CHAPTER: III
SOME ASPECTS OF ALLOPHONIC PROCESS

3.1 Allophone

This chapter is focusing to analyze the process of identification of allophones of the Bodo language. Phoneticians have opinions that phonetic variants of a phoneme are called allophone. According to R. Tim allophone is "*the several variants of speech sounds, which constitute a phoneme.*"[1] As opinion of Radhey L. Varshney "*an allophone is a speech sound which is one of a number of variants of a phoneme*."[2]

3.1.1 Data collection and Methods of Analysis

For the purpose of study of allophonic variations of vowels and consonants, the speech database is made off by the following procedures as given below:

i. Words are selected in three ways:
   (a) Occurrences of vowels and consonants in Initial position of a word
   (b) Occurrences of vowels and consonants in Medial position of a word
   (c) Occurrences of vowels and consonants in Final position of a word

ii. Sounds are collected from 10 nos. of speakers out of which 5 speakers are male and 5 speakers are female, age between 20 to 30 (Adult). All speakers are native speaker of Bodo. They are all well educated. Format of speakers practical performance is given at Appendix no. II.

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[1] Tim R: Encyclopaedic Dictionary of Linguistics (Volume-1), 1st Edition, IVY Publishing House, Delhi-110095, 2003, p. 17.

[2] Varshney, Radhey L: An Introductory Text Book of Linguistics and Phonetics (Sixteenth Edition), Student Store, Bareilly, 2005-06, p. 73.

iii. Recording setup: The data are recorded in normal way with Dynamic microphone having following tools:

(a) Software: Cool Edit Pro

(b) PCM: 16 bit

(c) Frequency rate: 22 K Hz

(d) Analysis Tool: PRAAT

3.2 Allophonic variants of vowels

There are six distinctive vowel phonemes in Bodo language viz. /i, *ɯ*, u, e, o, a/. All the six vowels are voiced and short vowel. Allophonic variations in Bodo language are not complex. Some environments which lead to allophonic variation are analyzed underneath with the proper examples.

3.2.1 Vowel allophones determined by the manner of articulation

Based on the manner of articulation there are three different types of allophones in each vowel phonemes in Bodo language. By the occurrences of vowel phonemes in the three positions of a word their manners of articulation are also changed and make the phonetic variants of a phoneme. All the relevant six Bodo vowel phonemes have the occurrence in all the positions of a word and have three allophones by its manners of articulation. Some opposite examples are presented by using Praat Computer software in the underneath.

In the Praat images green line indicates Intensity contour, Blue line indicates Pitch contour and the straight blue vertical lines indicates Pulse. The distribution of stress over connected sounds is called Intensity, The highness or lowness of tone is called pitch. It is defined in laboratory phonetics as the frequency of vibration in the musical sound of the voice and the regular beating of the heart is called pulse.

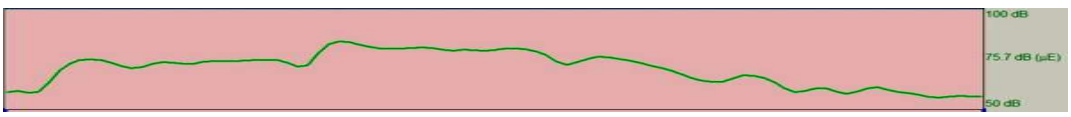


Figure: 3.1 Intensity Contour

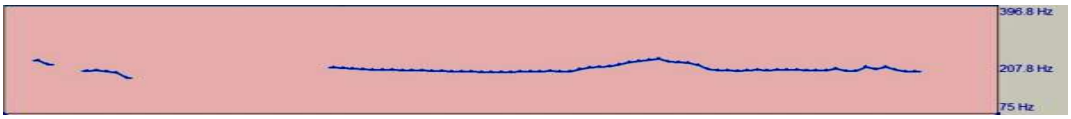


Figure: 3.2 Pitch Contour

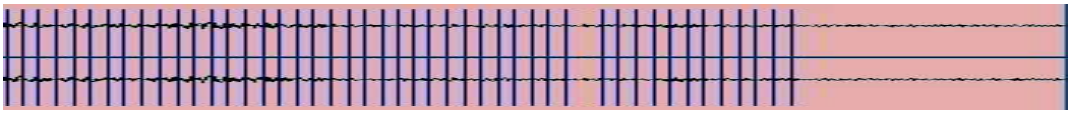
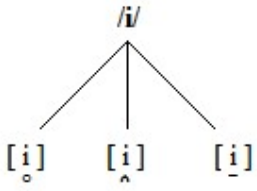


Figure: 3.3 Pulse

Allophonic Variants of /i/

/i/: is the high front unrounded vowel. During the articulation of /i/ vowel, the tongue is raised towards the position in between close and half close. The tongue is comparatively lax and position of the lips is unrounded. In Bodo language this vowel can occur initially, medially and finally in words.

By the occurrences in the three positions of a word their manners of articulation is also changed. This kind of changes in mode of articulation can also make the phonetic variants of a phoneme. Therefore based on its manner of articulation /i/ phoneme have three allophones. When /i/ is occur at the initial position of a word then its articulation becomes quickly and on the other hand, when it is occur at the medial position of a word then its articulation becomes weak and slow. When /i/ phoneme is occur at the final position of a word then compressed air is released rapidly and gets lower long character in articulation. For example:



Initial position		**Medial position**		**Final position**	
/is*ur*/	‘God’	/lir/	‘to write’	/gami/	‘village’
/inay/	‘injustice’	/bir/	‘to fly’	/goli/	‘cowshed’

The following typical Praat images have shown the different Positions as well as Allophones of /i/ phoneme in different words.

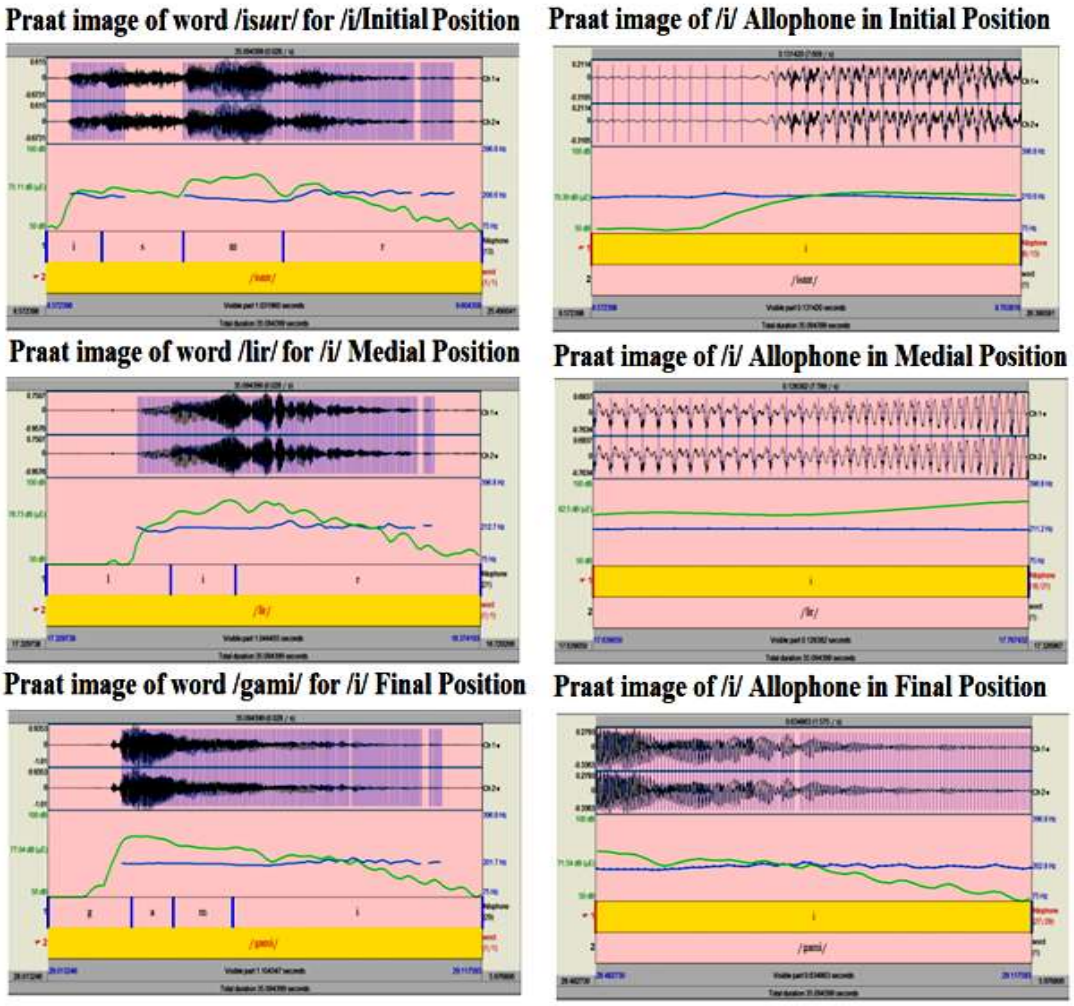


Figure: 3.4 Pitch Contour and Intensity Contour of Initial, Medial and Final Position of vowel /i/

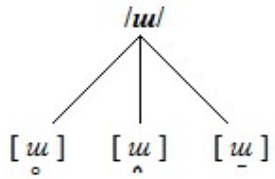
From the analysis on Allophones of /i/ phoneme in different words, it is observed that Pitch contour and Intensity contour are occurs differently in following manners:

Positions of word	**Pitch contour**	**Intensity contour**
Initial Position	210.6 Hz	70.39 dB
Medial Position	211.2 Hz	82.5 dB
Final Position	202.8 Hz	71.54 dB

Allophonic Variants of /ɯ/:

/ɯ/: is the high back unrounded vowel. During the articulation of special vowel /ɯ/ the part of the tongue in between central and back part is raised towards the back of the hard palate and soft palate. The height of the tongue is in between close and half close and the position of the lips is unrounded. In Bodo language this vowel can occur initially, medially and finally in words.

By the occurrences in the three positions of a word their manners of articulation is also changed, therefore based on its manner of articulation /ɯ/ phoneme have three allophones. This kind of changes can make the phonetic variants of a phoneme. When /ɯ/ is occur at the initial position of a word then its articulation becomes quickly in higher short character. On the other hand, when it occurs at the medial position of a word then its articulation becomes weak and slow. When /ɯ/ phoneme occurs at the final position of a word then compressed air is released speedily in lower long character. For example:



Initial position	**Medial position**	**Final position**
/ɯrɯinɯ/‘for no reason’	/k^{h}ɯma/ ‘ear’	/t^{h}ak^{h}ɯ/ ‘class’
/ɯrɯizay/ ‘by this side’	/zɯla/ ‘male’	/zɯ/ ‘female’

The following typical Praat images have shown the different Positions as well as Allophones of /ɯ/ phoneme in different words:

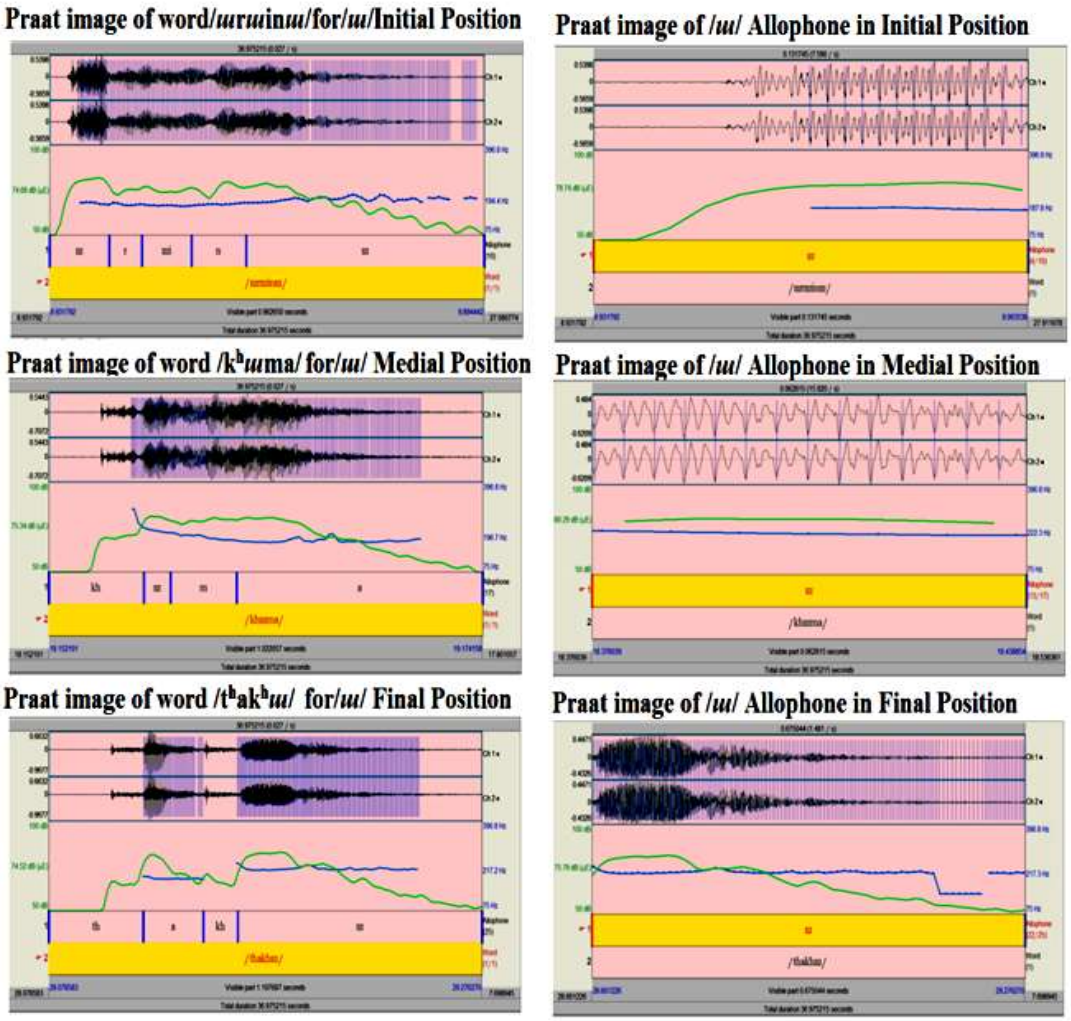


Figure: 3.5 Pitch Contour and Intensity Contour of Initial, Medial and Final Position of vowel /ɯ/

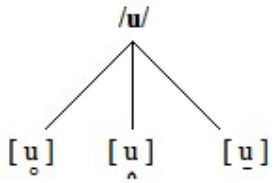
From the analysis on Allophones of /ɯ/ phoneme in different words, it is observed that Pitch contour and Intensity contour are occurs differently in following manners:

Positions of word	**Pitch contour**	**Intensity contour**
Initial Position	187.8 Hz	78.74 dB
Medial Position	222.3 Hz	80.29 dB
Final Position	217.3 Hz	75.79 dB

Allophonic Variants of /u/:

/u/: is the high back rounded vowel. While articulating this vowel the front part of the back of the tongue is raised in the direction of the soft palate to the height in between close and half closed position. The tongue is lax and the position of the lips is rounded. In Bodo language this vowel can occur initially, medially and finally in words.

By the occurrences in the three positions of a word their manners of articulation is also changed, therefore based on its manner of articulation /u/ phoneme have three allophones. This kind of changes can make the phonetic variants of a phoneme. When /u/ is occur at the initial position of a word then its articulation becomes quickly in higher short character and when it is occur at the medial position of a word then its articulation becomes weak and slow. When /u/ phoneme is occur at the final position of a word then compressed air is released rapidly and position of the lips becomes rounded. For example:



Initial position	**Medial position**	**Final position**
/uzi/ ‘to be born’	/k^{h}uga/ ‘mouth’	/maru/ ‘high land’
/ud*ui*/ ‘belly’	/mawk^{h}uli/ ‘office’	/sansu/ ‘midday’

The following typical Praat images have shown the different Positions as well as Allophones of /u/ phoneme in different words:

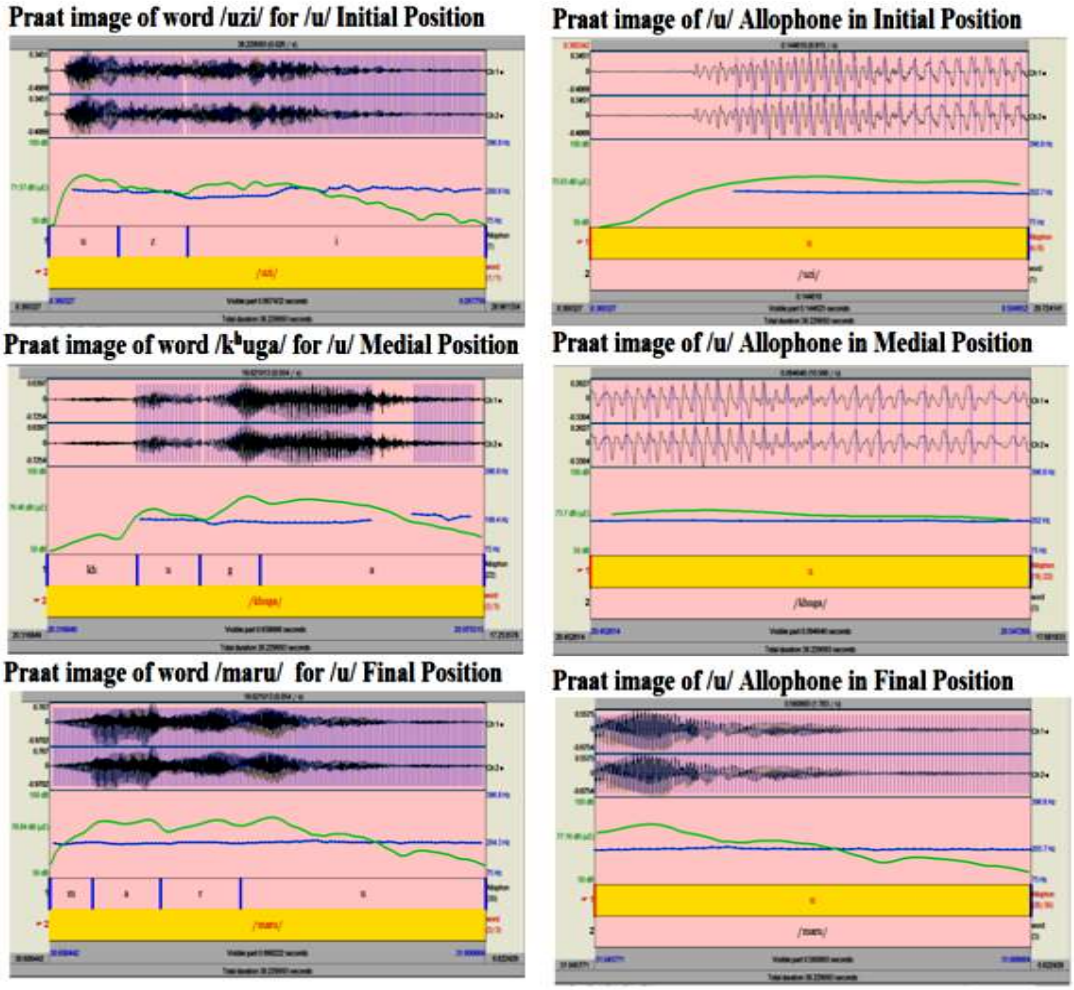


Figure: 3.6 Pitch Contour and Intensity Contour of Initial, Medial and Final Position of vowel /u/

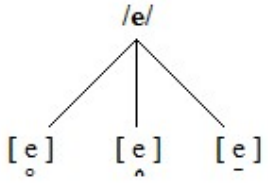
From the analysis on Allophones of /u/ phoneme in different words, it is observed that Pitch contour and Intensity contour are occurs differently in following manners:

Positions of word	**Pitch contour**	**Intensity contour**
Initial Position	202.7 Hz	75.63 dB
Medial Position	202 Hz	73.7 dB
Final Position	205.7 Hz	77.16 dB

Allophonic Variants of /e/

/e/: is the mid front unrounded vowel. During the articulation of /e/ vowel the front of the tongue is raised in between half-close and half open position towards the roof. The lips are loosely spread in the unrounded position. In Bodo language this vowel can occur initially, medially and finally in words.

By the occurrences in the three positions of a word their manners of articulation is also changed, therefore based on its manner of articulation /e/ phoneme have three allophones. This kind of changes can make the phonetic variants of a phoneme. When /e/ is occur at the initial position of a word then its articulation becomes quickly in higher short character. When it is occur at the medial position of a word then its articulation becomes weak and slow. When it is occur at the final position of a word then compressed air is released rapidly in lower long character. For example:



Initial position	**Medial position**	**Final position**
/erk^{h}o/ ‘to pick out’	/serza/ ‘Bodo musical instrument’	/mut^{h}e/ ‘to close the hole’
/embu/ ‘frog’	/hayen/ ‘plain land below the hills’	/m*uu*le/ ‘dim and indistinct in light’

The following typical Praat images have shown the different Positions as well as Allophones of /e/ phoneme in different words:

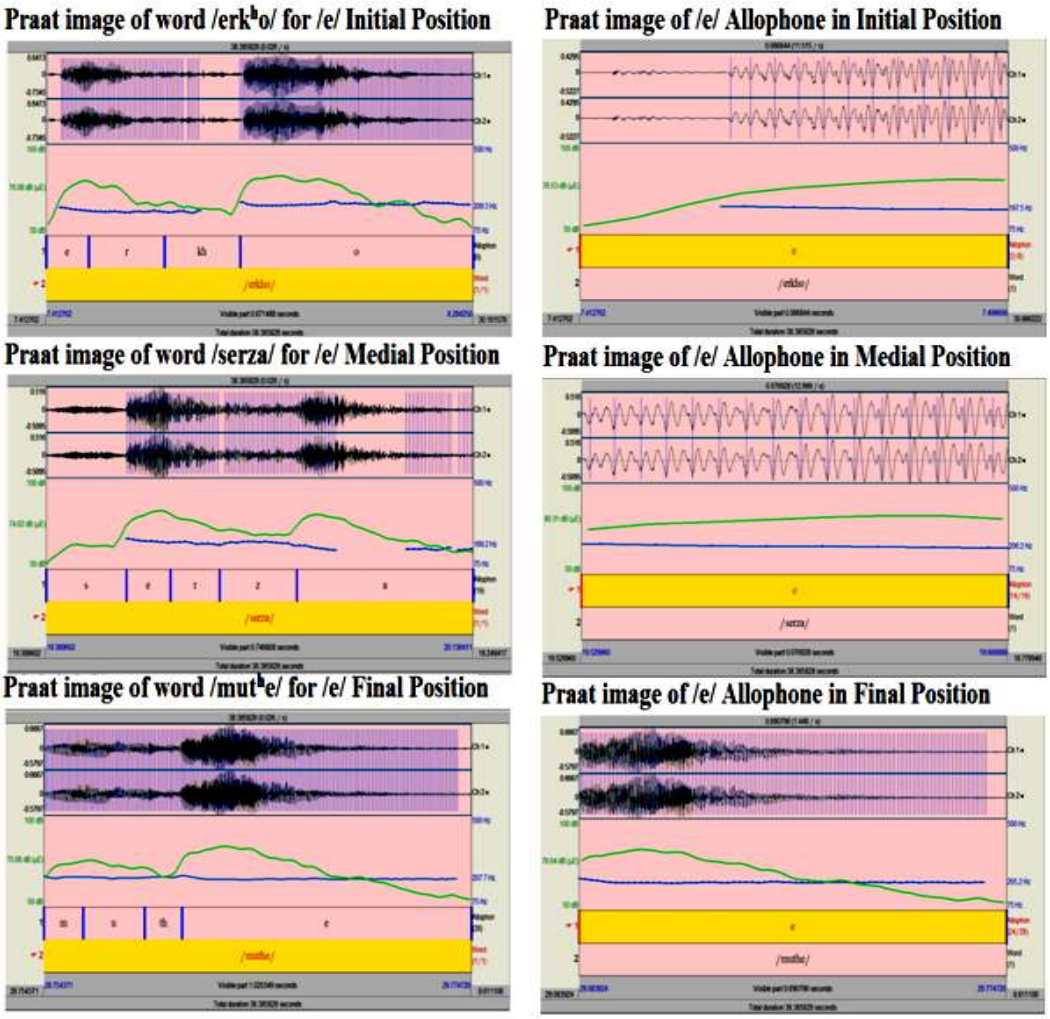


Figure: 3.7 Pitch Contour and Intensity Contour of Initial, Medial and Final Position of vowel /e/

From the analysis on Allophones of /e/ phoneme in different words, it is observed that Pitch contour and Intensity contour are occurs differently in following manners:

Positions of word	**Pitch contour**	**Intensity contour**
Initial Position	197.5 Hz	76.53 dB
Medial Position	206.2 Hz	80.31 dB
Final Position	205.2 Hz	76.64 dB

Allophonic Variants of /o/

/o/: is the mid back rounded vowel. During the articulation of /o/ vowel the back of the tongue is raised above half-open position towards the soft palate. The position of the lips is rounded. In Bodo language this vowel can occur initially, medially and finally in words.

By the occurrences in the three positions of a word their manners of articulation are also changed. This kind of changes can make the phonetic variants of a phoneme. Therefore based on its manner of articulation /o/ phoneme have three allophones. When /o/ is occur at the initial position of a word then its articulation becomes quickly in higher short character and on the other hand, when it is occur at the medial position of a word then its articulation becomes weak and slow. When /o/ phoneme is occur at the final position of a word then compressed air is released rapidly in lower long character. Position of the lips remains rounded during the articulation of all the three positions of a word. For example:

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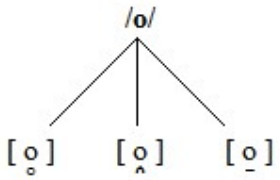


Initial position	**Medial position**	**Final position**
/ok^{h}ap^{h}*ur*/ ‘moon’	/dozi/ ‘sixty’	/sat^{h}ik^{h}o/ ‘to shrug’
/onzima/ ‘number’	/begor/ ‘seed’	/lat^{h}ik^{h}o/ ‘zero’

The following typical Praat images have shown the different Positions as well as Allophones of /o/ phoneme in different words:

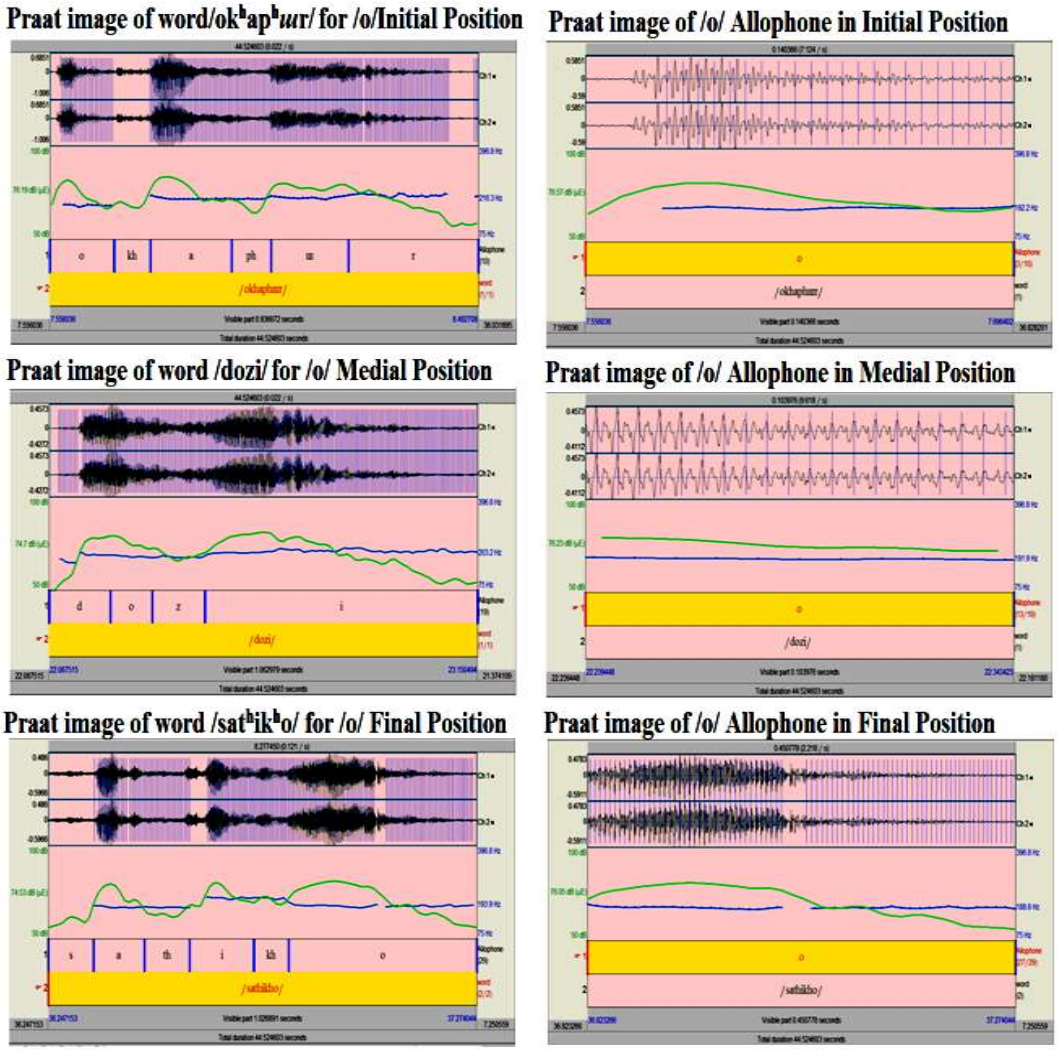


Figure: 3.8 Pitch Contour and Intensity Contour of Initial, Medial and Final Position of vowel /o/

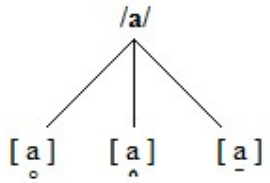
From the analysis on Allophones of /o/ phoneme in different words, it is observed that Pitch contour and Intensity contour are occurs differently in following manners:

Positions of word	**Pitch contour**	**Intensity contour**
Initial Position	192.2 Hz	76.57 dB
Medial Position	191.9 Hz	76.23 dB
Final Position	188.8 Hz	76.05 dB

Allophonic Variants of /a/

/a/: is the low central un-rounded vowel. During the articulation of this vowel the central part of the tongue is raised just above open position towards the roof of the mouth. The position of the lips is unrounded. In Bodo language this vowel can occur initially, medially and finally in words.

By the occurrences in the three positions of the word their manners of articulation is also changed and this kind of changes can make the phonetic variants of a phoneme. Therefore based on its manner of articulation /a/ phoneme have three allophones. When /a/ occur at the initial position of a word then its articulation becomes rapidly in higher short character and on the other hand, when it occur at the medial position of a word then its articulation becomes weak and slow. When /a/ phoneme occurs at the final position of a word then compressed air is released speedily in lower long character. For example:



Initial position	**Medial position**	**Final position**
/alasi/ ‘guest’	/k^{h}ar/ ‘to run’	/dok^{h}ona/ ‘Bodo women’s garment’
/asi/ ‘finger’	/zah*uu*n/ ‘reason’	/nimaha/ ‘excuse’

The following typical Praat images have shown the different Positions as well as Allophones of /a/ phoneme in different words:

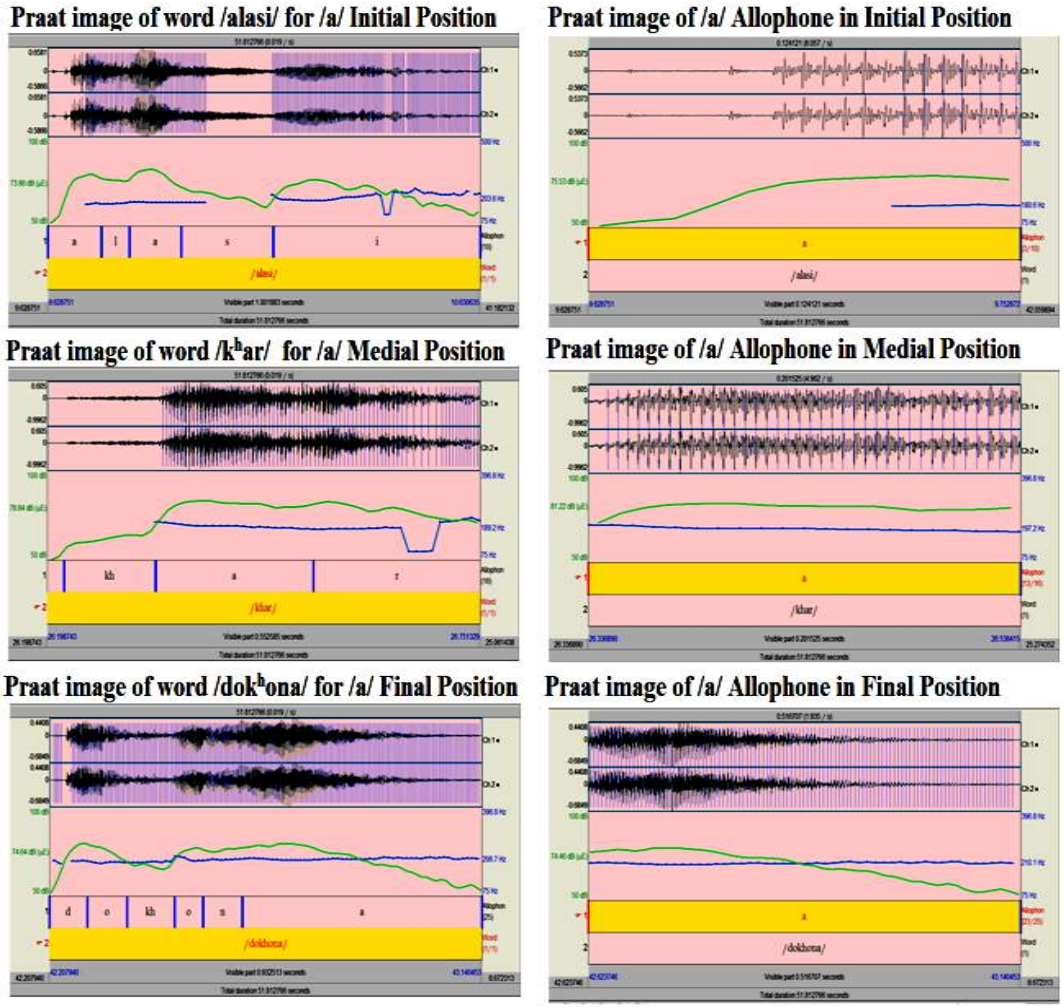


Figure: 3.9 Pitch Contour and Intensity Contour of Initial, Medial and Final Position of vowel /a/

From the analysis on Allophones of /a/ phoneme in different words, it is observed that Pitch contour and Intensity contour are occurs differently in following manners:

Positions of word	**Pitch contour**	**Intensity contour**
Initial Position	180.6 Hz	75.53 dB
Medial Position	197.2 Hz	81.22 dB
Final Position	210.1 Hz	74.46 dB

From the above overall analysis it is observed that all the relevant six vowels have the occurrence in all the positions of a word and manners of articulation of these phonemes

in word level is changed differently in all the positions. From the Praat analysis some important observation is found for the utterance of all the vowels:

(i) For initial position of the vowel utterance, the Intensity contour is increasing from it's initial position, i.e. the reference point and then it goes up above the position of pitch contour.

(ii) For medial position of the vowel utterance, the Intensity contour graph is remained constant from starting point to end point.

(iii) For final position of the vowel utterance, the Intensity contour shows an opposite behavior regarding the initial position of the vowel utterance. It is observed that the Intensity contour starts to decrease from initial position of utterance and then the said graph goes to below of the pitch contour graph.

(iv) It is observed that, in all the positions of vowel utterance, there is no distinct variation in pitch contour.

3.2.2 Vowel Allophones Preceded by the nasal sounds

All the six respective vowels of Bodo have the nasalized allophones if preceded by the nasal consonants, i.e. / m, n, ŋ /. For example: / ĩ, ʊ̃ʊ̃, ũ, ẽ, õ, ã / respectively. Nasalized allophones of vowels preceded by nasals are presented with following examples:

/ĩ/ nasalized allophone of /i/ vowel phoneme:

	Initial position	**Medial position**	**Final position**
m-i:	/mĩlʊ̃ʊ̃udʊ̃ʊ̃/ 'melodius'	/zarimĩn/ 'history'	/gamĩ/ 'village'
n-i:	/nĩzwm/ 'silent, solitary'	/manĩnaŋ/ 'respectful'	/minĩ/ 'to smile'
ŋ-i:	-----	-----	/biŋĩ/ 'one-stringed musical instrument'

/ʊ̃ʊ̃/ nasalized allophone of /*ʊʊ*/ vowel phoneme:

	Initial position	**Medial position**	**Final position**
m-*ʊʊ*:	/mʊ̃ʊ̃k^{h}aŋ/ 'face'	/k^{h}*ʊʊ*mʊ̃ʊ̃n/ 'fur, hair'	/k^{h}amʊ̃ʊ̃/ 'do/does burn'
n-*ʊʊ*:	/nʊ̃ʊ̃mp^{h}a/ 'your father	/g*ʊʊ*nʊ̃ʊ̃g*ʊʊ*th*ʊʊ*/ 'confuses'	/*ʊʊ*r*ʊʊ*inʊ̃ʊ̃/ 'for no reason'
ŋ-*ʊʊ*:	-----	-----	/t^{h}aŋʊ̃ʊ̃/ 'goes'

/ũ/ nasalized allophone of /u/ vowel phoneme:

	Initial position	**Medial position**	**Final position**
m-u:	/mũŋ/ ‘name’	/hasumũt^{h}ra/ ‘bedwetter’	/harimũ/ ‘culture’
n-u:	/nũza/ ‘to appear’	-----	/gunũ/ ‘having good eye sight’
ŋ-u	-----	-----	-----

/ẽ/ nasalized allophone of /e/ vowel phoneme:

	Initial position	**Medial position**	**Final position**
m-e:	/mẽgon/ ‘eye’	/t^{h}omẽn/ ‘to sprout’	-----
n-e:	/nẽulai/ ‘mongoose’	/nanẽk^{h}a/ ‘freckles’	/danẽ/ ‘don’t wait’
ŋ-e:	**-----**	**-----**	**-----**

/õ/ nasalized allophone of /o/ vowel phoneme:

	Initial position	**Medial position**	**Final position**
m-o:	/mõhor/ ‘physical structure’	/samõk^{h}iŋk^{h}iri/ ‘a kind of snail’	/samõ/ ‘snail’
n-o:	/nõsa/ ‘hut’	/monõnai/ ‘swallowing’	/k^{h}onõ/ ‘thrust ones hand into a hole and search something’
ŋ-o:	**-----**	**-----**	**-----**

/ã/ nasalized allophone of /a/ vowel phoneme:

	Initial position	**Medial position**	**Final positio**
m-a:	/mãuzi/ ‘cat’	/p^{h}*u*imãl/ ‘failure’	/omã/ ‘pig’
n-a:	/nãt^{h}ur/ ‘prawn’	/inãi/ ‘injustice’	/gohenã/ ‘ornament’
ŋ-a:	-----	/baŋãy/ ‘a little’	/diŋã/ ‘boat’

3.3 Allophonic variants of consonants

In Bodo language there are sixteen consonantal phonemes i.e. / p^h, b, t^h, d, k^h, g, m, n, ŋ, s, z, h, r, l, w, y /, where /w/ and /y/ are Semi vowels. /w/ and /y/ are occurs intervocalically always as glides. So, here excluding semi vowels only allophonic variants of / p^h, b, t^h, d, k^h, g, m, n, ŋ, s, z, h, r, and l/ consonants are analyzed. Allophones of these fourteen consonantal phonemes are determined by the simple environment. Some environments which lead to allophonic variation of consonants are analyzed with the proper examples as given below:

3.3.1 Consonant allophones determined by the manner of articulation

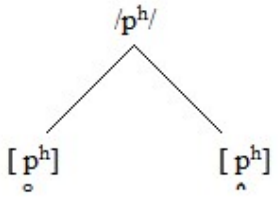
Based on the manner of articulation different types of allophones are occurs in each consonantal phoneme in Bodo language. By the occurrences of consonant phonemes in the different positions of a word their manners of articulation are also changed. Allophonic variations of consonantal phonemes are analyzed and presented by using Praat Computer software in the underneath.

Allophonic Variants of /p^h/

/p^h/: is the voiceless aspirated bilabial stop consonant phoneme. During the articulation of /p^h/, the soft palate is raised to block the nasal passage. The air is compressed in the mouth by the two lips followed by a sudden release. The vocal cords are held apart, so, it doesn't vibrate during its articulation. Therefore, it is a voiceless sound. In Bodo language it occurs initially and medially in words.

By the occurrences in the two positions of a word their manners of articulation are also changed, therefore based on its manner of articulation /p^h/ phoneme have two allophones. When /p^h/ occurs at the initial position of a word then its articulation becomes quickly and on the other hand, when it occurs at the medial position of a word then its articulation becomes weak and slow. This kind of changes can make the phonetic variants of a phoneme. /p^h/ phoneme does not occur in the final position of Bodo basic word but occasionally it is used during the time of articulation of loan words. For example: फाफ /p^hap^h/ meaning 'sin', etc.

For example:



Initial Position	Medial Position	Final position
/pʰoŋbai/ ‘younger brother’	/apʰad/ ‘association’	Does not occur
/pʰinsaza/ ‘revenge’	/empʰ*uu*u/ ‘insect’	in this position

The following typical Praat images have shown the different Positions as well as Allophones of /pʰ/ phoneme in different words:

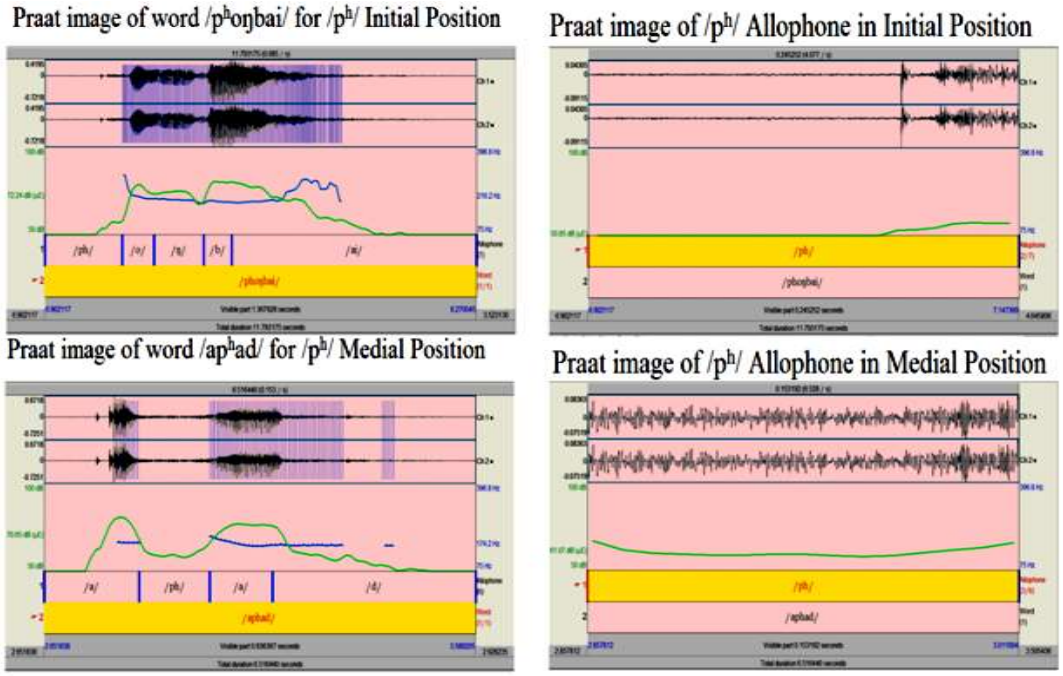


Figure: 3. 10 Pitch Contour and Intensity Contour of Initial and Medial Position of consonant /pʰ/

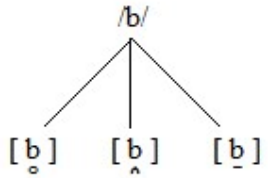
From the analysis on Allophones of /pʰ/ phoneme in different words, it is observed that Pitch contour and Intensity contour are occurs differently in following manners:

Positions of word	Pitch contour	Intensity contour
Initial Position	Does not occur	50.85 dB
Medial Position	Does not occur	61.07 dB

Allophonic Variants of /b/

/b/: is the voiced un-aspirated bilabial stop consonantal phoneme. During the time of articulation /b/ consonant phoneme, air stream is compressed in the mouth by the two lips followed by a sudden release. The soft palate is raised to block the nasal passage. The vocal cords vibrate during its articulation. In Bodo language /b/ phoneme have the occurrences in all the positions of a word, i.e. initial, medial and final position.

By the occurrences in the three positions of the word their manners of articulation is also changed, therefore based on its manner of articulation /b/ phoneme have three allophones. When /b/ is occurs at the initial position of a word then its articulation becomes quickly and compressed air stream is released. When it occurs at the medial position of a word then its articulation becomes weak and slow and its compressed air stream is released. This kind of changes can make the phonetic variants of a phoneme. When /b/ phoneme occurs at the final position of a word then air is compressed behind the closure. It is not released audibly when it occur in final position. For example:



Initial Position	**Medial Position**	**Final Position**
/bon/ ‘firewood’	/abad/ ‘cultivation’	/gab/ ‘to cry’
/beher/ ‘mire’	/s*u*bk^{h}o/ ‘to absorb any liquid’	/hork^{h}ab/ ‘suddenly’

The following typical Praat images have shown the different Positions as well as Allophones of /b/ phoneme in different words:

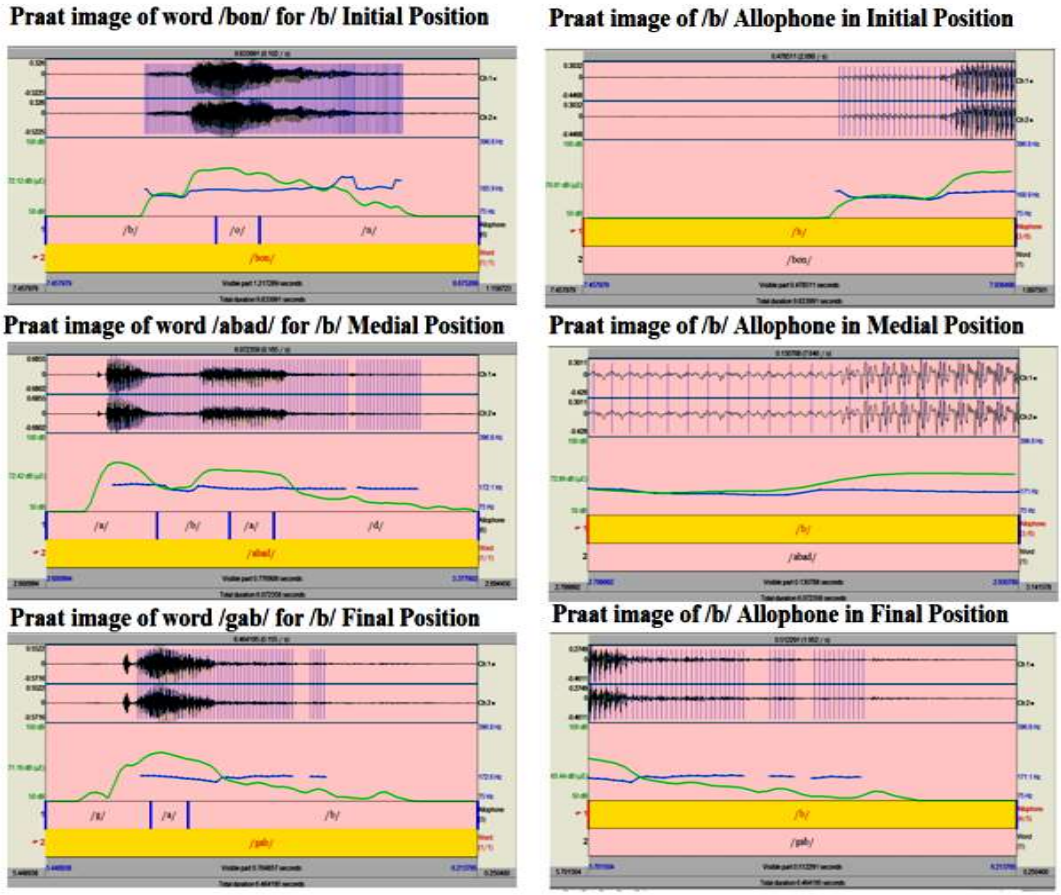


Figure: 3.11 Pitch Contour and Intensity Contour of Initial, Medial and Final Position of consonant /b/

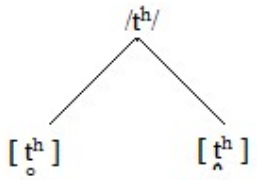
From the analysis on Allophones of /b/ phoneme in different words, it is observed that Pitch contour and Intensity contour are occurs differently in following manners:

Positions of word	**Pitch contour**	**Intensity contour**
Initial Position	168.9 Hz	70.81 dB
Medial Position	171 Hz	72.99 dB
Final Position	171.1 Hz	65.44 dB

Allophonic Variants of /t^h/

/t^h/: is the voiceless aspirated alveolar stop consonant phoneme. During the articulation of this consonant the soft palate is raised to close the nasal passage. The tip and blade of the tongue is raised against the alveolar ridge to block the air passage. The vocal cords are held apart during its articulation. In Bodo language it occurs initially and medially in words.

By the occurrences in the two positions of the word their manners of articulation is also changed, therefore based on its manner of articulation /t^h/ phoneme have two allophones. When /t^h/ is occur at the initial position of a word then its articulation becomes quickly and on the other hand, when it is occur at the medial position of a word then its articulation becomes slow. This kind of changes can make the phonetic variants of a phoneme. For example:



Initial Position	**Medial Position**	**Final Position**
/t^hagibi/ ‘indigenous’	/k^hit^her/ ‘revenge’	Does not occur in
/t^hunlai/ ‘literature’	/gant^{h}i/ ‘knot’	this position.

The following typical Praat images have shown the different Positions as well as Allophones of /t^h/ phoneme in different words:

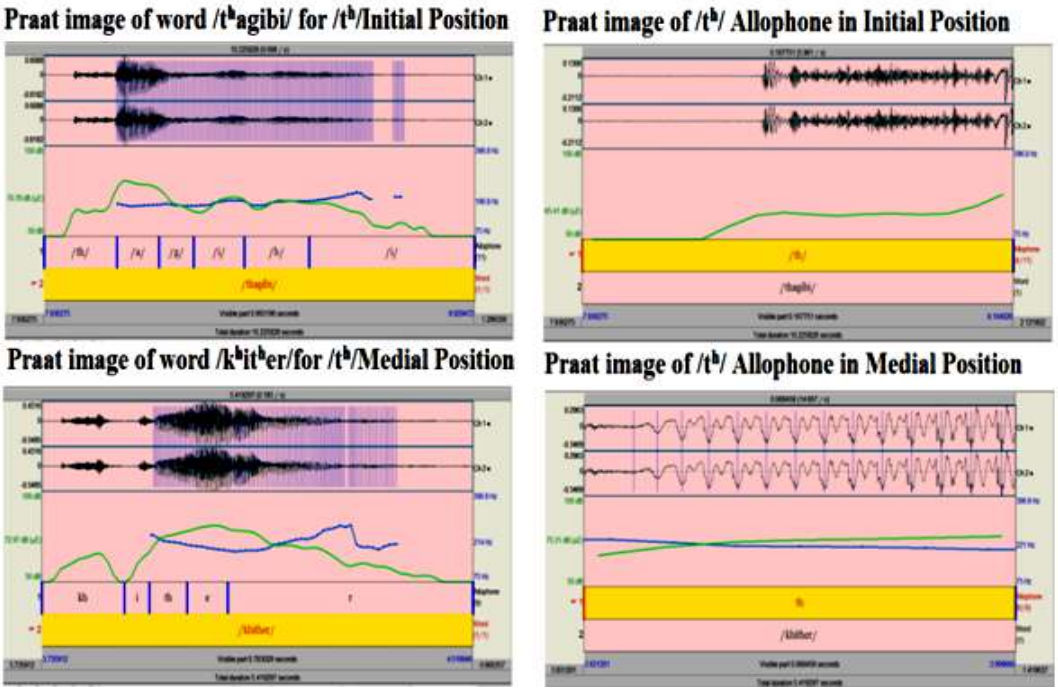


Figure: 3.12 Pitch Contour and Intensity Contour of Initial and Medial Position of consonant /t^h/

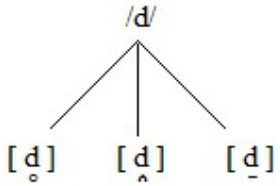
From the analysis on Allophones of /t^h/ phoneme in different words, it is observed that Pitch contour and Intensity contour are occurs differently in following manners:

Positions of word	**Pitch contour**	**Intensity contour**
Initial Position	Does not occur	65.41 dB
Medial Position	221 Hz	75.31 dB

Allophonic Variants of /d/

/d/: is the voiced un-aspirated alveolar stop consonantal phoneme. During the articulation of this consonant the soft palate is raised to close the nasal passage. The tip and blade of the tongue are raised against the alveolar ridge to block the air passage. The air is compressed followed by a sudden release. The vocal cords vibrate during its articulation. It can occur in all the positions of a word.

By the occurrences in the three positions of the word their manners of articulation is also changed, therefore based on its manner of articulation /d/ phoneme have three allophones. When /d/ is occur at the initial position of a word then its articulation becomes quickly and on the other hand, when it is occur at the medial position of a word then its articulation becomes weak and slow. When /d/ phoneme is occur at the final position of a word then compressed air is released rapidly. For example:



Initial Position	**Medial Position**	**Final Position**
/dubli/ ‘cultivating field’	/t^{h}and*ɯ*i/ ‘messenger’	/zigr*ɯ*d/ ‘talkative’
/daurai/ ‘peacock’	/ada/ ‘elder brother’	/k^{h}*ɯ*ul*ɯ*b*ɯ*d/ ‘baseless talking’

The following typical Praat images have shown the different Positions as well as Allophones of /d/ phoneme in different words:

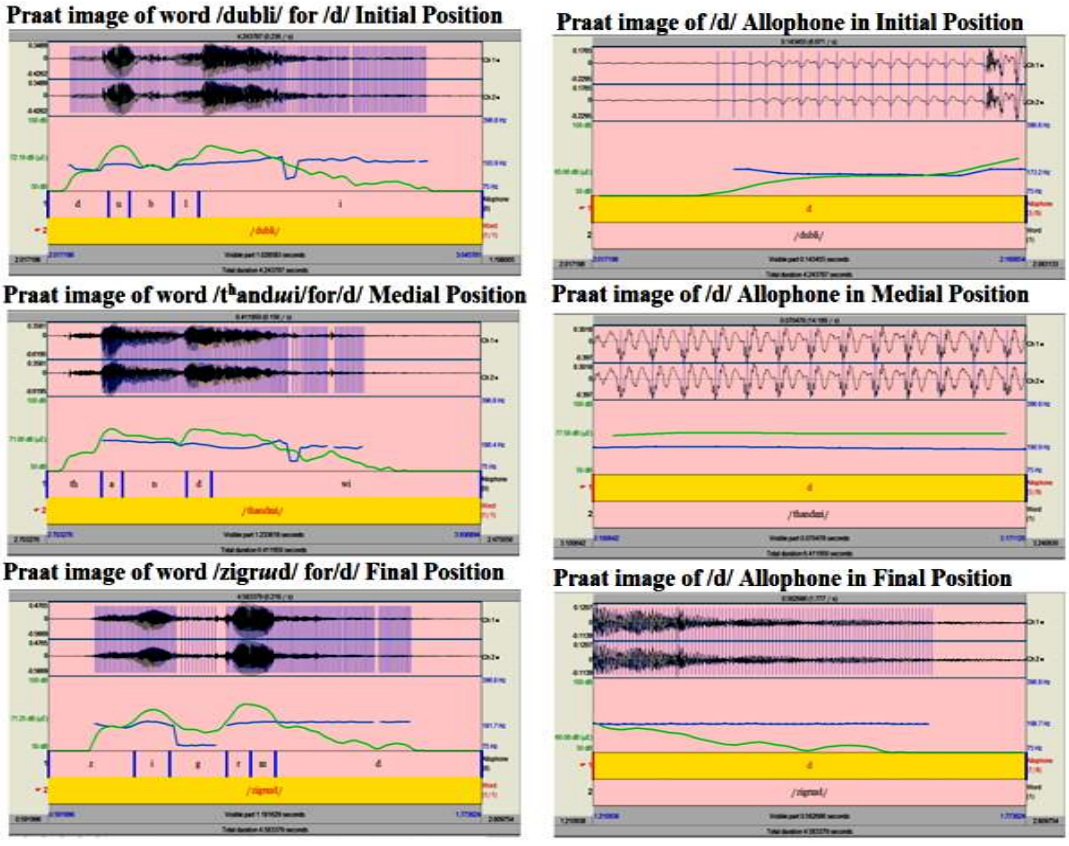


Figure: 3.13 Pitch Contour and Intensity Contour of Initial, Medial and Final Position of consonant /d/

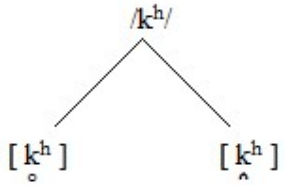
From the analysis on Allophones of /d/ phoneme in different words, it is observed that Pitch contour and Intensity contour are occurs differently in following manners:

Positions of word	Pitch contour	Intensity contour
Initial Position	173.2 Hz	65.66 dB
Medial Position	190.9 Hz	77.58 dB
Final Position	198.7 Hz	60.08 dB

Allophonic Variants of /k^h/

/k^h/: is the voiceless aspirated velar stop consonant phoneme. During its articulation the soft palate is raised to block the nasal passage. The soft palate is also the passive articulator here against which the back of the tongue is raised to block the air. The compressed air is suddenly released resulting in the explosive sound. The vocal cords are held apart during its articulation. Hence, it is a voiceless sound. It occurs initially and medially in Bodo words.

By the occurrences in the two positions of the word their manners of articulation is also changed, therefore based on its manner of articulation /k^h/ phoneme have two allophones. When /k^h/ is occur at the initial position of a word then its articulation becomes quickly and on the other hand, when it is occur at the medial position of a word then its articulation becomes weak and slow. This kind of changes can make the phonetic variants of a phoneme. /k^h/ phoneme does not occur in the final position of Bodo basic word but occasionally it is used during the time of articulation of loan words. For example:



Initial Position	Medial Position	Final position
/k^hont^{h}ai/ ‘poem’	/ak^{h}ai/ ‘hand’	Does not occur
/k^h*uu*uraŋ/ ‘news’	/t^{h}ik^{h}ini/ ‘peak, pigtail’	in this position

The following typical Praat images have shown the different Positions as well as Allophones of /k^h/ phoneme in different words:

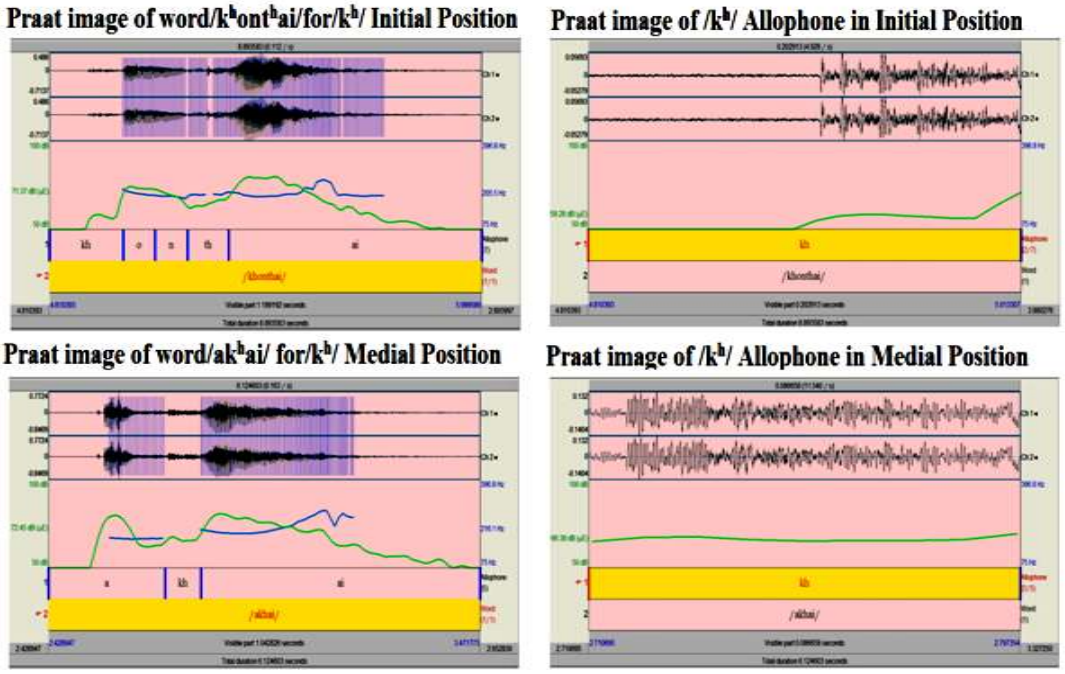


Figure: 3.14 Pitch Contour and Intensity Contour of Initial and Medial Position of consonant /k^h/

From the analysis on Allophones of /k^h/ phoneme in different words, it is observed that Pitch contour and Intensity contour are occurs differently in following manners:

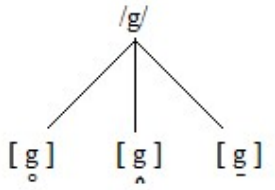
Positions of word	**Pitch contour**	**Intensity contour**
Initial Position	Does not occur	58.28 dB
Medial Position	Does not occur	66.38 dB

Allophonic Variants of /g/

/g/: is the voiced un-aspirated velar stop consonant phoneme. During its articulation the soft palate is raised to block the nasal passage. The back of the tongue is raised against the soft palate to compress the air before the sudden release. During its articulation the vocal cords vibrate. Hence, it is a voiced sound. It occurs in the initial and medial positions of Bodo words.

By the occurrences in the two positions of the word their manners of articulation is also changed, therefore based on its manner of articulation /g/ phoneme have three

allophones. When /g/ is occur at the initial position of a word then its articulation becomes quickly and on the other hand, when it is occur at the medial position of a word then its articulation becomes weak and slow. This kind of changes can make the phonetic variants of a phoneme. When /g/ phoneme is occur at the final position of a word then compressed air is released rapidly. For example:



Initial Position	**Medial Position**	**Final Position**
/gont^{h}oŋ/ ‘nose’	/ag*ɯ*ma/ ‘one’s own’	/mulug/ ‘world’
/gab/ ‘to cry’	/eŋgar/ ‘to give up’	/p^{h}arag/ ‘separate, distinct’

The following typical Praat images have shown the different Positions as well as Allophones of /g/ phoneme in different words:

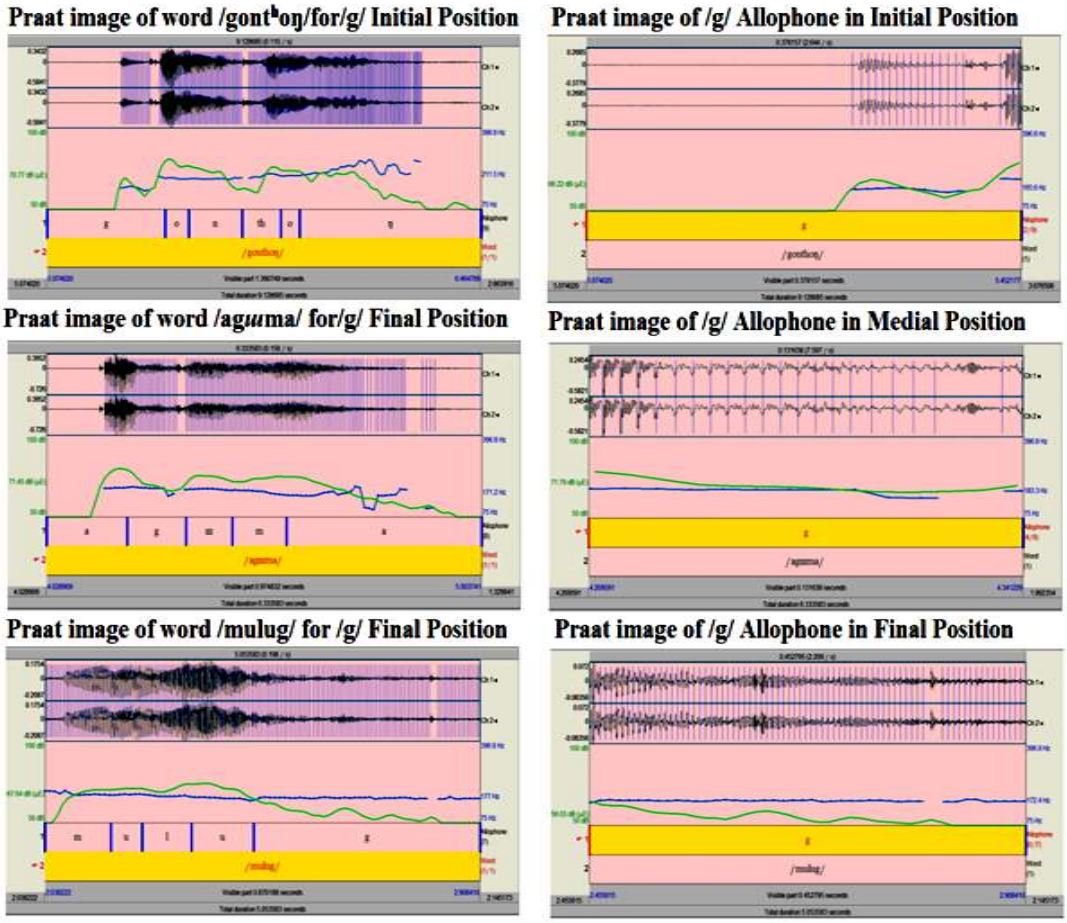


Figure: 3.15 Pitch Contour and Intensity Contour of Initial, Medial and Final Position of consonant /g/

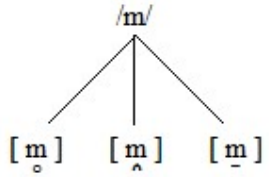
From the analysis on Allophones of /g/ phoneme in different words, it is observed that Pitch contour and Intensity contour are occurs differently in following manners:

Positions of word	Pitch contour	Intensity contour
Initial Position	165.6 Hz	66.22 dB
Medial Position	183.3 Hz	71.79 dB
Final Position	172.4 Hz	56.63 dB

Allophonic Variants of /m/

/m/: is the voiced bilabial nasal consonant phoneme. During articulation of /m/, the soft palate is lowered to allow the air to pass through the nose. The oral passage is blocked by the two lips. The vocal cords vibrate during its articulation. It occurs in all the positions of words.

By the occurrences in all positions of the word their manners of articulation is also changed, therefore based on its manner of articulation /m/ phoneme have three allophones. When /m/ is occurring at the initial position of a word its articulation becomes quickly and compressed air is released. When it is occur at the medial position of a word its articulation becomes weak and slow and its compressed air is released. This kind of changes can make the phonetic variants of a phoneme. When /m/ phoneme is occur at the final position of a word then air is compressed behind the closure. It is not released audibly when it is occurred in word final. For example:



Initial Position	Medial Position	Final Position
/mai/ ‘paddy’	/gomt^{h}a/ ‘grave’	/*uu*ŋk^{h}am/ ‘cooked rice’
/muŋdaŋk^{h}a/ ‘famous’	/geremsa/ ‘bushy’	/sambram/ ‘onion’

The following typical Praat images have shown the different Positions as well as Allophones of /m/ phoneme in different words:

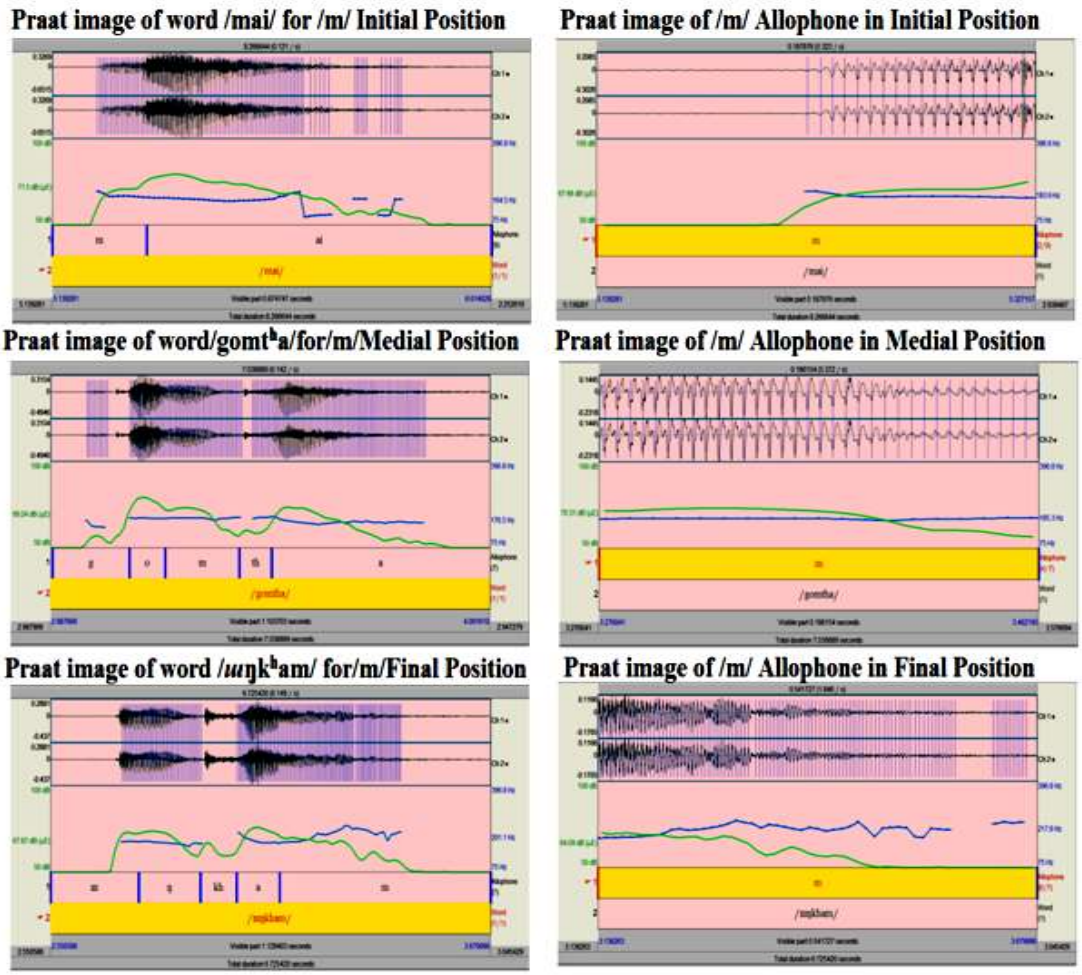


Figure: 3.16 Pitch Contour and Intensity Contour of Initial, Medial and Final Position of consonant /m/

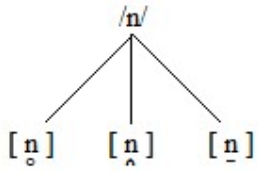
From the analysis on Allophones of /m/ phoneme in different words, it is observed that Pitch contour and Intensity contour are occurs differently in following manners:

Positions of word	**Pitch contour**	**Intensity contour**
Initial Position	183.9 Hz	67.98 dB
Medial Position	185.3 Hz	70.31 dB
Final Position	217.8 Hz	64.09 dB

Allophonic Variants of /n/

/n/: is the voiced alveolar nasal consonant phoneme. During the articulation of /n/ the tip and blade of the tongue is raised against the alveolar ridge to block the oral passage. The soft palate is lowered to allow the air to pass through the nasal passage. The vocal cords vibrate during its articulation. In Bodo language /n/ phoneme have the occurrences in all the positions of a word, i.e. initial, medial and final position.

By the occurrences in the two positions of the word their manners of articulation is also changed, therefore based on its manner of articulation /n/ phoneme have three allophones. When /n/ is occur at the initial position of a word then its articulation becomes quickly and compressed air is released. When it is occur at the medial position of a word then its articulation becomes weak and slow and its compressed air is released. This kind of changes can make the phonetic variants of a phoneme. When /n/ phoneme is occur at the final position of a word then air is compressed behind the closure. It is not released audibly when it is word final. For example:



Initial Position	Medial Position	Final Position
/nosa/ ‘a small hut’	/and*ɯ*/ ‘hidden’	/oron/ ‘forest’
/nik^{h}auri/ ‘poor’	/k^{h}anai/ ‘hair’	/dan/ ‘to cut’

The following typical Praat images have shown the different Positions as well as Allophones of /n/ phoneme in different words:

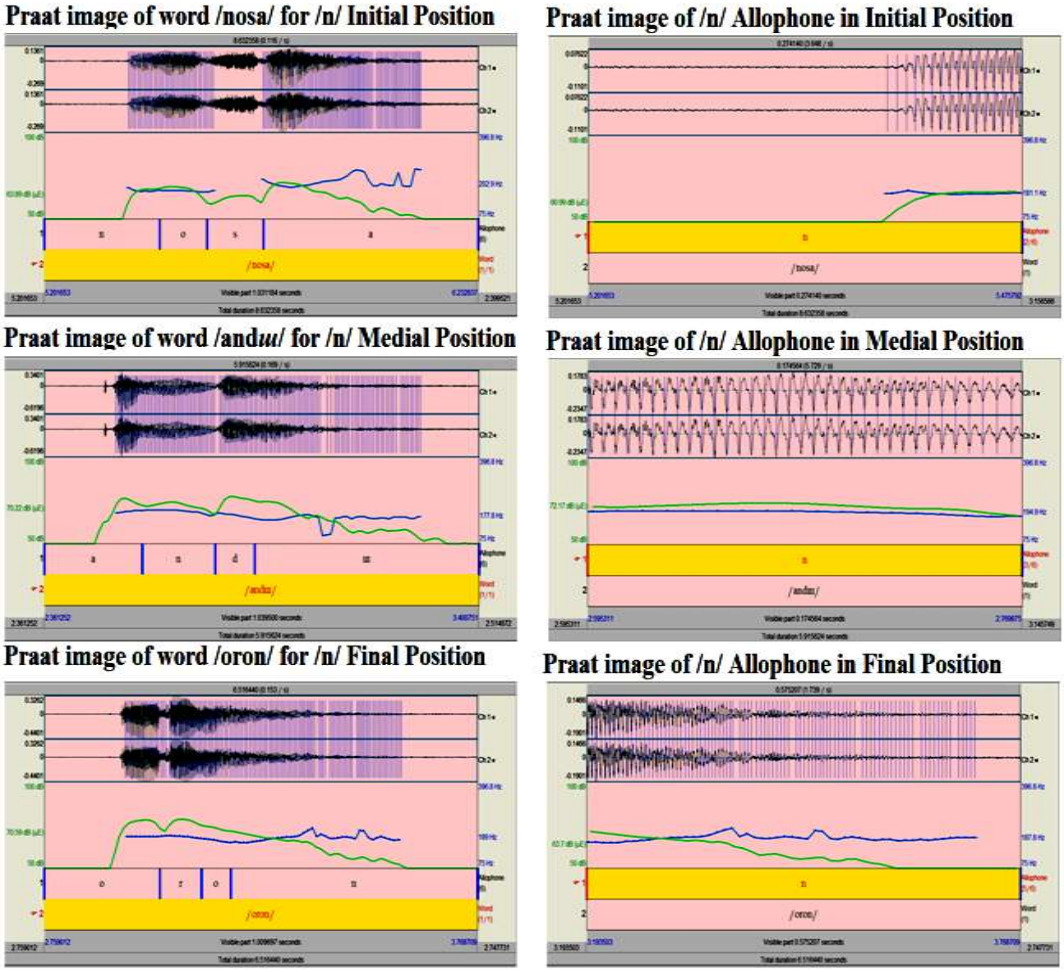


Figure: 3.17 Pitch Contour and Intensity Contour of Initial, Medial and Final Position of consonant /n/

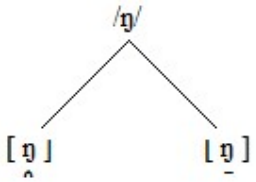
From the analysis on Allophones of /n/ phoneme in different words, it is observed that Pitch contour and Intensity contour are occurs differently in following manners:

Positions of word	**Pitch contour**	**Intensity contour**
Initial Position	181.1 Hz	60.99 dB
Medial Position	194.9 Hz	72.17 dB
Final Position	187.8 Hz	63.7 dB

Allophonic Variants of /ŋ/

/ŋ/: is the voiced velar nasal consonant phoneme. During the time of articulation of Bodo /ŋ/ the back of the tongue is raised against the soft palate to block the oral passage. The vocal cords vibrate during its articulation. It occurs only medially and finally in Bodo words.

By the occurrences in the two positions of the word their manners of articulation is also changed, therefore based on its manner of articulation /ŋ/ phoneme have two allophones. When a word is contains in two syllables and first syllable is ended in /ŋ/ consonant and second syllable is also started with a consonant then articulation of first syllable becomes strong along with long character and second syllable is articulated as quickly. But if first syllable ended in a vowel and second syllable is started with a consonant then articulation of both syllables of a word are becomes same and weak. Articulation of final position becomes strong and air passes through nasal. This kind of changes can make the phonetic variants of a phoneme. /ŋ/ phoneme does not occur in the Initial position of Bodo basic word. For example:



Initial position	**Medial Position**	**Final Position**
Does not occur in this position	/oŋk^{h}a/ ‘midge, sand-fly’ /baŋai/ ‘a little’	/aŋ/ ‘I’ /gidiŋ/ ‘to move around’

The following typical Praat images have shown the different Positions as well as Allophones of /ŋ/ phoneme in different words:

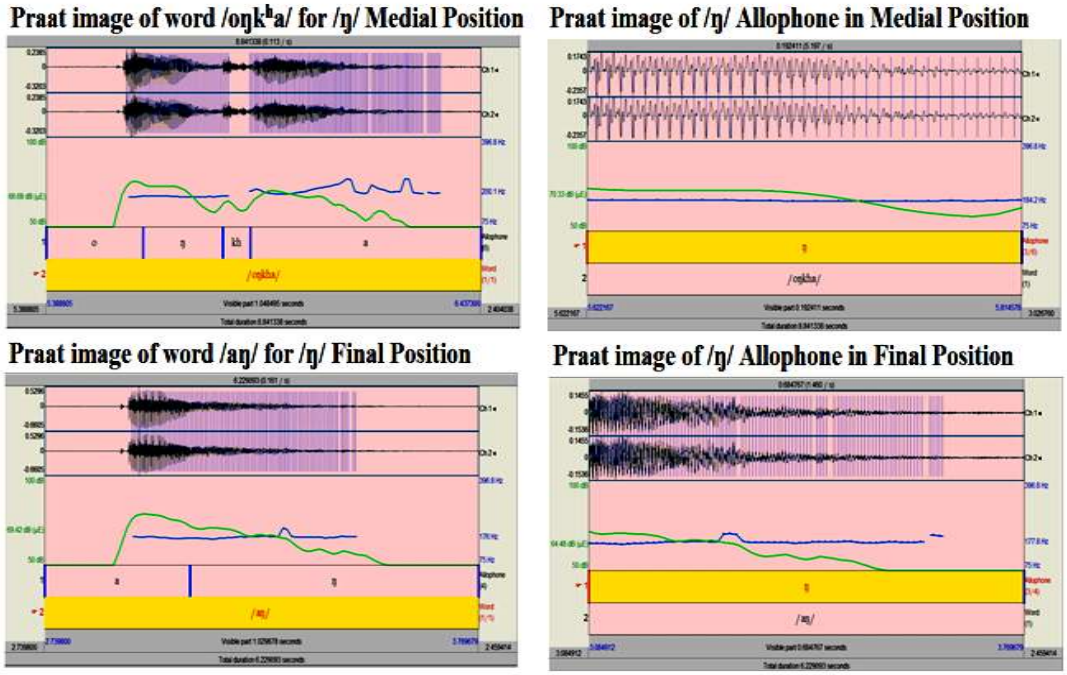


Figure: 3.18 Pitch Contour and Intensity Contour of Medial and Final Position of consonant /ŋ/

From the analysis on Allophones of /ŋ/ phoneme in different words, it is observed that Pitch contour and Intensity contour are occurs differently in following manners:

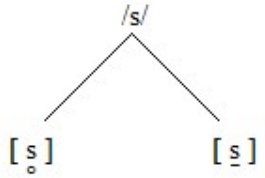
Positions of word	**Pitch contour**	**Intensity contour**
Medial Position	184.2 Hz	70.33 dB
Final Position	177.8 Hz	64.48 dB

Allophonic Variants of /s/

/s/: is the voiceless alveolar un-aspirated fricative consonant phoneme. In the articulation of /s/ the soft palate is raised to block the nasal passage. The tip and blade of the tongue is raised near the alveolar ridge leaving a narrow passage for the air to pass with friction. The vocal cords are held apart. Hence, it is a voiceless sound. It occurs initially and medially in Bodo words.

By the occurrences in the two positions of the word their manners of articulation is also changed, therefore based on its manner of articulation /s/ phoneme have two

allophones. When /s/ is occur at the initial position of a word then its articulation becomes quickly and on the other hand, when it is occur at the medial position of a word then its articulation becomes weak and slow. This kind of changes can make the phonetic variants of a phoneme. /s/ phoneme does not occur in the final position of Bodo basic word. For example:



Initial Position	**Medial Position**	**Final position**
/somp^{h}*ur*/ ‘day after to-morrow’	/asi/ ‘finger’	Does not occur
/sik^{h}la/ ‘young girl’	/t^{h}asari/ ‘situation’	in this Position

The following typical Praat images have shown the different Positions as well as Allophones of /s/ phoneme in different words:

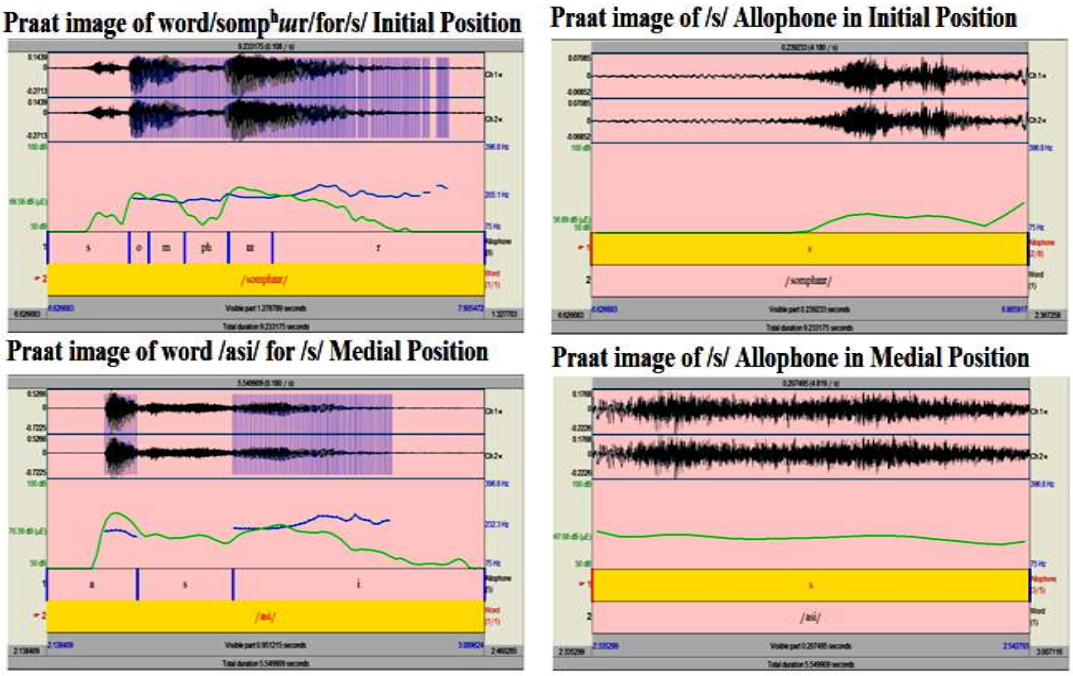


Figure: 3.19 Pitch Contour and Intensity Contour of Initial and Medial Position of consonant /s/

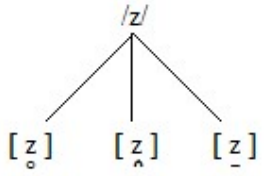
From the analysis on Allophones of /s/ phoneme in different words, it is observed that Pitch contour and Intensity contour are occurs differently in following manners:

Positions of word	**Pitch contour**	**Intensity contour**
Initial Position	Does not occur	56.89 dB
Medial Position	Does not occur	67.68 dB

Allophonic Variants of /z/

/z/: is the voiced alveolar un-aspirated fricative consonant phoneme. During the time of articulating /z/, the soft palate is raised to block the nasal passage. The tip and blade of the tongue is raised near the alveolar ridge leaving a narrow passage for the air to pass with friction. The vocal cords vibrate. It occurs initially, medially and finally in Bodo words.

By the occurrences in the two positions of the word their manners of articulation is also changed, therefore based on its manner of articulation /z/ phoneme have three allophones. When /z/ is occur at the initial position of a word then its articulation becomes quickly and on the other hand, when it is occur at the medial position of a word then its articulation becomes weak and slow. This kind of changes can make the phonetic variants of a phoneme. When /z/ phoneme is occur at the final position of a word then compressed air is released rapidly. For example:



Initial Position	**Medial Position**	**Final Position**
/zayk^{h}loŋ/ ‘rainbow’	/anzad/ ‘examination’	/aroz/ ‘prayer’
/z*ɯgu*nar/ ‘sweet gourd’	/enzor/ ‘rat’	

The following typical Praat images have shown the different Positions as well as Allophones of /z/ phoneme in different words:

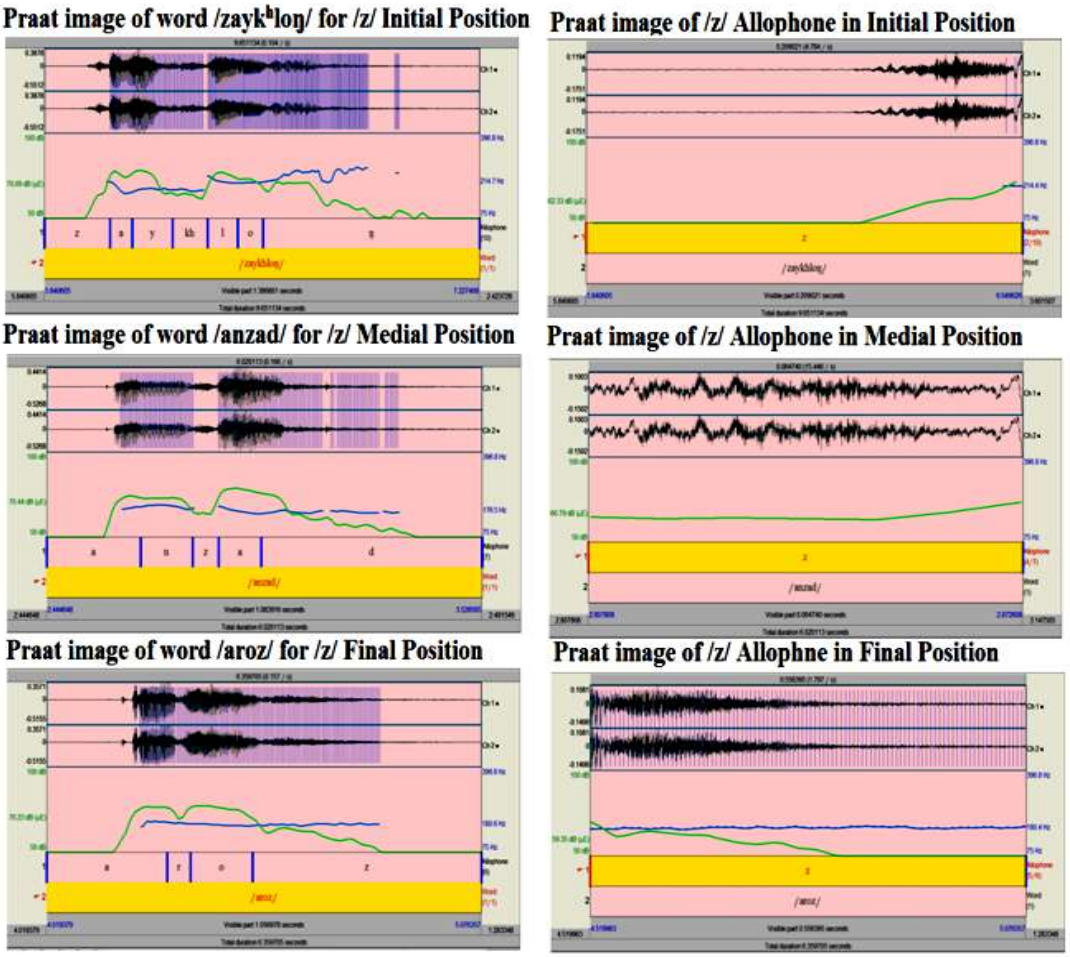


Figure: 3.20 Pitch Contour and Intensity Contour of Initial, Medial and Final Position of consonant /z/

From the analysis on Allophones of /z/ phoneme in different words, it is observed that Pitch contour and Intensity contour are occurs differently in following manners:

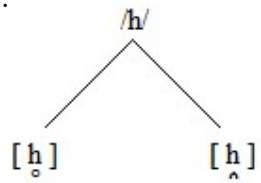
Positions of word	**Pitch contour**	**Intensity contour**
Initial Position	214.4 Hz	62.33 dB
Medial Position	Does not occur	66.79 dB
Final Position	180.4 Hz	59.35 dB

Allophonic Variants of /h/

/h/: is the voiceless glottal fricative consonant phoneme. While articulating of /h/ the soft palate is raised to close the nasal passage. The air from the lungs escapes through

the narrow passage in the glottis with audible friction. /h/ is occurs initially and medially in Bodo.

By the occurrences in the two positions of the word their manners of articulation is also changed, therefore based on its manner of articulation /h/ phoneme have two allophones. When /h/ is occur at the initial position of a word then its articulation becomes quickly and on the other hand, when it is occur at the medial position of a word then its articulation becomes weak and slow. This kind of changes can make the phonetic variants of a phoneme. /h/ phoneme does not occur in the final position of Bodo basic word. For example:



Initial Position	**Medial Position**	**Final position**
/haz*ɯ*/ ‘hill, mountain’	/gaham/ ‘good, well’	Does not occur
/haŋk^{h}ray/ ‘to call upon’	/zah*ɯ*n/ ‘reason’	in this Position

The following typical Praat images have shown the different Positions as well as Allophones of /h/ phoneme in different words:

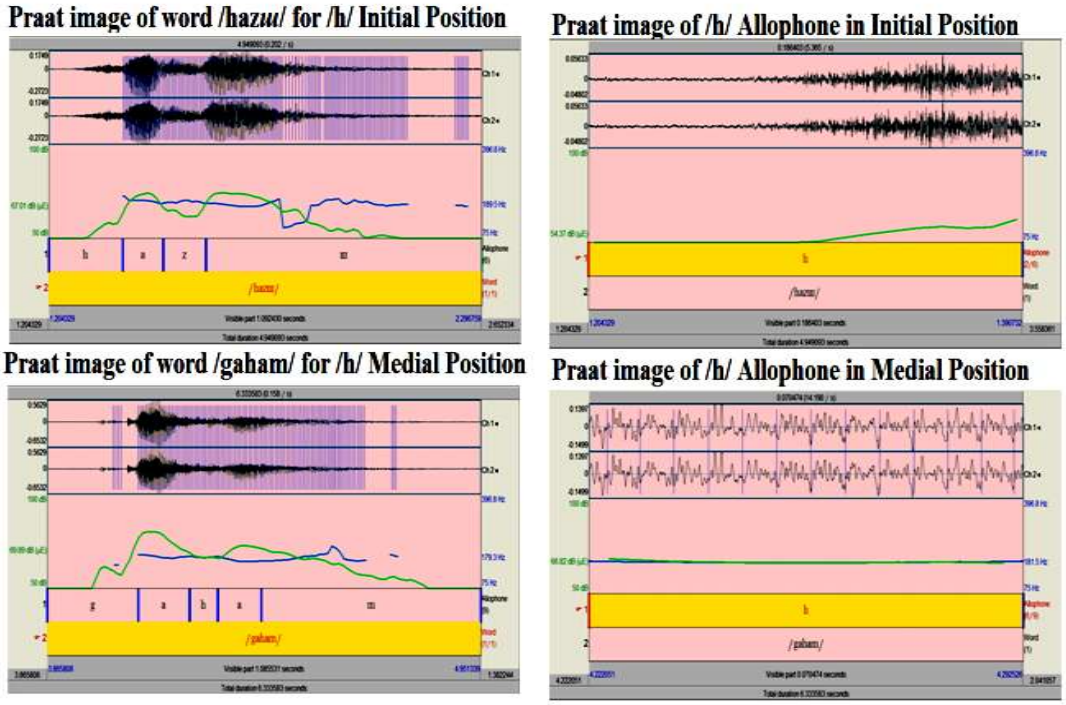


Figure: 3.21 Pitch Contour and Intensity Contour of Initial and Medial Position of consonant /h/

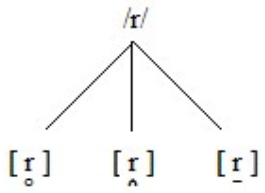
From the analysis on Allophones of /h/ phoneme in different words, it is observed that Pitch contour and Intensity contour are occurs differently in following manners:

Positions of word	Pitch contour	Intensity contour
Initial Position	Does not occur	54.37 dB
Medial Position	181.5 Hz	66.82 dB

Allophonic Variants of /r/

/r/: is the voiced alveolar trill consonant phoneme. During its articulation the soft palate is raised to close the nasal passage. The tip of the tongue is raised to tap against the alveolar ridge a few times. The vocal cords vibrate during its articulation. It occurs in all the positions of Bodo words.

By the occurrences in the two positions of the word their manners of articulation is also changed, therefore based on its manner of articulation /r/ phoneme have three allophones. When /r/ is occur at the initial position of a word then its articulation becomes quickly and on the other hand, when it is occur at the medial position of a word then its articulation becomes weak and slow. This kind of changes can make the phonetic variants of a phoneme. When it is articulated at the Final Position of a word then air passes from lungs through the front tongue becomes flapped.



Initial Position	Medial Position	Final Position
/raw/ ‘a language’	/oray/ ‘ever’	/inzur/ ‘walls of house’
/r*u*zab/ ‘to sing’	/hat^{h}ork^{h}i/ ‘star’	/lauk^{h}ar/ ‘cowboy’

The following typical Praat images have shown the different Positions as well as Allophones of /r/ phoneme in different words:

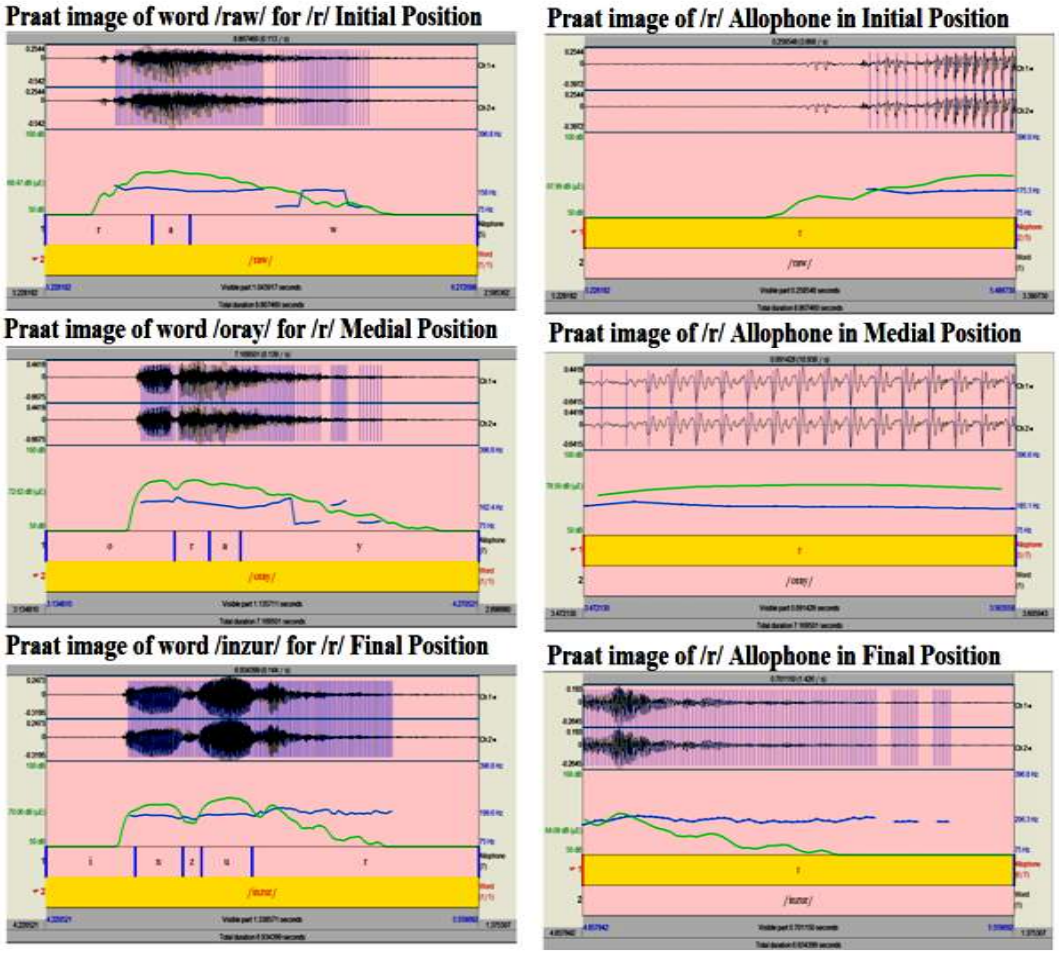


Figure: 3.22 Pitch Contour and Intensity Contour of Initial, Medial and Final Position of consonant /r/

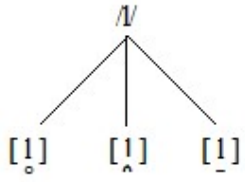
From the analysis on Allophones of /r/ phoneme in different words, it is observed that Pitch contour and Intensity contour are occurs differently in following manners:

Positions of word	**Pitch contour**	**Intensity contour**
Initial Position	175.3 Hz	67.99 dB
Medial Position	185.1 Hz	78.56 dB
Final Position	206.3 Hz	64.08 dB

Allophonic Variants of /l/

/l/: is the voiced alveolar lateral consonant phoneme. During its articulation the soft palate is raised to block the nasal passage. The tip of the tongue makes a firm contact against the teeth ridge. But the sides of the tongue are lowered to allow the air to escape without any friction. Vocal cords vibrate during its production. It occurs initially and medially in Bodo.

By the occurrences in the two positions of the word their manners of articulation is also changed, therefore based on its manner of articulation /l/ phoneme have three allophones. When /l/ is occur at the initial position of a word then its articulation becomes quickly and on the other hand, when it is occur at the medial position of a word then its articulation becomes weak and slow. When it is articulated at the Final Position of a word then air passes from lungs remains behind the closure. This kind of changes can make the phonetic variants of a phoneme. For example:



Initial Position	**Medial Position**	**Final Position**
/lanzai/ ‘tail’	/k^{h}awlai/ ‘cheek’	/k^{h}ant^{h}al/ ‘jackfruit’
/l*ur*baŋ/ ‘weak’	/g*ul*u*u*md*ui*/ ‘sweats’	/z*ua*ŋk^{h}*ul*/ ‘bright’

The following typical Praat images have shown the different Positions as well as Allophones of /l/ phoneme in different words:

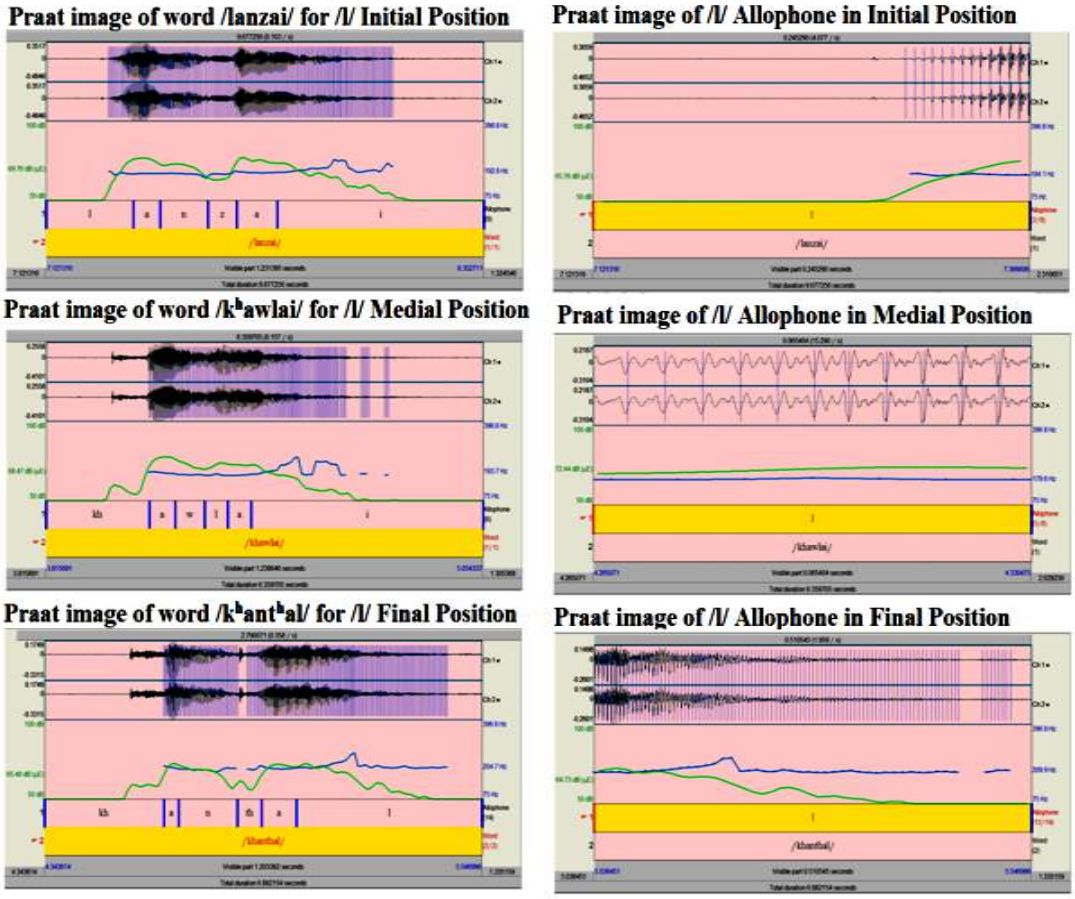


Figure: 3.23 Pitch Contour and Intensity Contour of Initial, Medial and Final Position of consonant /l/

From the analysis on Allophones of /l/ phoneme in different words, it is observed that Pitch contour and Intensity contour are occurs differently in following manners:

Positions of word	Pitch contour	Intensity contour
Initial Position	184.1 Hz	65.76 dB
Medial Position	179.6 Hz	72.44 dB
Final Position	209.9 Hz	64.73 dB

From the overall analysis on allophone of consonants, it is observed that the fourteen Consonants have changed in their manners of articulation in word level differently in different Positions and Pitch contour as well as Intensity contour are also occurs differently in each positions.

3.4 Summing up

Allophonic variants play an important function in articulating phonemes in different manners. It is observed that environments which lead to allophonic variation in Bodo language are not complex. There are different types of allophones in each phonemes defined based on the manner of articulation. Allophonic variants of Bodo phonemes can be summarized with the following findings:

i. All the relevant six Bodo vowel phonemes i.e. /i, *ɯ*, u, e, o, a/ have the occurrences in all positions of the word and all the six vowel phonemes have three allophones by its manners of articulation

ii. All the six respective vowels of Bodo have the nasalized allophones if preceded by the nasal consonants, i.e. / m, n, ŋ /. For example: / ĩ, ɯ̃, ũ, ẽ, õ, ã / .

iii. It is observed that the fourteen Consonants / p^h, b, t^h, d, k^h, g, m, n, ŋ, s, z, h, r, and l / have changed in manners of articulation in word level differently in different Positions and Pitch contour as well as Intensity contour are also occurs differently in each positions. They have different types of allophones in each phonemes defined based on the manner of articulation.

iv. It is observed that by the occurrences at the different positions of a word /ph, th, kh, s, h, ŋ/ consonant phoneme have two allophones in each and /b, d, g, m, n, z, r, l/ have three allophones in each phonemes.