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MATHEMATICS

FRACTIONS IN AREA MEASUREMENTS

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Abstract : The land measurements that are found mentioned in the inscriptions are not only large extent but the minutest values of area is also found. A mathematical attempt has been done to calculate the areas of such fractions mentioned.

Key words: Kāṇi, arai kāṇi, mundri, kīḻ mundri, kīḻ kīḻ mundri.etc.,

Introduction: In general the land is measured in terms of kuli, ma and veli. It is interesting to note that many of the inscriptions of Raja Raja Chola mentions some other area measures such as *kāṇi, arai kāṇi, mundri, kīḻ mundri, kīḻ kīḻ mundri.* Kāṇi is 1/80th of a Vēli, 1/40th of a vēli is termed as aṟai kāṇi, 1/320 of a vēli is mundri, The areas covered by these fractions are being calculated

Area covered by each area measure when different scales are employed

A unit of area is termed as *kuḻi* in the inscriptions.

(1* 1) *kōl* square = 1 *kuḻi*
100 *kuḻi* = 1 *ma*
20 *mā* = 1 *vēli*
400 *kuḻi* = 1 *kāṇi*
1 *vēli* = 5 *kāṇi*
2000 *kuḻi*=1*vēli*

A *vēli* becomes a basic unit. Also, $(\frac{1}{320})$ of a *vēli* is called a *mundri*.

1/ mundri= *kīḻmundri*
1/ *kīḻmundri*= *kīḻkīḻmundri*

Area is calculated by 12 *sān* kōl, 18*sān kōl* and 24 *sān kōl* under the assumptions such as one *vēli* equals 2000 *kuḻi*, 100 *kuḻi* equals one *mā* etc as stated above.

Area covered when 12*sān* kōl is used

$$1 \text{ mundri} = \frac{2000*144}{320} \text{ sq. } sān.$$
$$= 900 \text{ sq. } sān.$$
$$K\bar{\imath}\underline{l} \text{ mundri} = \frac{900}{320} \text{ sq. } sān.$$
$$= 2 \text{ sq. } sān. + \frac{260}{32\ 0} \text{ sq } sān$$

= 2 sq. *sān*. + $\frac{260}{320}$ sq. viral

= 2 sq. *sān*. + 29 sq. viral + $\frac{80}{320}$ * 64 sq. nel.

= 2 sq. *sān*. + 29 sq. viral + 16 sq. *nel.*

= (4608 + 1856 + 16) sq.*nel*.

= 6480 sq. *nel*.

Kīl̲ Kīl̲ mundri = $\frac{6480}{320}$ sq.nel.

= 20 sq.*nel* + $\frac{80}{320}$ sq.nel.

= (20 X 64 + $\frac{80}{320}$ X 64) sq.*yeḷ.*

= (1280 + 16) sq. yeḷ

= 1296 sq. *Yeḷ.*

Kīl̲ Kīl̲ Kīl̲ mundri = $\frac{1296}{320}$ sq. *yeḷ.*

= (4 + $\frac{16}{320}$) sq.*yeḷ.*

= (4 X 64) + ($\frac{16}{320}$ X 64) sq. *kaḍugu*

= (256 + 3.2) sq. *kaḍugu*

= 259.2 sq. *Kaḍugu*

Area covered when 16 *sān* kōl is used

1 *mundri*= $\frac{2000*256}{320}$

= 1600 sq. *sān*.

Kīl̲ mundri= $\frac{1600}{320}$

=5sq.*sān.*

=5* 36 sq. *viral*

=180 sq. *viral*

Kīl̲ Kīl̲ mundri = 180/320

= 9/16 sq. *viral*.

= $\frac{9 * 64}{16}$ sq.*nel*.

=36 sq. *nel*

Kīl̲ Kīl̲ Kīl̲ mundri = 36/320 sq. *nel*.

= $\frac{36\ X\ 64}{320}$ sq. *yeḷ.*

= 7.14 sq *yeḷ*

=7.2 sq. *yeḷ.* App.

= 7.2 * 64 sq. *kaḍugu*.

= 460.8 sq. *kaḍugu*

Area covered when 18*sān* kōl is used

1 mundri =$\frac{2000\ X\ 324}{320}$sq. *sān*.

= 2025 sq. *sān.*

Kīl̲ mundri = $\frac{2025}{320}$ sq.san.

= 6 sq. *sān*. + $\frac{105}{320}$ sq san

= 6 sq. *sān.* + $\frac{105}{320}$ X 36 sq. *viral*

= 6 sq. *sān.*+ 11 sq. *viral* + $\frac{260}{320}$ X 64 sq. *nel*.

=6 sq. *sān.* + 11 sq. *viral*+ 52 sq. *nel.*

= (13824 + 704 + 52) sq.*nel*.

= 14580 sq. nel.

Kīḻ Kīḻ mundri = $\frac{14580}{320}$ sq. nel.

= 45 sq.*nel* + $\frac{180}{320}$ sq. nel.

= (45 *64 + $\frac{180}{320}$ * 64) sq.*yeḷ.*

= (2880 + 36) sq. yeḷ

= 2916 sq. *yeḷ.*

Kīḻ Kīḻ Kīḻ mundri = $\frac{2916}{320}$ sq. *yeḷ.*

= (9 + $\frac{36}{320}$) sq.*yeḷ.*

= (9 x 64) + ($\frac{36}{320}$ x 64) sq. *kaḍugu*

= (576 + 7.2) sq. *kaḍugu*

= 259.2 sq. *kaḍugu*

= 583.2 sq. *kaḍugu*.

Area covered when 24 *sān* kōl is used

1 *mundri* = $\frac{2000\ X\ 576}{320}$sq. *sān.*

= 3600 sq. *sān*.

Kīḻ mundri = $\frac{3600}{320}$ sq. *san*.

= 11 sq. *sān*. + $\frac{80}{320}$ sq *san*

= 11 sq. *sān.* + $\frac{80}{320}$ X 36 sq. *viral*

= 11 sq. *sān.*+ 9 sq. *viral*

= (396 + 9) sq.*viral.*

= 405 sq. *viral*

Kīḻ Kīḻmundri = $\frac{405}{320}$ sq. *viral*.

=1 sq. *viral*+ $\frac{85}{320}$ X 64 sq. *nel*.

= (1X 64 + 17) sq.*nel.*

= (64 + 17) sq. *nel*

= 81 sq. *nel.*

Kīḻ Kīḻ Kīḻmundri =$\frac{81}{320}$ sq. *nel.*

= ($\frac{81}{320}$ X 64) sq.*yeḷ.*

= (16 sq. Yeḷ) + ($\frac{64}{320}$) sq.*yeḷ.*

= (16 X 64) + ($\frac{64}{320}$ X 64) sq. *kaḍugu*

= (1024 + 12.8)sq. *kaḍugu*

= 1036.8 sq. *kaḍugu*.

The values are tabulated below.

Area of fractions using various measuring rods

	12*sān kōl*	**16 *sān kōl***	**18 *sān kōl***	**24 *sān kōl***

Mundri	900 sq.*sān*	1600sq.*sān*	2025sq.*sān*	3600sq.*sān*.
Kīḻ mundri	6480sq.*nel*.	180sq.*viral= 11520 sq. Nel*	14580sq.nel	405 sq. *Viral= 25920 sq. nel*.
Kīḻ kīḻ mundri	1296 sq. *yeḷ*.	36 sq. *Nel= 2304 sq.yeḷ*	2916 sq. *yeḷ*	81 sq.*nel= 5184 sq. yeḷ*
Kīḻ kīḻkīḻ mundri	259.2 sq. *Kaḍugu.*	460.8 sq. *Kaḍugu*.	583.2 sq. *Kaḍugu.*	1036.8 sq. *Kaḍugu.*

From the table we can infer that if length of the rod is doubled then its coresponding area becomes 4times the original area. For example when the length of the rod 12 *sān* is doubled we get 24 *sān*. The area of 12 *sān* rod for mundri that is 900 square *sān* should be multiplied by 4 to get the area for 24 *sān* as 3600 square *sān*.

Therefore it is necessary to mention the length of the rod while mentioning the area. Modern equivalence for the above area

Assuming 1 *sān* = 21 cm

1 inch = 2.54cm= 2 *viral*

So, 1*viral* = 1.27 cm

8 paddy grain = 1 *viral*

So, 1 paddy = 1.27/8 cm.

= 0.15875 cm.

8 *yeḷ* = 1 *nel*

1 *yeḷ* = .15875/8 cm.

= 0.01984375 cm

8 *kaḍugu = 1 yeḷ = 0.01984375 cm*

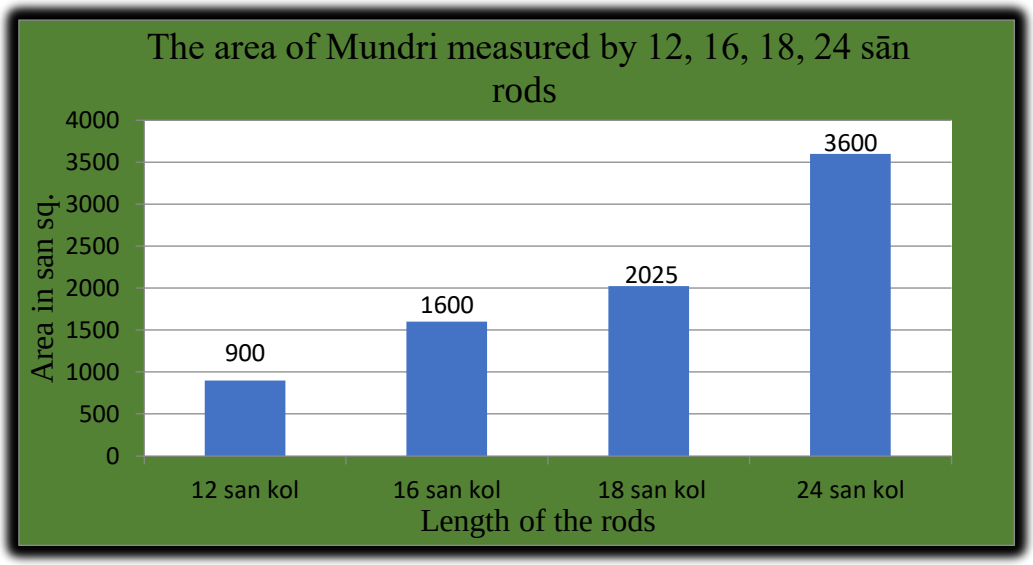
1 kaḍugu = 0.01984375/8 cm.

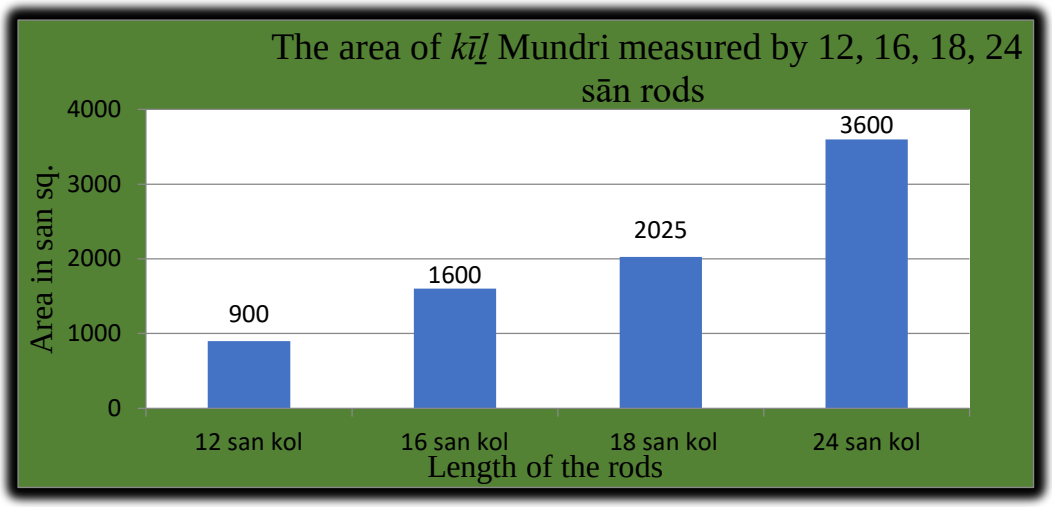
= 0.00248046875 cm

The following table is meant to show the conversion of area from *sān.*sq. to cm square.

Area of fractions using various measuring rods (in sq.cm)

	12 *sān kōl* (sq. cm)	16 *sān* kōl (sq. cm)	18 *sān* kōl (sq. cm)	24 *sān* kōl (sq. cm)
Mundri	396900	705600	893025	1587600
Kīḻ mundri	163.306	290.32	367.43878125	653.2245
Kīḻ kīḻ mundri	0.51033164062	.90725625	1.1482461914	2.413265625
Kīḻ kīḻ kīḻ mundri	0.00159479843	0.00283517578	0.00358826934	0.0063791455


The area of Mundri measured by 12, 16, 18, 24 sān rods
Area in san sq.
4000
3500
3000
2500
2000
1500
1000
500
0
900
1600
2025
3600
12 san kol
16 san kol
18 san kol
24 san kol
Length of the rods


The area of *kīḻ* Mundri measured by 12, 16, 18, 24 sān rods
Area in san sq.
4000
3000
2000
1000
0
900
1600
2025
3600
12 san kol
16 san kol
18 san kol
24 san kol
Length of the rods

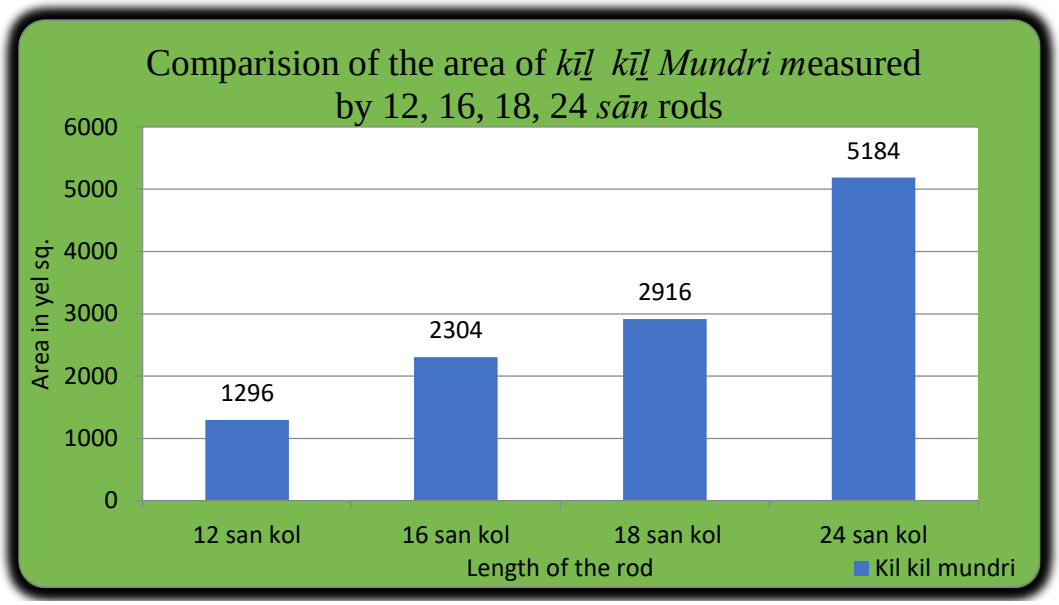
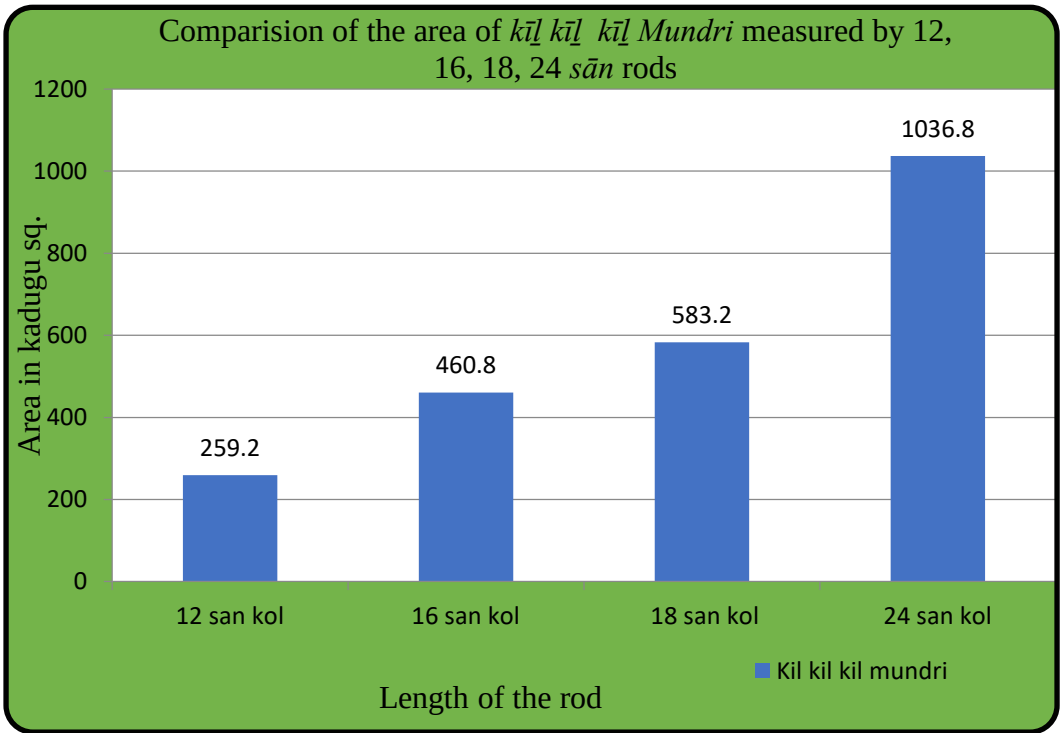


Figure. 3.15.

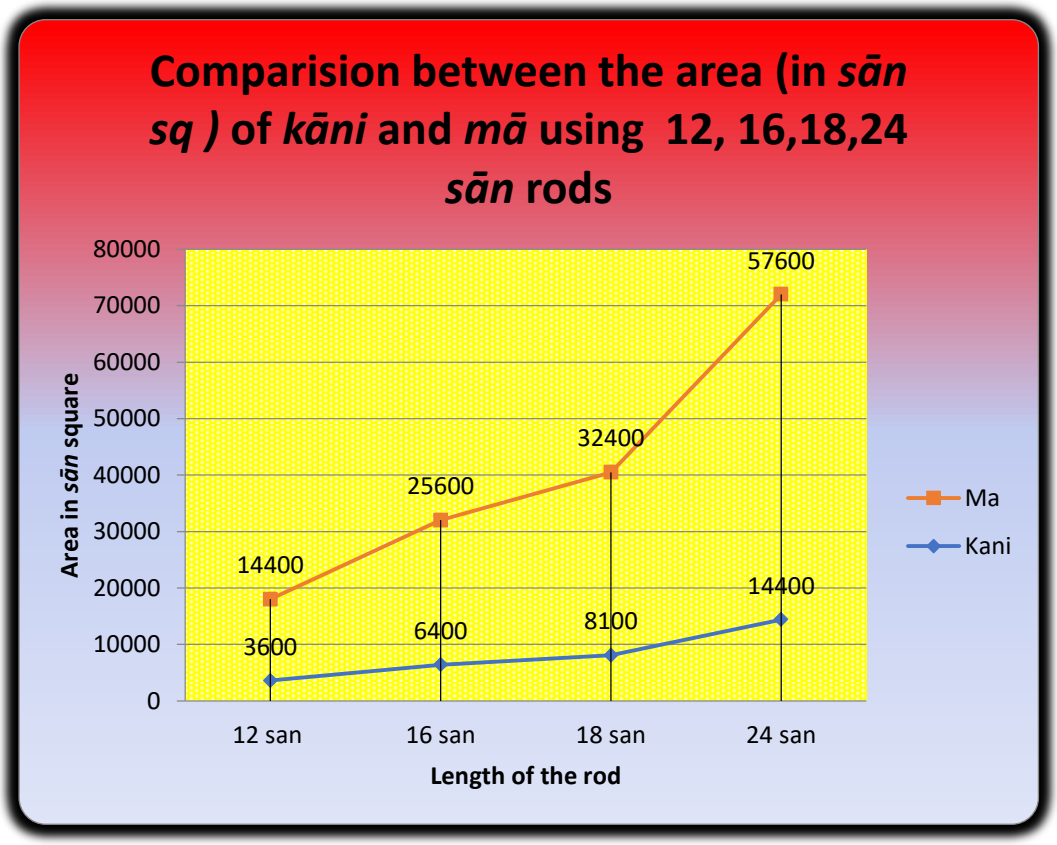


The areas for the higher denomination like *mā, kāṇi, vēli* for various lengths of the rods are calculated and are tabulated below.

Area of fractions using various measuring rods (in *sān* sq)

	12 *sān*	16 *sān*	18 *sān*	24 *sān*
Kāṇi	3600	6400	8100	14400
Ma	14400	25600	32400	57600
Vēli	288000	512000	648000	1152000

Here also we find that the values for 24 *sān* is 4 times that of that of 12 *sān.*



Conclusion:

We have calculated the areas of the fractions that are found mentioned in the Tamil inscriptions and we could not know why such a minute areas of land is being measured and what impact it has in the larger economic country like Chola. But the calculations reveals the mathematical knowledge of the Tamils.

References

[1]. Annual reports of South Indian Epigraphy (1887-1945), Mysore.

[2]. Annual reports of South Indian Epigraphy (1946 onwards).

[3]. Epigraphia Indica, (1872-1971), Archaeological survey of

India, Vols. I- XXXIX.

[4]. Indian Archaeology – A review published by the Archaeological survey of A.D. 325 to 1700,

[5]. South Indian Inscriptions, (1890-1983), Vol. I- XIV, XVII,XIX, XXII- XXVI, Archaeological survey of India.

[6] Karashima Noboru, (1984) South Indian History and Society studies from inscriptions, A.d. 850-1800, Oxford University press, New Delhi.

7]]. Karashima Noboru, (1966)Allur and Isanamangalam: two South Indian villages of the Chola Times.