



Africa Development, Vol. XXX, No.3, 2005, pp. 35–47

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(ISSN 0850-3907)

Traditional Igbo Numbering System: A Reconstruction

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Abstract

This article presents the properties of the traditional and decimalized Igbo number systems and the principles governing their formulation. It looks at the cultural and religious uses of Igbo traditional number system and their implications for the development of curricular in not just mathematics and ethno-mathematics in tertiary level education, but also in arithmetic for primary and secondary school levels.

Résumé

Cet article présente les propriétés du système traditionnel et décimal de numérotation igbo et les principes qui régissent leur formulation. Il examine les utilisations culturelles et religieuses du système de numérotation traditionnel igbo et leurs implications sur le développement de programmes d'enseignement pas seulement en mathématiques et en ethno-mathématiques dans le supérieur, mais aussi en arithmétique pour le primaire et le secondaire.

A person who does not know where he/she is coming from most probably does not know where he/she is going to. *Nti bu nka.*

A na esi no ulo mma ma napuwa ama. A man is least in what he knows not. I hold him the least who knows the least.

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Introduction

The formulation and development of any number system constitutes one of the most important bedrocks of mathematics, science and technology. Each of the various number systems is a beautiful creation of the human mind and active will, indeed a real invention. As a system each has a set of rules, principles and properties that govern the formulation and existence of number names and numerals other than the basic ones.

Many cultures (as regards distinct language groups) formulated and developed to some degree distinct number systems but the majority of such systems did not have numerals. By numerals we mean symbols or figures (that are enduring and generally acknowledged within the language group that developed the number system) denoting and standing for number names of the system so developed. Of the number systems that have numerals, a few are recorded in some details while a few others are mentioned in passing in some texts. Consequently, many people think that language groups, whose number systems have no numerals or are not recorded, did not develop number systems. Indeed they think that such language groups borrowed and translated some number systems and numerals into their languages and made use of them traditionally.

Another source of concern is that the records of the few number systems as published, are very simple. The properties of the number systems are not indicated and discussed. Also there are no articulated principles and rules given as governing the formulation and existence of number names and numerals especially those other than the basic ones. People therefore tend to think that the number names and numerals are revealed. They fail to appreciate the invention and beauty of these number systems and their religious and cultural underpinnings.

This article presents a brief summary of:

- (i) a reconstructed traditional Igbo number system;
- (ii) the modified or decimalised Igbo number system;
- (iii) the properties of the traditional and decimalised Igbo number systems and the rules/principles governing the formulations of other number names as derived from the basic ones; and
- (iv) some cultural and religious uses and curricular implications of the traditional number system.

The Igbo number systems – number names

The Igbo developed their traditional number system long before their contact with the Europeans. However, there is no evidence that the original or traditional Igbo number system had any numerals. Nonetheless in the recent past traditional Igbo people (non-literate in any other number system) used various assortments of tally marks and symbols to represent or record numbers, accounts or quantities of things, money or commodities they were concerned with on secured available surfaces. In the past also some cultural, religious, and sociopolitical organization of the Igbos had their various reserved number symbols.

Following the extensive and continued contact with the west and the worldwide desire to go metric and decimal, the Igbos in the recent past decimalised their number system. In essence there are the traditional (as reconstructed here) and the decimalised Igbo number systems. Table 1 as given below shows corresponding Hindu-Arabic numerals and number names in English to some reconstructed traditional and decimalised Igbo number names.

Table 1: Hindu-Arabic Numerals and English Number Names Corresponding to Some Traditional and Decimalised Igbo Number Names

Hindu-Arabic Numerals	English Number Names	Traditional Igbo number Names	Decimalised Igbo number Names
1	One	Otu	Otu
2	Two	Abuo	Abuo
3	Three	Ato	Ato
4	Four	Ano	Ano
5	Five	Ise	Ise
6	Six	Isii	Isii
7	Seven	Asaa	Asaa
8	Eight	Asato	Asato
9	Nine	Itolu	Itolu
10	Ten	Iri	Iri
11	Eleven	Iri na otu	Iri na out
12	Twelve	Iri na abuo	Iri na abuo
13	Thirteen	Iri na ato	Iri na ato
14	Fourteen	Iri na ano	Iri na ano
15	Fifteen	Iri na ise	Iri na ise
16	Sixteen	Iri na isii	Iri na isii

Table 1: Hindu-Arabic Numerals and English Number Names Corresponding to Some Traditional and Decimalised Igbo Number Names (contd.)

Hindu-Arabic Numerals	English Number Names	Traditional Igbo number Names	Decimalised Igbo number Names
17	Seventeen	Iri na asaa	Iri na asaa
18	Eighteen	Iri na asato	Iri na asato
19	Nineteen	Iri na Itolu	Iri na itolu
20	Twenty	Ogu	Iri abuo
21	Twenty-one	Ogu na out	Iri abuo na out
22	Twenty-two	Ogu na abuo	Iri abuo na s abuo
27	Twenty-seven	Ogu na asaa	Iri abuo na asaa
30	Thirty	Ogu na iri	Iri ato
40	Forty	Ogu abuo	Iri ano
80	Eighty	Ogu ano	Iri asato
97	Ninety-seven	Ogu ano na iri na asaa	Iri itolu na asaa
100	Hundred	Ogu ise	Nari
154	One hundred and fifty-four	Ogu asaa na iri na ano	Otu Nari na iri ise na ano
176	One hundred and seventy six	Ogu asato na iri na isii/Bere ano na Ogu itolu	Otu Nari na iri asaa na isii
200	Two Hundred	Ogu iri	Nari abuo
335	Three hundred and thirty five	Ogu iri na isii na iri na ise	Nari ato na iri ato na ise
400	Four hundred	Nnu	Nari ano
900	Nine Hundred	Nnu abuo na Ogu ise	Nari itolu
1000	One Thousand	Nnu abuo na ugu iri/Nnu abuo na ukara	Puku
8000	Eight thousand	Ogu nnu	Puku asato
160,000	One hundred and sixty thousand	(Nnukwuru nnu) Nde	Nari Puku na puku iri ise
1,000,000	One million	Nde isii na puku ise	Nde
64,000,000	Sixty-four million	Nnu nde/Ijeri	Nde iri isii na nde ano
1,000,000,000	One billion	-	Ijeri

The dash put in Table 1 under the traditional Igbo number names as corresponding to one billion does not in any way imply that no traditional Igbo number name can be contrived to express one billion. After all 'Puku nde' in the traditional Igbo number system gives the number 8,000 x 160,000 which

Is 1,280,000,000 – one billion two hundred and eighty million. It is left as an exercise for the reader to contrive, may be after learning or reviewing the rules for forming number names in the reconstructed traditional Igbo number system.

Properties of the reconstructed traditional Igbo number system and rules for forming its number names

Of course every system has its unique properties for it to be a system. It may also share some common properties with others systems. A system must in addition have rules or laws governing the affairs and concerns of the system. The traditional Igbo number system is no exception to the above observations.

The Traditional Igbo Number System (TINS) is vesimal (a base twenty system). It also has a minor base or a sub-base which is decimal or denary (a base ten system). Basically, counting in the system is done in bundles of twenty or possible positive integral powers of twenty. Consequently most of the numbers that are positive integral powers of twenty within the range of counting of the traditional Igbo person, have distinct names. The developers of the traditional Igbo number system were most probably informed or guided by the number of fingers and toes a normal person has, in deciding the main base (vesimal) and minor base (decimal) of the system. Thus the traditional Igbo number system has such basic number names as Otu, Abuo, Iri, Ogu, Nnu, (20^2), Puku, (20^3), Nde, (20_4 & 20_5) (Nnu nde) /Ijeri, (20_6). The traditional Igbo number system, therefore has fifteen basic number names. Note that 'Nan' (100) as used in the decimalised Igbo number was not at best generally used in TINS. Of course it does not fit into TINS since 100 is not an integral power of twenty. These 15 basic number names were used as basis for forming other counting numbers. Besides these 15 basic number names and any others derived from them, TINS had names for fractions generally and specifically.

These names are exemplified by:

- (i) mpekele which means fraction;
- (ii) ukara which means half;
- (iii) Otu na uzo ise which is one fifth;
- (iv) Abuo na uzo ato as one third; etc.

As stated earlier, TINS has rules and principles that governed the formulation of non-basic number names. Thus in forming number names the TINS employed one, two or three of the additive multiplicative and subtractive rules. In employing the additive principle, it is only the main base in its integral multiples and powers and the minor base that may be added onto.

In using the multiplicative principle, it is only the main base that are multiplies by integers. The use of the subtractive principle involves usually subtracting the number one, two, three, four or five (though rarely) from the main base, the integral multiple or power of the main base or the minor base. Illustrations of:

(a) only the additive principle;

- (i) Iri na ano (Ten and Four, 14)
- (ii) Ogu na iri na ise, (Twenty and ten and five, 35) and
- (iii) Nnu na ogu na otu (four hundred and twenty and one, 421).

(b) Multiplicative rule alone;

- (i) Ogu ato (20 in three places ie 20 times 3, 60)
- (ii) Nnu ise (400 by five; 2000)
- (iii) Puku asaa (8,000 by 7; 56,000)
- (iv) Nnu iri (400 by 10; 4000)

(c) Subtractive rule only (usually applied in commerce or in accounting),

- (i) Bere abuo n'iri (Take away two from ten; 8) and
- (ii) Bere ato n'ogu (take away three from twenty; 17)

(d) Use of the combined rules

- (i) Ogu ano na isii (twenty by four and six, $20 \times 4 + 6 = 86$)
- (ii) Nnu abuo na ogu ise (four hundred by two and twenty by five ie $400 \times 2 + 20 \times 5 = 900$)
- (iii) Bere ato n'ogu isii (Take away or cut off three from five twenties ie $20 \times 5 - 3 = 97$)
- (iv) Bere otu n'nnu na ogu ato (Take away one from four hundred and three twenties, $400 + 20 \times 3 - 1$ that gives 459)

Generally when numbers are stated the highest valued component (or its multiple) is stated first then the rest, following the descending order of values. Examples are as given below:

- (i) Puku ano, nnu ato, ogu ise na iri na asaa ($8000 \times 4 + 400 \times 3 + 20 \times 5 + 10 + 7$ ie $32,000 + 1200 + 100 + 10 + 7 = 33,317$)
- (ii) Nnu iri, ogu asaa na itolu ($400 \times 10 + 20 \times 7 + 9 = 4,149$)

However, when the subtractive rule is employed, the number to be subtracted is stated first then the other components are stated, following the general

rule. (See illustration (C) above). Also in using the multiplicative principle the base or the positive integral power of the base is stated first followed by the multiplier, but when the multiplier is one or in extraordinary cases a positive integral power of the base, then the multiplier is stated first.

Examples are as follows:

(i) Otu puku na ogu ise

(ii) Nnu Puku

(iii) Ogu nnu (ihe)

(iv) Puku nde etc

It is important to point out here that there is an alternative to any number names formed using the subtractive principle. Most of the times the subtractive principle is employed to ensure;

(a) economy of words and/or

(b) the ease of carrying out a basic arithmetic operation.

Illustrations

(a) (i) 'Bere ato n'ogu ise' is also 'ogu ano na iri na asaa' (The first is of five words while the second is of six words).

(ii) *Bere ise n'nnu ego* can alternatively be stated as *ogu ego iri na itolu na ego iri na ise*. While the first has five words the alternative has ten words.

(b) (i) *Gbakoo bere ano n'gu asato na ogu na iri na asaa*. This will quickly give *ogu itolu na iri atoo* (Add eight twenties minus three and one twenty ten and seven. One twenty and eight twenties give nine twenties, there is still one ten and seven minus four gives three.

Altogether there are nine twenties, one ten and three and these sum up to 193.

(ii) *Mubaa Bere otu n'ogu ato nga/uzo ise* (ie multiply) (three twenties minus 1) by five). The above gives: *Ogu iri na ise ewepuru ise, na obu Bere ise n'ogu iri na ogu ise* $(3 \times 20 - 1) \times 5 = (15 \times 20 - 5)$.

The above indicates that the Igbos were aware that multiplication was distributive over subtraction (or addition).

Properties of and rules involved in the Decimalised Igbo Numeration System (DINS)

The numeration system of the Igbos is at present decimal/ denary. That is to say that counting is done in bundles often and some positive integrals often. Thus the systems has numbers as: Iri (101) - 10, nari (102) - 100, Puku (103) = 1000, nde (106) - 1,000*000 and Ijeri (109) = 1,000,000,000.

Consequently the decimalised Igbo numeration system has some semblance with the modern decimalised Hind-Arabic cum English number system. It has no numerals of its own rather the Hindu- Arabic numerals has been adopted.

As far as the *decimalised Igbo numeration system* (DINS) has gone, it has 14 basic number names (Otu, abuo,..., iri, nari, puku, nde and Ijeri). In the strict sense DINS is not a place' value system. Nevertheless DINS employs some value ordering in the expression/stating of number names. In stating any number, the highest component (in terms of integral powers of ten or its multiples) of the number is stated first then the subsequent components in a descending order or values. Also DINS employs the additive or the multiplicative rules, separately or jointly in the formulation of number names from the 14 basic number names. The system unlike the TINS does not employ the subtractive rule.

Illustrations

(a) Additive rule

- (i) Iri na isii ($10 + 6 = 16$)
- (ii) Nari na iri na abuo ($100 + 10 + 2 = 112$)

(b) Multiplicative rule

- (i) Nari ato ($100 \times 3 = 300$)
- (ii) Iriasato ($10 \times 8 = 80$)

(c) Combined rules

- (i) Iriasaanaano ($10 \times 7 + 4 = 74$)
- (ii) Nari ise, iri ato na asaa ($100 \times 5 + 10 \times 3 + 7 = 537$)
- (iii) Nari puku ato, nari ise na iri asato na isii ($100 \times 1000 \times 3 + 100 \times 5 + 10 \times 8 + 6$ which is equal to 100,586).

From the illustrations above, observe that:

- (i) the highest value of integral power of ten (in the number involved) is started with, then subsequent ones or its multiple, in strictly a descending order of values in the formulation of the number names;

- (ii) when a positive integral power often (other than ten) is used in multiplying a higher valued positive integral power of ten in the formulation of a number name, the multiplier is stated first, and
- (iii) in stating number names there are no place holder like zero as used in the Hindu-Arabic numerals given above.

Some uses and interpretations of numbers in some Igbo traditional subculture and societies

Traditional Igbo people, like many other traditional people used and interpreted numbers in a number of ways. In very broad terms the traditional Igbo people had: (i) the everyday or common place use and (ii) the humanistic (religious, mystic, socio-political) uses and interpretation of numbers.

General, everyday or common place usage

In everyday use, numbers have both cardinal and ordinal sense. In the cardinal sense, the traditional Igbo used numbers; as quantitative adjectives, or in answering the question how many? Thus people talk of ‘*ego iri, ugu ego ugu iri na ise, etc*’.

An ordinal number indicates not only how many but also answers the question in what order? For example the day of the month is really ordinal (Wilder 1973). It is surprisingly a fact of life that the traditional Igbo person like every other person (including those living today) confused or mixed up the cardinal and ordinal sense use of numbers when counting objects.

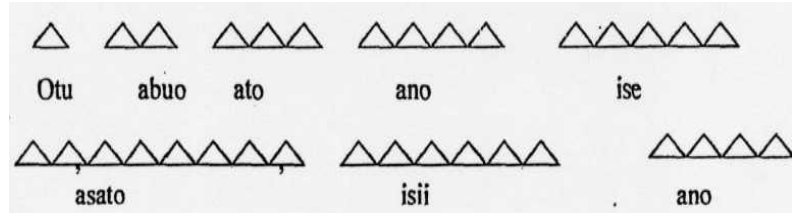
Illustrations

- (i) Supposing there are seven or more objects and an Igbo person wants to count them, the person will certainly pick up or touch the objects one after the other and assign numbers to them.



Assigning ‘Otu’ to an object is in order but assigning the number abuo, ato,... or asaa to a single object respectively could only be meaningful if it is being said that this is the next (an explanatory way is to say) nke mbu, nke abuo,..., nke asaa.

- (i) Supposing there are objects arranged in separate heaps or collections and the question is asked how many distinct objects are in each heap or collection? Then the cardinal sense usage of numbers becomes clear.



Thus the above presentation shows: one object, two objects, three objects, four objects, five objects, eight objects, six objects and four objects.

Consequent upon the ordinal and cardinal sense usage of number, the traditional Igbos might have developed their large number concepts and names from agricultural and commercial activities. Such activities most probably included:

- (i) Reckoning and counting seed yams/coco yams, for example, that they planted in or harvested from farms or stored in farms or bans (nnu ji/ede = 400 yams/ coco yams planted may be by one person in one day).
- (ii) Keeping accounts of or counting money (for instance ego ajara = cowries or cowry shells) for businesses, dowry payments, debt settlements, or purchase of land, property or slaves. Thus the Igbo people of yester years talked of ogu nnu ihe/ego or puku ayara --) 8,000 cowry shells for instance.

Social and religious uses and interpretation of numbers

In many situations and instances the traditional Igbo people see or use number names as if the number names:

- (i) are totems,
- (ii) possess some powers or individualities or
- (iii) are agents of gods or gods' representatives.

Generally the *traditional Igbo person* (TIP) sees even numbers as being more 'amicable' or acceptable than odd numbers are as omens and with respect to the cardinality of items or objects used in gifts. The TIP (especially if titled will jovially (or with all seriousness) reject gifts in odd numbers. In many Igbo societies, the TIP used the story or myth about the Gorilla's obsession for pairing objects available to it/ that comes its way to stress and teach the desirability of using even numbering objects for gift. The TIP may have been informed or made to take the above decision or accept such an attitude, belief or rule because of the fact that most parts of the body of a normal person are in pairs.

Further more the number of each set of objects presented during rituals for appeasing the gods or burial ceremonies of TIP (especially titled ones) was even most of the times. Although six (isii/ishii) as sacred, it is not to be mentioned by name when objects are counted during some occasions or in some circles. It is rather expressed as ‘The a na eji akaru mmadu/mmanya’ (something used to castigate or speak bad of man/wine). Those circle or situations include ‘Okonko’ and occasions or places where wine is shared and enjoyed. Most probably not the same but the Greek culture and the Pythagorean School saw six as a ‘perfect number (may be since $1 + 2 + 3 = 1 \times 2 \times 3 = 6$) (Wilder 1973). In the Igbo tradition (ato, ano, na asaa), three, four and seven are sacred or portentous.

Their being so may be informed from the expression:

- (i) *Ihe ruo ato ya ato n’anya* (a thing that reaches three stays forever or becomes irrevocable or unforgivable);
- (ii) *Ahia ano ubochi ano, izu*. (four markets of four days – complete circle/completeness) [izu = one week in Igbo traditional calendar]
- (iii) *Ikpa asaa, mmiri asaa, izu asaa* (most distant perilous journey, the length of the lunar month (on which the traditional Igbo calendar hinges). is izu asaa (28 weeks).

Another mystic/religious usage and interpretation of numbers in traditional Igbo setting is illustrated during the breaking of kola nuts. The traditional Igbo kola nut has at least three cotyledons for it to be accepted as normal. When a kola nut is broken by a person, the number of cotyledons the kola nut has portends the god/goddess that has or rather is associated with the kola nut. The number of cotyledons a kola nut has may also point to the character/mood of the presenter, the person it is presented to or the occasion. Thus kola nut may be said to belong to or represent:

- (i) the dumb spirit if it has two cotyledons;
- (ii) the spirit of valour, strength, fearlessness or extraordinary courage, if the nut has three cotyledons (in the traditional setting such a kola nut (Oji ike) is taken by acclaimed warriors, strong medicine men and men of extraordinary deeds;
- (iii) the god/goddess of fertility or fecundity if it has more than four cotyledons (*Oji Umunne, Oji izu - ahia ano ubocht ano*). There are a host of other such usages and interpretations of numbers in the traditional Igbo settings. In my humble opinion those others ought to be studied and documented.

Curricular implications and recommendations

This author is a teacher. He sees a lot that is of use for the business of teaching and learning. The teaching and learning of the richness and beauty in thought and culture can engender interest in the study of numbers or Mathematics. It may provide some positive distraction from the drudgery of routine classroom computations. The use of the additive and the subtractive principles in formulating number names and the applications of the fact that multiplication is distributive over addition and subtraction are of immense interest in the study of mathematics and ethno-mathematics.

The mathematical concepts and principles inherent in the above have been restricted to tertiary mathematics curricular. The study of the TINS shows that these concepts and principles can be taught and learned at even the primary school level. The learning of such concepts and principles make arithmetic computations a lot easier and meaningful. Certainly the teaching and learning of TINS will add to the richness and variety in the area/discipline of Igbo language and culture.

Summary

The Igbos developed and used a number system a long time before their contact with the western world. The TINS though devoid of numerals:

- (i) is mainly vigesimal and to a little extent decimal
- (ii) has 15 generally acknowledged basic number names
- (iii) employs the additive, multiplicative and subtractive rules (singly or in some combinations) in the formulations of non-basic number names but
- (iv) is not a place value number system. Recently the Igbo number system is decimalised. This recently decimalised number system: has 14 basic number names; employs the additive and the multiplicative rules in forming number names other than the basic ones; (although it has no numerals of its own) uses the Hindu- Arabic numerals and is not a place value system.

Besides the common place and general uses and functions of numbers, the traditional Igbo person attaches religious, mystic and humanistic functions to numbers. To the traditional Igbo person, numbers are portentous, totems and have their individualities. The study of these number systems have far reaching curricular implications. It is an area of Igbo culture that deserves serious investigation and documentation.

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