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Research Article

Iraqw Consonantal Phonological Processes at Dareda Ward in Manyara Region, Tanzania

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Abstract

Iraqw is a Southern Cushitic language spoken in northern Tanzania. Previous studies have described some aspects of Iraqw phonology, but more information is needed about the consonantal changes that occur in the language and the conditions under which they take place. This study examined lexical consonantal phonological processes in Iraqw, with the aim of identifying the processes, describing their conditioning environments, and explaining how they operate at the lexical level. The study used a qualitative design to analyse Iraqw consonantal phonological processes. Data were collected through elicitation, documentary sources, and focus group discussions with twelve native Iraqw speakers aged 50-80 from Loto and Bermi villages in Dareda Ward, Babati Rural District, Manyara Region, Tanzania. The analysis was guided by Lexical Phonology and Distinctive Feature Theory. The data were analysed by examining consonant changes and the linguistic environments in which they occur. Phonological rules were then formulated using the underlying representation (UR), lexical representation (LR), and phonetic representation (PR) model. The rules followed the format A → B / C __ D. The findings identified four (4) lexical consonantal phonological processes in Iraqw: consonant deletion, voicing, fortition, and glide formation. The processes occur in different phonological and morphological environments. For example, voicing occurs in plural formation, where the voiceless consonant /t/ changes to the voiced consonant [d]. These findings show that consonant changes in Iraqw follow identifiable patterns that can be explained through phonological rules. The study concludes that the identified processes help explain how consonants behave in different linguistic environments in Iraqw. It recommends that the findings be used in preparing Iraqw language teaching materials, dictionaries, and orthographic guidelines. It also calls for greater government and institutional support for documenting indigenous languages, promoting their use in education, and preserving them for future generations.

Keywords

Iraqw, Consonantal Phonological Processes, Lexical Phonology, Segmental Phonology

1. Introduction

This study focuses on consonantal phonological processes at the lexical level in Iraqw. It introduces the Iraqw language and provides the background to the study, explains the research problem, and presents the study objectives. It also discusses the significance and scope of the study and the theories used to analyse the consonantal processes in Iraqw.

1.1. Linguistic Overview

This chapter presents the introduction to the study, covering

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the linguistic profile of Iraqw, background, statement of the problem, objectives, significance, scope, theoretical framework.

Iraqw is a Southern Cushitic language spoken in northern Tanzania, primarily on the plateau between Lake Manyara and Lake Eyasi. It is the largest Southern Cushitic language, with approximately one million native speakers. The language operates in a multilingual context, interacting with Datooga, Hadza, Gorwaa, Maasai, and Bantu languages, with Kiswahili increasingly influencing Iraqw through loanwords. Iraqw is classified within the Cushitic branch of the Afro-Asiatic language family, specifically under Southern Cushitic, grouped with Gorowa, Alagwa, and Burunge in the Rift languages.

Typologically, Iraqw exhibits Subject-Object-Verb (SOV) word order, distinguishing it from neighbouring Bantu languages. It has rich inflectional morphology, with nouns displaying a three-way gender distinction (masculine, feminine, plural) determined through agreement rather than number. Verbs adopt gender-specific forms, with suffixes marking case, gender, number, and tense-aspect distinctions. These suffixes often serve as sites for phonological processes at morpheme boundaries.

The Iraqw phoneme inventory comprises 33 consonants spanning nine places of articulation, including distinctive lateral obstruents /ɬ, tɬ'/, pharyngeal fricatives /ħ, ʕ/, uvular consonants /q, qw/, and labialised velar and uvular consonants /kw, ɠw, ŋw, qw, xw/. Palatal consonants occur mainly in loanwords from Datooga and Kiswahili. The vowel system consists of ten vowel phonemes: five short /i, e, a, o, u/ and five long /iː, eː, aː, oː, uː/, with vowel length distinguishing meaning. This phoneme inventory provides the foundation for analysing consonantal phonological processes examined in this study.

1.2. Background of the Study

Consonants are one of the fundamental aspects of segmental phonology, which examines discrete sound segments as the building blocks of spoken language. Segmental phonology encompasses phoneme inventories, distinctive features, syllable structure, and phonological processes,
particularly those affecting consonants. The field has been shaped by numerous linguists including such as [7, 10, 13, 20, 27-29, 37], and [41, 66] laid the foundation by defining phonemes as bundles of oppositions, exemplified by contrasts such as /p/ versus /b/. [10] advanced the field through generative phonology, modelling phonemes as binary feature matrices that map underlying forms to surface realizations. [29] introduced distinctive features, later refined by [13], to explain natural sound classes such as [+nasal] consonants.

Segment inventories serve as the raw material for language, revealing a tension between universal principles and cultural variation. [58] provided the earliest classification of these units in Sanskrit, a principle that remains central to phonological analysis today. Across the globe, inventories vary widely; [42] noted the expansion of Indo-European languages through complex clusters and the massive 80-consonant systems of Khoisan languages. Within the Cushitic family, [15, 16] and [60] reconstructed a complex Proto-Cushitic inventory of 30 consonants. Building on this lineage, [50] provided the specific description of Iraqw consonant inventories that served as the basis for this study.

Consonantal processes, as identified by [57], include assimilation, deletion, metathesis, and lenition, and are widely attested across languages. Assimilation in English is observed when /n/ changes to [m], as in input → [ɪmpʊt]; in Hindi, nasals assimilate to the place of articulation of following stops [27]. Deletion occurs in Philippine English, where /t/ is omitted in internet → [ˈɪnərnɛt] [6], and in non-rhotic English dialects, where /r/ is dropped, as in car → [kaː]. Metathesis is documented in Bhili and Gondi, where sounds are reordered [40]. Lenition weakens consonants, as in Spanish, where /d/ becomes [ð] between vowels, cada → [ka ða]. Within Southern Cushitic, [50] and [36] identified diagnostic shifts such as sibilants transforming into lateral fricatives, and [24] observed ongoing lenition in West Rift languages.

Distinctive features demonstrate that segments are bundles of traits rather than indivisible sounds, enabling phonological change. [30] introduced universal contrasts such as [±voice], and [66] applied these oppositions to Slavic and German systems. [10] advanced the binary framework in English, formalising rules as feature changes like [±nasal] and demonstrating their generalisation across natural classes. In this study, distinctive features were employed as an analytical tool to formulate phonological rules in the format A → B / C __ D, where A represents the input segment, B the output, and C __ D the conditioning environment.

Features such as [±voice, ±nasal, ±coronal], and [±continuant] were used to group sounds into natural classes and formulate rules that account for consonantal processes in Iraqw. These studies explain why rules target classes of sounds: assimilation spreads feature as in English /n/ → [m] [27]; neutralisation removes contrasts in German final devoicing [66]. In Cushitic languages, [46] emphasised the complexity of consonantal features in Alagwaisa.

Several studies have examined different aspects of Iraqw. [68] offered a concise description of item categories in the language, supplemented with comparative data from Gorowa, Alagwa, and Burunge. [54] and [50] produced comprehensive grammatical analyses focusing mainly on morphology and syntax. [44] established a foundational Iraqw lexicon, then [45] examined interrogative intonation as part of the language's broader prosodic structure. [5] compiled corpus-based Iraqw texts, while [53] developed the Iraqw-English Dictionary, strengthening lexical documentation. More recently, [3] examined the Iraqw noun phrase from a syntactic and sociolinguistic perspective, and [4] analysed kinship terms and language contact with Kiswahili.

1.3. Statement of the Problem

Despite these contributions, the phonological processes involving consonants have not yet been described systematically. The absence of uniformity in consonant processes across the languages studied heightened the researcher's interest. Consequently, there was a particular curiosity about the situation in Iraqw, a curiosity further reinforced by the limited availability of comprehensive literature on the consonant phonology of this language. For Iraqw, it remains unclear how such consonant processes are realised. This study investigated the Iraqw segmental phonology to describe phonological processes involving consonants in Iraqw.

1.4. Objectives of the Study

1.4.1. General Objective

To analyse the consonantal phonological processes in Iraqw.

1.4.2. Specific Objectives

To analyse the consonantal phonological processes that occur at lexical level in Iraqw.

1.5. Significance and Scope of the Study

This study held importance for both practical and theoretical reasons. On a practical level, the data contributed to expanding knowledge of segmental phonology, an area that often presents challenges due to linguistic diversity. It showed how consonant phonological processes work in Iraqw and provided useful information for other linguists who wish to study Cushitic languages or compare them with languages from other families. The study also added new data that future researchers can use when looking at consonantal processes. Theoretically, the study applied Lexical Phonology to Iraqw. It revealed how phonological rules operate at different levels of grammar and how they interact with morphology. This helped other researchers use the same theory in their own studies of different languages. Finally, the study also preserved the Iraqw language by documenting its consonant phonology. The results are available for Iraqw speakers, learners, and linguists, making the language more accessible and supporting both research and community preservation.

This study examined the segmental phonology of Iraqw, a Southern Cushitic language spoken in northern Tanzania. The focus was on lexical phonological processes affecting consonants, covering both Stratum 1 and Stratum 2 lexical rules. Post-lexical processes, which apply across word boundaries in connected speech, were deliberately excluded from the scope of this study. Similarly, vowel processes and suprasegmental features such as tone, stress, and syllable structure were also excluded. This decision maintained a sharp focus on lexical consonant phonological processes. Iraqw shows no significant dialectal variation, so data gathered from the selected sites can reasonably represent the language as a whole. Fieldwork was carried out in the Manyara Region, specifically in Babati Rural District, in the villages of Loto and Bermi within Dareda Ward. Participants were selected using convenience sampling to identify fluent native speakers who are well-placed to provide reliable phonological data. The research was conducted from August 2025 to October 2026, allowing enough time for data collection, recording, transcription, detailed analysis, and proper documentation.

1.6. Theoretical Framework

This study employs two theoretical approaches: Lexical Phonology and Distinctive Features Theory. Lexical Phonology, developed by [37] and further developed by [49]. It explains the interaction between morphology and phonology through strata, rule ordering, and affix behaviour. It also distinguishes between lexical and post-lexical processes.

Distinctive Features Theory, associated with [29] and later developed by [32] and [10]. It represents sounds as bundles of phonological features and provides a precise way of formulating phonological rules. This is particularly important in the present study because some Iraqw processes are better expressed through feature changes than through ordinary phonemic notation. Together, they provide an appropriate basis for analysing the consonant, vowel, and post-lexical processes identified in Iraqw.

1.6.1. Lexical Phonology

Lexical Phonology, developed by [37] and [48], explains how morphology and phonology interact through ordered levels or strata. It distinguishes between lexical rules, which apply within words, and post-lexical rules, which may apply across word boundaries [14], and [49]. The framework assumes that phonological rules apply in a particular order, with derivational processes generally preceding inflectional processes [38], and [62]. This can be represented as Root → Stratum 1 → Stratum 2. For example, *heal* → *health* → *healthy* and *nation* → *national* → *nationality* show successive stages of word formation. Lexical Phonology also distinguishes Underlying Representation (UR), Lexical Representation (LR), and Phonetic Representation (PR) to trace changes from the underlying form to the surface form [21, 49]. In this study, the framework is used to establish the ordering, domain, and morphological conditioning of Iraqw consonant, vowel, and post-lexical processes.

Application of Lexical Phonology

Lexical Phonology has been widely applied in segmental phonology to account for rule interaction across grammatical levels, bridging morphology and phonology through rule ordering, cyclic application, and the lexical/post-lexical distinction. [21] applied it to English, [8] to Dutch and Polish, and [64] to Benadiri Somali. Key concepts include the Bracket Erasure Convention [14], the Principle of Neutral and Non-neutral Affixes [35], and multi-stratal word formation [39] and [48]. The current study applies this framework to Iraqw,

distinguishing lexical from post-lexical processes and formalising rules with distinctive features, thereby contributing to the documentation of under-described Cushitic phonology.

Lexical Phonology effectively captures the interaction between phonological rules and morphological structure in Iraqw through distinct levels of representation UR → LR → PR. At Stratum 1. At the lexical level, final consonant deletion occurs in adjectival forms such as */daqatła:kw/* → *[daqatła:]* 'weak', where the final */kw/* is deleted. This stratification, clearly separates morphologically conditioned lexical rules (Stratum 1 and 2) from automatic phonetic adjustments at the phrasal level, providing a principled framework for analysing Iraqw phonological processes.

1.6.2. Distinctive Features Theory

Distinctive Features Theory was first formulated by [29]. It was later developed [10, 31, 32] further developed the theory within Generative Phonology. The theory views phonological segments as bundles of distinctive features. These features distinguish one sound from another. They also help to identify natural classes and formulate phonological rules. Features are commonly expressed using binary values such as [±voice, ±nasal] and [±continuant]. [67] applied this approach to phonological processes in Kikuyu. Their study examined processes such as assimilation, glide formation, strengthening, insertion and deletion.

In this study, distinctive features theory explains what changes in the affected sounds. It is useful because it represents Iraqw segments through their phonological features and allows rules to be stated precisely. It also helps identify natural classes and the features shared by sounds undergoing the same process. For example, the change /t/ → [d] can be expressed as [-voice] → [+voice]. Therefore, the theory provides a clear basis for analysing and formulating rules for the consonant processes identified in Iraqw.

Therefore, Lexical Phonology and Distinctive Feature Theory complement each other in analysing Iraqw phonological processes. Lexical Phonology explains where and when processes apply through morphological levels and rule ordering. Distinctive Feature Theory explains what changes in the segments by identifying the features involved in each process. Together, the theories provide a framework for explaining both the application and nature of phonological changes in Iraqw.

2. Literature Review

The Consonantal phonological processes that occur at lexical level in other Languages. Consonantal phonological processes refer to the changes that consonants undergo in particular phonological environments. They may involve processes such as assimilation, deletion, insertion, and other modifications that alter the phonological form of an utterance. Previous studies show that these processes occur in different language families, although their forms and conditioning environments vary. The discussion below presents each process by first explaining its meaning and then reviewing relevant studies and their implications for the analysis of Iraqw.

Assimilation is a phonological process in which one sound becomes more similar to another sound, usually a neighbouring segment, by acquiring one or more of its phonological features. The change may involve features such as place of articulation, manner, voicing, or nasality. Assimilation commonly occurs when sounds come into contact within a word or across a morphological boundary. [27] treats assimilation as a general phonological process in which a segment takes on properties of another segment.

Studies by [19, 23, 25, 26, 34, 51, 52, 57], and [11] provide evidence of assimilatory patterns in different languages. [57], for example, discusses assimilation in Malay and Cairo Arabic. In Malay, the nasal consonant of a prefix varies according to the consonant that begins the following stem. In Cairo Arabic, the consonant of the definite article may assimilate to a following coronal consonant. These examples illustrate how the features of one consonant can influence the realisation of another. Examples in Tables 1, 2 and 3 show assimilation in Kalenjin in Kenya, Malay, and Cairo Arabic:

Table 1. *Assimilation in Kalenjin.*

1a */kep/* 'to notch'	*[kebe:t]* 'is notching'
b*./nap/* 'to sew'	*[nabe:t*] 'is sewing'
c. /luk/ 'to fight'	*[luge:t]* 'is fighting'
d. */ku:t/* 'to blow'	*[ku:te:t]* 'is blowing'

Source: Pandey (2014, p.89).

In Kalenjin, nasal consonants shift their place of articulation to match following consonants. The data show consonant alternation when verb stems combine with the following suffix. The final consonant of the stem changes in some forms, as /p/ becomes [b] in *kep* → *kebe* and /nap → nabe, while /k/ becomes [g] in *luk* → *luge*. However, /t/ remains unchanged in *ku* → *ku: te*. The examples therefore show that the phono-

logical change is conditioned by the morphological environment created by the suffix. Still, the change does not affect all final consonants in the same way.

Table 2. *Nasal Place Assimilation.*

2a baca	'read'	pəm-baca	'reader'
b. beli	'buy'	pəm-beli	'buyer'
c. cakap	'speak'	pən-cakap	'speaker'

Source: Pandey (2014, p. 90)

In Malay, Examples 2a-c in Table 2 show nasal place assimilation in the formation of agent nouns. In Example 2a, *baca* 'read' becomes *pəm-baca* 'reader', while in Example 2b, *beli* 'buy' becomes *pəm-beli* 'buyer'. In Example 2c, in Table 3 *cakap* 'speak' becomes *pən-cakap* 'speaker'. These examples show that the form of the prefix is influenced by the consonant that follows it. The change occurs when the prefix is attached to the stem, showing the interaction between phonology and morphological word formation.

Table 3. *Cairo Arabic Assimilation.*

3a. il + dars 'lesson' → iddars 'the lesson'

b. il- + šams 'sun' → iššams 'the sun'

c. il- + nās 'people' → innās 'the people'

Source: Pandey (2014, p. 92)

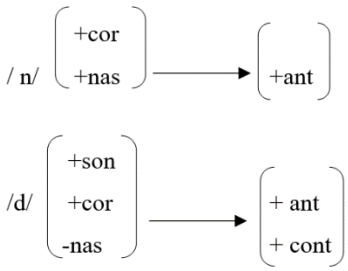
In Cairo Arabic, the definite article il- assimilates to coronal consonants, producing gemination. In (3a), the lateral /l/ assimilates to alveolar /d/, yielding [dd]. In (3b), it assimilates to palato-alveolar /š/, yielding [šš]. In (3c), it assimilates to nasal /n/, yielding [nn].

Across Kalenjin, Malay, and Cairo Arabic, Examples 1, 2, and 3 revealed how assimilation functioned as a natural phonological process that aligned adjacent sounds for ease of articulation. These assimilations provided the researcher with a framework for describing phonological processes involving consonants in Iraqw.

Consonantal relationships in Sumbwa are examined from a distinctive-feature perspective in [34], showing how shared phonological features can account for consonantal alternations. [19] also discusses consonantal assimilation in African languages, while [23]' [25] describe consonantal alternations in Gorwaa. [51] and [52] provides relevant discussion from the Cushitic context, and [26] examines consonantal alternations, including palatalisation, in Bantu. [11] further shows that nasal-prefix constructions in Bantu can involve several types of consonantal alternation, including voicing, denasalisation, deaspiration, and deaffrication. Example no 4 shows assimilation patterns defined by shared features.

Assimilation Patterns Defined by Shared Features

4.



Source: Kahigi (1988, p. 67).

Figure 1. *Assimilation process.*

Assimilation could be explained through the distinctive features of /n/ and /d/. Both shared [+coronal] and [+anterior], placing them in the same natural class of coronal consonants. When /d/ occurs next to /n/, the [+nasal] feature of /n/ spreads to /d/, changing it into [n]. The consulted literature on distinctive features provides frame work for conducting the current study on Iraqw consonantal processes.

Deletion involves the loss of a segment from a phonological representation. The deleted segment may be a consonant or a vowel, and its loss may be conditioned by the phonological environment, morphological structure, or the interaction of neighbouring segments. [27] describes deletion as a general

phonological process in which a segment is omitted under particular structural conditions.

Studies by [6, 27, 63, 65], and [59] provide examples of deletion in different languages. [6] report consonant deletion in varieties of English. [63] identifies elision among the phonological processes associated with verb conjugation in Bantu languages, showing that deletion may be connected with morphological formation. [59] discusses the phonological adaptation of Swahili loanwords in Nyakyusa and notes that deletion can form part of the changes that occur when borrowed words are incorporated into the language. From a Cushitic perspective, [65] identifies deletion together with insertion, devoicing, spirantisation, assimilation, and metathesis in Kussummiya.

Insertion, commonly referred to as epenthesis, occurs when a segment that is absent from the underlying representation is introduced into a word or phonological form. It may be motivated by phonotactic restrictions, syllable structure, morphological requirements, or the adaptation of borrowed forms. [27] treats insertion as a general phonological process through which an additional segment is introduced to satisfy particular structural conditions.

Studies by [47, 43], and [65] illustrate different functions of insertion. [47] examine vowel insertion in Malay consonant clusters produced by native speakers of Kashmiri. Their findings show that a vowel may be inserted between consonants when the original cluster does not fit the phonotactic structure of the receiving language. [43] similarly discuss epenthesis in the rephonologisation of English loanwords in Kinshasa Lingala. In their analysis, vowel insertion helps borrowed forms conform to the phonological structure of Lingala. [65] also identifies insertion among the phonological processes found in Kussummiya.

Voicing refers to the acquisition of vocal-fold vibration by a consonant, particularly when a voiceless consonant becomes voiced. Devoicing is the opposite process, in which a voiced consonant loses or reduces vocal-fold vibration. [27] discusses voicing and related consonantal changes as processes that may be conditioned by the surrounding phonological environment or by the position of a segment within a word.

Voicing and devoicing in Bantu nasal-prefix constructions are discussed in [11] alongside other consonantal alternations, including denasalisation, deaspiration, and deaffrication. The study shows that consonants associated with nasal prefixes may undergo changes in their phonological properties. [33], in their study of French, examine word-final obstruents and show that the development of final devoicing can be gradual, with phonetic changes appearing before complete neutralisation of the voicing contrast.

Fortition refers to the strengthening of a consonant, whereas lenition refers to its weakening. Strengthening may involve greater articulatory constriction or movement towards a stronger consonantal type, while weakening generally involves reduced constriction. [27] and [42] discuss these processes as part of the broader range of consonantal changes found across languages. [2] similarly describes fortition in terms of strengthening and movement towards a stronger position in the sonority hierarchy.

Several studies illustrate different types of strengthening and weakening. [25] describe consonantal weakening in Gorwaa, particularly in intervocalic environments, where consonants may become less strongly articulated. [9] discusses the relationship between prosodic strength and phonological patterns in the same language. These studies indicate that fortition and lenition may be conditioned by prosodic position, surrounding segments, or morphological structure.

Consonant copying involves the repetition of a consonant in another position within a word or phonological domain. It may occur as part of reduplication or as an independent phonological strategy. Reduplication more broadly involves copying part or all of a linguistic form and may serve grammatical or lexical functions. [27] treats copying and reduplication as processes in which phonological material is repeated to produce a new form.

Reduplication and phonological copying in the Lukisa dialect are discussed in [56], which shows that copying may involve changes in vowel length, vowel quality, and syllable structure. The copied material therefore does not necessarily reproduce the original form without modification. The process can provide an onset to a following vowel-initial word, showing that consonant copying may also serve a prosodic function.

Glide formation occurs when a vowel, particularly a high vowel, is realised as a glide in a particular phonological environment. The process commonly occurs when two vowels come together. Instead of maintaining two full vowel nuclei, one of the vowels may become a glide, allowing the sequence to be realised more smoothly. [27] discusses such changes as part of the interaction between vowels and neighbouring segments.

The relationship between glide formation and vowel elision in Edoid languages is examined in [17]. The study distinguishes the two processes and shows that a high vowel may become a glide rather than being deleted when vowels occur in sequence. [12] similarly examines vowel hiatus in English word formation and shows that high vowels may be realised as glides in particular environments. [64] provides a Cushitic example from Benadiri Somali, where a glide is inserted between a stem-final /i/ and a plural suffix beginning with /o/. Example 5 in Table 4 shows the glide Insertion in Benadiri.

Table 4. *Glide Insertion.*

Noun base	Noun + sfx	LR	PR	Gloss
5a. /ˊðɔ:li/	/ˊðɔ:li/ + /ɔ/	/ðɔ:liɔ/	[ðɔ:lɪˊjɔ]	mice
b. /ˊga:ri/	/ˊga:ri/ + /ɔ/	/ga:riɔ/	[ga:rɪˊjɔ]	cars

Source: Sulub (2020, p.48).

In Benadiri, glide insertion resolves hiatus when the plural suffix /ɔ/ attaches to noun bases ending in /i/. In (6a), */ˊðɔ:li/* 'mouse' + */ɔ/ → /ðɔ:liɔ/ → [ðɔ:lɪˊjɔ],* where /j/ is inserted between /i/ and /ɔ/ with vowel raising to [ɪ]. The same pattern occurs in (6b): */ˊga:ri/* 'car' + */ɔ/ → [ga:rɪˊjɔ]*. However, [64] does not explain why /j/ is inserted rather than another glide, why insertion occurs in some contexts, or whether the process is lexical or post-lexical.

Palatalisation is a process in which a consonant acquires palatal or palatal-like properties, often under the influence of a neighbouring sound such as a high front vowel. [27] discusses palatalisation in languages such as Russian, where consonants may undergo changes before front vowels. [26] reports palatalisation among consonantal alternations in Bantu languages.

Example 6 Palatalisation in Russian:

a. ruka → ruč-i 'hand'

b. noga → nož-i 'foot'

c. muxa → muš-i 'fly'

Source: Hyman (1975, p. 91)

In Russian, velar stops /k, g, x/ palatalise to [tʃ, ʒ, ʃ] respectively before the front vowel /i/ in locative case forms.

Metathesis differs from palatalisation because it involves a change in the linear order of segments. [1] discusses metathesis in languages including C'lela, Elmolo, Sidamo, and Fur, showing that segments may change their positions within a word and that the process may occur alongside morphological operations such as prefixation or suffixation. Example 7 shows metathesis in Various Languages:

7. In C'lela, adjacent CV metathesis occurs in plural formation with the suffix [-nV].

a. */sàr-nV/ → [sàr nà]* 'tsetse flies'.
b. In Elmolo, metathesis occurs with the plural suffix /-o/.
tikir → tirko 'catfish'.
c. In Sidamo, metathesis occurs before suffixes with initial sonorant /-n/.
gud-nonni → gundonni 'they finished'.
d. Fur the metathesis triggered by prefixation with k- 'we'.
k-ba- → kab- 'we drink'.

Source: Aliero (2015, p.7)

Metathesis across several languages was surveyed in [1], but the study did not include Iraqw or other Southern Cushitic languages, nor did it explain its conditioning in different morphological environments. Previous studies also relied mainly on descriptive analysis and did not use Lexical Phonology to distinguish lexical from post-lexical processes or account for rule ordering. The present study addresses these gaps by applying Lexical Phonology to the analysis of phonological processes in Iraqw and their conditioning environments.

The reviewed literature shows that consonantal phonological processes occur across a wide range of languages, but their conditioning environments are not uniform. Assimilation is commonly associated with the influence of neighbouring segments, while deletion and insertion may be conditioned by phonological structure, morphology, or loanword adaptation. Voicing and devoicing involve changes in laryngeal features, whereas fortition and lenition involve changes in consonantal strength. Copying, glide formation, palatalisation, and metathesis likewise operate under different phonological and morphological conditions.

The previous studies also shows that Bantu languages have received considerable attention in studies of consonantal processes. Studies such as those by [11, 26, 63], and [67] provide useful evidence from this group. Cushitic studies are fewer, although [65] on Kussummiya and [64] on Benadiri Somali provide relevant comparative material. [50, 52] is particularly important for the description of Iraqw itself, providing a foundation for understanding its grammatical and phonological structure.

Despite this body of studies, the available literature does not provide a detailed integrated account of the lexical consonantal processes examined in the present Iraqw data. In particular, the relationship between these processes, their morphological conditioning, their position within lexical strata, and their or-

dering requires further examination. The present study addresses these aspects by analysing Iraqw consonantal processes within a Lexical Phonology and Distinctive Feature Theory framework. This makes it possible to describe the processes identified in the language while also accounting for the stage at which they occur and the phonological features involved in the resulting changes.

3. Methodology

This study employed a qualitative research approach to investigate consonantal phonological processes in Iraqw as they naturally occur in everyday speech. The qualitative approach was selected because it allowed for an in-depth exploration of phonological patterns and variations through participants' explanations and contextualised speech data.

This study adopted an ethnographic descriptive design, which enabled the researcher to investigate Iraqw consonantal phonology in its natural speech environment. The design facilitated the collection of authentic linguistic data from everyday conversations, storytelling, narration, songs, and written texts, ensuring that consonantal processes were observed as they naturally occur rather than under experimental conditions. As a native speaker, the researcher spent two months within the Iraqw-speaking community, documenting naturally occurring conversations from which consonantal phonological processes were analysed.

The study was conducted at Dareda Ward, in Babati Rural District, Manyara Region, northern Tanzania. Specifically, data were gathered from Loto and Bermi villages. This area was suitable because Iraqw is widely spoken as a first language, making it an ideal site for collecting authentic linguistic data. Dareda offers a purer, more stable baseline for collecting authentic phonetic data, directly aligning with the study's objective of analysing consonantal phonological processes.

The target population consisted of all Iraqw native speakers from Dareda Ward, specifically from Loto and Bermi villages. [18] estimates approximately 1,000,000 native speakers of Iraqw. This population was targeted because of their fluency in Iraqw and their minimal exposure to external linguistic influences compared to younger generations.

The study employed convenience sampling, a non-probability sampling technique in which participants were selected based on accessibility and willingness to participate. The sample consisted of (12) native Iraqw speakers aged between 50-80 years, both male and female, selected from Loto and Bermi villages. The sample comprised an equal number of male (6) and female (6) participants. Older speakers were intentionally included because they are more likely to preserve conservative phonological forms, reducing external influence from other languages.

Three methods of data collection were employed: elicitation sessions involving guided storytelling and descriptive tasks, extraction from written sources including the Iraqw-English Dictionary [53] and grammar books, and focus group discussions where participants engaged in natural conversations on provided topics.

Data analysis followed a thematic approach, morphological parsing and employing Distinctive Features as proposed by [10] to formulate phonological rules in the format A → B / C __ D, using features such as [±voice, ±nasal, ±coronal], and [±continuant] to group sounds into natural classes. The UR-PR model was applied to identify consonantal lexical processes, consistent with Lexical Phonology Theory [37], and [49]. Validity was ensured through expert review of instruments, while reliability was strengthened through triangulation of data from multiple sources. Ethical considerations were addressed through informed consent, voluntary participation, and strict confidentiality.

4. Findings and Discussion

4.1. Introduction

This chapter presents, analyses, and discusses the findings of the study on the Iraqw segmental phonology specifically phonological processes.

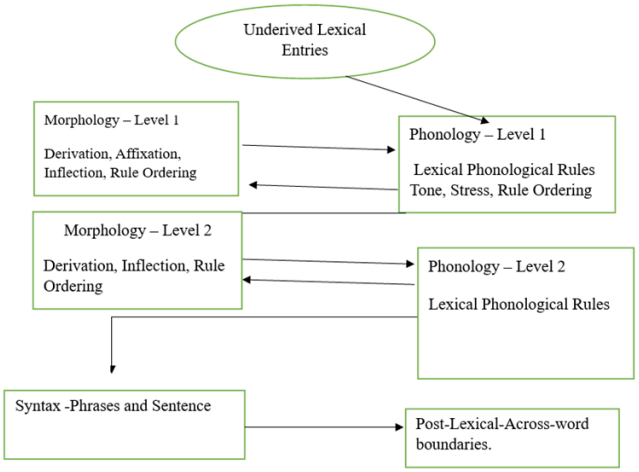
The chapter is organised according to the objective of this paper that, the analysis of phonological processes involving consonants in Iraqw. Each section presents the data, provides rule formulations using distinctive features, and discusses the findings in relation to the existing literature on languages and phonological theory.

Throughout the analysis, the following conventions are observed: underlying representations (UR) are given in phonemic transcription within slashes / /, phonetic representations (PR) are provided in square brackets [ ], and glosses are provided in single quotation marks.

Arrangement of Roots and Affixes in the Iraqw Lexicon

The findings indicate that Iraqw has a hierarchical lexical structure in which words are formed through the interaction of morphology and phonology. Morphological processes, including derivation, affixation, and inflection, apply across successive lexical levels. The output of each level becomes the input to the next until lexical processing is complete.

The resulting lexical items are then transferred to the syntactic component, where they combine into phrases and sentences. The syntactic output subsequently enters post-lexical phonology, where across-word processes, including assimilation, deletion, and epenthesis, apply. For example, */aning an guʔu/* 'I am sleeping' is realised as *[anan guʔu]* through nasal assimilation before the final phonetic representation is produced, as shown in Figure 2.



Source: Researcher (2026).

Figure 2. *The Iraqw Lexicon.*

Figure 2 shows the organisation of the Iraqw lexicon within the Lexical Phonology. The syntactic output then passes to post-lexical phonology, where across-word processes, such as assimilation, deletion, and epenthesis, apply, producing the final phonetic representation surface form of Iraqw utterances.

4.2. Consonantal Phonological Processes in Iraqw

Consonantal phonological processes refer to the rule-governed changes that consonant sounds undergo when they are spoken in real speech compared to how they are stored in a speaker's mental dictionary, their underlying abstract form as seen in the data presentation in all processes. Table 5 presents the consonants identified in Iraqw, showing their digraph and orthographic representations, phonetic representations (PR), and corresponding examples. The table, therefore, provides the basis for the discussion of the consonantal phonological processes identified in the language.

Table 5: Iraqw Consonants and their examples.

Digraph	Phonemic	Orthographic	PR	Gloss
/ /	ɻ/	*/ameeni*	*[ɻame:ni]*	woman
'	/ʔ/	*fur 'a*	*[furʔa]*	wind
b	/b/	*baaba*	*[ba:bå]*	father
d	/d/	*dasi*	*[däsi]*	girl
k	/k/	*kunee*	*[kune:]*	mortar
h	/h/	*hee*	*[he:]*	person
hh	/ħ/	*hhae´e*	*[ħaeɻe]*	siblings
sl	/ɬ/	*slee*	*[ɬe:]*	cow
s	/s/	*saargi*	*[sa:rgi]*	gazelle
r	/r/	*aara*	*[a:ra]*	goats
ch	/tʃ/	*lach*	*[lätʃ]*	a name
t	/t/	*tiaim*	*[tiaim]*	run
tl	/ɬl/	*tlaa/a*	*[ɬla:ʔa]*	stone
ts	/ts'/	*tsataay*	*[ts'ata:j]*	knife
w	/w/	*weeli*	*[we:li]*	rope
x	/x/	*xa´ano*	*[xaʔano]*	tree
y	/j/	*yaae*	*[ja:e]*	leg, river
gw	/gw/	*gweera*	*[gwe:ra]*	to open
kw	/kw/	*kwaslu*	*[kwału]*	beads
ngw	/ŋw	*paa/angw*	*[pa:ɻaŋw]*	opportunity
qw	/qw/	*slaqwara*	*[łaqwara]*	war
xw	/xw/	*tlaaxwek*	*[ɬla:xwek]*	buy

Digraph	Phonemic	Orthographic	PR	Gloss
nqw	/ŋqw/	*faanqw*	*[fa:ŋqw]*	seven

Source: Field Data (2026)

The Table 5 show the consonants that occur in Iraqw and their different written and phonetic representations. An important pattern emerging from the analysis is that consonant deletion is particularly prominent in the Iraqw data. The findings indicate that Iraqw has a rich system of word-final consonant deletion processes, occurring in phonologically and morphologically conditioned environments. At the consonantal level, four processes were identified: deletion, voicing, fortition, and gliding.

4.2.1. Consonantal Deletion Processes

Consonantal deletion is a phonological process in which a consonant is omitted from a word or syllable [61]. In Iraqw, the identified deletion processes include final nasal deletion with compensatory lengthening /ŋ/, final nasal deletion with compensatory lengthening /n/, deletion of /k/ before the suffix -ko, final nasal deletion before *aga*, Final Consonant Voicing /t/ → [d], Consonant Fortition in Plural Formation and glide formation. The processes occur in different phonological and morphological environments, as shown in the following subsections:

(i). Final Nasal Deletion with Compensatory Lengthening /ŋ/

Final nasal deletion is a phonological process in which the velar nasal consonant /ŋ/ is deleted when it occurs in word-final position. In this process, the segment /ŋ/ present in the underlying representation (UR) does not surface in the phonetic representation (PR), resulting in a shorter word ending in a vowel lengthening. This occurs predominantly within pronouns, directional suffixes, and singular imperative verb extensions containing underlying /-aŋ/ or /-uŋ/ and /oŋ/ suffixes as shown in Table 6.

Table 6. *Final Nasal Deletion with Compensatory Lengthening.*

Orthography	UR	PR	Gloss
aning	/aniŋ/	[ani:]	I / me
kung	*/kuŋ/*	*[ku:]*	you (masc.)
king	*/kiŋ/*	*[ki:]*	you (fem.)
qwalang	*/qwalaŋ/*	*[qwala:]*	come!
dohung	*/dohuŋ/*	*[dohu:]*	your home
sooxang	*/so:xaŋ/*	*[so:xa:]*	urinate!
tsatang	*/tsataŋ/*	*[tsata:]*	cut!
boohong	*/bo:hoŋ/*	*[bo:ho:]*	hole
tu/ang	*/tuʕaŋ/*	*[tuʕa:]*	save me!
kwahhangw	*/kwaħaŋʷ/*	*[kwaħa:]*	throw!
warangw	/waraŋʷ/	[wara:]	seed

Source: Field Data (2026)

The data from Table 6 reveals the regular process of final velar nasal deletion in Iraqw, whereby the underlying velar nasal /ŋ/ is deleted in word-final, as we can see in Example 8:

8 a. */aniŋ/* → *[ani:]* 'I/me'

b. */qwalaŋ/* → *[qwala:]* 'come'

Examples 8a-b involve single lexical roots, */aniŋ/* 'I/me' and */qwalaŋ/* 'come'. During pronunciation, the final /ŋ/ is deleted, and the preceding vowel is lengthened to compensate for the lost consonant. Thus, *[ani:]* 'I/me' and *[qwala:]* 'come'. These examples show that Iraqw simplifies pronunciation through final consonant deletion, with compensatory vowel lengthening occurring to compensate for the deleted

consonant. Example 9 shows the rule which can be represented as: The rule for final nasal deletion /ŋ/

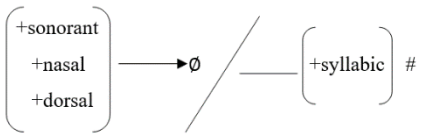


Figure 3. *Rule Representation of Word-Final /ŋ/ Deletion.*

The velar nasal /ŋ/ (input) is deleted → ∅ (output) when it occurs after a vowel (V) and before a word boundary (#).



Figure 4. *Compensatory Vowel Lengthening.*

A vowel is lengthened when a word-final nasal consonant is deleted.

Iraqw deletes word-final /ŋ/ in different grammatical categories. Unlike Benadiri Somali, where nasal assimilation has been reported [64], and T'ambaaroa, where deletion may occur optionally [55], the Iraqw data show that word-final /ŋ/ deletion is a regular process. The process is therefore closely associated with the word-final position rather than occurring freely. The deletion is accompanied by compensatory lengthening of the preceding vowel, as seen in forms such as */aniŋ/ → [ani:]'i/me/* and */qwalaŋ/ → [qwala:]'come'*. In terms of Lexical Phonology, the process is placed at Stratum 2 because it applies after the basic stem formation. From a phonetic perspective, deleting the final consonant makes the form easier to pronounce, while lengthening the preceding vowel provides an adjustment for the loss of /ŋ/. The Iraqw pattern therefore involves not only the deletion of a consonant but also a corresponding change in vowel duration.

(ii). Nasal Deletion with Compensatory Lengthening /n/

Nasal deletion with compensatory lengthening occurs when a nasal consonant is deleted and the preceding vowel becomes longer. The word-final /n/ is deleted at the end of the lexical root. The preceding vowel */e/* or */a/* is lengthened to *[a:]* and *[e:]*, after the deletion. Table 7 presents the data on the nasal /n/ deletion with compensatory lengthening.

Table 7. *Nasal Deletion /n/.*

Base	UR	PR	Gloss
aten	/aten/	[ate:]	We/us
gaasan	*/ga:san/*	*[ga:sa:]*	kill
qaren	*/qaren/*	*[qare:]*	old
/ayan	/ʕajan/	[ʕaja:]	eat
aran	/aran/	[ara:]	see
tlawan	/ɬlawan/	[ɬlawa:]	go
wahan	/wahan/	[waha:]	drink
dahan	/dahan/	[daha:]	enter

Source: Field Data (2026)

The data presented in Table 7 shows a pattern of word-final nasal deletion in Iraqw. The process affects the alveolar nasal consonant /n/ when they occur in word-final position. This process is shown in Example 9:

9a. atee tlee a gaasaa 'we will kill the cow'

b. lei aga araa 'we saw the goat'

c. maay ina wahaa 'we drank the water'

Source: Field Data (2026)

The examples in (9a-c) show nasal deletion with compensatory vowel lengthening in Iraqw. In (9a), *atee* comes from /aten/ 'we' through the deletion of final /n/ and the lengthening of the preceding /e/ to *[e:]*. Similarly, */aran/* 'saw' is realised as *[araa]* in (9b), while */wahan/* 'drank' becomes *[wahaa]* in (9c). In all three examples, the final /n/ of the lexical root is deleted, and the preceding vowel is lengthened. Figure 5 shows the rule which can be represented as: Deletion rule in feature matrix.

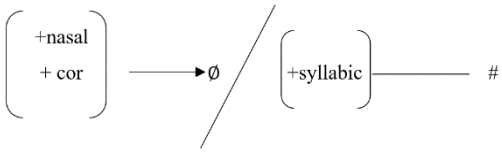


Figure 5. *Nasal Deletion.*

The alveolar nasal /n/ is deleted word-finally after a vowel. The rule applies to the natural class of coronal nasals, specified by the features [+nasal, +coronal].

Figure 6 Showing compensatory lengthening

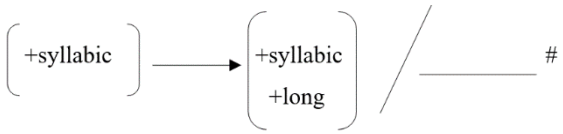


Figure 6. *Showing compensatory vowel lengthening.*

The vowel preceding the deleted /n/ is lengthened to compensate for the loss of the consonant.

Earlier research has established deletion as a common phonological process. [27] describes consonant deletion as a way of simplifying syllable structure, and work by [22, 23, 26] reports consonant deletion and cluster simplification across African languages. Data from Iraqw also show consonant deletion, but in a more restricted, word-final pattern: /n/ is deleted and the preceding vowel is lengthened. Thus */aten/* 'we' is realised as *[ate:]* and */aran/* 'saw' as *[ara:]*. These forms suggest that deletion in Iraqw is not just the loss of a consonant; it also affects vowel duration. The process therefore involves both consonant loss and compensatory lengthening. This pattern extends previous descriptions by clarifying how deletion operates in Iraqw and how it contributes to changes in word-final syllable structure.

(iii). Deletion of the Voiceless Plosive /k/

Deletion of the voiceless plosive is a phonological process in which the consonant /k/ is omitted from the phonological form when it occurs before the suffix *-ko*. This process results in a difference between the underlying form, which contains /k/, and the surface form, in which /k/ is not pronounced. Table 8 presents the data from the field about the deletion of the voiceless plosive. Here the focus is on the consonant deletion apart from having co-occurrence of the vowel processes.

Table 8: Deletion of the voiceless plosive with suffix –ko.

Base +sfx	UR	PR	Gloss
[[muu]$_N$ + ku-ko]$_N$	*/mu:kuko/*	*[muko:]*	some people
[[dawa]$_N$ + ku-ko]$_N$	*/dawakuko/*	*[dako:]*	some hand
[[afa]$_N$ + ku-ko]$_N$	*/afakuko/*	*[afko:]*	some mouth
[[qara]$_N$ + ku-ko]$_N$	*/qarkuko/*	*[qarko:]*	some toxic
[[kuru]$_N$ + ku-ko]$_N$	*/kurkuko/*	*[kurko:]*	some year
[[qwari]$_{Adj}$ + ku-ko]$_N$	*/qwarikuko/*	*[qwarko:]*	some hungry
[[narak]$_N$ + ku-ko]$_N$	*/narakuko/*	*[narako:]*	some poverty
[[hhek]$_V$ + ku-ko]$_N$	*/ħekuko/*	*[ħeko:]*	some fetches

Source: Field Data (2026)

As shown in Table 8, the voiceless plosive /k/ is deleted in forms involving the suffix */-ko/*, particularly in the sequence *-ku-ko*. The suffix *-ko* 'some' occurs with nouns, adjectives, and verbs. As shown in Example 10, the deletion of /k/ is morphologically conditioned and occurs at the stem-suffix boundary.

Example 10.

kurukuko *kurko* 'some year'
/-kur-/ *Underlying* representation
[[kur] u] Affix
[[kur] u] ku] *Affix*
[[kur] u] ku] ko] Affix
[[kur] ku] ko /u/ → ∅
[[kur]u] ko] /k /→ ∅
[[kur]ko] /u /→ ∅
[[kur] ko:] /o/→ [o:]
kurko: Phonetic representation
Source: Field Data (2026)

As shown in Example 10, the analysis focuses on the dele-

tion of the consonant /k/ segment as a morphologically conditioned process. The deletion /k/ occurs after affixation and co-occurs with vowel deletion and vowel lengthening. The first /u/ is deleted, becoming kurkuko, which then undergoes /k/ deletion to produce *kuruko*. The second /u/ is then deleted, followed by lengthening of the final /o/ to give *kurko:*. This shows recyclicity in Lexical Phonology, where the output of one process serves as the input to another. The process can be represented by the following rule in Figure 7 showing the deletion voiceless plosive.

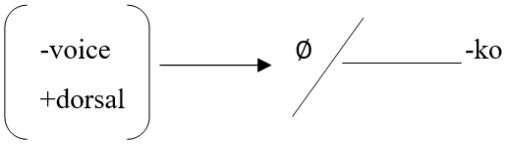


Figure 7. *Deletion of the Voiceless Plosive.*

The Rule states that the voiceless dorsal consonant /k/ is deleted when it occurs before the suffix *-ko*.

This finding agrees with [27, 37], and [57], who describe deletion as the loss of a segment in a particular phonological environment. However, the Iraqw data show a more specific pattern of /k/ deletion that occurs when the suffix *-ko* is attached. This differs from the general descriptions of deletion in the previous studies because, in Iraqw, the deletion is closely linked to the morphological structure of the word. The finding therefore shows that the attachment of *-ko* can create an environment in which a phonological change takes place, illustrating the interaction between morphology and phonology.

4.2.2. Final Consonant Voicing /t/ → [d]

Final consonant voicing is a phonological process in which a voiceless consonant at the end of a word becomes its voiced counterpart. In the Iraqw data, the voiceless alveolar stop /t/ changes to the voiced alveolar stop *[d]* in the corresponding plural form. The process is accompanied by the addition of the plural suffix /u/. Table 9 presents examples of final consonant voicing in the plural formation.

Table 9. *Final Consonant Voicing in Plural Formation /t/ → [d].*

Base +sfx	UR	PR	Gloss
[[me:we:t] $_N$ *+ u]* $_{PL}$	*/me:we:tu/*	*[me:we:du]*	grain store (outside)
[[iringe:t] $_N$ *+ u]* $_{PL}$	*/iringe:tu/*	*[iringe:du]*	crime, sin
[[gadje:t] $_N$ *+ u]* $_{PL}$	*/gadje:tu/*	*[gadje:du]*	work, task
[[majsho:t] $_N$ *+ u]* $_{PL}$	*/majsho:tu/*	*[majsho:du]*	leather bag
[[ga:mbo:t] $_N$ *+ u]* $_{PL}$	*/ga:mbo:tu/*	*[ga:mbo:du]*	shield
[[geewo:t] $_N$ *+ u]* $_{PL}$	*/ge:wo:tu/*	*[ge:wo:du]*	kind of disease
[[sime:t] $_N$ *+ u]* $_{PL}$	*/sime:tu/*	*[sime:du]*	well, small canal beside water

Source: Field Data (2026)

The data in Table 9 show that /t/ changes to [d] during plural formation. The plural suffix /-u/ triggers this voicing process. Both /t/ and /d/ are alveolar stops and have the same place and manner of articulation, but they differ in voicing. The sound /t/ is voiceless, while /d/ is voiced. Therefore, /t/ becomes voiced and is realised as *[d]* in the plural form as indicated in Example 16.

11. *a /me:we:t+u/ [me:we:du]* 'grain store (outside)'
/-me:we:t-/ Underlying Representation
[[me:we:t] u] Affix
[[me:we:d] u] /t/ → [d]
me:we:du Phonetic representation
b /iringe:t +u/ [iringe:du] 'crime, sin'
/-iringet-/ Underlying representation
[[iringe:t] u] Affix
[[iringe:d]u] /t/ → [d]
iringe:du Phonetic representation
Source: Field Data (2026)

As shown in Example 11a-b, the final consonant /t/ changes to [d] when the plural suffix /-u/ is attached. At Stratum 2, the suffix is first added to the noun base, and the resulting form then undergoes voicing, changing /t/ → *[d]*. This gives *me:we:du* 'grain store (outside)' and *iringe:du* 'crime/sin'. The process can be represented as /t/ → [d], involving a change from [-voice] to [+voice]. Thus, the examples show that affixation provides the input for the subsequent voicing rule, illustrating the ordered interaction between morphology and phonology in Lexical Phonology.

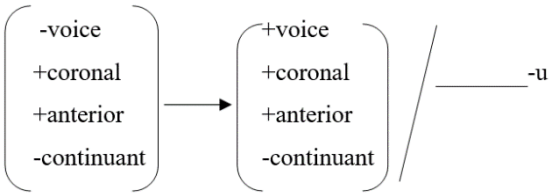


Figure 8. *Final Consonant Voicing in Plural Formation.*

A voiceless alveolar stop becomes voiced when the plural suffix *-u* is added.

This finding is supported by [37] and [48], who explain the relationship between morphology and phonology in terms of ordered lexical strata. In Iraqw, the plural suffix *-u* is added at Stratum 2, and the final /t/ is subsequently realised as *[d]*. This pattern indicates that the addition of the plural marker creates the environment for the voicing process to apply at the lexical level.

4.2.3. Consonant Fortition in Plural Formation

Consonant fortition is a phonological process in which a consonant changes from a less restricted sound to a more restricted one. It involves a change in manner of articulation, such as a fricative or approximant becoming a stop [27] and [42]. In the Iraqw data, fortition occurs in plural formation, where the trill /r/ changes to *[d]* and the glide /w/ in the singular forms are realised as the voiced plosive stop *[b]* in the plural forms. Table 10 presents the data of consonant fortition in Iraqw plural formation.

Table 10. *Consonant Fortition in Plural Formation.*

UR	Gloss	PR	Gloss
/fara/	Bone	*[fadu]*	bones
/bara/	Side	*[badu]*	sides
/ts'a:wu/	Axe	*[ts'abu]*	axes
/ħara/	Stick	*[ħado]*	sticks
/gara/	Forest	*[gado]*	forests
/ɬlawi/	lake, sea	*[ɬlabe:mo]*	lakes, seas
/dawa/	hand, arm	*[dabe:]*	hands, arms

Source: Field Data (2026)

These findings in Table 10 suggest that plural formation triggers consonantal strengthening, rather than the alternations being random. The changes from the more open /r/ and */w/* to the more constricted stop consonants *[d]* and *[b]* indicate an increase in articulatory constriction. The data therefore provide evidence that fortition is morphologically conditioned in Iraqw, with the plural form serving as the environment for the consonantal alternation as shown in Example 12:

12a. */fara/ → [fadu]* 'bones'

/-far-/	Underlying representation
[[far]a]	Affix
[[far]u]	/a/→[u]
[[fad]u]	/r/→[d]
fadu	Phonetic representation

b. */dawa/→ [dabee]* 'hands/arms'

/-daw-/	Underlying representation
[[daw]a]	Affix
[[dab]a]	/w/→[b]
[[dab]e:]	/a/→[e:]
dabe:	Phonetic representation

Source: Field Data (2026)

As shown in Examples (12a-b), consonant fortition in Iraqw occurs during plural formation. In (12a), */fara/* 'bone' becomes *[fadu]* 'bones', with the final /a/ changing to /u/ and root-final consonant /r/ changing to *[d]*. In (12b), */dawa/* 'hand, arm' becomes *[dabe:]* 'hands, arms', with the final /a/ changing to [e:] and root-final glide /w/ changing to voiced bilabial stops [b]. The vowel changes occur alongside these consonant changes as part of plural formation. The fortition process can be represented as /r/ → [d] before the plural marker as indicated in Figure 9:

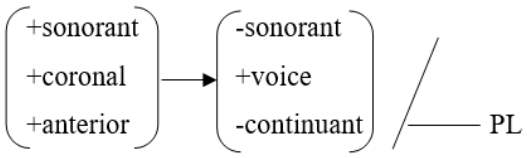


Figure 9. *Consonant fortition in plural Formation.*

The rule state that, the root-final /r/, a voiced coronal sonorant, changes into [d], a voiced coronal stop, when it occurs before the plural marker.

The fortition process can be represented as /*w*/ → [*b*] before the plural marker:

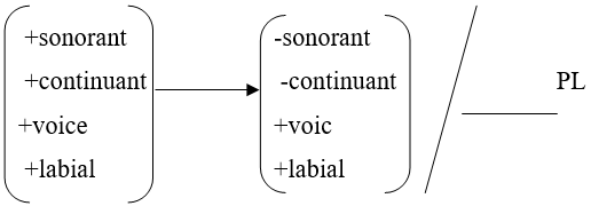


Figure 10. *Consonant fortition in plural formation.*

Therefore, the rule states that the root-final glide /w/, a voiced labial sonorant, changes into [b], a voiced labial stop, before the plural marker.

The findings relate to [25], who report consonantal weakening in Gorwaa, particularly in intervocalic environments. The Iraqw data, however, show a different pattern involving consonantal strengthening. In the present study, /r/ is realised as [d] and /w/ as [b] in the formation of certain plural forms. The change is therefore from a weaker consonant to a stronger one, rather than the weakening reported in Gorwaa. The Iraqw pattern is also associated with plural formation, indicating that the process is conditioned by a morphological environment. This suggests that fortition in Iraqw is not simply a phonetic response to the surrounding sounds, but is linked to a particular grammatical function.

4.2.4. Glide Formation

Gliding is a phonological process in which a high vowel changes into a corresponding non-syllabic glide, particularly when it occurs in a vowel sequence. In Iraqw, gliding occurs in the phonological adaptation of Kiswahili loanwords, where borrowed forms may be modified to conform to Iraqw phonotactic patterns. In this process, the high back vowel /u/ changes to the labiovelar glide [w], while the high front vowel /i/ changes to the palatal glide *[y]*. Thus, the adaptation of Kiswahili loanwords leads to gliding, represented as */u/ → [w]* and */i/ → [y]*. Table 11 presents field data collected on gliding in Iraqw, showing the Kiswahili source forms and their corresponding Iraqw adaptations.

Table 11. *Glide Formation.*

UR	PR	Gloss
/barua/	[barwa]	letter
/gauni/	[gawni]	dress
/kofia/	[kofja]	hat
/mlimau/	[malmaw]	citrus fruit
/kuanza/	[kwansa]	to begin
/biashara/	[bjashara]	business
/nia/	[nja]	intention
/mia/	[mja]	hundred
/sufuria/	[safurija]	cooking pot

Source: Field Data (2026)

The data presented in Table 11 show that gliding occurs during the phonological adaptation of Kiswahili loanwords in Iraqw. Gliding in Iraqw can be analysed within the Lexical Phonology framework as a lexical phonological adaptation of Kiswahili loanwords. The process occurs when high vowels /u/ and /i/ lose their syllabicity and become the corresponding glides *[w]* and *[y]*, as it is shown in Example 13:

13a. */barua/ [barwa]* 'letter'

b. /biashara/ [bjashara] 'business'

Example 13 (a-b) shows that gliding occurs when Kiswahili loanwords are adapted into Iraqw. In */barua/ → [barwa]* 'let-

ter', the vowel /u/ changes to the glide [w]. Similarly, */biashara/ → [bjashara]* 'business' shows /i/ changing to [y]. These changes occur in vowel sequences and help the borrowed words conform to Iraqw phonological patterns. The formal gliding rule can be stated as:

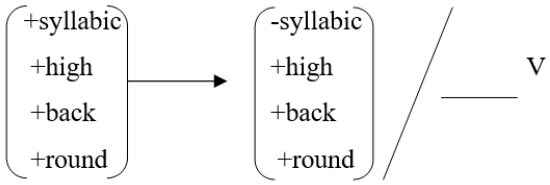


Figure 11. *Glide Formation.*

The rule states that a high, syllabic vowel becomes non-syllabic (a glide) before another vowel.

The finding is compared with [64], who reports the use of glides in Benadiri Somali. Although both studies identify glide formation as a way of resolving vowel sequences, the processes are not the same. In Benadiri, [64] describes glide insertion, in which a glide is added between vowels. In Iraqw, by contrast, no new segment is inserted. Instead, one of the existing high vowels changes its realisation and functions as a glide. This difference is important because it shows that languages may use different phonological strategies to deal with similar vowel-sequence environments.

The Iraqw pattern also shows that the process is particularly evident in borrowed words. This suggests that gliding plays a role in the phonological adaptation of Kiswahili words when they are incorporated into Iraqw. The change from /u/ to [w] and from /i/ to [y] preserves the vowel's place-related properties while changing its syllabic function from a vowel to a glide. The difference from Benadiri further indicates that, although gliding may serve a similar function across languages, its phonological implementation can vary.

4.2.5. Analysis of Consonantal Processes in the Context of Lexical Phonology and Distinctive Feature Theory

The findings show that consonantal processes in Iraqw are closely related to word formation and morphological structure. The processes identified include consonant deletion, final consonant voicing, fortition, and glide formation. Their occurrence depends on particular morphological and phonological environments.

Within Lexical Phonology, these processes can be associated with different stages of word formation. At Stratum 2, morphological operations create environments for phonological changes. For example, the addition of the plural suffix *-u* causes final /t/ to change to [d], as in */meeweet+u/ → [me:we:du]* 'grain stoo outside'. In Distinctive Feature Theory, this change involves a shift in the [±voice] feature from [-voice] to [+voice].

Plural formation also triggers fortition, where /r/ changes to [d] and /w/ changes to [b]. These changes show the interaction between morphological processes and the phonological properties of consonants.

Rule ordering is also evident in the data. The addition of *-ko* creates the environment for /k/ deletion in forms containing *-ku-ko*. Likewise, the deletion of final /ŋ/ and /n/ is followed by vowel lengthening, as in */aniŋ/ → [ani:]* 'I/me' and */aten/ → [ate:]* 'we'. This indicates that the processes apply in sequence, with the output of one rule providing the environment for another.

Glide formation is found in the adaptation of Kiswahili loanwords. The vowels */u/* and */i/* change to [w] and [y], respectively, before another vowel, as in */barua/ → [barwa]* 'letter' and */biashara/ → [bjashara]* 'business'. The vowels are not deleted; instead, they become non-syllabic glides, helping the borrowed forms conform to the phonological structure of Iraqw.

At Stratum 1, the lexical form undergoes derivational processes. At Stratum 2, suffixation and inflection interact with phonological processes such as voicing, fortition, and consonant deletion.

5. Summary of the Findings

The study identified four consonantal phonological processes in Iraqw: consonantal deletion, voicing, fortition, and glide formation. The findings show that these processes are conditioned by particular morphological and phonological environments and contribute to the formation and pronunciation of Iraqw words.

First, the study found that consonantal deletion occurs in several environments. Word-final /ŋ/ and /n/ are deleted, with compensatory lengthening of the preceding vowel. For example, */aniŋ/ → [ani:]* 'I/me' and */aten/ → [ate:]* 'we/us'. The study also identified /k/ deletion in the morphological construction involving *-ko*, as in */kurkuko/ → [kurko:]* 'some year'. These findings show that deletion can interact directly with morphological structure.

Third, the study found final consonant voicing in plural formation. The voiceless alveolar stop /t/ changes to the voiced stop [d] when the plural suffix *-u* is added. For example, */me:we:t + u/ → [me:we:du]*. The change involves the [voice] feature while the place and manner of articulation remain largely unchanged. This demonstrates the interaction between suffixation and phonological voicing.

Fourth, consonant fortition occurs in plural formation. The root-final /r/ changes to [d], while /w/ changes to [b]. For example, */fara/ → [fadu]* 'bones' and */dawa/ → [dabe:]* 'hands/arms. These changes involve increased articulatory constriction and are associated with the formation of plural forms.

Finally, glide formation occurs mainly in the adaptation of Kiswahili loanwords. The high vowels /u/ and /i/ become the

corresponding glides [w] and [y] in appropriate vowel sequences. Examples include */barua/ → [barwa]* 'letter' and */biashara/ → [byashara]* 'businesses. This shows that consonantal processes in Iraqw also operate in loanword adaptation.

Therefore, the findings demonstrate that consonantal phonology in Iraqw is closely connected with morphology, word formation, aspect marking, plural formation, and loanword adaptation. The processes are therefore not random sound changes but are conditioned by specific grammatical and phonological environments.

6. Conclusion

The study concludes that Iraqw has a rich system of consonantal phonological processes involving deletion, voicing, fortition, and glide formation. These processes occur in different morphological and phonological environments and contribute to the formation of grammatical and lexical forms.

The findings further demonstrate a strong interaction between morphology and phonology. For example, the addition of the plural suffix *-u* creates the environment for /t/ → [d] voicing and consonant fortition, while habitual aspect formation creates the environment for consonant copying. Similarly, the insertion of /r/ and /m/ contributes to the expression of frequentative and durative meanings.

The findings support the application of Lexical Phonology to Iraqw consonantal processes. The data indicate that morphological operations and phonological rules are ordered rather than applying randomly. For example, plural formation precedes the application of the /t/ → [d] voicing rule, while habitual formation provides the morphological environment for consonant copying. This supports the view of [37] and [48] that morphological and phonological operations interact through ordered lexical strata.

The study also concludes that some consonantal processes are shared with other African languages, particularly Cushitic and Bantu languages, but their forms, environments, and grammatical functions may differ. For instance, consonant copying has been reported in Sidaama, but the Iraqw process is associated with habitual aspect formation rather than the same grammatical function reported elsewhere. Likewise, Iraqw /r/ and /m/ insertion has aspectual functions that distinguish it from consonant insertion reported for other languages.

Therefore, the study contributes to the documentation of Iraqw segmental phonology by showing how consonantal processes operate within the grammatical and phonological structure of the language. It also demonstrates the usefulness of combining Lexical Phonology with Distinctive Feature Theory: Lexical Phonology accounts for the relationship between morphology and the ordering of processes, while Distinctive Feature Theory describes the specific phonological features involved in changes.

7. Recommendations

7.1. Recommendations for Action

Based on the findings, several actions are recommended.

Iraqw phonological data should be documented and preserved. The findings show that Iraqw has a range of morpho-phonological processes that should be recorded systematically. Examples such as */aniŋ/ → [aniː]* 'I/me' and */meːweːt + u/ → [meːweːdu]* 'the grain store outside' should be preserved together with their morphological and grammatical information.

Iraqw should be considered in the development of language-learning materials.

The documented processes can be useful in preparing dictionaries, grammar books, reading materials, and other educational resources. For example, information about plural formation and habitual forms can help learners understand their base forms.

Researchers and language practitioners should document natural connected speech.

Some phonological processes may not be fully visible in isolated word forms. Future documentation should therefore include conversations, narratives, songs, storytelling, and other naturally occurring speech.

The findings should be incorporated into digital language documentation. Audio recordings, transcriptions, translations, and phonological analyses should be stored in accessible digital archives where appropriate. This can support future linguistic research and help preserve Iraqw linguistic knowledge.

Further comparative research should be encouraged. The similarities and differences between Iraqw and other Cushitic languages show the importance of comparative work. Such research can clarify whether particular processes are specific to Iraqw or occur more widely within Southern Cushitic.

7.2. Recommendations for Further Studies

Further studies should investigate the following areas:

Post-lexical consonantal processes: More research should examine consonantal changes in connected speech, including nasal assimilation, nasal deletion, and consonant insertion across word boundaries. For example, future research could investigate how final consonants behave when words occur in different syntactic environments.

Vowel-consonant interaction: Further research should examine the interaction between consonantal and vowel processes. In forms such as */fara/ → [fadu]*'bones' and */dawa/ → [dabeː]* 'hands' consonant changes occur together with vowel changes during plural formation.

Loanword adaptation: Further studies should investigate the adaptation of Kiswahili and other contact-language loanwords in Iraqw. Particular attention should be given to processes such as gliding, vowel deletion, vowel coalescence, and consonant substitution.

Experimental phonological research: Acoustic and instrumental studies could be conducted to provide detailed measurements of processes such as vowel lengthening, voicing, and fortition. For example, measurements of */t/ → [d]* could provide acoustic evidence of the voicing difference between the underlying and surface forms.

Comparative Southern Cushitic research: A broader comparative study involving Iraqw, Gorwaa, Alagwa, and other Southern Cushitic languages could investigate shared phonological patterns and language-specific developments. Such research would contribute to a better understanding of the historical and structural relationships among these languages.

Further theoretical analysis: Future studies could examine the Iraqw data using other phonological frameworks in addition to Lexical Phonology and Distinctive Feature Theory. This could provide alternative explanations for processes such as deletion, copying, fortition, and loanword adaptation.

Abbreviations

Ant	Anterior
C	Consonant
Cont	Continuant
Cor	Coronal
CV	Consonant-vowel
LR	Lexical Representation
N	Noun
Nas	Nasal
PL	Plural
PR	Phonetic Representation
Son	Sonorant
SOV	Subject-Object-Verb
UR	Underlying Representation
V	Vowel
#	Word Boundary
+	Morpheme Boundary
/ /	Phonemic Underlying Representation (UR)
[ ]	Phonetic Representation (PR)
___	Environment (Position Marker in Rules)
→	Becomes / Changes to
∅	Zero (Deletion)
ˊ	Primary Stress
:	Vowel Length
A	Rule Variable (Input)
B	Rule Variable (Output)
C	Rule Variable (Consonant)
D	Rule Variable (Environment)
V	Vowel
ʼ	Glottal Stop (Orthographic)
ˊ	Glottal Stop (Orthographic Variant)

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Conflicts of Interest

The authors declare no conflicts of interest.

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