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Morphophonological Number Marking in Luo

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Abstract

This study discusses morphophonological number marking in Luo, a western Nilotic language spoken in Kenya, Uganda, Tanzania, South Sudan, and Ethiopia. Luo, being an agglutinative language, most of its nouns can be easily fragmented into several morphemes, although there are some nouns that are morphologically unmarked for singular or plural. Nilotic languages have shown the connection between morphological morphemes and phonological aspects like tone, vowel length, sound alternation, and change in ATR vowel quality in creating inflection values. This study specifically discusses the impact of both morphological markers and phonological markers of number inflection in Luo. Data collection involved seven Luo native speakers from the Rorya district of Tanzania, where the language is predominantly spoken within the country. The study employed a descriptive research design guided by Distributed Morphology theory. The study also used an elicitation method for data collection. Findings describe suffixation as a dominant number marking process, with processes such as change in syllable coda, internal sound changes, voicing, and devoicing having an inescapable role in unveiling number inflection in both nouns and adjectives. Both suffixation and the aforementioned phonological processes display irregularity when attached to different stems and nouns. The study also discusses the tripartite number marking system in Luo, which is common across Nilotic languages. The system has singulative markers where plural is unmarked, plurative markers where singular is unmarked, and nouns that have both singular markers and plural markers.

Keywords

Nilotic languages, Number marking, Morphophonological, Tripartite number marking

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Introduction

Past research has focused significantly on the inflectional paradigm in Nilotic languages (Simeoni, 1978; Dimmendaal, 2000; Xu, 2017; Kouneli, 2020; Dimmendaal, 2018; Remijensen & Ayoker, 2019; Dimmendaal, 2023). These studies consistently argue that morphophonological processes are fundamental in shaping inflectional features within this language family.

Early authors of Nilotic languages explain the perplexity of number marking, referring to it as complex and irregular. Edgar (1989) claims that there is no sure way to be able to predict singular and plural suffixes for each and every noun in the Masalit language. Same to Welmer (1973) on nominal morphology in Nilotic languages, who says it is hard to beat number inflection in this language family. This resembles what was addressed by Tucker and Mpaayei (1955) on the Maasai language, that the rule to learn the plural inflection of Maasai nouns is to learn the plural form of each noun.

The Nilotic language family belongs to the Nilo-Saharan language which is a big language phylum. Languages belonging to this phylum are found in a vast area ranging from eastern Tanzania to eastern Mali (Dimmendaal, 2000). They are also situated opposite to Niger-Congo languages in the south of Africa and Afro-Asiatic languages in the north of Africa (Dimmendaal, 2000). There are approximately thirty languages constituting the Nilotic branch within the Nilo-Saharan phylum (Dimmendaal, 2023). These languages exist over several countries in eastern Africa, ranging from central Tanzania in the south, across western Kenya and neighbouring zones of Uganda to South Sudan, with extensions into the northwestern corner of the Democratic Republic of Congo, western Ethiopia, and eastern Sudan (Dimmendaal, 2023).

The Nilotic language family branches into three: Western Nilotic, Eastern Nilotic, and Southern Nilotic. Dimmendaal (2023) maintains that protagonists of the former theories, such as Tucker et al. (1956), refer to Western Nilotic as “Nilotic”, whereas Southern and Eastern Nilotic are referred to as “Nilo-Hamitic”. Western Nilotic languages include languages like Burun, Dinka-Nuer, and Lwoo.

The established discussion above on the complexity and irregularity of Nilotic languages gives an avenue to discuss one of the languages of the Nilotic family, Luo, from the western Nilotic branch. Luo people have historically migrated across various East African countries, including Kenya, Sudan, Ethiopia, South Sudan, Uganda, and Tanzania, where Luo is spoken natively (Midigo & Wambura, 2024). The history teaches that the Luo people immigrated from the Southern part of Sudan in the early medieval period and travelled along the river Nile, then settled around Lake Victoria (Oyonyo, 2012). As for today, Luo people are in greater numbers in Kenya than in any other country (Midigo & Wambura, 2024). However, the data for this study were based on Luo spoken in Tanzania due to the proximity of the researcher. The focus of this paper lies on number marking, which is widely revealed to be a consideration of suffixation, tone alteration, change in any part of the syllable, vowel length, and change in ATR vowels from +ATR vowels to –ATR vowels and vice versa as number markers in the Nilotic language family.

Literature on Morphophonological Number Marking

Dimmendaal (2000) postulates that number marking in the Nilo-Saharan phylum is expressed by suffixation. He exemplifies his claim by presenting morphological analysis of Fur, Aiki (Runga), and Turkana nouns that take the shape of suffixation. Moreover, Dimmendaal (2023) talks about segmental innovation in Western Nilotic languages, which he claims requires more detailed tonal studies in order to support the hypothesis in nominal morphology across the phylum.

Remijensen & Ayoker (2019) agree on the morphological marking of nominal inflection, especially number inflection. However, they claim that what about morphological marking beyond suffixation? They offered the following examples from Shilluk nouns to support their claim;

(1) *pâaal-ɔ̌* – *pàaal*^h ‘knife’ SG:PL

(2) *kwâaaj-ɔ̌* – *kwâaaj*^h ‘ancestor’ SG:PL

Morphologically, singular forms are marked by the suffix -ɔ̌, leaving plural forms unmarked. However, plural forms manifest change in tones expressed by the syllable nucleus moving from a falling tone in the singular to a low tone in the plural. This has to be considered as marked, to pave the way to morphophonological processes to nominal inflection. Remijensen & Ayoker (2019) posit that in this context, it is also crucial to note that overlong vowel length

in West Nilotic languages has its diachronic origin in lost suffixes. They date the finding from Andersen (1990), who showed that overlong vowels in Dinka correspond to suffixed stems with a long vowel in Pāri, which does not have three-level vowel length. They consider Dinka *c̣īin* 'intestine', corresponding to Pāri *c̣in-ò* 'intestine'. In Shilluk, stem syllables with an overlong vowel alternate in the inflection paradigm with both long and short stem vowels (Remijensen & Ayoker, 2019). Therefore, an overlong vowel in the stem can be interpreted as the diachronic result of a suffixed stem syllable with a short or a long vowel.

Vowel length is another phonological process that aids the marking of nominal inflection in Nilotic languages. Many languages in this language family have up to three levels of vowel length. Andersen (1987) argues that there are short, medium, and long vowels, which he represents respectively as /V/, /VV/, and /VVV/. However, Hayes (1989) & Hyman (1992) consider moraic analysis, which explains the length by means of syllable weight (mora). This means that the length can have one mora /V/, two mora /VV/, and three mora /VVV/. Additionally, Remijensen & Ayoker (2019) argue that a length with one mora has a short vowel, a length with two mora has a long vowel, while a length with three mora has an extra-long vowel. The following Shilluk examples elucidate what has been said.

(3) *m̄l̄l̄t̄* – *m̄l̄l̄l̄t̄* 'friend' SG: PL

(4) *ḡûur* – *ḡûuur* 'Nile perch' SG: PL

(5) *l̄êem* – *l̄êeem* 'surgery knife' SG: PL

In examples (3), (4), and (5), number distinction is marked through vowel length. Specifically, singular forms exhibit long vowels, whereas their plural counterparts are realized with extra-long vowels. That is, singular nouns have two mora /VV/ while plural nouns have three mora /VVV/. This contrastive vowel lengthening functions as a morphophonological strategy for encoding grammatical number within the nominal paradigm in Shilluk.

Moreover, some Nilotic languages depict number inflection by using a change in ATR vowel quality. This means +ATR vowels become –ATR vowels and vice versa, at either the root level or the lexical level. Consider the following Akie nouns from König et al. (2015):

(6) *kwééye* – *kwééye* 'shoe, sandal' SG: PL

(7) *keeti* – *kéét̄* 'tree, wood, medicine' SG: PL

Example (6) exhibits a shift from –ATR vowels in the singular form to +ATR vowels in the plural form, whereas example (7) demonstrates the opposite pattern, with +ATR vowels in the singular alternating with –ATR vowels in the plural.

Despite the manifestation of morphophonological processes in nominal inflection, especially number marking in Nilotic languages, the language family also exhibits a multitude of suffixation as far as number marking is concerned. Dimmendaal (2000) says that at least all languages belonging to the Nilo-Saharan phylum mark number by suffixation. Consider examples by Storch (2007) from the Anywaa language spoken in western Ethiopia and South Sudan.

(8) *okoot* – *okóód-í* 'bell' SG: PL

(9) *búób-ò* – *búóp* 'butter' SG: PL

(10) *kèèl-á* – *kèèl-é* 'loincloth' SG: PL

The Anywaa language exhibits what is considered a classic number marking across Nilo-Saharan languages (Dimmendaal, 2000). Languages belonging to this phylum, including Nilotic languages, have nouns that are marked in singular, nouns that are marked in plural, and nouns that can be marked in both singular and plural. Storch (2007) paraphrases that this system of number marking has three principles, namely, pluralisation, singulativisation, and substitution of number morphemes. This system of number marking is known as tripartite number marking, which was put forward for the first time by Dimmendaal (2000), claiming that this is the common way of representing numbers across the Nilo-Saharan phylum. Tripartite number marking is discussed in the data analysis and results discussion.

Nilo-Saharan languages normally have extensive suffixes for number marking. In this case Masalit language, which belongs to the Maban subgroup and is spoken in eastern Chad, has singulative markers such as *-di*, *-ti*, *-ko*, *-gi*, *-ngi*, and *-i*, as well as plural markers like *-di*, *-je*, *-ij*, *-kar*, *-ter*, *-dur*, *-cor*, *-ta*, *-si*, and *-i* (Dimmendaal, 2000). Many of

these suffixes and others are also being applied as replacement markers in tripartite number marking in the Masalit language (Dimmendaal, 2000).

Theoretical Approach

This paper adopts distributed morphology theory to describe the role of morphophonological processes in unveiling the nature of number marking in the Luo language. The introduction of Distributed Morphology (DM) was first initiated by Morris Halle and Alec Marantz in the early 1990s. This was to challenge lexicalism and the functionality of linear morphology (Halle, 2000). The theory brings forth the division of roles among elements of grammar in forming words, phrases, and sentences, which in other theories are collected in the lexicon (Harley & Noyer, 1998). This means that functions of word formation are distributed among components of grammar, as there is no unified lexicon, as in the earlier generative treatments of word formation. Unlike lexicalism, in distributed morphology, syntax proper does not manipulate anything resembling lexical items, but rather, generates structures by combining morphosyntactic features via syntactic operations such as merger, impoverishment, and fission selected from the inventory available, subject to the principles and parameters governing such combination (Harley & Noyer, 1998).

Distributed Morphology has three basic features, and these features include: late insertion, under-specification, and syntactic structure all the way down (Muhammad, 2019). Late insertion is the most significant feature of DM; it explains how abstract morphemes within syntactic terminals combine with phonological feature(s) via a process called spell out to create vocabulary items (Harley & Noyer, 1998). In other words, syntactic terminals organized into familiar hierarchical structures by the principles and operations of the syntax proper are complexes of semantics and syntactic features but systematically lack all phonological features (Muhammad, 2019). However, phonological features are supplied after syntax by the insertion of vocabulary items into the terminal nodes (Muhammad, 2019). According to Harley & Noyer (1998), late insertion is when the phonological expression of morphemes is supplied at the terminal node. In other words, syntactic categories (morphological morphemes) are purely abstract, having no phonological content. These morphemes are called vocabulary items only after phonological insertion in a process called Spell-Out.

It is worth noting that in DM, the term morpheme refers to a syntactic (or morphological) terminal node and its content without phonological expression. Suppletion of phonology is what gives out vocabulary items. Vocabulary items are divided into two, i.e, lexical morphemes (LM) and functional morphemes (FM). Lexical morphemes have their phonological expression fixed, and they are free from competing to be attached at the node. Whereas, functional morphemes have their phonological expression delayed until the syntax operation, and they are to compete to be attached at the node. Lexical morphemes can be a stem, a root, or a word like *pen*, *table*, *work*, or *smile*, while functional morphemes are affixes that carry syntactic information: e.g, *-s* for English plural.

Another crucial feature of DM is under under-specification of vocabulary items. This entails that the phonological expressions do not need to be fully specified for the syntactic positions where they can be inserted because they are to compete for insertion. Finally, syntactic structure all the way down, this means that terminal nodes into which vocabulary items are inserted are organized into hierarchical structures determined by the principles and operations of the syntax. The theory also addresses the issue of post-syntactic operations, which are involved in the processes of vocabulary item attachment. These operations are like morphological merger, fusion, fission, impoverishment, and phonological adjustment. Therefore, in this study, as far as DM is concerned, vocabulary items are both stems or roots and number morphemes, which are attached to the node according to the demands of either singular or plural. The study considers stems or roots as lexical morphemes, which have their phonology already defined, while number morphemes are functional morphemes that are attached to the node by syntax in accordance with the proper phonology needed. Also, out of the phonology of vocabulary items, this study considers phonological processes to be phonological adjustments of post-syntactic operations.

Methodology

Data for this study were collected through elicitation, which was done with seven Luo native speakers sampled purposively from Rorya district, Mara, Tanzania, where Luo is predominantly spoken within the country. Elicitation method involves the use of visual, oral, or written stimuli to prompt participants to discuss particular topics that may not be surfaced in open-ended questions alone (Creswell & Poth, 2018). The elicitation method was of great advantage since it allowed the researcher to intentionally design questions that brought out specific forms and

alternation needed for the analysis of phonemes and morphemes. The study also employed a descriptive research design guided by Distributed Morphology theory in data presentation and analysis. Descriptive design helped to establish and describe characteristics of phonemes and morphemes in this morphophonological Luo study. Elicitation questions were prepared in the Swahili language to make it easier for respondents whose language of wider communication is Swahili. The totals of 150 nouns, with the exception of proper nouns, were collected, and 7 adjectives were found to match morphophonological number marking criteria and finally analyzed through Distribution Morphology principles.

Limitations of the Study

This study was limited to data collected from the Luo-speaking community in Tanzania. Consequently, it did not include Luo speakers from Kenya and Uganda, where distinct dialectal or phonological variations may occur. This geographical restriction may therefore limit the generalizability of the findings to the wider Luo-speaking population across East Africa.

Data Presentation and Discussion

Luo number marking follows a tripartite number marking system, which is argued to be a prototypical Nilo-Saharan number marking system (Dimmendaal, 2000). The system displays singulative, plural, and replacement marking. This is primarily achieved through suffixation, a common feature across Nilotic languages. However, suffixes alone are often insufficient for marking number; phonological adjustments play a crucial role in completing the process. In a tripartite number marking system, singulative marking occurs when a lexically plural stem takes singular markers, while plural marking applies when a lexically singular stem receives plural markers. Replacement marking, on the other hand, involves a stem that can take both singular and plural markers. The prominent number makers in Luo are *-e*, *-i*, and *-ni*, which mark plural, and *-o* and *-a* mark singular. These markers (suffixes) are accompanied by phonological processes, notably, change in syllable coda, insertion, internal sound changes, vowel harmony, and voicing and devoicing in marking number inflection. Consider Table 1.

Table 1: Tripartite Number Marking in Luo

	Singular	Plural	Gloss
Singulative Marking	<i>winy-o</i>	<i>winy</i>	Bird
	<i>gwen-o</i>	<i>gwen</i>	Chicken
Plural Marking	<i>rech</i>	<i>rech-ni</i>	Fish
	<i>lwet</i>	<i>lwet-ni</i>	Arm
	<i>kuon</i>	<i>kuond-e</i>	Ugali
	<i>yien</i>	<i>yiend-e</i>	Firewood
	<i>kom</i>	<i>komb-e</i>	Chair
	<i>osiep</i>	<i>osiep-e</i>	Friend
	<i>guok</i>	<i>guog-i</i>	Dog
	<i>ruoth</i>	<i>ruodh-i</i>	Lord
Replacement Marking	<i>tiel-o</i>	<i>tiend-e</i>	Leg
	<i>bug-o</i>	<i>bug-ni</i>	Hole
	<i>ajuog-a</i>	<i>ajuog-e</i>	Sorcerer/sorceress
	<i>bur-a</i>	<i>buch-e</i>	Meeting

Singulative marking, as in Table 1, spontaneously has unmarked plural nouns which welcome the suffix *-o* for singular formation. In other words, the plural form is suffix less while the singular form is marked with a singulative suffix. Singular marking can also be done by the suffix *-a* in a replacement number marking only. Suffix *-o* of

singulative marking is attached to the single-syllable plural noun with a nasal coda. Namely, voiceless palatal nasal /ɲ/ and voiced alveolar nasal /n/.

(11) **Singular** **Plural**

winyo *winy*

A word	Morphemes	V.I	L.F
<i>winyo</i>	LM: <i>winy</i> [root][+count][+animate] FM: -o [num][sing]	LM: /wɪɲ/ FM: /o[mid,back,rounded][+short]/wɪno/	Bird(s)

(12) **Singular** **Plural**

gweno *gwen*

A word	Morphemes	V.I	L.F
<i>gweno</i>	LM: <i>gwen</i> [root][+count][+animate] FM: -o [num][sing]	LM: /gwen/ FM: /o[mid,back,rounded][+short]/gwen/	Chicken

Plural marking, as presented in Table 1, has unmarked singular nouns that receive suffixes *-e*, *-i*, and *-ni* to form plural nouns. The attachment of suffixes *-e*, *-i*, and *-ni* is both phonologically and morphologically conditioned. By considering examples in Table 1, the suffix *-e* is mostly attached to the singular nouns ending with nasals /m/, /n/, and a voiceless bilabial plosive /p/. Suffix *-i* is attached to the singular noun ending with a voiceless velar stop /k/ and voiceless dental fricative /θ/. The attachment of the suffix *-i* is also triggered by the change of the coda of a monosyllabic singular noun to ensure a disyllabic plural word. The change from voiceless velar plosive to voiced velar plosive in *guok*(/guok/) – *guogi*(/guogi/) and the change from voiceless dental fricative to voiced dental fricative in *ruoth* (/ruoθ/) – *ruodhi* (/ruoði/). Lastly, the suffix *-ni* is attached mostly to the singular nouns ending with a voiceless obstruent like /tʃ/ and /t/.

(13) **Singular** **Plural**

osiep *osiepe*

A word	Morphemes	V.I	L.F
<i>osiepe</i>	LM: <i>osiep</i> [root][+count][+animate] FM: -e [num][pl]	LM: /osiep/ FM: /e/ [mid, front, unrounded][+short] /osiepe/	Friend(s)

(14) **Singular** **Plural**

guok *guogi*

A word	Morphemes	V.I	L.F
<i>guogi</i>	LM: <i>guok</i> [root][+count][+animate] FM: (g)-i[num][pl]	LM: /guok/ FM: (/g/)/ɪ/[close,front,unrounded][+short] /guoɡɪ /	Dog(s)

(15) **Singular Plural***rech rechni*

A word	Morphemes	V.I	L.F
<i>rechni</i>	LM: <i>rech</i> [root][+count] [+animate] FM: -ni [num][pl]	LM: /retʃ/ FM: /nɪ/ /retʃnɪ/	Fish

Replacement marking has both singular nouns and plural nouns marked as presented in Table 1. That is, in Luo, singular nouns take suffix *-o* and *-a*, while plural nouns, as aforementioned, take suffix *-e*, *-i*, and *-ni*. Replacement marking also involves mostly phonological adjustments in attaching both singular and plural markers. From table 1, the pair *tiel-o tiend-e* has a stem *tiel*, which allows attachment of the suffix *-o* to mark the singular. On the other side of plural formation, it allows the change of onset of the final syllable from voiced alveolar lateral approximant /l/ of the singular noun to voiced prenasalized alveolar /ⁿd/ to attach the plural suffix *-e*. Another pair is *bur-a buch-e*, whose stem root *bur* welcomes suffix *-a* as a plural marker but also allows change of onset of the final syllable from voiced alveolar trill /r/ of the singular noun to a voiceless postalveolar affricate /tʃ/ to attach plural suffix *-e*. Consider the analysis below;

(16) (a) **Singular**

A word	Morphemes	V.I	L.F
<i>tielo</i>	LM: <i>tiel</i> [root][+count] [+animate] FM: -o [num][sing]	LM: /tiel/ FM: /o/[mid,back,rounded][+short]/tielo/	A leg

(b) **Plural**

A word	Morphemes	V.I	L.F
<i>tiende</i>	LM: <i>tiend</i> [root][+count] [+animate] FM: -e [num][pl]	LM: /tiend/ FM: /e/[mid,front,unrounded][+short]/tiende/	Legs

(17) (a) **Singular**

A word	Morphemes	V.I	L.F
<i>bura</i>	LM: <i>bur</i> [root][+count] [-animate] FM: -a [num][sing]	LM: /bur/ FM: /a/[open,central,unrounded][+short]/bura/	A meeting

(b) **Plural**

A word	Morphemes	V.I	L.F
<i>buche</i>	LM: <i>buch</i> [root][+count] [+animate] FM: -e [num][sing]	LM: /butʃ/ FM: /e/[mid,front,unrounded][+short]/butʃe/	Meetings

Syllable Codas as Number Markers

Morphological number marking in Luo can also be expressed through a change in syllable coda, as it is in other Nilotic languages like Shillak. [Remijensen & Ayoker \(2019\)](#) argue that these are suffix less bases that are morphologically marked to mark both singular and plural. In Luo, syllable codas play a significant role in marking this distinction, as it is presented in the replacement marking of tripartite analysis below.

Singular	Plural	Gloss
<i>diel</i>	<i>diek</i>	Goat(s)
<i>dhianɡ</i>	<i>dhok</i>	Cattle(s)

(18) (a) Singular

A word	Morphemes	V.I	L.F
<i>diel</i>	LM: <i>die</i> [root][+count][-animate] FM: <i>-l</i> [num][sing]	LM: /die/ FM: /l/[+cons,+cor,+appr,+voiced]/diel/	A goat

(b) Plural

A word	Morphemes	V.I	L.F
<i>diek</i>	LM: <i>die</i> [root][+count][-animate] FM: <i>-k</i> [num][pl]	LM: /die/ FM: /k/[+cons, -cor, +cont]/diek/	Goats

(19) (a) Singular

A word	Morphemes	V.I	L.F
<i>dhianɡ'</i>	LM: <i>dhia</i> [root][+count][-animate] FM: <i>-nɡ'</i> [num][sing]	LM: / <i>ɖ</i> ia/ FM: / <i>ŋ</i> /[+cons, +nas, -cor]/ <i>ɖ</i> ia <i>ŋ</i> /	A cattle

(b) Plural

A word	Morphemes	V.I	L.F
<i>dhok</i>	LM: <i>dho</i> [root][+count][-animate] FM: <i>-k</i> [num][pl]	LM: / <i>ɖ</i> o/ FM: /k/[+cons, -cor,+cont]/ <i>ɖ</i> ok/	A cattle

In (18), alveolar lateral /l/ marking singular changes to velar stop /k/ for plural. Meanwhile, in (19) velar nasal /ŋ/, which morphologically marks singular, is replaced by velar stop /k/ to mark plural. The data also exhibit vowel alternation that takes place before the attachment of the plural marker. That is, in (19), vowel /ia/, which is a diphthong, changes to /o/, which is the mid-back rounded vowel, to attach /k/ for pluralization. Coda alternation is not an obvious case for number marking in Luo, as only two examples were found to explain this morphophonological process. Nevertheless, all the singular codas /l/ and /ŋ/ only change to velar stop /k/.

Voicing and Devoicing

Voicing and devoicing play a role in plural formation in Luo, particularly in noun morphology. This is to say, in some cases, voiceless consonants change to voiced consonants to form a plural, in the same way voiced consonants become voiceless consonants to form a plural. This change is only subject to root final consonants. Consider Table 2.

Table 2: Voiced and Voiceless Aspects of Number Marking

	Singular	Plural	Gloss
Voiceless to voiced (Voicing)	bat	bed-e	Arm
	luθ	luɖ-e	Walking stick
	arip	arib-e	Milky way
	juok	juog-i	Sorcerer
Voiced to voiceless	kid-l	kit-e	Stone

(devoicing)	oke b -e	oke p -e	Tin can
	tʃog-o	tʃok-e	Bone

From table 2, voiceless alveolar stop /t/, which is a coda of a monosyllabic singular noun, changes into voiced alveolar stop /d/, an onset of the final syllable in the disyllabic plural noun, to attach the plural morpheme *-e*. Meanwhile, a voiceless dental fricative /θ/, a coda of a monosyllabic singular noun, changes into a voiced dental fricative /ð/, an onset of the final disyllabic plural noun, to attach the plural morpheme *-e*. In another example, the voiceless bilabial stop /p/ of a singular noun becomes the voiced bilabial stop /b/, an onset of the final syllable of a plural disyllabic noun to attach the plural morpheme *-e*. Finally, the change from voiceless to voiced to attach plural morphemes is exemplified by the change from a voiceless velar stop /k/, a coda of a monosyllabic singular noun, to a voiced velar stop /g/, an onset of a disyllabic plural noun, to attach the plural morpheme *-i* as seen in Table 2 above.

Table 2 also shows the counterpart, where voiced consonants change to voiceless consonants to attach plural morphemes. That is, the voiced velar stop /d/, an onset of the final syllable of the singular noun, becomes voiceless velar stop /t/ in the onset position of the final syllable of a plural noun to attach the plural morpheme *-i*. Also, voiced bilabial stop /b/ in an onset position of the final syllable of a singular noun becomes voiceless bilabial stop /p/ at the same position in the plural noun to attach the plural morpheme *-e*. Finally, voiced velar stop /g/ in an onset position of the final syllable of a singular noun becomes voiceless velar stop /k/ in a plural noun at the same position to attach the plural morpheme *-e*. Something to note here is that the change only allows cognate pairs.

The most intriguing observation in voiced to voiceless data is the broadening use of plural morphemes *-e* and *-i* to also mark singular, as in *kid-i* - *kit-e* 'stone(s)', *okeb-e* - *okep-e* 'tin can'.

Voiceless Postalveolar Affricate and Plural Formation

In this aspect, data suggest that there are some words in which a voiceless post-alveolar affricate /tʃ/ is inserted before the attachment of plural markers. This phonological adjustment most notably triggers final syllable change and stem modification in some cases.

Table 3: Voiceless Postalveolar Affricate in Plural Formation

Singular	Plural	Singular IPA	Plural IPA	Gloss
bura	buche	/bura/	/butʃe/	Meeting(s)
agulu	aguche	/agulu/	/agutʃe/	Pot(s)
apuoyo	apuoche	/apuojo/	/apuotʃe/	Hare(s)
okoyo	okoche	/ɔkojo/	/ɔkotʃe/	Nile perch(es)
anguro	anguche	/angurɔ/	/angutʃe/	Pig(s)
sibuor	sibuoche	/sibuɔr/	/sibuotʃe/	Lion(s)
wach	weche	/watʃ/	/wetʃe/	Word(s)
gari	geche	/garɪ/	/getʃe/	Vehicle(s)
weru	kweche	/kweru/	/kwetʃe/	Hand hoe(s)
liel	lieche	/liɛl/	/lietʃe/	Funeral(s)
sufuriia	sufurieche	/sufuri:a/	/sufurietʃe/	Cooking pot(s)
wuoche	wuoch	/wuotʃe/	/wuotʃ/	Shoe(s)

From table 3, as far as final syllable change is concerned, data show that the onset of the final syllable of the singular noun is replaced by the voiceless postalveolar affricate /tʃ/ to attach the plural morpheme, eg, /bura/- /butʃe/. However, in /sibuɔr/- /sibuotʃe/ the coda of the final syllable of an unmarked singular noun, voiced alveolar trill /r/ is also replaced by voiceless postalveolar affricate /tʃ/ to attach the plural morpheme *-e*. The same happens to /liɛl/- /lietʃe/ where alveolar lateral /l/ is replaced by voiceless postalveolar affricate /tʃ/ to attach the plural morpheme *-e*. On the other hand, stem modification comes as a result of the attachment of a plural morpheme to the singular

monosyllabic noun, which already has a coda of a voiceless postalveolar affricate to attach the plural morpheme. This changes the nuclear of the monosyllabic singular noun /a/ a open central unrounded short vowel to /e/ a mid-front unrounded short vowel which is the nuclear of the first syllable of the disyllabic plural noun as in /watʃ/- /wetʃe/. In contrast, a disyllabic marked singular noun is also subjected to stem modification from /a/ a open central unrounded short vowel nuclear of the first syllable to /e/ a mid-front unrounded short vowel, which is the nuclear of the first syllable of the disyllabic plural noun that aids the attachment of voiceless postalveolar affricate as in /garɪ/- /getʃe/.

Prenasalization in Plural Marking

Prenasalization in Luo plural formation marks another phonological process, which is evident and resonant to the attachment of plural markers. On prenasalization, one might have contrasting views on what should be regarded as a prenasal consonant, but prenasal consonants are phonetic sequences of a nasal followed by a consonant, which function unitarily as a single segment (Herbert, 1975). Additionally, this sequence is commonly of a nasal consonant and a voiced stop. The impact of prenasal consonants on plural formation in Luo can be drawn from a final open syllable of a singular noun and a final closed syllable of a singular noun.

Table 4: Prenasalization and Plural Formation

Singular	Plural	Singular IPA	Plural IPA	Gloss
bam	bembe	/bam/	/bɛ ^m b-e/	Lap(s)
osipital	osipitende	/osipital/	/osipitɛ ⁿ d-e/	Hospital(s)
rabuon	rabuonde	/rabwɔn/	/rabwɔ ⁿ d-e/	Potato(es)
tielo	tiende	/tielo/	/tiɛ ⁿ d-e/	Leg(s)
tol	tonde	/tɔl/	/tɔ ⁿ d-e/	Rope(s)
kalaam	kalembe	/kala:m/	/kalɛ ^m b-e/	Pen(s)
kuon	kuonde	/kwɔn/	/kwɔ ⁿ d-e/	Ugali
lum	lumbni	/lum/	/lu ^m bni/	Grass(s)
yien	yiende	/jiɛn/	/jiɛ ⁿ d-e/	Firewood(s)
tong'	tonge	/tɔŋ/	/tɔ ⁿ g-e/	Egg(s)
skuul	skuunde	/sku:l/	/sku ⁿ d-e/	School(s)
oluthkuon	oluthkuonde	/oluθk ^w ɔn/	/oluθk ^w ɔ ⁿ d-e/	Spatula
otanda	otende	/ota ⁿ da/	/ote ⁿ d-e/	Bed(s)
okombe	okombni	/ɔkɔ ^m bɛ/	/ɔkɔ ^m bni/	Cup(s)

From table 4, a final open syllable of a singular noun which includes a singular marker is replaced by a prenasal consonant and plural marker in forming a plural noun; eg, /tiel-o/-/tiɛⁿd-e/. However, there are singular nouns which inherently have prenasal consonants before singular markers; eg, /otaⁿd-a/- /oteⁿd-e/. These nouns retain prenasals before attaching plural markers when forming plural nouns. Conversely, a singular noun with a final closed syllable gives two realizations. The first one is the syllable word having a voiced alveolar lateral approximant /l/ as coda, which is replaced by a prenasal consonant before attaching a plural marker in plural formation; [tɔl]- [tɔⁿd-e]. The second one is the final syllable and a syllable word, both ending with nasal sounds, namely, voiced bilabial nasal /m/, voiced alveolar nasal /n/, and voiced velar nasal /ŋ/. Voiced bilabial nasal /m/ receives voiced bilabial stop /b/ while voiced alveolar nasal /n/ receives voiced alveolar stop /d/ for prenasal formation before attaching plural markers for plural formation as in [bam]- [bɛ^mbɛ], [rabwɔn]- [rabwɔⁿdɛ], and [kala:m]- [kalɛ^mbɛ]. Each nasal between /m/ and /n/ has welcomed a consonant with which they share the same place of articulation. This is the same as voiced velar nasal, which changes to a prenasalized voiced velar stop to attach the plural marker.

Dental Fricative Substitution

This phonological aspect involves alternation between the voiceless dental fricative /θ/ and the voiced dental fricative /ð/. Consider Table 5 below.

Table 5: Dental Fricative and Number Marking

Singular	Plural	Singular IPA	Plural IPA	Gloss
luth	lutdh-e	/luθ/	/luðe/	Walking Stick(s)
puodh-o	puoth-e	/puɔðo/ or /pwoðo/	/pwoθe/	Farm(s)
moo	modh-i	/mɔ:/	/mɔði/	Oil
ruoth	ruodh-i	/ruɔθ/ or /ruoθ/	/ruɔði/	Lord(s)
ruath	ruedh-i	/ruaθ/	/rueði/	Bull(s)
yath	yedh-i	/jaθ/	/jeði/	Tree(s)

Table 5 shows that a voiceless dental fricative /θ/, which is a coda of a singular syllable noun, becomes a voiced dental fricative /ð/, an onset of the final syllable of the disyllabic plural noun before attaching plural markers *-i* and *-e*; e.g. /luθ/- /luðe/, /ruɔθ/- /ruɔði/. Surprisingly, there is one word which reverse the process i.e a voiced dental fricative /ð/ which is the onset of the final syllable of the singular noun before singular markers is replaced by voiceless dental fricative /θ/ which becomes an onset of the final syllable of the plural noun and enhance the attachment of the plural marker *-e*; e.g. /pwoðo/- /pwoθe/. Nevertheless, the alternation between these two sounds appears to be morphologically conditioned as the voicing of the voiceless dental fricative only occurs in the presence of the plural marker *-i* and *-e*. That is to say that morphological structure provides the context for fricative voicing.

Pluralization Guided by Vowel Harmony

Plural marking in Luo is also guided by the vowel harmony process in some words where plural morphemes *-e*, *-i*, and *-ni* harmonize with a root vowel. Consider Table 6 below.

Table 6: Pluralization and Vowel Harmony

Singular	Plural	Singular IPA	Plural IPA	Gloss
wang'	weng'-e	/waŋ/	/weŋe/	eye(s)
wach	wech-e	/watʃ/	/wetʃe/	Word(s)
bao	bep-e	/bao/	/bepe/ or	Timber(s)
pap	pew-e	/pap/	/pewe/	Field(s)
gari	gech-e	/gari/	/getʃe/	Car(s)
yath	yedh-i	/jaθ/	/jeði/	Tree(s)
lak	lek-e	/lak/	/leke/	Tooth/teeth
pal-a	pel-ni	/pala/	/pelni/	Knife/knives
law	lew-ni	/law/	/lewni/	Arm(s)
otand-a	otend-ni	/otanda/	/otendni	Bed(s)

In Table 6, vowel harmony happens when a root vowel changes from /a/, the open central unrounded vowel of the singular noun, to /e/, the mid front unrounded vowel, when plural morphemes (*-e*, *-i*, and *-ni*) are attached. Nevertheless, first-syllable nuclear vowel alternation can also fit the description of the data. This suggests that internal vowel alternation can be driven by morphophonological rules linked to plurality.

Phonological Realities in Adjectival Number Marking

Luo's adjectival plural formation involves vowel harmony among others, especially in the shift of the initial vowel of the adjective stem when a plural suffix is added. For instance, the adjective /ratɛŋ/ 'black' (SG) becomes /rotɛŋg-e/ in the plural form. Consider Table 7.

Table 7: Morphophonology in Adjectival Plural Formation

Singular	Plural	IPA (Singular)	IPA (Plural)
rachar	rocher-e	/ratʃar/	/rotʃer-e/
rakwar	rokwer-e	/rakwar/	/rokwer-e/
rateng'	roteng-e	/ratɛŋ/	/rotɛŋg-e/
duong'	dong-o	/duɔŋ/	/dɔŋg-o/
thin	thind-o	/θin/	/θi ⁿ d-o/

(20) Singular Plural

rachar rochere

A word	Morphemes	V.I	L.F
<i>rochere</i>	LM: <i>rocher</i> [root] FM: <i>-e</i> [num][pl]	LM: /rotʃer/ FM: /e/[mid, front, unrounded][+short]/rotʃere/	white

(21) Singular Plural

thin thindo

A word	Morphemes	V.I	L.F
<i>thindo</i>	LM: <i>thin</i> [root] FM: (d)- <i>e</i> [num][pl]	LM: /θi ⁿ d/ FM: /o/[mid, back, rounded][+short]/θi ⁿ do/	Small

From Table 7, the open central vowel /a/ in the singular stem changes to the mid-back vowel /o/ in the plural, showing a pattern of vowel raising or backing. Similar alternations are seen in /rakwar/ → /rokwere/ and /rachar/ → /rochere/. This pattern suggests a type of regressive vowel harmony, likely motivated by the features of the plural suffix vowels /e/. The harmony affects the root vowel, aligning it in terms of backness or height with the suffix vowel.

Nevertheless, data from Table 7 shows one example where the adjective plural morpheme *-o* is added to the singular adjective stem after the insertion of a prenasalized consonant for plural formation. This is in /θm/ → /θindo/, where the addition of the plural marker triggers prenasalization of the root-final consonant from /n/ to /ⁿd/, resulting in a homorganic relationship between voiced alveolar nasal and voiced alveolar plosive. However, in /duɔŋ/-/dɔŋgo/ there is syllable restructuring, where the nuclear diphthong of the first syllable of singular adjectives /uɔ/ reduces to /ɔ/ in plural formation.

Conclusion

This study presents an analysis of morphophonological number marking in Luo, a Western Nilotic language. Findings demonstrate that both morphological and phonological processes complement each other in forming number inflection value, as it is consistent with other Nilotic and broader Nilo-Saharan languages. The study has shown that suffixation remains a dominant number marker; however, it is rarely sufficient on its own. Phonological processes such as coda alternation, voicing and devoicing, insertion, prenasalization, and vowel harmony operate complementarily with suffixation to mark number in both nouns and adjectives.

Most notably, the study also discusses a tripartite number marking system, where some nouns are marked for singular only, others for plural only, and others for both singular and plural. This system reflects a typologically significant pattern in Nilo-Saharan languages (Dimendaal, 2000). Findings also highlight the irregularity and unpredictability that often characterize number marking in this language family.

The study has also shown that phonological processes such as change in syllable coda, insertion, internal sound changes, vowel harmony, and voicing and devoicing are conditioned by number marking needs, reaffirming the claim that morphological and phonological components in this case are working interdependently rather than separately.

Furthermore, the study explains morphophonological number marking in adjectives, where suffixation, vowel harmony, and prenasalization work in conjunction.

Generally, this study affirms that Luo number marking is a component of many phonological processes and morphological realities intertwined. These findings not only provide an understanding of Luo but also contribute to broader discussions on typological patterns of inflection in Nilo-Saharan languages. The study recommends further research on number inflection in Luo and across the language family with a focus on phonological aspects such as tone, vowel length, and vowel quality, which appear to be underexplored and yet might play a crucial role in number marking.

Abbreviations

SG - Singular

PL - Plural

V - Vowel

ATR - Advance Tongue Root

DM - Distributed Morphology

LM - Lexical Morpheme

FM - Functional Morpheme

PF - Phonological Form (Phonological Terminal Node)

LF - Logical Form

VI - Vocabulary Item

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