Proposal to encode the Nandinagari script in Unicode

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1   Introduction

This is a proposal to encode the Nandinagari script in Unicode. It supersedes the following document:

- L2/13-002 "Preliminary Proposal to Encode Nandinagari in ISO/IEC 10646"

2   Description

Nandinagari is a Brahmi-based script that was used in southern India between the 8th and 19th centuries CE for producing manuscripts and inscriptions in Sanskrit in south Maharashtra, Karnataka and Andhra Pradesh. It was the official script of the Vijayanagara kingdom of southern India (1336–1646). There are numerous manuscripts and inscriptions bearing Nandinagari. Several of these manuscripts are biscriptal with text in the Kannada and Tigalari (Tulu) scripts. Nandinagari was also used for writing Kannada in Karnataka.

Nandinagari derives from the central group of 'Nagari' scripts and is related to Devanagari. There are several similarities between Nandinagari and Devanagari in terms of character repertoire, glyphic representation, and structure (see comparisons in tables 1–4). However, Nandinagari differs from Devanagari in terms of letterforms, the lack of a connecting headline, and in the rendering of consonant-vowel combinations and consonant conjuncts. There are several styles of Nandinagari, which are properly defined as variants of this particular type of 'Nagari' and do not resemble styles of other members of this class. As such, Nandinagari cannot be considered a stylistic variant of Devanagari. The independent status of Nandinagari is articulated by Saraju Rath (2009), who writes:

> From statements in various early and recent secondary literature [...] one could infer that Nandināgarī, Nāgarī and Devanāgarī are very close and show only minor distinctions. From a study of the available evidence in manuscripts, however, it is clear that the scripts are indeed related as sister scripts, but that there are significant and systematic differences which justify us in considering them as different scripts. In the case of Nandināgarī the separate status is very clear but because of neglect and misleading statements in secondary literature it is frequently noted that scholars who try to read the script without proper preparation fail and have to give up.

Following the above, despite its similarities to Devanagari, Nandinagari cannot be unified with the 'Devanagari' encoding in Unicode. The proper representation of Nandinagari in plain text requires the preservation of the glyphic distinctions of its letterforms, consonant conjuncts, and consonant-vowel ligatures. The script also has its own historical styles and variant forms of letters, which diverge from Devanagari styles. Support for Nandinagari at the character level will provide for representation of the script in plain text. The block will, in turn, offer a means for unifying various styles of the script.

There is an active community of scholars conducting research on Nandinagari in the areas of epigraphy, preservation of manuscripts, and optical-character recognition. The Sri Vadiraja Research Foundation, sponsored jointly by the National Mission for Manuscripts of the Government of India and the Puttige Math in Udupi, Karnataka has been working to preserve Nandinagari palm leaf manuscripts from 2007 to the present (Prabhu 2012). The French Institute of Pondicherry has also digitized its collection of Nandinagari manuscripts and made them available online (see `http://apps.ifpindia.org/manuscripts/`). Study of Nandinagari is also advanced through the work of independent specialists with an interest in the script, who have analyzed manuscripts and produced character inventories (see, for example, figures 17–26). Moreover, there have been recent attempts to develop technologies for optical-character recognition of Nandinagari (Guruprasad *et al* 2011, 2013). An encoding for Nandinagari in the Unicode will help to advance research, study, and preservation of the script.

3   Script Details

3.1   Structure

The general structure (phonetic order, *mātrā* reordering, use of *virāma*, etc.) of Nandinagari is similar to that of Devanagari. Several consonant-vowel combinations are written as ligatures. Consonant clusters are represented as conjuncts. Some consonants have special behaviors when they occur conjuncts. The headstroke of Nandinagari letters do not join with preceding or following letters.

3.2   Character repertoire and representative glyphs

The proposed repertoire is based upon character inventories in manuscripts (see figures 1 and 2) and those published in secondary sources, such as Grünendahl (2001) and Visalakshy (2003). The representative glyphs are normalizations of forms attested in these sources. Several characters have variant forms and these are considered glyphic variants purposes of the encoding. The glyphs used here have been designed by the proposal author.

3.3   Vowels

There are 12 vowel letters:

     अा   NANDINAGARI VOWEL LETTER A

     अा   NANDINAGARI VOWEL LETTER AA

     इ   NANDINAGARI VOWEL LETTER I

     ई   NANDINAGARI VOWEL LETTER II

     उ   NANDINAGARI VOWEL LETTER U

     ऊ   NANDINAGARI VOWEL LETTER UU

ꜱ   NANDINAGARI VOWEL LETTER VOCALIC R

ꜱ   NANDINAGARI VOWEL LETTER VOCALIC RR

∇   NANDINAGARI VOWEL LETTER E

∀   NANDINAGARI VOWEL LETTER AI

ꝫ   NANDINAGARI VOWEL LETTER O

ꝫ   NANDINAGARI VOWEL LETTER AU

The ꜱ VOWEL LETTER VOCALIC R and ꜱ VOWEL LETTER VOCALIC RR are also represented as a consonant-vowel combination with the letter ꜰ RA, as:

ꜰ   <ꜰ RA, ◌ VOWEL SIGN VOCALIC R>

ꜰ   <ꜰ RA, ◌ VOWEL SIGN VOCALIC RR>

Distinctive letters for *VOWEL LETTER VOCALIC L and *VOWEL LETTER VOCALIC LL are not attested, but space for them has been reserved in the event that an attestation is discovered. The sound of *VOWEL LETTER VOCALIC L is represented using the letter ल LA (see figure 1):

ल   <ल LA, ◌ VOWEL SIGN U>

3.4 Vowel Signs

There are 11 dependent vowel signs:

◌   NANDINAGARI VOWEL SIGN AA

◌   NANDINAGARI VOWEL SIGN I

◌   NANDINAGARI VOWEL SIGN II

◌   NANDINAGARI VOWEL SIGN U

◌   NANDINAGARI VOWEL SIGN UU

◌   NANDINAGARI VOWEL SIGN VOCALIC R

◌   NANDINAGARI VOWEL SIGN VOCALIC RR

◌   NANDINAGARI VOWEL SIGN E

◌   NANDINAGARI VOWEL SIGN AI

◌   NANDINAGARI VOWEL SIGN O

◌   NANDINAGARI VOWEL SIGN AU

There is no dependent form for ꝫ VOWEL LETTER A. This sound is the inherent vowel in each consonant letter. Distinctive forms for *VOWEL SIGN VOCALIC L and *VOWEL SIGN VOCALIC LL are not attested. Space is reserved for VOWEL SIGN VOCALIC L and VOWEL SIGN VOCALIC LL in the event that distinctive forms are identified.

The dependent vowel signs are combined with consonants in encoded representations as follows:

cā	वा	<व CA, ा VOWEL SIGN AA>
ci	鲁	<व CA, ি VOWEL SIGN I>
cī	वी	<व CA, ী VOWEL SIGN II>
cu	ऊ	<व CA, ੁ VOWEL SIGN U>
cū	ऊ	<व CA, ੂ VOWEL SIGN UU>
cṛ	वृ	<व CA, ृ VOWEL SIGN VOCALIC R>
cṝ	वृ	<व CA, ॄ VOWEL SIGN VOCALIC RR>
ce	वे	<व CA, े VOWEL SIGN E>
cai	वै	<व CA, ै VOWEL SIGN AI>
co	वो	<व CA, ो VOWEL SIGN O>
cau	वौ	<व CA, ौ VOWEL SIGN AU>

The ि NANDINAGARI VOWEL SIGN I is positioned at the top right of a consonant at the edge of the headstroke. The sign is often written such that its stroke straddles the headstroke at its midpoint.

Some consonant-vowel combinations may be rendered as ligatures.

ku	कु	<क KA, ੁ VOWEL SIGN U>
kū	कू	<क KA, ੂ VOWEL SIGN UU>
kṛ	कृ	<क KA, ृ VOWEL SIGN VOCALIC R>
du	दु	<द DA, ੁ VOWEL SIGN U>

3.5   Consonants

There are 35 consonant letters:

क	NANDINAGARI LETTER KA
ख	NANDINAGARI LETTER KHA
ग	NANDINAGARI LETTER GA
घ	NANDINAGARI LETTER GHA
ङ	NANDINAGARI LETTER NGA
च	NANDINAGARI LETTER CA
छ	NANDINAGARI LETTER CHA
ज	NANDINAGARI LETTER JA

ꣳ	NANDINAGARI LETTER JHA
ꣳ	NANDINAGARI LETTER NYA
ꣳ	NANDINAGARI LETTER TTA
ꣳ	NANDINAGARI LETTER TTHA
ꣳ	NANDINAGARI LETTER DDA
ꣳ	NANDINAGARI LETTER DDHA
ꣳ	NANDINAGARI LETTER NNA
ꣳ	NANDINAGARI LETTER TA
ꣳ	NANDINAGARI LETTER THA
ꣳ	NANDINAGARI LETTER DA
ꣳ	NANDINAGARI LETTER DHA
ꣳ	NANDINAGARI LETTER NA
ꣳ	NANDINAGARI LETTER PA
ꣳ	NANDINAGARI LETTER PHA
ꣳ	NANDINAGARI LETTER BA
ꣳ	NANDINAGARI LETTER BHA
ꣳ	NANDINAGARI LETTER MA
ꣳ	NANDINAGARI LETTER YA
ꣳ	NANDINAGARI LETTER RA
ꣳ	NANDINAGARI LETTER LA
ꣳ	NANDINAGARI LETTER VA
ꣳ	NANDINAGARI LETTER SHA
ꣳ	NANDINAGARI LETTER SSA
ꣳ	NANDINAGARI LETTER SA
ꣳ	NANDINAGARI LETTER HA
ꣳ	NANDINAGARI LETTER LLA
ꣳ	NANDINAGARI LETTER RRA

Each consonant letter bears the inherent vowel /a/. This inherent vowel is silenced using ◌ VIRAMA. Clusters of consonants are represented as conjuncts (see section 3.7).

The ꣳ NANDINAGARI LETTER RRA is not part of the traditional consonant inventory. It appears to have been introduced in the 11th century for transcribing the Kannada letter ಱ U+0CB1 KANNADA LETTER RRA (see figure 3).

3.6 Virama

The ◌ NANDINAGARI SIGN VIRAMA has two functions, similar to the corresponding character of Devanagari. It is used as a *halanta* for marking the absence of the inherent vowel of a consonant letter. It is also a control character that is used for producing conjuncts.

The VIRAMA ligates with the base letter at the lower right edge:

> *k*   ꘥   <ꘞ KA, ◌ VIRAMA>

> *c*   ꘩   <꘧ CA, ◌ VIRAMA>

3.7 Conjuncts

Consonant clusters are represented as conjuncts. It is appropriate to adopt the Devanagari model for producing conjuncts. The control character ◌ NANDINAGARI SIGN VIRAMA is placed after each non-initial consonant in a cluster, ie. <(*C*, ◌ VIRAMA)*, *C*>. This model also uses the generic control characters ZWJ U+200D ZERO WIDTH JOINER (abbreviated as ZWJ) and ZWNJ U+200C ZERO WIDTH NON-JOINER (abbreviated as ZWNJ) for controlling alternate representations of conjuncts. Described below are the various ways of rendering conjuncts in Nandinagari and the proposed methods for their encoded representations.

Atomic ligatures   Some clusters are represented using atomic or *akhaṇḍa* ligatures, in which the forms of the constituent letters are not readily recognizable. Examples of such ligatures are:

> *kṣa*   ꘨   <ꘞ KA, ◌ VIRAMA, ꘫ SSA>

> *jña*   ꘩   <꘨ JA, ◌ VIRAMA, ꘪ NYA>

Clusters involving the above consonants are always represented using atomic ligatures. They are not produced using the other methods shown below. However, as the encoding allows for alternate representations of conjuncts, irregular forms of these conjuncts are permitted.

Regular ligatures   Conjuncts may be represented as ligatures in which the shapes of individual letters are visible.

> *ccha*   ꘩9   <꘧ CA, ◌ VIRAMA, ꘢ CHA>

> *tta*   ꘥   <꘨ TA, ◌ VIRAMA, ꘨ TA>

> *tra*   ꘣   <꘨ TA, ◌ VIRAMA, ꘢ RA>

> *dda*   ꘩   <꘩ DA, ◌ VIRAMA, ꘩ DA>

> *ṣṭa*   ꘫ   <ꘫ SSA, ◌ VIRAMA, ꘩ TTA>

Initial half-forms   The initial letter in a cluster may be represented as a half-form if its graphical structure provides such an opportunity. Generally, if the letter has a right descender it is removed to produce a half form; the headstroke is typically retained, eg. ꘨ → ꘩ for the half-form of TA. These are represented in encoded text as follows:

    tka   ॐ   <न TA, ् VIRAMA, क KA>

Conjoined forms   Conjuncts may be represented by fusing the unaltered regular forms of letters together. In order to prevent ligature formation and to preserve the regular form of letters, the control character ⓩⓦ ZWJ is placed before VIRAMA for producing such forms. Conjoined forms are produced by joining letters together at the edges:

    tpa   तप   <न TA, ⓩⓦ ZWJ, ् VIRAMA, प PA>

    bda   बर   <ब BA, ⓩⓦ ZWJ, ् VIRAMA, र DA>

    stha सथ   <स SA, ⓩⓦ ZWJ, ् VIRAMA, थ THA>

As the headstroke is not generally connected in Nandinagari, a conjoined conjunction may be produced by joining the headstroke between letters in a cluster:

    tpa   तप   <न TA, ⓩⓦ ZWJ, ् VIRAMA, प PA>

    bda   बर   <ब BA, ⓩⓦ ZWJ, ् VIRAMA, र DA>

The headstroke is elongated for letters without a full-width headstroke so that the conjunction is seamless. This modification occurs with क KA, which has a half-width headstroke, when it is not in a cluster that is rendered using an atomic ligature.

    kśa   करा   <क KA, ⓩⓦ ZWJ, ् VIRAMA, रा SHA>

Conjoined forms can also be produced for clusters in which adjacent consonants may be treated as atomic ligatures. In such cases, the atomic ligature is produced first, then the following letter is fused with it. The headstrokes of these are also joined as necessary.

    kṣma रुम   <क KA, ् VIRAMA, ष SSA, ⓩⓦ ZWJ, ् VIRAMA, म MA>

Some fused conjuncts may resemble those produced using an initial half-form, particularly when the second element is य YA.

Subjoined   Some consonants are rendered as subjoined forms when they are non-initial in a cluster:

    gla   ग्ल   <ग GA, ् VIRAMA, ल LA>

    ṭva   ट्व   <ट TTA, ् VIRAMA, व VA>

This type of conjunct normally occurs when the initial consonant does not have a half-form and when the shape of the following consonant provides a feasible means for producing a subjoined form.

Special cases   The following letters have special behaviors in conjuncts.

• TA   The letter न TA can be rendered in different ways when it is initial in a cluster. The first is as a half-form, as shown above:

      tka   ॅक   \<त TA, ्ं VIRAMA, क KA\>

The other is by truncating the left stroke (त → त) to retain the letter as the base and to attach the following consonant as a subjoined form:

      tna   ॅन   \<त TA, ्ं VIRAMA, न NA\>

      tta   ॅत   \<त TA, ्ं VIRAMA, त TA\>

- YA   The letter य YA is generally represented using the post-base form ⟋. This form is produced by default using the sequence \<*C*, ्ं VIRAMA, य YA\>:

      kya   क्य   \<क KA, ्ं VIRAMA, य YA\>

      gya   ग्य   \<ग GA, ्ं VIRAMA, य YA\>

      tya   त्य   \<त TA, ्ं VIRAMA, य YA\>

      yya   य्य   \<य YA, ्ं VIRAMA, य YA\>

      ṣya   ष्य   \<ष SSA, ्ं VIRAMA, य YA\>

When YA is non-initial it can also form conjuncts with a half-form of the initial letter. In such cases, the [zw] ZWJ is placed after VIRAMA to produce a half-form of the initial letter:

      gya   ग्य   \<ग GA, ्ं VIRAMA, [zw] ZWJ, य YA\>

      sya   स्य   \<ष SSA, ्ं VIRAMA, [zw] ZWJ, य YA\>

The sequence \<YA, YA\> can be rendered in two ways. The default is to use the post-base form of the second letter:

      yya   य्य   \<य RA, ्ं VIRAMA, य YA\>

The alternative is to use a conjoined ligature:

      yya   य्य   \<य RA, [zw] ZWJ, ्ं VIRAMA, य YA\>

- RA   When र RA is the initial consonant in a cluster it takes the form ं, which is called *repha*. This form is the default representation of the sequence \<र RA, ्ं VIRAMA, *C*\>:

      rka   र्क   \<र RA, ्ं VIRAMA, क KA\>

      rṣa   र्ष   \<र RA, ्ं VIRAMA, ष SSA\>

When it is non-initial it has the form ◌्र *ra-kara*. This form is the default representation of the sequence \<*C*, ्ं VIRAMA, र RA\>:

pra   प्र   <प PA, ् VIRAMA, र RA>

śra   श्र   <श SHA, ् VIRAMA, र RA>

- RA + YA   When र RA is immediately followed by य YA in a cluster, it takes precedence over the latter. The conjunct RA is rendered as *repha*:

rya   र्य   <र RA, ् VIRAMA, य YA>

The post-base form of YA is not used with RA:

rya   *र्या   <र RA, ् VIRAMA, य YA>

Breaking conjunct formation   As is the case in Devanagari and other Indic scripts, default conjunct formation may be modified using [ZWNJ] ZWNJ and [ZWJ] ZWJ.

An atomic ligature may be rendered with visible VIRAMA or as a conjoined ligature:

kṣa   क्ष   <क KA, ् VIRAMA, ष SSA>

kṣa   क्‌ष   <क KA, ् VIRAMA, [ZWNJ] ZWNJ, ष SSA>

kṣa   क्ष   <क KA, [ZWJ] ZWJ, ् VIRAMA, ष SSA>

Rendering of *repha* may be prevented:

rka   र्क   <र RA, ् VIRAMA, क KA>

rka   र्क   <र RA, [ZWJ] ZWJ, ् VIRAMA, क KA>

The post-base form of YA may be produced after RA:

rya   र्य   <र RA, ् VIRAMA, य YA>

rya   र्य   <र RA, ् VIRAMA, [ZWJ] ZWJ, य YA>

3.8   Various Signs

The following signs are used as vowel modifiers:

◌ं   NANDINAGARI SIGN ANUSVARA

◌ः   NANDINAGARI SIGN VISARGA

The ◌ं ANUSVARA is used for marking nasalization. It is generally placed to the right of a base letter, but may also be placed above it. The ◌ः VISARGA is used for representing post-vocalic aspiration in words of Sanskrit origin. They are used in encoded text as follows:

kaṃ कं० ‹क KA, ○० ANUSVARA›

kaḥ कः ‹क KA, ○ः VISARGA›

3.9 Avagraha

The following character is included in the repertoire:

ऽ NANDINAGARI SIGN AVAGRAHA

This sign is used for marking the elision of word-initial *a* in Sanskrit as a result of sandhi (see figure 5).

3.10 Invocation signs

The following character is included in the repertoire:

ꣳ NANDINAGARI SIGN SIDDHAM

The sign ꣳ SIDDHAM is a symbol used as an invocation at the beginning of documents (see figure 3).

The syllable ꣽ० *oṃ* is used frequently. However, this is not an atomic character. It is represented using the sequence:

oṃ ꣽ० ‹ꣽ O, ○० ANUSVARA›

3.11 Punctuation

Nandinagari uses । *daṇḍā* and ॥ double *daṇḍā* for punctuation. These should be unified with the corresponding Devanagari characters. Script extensions have been specified in section 4.5.

3.12 Spacing headstroke

The following character is included in the repertoire:

‾ NANDINAGARI HEADSTROKE

The ‾ HEADSTROKE is used as a sign of spacing or joining a word. It may be used for connecting a word that is broken on account of imperfections on a writing surface. It is also used as placeholder (see figure 6). A sequence of multiple headstrokes are generally unconnected:

भ‾‾झ ‹भ BHA, ‾ HEADSTROKE, ‾ HEADSTROKE, झ JHA›

The HEADSTROKE may also occur between *daṇḍā*-s at the end of a section:

॥‾‾॥ ‹॥ U+0965 DEVANAGARI DOUBLE DANDA, ‾ HEADSTROKE, ‾ HEADSTROKE,
       ॥ U+0965 DEVANAGARI DOUBLE DANDA›

3.13   Digits

A full set of digits is used in Nandinagari:

౦	NANDINAGARI DIGIT ZERO	౪	NANDINAGARI DIGIT FIVE
౧	NANDINAGARI DIGIT ONE	౬	NANDINAGARI DIGIT SIX
౨	NANDINAGARI DIGIT TWO	౭	NANDINAGARI DIGIT SEVEN
౩	NANDINAGARI DIGIT THREE	౮	NANDINAGARI DIGIT EIGHT
౪	NANDINAGARI DIGIT FOUR	౯	NANDINAGARI DIGIT NINE

Nandinagari digits are similar to Kannada digits (see table 4). However, they are currently included in the proposed repertoire because they are used commonly in Nandinagari environments and are written in a style that matches the Nandinagari handwriting. If the differences between Nandinagari and Kannada forms are truly artificial, then it may be practical to unify these digits with the corresponding Kannada characters.

3.14   Number forms

Fraction signs occur used in Nandinagari sources (see figure 7; also L2/15-243: 22). These may be represented using characters already encoded in the 'Common Indic Number Forms' block (U+A830):

		Corresponding character
I	¼	I U+A830 NORTH INDIC FRACTION ONE QUARTER
II	½	II U+A831 NORTH INDIC FRACTION ONE HALF
III	¾	III U+A832 NORTH INDIC FRACTION THREE QUARTERS
⌐	¼	⌐ U+A833 NORTH INDIC FRACTION ONE SIXTEENTH
=	½	= U+A834 NORTH INDIC FRACTION ONE EIGHTH
≡	¾	≡ U+A835 NORTH INDIC FRACTION THREE SIXTEENTHS

These characters are specified as script extensions for Nandinagari. The 'Common Indic Number Forms' are described briefly in *The Unicode Standard* (chapter 22.3 'Numerals', pp. 770–771) and in more detail in the original encoding proposal (L2/07-354).

3.15   Vedic signs

Signs for Vedic notation are found in Nandinagari manuscripts (see L2/15-101: 7–9). They are not included in the proposed repertoire. The following marks for intonation are attested (the given values are tentative):

- ◌˛   *svarita*
- ◌̤   *anudatta*
- ◌̒   *udatta*

Usage of these signs is shown in figures 12 and 13. Additional research is required to determine if these signs should be encoded as specific to Nandinagari or in the generic Vedic Extensions block (1CD0..1CFF).

Other signs, such as ⟨ *jihvāmūlīya* (see figures 8, 9) and ⟨ Vedic *anusvāra* (see figure 10), are attested but these may be unified with existing characters in Vedic Extensions:

		Corresponding character
◌⟨	*jihvāmūlīya*	◌⟨ U+1CF2 VEDIC SIGN ARDHAVISARGA
◌⟨	*upadhmānīya*	◌⟨ U+1CF2 VEDIC SIGN ARDHAVISARGA
⟨	*anusvāra*	⟨ U+1CE9 VEDIC SIGN ANUSVARA ANTARGOMUKHA

A doubled form of ⟨ Vedic *anusvāra* / *anunāsika* is attested in Nandinagari manuscripts (see figure 11):

     ⟨   Vedic double *anusvāra*

This character is not yet encoded in Unicode, but should be considered for inclusion. If encoded, it may be allocated to the Vedic Extensions block if there is space.

3.16 Collation

The sort order for Nandinagari is as follows:

अ A < आ AA < इ I < ई II < उ U < ऊ UU < ऋ VOCALIC R < ॠ VOCALIC RR <

ए E < ऐ AI < ओ O < औ AU < क KA < ख KHA < ग GA < घ GHA < ङ NGA <

च CA < छ CHA < ज JA < ञ NYA < ट TTA < ठ TTHA < ड DDA < ढ DDHA <

ण NNA < त TA < थ THA < द DA < ध DHA < न NA < प PA < फ PHA < ब BA <

भ BHA < म MA < य YA < र RA < ल LA < व VA < श SHA < ष SSA < स SA <

ह HA < ळ LLA < ऱ RRA < ◌ VOWEL SIGN I < ◌ VOWEL SIGN II < ◌ VOWEL SIGN U <

◌ VOWEL SIGN UU < ◌ VOWEL SIGN VOCALIC R < ◌ VOWEL SIGN VOCALIC RR <

◌ VOWEL SIGN E < ◌ VOWEL SIGN AI < ◌ VOWEL SIGN O < ◌ VOWEL SIGN AU <

◌ VIRAMA

The letter ऱ RRA does not have a position in the traditional order. For this reason it is sorted after the last consonant ळ LLA.

4   Character Data

4.1   Character Properties

In the format of `UnicodeData.txt`:

```
11B90;NANDINAGARI LETTER A;Lo;0;L;;;;;N;;;;;
11B91;NANDINAGARI LETTER AA;Lo;0;L;;;;;N;;;;;
11B92;NANDINAGARI LETTER I;Lo;0;L;;;;;N;;;;;
11B93;NANDINAGARI LETTER II;Lo;0;L;;;;;N;;;;;
11B94;NANDINAGARI LETTER U;Lo;0;L;;;;;N;;;;;
11B95;NANDINAGARI LETTER UU;Lo;0;L;;;;;N;;;;;
11B96;NANDINAGARI LETTER VOCALIC R;Lo;0;L;;;;;N;;;;;
11B97;NANDINAGARI LETTER VOCALIC RR;Lo;0;L;;;;;N;;;;;
11B98;<reserved>
11B99;<reserved>
11B9A;NANDINAGARI LETTER E;Lo;0;L;;;;;N;;;;;
11B9B;NANDINAGARI LETTER AI;Lo;0;L;;;;;N;;;;;
11B9C;NANDINAGARI LETTER O;Lo;0;L;;;;;N;;;;;
11B9D;NANDINAGARI LETTER AU;Lo;0;L;;;;;N;;;;;
11B9E;NANDINAGARI LETTER KA;Lo;0;L;;;;;N;;;;;
11B9F;NANDINAGARI LETTER KHA;Lo;0;L;;;;;N;;;;;
11BA0;NANDINAGARI LETTER GA;Lo;0;L;;;;;N;;;;;
11BA1;NANDINAGARI LETTER GHA;Lo;0;L;;;;;N;;;;;
11BA2;NANDINAGARI LETTER NGA;Lo;0;L;;;;;N;;;;;
11BA3;NANDINAGARI LETTER CA;Lo;0;L;;;;;N;;;;;
11BA4;NANDINAGARI LETTER CHA;Lo;0;L;;;;;N;;;;;
11BA5;NANDINAGARI LETTER JA;Lo;0;L;;;;;N;;;;;
11BA6;NANDINAGARI LETTER JHA;Lo;0;L;;;;;N;;;;;
11BA7;NANDINAGARI LETTER NYA;Lo;0;L;;;;;N;;;;;
11BA8;NANDINAGARI LETTER TTA;Lo;0;L;;;;;N;;;;;
11BA9;NANDINAGARI LETTER TTHA;Lo;0;L;;;;;N;;;;;
11BAA;NANDINAGARI LETTER DDA;Lo;0;L;;;;;N;;;;;
11BAB;NANDINAGARI LETTER DDHA;Lo;0;L;;;;;N;;;;;
11BAC;NANDINAGARI LETTER NNA;Lo;0;L;;;;;N;;;;;
11BAD;NANDINAGARI LETTER TA;Lo;0;L;;;;;N;;;;;
11BAE;NANDINAGARI LETTER THA;Lo;0;L;;;;;N;;;;;
11BAF;NANDINAGARI LETTER DA;Lo;0;L;;;;;N;;;;;
11BB0;NANDINAGARI LETTER DHA;Lo;0;L;;;;;N;;;;;
11BB1;NANDINAGARI LETTER NA;Lo;0;L;;;;;N;;;;;
11BB2;NANDINAGARI LETTER PA;Lo;0;L;;;;;N;;;;;
11BB3;NANDINAGARI LETTER PHA;Lo;0;L;;;;;N;;;;;
11BB4;NANDINAGARI LETTER BA;Lo;0;L;;;;;N;;;;;
11BB5;NANDINAGARI LETTER BHA;Lo;0;L;;;;;N;;;;;
11BB6;NANDINAGARI LETTER MA;Lo;0;L;;;;;N;;;;;
11BB7;NANDINAGARI LETTER YA;Lo;0;L;;;;;N;;;;;
11BB8;NANDINAGARI LETTER RA;Lo;0;L;;;;;N;;;;;
11BB9;NANDINAGARI LETTER LA;Lo;0;L;;;;;N;;;;;
11BBA;NANDINAGARI LETTER VA;Lo;0;L;;;;;N;;;;;
11BBB;NANDINAGARI LETTER SHA;Lo;0;L;;;;;N;;;;;
11BBC;NANDINAGARI LETTER SSA;Lo;0;L;;;;;N;;;;;
11BBD;NANDINAGARI LETTER SA;Lo;0;L;;;;;N;;;;;
11BBE;NANDINAGARI LETTER HA;Lo;0;L;;;;;N;;;;;
11BBF;NANDINAGARI LETTER LLA;Lo;0;L;;;;;N;;;;;
11BC0;NANDINAGARI LETTER RRA;Lo;0;L;;;;;N;;;;;
11BC1;NANDINAGARI VOWEL SIGN AA;Mc;0;L;;;;;N;;;;;
11BC2;NANDINAGARI VOWEL SIGN I;Mn;0;NSM;;;;;N;;;;;
11BC3;NANDINAGARI VOWEL SIGN II;Mc;0;L;;;;;N;;;;;
11BC4;NANDINAGARI VOWEL SIGN U;Mn;0;NSM;;;;;N;;;;;
11BC5;NANDINAGARI VOWEL SIGN UU;Mn;0;NSM;;;;;N;;;;;
```

```
11BC6;NANDINAGARI VOWEL SIGN VOCALIC R;Mn;0;NSM;;;;;N;;;;;
11BC7;NANDINAGARI VOWEL SIGN VOCALIC RR;Mn;0;NSM;;;;;N;;;;;
11BC8;<reserved>
11BC9;<reserved>
11BCA;NANDINAGARI VOWEL SIGN E;Mn;0;NSM;;;;;N;;;;;
11BCB;NANDINAGARI VOWEL SIGN AI;Mn;0;NSM;;;;;N;;;;;
11BCC;NANDINAGARI VOWEL SIGN O;Mc;0;L;;;;;N;;;;;
11BCD;NANDINAGARI VOWEL SIGN AU;Mc;0;L;;;;;N;;;;;
11BCE;NANDINAGARI SIGN ANUSVARA;Mc;0;L;;;;;N;;;;;
11BCF;NANDINAGARI SIGN VISARGA;Mc;0;L;;;;;N;;;;;
11BD0;NANDINAGARI SIGN VIRAMA;Mc;9;L;;;;;N;;;;;
11BD1;NANDINAGARI SIGN AVAGRAHA;Lo;0;L;;;;;N;;;;;
11BD2;NANDINAGARI SIGN SIDDHAM;Lo;0;L;;;;;N;;;;;
11BD3;NANDINAGARI HEADSTROKE;Po;0;L;;;;;N;;;;;
11BE0;NANDINAGARI DIGIT ZERO;Nd;0;L;;0;0;0;N;;;;;
11BE1;NANDINAGARI DIGIT ONE;Nd;0;L;;1;1;1;N;;;;;
11BE2;NANDINAGARI DIGIT TWO;Nd;0;L;;2;2;2;N;;;;;
11BE3;NANDINAGARI DIGIT THREE;Nd;0;L;;3;3;3;N;;;;;
11BE4;NANDINAGARI DIGIT FOUR;Nd;0;L;;4;4;4;N;;;;;
11BE5;NANDINAGARI DIGIT FIVE;Nd;0;L;;5;5;5;N;;;;;
11BE6;NANDINAGARI DIGIT SIX;Nd;0;L;;6;6;6;N;;;;;
11BE7;NANDINAGARI DIGIT SEVEN;Nd;0;L;;7;7;7;N;;;;;
11BE8;NANDINAGARI DIGIT EIGHT;Nd;0;L;;8;8;8;N;;;;;
11BE9;NANDINAGARI DIGIT NINE;Nd;0;L;;9;9;9;N;;;;;
```

4.2   Linebreaking

In the format of `LineBreak.txt`:

```
11B90..11B97; AL   # NANDINAGARI LETTER A .. NANDINAGARI LETTER VOCALIC RR
11B9A..11BC0; AL   # NANDINAGARI LETTER E .. NANDINAGARI LETTER HA
11BC1..11BC7; CM   # NANDINAGARI VOWEL SIGN AA .. NANDINAGARI VOWEL SIGN VOCALIC RR
11BCA..11BD0; CM   # NANDINAGARI VOWEL SIGN E .. NANDINAGARI SIGN VIRAMA
11BD1..11BD3; AL   # NANDINAGARI SIGN AVAGRAHA .. NANDINAGARI HEADSTROKE
11BE0..11B9E; NU   # NANDINAGARI DIGIT ZERO .. NANDINAGARI DIGIT NINE
```

4.3   Syllabic Categories

in the format of `IndicSyllabicCategory.txt`:

```
# Indic_Syllabic_Category=Bindu
11BCE          ; Bindu                 # Mc        NANDINAGARI SIGN ANUSVARA


# Indic_Syllabic_Category=Visarga
11BCF          ; Visarga               # Mc        NANDINAGARI SIGN VISARGA


# Indic_Syllabic_Category=Virama
11BD0          ; Virama                # Mn        NANDINAGARI SIGN VIRAMA


# Indic_Syllabic_Category=Vowel_Independent
11B90..11B97  ; Vowel_Independent    # Lo   [9] NANDINAGARI LETTER A ..
                                                 NANDINAGARI LETTER VOCALIC RR
11B9A..11BC0  ; Vowel_Independent    # Lo   [4] NANDINAGARI LETTER E ..
                                                 NANDINAGARI LETTER AU


# Indic_Syllabic_Category=Vowel_Dependent
11BC1          ; Vowel_Dependent      # Mc        NANDINAGARI VOWEL SIGN AA
11BC2          ; Vowel_Dependent      # Mn        NANDINAGARI VOWEL SIGN I
```

```
11BC3           ; Vowel_Dependent      # Mc        NANDINAGARI VOWEL SIGN II
11BC4..11BC7  ; Vowel_Dependent      # Mn     [4] NANDINAGARI VOWEL SIGN U ..
                                                   NANDINAGARI VOWEL SIGN VOCALIC RR
11BCA..11BCB  ; Vowel_Dependent      # Mn     [2] NANDINAGARI VOWEL SIGN E ..
                                                   NANDINAGARI VOWEL SIGN AI
11BCC..11BCD  ; Vowel_Dependent      # Mc     [2] NANDINAGARI VOWEL SIGN O ..
                                                   NANDINAGARI VOWEL SIGN AU


# Indic_Syllabic_Category=Consonant
11B9E..11BC0  ; Consonant            # Lo    [35] NANDINAGARI LETTER KA ..
                                                   NANDINAGARI LETTER RRA
```

4.4   Positional Categories

In the format of `IndicPositionalCategory.txt`:

```
# Indic_Positional_Category=Top
11BC2           ; Top     # Mn        NANDINAGARI VOWEL SIGN I
11BCA..11BCB  ; Top     # Mn    [2] NANDINAGARI VOWEL SIGN E ..
                                     NANDINAGARI VOWEL SIGN AI

# Indic_Positional_Category=Bottom
11BC4..11BC7  ; Bottom  # Mn    [4] NANDINAGARI VOWEL SIGN U ..
                                     NANDINAGARI VOWEL SIGN VOCALIC RR
11BD0           ; Bottom  # Mn        NANDINAGARI SIGN VIRAMA

# Indic_Positional_Category=Right
11BC1           ; Right   # Mc        NANDINAGARI VOWEL SIGN AA
11BC3           ; Right   # Mc        NANDINAGARI VOWEL SIGN II
11BCC..11BCD  ; Right   # Mc    [2] NANDINAGARI VOWEL SIGN O ..
                                     NANDINAGARI VOWEL SIGN AU
11BCE..11BCF  ; Right   # Mc    [2] NANDINAGARI SIGN ANUSVARA ..
                                     NANDINAGARI SIGN VISARGA
```

4.5   Script Extensions

The following characters should be extended for use with Nandinagari in `ScriptExtensions.txt`:

```
0964           ; # Po        DEVANAGARI DANDA
0965           ; # Po        DEVANAGARI DOUBLE DANDA

A830..A835  ; # No     [6] NORTH INDIC FRACTION ONE QUARTER..
                            NORTH INDIC FRACTION THREE SIXTEENTHS
```

5   References

Grünendahl, Reinhold. 2001. *South Indian scripts in Sanskrit manuscripts and prints : Grantha Tamil, Malayalam, Telugu, Kannada, Nandinagari*. Wiesbaden: Harrassowitz.

Guruprasad, Prathima; Jharna Majumdar; Guruprasad [K. S. Rao]. 2013. "Feature Extraction and Classification Techniques for Handwritten Nandinagari Vowels". *Anusandhana: Journal of Science, Engineering and Management*, vol. 2, no. 2 (December).

Guruprasad, Prathima; Guruprasad K. S. Rao. 2011. "A Survey of Nandinagari Manuscript Recognition System". *International Journal of Science & Technology*, vol. 1, no. 1 (November).

Mukhopadhyaya, Satkari. 2005. "Palaeographical Importance of Nandinagari". `http://www.harekrsna.com/sun/features/06-07/features681.htm`

Pandey, Anshuman. 2007. "Proposal to Encode North Indic Number Forms in ISO/IEC 10646". L2/07-354. `http://www.unicode.org/L2/L2007/07354-north-indic.pdf`

———. 2013. "Preliminary Proposal to Encode Nandinagari in ISO/IEC 10646". N4389 L2/13-002. `http://www.unicode.org/L2/L2013/13002-nandinagari.pdf`

Prabhu, Ganesh. 2012. "Foundation on a mission to protect palm leaf manuscripts". *The Hindu*, Karnataka ed., December 25, 2012. `http://www.thehindu.com/todays-paper/tp-national/tp-karnataka/foundation-on-a-mission-to-protect-palm-leaf-manuscripts/article4237455.ece`

Rath, Saraju. 2009. "Nandināgarī manuscripts: distinctive features, geographical and chronological range". Abstract of a conference paper for the 14th World Sanskrit Conference, Kyoto, Japan, 1–5 September, 2009. `http://www.indology.bun.kyoto-u.ac.jp/14thWSC/programme/16/Rath.pdf`

Rice, Lewis. 1879. "Two new Chalukya grants". *Indian Antiquary*, vol. 8 (April), pp. 89–98.

Srinidhi A. 2015a. "Encoding of Vedic characters used in non-Devanagari scripts". L2/15-101. `http://www.unicode.org/L2/L2015/15101-vedic.pdf`

———. 2015b. "Representation of Fractional Signs in Kannada script". L2/15-243. `http://www.unicode.org/L2/L2015/15243-kannada-frac.pdf`

Visalakshy, P. 2003. *Nandināgarī Script*. Dravidian Linguistics Association no. 83. 1st ed. Thiruvananthapuram: Dravidian Linguistics Association.

6   Acknowledgments

	11B9	11BA	11BB	11BC	11BD	11BE
0	श्र 11B90	ग 11BA0	॰ 11BB0	ट 11BC0	◌ 11BD0	० 11BE0
1	श्रा 11B91	घ 11BA1	न 11BB1	◌ 11BC1	ऽ 11BD1	१ 11BE1
2	इ 11B92	ॱ॰ 11BA2	प 11BB2	◌ 11BC2	ॽ 11BD2	७ 11BE2
3	ई 11B93	व 11BA3	फ 11BB3	◌ 11BC3	— 11BD3	३ 11BE3
4	उ 11B94	क 11BA4	ब 11BB4	◌ 11BC4		४ 11BE4
5	ऊ 11B95	ख 11BA5	न 11BB5	◌ 11BC5		५ 11BE5
6	ऋ 11B96	न 11BA6	भ 11BB6	◌ 11BC6		६ 11BE6
7	ॡ 11B97	ळ 11BA7	य 11BB7	◌ 11BC7		७ 11BE7
8		ढ 11BA8	न 11BB8			८ 11BE8
9		ठ 11BA9	ल 11BB9			९ 11BE9
A	∇ 11B9A	३ 11BAA	व 11BBA	◌ 11BCA		
B	∀ 11B9B	ळ 11BAB	रा 11BBB	◌ 11BCB		
C	ॐ 11B9C	Ⅲ 11BAC	घ 11BBC	◌ 11BCC		
D	श्री 11B9D	त 11BAD	स 11BBD	◌ 11BCD		
E	क 11B9E	ब 11BAE	स 11BBE	◌॰ 11BCE		
F	र 11B9F	र 11BAF	ल 11BBF	◌॰ 11BCF		

Independent vowels

11B90	अ	NANDINAGARI LETTER A
11B91	आ	NANDINAGARI LETTER AA
11B92	इ	NANDINAGARI LETTER I
11B93	ई	NANDINAGARI LETTER II
11B94	उ	NANDINAGARI LETTER U
11B95	ऊ	NANDINAGARI LETTER UU
11B96	ऋ	NANDINAGARI LETTER VOCALIC R
11B97	ॠ	NANDINAGARI LETTER VOCALIC RR
11B98	▨	<reserved>
11B99	▨	<reserved>
11B9A	ए	NANDINAGARI LETTER E
11B9B	ऐ	NANDINAGARI LETTER AI
11B9C	ओ	NANDINAGARI LETTER O
11B9D	औ	NANDINAGARI LETTER AU

Consonants

11B9E	क	NANDINAGARI LETTER KA
11B9F	ख	NANDINAGARI LETTER KHA
11BA0	ग	NANDINAGARI LETTER GA
11BA1	घ	NANDINAGARI LETTER GHA
11BA2	ङ	NANDINAGARI LETTER NGA
11BA3	च	NANDINAGARI LETTER CA
11BA4	छ	NANDINAGARI LETTER CHA
11BA5	ज	NANDINAGARI LETTER JA
11BA6	झ	NANDINAGARI LETTER JHA
11BA7	ञ	NANDINAGARI LETTER NYA
11BA8	ट	NANDINAGARI LETTER TTA
11BA9	ठ	NANDINAGARI LETTER TTHA
11BAA	ड	NANDINAGARI LETTER DDA
11BAB	ढ	NANDINAGARI LETTER DDHA
11BAC	ण	NANDINAGARI LETTER NNA
11BAD	त	NANDINAGARI LETTER TA
11BAE	थ	NANDINAGARI LETTER THA
11BAF	द	NANDINAGARI LETTER DA
11BB0	ध	NANDINAGARI LETTER DHA
11BB1	न	NANDINAGARI LETTER NA
11BB2	प	NANDINAGARI LETTER PA
11BB3	फ	NANDINAGARI LETTER PHA
11BB4	ब	NANDINAGARI LETTER BA
11BB5	भ	NANDINAGARI LETTER BHA
11BB6	म	NANDINAGARI LETTER MA
11BB7	य	NANDINAGARI LETTER YA
11BB8	र	NANDINAGARI LETTER RA
11BB9	ल	NANDINAGARI LETTER LA
11BBA	व	NANDINAGARI LETTER VA
11BBB	श	NANDINAGARI LETTER SHA
11BBC	ष	NANDINAGARI LETTER SSA
11BBD	स	NANDINAGARI LETTER SA
11BBE	ह	NANDINAGARI LETTER HA
11BBF	ळ	NANDINAGARI LETTER LLA
11BC0	ऱ	NANDINAGARI LETTER RRA

Dependent vowel signs

11BC1	ा	NANDINAGARI VOWEL SIGN AA
11BC2	ि	NANDINAGARI VOWEL SIGN I
11BC3	ी	NANDINAGARI VOWEL SIGN II
11BC4	ु	NANDINAGARI VOWEL SIGN U
11BC5	ू	NANDINAGARI VOWEL SIGN UU
11BC6	ृ	NANDINAGARI VOWEL SIGN VOCALIC R
11BC7	ॄ	NANDINAGARI VOWEL SIGN VOCALIC RR
11BC8	▨	<reserved>
11BC9	▨	<reserved>
11BCA	े	NANDINAGARI VOWEL SIGN E
11BCB	ै	NANDINAGARI VOWEL SIGN AI
11BCC	ो	NANDINAGARI VOWEL SIGN O
11BCD	ौ	NANDINAGARI VOWEL SIGN AU

Various signs

11BCE	ं	NANDINAGARI SIGN ANUSVARA
11BCF	ः	NANDINAGARI SIGN VISARGA
11BD0	्	NANDINAGARI SIGN VIRAMA

Additional signs

11BD1	ऽ	NANDINAGARI SIGN AVAGRAHA

Invocation sign

11BD2	?	NANDINAGARI SIGN SIDDHAM

Punctuation

11BD3	‾	NANDINAGARI HEADSTROKE
		• used as a spacing or filler mark

Digits

11BE0	೦	NANDINAGARI DIGIT ZERO
11BE1	೧	NANDINAGARI DIGIT ONE
11BE2	೨	NANDINAGARI DIGIT TWO
11BE3	೩	NANDINAGARI DIGIT THREE
11BE4	೪	NANDINAGARI DIGIT FOUR
11BE5	೫	NANDINAGARI DIGIT FIVE
11BE6	೬	NANDINAGARI DIGIT SIX
11BE7	೭	NANDINAGARI DIGIT SEVEN
11BE8	೮	NANDINAGARI DIGIT EIGHT
11BE9	೯	NANDINAGARI DIGIT NINE

	Nandinagari	Devanagari		Nandinagari	Devanagari
KA	के	क	DHA	᧑	ध
KHA	रप	ख	NA	न	न
GA	ग	ग	PA	प	प
GHA	घ	घ	PHA	फ	फ
NGA	²°	ङ	BA	व	ब
CA	व	च	BHA	न	भ
CHA	क	छ	MA	ब	म
JA	ह	ज	YA	य	य
JHA	न	झ	RA	न	र
NYA	⅁	ञ	LA	ल	ल
TTA	ट	ट	VA	व	व
TTHA	ढ	ठ	SHA	रा	श
DDA	३	ड	SSA	घ	ष
DDHA	ढ	ढ	SA	स	स
NNA	ꠏꠏꠏ	ण	HA	र	ह
TA	ल	त	LLA	ल	ळ
THA	घ	थ	RRA	ꠐ	ऱ
DA	र	द			

Table 1: Comparison of basic letters and signs of Nandinagari and Devanagari.

	Nandinagari	Devanagari			Nandinagari	Devanagari
A	श्र	अ			Inherent vowel	
AA	श्रा	आ		SIGN AA	○ा	○ा
I	३	इ		SIGN I	૬	ि○
II	३ी	ई		SIGN II	○ी	○ी
U	૩	उ		SIGN U	○	○
UU	૩	ऊ		SIGN UU	○	○
VOCALIC R	म	ऋ		SIGN VOCALIC R	○	○
VOCALIC RR	म	ॠ		SIGN VOCALIC RR	○	○
E	▽	ए		SIGN E	○	○
AI	⩔	ऐ		SIGN AI	○	○
O	૪	ओ		SIGN O	○	○
AU	श्रौ	औ		SIGN AU	○	○

Table 2: Comparison of basic letters and signs of Nandinagari and Devanagari.

	Nandinagari	Devanagari
ANUSVARA	○o	○̇
VISARGA	○	○:
VIRAMA	○	○
AVAGRAHA	ऽ	ऽ

Table 3: Comparison of various signs of Nandinagari and Devanagari.

	Nandinagari	Kannada	Devanagari
ZERO	೦	೦	०
ONE	೧	೧	१
TWO	೨	೨	२
THREE	೩	೩	३
FOUR	೪	೪	४
FIVE	೫	೫	५
SIX	೬	೬	६
SEVEN	೭	೭	७
EIGHT	೮	೮	८
NINE	೯	೯	९

Table 4: Comparison of digits of Nandinagari, Kannada, and Devanagari.
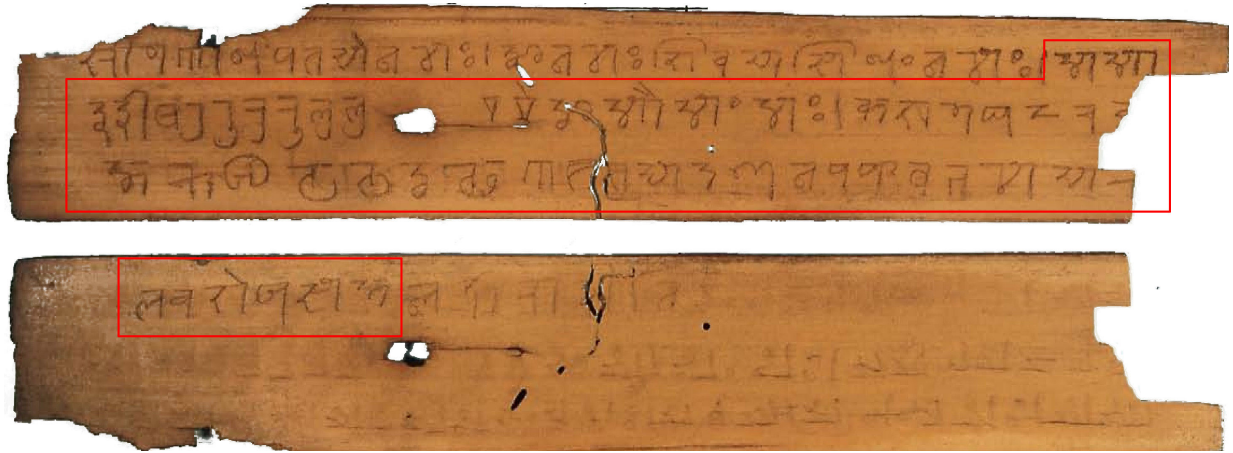
Figure 1: Nandinagari character inventory in a manuscript. Note the representation of the vocalic letters *r̥, r̥̄, l̥, l̥̄* using ꣲ RA and ꣲ LA combined with ꣲ VOWEL SIGN U. The letter ꣲ° NGA is shown without the ° *bindu*. The letter ꣲ CHA and half of ꣲ RA is missing because the folio is damaged.
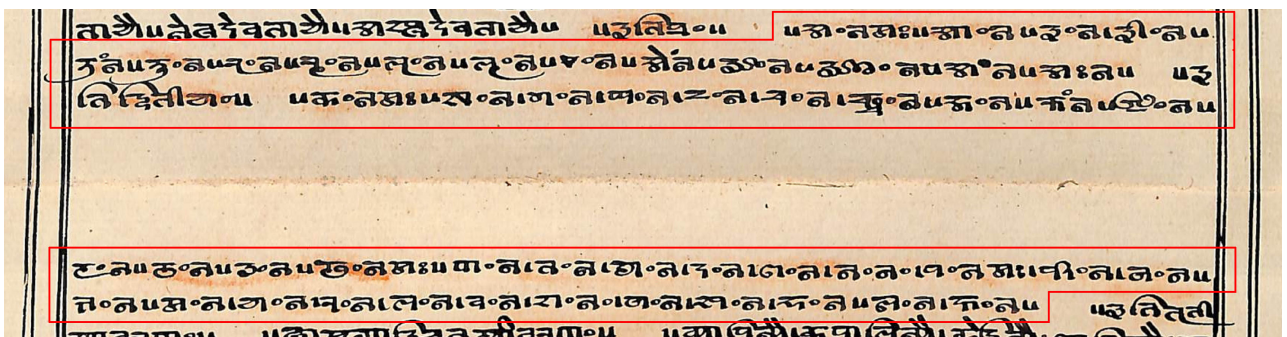
Figure 2: Nandinagari character inventory in a manuscript.
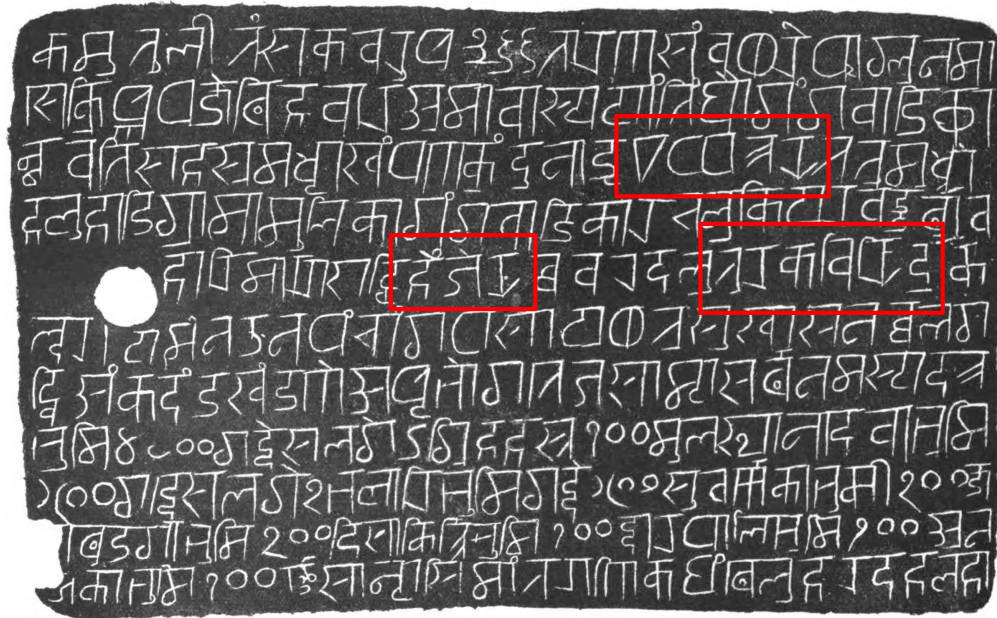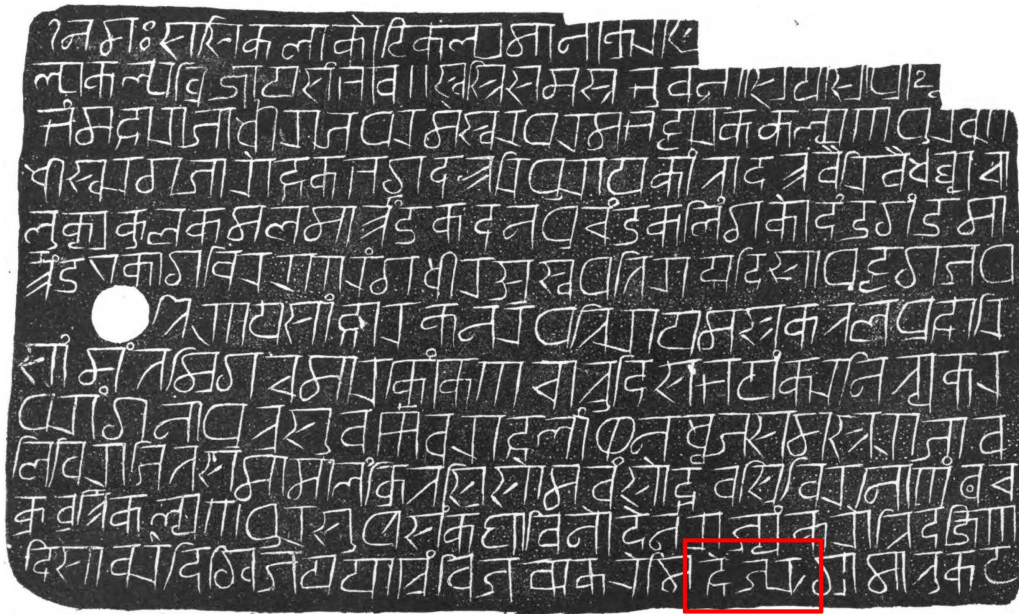
Figure 3: Copper plate of Vīranoṇamba bearing a grant inscribed in Nandinagari, Saka 366 (from Rice 1879, plates 1, 2). The letter ꡫ RA occurs in the name of the village Henjara (*heṃjaṟa-grāmā*) and in the phrases *eppattaṟa* and *turakaviṟidu*.
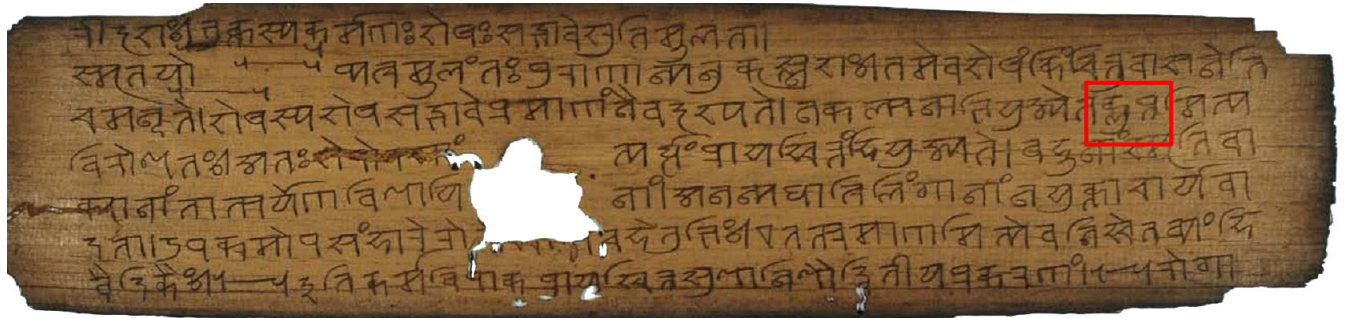
Figure 4: Occurrence of *ḷ* in the word *kḷpta*.
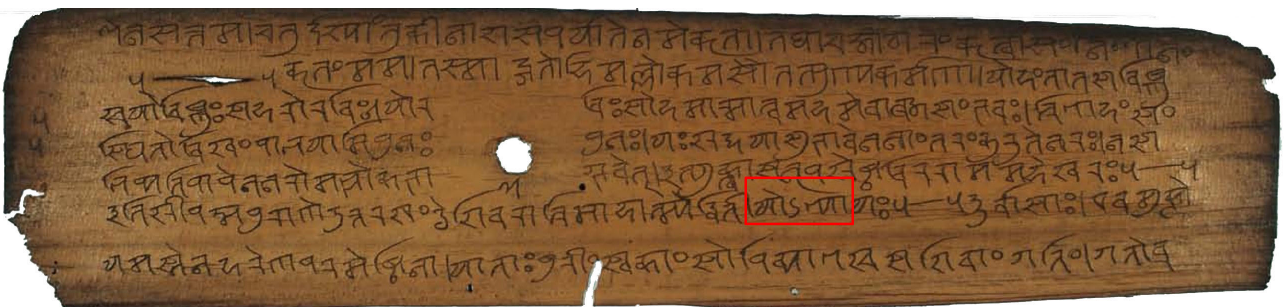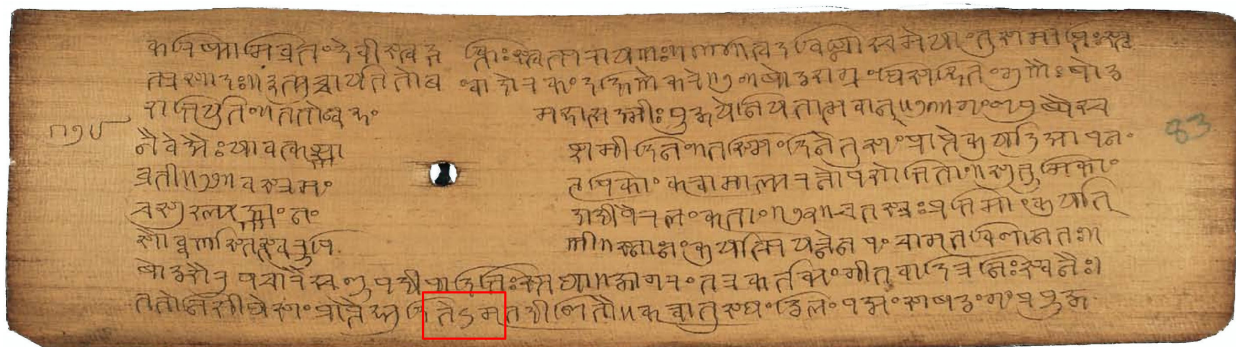
Figure 5: Nandinagari folios showing usage of ꣸ ɴᴀɴᴅɪɴᴀɢᴀʀɪ sɪɢɴ ᴀᴠᴀɢʀᴀʜᴀ.
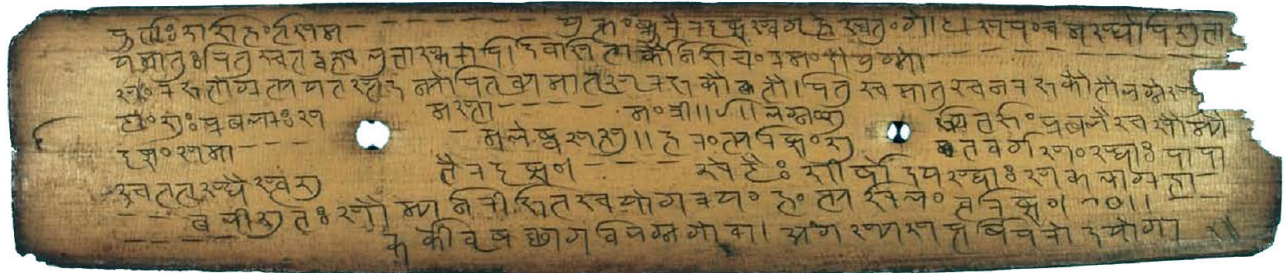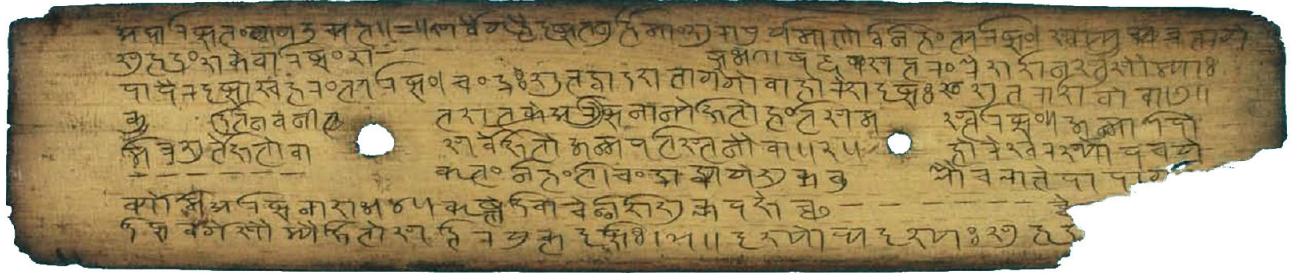
Figure 6: Usage of the ‾ ɴᴀɴᴅɪɴᴀɢᴀʀɪ ʜᴇᴀᴅꜱᴛʀᴏᴋᴇ (from *Jyotisham Vastulakshanam*, IFP no. RE33587).
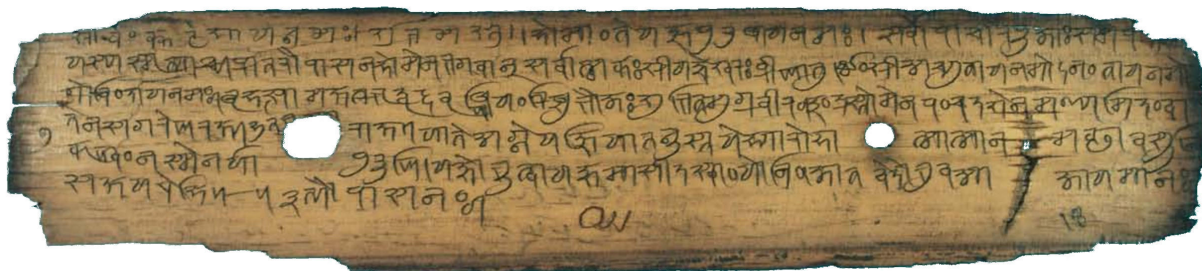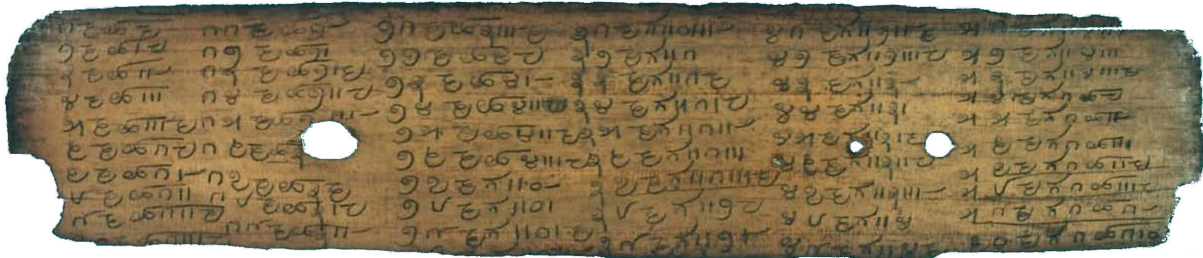
Figure 7: Usage of fraction signs in Nandinagari (from *Jyotisham Vastulakshanam*, IFP no. RE33587).
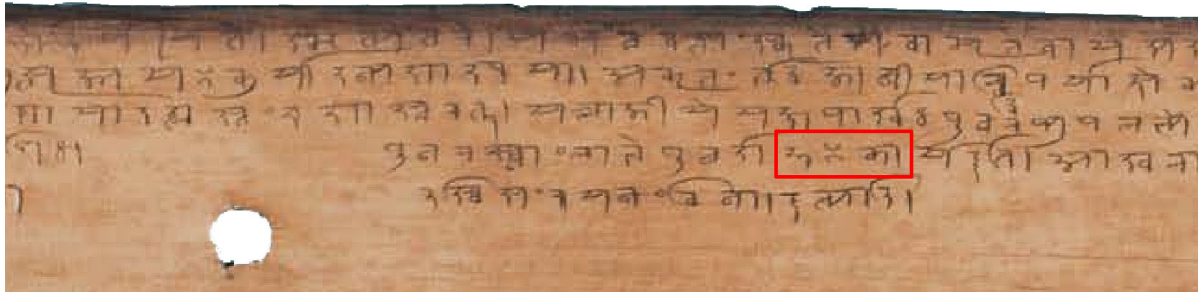
Figure 8: Usage of *jihvāmūlīya* in Nandinagari.
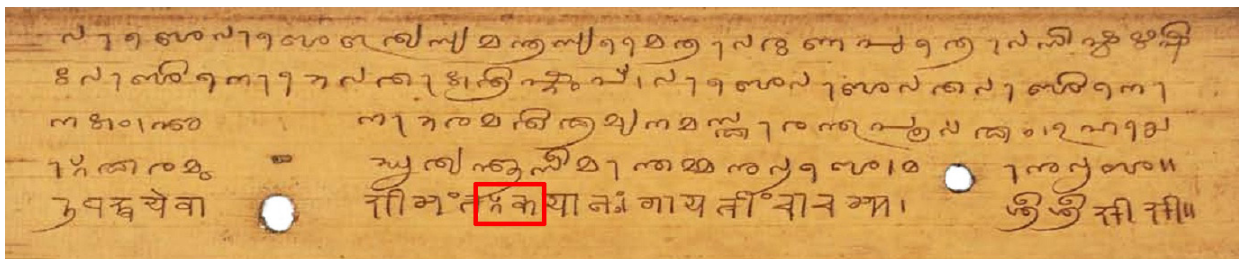
Figure 9: Usage of *jihvāmūlīya* in Nandinagari.
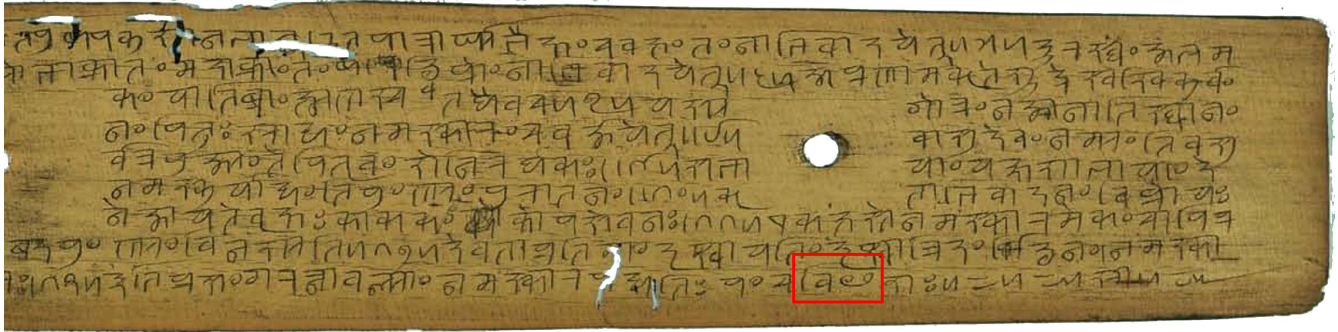
Figure 10: Usage of Vedic *anusvāra* in Nandinagari.
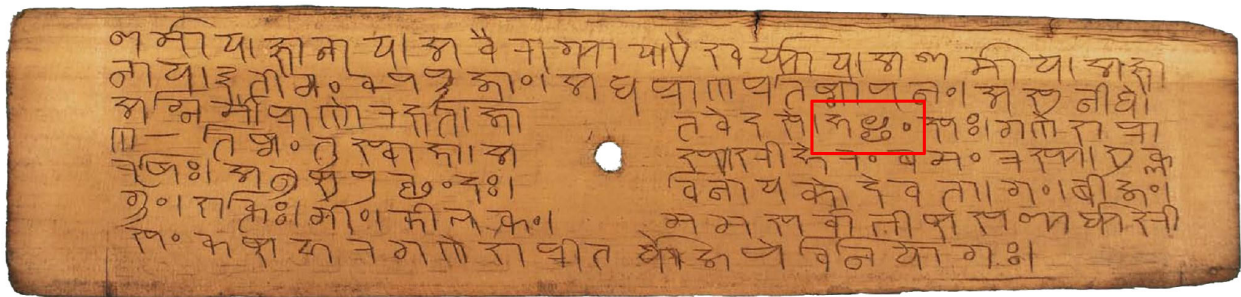
Figure 11: Usage of double *anusvāra* in Nandinagari.
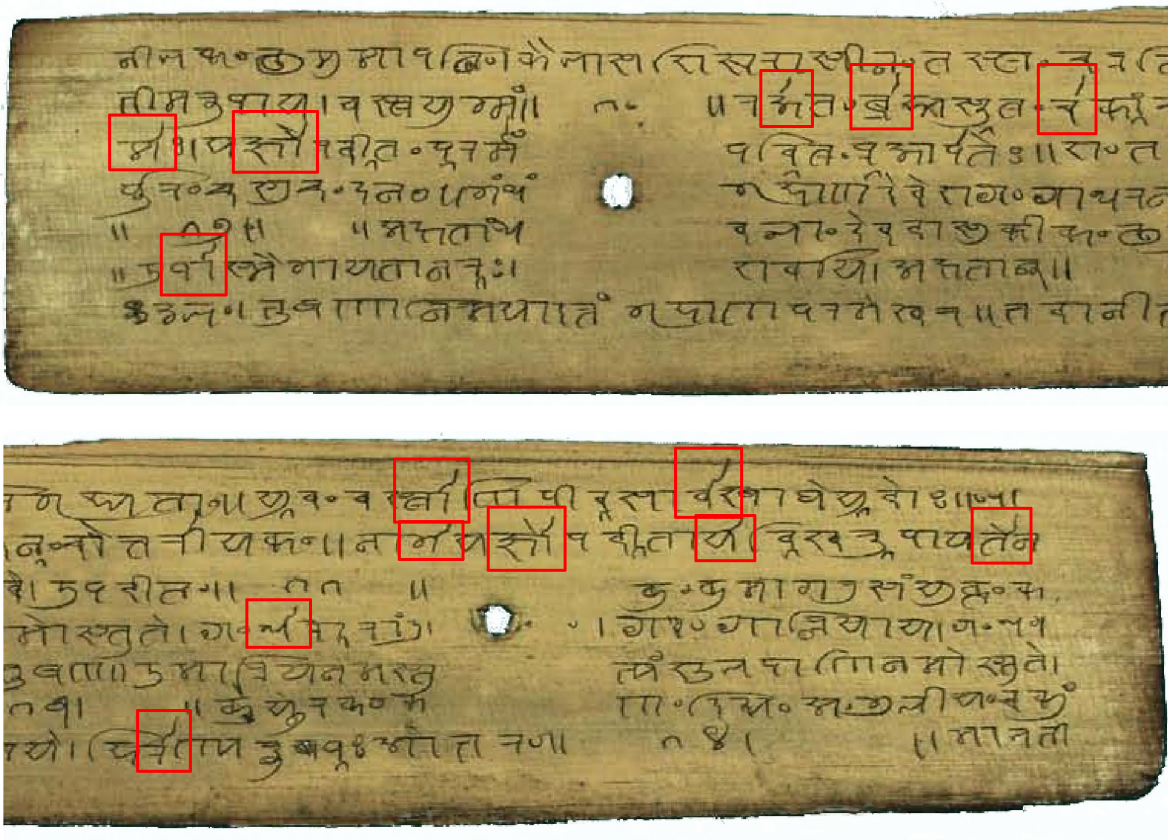
Figure 12: Usage of the Vedic intonation sign ○꜔ *svarita* in Nandinagari.
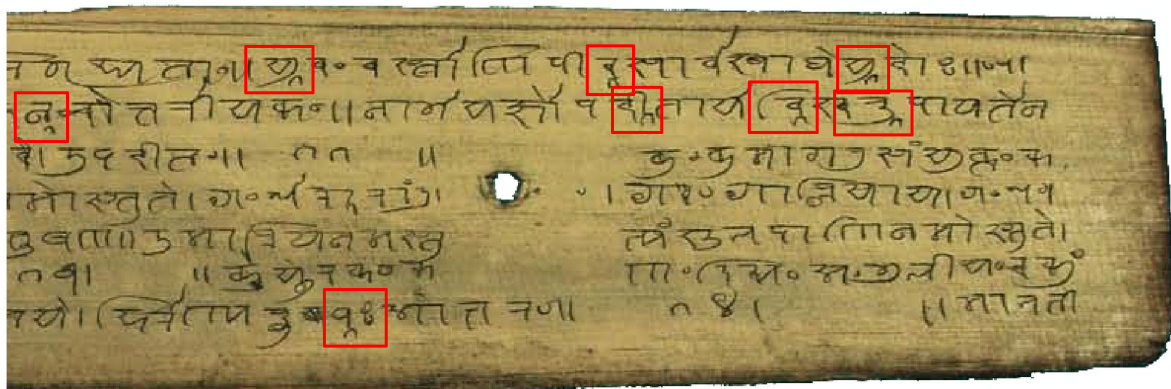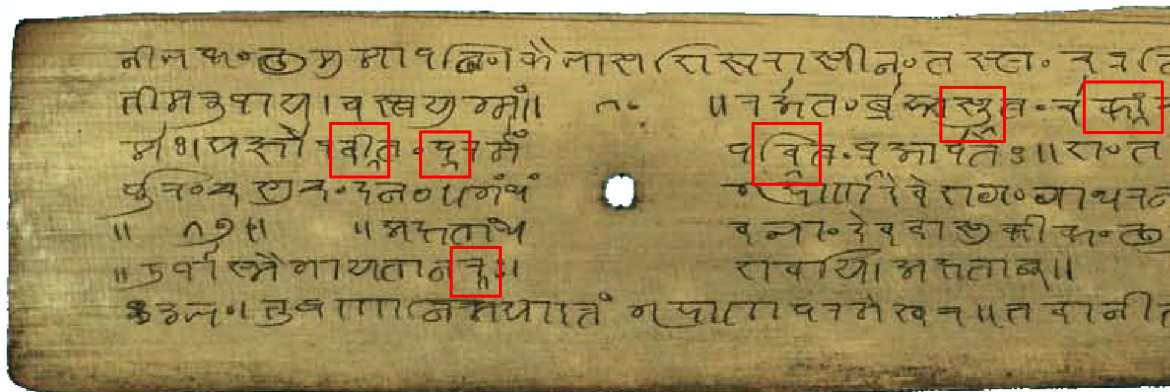
Figure 13: Usage of the Vedic intonation sign ◌॒ *anudatta* in Nandinagari.
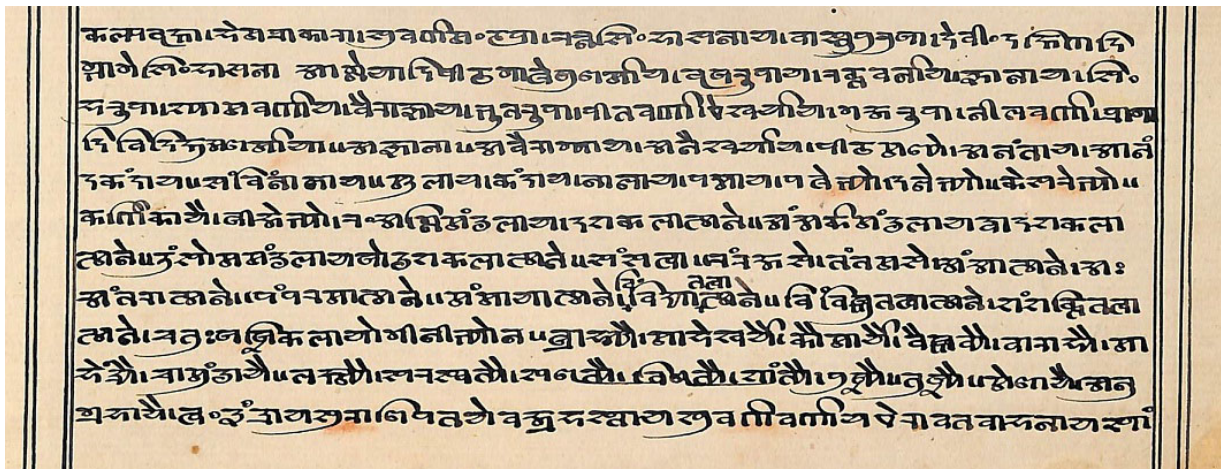
Figure 14: Example of a style of Nandinagari written in ink, which differs from the style used on palm leaves, as shown in the preceding figures.

Figure 15: A coin of Krishnadevaraya, the emperor of Vijayanagara (r. 1509–1530), with the inscription "*srīkṛṣṇarāya*" in Nandinagari on the observe.

The Krāku Grant of Harihara Ⅱ - Plate XXXV

Śaka 1298 (A.D.1376/1377)
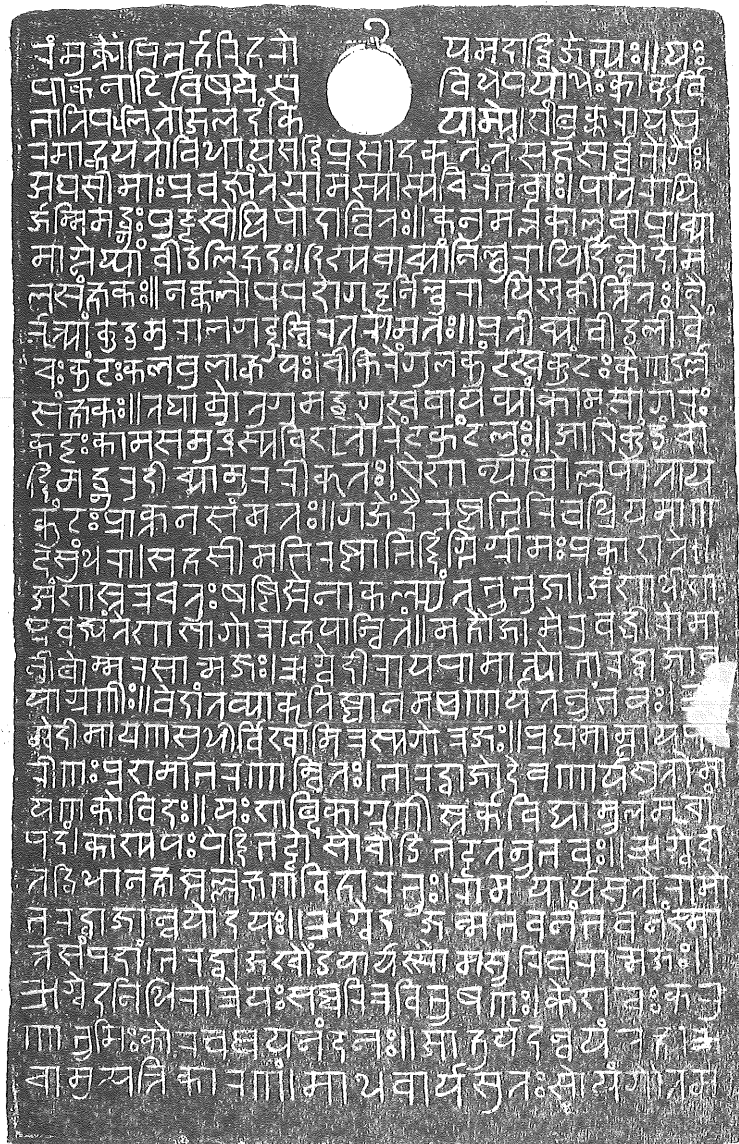
Figure 16: A plate containing a record in Nandinagari (from Visalakshy 2003: 266).

Figure 17: Handwritten chart of Nandinagari characters (courtesy of Srinidhi A., Tumkur, Karnataka).

Vowel signs

क का कि की कु कू कृ कॄ के कै को कौ
ka   kā   ki   kī   ku   kū   kṛ   kṝ   ke   kai   ko   kau

Various signs

Anusvara- ं०   Visarga- ः   Ardhavisarga- ꙮ

Avagraha- ऽ   Vedic Anusvaras- ꙩ , ꙩ

Virama- ्

क्–k , ग्–g त्–t न्–n , ट्–ṭ

Digits (Kannada digits)

೦   ೧   ೨   ೩   ೪   ೫   ೬   ೭   ೮   ೯

0   1   2   3   4   5   6   7   8   9

Variants

श्र – श्र , श्र   व – ब , व

वे – वे   म – म

ष – ष   प – प , प

ट – ट   स – श , स

ट – ट   ्र – ्र

ट – ३   ्र – ्र

ध – ध   ्र – ्र

ण – ण , ण

फ – फ , फ   ळ – ळ

Figure 18: Handwritten chart of Nandinagari characters (courtesy of Srinidhi A., Tumkur, Karnataka).

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Figure 19: Handwritten table of Nandinagari conjuncts (courtesy of Srinidhi A., Tumkur, Karnataka).

Figure 20: Handwritten table of Nandinagari conjuncts (courtesy of Srinidhi A., Tumkur, Karnataka).

Figure 21: Handwritten table of Nandinagari conjuncts (courtesy of Srinidhi A., Tumkur, Karnataka).

Figure 22: Handwritten table of Nandinagari conjuncts (courtesy of Srinidhi A., Tumkur, Karnataka).

Figure 23: Handwritten table of Nandinagari conjuncts (courtesy of Srinidhi A., Tumkur, Karnataka).

Figure 24: Handwritten table of Nandinagari conjuncts (courtesy of Srinidhi A., Tumkur, Karnataka).

Figure 25: Handwritten table of Nandinagari conjuncts (courtesy of Srinidhi A., Tumkur, Karnataka).

Figure 26: Handwritten table of Nandinagari conjuncts (courtesy of Srinidhi A., Tumkur, Karnataka).

CHAPTER II
ALPHABETS AND NUMERALS

Nandināgarī has twelve vowel letters and thirty five consonant letters. The number excludes 'a' with anusvāra and 'a' with visarga. In the inventory of Nandināgarī alphabets 'kṣa' and 'jña' are treated as single letters. In the case of the letter for 'kṣa' it does not show any apparent resemblance with the letters of ka and ṣa. However, in the case of 'jña' it has some resemblance with the letter ja. The letter for 'ba' is very often used to represent 'va' and the letter for 'sa' is commonly used to represent 'śa'. Since a few instances are noticed where sa-śa and ba - va are distinguished by separate letters, all the four are included in the inventory of letters.

VOWELS

There exists only four basic vowel letters. The other letters representing vowels are only derivations. These four primary vowel letters are those which represent a, i, u and e. The long vowels ā, ī, and ū are derived by the use of subsidiary symbols. The vowels ṛ and ḷ are derived from the consonant letters 'ra' and 'la'. The letters for long vowels ṝ and ḹ are absent. The dipthong 'ai' is formed by the use of subsidiary symbol with the letter for the vowel 'e', the letters for 'o' and 'au' are formed by adding subsidiary symbols to the letter 'ā'. The vowels of Nandināgarī script are given below.

NANDINĀGARĪ	ROMAN	DEVANĀGARĪ
३न	A	अ
३ग	Ā	आ
३	I	इ

NANDINĀGARĪ	ROMAN	DEVANĀGARĪ
३ो	O	ओ
३ो	AU	औ

CONSONANTS

The basic consonant letters of Nandināgarī, similar to that of other Indian scripts, indicate the consonant + the vowel 'a'. As in Devanāgarī, letters are found for all the varga consonants. When a pure consonant i.e. without any vowel is to be represented, a separate subsidiary symbol which is identical with the symbol in the Devanāgarī script is found to be in use. Eg.　(k)　,　(c)　,　(t). The consonant letters are as follows:

NANDINĀGARĪ	ROMAN	DEVANĀGARĪ
फ	KA	क
रव	KHA	ख
ग	GA	ग

NANDINĀGARĪ	ROMAN	DEVANĀGARĪ
इ	Ī	ई
३	U	उ
३	Ū	ऊ
₹	Ṛ	ऋ
ल	Ḷ	ऌ
∂	E	ए
∂	AI	ऐ

NANDINĀGARĪ	ROMAN	DEVANĀGARĪ
घ	GHA	घ
₹	ṄA	ङ
व	CA	च
क	CHA	छ
३	JA	ज
७	JHA	झ
ॐ	ÑA	ञ

Figure 27: Charts showing basic characters of Nandinagari (from Visalakshy 2003: 20–23).

NANDINĀGARĪ	ROMAN	DEVANĀGARĪ
ब	ṬA	ट
ठ	ṬHA	ठ
ड	ḌA	ड
ढ	ḌHA	ढ
ण	ṆA	ण
त	TA	त
घ	THA	थ

NANDINĀGARĪ	ROMAN	DEVANĀGARĪ
द	DA	द
ध	DHA	ध
न	NA	न
प	PA	प
फ	PHA	फ
ब	BA	ब
भ	BHA	भ

NANDINĀGARĪ	ROMAN	DEVANĀGARĪ
म	MA	म
य	YA	य
र	RA	र
ल	LA	ल
व	VA	व
श	ŚA	श
ष	ṢA	ष

NANDINĀGARĪ	ROMAN	DEVANĀGARĪ
स	SA	स
ह	HA	ह
क्ष	KṢA	क्ष
ज्ञ	JÑA	ज्ञ

ANUSVĀRA AND VISARGA

Anusvāra   ○

Visarga   ः

Figure 28: Charts showing basic characters of Nandinagari (from Visalakshy 2003: 24–27).

ļ. For the combination of the vowel 'ļ' with consonants, instead of a separate subsidiary symbol the letter for ļ itself is used.

Subsidiary Symbols of Vowels:

SUBSIDIARY SYMBOL (NANDINĀGARĪ)	VOWEL REPRESENTED	DEVANĀGARĪ
	Ā	आ
	I	इ
	Ī	ई
	U	उ
	Ū	ऊ
	Ṛ	ऋ

NANDINĀGARĪ	ROMAN	DEVANĀGARĪ
	KĀ	का
	KI	कि
	KĪ	की
	KU	कु
	KŪ	कू
	KṚ	कृ
	KḶ	क्लृ

SUBSIDIARY SYMBOL (NANDINĀGARĪ)	VOWEL REPRESENTED	DEVANĀGARĪ
	E	ए
	AI	ऐ
	O	ओ
	AU	औ

Letters Representing Consonant Vowel Combinations

Though ṛ does not occur with all consonants, its combination with consonants is not very much restricted and also has a regular pattern. Hence all C+ṛ combinations are given. Only very few examples are found for the occurrence of consonant +vowel ļ.

NANDINĀGARĪ	ROMAN	DEVANĀGARĪ
	KA	क

NANDINĀGARĪ	ROMAN	DEVANĀGARĪ
	KE	के
	KAI	कै
	KO	को
	KAU	कौ
	KHA	ख
	KHĀ	खा
	KHI	खि

Figure 29: Dependent vowel signs in Nandinagari (from Visalakshy 2003: 30–33).

NUMERALS

In order to represent numerals, Nandināgarī uses ten symbols. They are as follows:

NANDINĀGARĪ	ROMAN	NANDINĀGARĪ	ROMAN
o	0	२ෑ	5
∩	1	ℰ	6
൭	2	೨	7
२	3	ᴜ	8
γ	4	୮	9

The combination of these symbols derive higher numerals. The patterns of combinations are same as in Devanāgarī. The following are some examples:

NANDINĀGARĪ	ROMAN	NANDINĀGARĪ	ROMAN
∩o	10	∩ooo	1000
∩∩	11	೨೨२२ෑ	2235

Figure 30: Nandinagari digits (from Visālakshy 2003: 86).

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CHAPTER VII

VARIANTS

Some variant letters/symbols noticed in Nandināgarī are given here. Some of the variants may be due to the interference of other writing systems such as Devanāgarī.

Nandināgarī		Letter Represented	
Regular Form	Variant Form	Roman	Devanāgarī
		u	उ
		ṛ	ऋ
		e	ए
		ai	ऐ
		ku	कु

Nandināgarī		Letter Represented	
Regular Form	Variant Form	Roman	Devanāgarī
		kū	कू
		kra	क्र
		kha	ख
		cā	चा
		ci	चि
		cha	छ

Nandināgarī		Letter Represented	
Regular Form	Variant Form	Roman	Devanāgarī
		ṭha	ठ
		tna	त्न
		tra	त्र
		tva	त्व
		dya	द्य
		dha	ध

Nandināgarī		Letter Represented	
Regular Form	Variant Form	Roman	Devanāgarī
		pa	प
		ppa	प्प
		pha	फ
		ba	ब
		bhū	भू
		ma	म

Figure 31: Glyphic variants in Nandinagari (from Visalakshy 2003: 235–238).

Nandināgarī		Letter Represented	
Regular Form	Variant Form	Roman	Devanāgarī
ꯑ	य	ya	य
ꯒ	ꯓ	ra	र
ꯔ	ꯕ	rū	रू
ꯖ	ꯗ	la	ल
ꯘ	ꯙ	rla	ऴ

Nandināgarī		Letter Represented	
Regular Form	Variant Form	Roman	Devanāgarī
ꯚ	ꯛ	ṣa	ष
ꯜ	ꯝ	ṣṭa	ष्ट
ꯞ	ꯟ	srī	श्री
ꯠ	ꯡ	jña	ज्ञ
0 (Anusvāra)	ꯢ	ṃ	ं

Nandināgarī		Letter Represented	
Regular Form	Variant Form	Roman	Devanāgarī
ꯣ	ꯤ	2	२
ꯥ	ꯦ	6	६
ꯧ	ꯨ	7	७
ꯩ	ꯪ	9	९

Figure 32: Glyphic variants in Nandinagari (from Visalakshy 2003: 235–238).

The following letters show close resemblance and care is required to distinguish them.

	NANDINĀGARĪ	ROMAN	DEVANĀGARĪ
SET I	इ	I	इ
	उ	U	उ
	ड	ḌA	ड
	ज	JA	ज
SET II	झ	JHA	झ
	र	RA	र

	ROMAN	DEVANĀGARĪ	NANDINĀGARĪ
SET III	त	TA	त
	भ	BHA	भ
SET IV	ङ	ṄA	ङ
	द	DA	द
SET V	प	PA	प
	य	YA	य

CONSONANT VOWEL COMBINATIONS

As already pointed out, the basic consonant letter represents the combination of consonant and the vowel 'a'. All the other vowel combinations with the consonants are represented by using subsidiary symbols with the basic consonant letter except in the case of

Figure 33: Internal 'confusables' in Nandinagari (from Visalakshy 2003: 28–29).

Appendix: Distinctive Features of Nandinagari

Vowels	Initial	Diacritic	k-Ligatures
a	श्ा & स्ा & अ		क्ा
ā	श्ाा & स्ाा & अा	□ा	क्ाा
i	इ & उ	ि & ि & ि	कि & कि & कि
ī	शी & गी	ी	की
u	ऽ & ३	ु	कु
ū	ऽ & ३ऽ	ू	कू
ṛ	ॄ (="rṛ")	ृ	कृ
ṝ	ॄ (="rṝ")	ॄ	कॄ
ḷ	(*not documented*)	ॢ	कॢ
ḹ	(*not documented*)		
e	� & ▽	े	के
ai	꒐ & ꒐	ै	कै
o	꒦ & ꒦	ो	को
au	श्ौ	ौ	कौ

Figure 34: Distinctive features of Nandinagari (from Grünendahl 2001: 201).

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Consonants: Velar　　　　　*Retroflex*

ka	布	ṭa	ᘓ & ᘓ & ᘓ
kha	ᗡ & ᗡ	ṭha	ᘓ & ᘓ & ᘓ *(cf.* ḍha)
ga	ᘓ & ᘓ & ᘓ & ᘓ & ᘓ	ḍa	ᘓ & ᘓ
gha	ᘓ & ᘓ	ḍha	ᘓ
ṅa*	ᘓ	ṇa	ᘓ

Palatal　　　　　　　　*Dental*

ca	ᘓ & ᘓ	ta	ᘓ
cha	ᘓ & ᘓ & ᘓ *(cf.* ccha)	tha	ᘓ & ᘓ
ja	ᘓ & ᘓ	da	ᘓ & ᘓ
jha†	ᘓ	dha	ᘓ & ᘓ & ᘓ
ña	*(not documented)*	na	ᘓ

* *interpolated from conjuncts*

† *to be distinguished from* ᘓ ru

Figure 35: Distinctive features of Nandinagari (from Grünendahl 2001: 202).

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Labial   *Sibilants*

pa   प & प   śa   रा & रा

pha   फ़ & पी   ṣa   ष & ष

ba   ब   sa   स्रा & स्रा

bha   त & त

ma   म

Sonorants   *Other*

ya   ꢩ & ꢩ & प & प & ण   ha   ꢲ & ꢲ

ra   ꢬ   ḷa   ꢳ

la   ꢮ & ꢮ

va   व & व

Figure 36: Distinctive features of Nandinagari (from Grünendahl 2001: 203).

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Additional Graphs

o -ṃ (*anusvāra*)

ꙩ -m̐ (*anunāsika*)

ᴥ & ꙍ -ḥ (*visarga*)

ꙍ *avagraha*

□̢ & □̣ *virāma*, e.g. -ṭ ꚋ   -t ꙮ & ꙮ

□̣ & □̣ & □ʾ   Vedic accents (preceding accented syllables)

ꙮ *oṃ*

Numerals (cf. pp. 138, 180)

∩ ꙍ ꙍ & ꙍ & ꙍ & ꙍ ꙍ ꙍ & ꙍ

1 2 3 4 5

ꙍ & ꙍ ꙍ & ꙍ ꙍ & ꙍ ꙍ & ꙍ O

6 7 8 9 0

Figure 37: Distinctive features of Nandinagari (from Grünendahl 2001: 204).

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Conjuncts

kka			gga		
kca			gna		
kta			gya		
ktyā			gra		
ktra			gla		
ktva					
ktha			ghna		
kya					
kra			ṅ- *usually appears as* anusvāra		
kla			ṅmu		
kṣa		kṣū			
kṣma			cca		
kṣmyā			ccha	*(cf.* cha)	
kṣya			cchṛ	*(also for* cchru)	
			cchva		
khya			cya		

Figure 38: Distinctive features of Nandinagari (from Grünendahl 2001: 205).

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cyu   ⟨glyph⟩   ḍhva   ⟨glyph⟩

cra   ⟨glyph⟩

                              ṇya   ⟨glyph⟩   ⟨glyph⟩

jjha   ⟨glyph⟩   ṇva   ⟨glyph⟩

jña   ⟨glyph⟩

jñya   ⟨glyph⟩   tka   ⟨glyph⟩   tku   ⟨glyph⟩

jya   ⟨glyph⟩   ⟨glyph⟩   tta   ⟨glyph⟩   ⟨glyph⟩

jyo   ⟨glyph⟩   ⟨glyph⟩   tna   ⟨glyph⟩

jva   ⟨glyph⟩   tpa   ⟨glyph⟩   ⟨glyph⟩

                              tpra   ⟨glyph⟩

ñ- *is usually appears as* anusvāra   tpha   ⟨glyph⟩

                              tma   ⟨glyph⟩

ṭya   ⟨glyph⟩   tmya   ⟨glyph⟩

ṭva   ⟨glyph⟩   tya   ⟨glyph⟩

                              tra   ⟨glyph⟩

ḍya   ⟨glyph⟩   trya   ⟨glyph⟩

Figure 39: Distinctive features of Nandinagari (from Grünendahl 2001: 206).

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NANDINAGARI   207

tva	𑘮		dhva	
tsa				
tsya			nta	
tsva			nma	
			nya	nyu
dga			nva	
dda		ddu		
ddha			pta	
dba			pna	
dbra			pno	
dma			pra	
dya		dyu		
dra			bda	
dva			bra	
dhya			bhya	

Figure 40: Distinctive features of Nandinagari (from Grünendahl 2001: 207).

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bhra	石		vya	द्या
			vra	द
mpa	अप			
mya	अया		śca	२व
mra	अ		śna	२ळ
			śya	२या
yya	ⅥЛ ⅥЛ		śra	स
			śrī	सी śrū सु
rda	₹		śva	२व
rma	र्म			
rya	र्		ṣka	ष्क ष्क
rṣa	र्		ṣkṛ	ष्क
rṣe	^ र्		ṣṭa	ष्ट
rṣya	र्व्		ṣṭra	ष्ट्र
			ṣṭva	ष्ट्व ष्ट्व
lkya	ल्कया		ṣṭha	ष्ठ ष्ठ

Figure 41: Distinctive features of Nandinagari (from Grünendahl 2001: 208).

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NANDINAGARI   209

ṣṇa	凮		sma	रऄ	स्अ
ṣṇu	闧		sya	रय	रय
ṣṇva	冐		sra	रन	स्न
ṣma	ध	凲	sva	रव	रय
ṣya	धय				
ṣva	ड		hna	रॄ	
			hma	रॄ	
ska	रक	स्क	hya	रया	
sta	रन	स्त	hla	रॣ	
stra	रत	स्त	hva	रॄ	
stha	रॄ	स्थ	रच		

Figure 42: Distinctive features of Nandinagari (from Grünendahl 2001: 209).

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Figure 43: A chart showing letters of Nandinagari (from Mukhopadhyaya 2005).