History all over the world has come to be treated not as information laid out in chronological order but as an exploration and analysis of the society of the present and of the past. Such attempts are deeply influenced by a range of ideologies and environs from time to time. From the 1960’s there is a shift in Nationalist idea. There is a growing recognition of the importance of administrative, social and economical aspects of History.

Measurement system is an essential and important part of particularly agriculture, trade and commerce, apart from that of secular, religious or defense architecture. While dealing with economic and architectural aspects of a period or region in history, usually the measurement system prevalent then or in that area through the ages as known from inscriptions and literature are compiled and discussed. But the evolution of the units of measurements, of varied kinds in vogue from time to time is hardly attempted for the simple reason that the source material such as tables, scales etc used then are not available.

With sound financial support a state could survive longer, a state surviving for a longer period would indicate availability and more so management of good resource at its command. Resource mobilization is possible through more refined and rigorous policy in tax collection. Many studies of the contemporary works that appeared, have over looked the dynamics of revenue aspect of State. Rigorous and refined taxation must have been an outcome of more refinement in Measurement System and its application.

Dipakranjan Das is of the opinion that in Ancient India there were a number of land measures. The area indicated by these measures may sometimes be ascertained with the help of epigraphs and literary works. He further remarks that it is not safe to understand the same geographical area by the same measure in all places and periods.
Sheik Ali, while dealing with the revenue administration of the Western Gangas raises certain questions as to
(a) Whether all the available land was measured according to one uniform measurement?
(b) Whether the soil was divided into different categories on the basis of fertility?
(c) Whether the assessment of tax was based on any principle or was it just arbitrary?

While discussing these and other questions he states that concrete answer cannot be found to these questions on account of paucity of relevant historical material.

Chidananda Murthy has discussed about weights and measures and fraud in the system. Attempts in the matter of weights and measures by Krishnappa and Jagadeesh Shetty are brief, sketchy and introductory in nature. Ritti et al list some terms of Measures, Weights and Coinage.

In one extreme there was highly developed mathematics in Ancient India. Medhatiti a vedic rishi of Kanva gotra, adopted 10 as basis of numeration and expressed numerical quantities in numbers based upon decimal system by successive multiplication by 10; a system universally accepted today. On the basis of a brief hymn addressed to the fire God Agni in Yajur veda, he listed 13 successive numbers each individually named from Eka (One – 1) to Parardha (a million million –1,000,000,000,000). The linear measure ranged from Paramanu- atom size and trasarenu- spec of dirt seen in shaft of Sun light to Yojana a distance of 7,68,000 Angulas.

The time division ranged from a minute fraction of a second to a vast period of billion of years. Truti- equivalent to about one hundred thousandth of a second (exactly 1/1,12,500 of second ) and the highest by Mahakalpa, the life span of Brahma- which is equal to three hundred eleven million forty thousand million years (311,040,000,000,000 years).

For what purpose did the ancient Indians need such a minute to so vast measures is still a riddle. It is not known yet if they had any mechanical instruments to measure such units. It may also probably indicate their intellectual development, rigorous exercise for understanding the existence of extremely minute to enormously vast intervals in the units of an ideal measurement.
With regard to the present Indian Government including the British period, it is found that the Government introduced more than 50,000 resolutions pertaining to the land system during AD 1880-1990. This highlights failure in understanding and standardising the Indian system of Measurement - by the British’s and the Government of India. The administrators and the foreign authors generally speak in terms of foreign units, with which they are conversant in their countries. Most of our studies are a continuation of this, hence the complexity.

1.1 MEASURING AND CALCULATING

One of the overall signs of scientific processes, which has been mentioned, is that they have increasing quantitative element. Quantification means using numbers in a particular way when the difference between one item and another is quantified. From this it is possible to tell how much one thing is longer, shorter, hotter or faster, heavy or light than the other and the relationships can be refined, patterns identified and predictions made from them.

The basis for saying “how much” needs to be in terms of some uniform unit. Measurement is a multiple of a given unit. Whether the unit is arbitrary or standard, however it has to be appropriate to the size of the quantity being measured.

Accuracy in measurement comes only partly from the skill of using a measuring instrument carefully. It also depends on the procedures adopted, such as how many different measurements are taken and how many times each measurement of the same is repeated. How much more .... is this than that?

There are numerous references to measurement terms, either it is linear, area, weight or volume mentioned in inscriptions as well as literary works of our country in general and Karnataka in particular. Along with this there are archaeological designs of measuring poles/rods depicted on the medieval monuments. But due attempt has not been made to co-relate all these different types of source materials to understand these standards and to obtain conversion factors. A separate study on the varieties of measurements and their evolution, modification and improvements is therefore necessary. Indeed why and how such diverse standards were evolved and managed is worth studying. It is also worth probing that whether there was any common standard to which all these diverse
standards and traditions could be converted without any hitch. Also whether a single standard measure led to such diverse system is to be clarified.

The diversity of units in weights and measures makes it difficult to find a common connecting link to form a basis of discussion. In the first place it is necessary to find out if possible whether there is any similarity in these things that were in vogue.

1.2 ENCYCLOPEDIC WORKS IN KARNATAKA

There are two Encyclopedic works written during the study period. They are “Rajamanasollasa” (also called “Abhilashitartha Chintamani”) and “Śivatattvaratnākara”.

Manasollasa is composed by the Chalukya King Somesvara III (AD1126-38). Somesvara was the son of Vikramaditya VI. Besides the above work he has also composed “Vikramankabhyuyadayan”. Manasollasa is divided into five Prakaranas. Each of these Prakaranas consists of 20 chapters and each of these chapters is devoted to one branch of knowledge. In total there are 100 chapters.

Śivatattvaratnākara is composed by Keladi King Basavaraja (AD 1696-1714). It consists of nearly 13000 Sanskrit verses. This like the above mentioned work, touches on all departments of oriental culture. This is divided into nine Kallolas (tides) and each kallola consisting of several of tarangas (ripples). In all there are 108 tarangas.

In Śivatattvaratnākara a sloka mentions that there are three types of measures used in commercial practice. They are āṅgula, tula and prastha measurements. These in modern terms are linear, weight and volumetric measurements respectively. The kaditha in Sringeri mata while mentioning a new settlement of farmers, says that the settlement shall follow the rules of measure, weight, and…

1.3 MATHEMATICAL WORKS IN KARNATAKA

There were many renowned mathematicians in India. They are Mahavira (4<sup>th</sup> Century), Aryabhata I (AD 475), Varahamihira (AD 505-587), Bhaskara I (AD 600), Brahmagupta (AD 628), Aryabhata II (AD950), Sripati (AD1039), Bhaskara II (AD 1114-1200) etc.
Bakhshali manuscript which deals with mathematics was earlier thought to be of 12th century. It is now considered to be as written in AD 400. The text deals with problems involving linear equations and it also gives a table of conversion factors for time, arc of a circle, money, weight, length and capacity.

Karanataka also had mathematicians who produced great works. They are Mahaviracharya (AD 814-878), Rajaditya (AD 1190) and Thimmarasa (16th Century).

Mahaviracharya was during the rule of Rashtrakuta King Amoghavarsa Nripatunga (AD 814-878) and had written Ganita Sara Sangraha. The work is in nine chapters and the rules quoted are comprehensive and it gives a large number of examples for illustration of exercise. Though his fame was not spread to North India, it seems that his work was widely known and appreciated in southern India. It was translated into Telugu by Pavuluri Mallana during 11th century.

Rajaditya was in the court of Hoysala Vira Ballala II (AD 1173-1220). He has written many mathematical works. They are Kshetra Gañita, Lilavathi, Vyavahāra Gañitam etc. These books are not available in full form. Mariappa Bhat has edited the Vyavahāra gañitam in 1955. The Vyavahāra Gañitam as the title suggests is mainly of arithmetics of commercial transactions and is having about eight sections. The work abounds in hundreds of problems almost taken from everyday life and it enables us to peep into the socio-economic conditions of Karnataka.

Rajaditya’s native place was Hoovina Bage in Koondi mandala. Rajaditya says that his master was Shubachandra. His father and mother were Shripathi and Vasanthi. His brothers were Shanta and Atmeshvara. His guardians were Bharata and Bhaubali. Who were dandanayakas and held the office of Mahapradhana and Mānikya Bhandāri under Hoysala Viraballala II. Rajaditya held many titles, they are rāja, rājavarma, bhāskara, bāchaya, gañita vilāsa, ojevengada, padya vidhyādhara, uttama bhāvya bhūṣana etc.

In almost every topic of Vyavahāra Gañitha, the principle is first stated, then it is followed by a good number of problems bearing on that principle. Every problem is followed by brief analysis supplying relevant information.

Timmarasa is the author of kshetra gañita. His father was Lakshmarasa and belonged to Srivatsa gotra. Timmarasa has given various mathematical formulae for area calculation. He is said to hail from Kamba, East of Ghanagiri.
Penugonda). The text is said to have been written in 16th century\textsuperscript{16}. Bhanumati of Kuvempu institute of Kannada Studies is of the opinion that Ghanagiri suggest Doddabetta (Indragiri) of Sravanabelagola and towards east of this the is village kamabhadahalli. This may be taken as Kambha the native village of poet\textsuperscript{17}.

This text is written in same style and principles adopted by Rajaditya. The \textit{sutra} (formula) is written first, and this is followed by \textit{jiku} (explanation) with geometrical figures. The terminology adopted being archaic for the modern students, it requires some effort to understand the subject dealt in the above two texts.

A few formulae and tables of measurement that are useful for the present study are quoted in the Appendix - 7.1

There are approximately 25,000 Kannada inscriptions now available, 70% of them are donative records which help us in inferring about measurement system\textsuperscript{18}.

1.4 PERIODISATION

For a convenient chronological treatment of the subject under study, the period of study from the beginning of Ganga- Kadamba rule in about AD 325 up to the rule of regional paleyagars i.e. roughly AD1700 is chosen.

This study period is divided into \textbf{FOUR} successive divisions as follows:

\textbf{PERIOD I:} The period from the Ganga - Kadamba to the end of Rashtrakuta rule is considered, since there is a dearth of evidence, it that there is not much change in the measurement system adopted. However to ascertain as meticulously and minutely as possible, the system in vogue through the period under changing political scenario, it is further sub divided as under:

- \textit{A} Ganga- Kadamba \ AD 325 to AD 525 -- 200\text{years}
- \textit{B} Badami Chalukya \ AD 525 to AD 752 -- 227\text{years}
- \textit{C} Rashtrakuta \ AD 752 to AD 973 -- 221\text{years} \hspace{1cm} 648\text{years}

\textbf{PERIOD II:} The period of Kalyana Chalukya from AD 973 to 1183 -- 210\text{years} under whom the area of rule was greater than the present boundaries of Karnataka state.
PERIOD III: The period of Seuna and Hoysala from AD 1183 to 1336 -- 153 years.

PERIOD IV: The period from Vijayanagara rule to the end of Keladi from AD 1336 to 1700 -- 364 years.

The formation of seven new districts in 1998 carved out of existing taluks has been considered. The earlier Dharwad district is bifurcated into three districts. These are Dharwad, Gadag and Haveri districts. Similarly few districts have been bifurcated. They are: South Kanara district now bifurcated as South Kanara and Udupi districts. From Bijapur, Raichur and Mysore districts, the districts of Bagilukote, Koppala and Chamarajanagar are bifurcated respectively. Davanagere district is formed out from taluks of Harapanahalli (Bellary Dt), Harihar and Davangere (Chitradurga Dt) Channagiri and Honnali (Shimogga Dt).

The village names have their own significance, the pronunciation of these names when written in Government records and other books may vary. There is slight variation in pronunciation of names in the published volumes of inscriptions. To avoid this variation and for better understanding, the village names as in “Karnāṭaka grāma sūchī” a descriptive catalogue of villages prepared by the Government of Karnataka in 1985 is used in the thesis 19.

The examination of the subject Measurement system entails the following basic questions.

1. What was the measurement system for the people of medieval Karnataka? How did it work?
2. Was there any universal standard of measurement system as such?
3. Was the measurement system regional?
4. If each village can have its own measuring rod could there be any uniformity in the system?
5. Was the system practically applicable, how was such diversity understood? How did this diversity affect the day to day life of the people?
6. How did the people comprehend and adapt to the diversity?
7. Was there any conversion system facilitating adoption of these diversities?
8. What were the nature of such facilitating conversion factors?
9. Can a comparison be made between such conversion factors and the present day Conversion system?
10. What was the effect of accessions of small and new kingdoms/regions to the imperial kingdom on local measurement system?

11. Though for the reconstruction of history and culture of Karnataka, as many as 25,000 inscriptions are available, how many of them offer details on measurement system? With a limited data is it possible to arrive at some concrete conclusion? Does it help in answering the above questions?

12. If the purpose of any measurement is taxation, then how was the taxation system formulated? How was the changes integrated?

It is against this historical background of over a period of 1375 years, the Measurement System in Karnataka is examined.
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