** the wrongdoing activity is raping females

  **AND** the raped female is=" no virgin and has no husband"

      **THEN**

➢ The wrongdoing activity is categorized under Gumaa Gudeeddii

- ➢ The doer has the responsibility to inform his family and the family interns inform the Abbaa Gadaa or Jaarsa biyyaa
- ➢ The injured person does not go for revenge but accepts what Abbaa Gadaa says.
- ➢ The doer has to compensate with <5 cattle based on its occurrence, but if the doer dies during raping female, the compensation is a **male donkey.**
- ➢ The injured clan have to receive the compensation after Abbaa Gadaa/elders decided it

🔸 **Rule 10:**

**IF** the wrongdoing activity is simple injuries
  **AND** types of injury is =”Intentional”
   **AND** the injury is=” blooding human body”
    **THEN**

- ➢ The wrongdoing activity categorized under **Gumaa miidhaa salphaa**
- ➢ The doer has the responsibility to inform his family and the family interns inform the Abbaa Gadaa or Jaarsa biyyaa
- ➢ The injured person does not go for revenge but accepts what Abbaa Gadaa says.
- ➢ The doer has to compensate with special clothes called wayyaa/ bullukkoo.
- ➢ The injured clan have to receive the compensation after Abbaa Gadaa/elders decided it

**IF** the wrongdoing activity is simple injuries
  **AND** types of injury is “Un-intentional”
   **AND** the injury is “blooding human body”
    **THEN**

- ➢ The doer has the responsibility to inform his family and the family interns inform the Abbaa Gadaa or Jaarsa biyyaa
- ➢ The injured person does not go for revenge but accepts what Abbaa Gadaa says.
- ➢ The doer has to compensate with special clothes called wayyaa/ bullukkoo, but some consideration if there is a relationship.
- ➢ The compensation paid for this action is like a donation (Gumaata) of honey, butter, milk, slaving, and feeding the injured person.
- ➢ The injured clan have to receive the compensation after Abbaa Gadaa/elders decided it

**IF** the wrongdoing activity is simple injuries
  **AND**

- ➢ The wrongdoing activity is insulting wayyuu (secret respect) then
- ➢ The doer has the responsibility to inform his family and the family interns inform the Abbaa Gadaa or Jaarsa biyyaa
- ➢ The injured person does not go for revenge but accepts what Abbaa Gadaa says.
- ➢ The doer has to compensate with special clothes called wayyaa/ bullukkoo.
- ➢ The injured clan have to receive the compensation after Abbaa Gadaa/elders decided it.

## Chapter Five

### 5. Designed Framework and developed prototype

#### 5.1. Design indigenous knowledge management framework (IKMF)

The results from data analysis and literature review shows that, managing IK of Oromo Gadaa system for conflict resolution is explained insufficient and there is no application of KM approach that support to design and develop a framework. The knowledge management framework (KMF), according to [1] [71] [45], assists the community in making a better decision and comprehending the knowledge that exists in the community in the simple way.

To support the IKM process, awareness, willingness, objective, and overall planning, a knowledge management framework (KMF) is used to tie the organization with the core aspects of the KM processes. Therefore, the KM process could effectively utilize and preserve when all KM components were integrated and a single framework was designed rather than a distinct model for each component [24].

In this study, the researchers were designed IKMF and developed prototype for IK Gumaa in OGS to enhance the degree of KM process. The basic KM process that was included in designed IKMF were knowledge acquisition, capturing, representing, sharing, applying/utilizing and preservation of IKM of OGS used for conflict resolution (Gumaa) as depicted in figure 5.1 of the proposed IKMF of Gumaa.
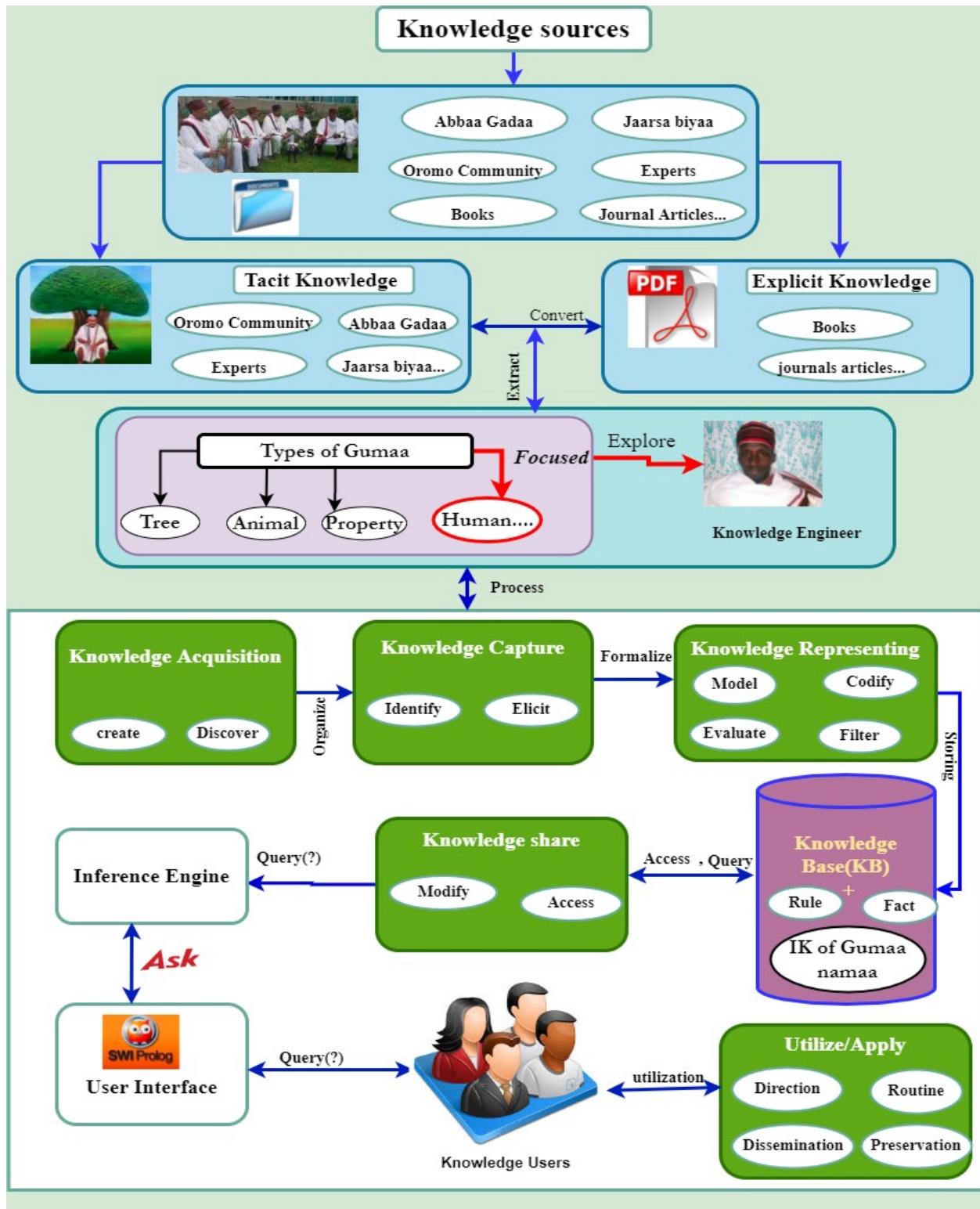
*Figure 5. 1:  proposed IKMF*

**5.1.1.**        Descriptions of the Proposed IKM Framework

The proposed indigenous knowledge management framework for Gumaa in the Oromo Gadaa system (OGS) is described in detail in this portion of the study.

**Knowledge sources:** In the proposed framework (figure 5.1 proposed IKMF); knowledge source is the first component, from which the necessary knowledge and information about IK of conflict resolution (Gumaa) in OGS were obtained.  In this study, the researchers obtained primary data from Gadaa system leaders, local elders, and the community, as well as domain experts of West Arsi zone Oromo Gadaa system through interview, questionnaires and technical observation. In addition, different research papers done by different researchers were reviewed as secondary data sources.  Therefore, both tacit and explicit knowledge of IK of Gumaa were obtained from these sources and transform from one form to another (tacit-tacit, tacit-explicit, explicit-explicit, and explicit-tacit) based on Nonaka and Takeuchi's SECI model.

**Knowledge engineers:** In figure 5.1 of the proposed IKMF, knowledge engineers are agents who engage in the extraction, elicitation, modeling, representing, filtering, implementation, testing, and evaluating of knowledge using a KBS to solve problems in the given society. For this study, the researchers used experts and hayyuu (intellectual) of OGS from the West Arsi zone Gadaa system as knowledge engineers.

**Knowledge Acquisition (KA):** As depicted in figure 5.1 of the proposed IKMF, Knowledge acquisition (KA) is a first KM process used to create and discover the IK institutions existed in OGS for conflict resolution (Gumaa) in order to improve individuals or group's ability to perceive and acquire this critical IK in solving a social problem.

**Knowledge capturing (KC):**  In the proposed IKMF, knowledge capturing (KC) is the process of arranging and organizing acquired IK of conflict resolution existed in OGS and identify, elicit, and converted it to explicit and then prepared for representation to store it into KB for later access.

**Knowledge representations (KR):** Another essential component of the proposed IKMF of Gumaa for conflict resolution is knowledge representation (KR), which is intended for formalizing the captured IK of Gumaa used for conflict resolution and then storing it into KB using rule-based KR techniques.

**Knowledge base (KB):**  As shown in Figure 5.1 of the proposed IKMF, knowledge base (KB) is another core component of the proposed framework in which the formalized IK of Gumaa namaa, its rules, facts, right, obligation of both injured and injure, categories of wrongdoing, types of injuries and other rules of Gumaa system were stored and access for future.

**Knowledge sharing (KB):**  As shown in figure 5.1, knowledge sharing (KS) is a successive of KC and KR processes in which the stored IK of Gumaa institutions were disseminated to knowledge seekers by querying, accessing, modifying and exploring the desired IK from KB.

**Inference engine (IE):**  The proposed IKMF of Gumaa also includes inference engine (IE) to allow a user to communicate with a KB by making a link in a computer system using a logical query known as rule-based (IF-THEN-rule) to retrieve IK of conflict resolution (Gumaa) from a KBS.

**User interface (UI):**  As described in figure 5.1, all aspects of the knowledge base system (KBS) were linked to the user interface (UI) in order to send a query for accessing the IK of Gumaa and its facts and rules stored in to KB.

**End users (EU):**   As proposed IKMF shows, end users are agents who interact with KB via a user interface query to perform and use IK of conflict resolutions (Gumaa) that helps Oromo and non-Oromo community in socio-cultural, political and psychological activates.

**Knowledge utilization/application (KU):** The final components of the proposed IKMF is knowledge utilization (KU) which includes direction, routines, dissemination and preservation of IK of Gumaa used for conflict resolution for the next generation. Therefore, the ultimate goal of this study is to explore and improve the utilization and preservation of IK in OGS by designed a desired indigenous knowledge management framework (IKMF).

**5.1.2.**        Developed prototype for IKMF of Gumaa institutions

KM, according to [72] is a relatively new philosophy that has been implemented in a number of small, medium, and large organizations. Furthermore, the KMS idea aims to improve and simplify the degree of managing and handling quality of human resources (assets) within the community in order to increase the communication and knowledge transfer capacity between all members of an organization, whether it is tacit or explicit knowledge.

As a result, the goal of developing IKM prototype is to evaluate how to access and use the designed framework in order to solve a societal problem effectively and efficiently. Therefore, the researchers gathered relevant data and information from West Arsi zone Abbaa Gadaa, local elders, local community, experts of culture and tourism bureau and then developed a prototype for the IKMF of conflict resolution in OGS (Gumaa) which is mainly focused on IK of Gumaa namaa (compensation for injured human beings) using prolog programming language.

**5.1.3.**    User interface for developed prototype

The user interface is an interaction between users and the knowledge base to access the knowledge stored in KBS with help a production rule and inference engine in a user-friendly manner. The user interface for this research study was developed with the SWI-prolog version 8.4.0 as discussed in the methodology. As a result, users can communicate with the system by typing, "**start**" followed by a full stop "**.**" and then pressing "Enter" to access knowledge stored in the KB via the SWI-prolog window. "**WELCOME TO IKM OF GUMAA IN OROMO GADAA SYSTEM**" and queries about wrongdoing action were displayed automatically, followed by "**?**" as shown in figure 5.2. Then users have to respond by typing "**yes/y**" or "**no/n**" followed by a full stop "**.**"



Figure 5. 2: Snapshot for user interface to access IK of Gumaa intuitions

As shown in figure 5.2. If the user responds "yes/y" to the question "**Does the wrongdoing activity is: killing _somebody**?" then the system displays the categories of wrongdoing action and rules for both parts and the scale of compensation once the user replies. However, if the users responds with "no/n" followed by a full stop ".." Then the system moves on to the next category of wrongdoing actions from a list of 10 Gumaa namaa categories recorded in knowledge base (KB) as depicted in figure 5.3 and 5.4 respectively.

```
SWI-Prolog -- c:/Users/bh/Desktop/Bifa file/bh/coommunity research/Prototype for IKM of Gumaa in OGS.pl

File  Edit  Settings  Run  Debug  Help

Welcome to SWI-Prolog (threaded, 64 bits, version 9.2.5)
SWI-Prolog comes with ABSOLUTELY NO WARRANTY. This is free software.
Please run ?- license. for legal details.

For online help and background, visit https://www.swi-prolog.org
For built-in help, use ?- help(Topic). or ?- apropos(Word).

?- start.

****************WELECOME TO IKM OF GUMAA IN OROMOO GADAA SYSTEM ************
==============SIKO MANDO OROMOO COMMUNITY ====================
==========================================================================
        ********************|| MADDA WALABU UNIVERSITY ||********************
        ********************|| COMMUNITY RESEARCH          ||********************
        ********************|| 2024 G.C                    ||********************
==========================================================================


Does the wrongdoing activity is:killing_somebody? y.

Does the wrongdoing activity is:intentional? |: y.

Does the wrongdoing activity is:un-intentional? |: y.

#######################################################
COMPENSATION AND RULES FOR PURIFICATIONS
#######################################################


xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
RULE 1: Doer have the responsibilty to inform to Abbaa Gadaa/Jaarsa biyyaa biyyaa.
RULE 2: Doer have the right to not killed/wanted by injured clan.
RULE 3: For intentional doer who do such activity have to compensate with 100 cattl
RULE 4: For un-intentional and family doer have to compensate with <100 cattles.
RULE 5: Injured clan have the resposiblity to accept what Abbaa Gadaa said.
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
```

Figure 5. 3: Snapshot for IK of Gumaa Lubbuu Namaa (compensation for killing somebody)

```
*C:\Users\bh\Desktop\Bifa file\bh\coommunity research\Prototype for IKM of Gumaa in OGS.pl - Notepad++

File  Edit  Search  View  Encoding  Language  Settings  Tools  Macro  Run  Plugins  Window  ?

Prototype for IKM of Gumaa in OGS.pl

32   /*wrongdoing(unknown) :-no punishment*/
33   /*wrongdoing Identification Rules*/
34   gumaa_lubbuu :-
35   verify(killing_somebody),
36   verify(intentional),
37   verify(un-intentional),
38
39   write('###############################################################'),nl,
40   write('COMPENSATION AND RULES FOR PURIFICATIONS'),nl,
41   write('###############################################################'),nl,
42   nl,
43   write('xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
44   write('RULE 1: Doer have the responsibilty to inform to Abbaa Gadaa/Jaarsa biyyaa biyyaa.'),
45   nl,
46   write('RULE 2: Doer have the right to not killed/wanted by injured clan.'),
47   nl,
48   write('RULE 3: For intentional doer who do such activity have to compensate with 100 cattle/dhibba
49   nl,
50   write('RULE 4: For un-intentional and family doer have to compensate with <100 cattles.'),
51   nl,
52   write('RULE 5: Injured clan have the resposiblity to accept what Abbaa Gadaa said.'),
```

Figure 5. 4: snapshot for Sample code for prototype development

### 5.2. Discussion and Result Finding

In this study, this section incorporates the discussion and evaluation procedures of the proposed IKMF of Gumaa institutions in OGS based on the parameters and data gathered from West Arsi zone and Bale Oromo communities Gadaa system through questionnaires, interview, technical observation and as well as reviewed different related literatures and analyzed it.

As a result, most of the data and information gathered from various sources (from Abbaa Gadaa, Haadha siiqqee, local elders ,local communities, experts) were indicated that the IK of OGS used for conflict resolution (Gumaa) were a tacit (uncodified) knowledge and needs transformation mechanism for easily utilizing and preserving. Therefore, the researchers used Nonaka model of SECI in order to convert this tacit (un-codified) knowledge to explicit (codified) and designed framework for Gumaa institutions used for conflict resolution and developed a functional prototype for user acceptance test using SWI-Prolog programming language and lastly the result were evaluated and discussed in the following section.

#### 5.2.1.  User Acceptance Testing

User acceptance testing is the most critical validation and evaluation of a developed system conducted by end users, and it is the approach for identifying whether the system has fulfill the user requirements or not [73]. After the demonstration of the developed prototype to the end users, the researchers prepared and distributed user acceptance testing questionnaires to them in order to test and evaluate the proposed framework's performance. Then the researchers chose 20 key respondents based on their biography like age, sex, organization they work in, years of experiences, field of specialization, and academic rank as illustrated in table 5.1.

*Table 5. 1: End users' biography*

| End users' biography | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Age | Sex | | Organization | | | Field of specialization | | | | Experience | | | Academic rank | | | |
| >=20 | M | F | Culture& Tourism | ICT | OGSI nstn. | IT | CS | IS | SE | 0-5 | 6-10 | >10 | No | BSc | MSc | PhD |

| 14 | 6 | 6 | 10 | 4 | 8 | 6 | 4 | 2 | 4 | 6 | 10 | 4 | 6 | 9 | 1 |
|----|---|---|----|---|---|---|---|---|---|---|----|---|---|---|---|

Therefore, based on the (ISO-9126) standards the researchers prepared questionnaires for evaluating and testing the performance of the proposed IKMF using developed prototype for IK of Gumaa namaa (compensation for injured human beings) as depicted in table 5.1. Such standards are 1) Attractiveness in IK acquisitions, 2) Simplicity in IK capturing, 3) Efficiency in sharing and utilization, 4) Deliverability in knowledge and decision-making, 5) Portability in the desired user requirement, 6) Usability improvement of IK in resolving a social problem, 7) Functionality appropriate, and 8) maintainability for additional requirements.

*Table 5.2: Questionnaire prepared for user's acceptance test*

| No. | Questionnaire prepared for user acceptance test |
|-----|--------------------------------------------------|
| 1 | Is the proposed IKM framework of Gumaa institution is **attractive** and user friendly in acquiring appropriate Indigenous knowledge? |
| 2 | Is the mechanism of capturing and utilizing IK is **simplified** due to IKMF of Gumaa in OGS is designed and developed? |
| 3 | Does the proposed framework is **efficiency** in capturing and disseminating IK in terms of response time? |
| 4 | Is the designed framework and developed prototype for Gumaa in OGS increase the degree of sharing and **accessibility** of IK for better decision making? |
| 5 | Is the developed prototype for selected IK (Gumaa) **portable** for OGS to facilitate the preservation and application? |
| 6 | Is the proposed framework and prototype helps as a baseline and improve the **usability** of other IK found in OGS for further utilization and preservation? |
| 7 | Is the proposed framework is **functionally** appropriate in knowledge disseminating process of IKM of Gumaa institution in OGS? |
| 8 | Is the proposed IKMF for IK of Gumaa is **maintainable** if some additional requirement are needed? |

The researchers assigned the values for measurement criteria for each parameters of the prepared questionnaires in order to test and evaluate the proposed framework and developed prototype as: Strongly agree='5', Agree='4', Neutral='3', Disagree='2', and strongly disagree='1'. As well as ISO-9126 evaluation standards such as attractiveness= Q1, Simplicity =Q2, efficiency= Q3, accessibility =Q4, portability=Q5, Usability=Q6, functionality=Q7, maintainability=Q8 were used as shown in table 5.3.

*Table 5. 2: End user evaluation result*

| Q# | Strongly agree | | Agree | | Neutral | | Disagree | | Strongly disagree | |
|----|----------------|--|-------|--|---------|--|----------|--|-------------------|--|
| | No. of Respondents (20) | 100% | No. of Respondents (20) | 100% | No. of Respondents (20) | 100% | No. of Respondents (20) | 100% | No. of Respondents (20) | 100% |
| Q1 | 16 | 80% | 3 | 15% | 0 | 0% | 1 | 5% | 0 | 0% |
| Q2 | 12 | 60% | 5 | 25% | 1 | 5% | 1 | 5% | 1 | 5% |
| Q3 | 13 | 65% | 4 | 20% | 2 | 10% | 0 | 0% | 1 | 5% |
| Q4 | 14 | 70% | 4 | 20% | 1 | 5% | 1 | 5% | 0 | 0% |
| Q5 | 15 | 75% | 4 | 20% | 1 | 5% | 0 | 0% | 0 | 0% |
| Q6 | 17 | 85% | 1 | 5% | 1 | 5% | 1 | 5% | 0 | 0% |
| Q7 | 13 | 65% | 3 | 15% | 2 | 10% | 1 | 5% | 1 | 5% |
| Q8 | 10 | 50% | 7 | 35% | 1 | 5% | 1 | 5% | 1 | 5% |

As shown in table 5.2, 80% of the stakeholders were strongly agreed on attractiveness and user friendly of proposed framework in acquiring appropriate IK of Gumaa in Oromo Gadaa system. And as well as 60% of the evaluators were strongly agreed on simplicity of the proposed framework of IK of Gumaa in capturing and utilization mechanism, 65% of the respondents were strongly agreed on efficiency in capturing and disseminating of IK in terms of response.

The degree of sharing and accessibility of the proposed framework has evaluated as 70% as strongly agree, in better decision making process, 75% of the evaluators were strongly agreed on the importance of the proposed framework.  In addition, 85% of the stakeholders were strongly agreed on improvement of the usability of the proposed framework and its baseline for other IKM in OGS and other nation's IK as well as 65% of the evaluators are strongly agreed on the functionality of the proposed framework for easily disseminating IK of Gumaa institutions in appropriate way. Lastly, 50% of the respondents were strongly agreed on the maintainability of the proposed IKMF and its prototype when some additional requirements are needed. Mostly, the performance assessment result showed that the designed IKMF and the developed prototype were highly usable for the improvement of other IK existed in Oromo Gadaa system and other society's IK and the overall visualization result were clearly illustrated in figure 5.6.
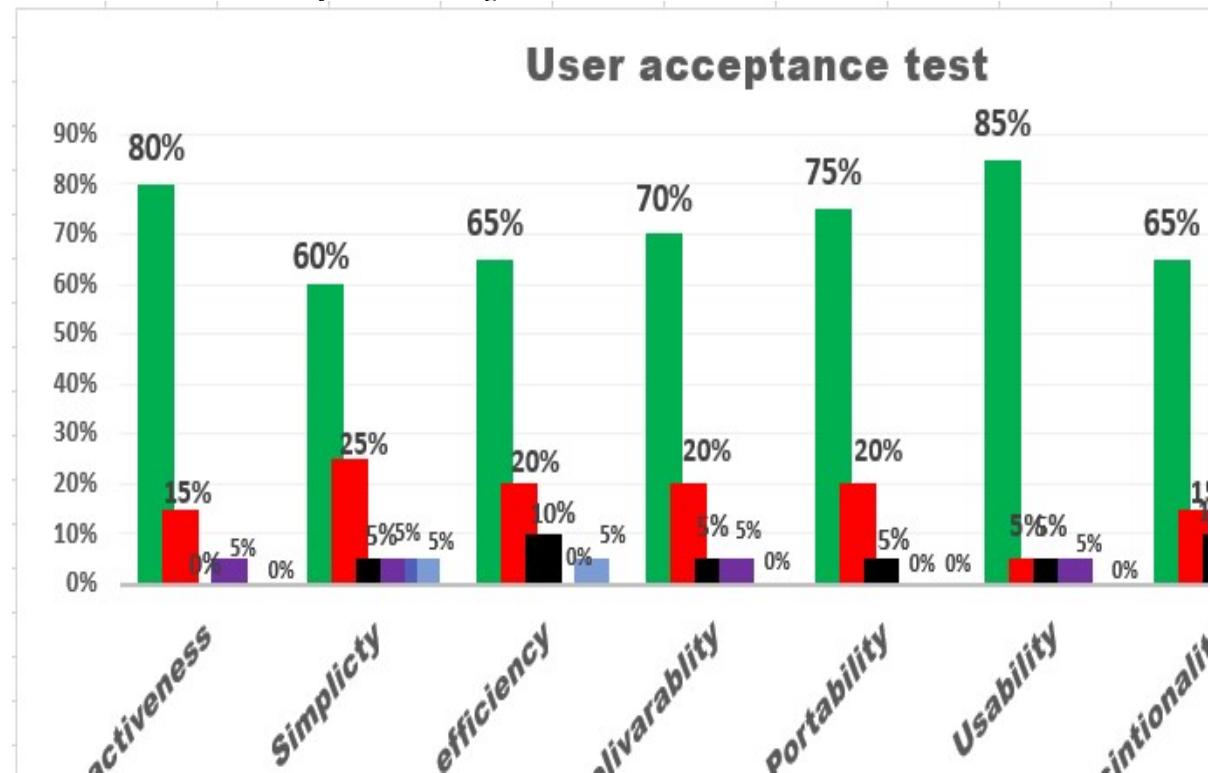


Figure 5. 5: End Users Acceptance test visualization

### 5.3. Contribution

The final contribution of this study is to explore the IK exited in OGS used for conflict resolution (Gumaa) and then "designed and developed IKMF for Gumaa in the Oromo Gadaa system" with its prototype and try to convert the IK of Gumaa used for conflict resolution from tacit (uncodified) to explicit (codified) to increase the KM process. This study also contributes a new and advanced concept of technology-enabled indigenous knowledge management (IKM) mechanism for easily assist community and disseminate it to the next generations. Additionally, this study contributes a common platform to reduce the communication barriers of Gadaa system leaders living in different areas. Lastly, this study can be used as input or baseline for other researchers for developing full implementation of IKM application of Gumaa institutions and move on to other IKM found in Oromo Gadaa system.

**Chapter Six**

## 6.    *Conclusion and Recommendation*

In this chapter, the researchers summarize the findings of the study and makes recommendations for future improvements to the Oromo Gadaa indigenous knowledge management system, which helps the whole community in their everyday life.

### 6.1. Conclusion

As the research study finding indicates, the current indigenous knowledge management (IKM) of Gumaa institutions in the Oromo Gadaa system were low in all KM processes (acquisition, capturing, storing, sharing, application/utilization and preservation). Therefore, based on the analyzed primary and secondary data this research study concluded that KM approaches could be a feasible alternative solution for managing and disseminating IKM of Gumaa in OGS by help of using designed IKMF of Gumaa in Oromo Gadaa system and developed prototype. As a result, the newly proposed IKM framework of Gumaa institution incorporates almost all KM process in order to increase degree of utilization and preservation of IK of OGS for the next generations.

After designed a desired IKMF, the functional prototype was developed for the integrated KM process using prolog-programming language and demonstrated to users for testing purpose. Finally the proposed framework has been tested and evaluated based on the (ISO- 9126) standards evaluation parameters such - 1) Attractiveness, 2) Simplicity,3) Efficiency, 4) Deliverability, 5) portability, 6) Usability, 7) appropriate in functionality, and 8) maintainability for additional requirement.  The findings were 80%, 60 %, 65%, 70%, 75%, 85%, 65%, and 50%, respectively, based on their evaluation. Accordingly, the designed IKM framework and developed prototype has the capability to improve the performance of IKM processes in Oromo Gadaa system.

The key contribution of this research study is the designed IKMF of Gumaa in OGS and developed prototype. The designed framework simplifies and increase usability of IKM process and the study accomplished its objectives and provided answers to the research questions by making significant contributions to a new knowledge domain.

### 6.2. Recommendations

In this study, the IK of Gumaa institutions in OGS was explored, and then framework has designed with functional prototype. However, as the research study finding indicated that still there is very short related works and the Current Status of KM process in IK of OGS is very low especially in IK of conflict resolution due to lack of application of KM approach (technology).

Accordingly, the following recommendations are forwarded:

➢ The researchers proposed IKMF for Gumaa institution for conflict resolution in this study, along with its prototype. Furthermore, framework and prototyping are required for the rest of the IK exist in Oromo Gadaa system.

➢ In this study, a rule-based knowledge representation was used to represent and store the IK of Gumaa institutions.  As a result, this IK should be extended to include other knowledge representation techniques (like case based, frame based etc. in AI).

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*Appendices*

**Appendix 1: survey questionnaire prepared for Local community and experts (works in West Arsi and Bale zone culture and tourism bureau)**
**Dear Respondents**

The purpose of this survey is to collect data and information for Exploring and Designing indigenous Knowledge Management Framework for Gumaa in Oromo Gadaa System in the case of Siko Mando. The primary goal of this study is to design and implement the IKM framework for Gumaa in Oromo Gadaa system for easily sharing, preserving and utilizing Indigenous knowledge of Oromo Gadaa system used for conflict resolution in the Oromo communities.

We assure you that the results will be used for research purposes only as well as the information provided will be treated with the utmost confidential. The researchers shall be grateful for your valuable inputs and active co-operation.

This survey (interview, questionnaire and checklist) contains questions based on the selected parameters that related to conflict resolution mechanisms especially on Gumaa in OGS particularly for Siko Mando Oromo community. To save your valuable time, we have presented most of the questions with the possible answers, so that you can choose the answers which best explains your views. Your precious effort in completing this survey questionnaire can greatly have appreciated.

Thank you for your cooperation
   Sincerely yours,

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### Part 1: Background of Respondents

1. Saala
   a) dhiira [ ]          b)    dhalaa

2. umrii
   a) 20-30 [ ]      b) 31-40 [ ]       c) 41-50 [ ]      d) 50 and above [ ]

3. Hariiroo:  a) kan fuudhe [ ]     b) kan hin fuudhin [ ]     c) kan fuudhee hike d [ ]     d) kan abbaan manaa ykn haati manaa irraa duute/due [ ]

4. Sadarkaa barnootaa
   a)  1-8 [ ]     b)  9-12 [ ]     c) diploma [ ]     d) degree jalqabaa fi isaa ol [ ]     g) kan hin baratin [ ]

5. Sirna Gadaa Oromoo keessatti gaheen hojii keessanii maalidha??
   a)   Abbaa Gadaa [ ]     b)  Abbaa Bokkuu [ ]     c) Qaalluu [ ]

   d) Jaarsa biyyaa) [ ]     e) Hawaasa biroo [ ]     f) Haadha siiqqee
   gahee biro yoo qabaattan asitti barreessaa_____

6. Gaaffii  Q# '5' gaheen hojii keessanii  Abbaa Gadaa yoo tahe muuxannoo waggaa meeqaa qabdu?
   a)   1waggaa [ ]     b) 2wagga [ ]     c) 3 waggaa [ ]     d) 4 waggaa [ ]     e) 5 waggaa fi isaa ol [ ]     f) muuxannoo hin qabu [ ]

### Part 2: Answer the following questions by putting (√) in front your answer according to questions provided.

1. Do you have any experience from where indigenous knowledge acquired?
   a) From Abbaa Gadaa [ ]     b) form jaarsa biyyaa [ ]     c) form local community [ ]
   d) Form experts [ ]     e) mention if any_____

2. Do you believe that the acquisition capacity of knowledge seekers is good during oral teaching of IK?
   Yes [ ]          b No [ ]

3. During knowledge discovery and acquisition process, the IK transfer is through verbal or oral communications and teaching the community; So, is there evaluation criteria whether knowledge seekers exactly acquired or not?

a) Yes [ ]   b) No [ ]

4. Is there a mechanism to capture IK (tacit knowledge) from the knowledge sources?

   a) Yes [ ]   b) No [ ]

5. Did you believe that capturing IK help the community in their social life?

   a) Yes [ ]   b) No need [ ]

6. Do you know IK institution in OGS used for conflict resolution and how the community capture and preserved within the Oromo community?

   a) Gumaa [ ]   b) Siiqqee [ ]   c) Qaalluu [ ]   d) Jaarsummaa [ ]

   e) Mention if any_____

7. If your answer for Q# '6' is 'yes' Can you mention some IK institution for conflict resolution that needs KM process (acquiring, capturing, sharing, preserving and utilizing)?

   a) Yes [ ]   b) No need

8. In the Oromo Gadaa system, there are multitude institutions for justice administration and peace building activities like Gumaa, siiqqee, Jaarsumaa, Qaalluu, etc. Among that, did you know what are the rule and regulation practiced in Gumaa system and how to capture IK of Gumaa institution in Oromo community for solving conflict?

   a) Yes [ ]   b) No [ ]

9. In OGS, not all wrongdoing activities can be included in the Gumaa system for settling blood feuds; thus, what are the most serious wrongdoing activities that should be included under Gumaa system needs preserved?

a. Gumaa Namaa (compensation paid for injured human beings)?

b. When a person's properties are damaged

10. Did you know how rules and regulations practiced and practicing in Oromo community for solving such kinds of wrongdoing activity using Gumaa institutions in OGS, that has to captured and disseminated for the knowledge seekers?

   a) Yes [ ]   b) No [ ]

11. Did you believe that is there punishment or compensation payment rules during solving conflict through Gumaa institution that needs capturing and sharing from those who done such wrongdoing actions (homicide/murder, injuring human bodies?

   a) Yes [ ]   b) No [ ]

12. Did you know how captured indigenous knowledge (IK) institution in OGS represented for easily understanding and utilizing it?

   a) Yes [ ]   b) No [ ]

13. Did you believe that is there the representation techniques and rules for IK institution that serves the community during conflict resolution in OGS (Gumaa)?

   a) Yes [ ]   b) No [ ]

14. Could you explain some issues and challenges in the current state of representing IK institutions in OGS for conflict resolution (Gumaa)?

   a) Yes [ ]   b) No [ ]

15. Do you have willingness to share how IK institution in Oromo Gadaa system serves the community in solving conflict?

16. Yes [ ]   b) No

17. Is there an awareness from new generation during IK sharing process from Abbaa Gadaa or local elders?

   a) Yes [ ]   b) No [ ]   c) in didn.t know [ ]

18. Normally traditional knowledge acquisition and capturing process can transfer from knowledge holder to the seekers of knowledge either formally or informally. Can you explain formal and informal activities to encourage IK institution for conflict resolution of Gumaa in OGS and ways of sharing and maintained within the Oromo community?

   a) Yes [ ]   b) No [ ]

19. Do you have experience to share on resolving conflict using IK institution of OGS? (if you have participated in any conflict resolution activity)?

   a) Yes [ ]   b) No [ ]

20. What are the IK institutions for conflict resolution are available in Oromo Gadaa system that has to stored and preserved within the Oromo community? (depending on your experiences)

   a)  Gumaa as Oromo Indigenous Conflict Resolution Institutions

   b)   Siiqqee as Oromo Indigenous Institutions Of Conflict Resolution

   c)  Jaarsummaa As Indigenous Conflict Resolution Institution

   d)  Qaalluu as Indigenous Conflict Resolution Institutions

If any other different mention it_____
_____

21. What is the functions of storing IK institution for conflict resolution that exist in OGS and how to evaluate the developed IKMF of Gumaa?

   a)  To acquire and dissemination of knowledge

   b)  To simplify capturing and preservation process of IK

   c)  To increase accessibility and sharing capacity of knowledge

   d)  To identify and measure the technology dependent of IKMF

   e)  For easily utilizing ,applying and preserving IK existed in OGS

If any other different mention it _____
_____

22. Did you know how stored knowledge (IK in OGS) for conflict resolution accessed and give a service the community?

   a)  Yes                                      b) No

23.    Do you support preserving IK institution for conflict resolution exist in OGS (Gumaa) is essential for social, economic and psychological aspects of the Oromo community?

   a)  Yes            b)  No            c) I don't know

24. What degree of utilization of the IK of Gumaa institution and in what situations it is used in OGS?
   a)  during Araaraa (reconciliation)  process
   b)  during Jaarsummaa(arbitrary) process
   c)  during Guddifachaa(adoption)
   d)  during respect of wayyuu (secret respect)
   e)  during fuudhaa fi heerumaa(marriage system)
   f)  during Irreecha, wedding (thanks giving to God)
   g)  during giving values for human being(Namummaa)
   h)  during dhibaayyuu (libation)
   i)  during Siiqqee (women's fight for their right)
   j)  during safuu ( norm)
If there is different mention it_____
_____

25. Is the dissemination/ distribution of IK for conflict resolution in OGS (Gumaa) equally practicing and utilizing by Oromo community in rural and urban area of Oromia zone?

   a)  Yes                              b) No

26. Are the rule and scale of compensation in conflict resolution process for wrongdoing activity for same injury is similarly disseminate in every zone of Oromia?

   a)  Yes                              b) No

27. If answer for Q# '26' is "No" mention it with examples (based on you experience)

_____
_____

28. Do you think that oral communications, teaching and learning process of local elders and Abbaa Gadaa used during conflict resolution is helpful for easily capturing, sharing, preserving and utilizing the IK of Gumaa in OGS?

   a) Yes                    b) No

29.  If your answer for question No '6' 'yes', mention some of the drawback

30. What is your opinion, if IKMF for Gumaa in OGS designed and developed which allows you to easily capture, share, preserve and apply using KM approach and computing technology? (explain it)

_____

_____

**Appendix II: Questionnaire for end user to evaluate the propose framework**

**Instruction**: Please use tick mark the most appropriate option in the box, 1 = Strongly, Agree, 2 = Agree, 3 = Neutral, 4 = Disagree, 5 = Strongly Disagree

| No. | Questionnaires prepared users' acceptance test |
|---|---|
| 1 | Is the proposed IKM framework of Gumaa institution is **attractive** and user friendly in acquiring appropriate Indigenous knowledge? |
| | Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree ☐ |
| 2 | Is the mechanism of capturing and utilizing IK is **simplified** due to IKMF of Gumaa in OGS is designed and developed? |
| | Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree ☐ |
| 3 | Does the proposed framework is **efficiency** in capturing and disseminating IK in terms of response time? |
| | Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree ☐ |
| 4 | Is the designed framework and developed prototype for Gumaa in OGS increase the degree of sharing and **accessibility** of IK for better decision making? |
| | Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree ☐ |
| 5 | Is the developed prototype for selected IK (Gumaa) **portable** for OGS to facilitate the preservation and application? |
| | Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree ☐ |
| 6 | Is the proposed framework and prototype helps as a baseline and improve the **usability** of other IK found in OGS for further utilization and preservation? |
| | Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree ☐ |
| 7 | Is the proposed framework being **functionally** appropriate in knowledge disseminating process of IKM of Gumaa institution in OGS? |
| | Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree ☐ |
| 8 | Is the proposed IKMF for IK of Gumaa is **maintainable** if some additional requirement are needed? |
| | Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree ☐ |

**Appendix III: Manual for Users**

The knowledge management system (KMS) serves as a bottleneck in improving the organization and management of indigenous knowledge in a certain community. However, there are fears that the community will lose sight of its own cultures and norms due to different factors. As a result, it is better if practical demonstration is given to the users and here are some general guidelines that are recommended and briefly described:

➤ End-users who want to use the IKM of Gumaa systems should start by typing "**go**" followed by a full stop "**.**" and then pressing "enter" from the keyboard in the SWI-Prolog window.

➤ As shown in figure 5.2, after "**WELCOME TO IKM OF GUMAA IN OROMO GADAA SYSTEM**", and questions about wrongdoing activity were displayed on the screen, followed by "**?**" Then, users can response by typing "yes/y" or "no/n" followed by a full stop "**.**".

➤ Finally, users can access, share, apply, and preserve IK of Gumaa rules and facts for conflict resolution.