

Minimality and Morae in Malila (M.24)

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1. Introduction¹

1.1. The language

Malila, called /ɪfɪmáɪlɪ/ by its speakers, is a Bantu language of the Lake Corridor, spoken in the Mbeya Region in south-west Tanzania. It is classified as M.24 by Guthrie (1967-71). According to Gordon (2005), the language has an estimated 65,000 speakers. Closely related and geographically adjacent languages in the M.20 group are Ndali, Nyiha, and Safwa.

To the best of my knowledge, there are no linguistic publications on Malila. Mention is made of Malila in several regional surveys, and a wordlist and preliminary notes on the language exist (Maho and Sands, 2003:173). My initial study on this language, which started in 2004, has revealed a number of interesting topics in the sound system, particularly the vowels. One of these concerns the area of vowel-length alternation in the augment-prefix combinations.²

1.2. The topic

Malila nouns have both a noun-class prefix (PX)³ and a pre-prefix or augment (AUG) in their citation form. In most classes, the noun-class prefix consists of a CV-syllable, whereas the augment consists of a V-syllable. Noun stems are therefore normally preceded by an augment-plus-prefix (AUG-PX) combination of VCV-.

- (1) umú-jeni⁴ ‘visitor’
 ama-jéembe ‘hoe’

Classes 5 and 9/10, however, have alternating vowel lengths in the AUG-PX, as is shown in the following examples.

- (2) cl. 5 í-kuló ‘liver’
 í-junza ‘egg’

 cl. 9/10 íín-sama ‘lion’
 im-bóléla ‘manure’

The question is how to interpret this vowel-length alternation.

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² The principal informant with whom I was able to work out the details of this vowel-length alternation is John Mbeyale. I have always very much appreciated our research sessions on his language and thank him for our positive and pleasant collaboration.

³ Abbreviations are as follows: AUG augment, AUG-PX augment-prefix combination, ATR Advanced Tongue Root, C consonant, cl. class, PX prefix, V vowel.

⁴ The International Phonetic Alphabet is used for the transcription of the data, except that <j> represents IPA /j/ and <y> represents IPA /j/.

In class 5, the noun-class prefix preceding consonant-initial stems could consist of the vowel *ɪ*-, preceded by the augment, *ɪ*-, together *ɪɪ*- underlyingly. In that case, a process of vowel shortening should be proposed for those words which have a short AUG-PX. Conversely, there could have been a historical merger of augment and prefix in such a way that the underlying form of the AUG-PX consists of a short vowel synchronically. In that case, a process of vowel lengthening should be proposed to account for the long AUG-PX vowels.

In classes 9/10, the noun-class prefix consists of prenasalisation to the stem, *N*-,⁵ and preceding that, the augment *ɪ*-, together *ɪN*- underlyingly. If *ɪN*- is subject to compensatory vowel lengthening (§2.1), the default surface realisation is *ɪɪN*-, and a process of vowel shortening should account for those words which have *ɪN*-. Conversely, if there is a constraint on compensatory lengthening in that it cannot occur word-initially (in the same way as it does not apply word-finally), then the default surface realisation is short, and a process of lengthening should account for the forms with the long vowel in the AUG-PX, *ɪɪN*-.

Both possibilities will be considered, and additional arguments will be taken into account, namely augment-vowel lengthening in other classes, and vowel shortening in other contexts.

Malila has both contrastive and compensatory vowel length (§2.1), as attested widely in Lacustrine Bantu languages (Bastin 2003). However, there are certain constraints on lengthened vowels, so vowel shortening takes place under certain conditions (§5). On the other hand, there is vowel lengthening in order to satisfy a four-morae minimality constraint (see §4 and §6).

Constraints on the occurrence of long vowels have been mentioned here and there in the literature: Botne (1998) on ChiNdali; Daelemans (1959) on KiKongo; Kisseberth and Abasheikh (2004) on ChiMwiini; Odden (1996) on KiMatumbi. In most of these descriptions, this topic was not the main focus of the description and has therefore not been elaborated in great depth.

The Malila facts are the same as those mentioned by Daelemans (1959:96) for KiKongo (H.10), and by Kisseberth and Abasheikh (2004) for ChiMwiini (G.41). I have not encountered any description nor examples of what I analyse in Malila as vowel lengthening due to a minimality constraint.

Before the sections on the behaviour of long and short vowels, I give some background information on the vowel system, the noun-class system, and the tone system of Malila (§2).

2. Background information

2.1. The vowel system

Malila has a 7/9 vowel system: seven contrastive vowels with nine surface realisations, exhibiting ATR vowel harmony.

(3)	[-ATR]		[+ATR]
	ɪ ʊ		i u
	ɛ ɔ		[e] [o]
	a		(a)

The vowels /ɛ/ and /ɔ/ are contrastive, and have [e] and [o] as allophonic [+ATR] variants, conditioned by the [+ATR] vowels /i/ or /u/ elsewhere in the word. The vowel /a/ is transparent: it does not change its phonetic quality in [+ATR] environment, nor does it block vowel harmony.

In addition to this basic vowel system with ATR vowel harmony, there is both contrastive and compensatory vowel length. Examples of contrastive vowel length are the following verb infinitives.

⁵ In the language examples, the prenasalisation is represented by a nasal consonant: *m* preceding labial consonants, and *n* preceding all other consonants. A capital N is used for prenasalisation in general, unspecified for place of articulation.

(4)	kú-pata	‘to hate’	kú-tɛga	‘to set a trap’
	ku-páata	‘to peel, shell’	ku-téega	‘to get lost’

Compensatory vowel length is found in the following environments: preceding -NC and following Cw- or Cy-, both within morphemes and across morpheme boundaries, but not finally following Cw- or Cy-.

(5)	-NC	axa-páango	‘story’ (12) ⁶
		ám-iinzi	‘water’ (6)
		ím-bíla	‘jackal’ (9/10)
	Cw-	ín-kwaapa	‘armpit’ (9)
		úm-w-eezi	‘moon, month’ (3)
		umw-óoto	‘fire’ (3)
	but:	íi-zwa	‘eagle’ (5)
	Cy-	ku-zyóuxa	‘to come to life’ (15)
		ily-úuba	‘sugar cane’ (5)

2.2. The noun-class system

Malila has noun classes 1-18 and 20 (Meeussen 1967). For each class, an augment and a noun-class prefix precede the noun stem. Verb infinitives (class 15) have no augment.

Each augment-prefix combination with a [+high] vowel has a [-ATR] and a [+ATR] variety, conforming to the ATR-quality of the vowels of the noun stem. The [-ATR] form is the underlying form. The examples below present both [-ATR] and [+ATR] forms of some of the noun classes.

(6)	cl. 3	umó-βili	‘body’
		úmu-tiinho	‘ladle’
	cl. 8	ívi-βanza	‘congregations’
		ivi-péeni	‘knives’
	cl. 14	úβu-pɛɛmba	‘sorghum’
		úβu-siku	‘night’

2.3. Tone

For tone placement in Malila, it is necessary to count morae. Short syllables are monomoraic and can carry only a single tone; long syllables are bimoraic and can bear two tones. Canonical noun and verb stems consist of two syllables: -CVCV, or -CVVCV; this means that they have two or three morae.

Since the minimality requirement seems to be motivated by tonal melodies, I present the basic tonal melodies of nouns and verb infinitives in their citation forms first.

Verb infinitives have no contrastive tonal melodies but they carry a High tone on the antepenultimate mora; see the examples of vowel length above in (4). This means that the H tone is sometimes realised on the root or stem, and sometimes on the class prefix.

⁶ Numbers preceding or following glosses represent the noun class(es) to which the lexical item belongs.

Nouns in their citation forms exhibit four contrastive tonal melodies. Each tone occupies one mora.

1. L L H L
2. L H L L
3. H ... L H L⁷
4. H ... L L L

Each melody is described below.

L L H L: H tone on the penultimate mora:

- (7)
- | | | |
|----------|------------------------------------|-------------------|
| cl. 7/8 | ifí-dúγwi / ivi-dúγwi ⁸ | ‘water source’ |
| cl. 5/6 | r-kóókó / ama-kóókó | ‘big insect, sp.’ |
| cl. 5/6 | ily-aándi / am-aándi | ‘ridge’ |
| cl. 9/10 | im-bóléla | ‘manure’ |

L H L L: H tone on the antepenultimate mora:

- (8)
- | | | |
|-----------|-------------------------|-----------|
| cl. 7/8 | ifí-xanu / iví-xanu | ‘animal’ |
| cl. 7/8 | ifí—jíjiji / ivi-jíjiji | ‘village’ |
| cl. 12/13 | axa-páango / utu-páango | ‘story’ |
| cl. 5/6 | r-góǵjelo / ama-góǵjelo | ‘thumb’ |

H ... L H L: Two H tones, one on the penultimate mora, and one on the noun-class prefix mora, i.e. the one just preceding the noun stem. However, there must be at least one L tone between the two H tones, which means that with bimoraic stems, the first H tone is not realised on the noun-class prefix, but one syllable earlier, namely on the augment (cf. the first example in (9) below). There are examples with as many as three L tones between the two H tones. When the LH sequence in this melody immediately follows a H tone and is realised on a long vowel, it generally surfaces as a downstepped H tone: H.LH.L > [H.¹HH.L] (cf. ‘calabash’).

- (9)
- | | | |
|-----------|--|-------------|
| cl. 5/6 | íi-gúle / áma-gúle | ‘tick’ |
| cl. 9/10 | ín-dogómi | ‘donkey’ |
| cl. 9/10 | ín-kungúólo | ‘crow’ |
| cl. 5/6 | í-jǵngǵóólo / amá-jǵngǵóólo | ‘millipede’ |
| cl. 11/10 | uló- ¹ páále / ím- ¹ páále | ‘calabash’ |

H ... L L L: H tone on the first mora of the noun, i.e. on the augment. The examples in (10) illustrate words of four, five, six, and seven morae with this tonal melody.

- (10)
- | | | |
|---------|-------------------------------|-------------------------|
| cl. 6 | áma-futa | ‘oil’ |
| cl. 6 | ám-iinzi | ‘water’ |
| cl. 5/6 | í-junza / áma-junza | ‘egg’ |
| cl. 5/6 | í-xaambaku / áma-xaambaku | ‘plant, sp. (for rope)’ |
| cl. 7/8 | ifí-badalimgo / ivi-badalimgo | ‘lower door frame’ |

⁷ The dots in the third and fourth tonal melodies indicate that there may be intervening L tones.

⁸ Unlike in verbs, a /y/ or /w/ following a consonant in the word-final syllable is not moraic.

If there were less than four morae for tone placement, L L H L and H L H L could not be differentiated, and L H L L and H L L L could not be differentiated. So, four morae is indeed the minimum needed to differentiate these four tonal melodies.

A canonical noun root or stem contains two syllables, which means two morae if the syllables are short, or three morae if there is a long vowel in the penultimate syllable. Preceding the stem is the AUG-PX, which in most cases also contains two morae. Most nouns, therefore, have at least four or five morae; this is enough for all four tonal melodies on nouns to be differentiated.

3. Short and long AUG-PX vowels

It appears that, on the surface, some words have short, and others have long augment vowels. This happens predominantly in classes 5 and 9/10. At first sight, it is not clear what the default surface length should be. In all other classes, the surface default is clearly a short vowel, but there are also examples with a long augment vowel. An inventory is taken in this section.

The AUG-PX of class 5 can be short: *ɪ-/i-*, or long: *ii-/īi-*; similarly, the AUG vowel in classes 9/10 can be short or long: *ɪN-/iN-* or *iiN-/īiN-*.

(11)	<i>short AUG-PX vowel</i>		<i>long AUG-PX vowel</i>	
cl. 5	ɪ-jéembe	‘hoe’	ii-fuku	‘heat’
	ɪ-joomvu	‘cowbell’	ii-kulu	‘liver’
	ɪ-daadu	‘maize beer’	ii-gúle	‘tick’
	i-bumúunda	‘local white bread’	ii-βo	‘war, fight’
	ɪ-βuututu	‘bird, sp.’	ii-papa	‘lung’
(12)	<i>short AUG vowel</i>		<i>long AUG vowel</i>	
cl. 9/10	ín-haaya	‘home’	iiN-sale	‘skin cutting’
	m-bínzɔ	‘small axe’	iiN-bíla	‘jackal’
	ím-beesu	‘fog’	iiN-sama	‘lion’
	i-futáali	‘stir-fried dish’	iiN-sɪ	‘land, earth’
	in-dundúulu	‘waist beads’	iiN-pwa	‘wildfire’

The data I have gathered contain 136 words belonging to class 5 and 178 words belonging to classes 9/10 or 11/10. Nearly 70% of the class 5 words have a short AUG-PX vowel, and just over 30% have a long AUG-PX vowel. Similarly, in classes 9/10 and 11/10, just over 70% of the words have a short AUG vowel and nearly 30% have a long AUG vowel.

Looking at the examples in the left column above, it is evident that whenever the noun stem has at least three morae, the AUG-PX has one mora only; the resultant citation form contains minimally four morae. However, when the noun stem is shorter, i.e. consists of two morae, as in the right column, the AUG-PX consists of two morae, which, once again, results in a total of four morae. And finally, when the noun stem is monomoraic as in ‘war’, ‘land’, or ‘wildfire’, the AUG-PX is bimoraic, and the citation form is trimoraic.

In the following sections, I will discuss the two contrastive hypotheses: vowel lengthening, and vowel shortening. The question is whether the 70% of the nouns with the short AUG-PX vowel or the 30% with the long AUG-PX vowel constitute the basic surface forms. In the first analysis, a process of lengthening would need to be posited; in the second analysis, a process of shortening would take place. Both are discussed in the sections below.

Additionally, examples of words from other classes containing a long augment vowel include:

(13)	cl. 1/2	uúmu-fwe	aáβa-fwe	‘dead person’
	cl. 3/6	uómu-fwɔ	aáma-fwɔ	‘knife’
	cl. 4	uúβu-fwe		‘death’
	cl. 7/8	iifí-sa	iiví-sa	‘kindness’
	cl. 11	uúlu-kwi		‘firewood’
	cl. 12 (diminutive)	aáxa-swɪ		‘fish’

It appears that all these words have monomoraic roots. Lengthening the augment results in a trimoraic AUG-PX, which yields a surface citation form of four morae. The assumption is that in these words, the augment vowel is lengthened to conform to the minimality requirement of four morae.

4. Vowel lengthening

The first possible interpretation of the vowel-length alternation assumes that the underlying form contains a short vowel, as found in the examples in the left column in (11) and (12) above. In the great majority of the citation forms of nouns in classes 5 and 9/10, the AUG-PX vowel is monomoraic. For class 5 nouns, this would mean that historically, augment and prefix have merged; and for classes 9/10, that there is a general constraint on compensatory lengthening in that it would not apply utterance-initially.

I will now link word length—in terms of number of morae—to the four contrastive tonal melodies, because these melodies cannot be realised on less than four morae. So, based on the assumptions just mentioned, the augment vowel remains short when a noun stem consists of three or more morae (i.e. minimally -CVVCV, -CVCVCV), because including the AUG-PX, the citation form contains at least four morae. However, a bimoraic noun stem (-CVCV) preceded by a monomoraic AUG-PX vowel does not satisfy this minimality requirement of four morae. The repair strategy would then consist in lengthening the initial vowel.

There are also shorter nouns, namely those with a monosyllabic, monomoraic -CV stem. A VCV- AUG-PX attached to a -CV noun stem would yield a total of three morae. The worst-case scenario for the minimality requirement would be a monosyllabic, monomoraic noun stem in classes 5 or 9/10, preceded by a monomoraic AUG-PX. The result would be a bimoraic citation form.

What actually happens is the following. With monosyllabic, monomoraic noun stems in classes 5 and 9/10, the augment is lengthened, yielding a three-morae citation form. (In all other classes, the VCV- AUG-PX is lengthened to VVCV-, yielding the preferred four-morae citation form; see the examples in (13) and (24)).

The following are examples of monosyllabic, monomoraic noun stems in classes 5 and 9/10.

(14)	cl. 5	íi-kwi	‘tree, wood’
		íi-βo	‘quarrel, fight, war’
		íi-vi	‘faeces’
		íi-twe	‘head’
		ír-fwɔ	‘big knife’
		íi-zwi	‘voice, word’
		íi-zwa	‘eagle’
		íi-zi	‘root’
		íi-ga	‘crack in foot’
		íi-γwe	‘stone’

(15)	cl. 9/10 or (11)/10	ím-sɪ	‘country, earth, land’
		ím-bwa	‘dog’
		ím-swɪ	‘fish’
		íin-kwi	‘firewood’
		íim-pwa	‘wildfire’
		íin-swa	‘termites’

In the examples in (14) and (15), the augment is lengthened and the total adds up to three morae per word. There is no strategy to produce four-morae citation forms with these monomoraic stems in classes 5 and 9/10 by extra lengthening of the AUG-PX; i.e. there is a higher-ranking constraint against trimoraic syllables.

The fact that these words have three morae only has consequences for the number of possible tonal melodies. In the previous section, I mentioned that with less than four morae for tone placement, L L H L and H L H L on the one hand, and L H L L and H L L L on the other hand, could not be differentiated. In fact, in this small set of three-morae nouns, there is indeed a neutralisation of tonal melodies in such a way that there are only two contrastive melodies: L H L (neutralisation of L L H L and H L H L) and H L L (neutralisation of L H L L and H L L L). In class 5 and in classes 9/10, there are representatives of both these tonal melodies, and only these.

Class 5 words have plurals in class 6. A monomoraic stem preceded by a bimoraic AUG-PX yields three morae. Since the minimality requirement is four morae, the augment is lengthened, once again as a repair strategy. Still, however, the tonal melodies remain the same as in the class 5 singular: there are two tone patterns only.

(16)	íi-zi	‘root’	pl: aamá-zi
	íi-ga	‘cracks in foot’	pl: aamá-ga
	íi-βo	‘quarrel’	pl: aáma-βo
	íi-vi	‘faeces’	pl: aáma-vi
	íi-ɣwe	‘stone’	pl: aamá-ɣwe
	íi-twe	‘head’	pl: aáma-twe
	íi-kwi	‘tree’	pl: aáma-kwi
	íi-zwa	‘eagle’	pl: aamá-zwa
	íi-zwi	‘voice, word’	pl: aamá-zwi

In conclusion, this hypothesis of vowel lengthening as an explanation for the alternating vowel length in the AUG-PX (particularly in classes 5 and 9/10, but less frequently also in other classes) is based on the following assumptions:

- an underlyingly monomoraic AUG-PX for class 5, having resulted from a historical merger of augment and prefix;
- a constraint against compensatory vowel length in word-initial position in classes 9/10;
- an underlyingly V-CV AUG-PX in other classes;
- a minimality requirement of four morae.

The hypothesis states that a repair strategy lengthens the initial augment vowel, which can produce four-morae citation forms out of three, but only three-morae citation forms out of two, because of a higher-ranking constraint against trimoraic syllables.

5. Vowel shortening

The second possible interpretation of the variation between short and long AUG-PX vowels is to consider the long vowels as basic, and to posit a process of shortening by which the long AUG-PX

vowels become short under certain conditions. This means that a majority of around 70% of the nouns in classes 5 and 9/10 undergo this process of vowel shortening.

Independently of the issue at stake, there is evidence that both contrastively and compensatorily long vowels can be reduced to become short vowels. This is due to two general constraints which operate within a prosodic unit (further study is needed in order to define this prosodic unit precisely in syntactic terms):

- A phonological word cannot contain two syllables with long vowels. Repair strategy: shorten the leftmost long syllable.
- A long vowel can only occur in the penultimate or antepenultimate syllable of a phonological word. Repair strategy: shorten the long syllable in a non-allowed position, i.e. when it is too far away from the right edge of the phonological word.⁹

In fact, these two constraints can be succinctly expressed together, as done by Daelemans in his “four moras law”; namely, “a long vowel does not pass the fourth mora (reckoned from the word end)” (Daelemans 1959:96). The long vowel that violates the constraint is shortened.

Such vowel shortening takes place in a variety of environments in Malila. Five such environments are described below.

1. The underlined vowels in the nouns in (17) should be subject to compensatory lengthening (cf. §2.1), but they are not lengthened because of the constraint against two long vowels within one word and because they are too far away from the word end.

(17)	cl. 9/10	in- <u>d</u> undúulu	‘waist beads’
	cl. 5	i-fw <u>e</u> léeji	‘trench’
	cl. 7	ij <u>i</u> -mfwíku	‘hiccoughs’
	cl. 5	í-j <u>o</u> ngolólo	‘millipede’

2. Nouns followed by a possessive pronoun form a prosodic unit (but not when followed by other modifiers, like adjectives, numerals, demonstratives). Long vowels in the noun stem or the augment (as in the left column in (18)) are shortened when the noun is followed by the possessive pronoun.¹⁰ The possessive pronoun has a long vowel, so any earlier long vowel within the prosodic unit must be shortened. In addition, the long vowel of the noun is too far away from the right edge of the phrase. The shortened vowels in the second column are underlined.

(18)	citation form		noun + possessive pronoun	
	úmwaana	‘child’	úmwa <u>n</u> a ywáani	‘my child’
	ijéembe	‘hoe’	ijé <u>m</u> be lyáaxo	‘your hoe’
	ugóoli	‘goalkeeper’	ug <u>o</u> lí ywaakwe	‘his goalkeeper’
	amadéeni	‘debts’	amad <u>e</u> ni gaaβo	‘their debts’
	ínkuko	‘chicken’	ínkuk <u>o</u> yíitu	‘our chicken’
	uβúuzu	‘thread’	uβú <u>u</u> zu βwáani	‘my thread’
	kuβaázya	‘studying’	kuβ <u>a</u> zyá kwiiju	‘your (pl) studying’

⁹ These same two constraints are found in ChiMwiini (G.41), and have been expressed as follows: “There are only two environments where a long vowel may occur: in the penult of the word or the antepenult” and “a long vowel may not occur in the antepenult and the penult at the same time.” (Kisseberth and Abasheikh 2004:xvii).

¹⁰ The noun carries a final L tone when the possessive pronoun has a H tone (1st and 2nd person sg), and a final H tone when the possessive pronoun has no H tone (3rd person sg, and 1st, 2nd, and 3rd person pl).

(23)	cl. 5/6	ɪ-í-tɔpɛ / a-má-tɔpɛ	‘mud’	
	cl. 16	pɪ-í-tɔpɛ / pa-má-tɔpɛ	‘at the mud’	(pa + ɪ > piɪ)
	cl. 17	kwi-í-tɔpɛ / ku-má-tɔpɛ	‘towards the mud’	(kɔ + ɪ > kwɪɪ)
	cl. 18	mwi-í-tɔpɛ / mu-má-tɔpɛ	‘in the mud’	(mɔ + ɪ > mwɪɪ)

It seems therefore, that the shortening hypothesis is, after all, more plausible for the explanation of the vowel length alternations in augments in Malila.

There remains only one problem: the examples in (16) above, in which the VCV- AUG-PX gets lengthened into VVCV-. These are class-6 nouns with monomoraic stems. However, this does not only occur with class-6 nouns, but also occasionally in other classes, as the following examples show.

(24)	cl. 11	uúlu-kwi		‘firewood’
	cl. 11	uúlu-pwa		‘wildfire’
	cl. 3/6	uómu-fwɔ	aáma-fwɔ	‘knife’
	cl. 5/4 (augmentative)	íu-fwɔ	íimi-fwɔ	‘big knife’
	cl. 14	uúβu-fwe		‘death’
	cl. 1/2	uúmu-fwe	aáβa-fwe	‘dead person’
	cl. 7/8	iiǰí-sa	iiví-sa	‘kindness’
	cl. 12 (diminutive)	aáxa-sɪ		‘earth’ (< íin-sɪ)
	cl. 12 (diminutive)	aáxa-βwa		‘dog’ (< íim-bwa)
	cl. 12 (diminutive)	aáxa-swɪ		‘fish’ (< íin-swɪ)

It seems implausible to posit underlyingly long vowels for the augment in these cases, only occurring with a monomoraic stem, which would then have to be shortened in all cases except preceding a monomoraic stem. Consequently, one would have to posit a basic VCV-form for the AUG-PX and a process of vowel lengthening whenever the stem is monomoraic, in order to obtain a four-morae citation form.

Looking at all the data and the various arguments presented above, I suggest that there is both *vowel shortening* (in the contexts of classes 5 and 9/10), and *vowel lengthening* in these last-mentioned contexts. A possible scenario in which sequence this could have developed is the topic of the final section.

6. Conclusion

In this final section, I propose that processes of both vowel shortening and vowel lengthening of the augment vowel take place synchronically in Malila.

The point of departure is that there are contrastively short and long vowels in Malila and that there is also a system of compensatory vowel lengthening.

In classes 9/10, the prenasalisation prefix normally causes compensatory lengthening of the augment vowel.

The class 5 AUG-PX combination is underlyingly *ɸɸ* before C-initial stems.

Because of vowel shortening attested in other contexts, *vowel shortening* of the AUG-PX vowel applies also in those same contexts, i.e. whenever the AUG-PX long vowel is too far away from the right edge of the word. A long vowel can only occur within the four morae from the right edge of the

word. This means that the AUG-PX vowel shortening applies to around 70% of the citation forms of the nouns in classes 5 and 9/10 in the present data.

Finally, after vowel shortening, the great majority of nouns have four morae, which may have led to the development of a new constraint, namely a minimality requirement of four morae in order to maximise environments for the contrastive tone melodies. *Augment-vowel lengthening* is introduced whenever a VCV- AUG-PX is followed by a monomoraic stem, resulting in a VVCV- AUG-PX (see examples of class 6 in (16) and of other classes in (24).

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