

Research Article

Designing and Implementation of Indigenous Knowledge Management Framework for Gumaa in Oromo Gadaa System (in Case of Siko Mando)

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Abstract

Indigenous knowledge (IK) systems play a vital role in social governance and conflict resolution in many African societies. The Oromo Gadaa System (OGS) represents one of the most established indigenous governance systems in Ethiopia, within which the Gumaa institution serves as a traditional mechanism for conflict resolution and social reconciliation. Despite its continued relevance, Gumaa knowledge remains largely tacit, orally transmitted, and weakly supported by modern knowledge management (KM) practices, posing risks to its preservation and intergenerational transfer. This study aims to design and implement an Indigenous Knowledge Management Framework (IKMF) for Gumaa within the OGS to enhance the acquisition, capture, representation, sharing, utilization, and preservation of this knowledge. A mixed research approach was employed, combining surveys, interviews, focus group discussions, and document analysis among Siko Mando Oromo communities of West Arsi and Bale zones. Quantitative data were analyzed using SPSS, while a rule-based prototype was developed using Prolog to demonstrate the framework's applicability. The proposed IKMF was evaluated using ISO-9126 quality attributes, yielding satisfactory results across usability, functionality, efficiency, and portability. The findings indicate that the proposed framework offers a practical and scalable solution for preserving and managing Gumaa knowledge and contributes to broader efforts in indigenous knowledge digitization and peacebuilding.

Keywords

Indigenous Knowledge, Knowledge Management, Gadaa System, Gumaa, Conflict Resolution

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1. Introduction

1.1. Background of the Study

Knowledge management (KM) provides systematic methods for acquiring, organizing, sharing, and preserving knowledge to support effective decision-making [1]. While KM practices have been widely applied in modern organizations, indigenous knowledge (IK) systems largely tacit, orally transmitted, and community-based remain insufficiently documented and technologically supported [2-4]. As a result, valuable indigenous practices are increasingly vulnerable to loss due to modernization, urbanization, and generational transitions [5].

In Ethiopia, the Oromo Gadaa System (OGS) represents a well-established indigenous governance framework encompassing political administration, social organization, and conflict resolution mechanisms. Recognized for its democratic principles and peaceful power transition, the Gadaa system includes various indigenous institutions that guide social life [6]. Among these institutions, Gumaa serves as a restorative conflict resolution mechanism that emphasizes compensation, reconciliation, and social reintegration rather than punishment. It addresses serious offenses such as homicide, physical injury, and violations of social norms through culturally defined rules and mediation processes led by elders and Gadaa leaders [7, 8].

Despite its continued relevance and effectiveness in maintaining social harmony, knowledge related to Gumaa remains largely undocumented and embedded in the experiences of elders. The absence of structured knowledge management approaches limits systematic acquisition, sharing, and preservation of this indigenous knowledge. Furthermore, the declining number of knowledgeable elders and the lack of technological support pose significant risks to the continuity of Gumaa practices [9, 5].

Applying KM approaches to the indigenous knowledge of Gumaa offers an opportunity to transform tacit knowledge into accessible, reusable, and preservable forms. By integrating appropriate KM models and computing technologies, Gumaa knowledge can be systematically managed, ensuring its sustainability and enhancing its contribution to community-based conflict resolution and peacebuilding.

1.2. Statement of the Problems

Indigenous knowledge institutions within the Oromo Gadaa System play a critical role in maintaining social order and resolving conflicts at the community level [9]. Among these institutions, Gumaa serves as a culturally grounded mechanism for addressing serious offenses through compensation, reconciliation, and social reintegration. Despite its long-standing practice and social importance, the management of Gumaa knowledge remains largely informal and unsupported by systematic knowledge management approaches.

Currently, knowledge related to Gumaa is predominantly tacit and transmitted orally by Abbaa Gadaa, local elders (Jaarsa Biyyaa), and other traditional authorities. This mode of transmission limits consistent knowledge acquisition, documentation, sharing, and preservation. As a result, valuable experiential knowledge is gradually diminishing due to the death of elders, migration, urbanization, and the growing influence of external legal and cultural systems [10].

Moreover, there is a lack of technological tools and structured frameworks to support the capture, organization, and reuse of Gumaa knowledge. Existing practices do not adequately facilitate intergenerational transfer, institutional collaboration, or integration with modern decision-support mechanisms. Consequently, the absence of an Indigenous Knowledge Management Framework constrains the effective utilization and sustainability of Gumaa as a traditional conflict resolution institution [10].

Although previous studies have explored indigenous knowledge management in areas such as agriculture and healthcare, limited research has focused on indigenous conflict resolution systems, particularly Gumaa within the Oromo Gadaa System. This gap highlights the need for a structured, technology-supported knowledge management approach that can systematically manage, preserve, and enhance the application of Gumaa knowledge for present and future generations.

1.3. 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?

1.4. Objectives of the Study

1.4.1. 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.

1.4.2. Specific Objectives

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

- 1) Identify and analyze the current status of Gumaa institutions for conflict resolution in Oromo community.
- 2) Categorize the major types of the wrongdoing activities and its rules that resulted to Gumaa (compensation) with

scale of compensation.

- 3) Investigate the technological barriers that hinder the effective management of IK of traditional conflict resolution practices in the community.
- 4) Investigate and analyze the appropriate KM processes (acquisition, capturing, representing, sharing and utilizing/applying) and models to design and develop IKMF of OGS.
- 5) Design and develop the proposed IKMF and prototype for functional implementation of designed IKMF.
- 6) Evaluate the applicability of the designed IKMF using (ISO- 9126) standard.

1.5. 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:

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

1.6. Scope and Limitation of the Study

1.6.1. 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 clusterly 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.

1.6.2. 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.

1.7. 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.

1.8. 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.

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 the study, 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 relevant information and wisdom that serves as a foundation for estimating and integrating new data and experiences for the development of organization [11], 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].

2.2.2. Knowledge Management (KM)

The concept of Knowledge management (KM) is defined differently by different researchers in different aspects. According to the study, [4,9, 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 the study [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.

(i). 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 1 shows SECI model of Nonaka and Takeuchi.

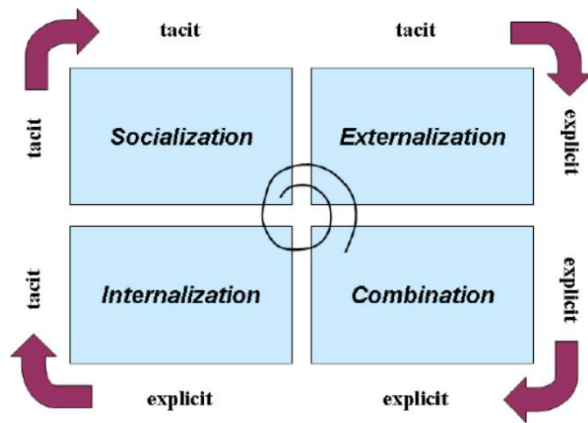


Figure 1. SECI KM Model [16].

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.

(ii). 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]. There-fore, as explained [18], process of transforming one type of knowledge into another is referred to as knowledge management (KM) process.

(iii). Knowledge Acquisition

Knowledge acquisition is a KM process that involves implementing novel/new knowledge or replacing existing content in ex-plicit (codified) and tacit (uncodified) knowledge through creating and discovering innovative information both within and outside of the organizations [18, 19]. 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).

(iv). 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).

(v). 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.

1) 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.

2) 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 [20, 22]. 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.

3) 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 [20, 23]. Therefore, the researchers address this concepts during knowledge representation process.

4) 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 [20, 24]. As a result, researchers use this frame-based knowledge representation during modeling IK of Gumaa namaa (compensation for injured human beings) and its attributes.

5) 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, 26]. 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. 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 KM S 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, 26]. 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.

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 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.

2.2.8. 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, is developed based on a combination of frameworks to identify the factors that improve components level framework through analysis of relevant literature [29].

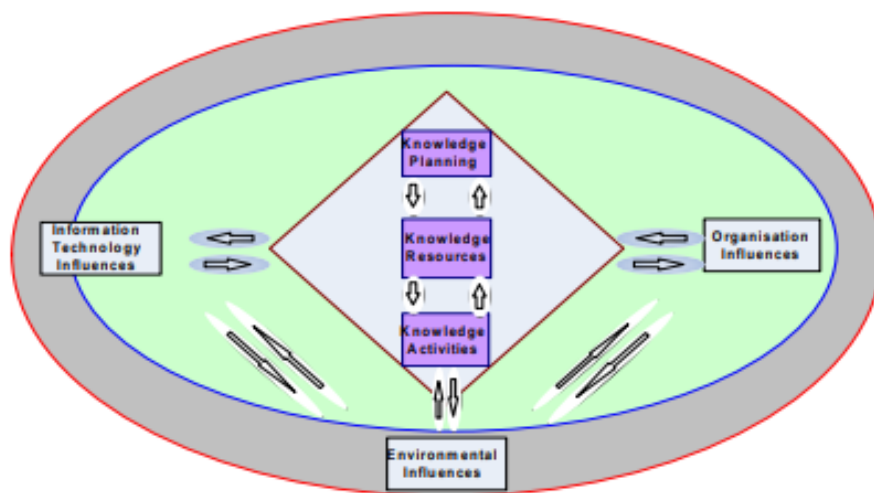


Figure 2. The Overall Knowledge management framework [28].

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.

3. Research Design and Methodology

3.1. Research Design and Approach

This study employed a knowledge engineering research design integrated with a mixed-methods approach to design and implement an Indigenous Knowledge Management Framework (IKMF) for Gumaa within the Oromo Gadaa System. The mixed-methods approach enabled the collection of both qualitative and quantitative data, ensuring a comprehensive understanding of indigenous knowledge practices and technological requirements [32]. Qualitative methods supported in-depth exploration of Gumaa practices, while quantitative methods facilitated empirical analysis of community perceptions and system evaluation.

The knowledge engineering approach was adopted to support systematic knowledge acquisition from domain experts,

knowledge modeling, system development, and validation through prototype implementation [31, 33].

3.2. Study Area and Population

The study was conducted in Siko Mando Oromo communities located in the West Arsi and Bale zones of Oromia Regional State, Ethiopia. These areas were selected due to the active practice of the Gadaa System and the continued use of Gumaa as a traditional conflict resolution institution.

The target population included Abbaa Gadaa, Jaarsa Biyyaa (elders), Haadha Siiqqee, cultural experts, and community members with practical experience in Gumaa practices. These participants were considered key knowledge holders essential for capturing both tacit and explicit indigenous knowledge related to Gumaa [34].

3.3. Data Sources and Data Collection Methods

3.3.1. Primary Data Sources

Primary data were collected using the following techniques:

Semi-structured interviews with elders and Gadaa leaders to elicit tacit knowledge and customary rules.

Questionnaire surveys administered to community members to assess awareness, acceptance, and challenges of Gumaa knowledge management.

Focus group discussions (FGDs) to validate knowledge consistency and capture diverse perspectives.

A total of 422 questionnaires were distributed, of which 385 valid responses were used for analysis, yielding a high response rate suitable for social science research [35,43].

3.3.2. Secondary Data Sources

Secondary data were obtained from scholarly articles, books, policy documents, theses, and reports related to indigenous knowledge, knowledge management, the Oromo Gadaa System, and conflict resolution mechanisms [36].

3.4. Sampling Techniques and Sample Size

Both purposive and random sampling techniques were employed. Purposive sampling was used to select key informants such as Abbaa Gadaa and elders due to their specialized knowledge of Gumaa practices. Simple random sampling was applied to select community respondents for the questionnaire survey to ensure representativeness [37].

The sample size was determined based on population size and research feasibility, ensuring adequate coverage of knowledge holders and community stakeholders.

3.5. Data Analysis Techniques

Quantitative data collected through questionnaires were coded and analyzed using the Statistical Package for Social Sciences (SPSS). Descriptive statistics such as frequencies, percentages, and mean values were used to summarize respondents' perceptions and challenges related to Gumaa knowledge management [38].

Qualitative data from interviews and FGDs were analyzed using thematic analysis, allowing the identification of recurring patterns, concepts, and rules related to Gumaa conflict resolution practices. The extracted knowledge was then structured for use in the framework design and prototype development [39].

3.6. Framework Design and Prototype Development

Based on the analyzed data, an Indigenous Knowledge Management Framework was designed by integrating indigenous knowledge processes with the SECI knowledge conversion model. The framework supports knowledge acquisition, representation, storage, sharing, and preservation [40].

A rule-based prototype was developed using SWI-Prolog to represent Gumaa decision rules and reasoning mechanisms. Prolog was selected due to its suitability for symbolic reasoning and logical rule inference in knowledge-based systems [41].

3.7. System Evaluation

The proposed framework and prototype were evaluated using the ISO-9126 software quality model, focusing on attributes such as functionality, usability, efficiency, maintainability, and portability. Expert evaluations and user feedback were collected to assess the system's effectiveness and practical applicability [42].

Descriptive analysis was used to interpret evaluation results and identify areas for improvement.

3.8. Ethical Considerations

Ethical principles were strictly followed throughout the study. Informed consent was obtained from all participants, and cultural sensitivity was maintained during knowledge acquisition and documentation. The use of indigenous knowledge was guided by respect for community values and intellectual ownership and facts.

4. Data Analysis and Discussion

4.1. Primary Data and Secondary Data Analysis

Both primary and secondary data were collected through questionnaires, interviews, and technical observations. The information gathered from Gadaa leaders, local elders, experts, and community members was triangulated with documentary sources to ensure consistency and validity.

4.2. Indigenous Knowledge Management (IKM) Process

4.2.1. Knowledge Acquisition and Capturing

Knowledge acquisition enabled identification of existing IK related to the Gumaa institution [10, 30]. The study captured key IK elements of the Oromo Gadaa System (OGS), including peacebuilding practices, cultural symbols, social norms, and dispute-resolution structures. These include Shanacha, Bokkuu, Kallacha, Caaccuu, Safuu, marriage systems, Moggaasa, Guddifachaa, Namummaa, Dhibaayyuu, Wayyuu, Waaqeffannaa, Irreecha, Araara, Qaalluu, Siiqqee, Jaarsummaa, and the Gumaa compensation system.

These elements were documented because they directly contribute to mediation, reconciliation, and social harmony.

4.2.2. Knowledge Engineering (KE) and Elicitation

Knowledge engineers mainly Gadaa leaders, elders, and cultural experts supported the extraction of tacit and explicit IK. Tacit knowledge was obtained through interviews, technical observation, and oral narration, whereas explicit knowledge was identified in books, articles, and reports.

The Nonaka SECI model guided conversion of tacit knowledge of Gumaa into explicit structured knowledge.

4.2.3. Knowledge Representation (KR)

The study applied production-rule representation (IF–THEN rules) because Gumaa practices operate through rule-based judgments. Extracted IK was modeled, codified, filtered, evaluated, and stored in a knowledge base. This included classification of wrongdoing categories, injury types, scopes of compensation, and rights and obligations of both parties.

4.2.4. Knowledge Sharing (KS)

The codified IK stored in the knowledge base is shared with knowledge seekers—mainly Oromo youth, community members affected by modernization, and researchers. The prototype system developed with SWI-Prolog provides a user interface enabling access and navigation of Gumaa-related IK.

4.2.5. Knowledge Application (KU)

Knowledge is applied through domain experts (culture and tourism office), knowledge engineers, and users interacting with the KB through an inference engine. The rule-based pro-

tototype enables decision support for conflict resolution scenarios according to the Gadaa system's norms, enabling preservation and utilization of Gumaa knowledge.

4.2.6. Knowledge Preservation (KP)

Documenting and formalizing IK ensures its long-term survival. The knowledge base preserves Gumaa-related rules, norms, values, and procedures for future generations and scholarly use 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 1](#).

Table 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%

Survey results (n=385) indicate that Gumaa (50.64%) and Siiqqee (32.46%) are the most commonly practiced IK institutions for conflict resolution, followed by Jaarsummaa (14.28%) and Qaalluu (3.89%). Gumaa and Siiqqee therefore form the core IK assets supporting peace and justice in OGS.

Table 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%

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	%
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%

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 2](#).

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 existed in OGS as shown in [Table 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 (married 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.

4.3.2. 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 3](#).

Table 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 property)	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 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 Qa-beenyaa (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.

4.3.3. 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 3.

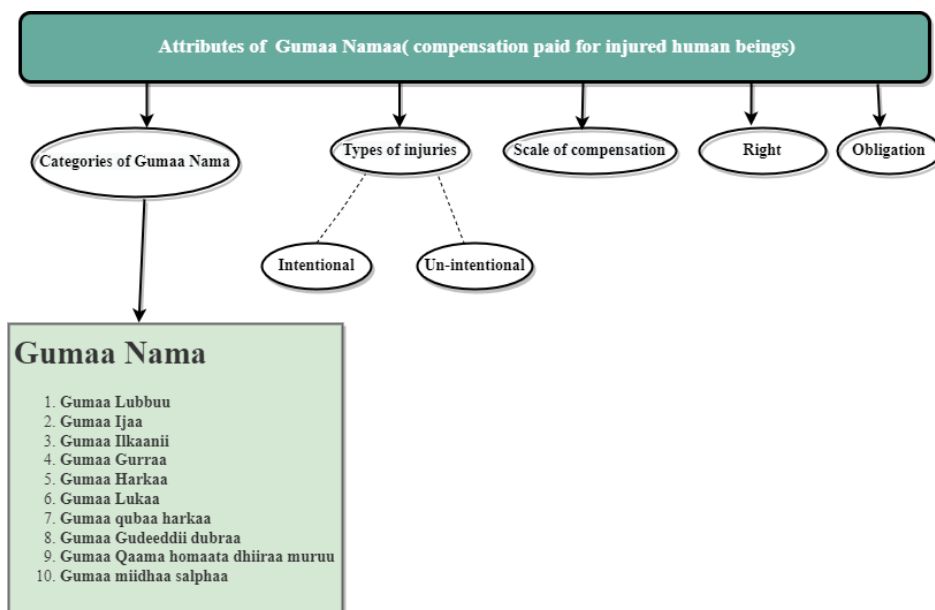


Figure 3. Attributes of Gumaa Namaa (compensation paid for injured human being).

4.3.4. 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 3.

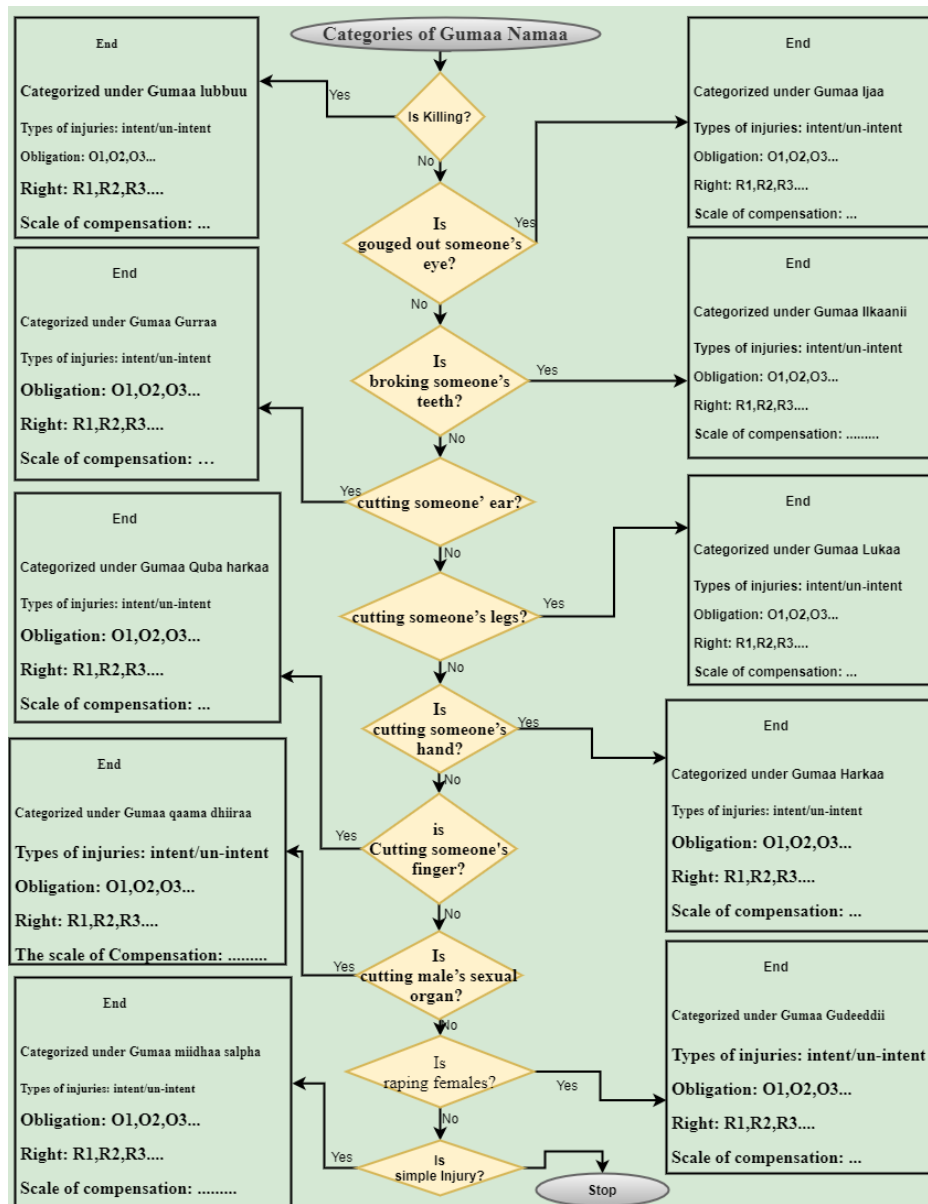


Figure 4. Model for IK of Gumaa Namaa for conflict resolution.

4.3.5. Formalization of Gumaa Namaa for Conflict Resolution in OGS Rule

All Gumaa categories were formalized into IF–THEN rules and encoded using SWI-Prolog. Rules specify the wrongdoing type, injury classification, compensation amount, and obligations of both parties. These formal rules constitute the knowledge base that supports reasoning and decision-making within the prototype system.

5. Presentation of the Proposed IKMF and Prototype

This chapter presents the Indigenous Knowledge Management Framework (IKMF) designed to support acquisition, representation, utilization, and preservation of Gumaa knowledge within the Oromo Gadaa System (OGS). The framework ensures that critical Indigenous Knowledge (IK) of conflict resolution is systematically captured and made accessible for future generations.

5.1. Components of the Proposed IKMF

Knowledge Sources

Knowledge sources are the foundation of the framework. Primary knowledge was obtained from Gadaa leaders, local elders, community members, and cultural experts in the West Arsi Zone through interviews, questionnaires, and observations. Secondary knowledge was gathered from scholarly works. Tacit and explicit knowledge were transformed using the SECI model.

Knowledge Engineers

Knowledge engineers experts and hayyuu of the OGS were responsible for extracting, organizing, modeling, and validating Gumaa knowledge. They ensured that the knowledge was accurately represented in a structured, rule-based format.

Knowledge Acquisition (KA)

KA focused on identifying IK institutions relevant to conflict resolution. This process enabled the discovery and documentation of essential Gumaa practices that contribute to peacebuilding and reconciliation.

Knowledge Capturing (KC)

KC involved organizing acquired IK, converting tacit knowledge into explicit formats, and preparing it for representation. This included arranging rules, norms, compensation procedures, and roles of actors in the Gumaa system.

Knowledge Representation (KR)

KR formalized the captured IK using production rules (IF-THEN). This technique effectively models wrongdoing categories, types of injuries, compensation scales, and rights and obligations of the concerned parties in the Gumaa process.

Knowledge Base (KB)

The KB houses all formalized Gumaa knowledge, including rules, facts, procedures, and categories of wrongdoing. It serves as a central repository for accessing, sharing, and preserving Indigenous justice knowledge.

Knowledge Sharing (KS)

KS allows dissemination of stored IK through queries that enable users to retrieve, explore, and apply Gumaa knowledge. This process connects knowledge seekers to the KB through a user interface.

Inference Engine (IE)

The IE applies logical reasoning using production rules to interpret user queries and retrieve relevant Gumaa information from the KB.

User Interface (UI)

The UI enables communication with the system. It provides a platform where users can query, navigate, and view Gumaa knowledge in a simple and interactive manner.

End Users (EU)

End users include community members, researchers, policymakers, and others seeking IK for social, cultural, or legal applications. The system preserves and transmits IK to support decision-making and cultural continuity.

Knowledge Utilization (KU)

KU ensures that extracted and stored IK is applied in real-

life contexts to support reconciliation, conflict resolution, and cultural preservation. It also covers long-term safeguarding of Gumaa knowledge for future generations.

5.2. Prototype Development for the IKMF

A prototype of the IKMF was developed to test its functionality and practical application. Using SWI-Prolog, the system models Gumaa Namaa the most critical form of IK within the Gumaa system.

The prototype demonstrates how users can interact with the knowledge base, how rules function, and how knowledge is retrieved to support decision-making in conflict scenarios.

5.3. User Interface for the Prototype

The user interface connects users to the KB through the inference engine. Implemented using SWI-Prolog (v8.4.0), it allows users to begin by typing: start.

Upon activation, the system displays:

“WELCOME TO IKM OF GUMAA IN OROMO GADAA SYSTEM”

The interface then presents Yes/No questions to determine the type of wrongdoing and returns the corresponding Gumaa rule, compensation scale, and obligations stored in the KB. The UI is designed to be simple, accessible, and culturally appropriate.

6. Discussion, Conclusion, and Recommendations

6.1. Results and Discussion

The findings of this study reveal that the management of Gumaa knowledge within the Oromo Gadaa System is predominantly informal and heavily dependent on tacit knowledge held by elders and traditional leaders. Quantitative results from the questionnaire survey indicate that a significant proportion of respondents acknowledged the effectiveness of Gumaa in resolving serious conflicts; however, they also confirmed the absence of structured documentation, technological support, and systematic preservation mechanisms [44].

Descriptive analysis shows that knowledge acquisition and sharing mainly occur through oral transmission, observation, and participation in conflict resolution processes. While this approach maintains cultural authenticity, it limits consistency, accessibility, and long-term preservation. These findings align with previous studies that highlight the vulnerability of indigenous knowledge systems when they are not supported by formal knowledge management practices [45, 46].

Qualitative findings from interviews and focus group discussions further revealed that elders possess extensive experi-

ential knowledge related to Gumaa rules, procedures, compensation mechanisms, and reconciliation rituals. However, this knowledge is not uniformly applied across communities, leading to variations in decision-making and outcomes. This inconsistency underscores the need for structured knowledge representation and reuse mechanisms [47].

Based on these findings, an Indigenous Knowledge Management Framework (IKMF) was designed by integrating indigenous knowledge processes with the SECI knowledge conversion model. The framework facilitates systematic knowledge acquisition from elders, externalization of tacit knowledge into explicit forms, and preservation through digital repositories. The proposed framework responds directly to the identified gaps in documentation, consistency, and sustainability [48].

The rule-based prototype implemented using Prolog successfully modeled Gumaa decision rules and reasoning logic. The prototype demonstrated the feasibility of representing indigenous conflict resolution knowledge using computational techniques without replacing the authority of traditional institutions. This supports earlier arguments that technology can complement, rather than undermine, indigenous governance structures [49].

Evaluation results based on the ISO-9126 quality model indicate that the system achieved satisfactory performance across key attributes. Usability and functionality received relatively higher scores, suggesting that users found the system understandable and relevant to Gumaa practices. Moderate scores in maintainability and efficiency indicate areas for future technical improvement but do not undermine the overall applicability of the framework [50].

Overall, the results confirm that applying knowledge management principles and appropriate technologies can significantly enhance the preservation, accessibility, and consistency of Gumaa knowledge while respecting its cultural foundations.

6.2. Conclusion

This study set out to design and implement an Indigenous Knowledge Management Framework for Gumaa within the Oromo Gadaa System. The findings demonstrate that Gumaa remains a highly effective and socially legitimate conflict resolution mechanism; however, its reliance on tacit and orally transmitted knowledge poses significant risks to sustainability and intergenerational transfer.

By applying knowledge management concepts, particularly the SECI model, this research successfully transformed core elements of Gumaa knowledge into structured, reusable, and preservable forms. The implementation of a rule-based prototype further demonstrated the practical applicability of the proposed framework in modeling indigenous decision-making processes.

The study contributes to both theory and practice by extending the application of knowledge management to indigenous conflict resolution systems an area that has received limited scholarly attention. It also provides a practical foundation for

integrating indigenous knowledge with modern information technologies in culturally sensitive ways.

6.3. 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:

- 1) 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.
- 2) 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).

Abbreviations

AI	Artificial Intelligence
EU	End Users
FGD	Focus Group Discussion
ICTs	Information and Communication Technologies
IE	Inference Engine
IK	Indigenous Knowledge
IKM	Indigenous Knowledge Management
IKMF	Indigenous Knowledge Management Framework
KA	Knowledge Acquisition
KB	Knowledge Bases
KC	Knowledge Capturing
KM	Knowledge Management
KMF	Knowledge Management Framework
KMS	Knowledge Management System
KBS	Knowledge-Based System
KR	Knowledge Representation
KS	Knowledge Sharing
KU	Knowledge Utilization
KP	Knowledge Preservation
OGS	Oromo Gadaa System
SECI	Socialization, Externalization, Combination, Internalization
SPSS	Statistical Package for the Social Sciences
SWI-Prolog	SWI Programming in Logic
UI	User Interface
ISO-9126	International Organization for Standardization Software Quality Model 9126

Conflicts of Interest

The authors declare that there are no financial, commercial, or personal relationships that could be perceived as potential conflicts of interest in relation to this research. This study was conducted independently for academic and research purposes, and no external organization or institution influenced the design, data collection, analysis, interpretation of results, or the decision to publish the findings.

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