EVERYDAY MATHEMATICS AND THE CLASSROOM: CASE STUDIES FROM RURAL SOUTH INDIA

DR L. S. SARASWATHI

FOREWORD

Alan Rogers and Brian Street

We have put together these studies by Dr L S Saraswathi of India because we believe they have a good deal to tell us which will be useful in both research and in developing adult learning programmes in development.

Dr Saraswathi is an adult educator who has been using ethnographic approaches in her work in Tamil Nadu, south India, and elsewhere since the 1970s. Developing new curricula for adults with the State Resource Centre in Madras (now Chennai) especially in literacy and numeracy, Dr Saraswathi promoted the view that adult learners do not come as a blank sheet to be written on afresh or an empty vessel to be filled with new knowledge from outside; rather, all adult education builds on what learning the adult learners bring with them to the classes. Each adult learner comes from a particular background and brings a great deal of **experiential prior learning** (Rogers and Horrocks 2010) – funds of knowledge and banks of skills that they are often unconscious they possess, indeed, funds of knowledge and banks of skills which they may even deny having but which form the basis of their decisions and their actions in their everyday lives (Moll *et al.* 1992) – and these will inevitably be involved in their new learning. Her understanding of adult education is of an educational process which is not a banking process as Freire pointed out (Freire 1972), but a process which builds on the knowledge and practices which the participants in her adult learning programmes have developed through informal learning and which they bring with them into the classes.

Numeracy: There are other studies undertaken by Dr Saraswathi than those presented here, especially on gender perceptions and practices (for example, about how women feel about themselves) among villagers in Tamil Nadu, but the present collection is concerned with the numeracy practices of these populations – the ways in which people expressed to each other numbers of groups and sets, time, spaces, linear measures, and capacity and weights. They bring all this practices with them into the classroom – and in the classroom they are entering, they often discover a completely new world of measures with different names and processes far removed from the names and processes they are already using, mostly unconsciously (Rogers 2013). The relationship between the familiar and well-used and the new is not at all clear, except that the classroom seems to regard the new as superior, the tried and tested as inferior.

Numeracy and literacy: In this respect, numeracy would seem to be rather different from literacy; for whereas some people may be claimed as being 'non-literate' in the sense that they have not developed the skills of reading and writing, although they will engage with literacy practices in other ways such as mediation, no-one can be

claimed to be ‘non-numerate’; everyone undertakes some forms of counting and calculations, however limited, in their daily lives.

Informal learning: Such an insight led Dr Saraswathi to expand her study. One aspect which she explores is still relatively unusual, how such numeracy practices are learned by the young and passed on from generation to generation. The importance of games in this respect is clearly revealed. There is a good deal of discussion of how the people she met developed the concepts they used in their everyday lives – how they started with concrete assessments of qualities of the individual object being used, and moved from there to making comparisons with other everyday objects, then to relationships between objects, and finally (though not always) to formalising the concepts. Learning informally in this way is a lengthy process, moving from one step to another as uses develop and the need for communication changes; and some of her respondents were only part way along this route. Her conclusion is that adult numeracy education should follow the same or a similar path but take it one stage further - to move from activities to concepts, from individual items to systems and relationships. Teaching numeracy in this context would seem to be to add additional ways of thinking, expressing and processing data to existing understandings and practices in a process of critical debate, as well as (and preferably before) adding new written numeracy processes.

The studies she and her team conducted are also **radical**. There is a concern here to explore whether the discourses and practices are gendered, whether men and women think, speak and act differently. Similarly, there is a concern about social exclusion - do people coming from scheduled castes and scheduled tribes in this part of India have their own terms and practices, different from those who regard themselves as 'mainstream'?

Facilitators: Saraswathi’s concern was that the facilitators in the functional adult literacy programme with which she was working at the time of these surveys should appreciate what the learners already knew as shown by their existing numeracy practices, that these teachers of adults should learn to build on the existing practices of their learners the new practices, both literacy and numeracy, in the functional literacy curriculum. To meet her concern, Dr Saraswathi developed a number of participatory training manuals for literacy and basic education teachers and for extension workers, based on these principles. The work here was designed to take that process of assisting facilitators further.

Ethnographic approaches: With these two questions in mind, she realised that it would be necessary to start by going out and discovering what the people already know and what they are doing. For if these uses of numeracy are unconscious, how can facilitators and other adult educators identify what exists and build on them rather than ignore them? This is the question which Dr Saraswathi faced - a question which is still just as relevant today as it was in the 1980s.

Ethnographic approaches: This being so, she realised that it would be necessary to to go to the villages themselves. What she needed to be discovered could not be found by sending out large scale surveys and questionnaires. The methodology which Dr Saraswathi and her team of researchers followed in these studies (see Appendix) was however rigorous but flexible. It combined both quantitative and qualitative approaches, in particular the use of observation. Statistical data is collected and analysed - and analysed critically. But in addition, ethnographic information is collected; the voices of the participants can be heard. She and her team of assistants went into the villages in Tamil Nadu in a true ethnographic spirit, sat with the people they met, listened to how they talked, watched what they did, and wrote up their findings in these papers. The riddles and games by which numeracy concepts are learned and disseminated reveal a society in which both adults and younger persons actively engaging with mathematical concepts and practices.

Using existing communication modes: Dr Saraswathi's studies have significance not only for adult educators but also for researchers. What is revealing is that Dr Saraswathi did not find it necessary to use some of the 'modern' (i.e. Western) tools of development programmes such as PRA (Participatory Rapid/Rural Appraisal). For her, observation and discussion with the participants showed that, using their existing modes of communication, they were capable of providing detailed accounts of complicated processes without the aid of matrixes and pie graphs. Such tools to provide information to observers may be very useful when there is a language gap; but within their own linguistic context, they do not appear to be needed. Some local people may not be able to express themselves to outsiders, but to those who share the same language, discourses and cultures, communication of complicated concepts and practices is entirely possible within existing terms and processes.

This ethnographic work of Dr Saraswathi in south India has been known to us for many years, and we have been fortunate to interact with her on a number of occasions. Since some of her works on the traditional numeracy practices in rural areas of south India have never been published and those which have been published are not easily accessible, we felt it right to put together a collection of the main papers which concern numeracy into one short book. The brevity of these papers mean that inevitably much has been omitted from her findings, but the essence is here. And the essays which were initially made available individually have been edited to avoid overlap and repetition; the detailed account of her research methodology which she provided has been added as an appendix; but otherwise they are as initially written in the 1980s.

SOME CONCLUSIONS

Because they are rooted in the local communities, these studies, conducted in the 1980s, still reveal much that is of value today. Some comments on her findings may be made here, but the readers will be able find other conclusions from these studies.

Diversity of concepts and practices: Perhaps the most striking thing about these studies is the diversity of ways of expressing much the same practices. Any one local community can have a number of different ways of talking about measures, so that the people are already engaged in code switching. The wide range of different Tamil terms for the same measure is very striking; similarly, a plurality of words are used to express the same concepts, the same objects and the same processes in the field of numeracy. This is not a question of different languages being used, for all are in Tamil. Nor is it in many cases a result of different castes or tribal groups. Rather it seems to be more local, village by village. How far these different ways of describing objects and processes reflect deeper issues of historic transitions is not a matter for discussion here. But they have implications for literacy and numeracy learning programmes. Increasing interaction between groups (for example, in market places) might at first sight seem to call for more standardised measures, including international metric measures; but the groups in these villages seem happy to switch between different local terms, and there are few signs of confusion or uncertainty. Adding to these codes internationally recognised ways of measuring will only engage with people's learning if the new codes are felt to be necessary, if they are called upon frequently in the various daily activities of the local community. To impose new standard categories of measurement in adult basic education classes without relating them to the existing measuring practices and terms being used would lead to compartmentalisation and indeed confusion, if not to rejection of the new in favour of the old. The situation in multi-lingual contexts may of course lead to different conclusions.

Complicated processes: The practices which Dr Saraswathi has identified are not simple ones – they involve a number of different steps which she sets out in each case. She suggests the processes involved in numeracy learning take place over time and (although unconscious) follow a sequence of recognition, comparison with other everyday objects or processes, definition and distinction, and then computation. The use of critical reflection in these steps is key. “The recognition of the need for and use of standard units” (page 23) is not likely to arise naturally when existing practices are fluent and satisfactory. She suggests this is one of the tasks of the functional literacy and numeracy programmes, that it might follow the same sequence of *recognition* of the existing everyday practices, *comparison* with other everyday objects or processes, *definition* and *distinction* between objects and processes, and *computation*. The use of games for such a process, especially local games, would enhance the teaching-learning process.

The common cultural base for Tamil society would seem to be revealed in that the base unit for sets seems to be five - unlike some other cultures where a vernacular base of three or twelve or even sixteen can be identified, and at times a mixture of different bases.

Digital numeracies: These studies were undertaken before television, mobile phones and battery-operated calculators became widespread (Jacobson, 2012; Dighe, and Reddi, 2006; UNESCO 2014; Kress, 2004; Warschauer, 2009). It would be interesting to conduct similar studies in the same region today to see how far numeracy terminology, practices and conceptualisations among non-literate adults have changed as a result of these and other new technologies.

Gap: One very clear impression left by these studies is that the gap between what is done in the community and what is being learned in the classroom, in terms of both language and processes, is very wide (Rogers 2013). An implication of this is that it would seem preferable to start with what is known, the existing numeracy practices of the learners, and move to the new, rather than start with the new (the textbook material) and expect that to be imported into what is already known and being used.

Teaching new numeracies: Thus the aim of adult literacy and basic education learning programmes in terms of numeracy would seem to be to help the participants to develop the skills of expressing and representing *their existing processes* and moving from these onto newer (textbook) processes which will widen the scope of numeracy concepts and practices and enable them to engage with wider processes. But not just a mechanical writing; rather, it starts with a process of *critical examination* of everyday numeracies rather than with the textbook of new processes.

There is much more here – and readers may well find insights for their own work different from those we have found. These papers, although based on work completed many years ago, have much to tell us. We are glad to offer them for use by researchers and programme developers and practitioners in adult learning programmes.

Readers of texts associated with BALID (the British Association for Literacy in Development – see www.balid.org.uk) may find themselves familiar with some aspects of these accounts, such as building on previous knowledge, and adopting a more ethnographic perspective to understanding local practices. And we may be fairly familiar with the notion of treating literacy as a social practice, focussing on local meanings and uses and recognising multiple literacies, rather than a single, ‘autonomous’ skill. At the same time, Saraswathi’s complex representation of numeracy practices in Tamil offers an original insight that may be applicable to numeracy practices; and she encourages us all to adopt the ethnographic perspective of suspending what we know whilst we attend to other people’s ways of thinking and acting.

REFERENCES

Dighe, A. and Reddi, U. (2006): *Women's literacy and information and communication technologies: lessons that experience has taught us*, Vancouver: Commonwealth of Learning. Available at: http://www.cemca.org.in/ckfinder/userfiles/files/CEMCA_Womens_Literacy1.pdf

Freire, P. (1972): *Pedagogy of the Oppressed* Penguin

Jacobson, E. (2012): *Adult Basic Education in the Age of New Literacies,* New York: Peter Lang.

Kress, G. (2004): *Literacy in the New Media Age,* London: Routledge

Moll, L, Amanti C, Neff D. and Gonzalez N. (1992): Funds of knowledge for teaching: using a qualitative approach to connect homes and classrooms, *Theory into Practice* 31 (2) pp 3-9

Rogers, A. and Horrocks N. (2010): *Teaching Adults* Open University Press

Rogers, A. (2013): The Classroom and the Everyday: The Importance of Informal Learning for Formal Learning http://pages.ie.uminho.pt/inved/index.php/ie/issue/view/1/showToc

UNESCO (2014): *Reading in the mobile era: A study of mobile reading in developing countries*, Paris: UNESCO, available at: http://unesdoc.unesco.org/images/0022/002274/227436e.pdf

Warschauer, M. (2009): Digital literacy studies: progress and prospects, in M Baynham and M. Prinsloo (eds) *Future of Literacy Studies* London: Palgrave Macmillan pp 123-140

EDITORIAL NOTE

DR L S SARASWATHI of Chennai, India *received her Master's degree in Home Science Education and Extension Education from M.S. University of Baroda, and her doctorate in Home Economics Education and Sociology from Iowa State University, Ames, Iowa. During her career as a university teacher and researcher in successive national adult literacy campaigns, especially during her time as Head of Research and Evaluation in the State Resource Centre, Madras/Chennai, Dr Saraswathi spent many years working with local groups of (mainly rural) men and women in Tamil Nadu, using ethnographic approaches to learn about the different ways in which they manage their lives, and exploring some of the implications of her findings for adult educators and others who work in development programmes in that area. She has engaged in training programmes widely across India and in the south Asia region for bodies such as UNESCO, FAO, DANIDA, and SIDA. Her special interest has been in the Participatory Approach, integrating the people's present practices with whatever the field of study has to offer – practices which involve the learners in the learning process and make education relevant to the lives of the learners. She has several publications to her credit in the fields of Home Science, Adult Education and Non-Formal Education for children. In particular, she prepared a series of participatory training manuals for adult educators for the Bay of Bengal Programme of FAO, and these were adapted by the Government of India for its National Adult Education Programme.*

This study was undertaken in south India in the 1980s as part of a programme to enhance the learning of literacy and numeracy in the state of Tamil Nadu. But its findings are of wider significance, and they are offered here both in terms of their findings and their methodologies. Although Dr Saraswathi's work is well known in certain circles in India, many of her findings have not been published but they appear so significant that we have drawn together the most important but inaccessible of her papers. In bringing them together, the papers have been edited to avoid repetition.

With her permission, these may be downloaded free and used in any training and research activities, provided acknowledgement is made both to Dr Saraswathi and the BALID website, www.balid.org.uk.

Alan Rogers
Brian Street

CONTENTS

CHAPTER I: INTRODUCTION

Learning is a natural and continuous process; it arises from our experiences. Hence, learners (adults/children) in educational programmes (formal/non-formal) are already engaged in learning. This natural learning can be built upon to achieve planned learning.

Learning numeracy or acquiring basic mathematical concepts and skills is continuously taking place as a result of everyday living experience. Hence it becomes important that the natural and continuous learning from life situations in this regard should be the basis of planned adult education programmes. Understanding the existing numeracy knowledge and practices of the people in the rural areas of Tamil Nadu used in everyday life may be considered vital if the planned programme is to be made relevant to the life of the learners. The present study is an effort in this direction.

The purpose of the study is to evolve ways of integrating what people have and do with what they need in terms of numeracy learning and practices. The objectives were:

1. To study the present numeracy practices in the day-to-day life of some people in rural Tamil Nadu with special attention to gender and caste;
2. To study the implications of these practices for teaching and learning numeracy in adult education programmes.

Some 300 respondents from seven villages were interviewed and their practices observed[1]. The majority of the participants were aged from 15 to 35 years. About one half were SC/ST[2]s, and the other half were other castes; the majority were Hindus. Most were married and belonged to a unitary family of two to five members. Nearly half were non-literate or had not finished their schooling; the other half had completed four to eight classes. The majority were agriculturists or agricultural labourers. Most had been residents of the village since birth and the majority had not travelled outside the village.

Data was collected from July 1983 to January 1984 through a specially developed interview schedule. A pilot study helped in developing the open-ended questions. As gender and caste were in focus, both men and women were interviewed, and care was taken to include about half from SC/STs.

[1] For details of the sampling methods, see Appendix A
[2] Scheduled castes/ scheduled tribes

CHAPTER II: PRACTICES IN ENUMERATION IN COUNTING AND COMPUTATION OF SETS OF OBJECTS

Villagers in Tamil Nadu engage in counting everyday in the course of agricultural production and marketing. While they often use common processes, they use different terms for the computing sets of objects in different villages and for different products. There are multiple ways to compute sets of objects.

This part of the study attempted to find out the mode of counting of large sets and small sets in day-to-day transactions in rural Tamil Nadu. A set is defined here as a group of things, and number is a property of sets. Exploring the physical (qualitative) attributes of sets helps in exploring number (quantitative) attributes. Sets of objects can be enumerated by counting when the sets are small. When one wishes to find the number of elements in large sets, counting is inefficient. One needs computational procedures for finding such totals.

The analysis was made under the following headings:
a) Basic observations about counting and numbers
b) Enumeration of agricultural, horticultural and other products – special terms used for unit sets of such products and their multiples
c) Modes of counting of small sets of pebbles or cowrie shells
d) Recording of counts or cumulative counts
e) Estimations of small sets of pebbles/cowrie shells and the bases for such estimations.

a) Basic observations about counting and numbers:
1. Number names in Tamil one to ten (*Onru, Irandu, Moonru, Nangu, Eindu, AAru, Ezhu, Ettu, Onpadu, Patthu*) were commonly used for counting sets of objects. Number names for hundreds and thousands were also used quite commonly.
2. The system of numeration used was a decimal system.
3. The number symbols generally used in the villages in Tamil Nadu were the Arabic numerals. The traditional Tamil alphabet number symbols were no longer in vogue.
4. In a predominantly oral culture in rural Tamil Nadu, number names rather than number symbols were used and communicated. The available literature in folk-lore and the present study indicate that the number names are communicated through songs, games, riddles, stories or combinations of these.

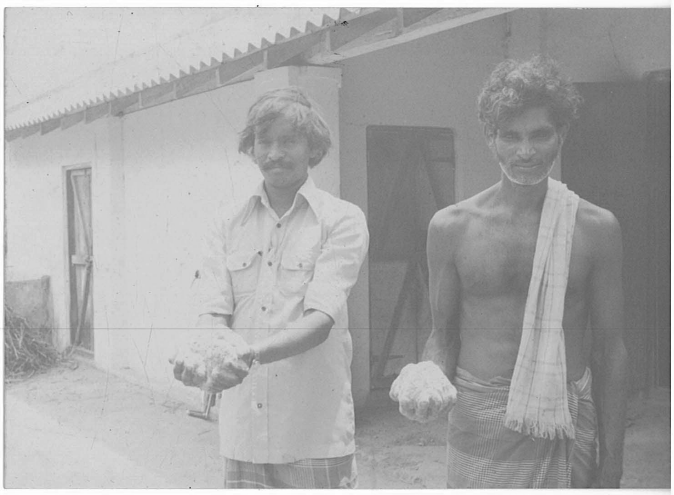
b) Enumeration of agricultural, horticultural and other products:
Special terms are used for unit set of agricultural produce and for their multiples: These depended upon
- the kind of objects and their size
- convenient volume unit sets in which they could be handled easily and hence counted fast

- a count of a standard number of unit sets for reaching the convenient count of a large set.

These volume unit sets were either **convenience** bundles (*kattus* in Tamil) - handfuls and headloads (*sumai* or *somai*), the load that could be carried on the head or on the shoulders; or **containers** (*koodai*, *sakku* etc) (basket, sack etc)

Convenience bundles: Much counting is done through making the products into convenience bundles or *kattus*. Convenience is generally determined by the ease of handling either by the hand or to be carried on the head.

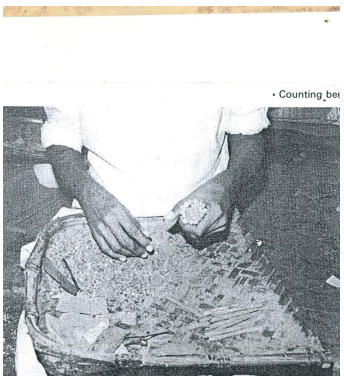
i) Handful: Most convenient unit sets of products were in terms of five-finger counts, one hand; thus one hand (*oru kai*) in a count of banana leaves, cowdung cakes etc, indicated five, and 20 hands made one hundred. A palm/handful (*kappangu* or *kaippangu*) is that which could be held within the palm and held tight by the fingers. Different terminologies and practices were found in different villages. For example, betel leaves in large numbers were counted in handfuls. The harvested betel leaves are arranged in order with all the stems on one side, and a handful is picked up with skill. In one of the villages studied where betel leaves was one of the main produce, this handful is considered to contain anywhere between 100 and 200 leaves depending upon the size of the leaves; six such handfuls make one *kauli*. In the other villages, one *kauli* is taken to be one hundred betel leaves which could be generally picked up in the hand. Two such *kaulis* made one *kattu* or (bundle) in another village. In a third village, one *adukku* or a set of lined-up leaves is 50 and a *kauli* is 100; 25 *adukkus* make one *mutti* and 25 *kaulis* make two *muttis*.



Two villagers showing hand measures of rice in front of a rice mill

In the case of paddy seedlings, one handful (*pidi)* contains 8–10 seedlings; this is also known as one *mudi* or knot. Ten *mudis* make one *kalasam* and 100 *mudis* make a *kattu* or bundle. In the case of *beedis* (indigenous cigarettes), a different way of counting was observed: a *kattu* (bundle) was counted by arranging some beedis in a circular form by holding them in the circle made out of the forefinger touching the

thumb. The beedis are taken to be 25 in number when three beedis are seen in the centre and two concentric circles around these three beedis. This arrangement ensures automatically 8 beedis around three in the centre and 14 beedis around the 8 beedi circle. Here the shape of the arrangement of the objects tight within a specified space made the counting easy. Counting up to 3 is all that was required. 40 *kattus* make 1000, 25 *kattus* make a packing.



Counting beedis by holding a bunch in one hand.

A villager showing the calculations involved in mat grass bundling and quantity of dye to be used

ii) Headload (*sumai or somai)*: In the case of sugarcane and bamboos, convenient headload bundles or *kattus* are made from 20 sugarcane sticks/bamboos. Five such bundles make 100, and 50 *kattus* make 1000. Piling the sugarcane bundles about 5 feet high, 10 feet long and about 3 feet wide make up approximately one ton of sugarcane. When the harvesting of sugarcane is done, the piling up is done generally in an orderly way.

Different fruits, major products of some tribal villages, were carried on their heads or shoulders in airy, net-like bags with varying sizes of eyes in the net to suit the varying sizes of the fruits. This net is long enough to hang on either side of the shoulders or the head. Counts of one headload of different fruits are given here: limes 500; *kolanji* (another variety of citrus fruits) 100-200; oranges 100; *kada*

narthangai (another citrus fruit) 40; pineapples 25; jackfruit 4 or 5; Bananas 2-6 *thars* or bunches on a stem; Pumpkin 1.

Naturally occurring bunches: Bananas are generally counted in terms of naturally occurring bunches. One *thar*/ *kolai*/ *sadu* (bunches on a stem) may contain from 50-300 bananas depending on the variety and size of the bananas. On the *thars*, the bananas are found in *seepus* or clusters; one *thar* may contain 3-15 *seepus*; each *seepu* may contain 10-20 bananas.Coconuts are counted in terms of a *kolai* or bunch which contains approximately 25 coconuts; one *orai* or 4 *kolais* is 100 coconuts.

Containers: Baskets of different sizes are used for counting fruits such as guavas, mangoes and oranges. Guavas have a specific basket. Once that basket is full, it is taken that it is 300 - but depending upon the size of the fruits, the number varies. In counting tea leaves, other containers are in use. One *sippai* or *kattu* (bunch) consists of 50 leaves; one *koodai* or a basket consists of 500 leaves, and one *mootai* (sack) consists of 800 leaves.

c) Modes of counting of small sets (of pebbles/cowrie shells etc):
The study explored the mode of counting used by the respondents by asking as well as observing the interviewees when they were asked to count a set of pebbles or cowrie shells. There were double and triple responses to the question on the mode of counting a set of small objects such as these. Hence the total added up to 364 for 304 respondents. The data collected are presented in Table 1.

The majority of the respondents (70%) counted the presented set of pebbles either individually or in pairs. Counting in pairs was more common than counting individually. About 16% of the responses were in terms of counting in fives. Very few used counts of six and above.

Looking at the data gender-wise, 81% of women counted individually or in pairs; the percentage of men counting individually and/or in pairs was 63%. Counting objects in sets of more than two was more frequently done by men (35%) as compared with women (15%).

Looking at the data caste-wise, there was very little variation between the SC/STs and other castes in the mode of counting the present set of small objects in not so very large numbers.

In indoor games, captured seeds are counted in sets of four called by the names of *sungu*, *uddai*, *pasu*.

d) Recording of counts or cumulative counts:
The respondents were asked how they kept a record of milk or eggs produced in a day or a month, or the amount of ragi or rice consumed per day, per week, per month. The consumption pattern over a period of time was remembered and reported. The consumption quantity reported per week was not necessarily the specified quantity per day multiplied by seven. Probably the consumptions when considered over a longer duration varied in reality and were not mere multiples of that which is consumed per day.

Group measuring milk

The majority of the respondents (about 52%) reported that they kept records in their mind; about 18% said they kept a written record whenever required. Some 30% said that they did not record anything. Looking at the data sex-wise, only three women recorded in symbols such as dots. About 18% of men and 16% of women kept a mental record. Hence there was not much variation between men and women.

Looking at the data caste-wise, there was some variation between the castes in the keeping of records of counts; a slightly higher proportion of SC/STs especially from one of the villages reported that they kept records of counts. Otherwise, there was hardly any variation between the castes in keeping mental records or not recording.

e) Estimation of small sets of pebbles /cowrie shells:
The participants were shown a small pile of pebbles or cowrie shells and asked to guess the number in the pile approximately without counting. Then they were asked to count. Both the guessed and actual numbers were recorded. The differences in appropriate guesses and actual counts were calculated. The data collected is presented in Table 2.

Very few participants (only 5.6%) could guess the number in the pile accurately. A small majority guessed less than the actual (about 51% less than the actual and 43% more than the actual). Looking at the data sex-wise, a majority of men guessed the number less than the actual, whereas among women the numbers guessing less

or more were almost equal (46%). Among those who guessed accurately, women and men were almost equal. Looking at the data caste-wise, there was some variation between the SC/STs and other castes. In general, a larger percentage of SC/STs (54.6%) guessed less than the actual number when compared with the other castes (about 47%). Among other castes, the percent estimating on the plus or minus side was almost equal.

The respondents were asked to describe how they guessed the number in a set of pebbles or cowrie shells, what were the things they observed. In general, a large number of these rural people interviewed (43%) said that they estimated the number of pebbles or cowrie shells by looking at the size of objects. A few (about 6%) said that they looked at the space occupied. About 30% said that they estimated the number out of their experience in estimating. They couldn't specifically identify the elements that helped them estimate the quantity. A large number did not respond (Table 1.3).

Looking at the data sex-wise, the responses of men and women did not vary much. A slightly higher percentage of women than men reported the basis of estimation of quantity as the size of the objects. A higher percentage of men than women said that they estimated because of their experience without specifying the elements, such as the size of objects, the space occupied by the objects as well as the closeness of the objects (arrangement of objects tight or loose).

Looking at the data caste-wise, the responses regarding the basis of estimation again did not vary much between the SC/STs and other castes. The size of the objects was identified as the basis of estimation of the number of objects by about 40% of SC/STs and 47% of other castes. Space occupied by the objects was considered as the basis of estimation by about 4% of SC/STs and 8% of other castes. Experience was cited by almost equal percentage of SC/STs and other castes (29% and 28%). A higher percentage of SC/STs did not give any response (27%) as compared with other castes (17%).

Implications of the study for adult education

The process of learning enumeration by counting and computation appears to be a natural process in the day-to-day practices of agricultural production or other products in the villages in Tamil Nadu. The process would seem essentially to be one of moving from **recognition** of unit sets such as one hand, volume unit sets of a handful, convenient bundles, containers, headloads, naturally occurring bunches, or recognition of the bases of estimations made, to **computation** of unit sets of objects in convenient, easy to remember ways according to the specific produce. Various terms are used in computing on a base of ten (e.g. one *pidi* (*mudi*) or knot is 10 seedlings; ten *mudis* make one *kalasam* or cone; 100 *mudis* make a *kattu* or bundle etc).

Introducing the classroom numerals into these everyday enumeration practices and gradually helping the class participants to understand their existing system of numbering and computations, their own signs and symbols will help them to see the relevance of the new numbers in day-to-day transactions. Educational programmes for adults in regard to enumeration by counting and computation of sets of objects, in practical terms, would involve:

- sharing of experiences of the learners in counting with reference to different kinds of produce and how they make the counting easy;
- helping learners to see the system that is involved in their own practices in enumeration of different objects;
- helping learners recognise through discussions the relationships between the system in practice in day-to-day life and the system of numerals and computation used in the classroom.

TABLE 2.1 : Sex-wise and Caste-wise Distribution of Responses according to the mode of Counting

Mode of counting	Men (189)	Women (115)	Total (304)	SC/STs (154)	Other Castes (150)
Individually (In ones)	52 (22.8%)	46 (33.8%)	98 (26.9%)	57 (31.7%)	41 (22.2%)
In pairs	91 (39.9%)	64 (47.1%)	155 (42.6%)	73 (40.6%)	82 (44.6%)
In threes	17 (7.5%)	5 (3.7%)	22 (6.0%)	7 (3.9%)	15 (8.2%)
In fours	9 (4.0%)	3 (2.2%)	12 (3.3%)	7 (3.9%)	5 (2.7%)
In fives	46 (20.2%)	13 (9.6%)	59 (16.2%)	30 (16.6%)	29 (15.8%)
Counts above Sixes up to tens	8 (3.5%)	-	8 (2.2%)	3 (1.6%)	5 (2.7%)
According to need	3 (1.3%)	3 (2.2%)	6 (1.7%)	1 (8.6%)	5 (2.7%)
No response	2 (0.8%)	2 (1.4%)	4 (1.1%)	2 (1.1%)	2 (1.1%)
Total	228 (100.0%)	136 (100.0%)	364 (100.0%)	180 (100.0%)	184 (100.0%)

TABLE 2.2: Sex-wise and Caste-wise Distribution of Respondents according to the differences in the estimated and actual counts

Differences in the estimated and actual counts	Men (189)	Women (115)	Total (304)	SC/STs (154)	Other Castes (150)
- 11 to –31	30 (15.9%)	18 (15.7%)	48 (15.8%)	29 (18.8%)	19 (12.6%)
- 6 to – 10	28 (14.8%)	15 (13.0%)	43 (14.1%)	24 (15.6%)	19 (12.6%)
- 1 to –5	44 (23.4%)	20 (17.4%)	64 (21.1%)	31 (20.1%)	33 (22.0%)
0	8 (4.2%)	9 (7.8%)	17 (5.6%)	8 (5.2%)	9 (6.0%)
+ 1 to + 5	29 (15.3%)	20 (17.4%)	49 (16.1%)	21 (13.6%)	28 (18.7%)
+6 to + 10	22 (11.6%)	10 (8.7%)	32 (10.5%)	16 (10.4%)	16 (10.7%)
+11 to + 31	22 (11.6%)	19 (16.5%)	41 (13.5%)	19 (12.4%)	22 (14.7%)
No Response	6 (3.2%)	4 (3.5%)	10 (3.3%)	6 (3.9%)	4 (2.7%)
	189 (100.0%)	115 (100.0%)	304 (100.0%)	154 (100.0%)	150 (100.0%)

TABLE 2.3: Sex-wise and Caste-wise Distribution of Respondents according to their bases of estimations of the presented set of pebbles/cowrie shells

Base for Estimation	Men (189)	Women (115)	Total (304)	SC/STs (154)	Other Castes (150)
Size of the object	79 (41.8%)	53 (46.2%)	132 (43.5%)	61 (39.6%)	71 (47.3%)
Space occupied by the objects	12 (6.4%)	6 (5.2%)	18 (5.9%)	6 (3.9%)	12 (8.0%)
Experience	59 (31.2%)	28 (24.3%)	87 (28.6%)	45 (29.2%)	42 (28.0%)
No Response	39 (20.6%)	28 (24.3%)	67 (22.0%)	42 (27.3%)	25 (16.7%)
Total	189 (100 %)	115 (100 %)	304 (100 %)	154 (100 %)	150 (100 %)

CHAPTER III: PRACTICES IN CAPACITY AND WEIGHT MEASUREMENTS IN RURAL TAMIL NADU

Measurements are useful in comparing or describing objects. Objects are compared and described with other objects which are continuous (e.g. the capacity of one vessel is seen in terms of the capacity of other vessels) or discrete (e.g. using a unit several times such as the capacity of the pot is about 10 tumblers of water). A standard measure or standard unit of measure is a quantity agreed upon by a group of people to which other quantities can be compared or described.

Looking at objects in terms of their volume (capacity) or weight, evolving a system of units of capacity or weight measurements and applying the system of units to describe and compare objects are all learned through experiences. These are some of the basic skills required in understanding and utilising objects.

Data regarding the following were collected: a) general modes of *describing* capacity or weight measures of 18 different items generally found in village homes/shops; b) ability of the people to *estimate* capacity or weight of certain selected objects and to explain the bases for their estimation; c) ability of the people to *recognize the tools of standard measures* of metric units such as litre measures and kilogram measures. The questions asked were open ended. The free responses were recorded. The items for which the respondents were asked to describe the units of capacity or weight were clustered and presented as follows:

Volume or weight measures (dry):

- seeds or grains produced or obtained as payments/wages;
- provisions generally used at home (cereals, pulses, oil seeds, flours, spices, whole and powdered);
- inputs in agriculture such as manures and fertilisers;
- animal fodders such as oil cake, paddy/pulse husks and hay;

Volume measures (liquids):

- milk, curd, butter milk; oils, kerosene; coffee/tea.

The collected data were analysed by counting frequencies and computing percentages of responses according to the types of units reported to be used by the respondents for each of the items or cluster of items. This was done with reference to capacity/weight measures in homes and in shops. The data analysed are presented in the following tables.

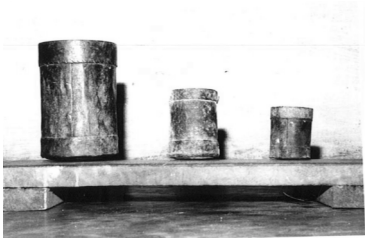
The findings: The data reveal that in rural Tamil Nadu

- People used a variety of units to describe the capacity of volume measures.
- The units used for any one item or a cluster of items varied in their specificity.

They were either vague or non-specific, or specific but different in the type of unit

base which was either hand measure or container measures available at home, or traditional standards of coordinated, interrelated volume measures, or metric measures.

- The units used at home/farm for **dry volume/weight** measures were metric units such as kilogram or litre; traditional, coordinated, interrelated units such as an *ollock* (1/8 measure), (*uzhakku* ¼ measure), *araipadi* (½ measure) and *padi* (one measure) and larger measures like *marakkal*, *kuruni*, *vallam*, *mootai* (one bag); container units of cart, baskets, buckets, winnower, small bags, tumblers, ladles, spoons, vessels of varying sizes; body units of one handful, one pinch, or provisions in terms of money spent and measure of produce in terms of the land area. The metric measures were found to be more in vogue in shops than at home.
- The units used for **liquid** items were metric units of millilitres and litres; traditional units of *ollock*, *padi*; container units in terms of the articles in which oil is held such as lamps or stoves, vessels, tumblers, ladles and spoons; money unit or the amount spent on the item. Metric measures were in use more in shops than at homes.
- The practices in volume/weight measure (dry or liquids) were item specific and situation specific.
- The most common units of capacity measures (dry) were traditional measures: *mootai, kalam, marakkal, pakka padi,* litre, *padi, uzhakku, ollock*. They are coordinated, interrelated measures.



padi, half padi and quarter padi

Litre, 500ml, 200 ml and 100 ml

The traditional capacity measures varied in volume among the villages, though the names remained the same. The names of the **granaries** and their holding capacities varied: *Pathayam* (20 *mootais* or quintals); *Ser*, *Thombai* (10 *mootais* or quintals); *Kengu* (8 *mootais* or quintals); *Podi*, *Mithi* (2 *mootais*/6 *mudal* 60 *vallam*); *Putti* (40 *marakkals*). (see Appendix to this chapter).

Generally in many villages, produce was measured in a bigger measure and grains given as wages (coolie) were measured in a smaller measure. Though the same name was used for the two, the peasants differentiated between the *padi* and coolie *padi* as the quantity varied.

Container measures - one ladle was considered to hold 10 spoons or 50 to 150 gms; one load of jelly was 40 baskets.

Body measures - *kai* or *sarangai* or one handful was considered to hold ½ *ollock* or 100 gms; *sittigai* or one pinch was equivalent to 5-10 gms.

The 'non-specific' units were mainly the participants' responses which were vague, for example, 'as much as', as needed or required.

The people in rural Tamil Nadu seemed to have had their own equivalences of home capacity/weight measures for the shop capacity or weight measures as these differed. They were as follow:

- Rice and other grains bought in shops in kilograms were measured in traditional measures of *padi* and/or *ollocks* or in container measures at home. Generally one kilogram of rice was considered equivalent to 5 *ollocks* or a can or tin of a specific size. The equivalence of larger measures of 2,5, or 10 kgs of rice and other grains were in terms of containers of tins or pots.
- Equivalences of less than a kilogram were in terms of specific containers for specific items such as bottles and vessels and also were in terms of hand measure.
- Half a kilogram of oil was reported to fill a 500 gms. horlicks bottle.
- Equivalences of litre measures of milk or butter milk were in terms of specific containers.

Gender and caste: There was only very slight variation between the responses of men and women in describing the capacity measures of both solid and liquid items (Tables 3.3 and 3.4). There was some variation in the responses of scheduled castes/ scheduled tribes and other castes in describing capacity measures at home. A higher percentage of other castes than SC/STs reported metric measures especially for items of grains, provisions such as ragi, rice, kambu, dhal and groundnuts. In all the other items, variations among castes were negligible (Tables 3.5 and 3.6).

Estimation of capacity weights

The interviewees were shown three items, oil (70 gms. in a small bottle), tuar dhal packet (100 gms). and ragi packet (500 gms), one by one and they were asked to estimate their weights. The responses were recorded and analysed according to sex and caste groups. The data reveal the following (Table 3.7)

- The majority could estimate the weight.

- The number who guessed accurately the weights of the items shown were less than those whose guesses or estimations were inaccurate.
- In case of tuar dhal and ragi, a large number either estimated it right or less than the actual weight.
- In the case of oil, a large number either estimated it right or more than the actual weight.
- The estimations done by men or women did not vary much for all the three items. Women tended to estimate less than the actual than men.
- The estimations done by SC/STs and other castes varied. A larger percentage of other castes estimated it more accurately than the SC/STs, for oil and tuar dhal. In the case of ragi, the estimations by the SC/STs and other castes were more or less the same. Probably ragi is something that they used more than the other items.
- The majority explained the basis of estimation as their experience in estimating. They could not specifically state the bases. A few said that they mentally saw the items in terms of the house measure and estimated the weight.
- The estimated weights when they were estimated more or less than the actual were mostly 25 to 50% of the actual weights.

Use of common standard tools of volume (capacity) or weight measurement

The common standard tools for volume (capacity) and weight measurement, namely, standard volume measures of one litre, half a litre, 200 ml. and 100 ml., and standard weight measures of one kilogram, half a kilogram, 200gms, 100 gms and 50 gms were shown to the interviewees for identification. The data (Table 3.8) reveal the following:

- The common standard tools of volume and weight measures mentioned above were commonly recognised by a majority of the respondents.
- A larger number of men were able to identify these measures than women.
- The variations among castes in identifying volume and weight measures were negligible.

<u>Implications of the study for adult education</u>

The process of learning to describe any object/item in terms of its volume/weight measure is essentially starts with **recognition** of the dimension of holding capacities or weights of items: examples could be:

"This granary holds large quantity of grains".
"This pot holds small quantity of rice".
"This bag of grain is heavy".
"This packet of grain is lighter".

leading to **measuring** the holding capacity or weight of objects by choosing any unit of continuous measure such as familiar containers in the environment (vessels of varying sizes) or body measures such as handfuls, or objects such as granite, brick or stone etc; leading to

recognition of the need for and use of standard units which could be iterated for a fairly accurate descriptions of objects - both traditional coordinated interrelated units as well as metric units. As it is more practical to use the traditional measures at home, recognizing the relationship of traditional and metric measures becomes important.

Granary used for storing grain at home

The demands for the descriptions of volume/weight measures in life situations are such that any individual or group could be at any of these stages with reference to any item at any time. Better understanding of the volume or weight measures results not from merely moving from stage 1 to stage 3 but from an understanding of the inter-relatedness of these stages and skill in using them with ease in tune with the demands of the life situations.

The people in these Tamil Nadu villages were at different stages, depending upon the items being measured or the situation in which the item is measured. The evolution of the process in measurement in the different stages outlined, when understood, could help anyone to be at any stage and yet be aware of the volume or weight measure and its place in understanding objects for utilising the same.

Educational programmes for adults in rural Tamil Nadu should help the learners understand the process of evolution in volume or weight measurement and thus the interrelatedness of stages. This will naturally help the learners to use the standard tools of measure wherever necessary. This, is practical terms, would mean the following steps:

- Sharing of experiences of the learners in measuring volume or weight measures of different items (objects) in their own life situations
- Helping the learners to systematise these experiences in measuring volumes or weights

- Organising activities to recognise the process of evolution of volume or weight measures and the system of relationships of diverse ways of measuring volume or weights
- Recognising through discussions the basis of the diverse ways of measuring capacities or weights of objects in real life situations
- Looking at the day-to-day life situation problems involving measurements in the light of the underlying patterns of relationships in the existing diverse measuring practices. This would help in recognising the need for common units of measures.

APPENDIX: Capacity measures in different villages:

***Mootai* or Quintal** varied in their capacities in different villages. Each *mootai* was reported to contain 16 *marakkals* or 64 *padis*; 2, 4, 6 *para*; 3, 4, *muda* or 30 to 40 *vallams*; 24 *kalams*. It was also reported as 100 Kgs. Sometimes it could be 45, 75, 80 Kgs.

Kalam, a larger traditional capacity measure also varied in its capacity from village to village: 24 or 12 *marakkals*; 12 or 16 small *marakkals* or *vallams*: 72 litres.

Koni (bag) was 12, 14, 16 *marakkals*; ***Urai*** was 14 *marakkals*; *Muda* was 10 *vallams*

Marakkal or ***kuruni's*** capacity was 4 to 8 *padis* or 32 *ollocks*; 4 or 6 *padis*; 4 *padis*; 2 to 6 *padis*; 4 *kacha padis* or 1½ to 1¼ *peria padi*; 2 *vallams*; *peria marakkal* or big *marakkal* consisted of 3 or 4 *peria padis* (big *padis*).

Vallam : 1, 4, 6 *padis*; 4, 5, 6 coolie *padis*; 2, 2½, 3 litre *padis*. *Pakka*, *magani*, *peria padi*, coolie *padi* were the names used for similar kinds of traditional measures (2 *padis*, 3 *kacha padi*, 2 *arai* or half *padis*, 4 *kal* or quarter *padis*, and 8 *araikkal* or one eighth *padis*; 2 to 2½ coolie *padis* and one *peria* (big) *padi*).

Litre *padi*, the metric measure seen in terms of traditional measures in vogue - 5 *ollocks* or 1¼ *padis*.

Uzhakku or *ser* was ¼ *padi*, two *araikkal padi* or one eighth measure

Ollock was one eighth *padi*, one tumbler, 200 gms.

Table 3.1:Average of percentages of villagers according to units used in measuring the capacity/weight of various items at home

	Items	Metric	Traditional Measures	Container	Ladles/ Spoons	Hand	Non-specific	Not known	Total
1.	Seeds and grains produced	9.5	28.0	6.9	-	3.3	0.6	51.7	100.00
2.	Rice, ragi, dhal, kambu, groundnut	16.1	72.7	3.6	-	1.7	0.3	5.6	100.00
3.	Flours	3.0	21.3	5.3	30.2	22.4	5.6	12.2	100.00
4.	Spices (dry) whole & Powder	2.0	2.0	45.3	-	29.0	13.0	8.7	100.00
5.	Manures and	5.3	10.5	26.6	-	1.6	7.6	48.4	100.00

	Fertilizers								
6.	Oil cake, husks of paddy, pulses	8.9	11.8	5.3	-	5.6	5.9	62.5	100.00
7.	Hay	-	22.7	-	-	7.9	9.2	60.2	100.00
8.	Milk, curd and butter milk	6.9	10.9	42.8	5.9	-	12.5	21.0	100.00
9.	Oils	5.9	-	41.8	35.2	-	4.0	13.1	100.00
10.	Kerosene	7.6	-	75.3	2.0	-	2.0	13.1	100.00
11.	Coffee/Tea	4.6	-	73.7	1.3	-	1.3	19.1	100.00

Table 3.2: Average of percentages of villagers according to units used in measuring the capacity/weight of various items in shops

	Items	**Metric**	**Traditional Measures**	**Containers/Vandi**	**Money**	**Non-specific**	**Not known**	**Total**
1.	Seeds and grains produced	31.6	9.4	8.6	0.7	-	49.7	100.00
2.	Rice, ragi, dhal, kambu, groundnut	72.7	6.2	5.9	7.9	-	7.3	100.00
3.	Flours	63.8	2.0	-	18.4	-	15.8	100.00
4.	Spices (dry) whole & Powder	56.6	1.5	-	34.4	2.6	4.9	100.00
5.	Manures and Fertilizers	15.4	4.0	11.5 24.7	2.6	-	41.8	100.00
6.	Oil cake, husks of paddy, pulses	26.6	17.8	4.0 0.3	1.3	-	50.0	100.00
7.	Hay	0.7	50.3	- 2.0	-	-	47.0	100.00
8.	Milk, curd and butter milk	43.4	19.7	10.2	-	4.3	22.4	100.00
9.	Oils	84.9	0.3	1.0	-	9.2	4.6	100.00
10.	Kerosene	84.9	0.3	2.0	-	2.3	10.5	100.00
11.	Coffee/Tea	14.2	0.6	12.8 23.4	-	2.3	46.7	100.00

For tables 3.3, 3.4, 3.5, 3.6, see Appendix B

Table 3.7: Estimation of weight measures: Sex-wise, caste - wise distribution of villagers according to differences in the estimated and actual weights of different food items.

S. No.	Items	Difference in estimated and actual weight	M	W	T	SC/ST	Other castes
1.	Oil (70 gms)	No difference	46 (24.3)	25 (21.7)	71 (23.4)	26 (16.9)	45 (30.0)
		Less than the actual	46 (24.3)	25 (21.7)	71 (23.4)	34 (22.1)	37 (24.6)
		More than the actual	92 (48.7)	59 (51.3)	151 (49.6)	86 (55.8)	65 (43.4)
		Don't know	5 (2.7)	6 (5.2)	11 (3.6)	8 (5.2)	3 (2.0)
		Total	189 (100.00)	115 (100.00)	304 (100.00)	154 (100.00)	150 (100.00)
2.	Tuar Dhal (100 gms)	No difference	89 (47.1)	56 (48.7)	145 (47.7)	69 (44.8)	76 (50.7)
		Less than the actual	65 (34.4)	47 (40.9)	112 (36.8)	60 (39.0)	52 (34.7)
		More than the actual	23 (12.2)	10 (8.7)	33 (10.9)	20 (13.0)	13 (8.6)
		Don't know	12 (6.3)	2 (1.7)	14 (4.6)	5 (3.2)	9 (6.0)
		Total	189 (100.00)	115 (100.00)	304 (100.00)	154 (100.00)	150 (100.00)
3.	Ragi (500 gms)	No difference	72 (40.2)	39 (38.2)	111 (39.5)	53 (40.4)	58 (38.7)
		Less than the actual	79 (44.1)	53 (52.0)	132 (47.0)	58 (44.3)	74 (49.3)
		More than the actual	20 (11.2)	5 (4.9)	25 (8.9)	14 (10.7)	11 (7.3)
		Don't know	8 (4.5)	5 (4.9)	13 (4.6)	6 (4.6)	7 (4.7)
		Total	179 (100.00)	102 (100.00)	281 (100.00)	131 (100.00)	150 (100.00)

Table 3.8: Sex-wise, Caste-wise distribution of Villagers according to their ability to identify standard units of volume (capacity) and weight measures.

S. No.	Items	Ability to identify	M (189)	W (115)	T (304)	SC/ST (154)	Other castes (150)
1.	Standard volume or capacity measures	Can identify	183 (96.8)	79 (68.7)	262 (86.2)	131 (85.1)	131 (87.3)
		Can't identify	6 (3.2)	36 (31.3)	42 (13.8)	23 (14.9)	19 (12.7)
2.	Standard weight measures	Can identify	183 (96.8)	81 (70.4)	264 (86.8)	133 (86.4)	131 (87.3)
		Can't identify	6 (3.2)	34 (29.6)	40 (13.2)	21 (13.6)	19 (12.7)

CHAPTER IV: PRACTICES IN IDENTIFYING (RECKONING), MEASURING AND PLANNING FOR UTILIZATION OF TIME IN RURAL TAMIL NADU, INDIA

Introduction

Time is part and parcel of all actions and events in life. Identifying, measuring and planning for utilization of time are all basic skills necessary for increasing the efficiency in performing actions and organizing/conducting events and are all learned. A study of modes of identifying, measuring and planning for utilizing time by the people in rural Tamil Nadu was undertaken as part of this study. Data regarding the general mode of identification or reckoning time at a specific point in a day, measuring time taken (duration of time) for some of the common actions/events in the context of their life situations and regarding the use of calendars and almanacs for planning and utilizing time were collected.

Identification or Reckoning of Time

Free responses given to an open-ended question how they identified time at a specific point in a day showed a variety. These responses are categorized and presented in Table 4.1 on page 35 below.

The majority of the responses (43.5 per cent) were in terms of identifying time by looking at the sun (its position, the shadow cast), the moon (its position) and the stars (position of easily identifiable stars). 26 percent of responses indicated the practice of reckoning time through daily routines such as temple bell, tea estate bell, siren, train sound,, bus time, school time, midday meal time etc. 9 per cent indicated a biological clock time, meaning the time identified by the noticeable rhythm in nature such as cock crowing, birds chirping while moving out of their nests and returning to their nests, cattle returning home after grazing. 17.6 per cent indicated the use of clock time and 3.8 per cent did not know the mode of identifying time. About five women said that they asked their husbands to read the clock for them.

Looking at the data sex-wise, more men used the clock for identifying time than women (23.7 per cent and 6.7 per cent). The same was true of use of sun, moon and stars (46.2 per cent and 39.6 per cent). The use of daily routines and the biological clocks of cocks crowing and birds chirping was used more by women than by men (21.3 per cent men and 33.1 per cent women in the case of the former and 8.0 per cent men and 10.5 per cent women in the case of the latter. Caste-wise the data did not show much variation. Compared to other castes, the SC/STs used biological clocks to a greater extent. The other castes used the sun, the moon and the stars and also the daily routines for identifying time more often than the SC/STs.

Identifying the time of day

The details of steps in identifying time at a particular point in a day were explained by two respondents in two different villages. They were highly interesting and scientific. It was considered important to present them here.

An old illiterate man described the procedure to reckon precisely the time to the minute at any point of the day through measuring the length of the shadow of one's own self. The tool used for measuring is one's own foot length. The tip of the head of the shadow of oneself could be adjusted to coincide with the edge of the road and a mark could be made on the ground where the feet are. This for any re-measuring one may want to do. Measuring with the feet should be done fairly accurately by placing one foot in front of the other foot without overlapping to cover the distance between the starting point and the edge of the road. The length of the shadow will thus be obtained in terms of the number of foot lengths. He argued that irrespective of the height of the person, the length of the shadow with one's own foot measure at a point in a day will remain the same. For example, if the length of the shadow is 11 foot lengths for one who is six feet tall, it will be 11 for one who is four feet when measured with his own foot, provided that the point of the day is the same. From morning sunrise to noon when the sun is rising, the rate of reduction in the length of the shadow follows a pattern. In the same way in the afternoon, the rate of increase in the length of the shadow also follows a pattern. As these rates have a definite pattern, the time at any point of the day could be reckoned fairly accurately if one is aware of this pattern.

On the basis of the description given by the villager and the guidance he gave in measuring the shadow at a point of the day and matching the shadow length with the time, the investigator kept a record of the length of the shadow with her own foot measure every hour in a day (July). The following pattern was found:

Morning	**Length of Shadow in foot lengths**	**Evening**
6 am	32	6 pm
7 am	21	5 pm
8 am	11	4 pm
9 am	6 ½	3 pm
10 am	4	2 pm
11 am	2	1 pm
12 Noon	-	12 Noon

Reckoning time by a simple device such as a straw for measuring shadow was explained by another villager. In this process, a piece of straw is used both as the object whose shadow is to be observed and measured and as the tool for measuring time.

A piece of straw of any length (for convenience in handling, the length of the straw is suggested to be four times the length of the four fingers when they are held together, meaning four times the width of the four fingers held together) is taken and this is divided into 16 equal parts by folding it half, then one quarter, then one eighth of its

length. Care should be taken to see that the straw is not broken and that the bends are visible when the straw is straightened. This straw is then bent like the letter L (with a horizontal and a vertical portion) and held on the ground with the vertical portion in such a way that the sun is behind the straw. The shadow of the upright portion falls now on the horizontal portion kept on the ground. The vertical or upright portion is adjusted in such a way that the length of its shadow is equivalent to the length of the horizontal portion. When adjusted this way the number of parts of the upright portion indicate the number of *nazhigais* (the traditional unit of time; one *nazhigai* is equivalent to 24 minutes) that have passed after the sun-rise if it is forenoon or the number of *nazhigais* that have passed from noon if it is afternoon. The whole procedure was conveyed by the villager through a four line Tamil poem, the translation of which follows :

Take a piece of hay
Divide it into 16 parts
Stretch part of it horizontally
(the extent decided by the length of the shadow of the vertical part)
Count the number of vertical parts for the number of *nazhigais*
(after sun-rise or noon as the case may be)

One of these two villagers, when asked what would they do if there were no sun as on a rainy day, described an indoor device using water (a kind of water clock). According to him, a large vessel is kept straight and flat supporting it with three stones, if necessary. The vessel is filled with water up to three fourths of its height. A small light weight cup (probably made of aluminium) with a very fine hole at the bottom is floated on the water. Slowly the water level in the cup rises. When the water gets filled in the cup, the cup sinks and touches the bottom of the vessel with a sound. When the cup goes down once it is one *jamam* (3 hours or 7 ½ *nazhigais*).

Measuring duration of time

A set of ten items, each one differing in the duration of time required for its completion, were given to the respondents one by one. Their free responses were recorded and analysed. The results are presented in Table 2.

The first three items of actions generally performed by everyone almost all the time require very little time, a split second to a few seconds in terms of standard units of time measure. The responses showed a general understanding that the time required for the first item, 'To look up to the person in front' is less than the second item 'To give this object in your hand', and the time required for the third item 'To drink a glass of water placed next to you' is more than the other two. This was evident from the increase in the percentage of responses in terms of the unit given in second(s) or minute(s). Time taken for such actions seemed to be measured but approximately. The differentiation between the units of seconds and minutes appeared to be mixed.

One tenth of the responses gave the duration of the time required by a comparison with another rhythmic action such as batting an eyelid or making a sound with the thumb and the middle finger pressing. Responses in vague measures such as 'instantaneously', 'immediately', 'fast' etc., were given for these items by some of the respondents.

Looking at the data sex-wise, men seemed to use the standard units of seconds for these items more often than women. Matching the actions mentioned with rhythmic actions or using terms representing vague measures were more often given by women than by men. The next two items of actions (4 and 5) generally performed or deemed to take place in the village could be expected to take time in terms of units in hours. The majority of the responses were in terms of hour(s), though there was a small percentage who measured these in units of minutes. The items under review were ‘To cook a simple meal for four persons’ and ‘To go to the next village and get back’. These two items warrant functioning as quickly as possible. Hence it is quite possible that the responses in units of minutes were more in the figurative sense than in the actual sense. There was very little variation in responses between the sex- groups and between the caste groups with reference to these items.

For the items 6 and 7, namely, ‘For the procession of the Lord during the festival’ (in the four streets around the temple)’ and ‘To plough an acre of land’, again the duration of time required for going through the event or performance of action could have been in units of hour(s) for item 6 and of hour(s) cum days for item 7, depending upon the mechanization or technology available for ploughing. A high percentage said that they did not know the time taken for the event or action mentioned in these items. Participating in the event or performing the action may have been considered more relevant than measuring the time.

For item 8, ‘To sow and harvest ragi (the period from sowing to harvesting)’, the majority of the respondents specified the duration in terms of a number of days or months (the number of days was the months converted to days, for example, 90 or 120 days). A considerable number of respondents said that they did not know the duration. Here again it is quite possible that, as the whole village is involved in agriculture, the operations are carried out seasonally and hence measuring time may not be necessary. Carrying out the operations is more important than keeping a count of time. They could carry on the operations by just looking at the field and the crops. Looking at the data sex-wise for the three items given above, the men responded in terms of the units more often than the women. When compared with men, more women did not know the duration. Looking at the data caste-wise, the responses of the other castes were similar to that of men, and of scheduled castes that of women.

For items 9 and 10, ‘For a five year old girl to come of age’ and ‘To fulfill all your wishes’ the responses could be in year(s) or a lifetime. A large number did not know what to say. Those who responded for item 9 mentioned a specific number of years. For this item more women and SC/STs than men and other castes responded.

For item 10 , the responses were in terms of ‘God Knows’, ‘Grace of God’, ‘Why should there be any God then?’, ‘It is not in our hands’, ‘Efforts, luck and our own actions in the past’, ‘We can’t be peaceful’, ‘Depends upon luck’, ‘Availability of wealth’, ‘Several millenniums’, ‘Lot of time’, ‘When the time comes’, ‘Before I die’, ‘Whole life’, ‘Years’. These responses are categorised as others in the Table. In the 14 different kinds of responses, six had something to do with time duration. There was hardly any variation between sex-groups and caste groups.

In general, the responses for these items showed that thinking about or actually measuring the duration of time taken by actions or events seemed to decrease with the increase in the duration of time required. Events rather than the time seem to be important.
The description given by the respondents regarding their occupation of agriculture showed that they could match each particular operation and the particular month of the day in which the particular operation needs to be done. They could describe the duration of time required for the sprouts to come out for the crops grown, the approximate timings for weeding. It is also true that the whole village more or less works at the same time on each of these operations. Once the sowing is done, it is not the time that needs to be counted. But it is the plants that will tell them what to do when, such as the time to weed, to apply fertilisers or insecticides, and to harvest.

Measuring duration of life (calculation of age)
The responses regarding the mode of calculating age showed that more than half the respondents reported having an horoscope made at the time of birth or knowing the date of birth (52.6 per cent). About 21 per cent estimated the age looking at facial features or rather the facial muscles. Nearly 18 per cent knew their own age approximately only. Few went by what the parents said. About six per cent could not say anything about their age.

Looking at the data sex-wise, a higher percentage of men (61.4 per cent) than women (38.3 per cent) used their birth date or horoscope for calculation of age, whereas more women (47.0 per cent) than men (33.9 per cent) gave approximate estimations of age. More women than men did not give any responses (12.2 per cent and 1.2 per cent respectively). Horoscopes are generally set or read by specialists in the village; people went to them when the child is born. Looking at the data caste-wise, a slight variation was seen between the two castes. A higher percentage of other castes than scheduled castes reported horoscopes and noting of birth date (56

per cent and 49.4 per cent), and also approximate estimations of age (42 per cent of other castes and 35.7 per cent of SC/STs).

Planning and utilization of time

Planning time can be considered the first step in efficient utilization of time. Planning time could be within a day or could be short or long duration in days/ weeks/ fortnights/ months/ years. This kind of planning events in advance may require use of formalized time-duration tables such as calendars and almanacs. Efforts were made in the present study to find out the extent of and purposes in using calendars and almanac. The results are presented here.

The majority of the respondents were reported to have a day calendar in their homes (76 per cent). When asked what they looked for in these calendars, the responses varied. They were: to know the day, date, the festival days, auspicious/inauspicious time/day, new moon day, full moon day, the day of *Krithigai* star, annual events such as the gruel feeding day in the month of Adi (July- August), the beginning of rainy season.

An almanac was said to be used only by 25.7 per cent of the respondents. It was used for setting horoscopes, finding out auspicious/inauspicious time/day, festival days, wedding days, the planetary movements and their effects, the quantum of rains in season for the current year (generally predicted in the almanac). Reading an almanac is generally a specialised function of a few. A large number of women did not use these tables of time (81.7 per cent of women and 69.8 per cent of men in the case of almanac, and 33 per cent of women and 18.5 per cent of men in the case of calendars). Caste-wise, the other castes used these devices more often than the SC/STs; thus 68 per cent of the other castes did not use almanac, and 30 per cent of SC/STs and 18 per cent of other castes did not use calendars.

Mostly the use of calendars and almanacs by the respondents seemed to be to follow certain religious prescriptions, namely choosing or avoiding certain time of day for certain types of actions; for knowing the dates of festivals, for fixing up prescribed celebrations at various stages in life, such as wedding, for following periodic practices of special worship, fasting etc., (every month) such as the new moon, full moon, the day of the *Krithigai* star. Except the prescribed celebrations at various stages, the rest of the things reported were common for all and communicated through word of mouth to all the people in the village. Planning for the performance of prescribed actions seemed to be the most common practice.

Implications of the findings for the Adult Education Programme

Time though invisible is pervasive in all activities in life. Actions and events in life have an underlying time base. Reckoning, measuring and planning time for better utilization are all processes in taking time out of the actions/events and putting it back in them in such a way that it helps in improving the efficiency of performance or conduct of actions and events. These processes can be learned.

The process of learning to identify/reckon and measure time is essentially a process of moving from :

Stage 1: (Action/event time) - of merely performing actions or participating in events in a routine manner; for example, it is time to get up, time to feed the child, time to get to the field, time to sow, time to weed, and so on;

To **Stage 2 (Action/event time against rhythmic reference in the environment) -** when the underlying time is given some attention through use of a reference base in the environment which is rhythmic in nature; for example, the action of giving an object to the person in front of you could be done as fast as you bat your eye-lid or you can make one flick with your thumb and forefinger; or the action of cleaning up the grain in the sack can be done by the time the sun comes up right above the head, and so on;

To Stage 3 (Time-time) - when the rhythm is divided into convenient segments/units or into measures of time independent of the action or event; for example the time taken for any action or event can be measured more accurately by the increasing or decreasing lengths of a shadow, or using devices with created rhythms such as water clocks or other clocks and watches by which the time at any point can be identified/reckoned.

In the continuum of action/event time to time-time stages, if the event alone or time alone is given importance, then the life may become quite mechanical. Action/event should be given attention with an eye on the time within which it can be performed well.

The practices regarding reckoning and measuring time in rural Tamil Nadu show that the majority of the people were moving back and forth between stages 1 and 2, and some were at stage 3.

Educational programmes for adults in rural Tamil Nadu should help learners to understand the process described through helping them systematise their existing practices and then introduce them to clock or watch reading. This, in practical terms, would mean the following steps:

- Sharing the experiences of the learners in identifying and measuring time in life situations;
- Systematising the experiences shared, taking a look at the practices to recognise the diverse situation-specific and routine nature of identifying or measuring time;
- Engaging in activities to recognise the underlying pattern or the system of relationships from the event-time to biological time to measuring time approximately through the position of the sun, moon and the stars, to measuring accurately the lengths of the shadow, from using other devices such as water clock to reading clocks and watches, and the place of all these in life situations;

- Discussing and recognising that the basis of the diverse measurements found in real life situations is just the mode of functioning of individuals and groups at different levels of measuring according to the demands of the situations.
- Looking at the day-to-day life situations, at problems involving measuring in the light of the understanding or insights gained about the underlying pattern of relationships in the existing diverse measuring practices, recognising the need for common units of measure - in short, expanding one's world of activities and gaining strength in facing the problems in day-to-day life. In other words, learning to become more efficient in planning and utilizing the time at one's disposal for varied activities and events.

Table 4.1 Modes of identifying time (as there were multiple responses by some of the respondents, the total adds up to 421 in the place of 304).

Table 1

Sex-wise and Caste-wise distribution of responses according to the mode of identification or reckoning Time

Mode of Identification	Men (189)	Women (115)	Total (304)	SC/STs (154)	Other castes (150)
Sun, Moon, Stars	115 (46.2)	68 (39.6)	183 (43.5)	89 (39.3)	94 (48.4)
Biological Clocks	20 (8.0)	18 (10.5)	38 (9.0)	28 (12.3)	10 (5.2)
Daily routines created by human beings	53 (21.3)	57 (33.1)	110 (26.1)	55 (24.2)	55 (28.3)
Clock Time	59 (23.7)	15 (8.7)	74 (17.6)	43 (18.9)	31 (16.0)
Dont't Know	2 (0.8)	14 (8.1)	16 (3.8)	12 (5.3)	4 (2.1)
Total	249 (100.0)	172 (100.0)	421 (100.0)	227 (100.0)	194 (100.0)

Note : Figures in the brackets indicate percentages.

Table 4.2:

Actions/ Events	Duration	Men	Women	Total	SC/STs	Other Castes
4. To cook a simple meal for four persons	Minute(s)	9 (4.8)	2 (1.7)	11 (3.6)	5 (3.2)	6 (4.0)
	Hour(s)	175 (92.6)	106 (92.2)	281 (92.4)	138 (89.6)	143 (95.3)
	Don't Know	5 (2.6)	7 (6.1)	12 (3.9)	11 (7.1)	1 (0.7)
	Total	189 (100.0)	115 (100.0)	304 (100.0)	154 (100.0)	150 (100.0)
5. To go to next village and get back	Minute(s)	4 (2.1)	3 (2.6)	7 (2.3)	4 (2.6)	3 (2.0)
	Hour(s)	158 (83.6)	81 (70.4)	239 (78.6)	117 (75.8)	122 (81.3)
	Day(s)	3 (1.6)	4 (3.5)	7 (2.3)	5 (3.3)	2 (1.3)
	Don't Know	24 (12.7)	27 (23.5)	51 (16.8)	28 (18.3)	23 (15.4)
	Total	189 (100.0)	115 (100.0)	304 (100.0)	154 (100.0)	150 (100.0)
6. For the procession of the Lord during the festival (in the four streets around the temple).	Hour(s)	91 (48.1)	50 (43.5)	141 (46.4)	60 (39.0)	81 (54.0)
	Day(s)	16 (8.5)	11 (9.6)	27 (8.9)	12 (7.8)	15 (10.0)
	Don't Know	82 (43.4)	54 (46.9)	136 (44.7)	82 (53.2)	54 (36.0)
	Total	189 (100.0)	115 (100.0)	304 (100.0)	154 (100.0)	150 (100.0)

(contd.)

CHAPTER V: PRACTICES IN LINEAR MEASUREMENTS IN RURAL TAMIL NADU (INDIA)

Introduction

Basically linear measurements are useful for comparing two or more objects where measurement is a means, and for describing any object where measurement is an end. Lengths of objects can be compared by superimposing one object on another or by relating these objects to a third object which is movable. The lengths of objects could be described in terms of objects of greater movability and/or of objects of general acquaintance of a given community. The movable objects used for comparison or description of lengths can be continuous or discrete such as a rope, string, body parts or any standard lengths commonly agreed.

Measuring lengths and understanding linear measurements involve two operations in terms of dividing the length of the object being measured into a series of intervals of equal lengths, the same length as the measuring rod or any movable measuring device, the appropriate number of times. This results in building up a system of units.

Describing objects in terms of their linear dimension (that is, observing the linear dimension of the object, superimposing one object over another, or breaking the length of the object into chosen units and expressing the length of the object in terms of the chosen unit), evolving a system of units of linear measurement, and applying the system of units to describe and compare objects are all learned through experiences. These are basic skills necessary for understanding and describing objects and beings in the environment and utilizing them and relating to them.

A study of modes of describing linear dimensions such as heights and depths, varying lengths, distances, girths, diameters, area, incline, and rainfall by the people of Tamil Nadu was undertaken as part of this study of the existing practices of the rural people regarding counting and measurements in day-to-day life. This was done to study the implications of these practices for an approach to teaching and learning linear measurements in adult education programmes. This is an effort at making the programme participatory and relevant to the life of adult learners.

Methodology

Modes of describing linear dimensions of 32 different items generally found in the village/village homes, which have some importance in terms of linear dimensions of the objects, the ability of people to recognize and utilize the tools of standard British and Metric units such as scale and tape; and the ability of estimations were explored. The questions asked were open ended and their free responses were recorded. The 32 items for which the respondents were asked to describe the units of linear dimension were clustered in terms of their linear dimensions. They were as follows:

- Heights and depths (4 items): Coconut/ palmyrah tree, tamarind/banyan tree; persons (men, women, boys, girls); depth of water in wells/lakes/ponds;
- Lengths (medium) (7 items): Ropes used for drawing water from a well, rope used for tying cattle, yoke or a front cross bar in a bullock cart, rope used for putting bullocks on to a cart, nose rope of bullocks, cloth (sari/dhoti), mat;
- Lengths (short) (6 items): Handle of a ladle, handle of a sickle, blade/handle of a knife, central wooden piece of a dry grinder, height of a winnower, mouth of a *chula* (clay oven), mouth of pots;
- Distances (4 items): Distance to the next house, to the next street, to the next village, to the market place;
- Girths Perimeters (4 items): Arm girth, hip girth, perimeter of a ring/chain;
- Diameters (2 items): Hole in a strainer ladle, stones in an ear ring;
- Area (2 items): House/house plot, land cultivated;
- Incline (2 items): Thatched roof, ladder against a wall;
- Rainfall

The collected data were analyzed. The analysis consisted of counting frequencies of responses according to the types of units reported to be used by the respondents for each of the items listed above. This was done according to sex and according to castes of the respondents. Percentages were computed for each item. An average of the percentages of responses of the villagers interviewed for each cluster of items mentioned above was computed according to sex and caste groups.

The results were tabulated. These tables are not presented here owing to the space required by such tables. Instead Table 5.1 presents a summary of responses for the clusters of items.

The data show that in rural Tamil Nadu

- People used a variety of units to describe the linear dimensions of objects.
- The units used for any one item or cluster of items varied in their specificity.
- In general, British units, body units and non-specific units were in vogue in describing the linear dimensions of objects in day-to-day life situations. To give an example, in measuring the depth of any water source such as a well/pond/ lake, a variety of non-specific units were used such as 'shallow/deep'; measures in terms of something in the environment such as the number of steps immersed

in water, the rope length that gets wet, the time taken for a stone to reach the bottom of the water source; and specific units in terms of the body units of ankle, knee, hip and neck deep, and also units of cubits and fathom; British units of feet and the metric units of metres and centimetres were all used in different contexts.

- Metric units for describing linear dimensions were minimal; they were more often used for measuring distances (which require some kind of transport), area and rainfall. Probably these are mentioned in metric units in mass media such as radio and television. It is to be noted that this is not true in measuring short distances.
- Certain dimensions of length seemed to be more frequently used than other dimensions. Distances, heights and depths were more frequently measured than varying lengths of objects or girths or diameters or area which were more often estimated.

The *most frequently measured* items (as shown by 80 per cent of interviewees reporting some unit of measure) were heights of palmyrah/ coconut tree, heights of persons, depths of water sources, rope used for drawing water from a well, sari/dhoti, handle of a ladle, handle/blade of a sickle, blade of a sickle/knife, distances to the next house, next street, next village and market place. In general, these items seemed to be described in terms of their linear dimensions; in other words, the important identification of these items is their linear dimension. The attention to linear dimension of these items could be spontaneous, and the measurement of the linear dimension itself seemed to serve the purpose of describing the object.

The items which were measured *with moderate frequency* (as shown by 60 to 80 per cent of the respondents reporting some unit of measure) were height of banyan/tamarind tree, mat, central wooden piece of dry grinder, mouth of pot, mouth of *chula*, height of a winnower, arm girth, hip girth, ring (ornament on the finger), house area, land area, rainfall. These items, except the banyan/tamarind tree, are all either manufactured in varying sizes by different occupation groups (such as mat weavers, potters, stone ware makers, goldsmith) for the people to choose from or the measurements are taken by those on specified jobs on whom the people rely on (examples: arm girth and hip girth by the tailor, house area and land area by revenue personnel, and rainfall by metereological personnel). There are variations in linear measurements available in these items requiring the people to choose to serve their own purposes. Here the attention of the people to linear measures is limited to the choices available with these items, the immediate spontaneous attention is on the function served, and the forced attention could be on the measurement of linear dimension. Function and measurement seemed to alternate. Function is important. Measurement could be useful in making a choice of items that are functional.

The *least frequently measured* items (as shown by less than 60 per cent of those interviewed reporting some unit of measure) were rope used for tying cattle, yoke or front cross bar of a bullock cart, rope used for putting a bullock on to a cart, nose rope of bullocks, length of chain (ornament around the neck), diameter of a hole in the strainer ladle, diameter of a stone in an ear ring. These items are in general those which were available in standard lengths in the market. There is hardly any variation in their sizes. When there are no choices to be made, probably forcing oneself to measure their linear dimension is superfluous and impractical.

Measuring the 'incline' was not very common. When asked about the incline of the roof of the hut or the incline of a ladder against a wall, the responses were generally in terms of the measure of the height of the wall or the length and width of the roof itself or the height of the ladder or the width of the steps of the ladder or the number of steps of the ladder.

These results indicate that the units of linear measurements used in these case studies appeared to be item specific and situation specific. The question arises are they also specific to certain groups within the rural community? To answer the question, the data were analysed according to sex and according to caste groups. The results are presented in Tables 5.2 and 5.3.

The data reveal the following:
Gender: Women seemed to use body measures and non-specific descriptions more often (exceptions, medium lengths and rainfall); British measures less often than men. This was especially true in case of heights and depths and short lengths. The use of metric units was minimal, and the variations in the use of these units were not noticeable. There was only slight variation between the responses of men and women in terms of 'non-measuring' of items. In other words, certain items which were reported to be 'not measured' by a majority did not mean that either men or women in large numbers did not measure them. In both sex-groups almost equal number reported that they did not measure.

Caste: The modes of describing of linear dimensions of objects varied with the caste groups. SC/STs (Scheduled Castes and Scheduled Tribes) seemed to use the metric and British measures less often and body measures more often than the other castes. The non-specific descriptions were given by SC/STs more often for dimensions of distances, heights and depths and rainfall. The use of metric units by SC/STs was less frequent compared to other castes. There was some variation between the responses of SC/STs and other castes in terms of 'non-measuring' of items. This means that a larger number of SC/STs did not measure the linear dimensions of the items studied.

Thus the linear measurements in rural Tamil Nadu seemed to be group specific, meaning, sex specific and caste specific.

Measuring the Linear Dimensions

The descriptions above indicate the general practices in terms of the types of units in vogue in describing the linear dimensions of objects. This means that people are familiar with a variety of units mentioned. Understanding the systems of measurement would mean understanding the basics, namely, division of a linear dimension into regular intervals in terms of any chosen unit and counting the number of such intervals. In the present study, efforts were made to find out the extent of awareness of the basics involved in linear measurements in the people in rural Tamil Nadu. This was done in terms of:

a) Estimation of lengths as an application of the basics of linear measurement;
b) Identification and utilization of common standard tools of linear measurement.

Estimation of Lengths

The interviewees were shown three different lengths of jute threads (3 inch, 6 inch and 3 feet) one by one and they were asked to estimate their lengths. The responses were recorded and analysed according to sex and caste groups. They are presented in Table 6.4. The data reveal the following:

- Estimations of lengths are not uncommon in rural Tamil Nadu: the majority could estimate the three lengths of jute threads.
- In general the respondents tended to estimate the lengths less than the actual.
- A considerable percentage of villagers estimated the lengths accurately.This was true more for the short and the long ones than the medium one.
- The estimations of lengths were done with fair amount of accuracy more often by men than by women. The difference between the estimated and actual lengths was smaller in the case of men rather than in the case of women.
- The estimations of lengths were done fairly accurately more often by the other castes than by Scheduled Castes and scheduled tribes.
- The majority of those who were interviewed could not specify the basis which helped them estimate the lengths. They said they knew it because of their experience. A few could say that they mentally measured the jute threads in terms of their own hand measures.

Identification and utilization of standard tools of linear measurement:

Two standard tools of linear measurement, namely, a wooden ruler/scale (12” or 30cms long) and a tape (60” or 150 cms long), were shown to the interviewees for identification; they were asked to measure something in the environment with them. The results are presented in Table 5.5.

The data reveal the following:

- The wooden scale and tape were commonly recognised tools of linear measurement in rural Tamil Nadu, though they were not being used frequently. A

large number of men were able to identify and utilize these tools. Among women, there was a wide variation between the number who could identify and the number who could utilize; a very small percentage of women could use these tools.

- There were variations between the SC/STs and other castes in identifying and utilising these common tools, with a higher percentage of the other castes showing the ability to identify and utilize the tools mentioned.

Implications for Adult Education

Linear measurement as explained earlier involves the process of recognising the linear dimension of any item/object, describing the same in terms of something in the environment, making a choice of any convenient unit which is somewhat or fairly common to others in the community, and making an estimate or measuring the linear dimension of objects with the chosen unit. These processes can be learned.

The process of learning to describe any object in terms of its linear dimension is essentially a process of moving from :

Stage 1: Recognition of linear dimension in the object: for example, The tree is tall; That person is short; The water is deep or shallow; The distance is long; The rain is sparse/heavy; The hole is big (or small).

to **Stage 2: Recognition of the linear dimension being described as similar to the linear dimension of some other item in the immediate environment.** Non-specific units of linear measure are sometimes used. For example, the depth of water in water sources may be measured in terms of the number of steps immersed in the water, the rope length that gets wet, or the time taken for a stone to reach the bottom of the source.

Other units of measurement are often used. For example, Distance in terms of number of houses; the mouth of a *chula* in terms of the size of the vessels to be placed on it or the number of fire-wood pieces required to be placed in it; Arm and hip girth in terms of bangles, belt or petticoat; Diameter of a hole in a strainer ladle in terms of objects known such as mustard seed, red gram dhal, a pepper, a black gram, or pupil in the eye, a dot and so on, or in terms of objects that can pass through the circular hole such as thread, match stick, broom stick, needle, nail; Rainfall in terms of levels of lakes and tanks, level of water collected in vessels or grinding stone (kept outside the house), the flow of water, the time or duration of raining, or in the quantity of rainfall collected on the land.

to **Stage 3: Choice of any unit of continuous measure:** The recognised linear dimension of any item may be described in terms of a stick or string or body parts.

to **Stage 4: Recognition of the need for the use of standard units and tools which could be iterated for a fairly accurate descriptions of objects:** The British and metric units and common tools of linear measure of wooden scale and tape are examples.

The demands for the description of linear measures in life situations are such that any individual or group could be at any of these stages at any time. Better understanding of linear measures results not from merely moving from Stage 1 to Stage 4 but from an understanding of the interrelatedness of these stages and skill in using them with ease in tune with the demands of the life situations.

The practices in linear measurements in rural Tamil Nadu, being item specific, situation specific and group specific, show that a majority of the people are used to certain stage of measuring with reference to the items, situations and also with reference to their own experiences and exposures. The rural Tamil Nadu people surveyed were at different stages, depending upon the items being measured or the situation in which the item is measured. The evolution of the process in measurement in the different stages outlined, when understood, could help anyone to be at any stage and yet be aware of the linear dimension and its place in understanding objects and utilizing the same.

Educational programmes for adults in rural Tamil Nadu should help the learners understand the process of evolution in linear measurement and thus the interrelatedness of the stages and then introduce them to the tools of measurement and the standard metric system. This, in practical terms, would mean the following:

- Sharing of experiences of the learners in measuring the linear dimensions of items/objects in their own life situations;
- Helping the learners to systematize these experiences in measuring linear dimensions;
- Organising activities to recognise the process of evolution of linear measures or the system of relationship from 'non-measuring' to recognition of linear dimension of objects; to seeing the linear dimension in an item similar to something in the environment; to choice of any specific unit which may vary with individuals and groups; to choice of specific unit which is common to all in and out of the village;
- Discussing and recognising that the basis of the diverse measurements found in real life situations is just the mode of functioning of individuals and groups at different levels of measuring according to the demands of the situation;
- Looking at day-to-day problems involving measuring in the light of the understanding or insights gained about the underlying pattern of relationships in the existing diverse measuring practices, so as to recognise the need for common units of measure. In short, it is for expanding one's world of activities and gaining strength in facing the problems in day-to-day life.

Table 5.1

Table 1

Average of percentages of villagers according to the Units used in measuring the linear dimensions.

Sr. No.	Clusters of objects according to linear dimensions	Metric	British/ Imperial	Percentage of responses in Units Body	Non-specific	Not measured	Total
1.	Distances (4)	15.46	68.09	1.97	9.45	5.03	100.00
2.	Heights and depths (4)	0.91	61.91	16.45	10.78	9.95	100.00
3.	Short lengths (6)	0.33	40.18	27.25	6.20	26.04	100.00
4.	Medium lengths (7)	4.70	16.78	28.57	12.01	37.94	100.00
5.	Girths (4)	2.06	16.09	29.85	18.52	33.48	100.00
6.	Diameters (2)	5.44	5.42	0.83	40.63	47.68	100.00
7.	Area (2)	27.63	31.41	-	7.24	33.72	100.00
8.	Rainfall	20.72	8.88	-	46.73	23.67	100.00
	Total	6.52	34.18	18.61	13.65	27.04	100.00

Note : Figures in the brackets indicate the number of items in each cluster of a linear dimension.

Table 5.2

Table 2

Sex-wise presentation of averages of percentages of villagers using varied Units in measuring linear dimensions

Sr. No.	Linear dimensions	- UNITS USED - Metric		Imperial		Body		Non-specific		Not-measured		Total
		M	W	M	W	M	W	M	W	M	W	M/W
1.	Distances (4)	18.52	10.43	69.71	65.43	1.46	02.83	07.01	13.48	03.30	07.83	100.00
2.	Heights and Depths (4)	00.80	01.09	70.10	48.48	12.30	23.26	08.34	14.78	08.46	12.39	100.00
3.	Short-lengths (6)	00.35	00.29	45.86	30.87	20.46	38.40	05.55	07.25	27.78	23.19	100.00
4.	Medium lengths (7)	04.69	04.72	17.46	15.65	26.91	31.30	11.41	09.20	39.53	39.13	100.00
5.	Girths (4)	01.72	02.61	19.05	11.31	28.17	32.60	18.12	19.13	32.95	34.35	100.00
6.	Diameters (2)	06.60	03.48	07.15	02.61	00.80	00.87	33.60	52.18	51.85	40.86	100.00
7.	Area (2)	28.31	26.52	34.93	25.66	–	-	06.08	09.14	30.68	38.68	100.00
8.	Rainfall	23.81	15.65	08.46	09.56	-	-	47.62	45.23	20.11	29.56	100.00
	Total	07.09	05.56	37.52	28.72	16.02	22.89	12.46	15.51	26.91	27.34	100.00

Number in the brackets indicates the number of items in each cluster.

M = Men = 189, W = Women = 115, Total = 304.

Table 5.3

Table 3

Caste-wise presentation of average of percentages of villagers using varied units in measuring linear dimensions.

Sr. No.	Linear dimensions	- UNITS USED - Metric SC/ST	Metric O.C.	Imperial SC/ST	Imperial O.C.	Body SC/ST	Body O.C.	Non-specific SC/ST	Non-specific O.C.	Not measured SC/ST	Not measured O.C	Total -SC.ST/O.C.
1.	Distances (4)	11.69	19.33	67.21	69.00	2.28	1.67	12.97	5.83	5.85	4.17	100.00
2.	Heights & Depths (4)	0.81	1.00	56.33	67.66	18.50	14.33	12.67	8.84	11.69	8.17	100.00
3.	Short-lengths (6)	0.33	0.34	34.63	45.89	33.44	20.89	5.96	6.44	25.64	26.44	100.00
4.	Medium lengths (7)	2.97	6.48	14.10	19.52	31.26	25.81	8.17	13.05	43.50	35.14	100.00
5.	Girths (4)	1.95	2.17	12.98	19.33	26.14	33.67	16.73	20.33	42.20	24.50	100.00
6.	Diameters (2)	1.63	9.33	2.60	8.33	0.97	0.67	40.58	40.67	54.22	41.00	100.00
7.	Area (2)	23.06	32.31	30.20	32.67	-	-	8.44	6.00	38.30	29.02	100.00
8.	Rainfall	16.23	25.34	12.34	5.33	-	-	39.61	54.00	31.82	15.33	100.00
	Total	4.86	8.20	31.01	37.44	20.30	16.87	13.36	13.91	30.47	23.58	100.00

Number in the brackets indicates the number of items in each cluster.

SC/ST = Scheduled Castes & Scheduled Tribes; N = 154; O. C. = Other Castes; N = 150; Total N = 304.

Table 5.4

Table 4

Estimation of Length

Sex-wise, Castewise distribution of respondents according to differences in the estimated and actual measurements of lengths of Jute threads.

Items	Difference in Estimated and Actual lengths	Men N=189	Women 115	Total 304	SC/STs 154	O. C. 150
3" length (7.6 Cm.)	No difference	87 (46.03)	25 (21.75)	112 (36.84)	45 (29.22)	67 (44.67)
	Less than the actual	73 (38.63)	64 (55.65)	137 (45.06)	76 (49.35)	61 (40.67)
	More than the actual	18 (9.52)	10 (8.70)	28 (9.22)	20 (12.98)	8 (5.33)
	No response	11 (5.82)	16 (13.90)	27 (8.88)	13 (8.45)	14 (9.33)
	Total	189 (100.00)	115 (100.00)	304 (100.00)	154 (100.00)	150 (100.00)
6" length (15.2 Cm.)	No difference	27 (14.29)	3 (2.60)	30 (9.86)	19 (12.33)	11 (7.33)
	Less than the actual	130 (68.78)	77 (66.96)	207 (68.10)	98 (63.64)	109 (72.67)
	More than the actual	15 (7.94)	18 (15.66)	33 (10.86)	23 (14.93)	10 (6.67)
	No response	17 (8.99)	17 (14.78)	34 (11.18)	14 (9.10)	20 (13.33)
	Total	189 (100.00)	115 (100.00)	304 (100.00)	154 (100.00)	150 (100.00)
3 feet (91.5 Cm.)	No difference	67 (35.45)	24 (20.88)	91 (29.93)	34 (22.07)	37 (38.00)
	Less than the actual	89 (47.10)	49 (42.60)	138 (45.40)	69 (44.80)	69 (46.00)
	More than the actual	21 (11.10)	29 (25.22)	50 (16.45)	38 (24.68)	12 (8.00)
	No response	12 (6.35)	13 (11.30)	25 (8.23)	13 (8.45)	12 (8.00)
	Total	189 (100.00)	115 (100.00)	304 (100.00)	154 (100.00)	150 (100.00)

Table 5.5

Table 5

Sex-wise, Caste-wise distribution of respondents according to their ability to identify and utilize the common standard tools of linear measurement.

Item	Ability to Identify/ Utilise	Men	Women	Total	SC/STs	O. C.
Wooden Scale	Can Identify	175 (92.59)	86 (74.80)	261 (85.85)	126 (81.82)	135 (90.00)
	Can't Identify	14 (7.41)	29 (25.20)	43 (14.15)	28 (18.18)	15 (10.00)
	Total	189 (100.00)	115 (100.00)	304 (100.00)	154 (100.00)	150 (100.00)
Woden Scale	Can Utilise	145 (76.72)	44 (38.26)	189 (62.18)	89 (57.80)	100 (66.67)
	Can't Utilise	44 (23.28)	71 (61.74)	115 (37.82)	65 (42.20)	50 (33.33)
	Total	189 (100.00)	115 (100.00)	304 (100.00)	154 (100.00)	150 (100.00)
Tape	Can Identify	165 (87.30)	84 (73.03)	249 (81.90)	123 (79.87)	126 (84.00)
	Can't Identify	24 (12.70)	31 (26.97)	55 (18.10)	31 (20.13)	24 (16.00)
	Total	189 (100.00)	115 (100.00)	304 (100.00)	154 (100.00)	150 (100.00)
Tape	Can Utilise	133 (70.37)	44 (38.26)	177 (58.23)	83 (53.90)	94 (62.27)
	Can't Utilise	56 (29.63)	71 (61.74)	127 (41.77)	71 (46.10)	56 (37.33)
	Total	189 (100.00)	115 (100.00)	304 (100.00)	154 (100.00)	150 (100.00)

VI: IDENTIFYING SHAPES

Introduction

Exploring and understanding environment is essentially understanding space and spatial relationships. Space, like time, is complex, and it is pervasive in the sense that it is the base on which everything exists. Position, shape and size in space can be understood, used, controlled and manipulated. Becoming aware of shapes and noticing that shape is an attribute by which objects differ, and hence they can be classified are indications of our ability in structuring of space.

We learn to structure space through our experiences. We seem to begin this process by learning to notice and understand notions of inside, outside, on, under, nearness, farness and betweenness of objects through perceptual experiences. Then we seem to learn to intuitively define edge, partial surface and vertex through experiences in manipulation of objects. Then we learn to conceptualise points, lines, angles, line segments, rays and curves. Using these, we learn to represent or symbolize objects in the real world which helps us see objects together or separated in space.

A study of modes of describing shapes of a variety of familiar objects in the immediate environment (which included a variety of shapes) was undertaken as part of this study of the existing practices of the rural people regarding counting and measurement in day-to-day life. This was done to gain an appreciation of the implications of these practices for an approach to teaching and learning with adults about shapes of objects and their significance in understanding their environment. This is part of an effort at making the programme participatory and relevant to the life experiences of adult learners.

The research project

A total of 304 adults in seven villages chosen across the state of Tamil Nadu participated in this study conducted by a team of researchers through interviews, discussions and observation. Twelve objects commonly seen in a rural environment were selected, and the interviewees were individually asked to describe the shape of each object listed, as they thought fit. The items listed were:
(1). Cart wheel; (2). Pot; (3) A Marble; (4) Dosai-pan; (5) Lid of a kerosene tin; (6) Kerosene bottle; (7) A Volume measure; (8) A Sitting plank (bench)[3]; (9) Bench top; (10) Roof of a hut; (11) Temple tower; (12) Flame.
The questions asked were open ended. The free responses were recorded. The analyses consisted of counting frequencies of responses in terms of the descriptions

[3] a sitting plank (which is likely to be in more houses than a bench) is supported on two very short supports about three to six inches from the floor; the bench is about eighteen inches high .

of shapes given for each of the items listed above. These were classified according to sex and caste.

Modes of describing Shapes

The tables at the end of this chapter present the data regarding descriptions of the shapes of various objects listed.

The first four items were cart wheel, pot, marble and dosai pan. They are all circular or spherical shapes. The majority of respondents (74% to 95%) described these different items as circles or spheres or just 'round'. About 10-17% used the terms 'circle' and 'sphere' interchangeably and described the spheres as circles and circles as spheres. The solid and plane shapes were also confused with each other. A small number (2% and 3% for the cartwheel and marble, 11% and 15% for the pot and the dosai pan respectively) described the shapes of the objects given in terms of objects that are similar. Thus the cart wheel is 'like a ring', the pot is 'like a balloon', marble is 'like an egg'. Or in terms of the colour: that the dosai pan is black; or in terms of the surface of objects such as the dosai pan is flat; or in terms of edges such as lengthy, 'wide', 'curved', or in terms of its perimeter such as lengths of thread in terms of number of span or cubit lengths.

The responses in terms of 'roundness' did not vary sex-wise or caste-wise. Descriptions in terms of edge, surface or colour, or in terms of other similar objects, however, were given more often by women than by men, more by scheduled caste than other castes. (Table 6.1)

Item 5, the lid of a kerosene tin, could in reality be either circular or square. Probably because of this, a third of the respondents did not describe the shape of this object. Those who did described it either as a circle or a square. A small percentage, about 7%, described it in terms of the surface as 'flat', and in terms of edge as 'wide' or in terms of the material with which it is made, such as it is 'wooden' (sometimes wooden lids are made to replace old rusted tin lids). (Table 6.2)

There were hardly any variations in the responses of men and women and of scheduled caste/tribe and other castes in describing the shape of the lid of kerosene tin. A larger number of women than men and scheduled castes/tribes than other castes did not describe the shape.

Items 6 and 7, 'kerosene bottle' and a 'volume measure' (traditional standard measure such as *padi* or *ollock*), are cylindrical. The descriptions of the shape of the volume measure was more often described as a cylinder than was the kerosene bottle. About 11% described the volume measure as 'cylindrical', whereas only 4% described the kerosene bottle as a cylinder. About 47% saw the circular face of the volume measure and described it as 'circle' or 'sphere'. It is well to remember that

two congruent circular faces and a round part make a cylinder. Only 18% saw the circular faces of the kerosene bottle. About 18% and 44% of the respondents described the volume measure and the kerosene bottle respectively in terms of the edges and described their shapes in terms of length, height and width. They said it is 'long', 'high' or 'wide'. About 6% described the volume measure in terms of either another volume measure or some other object such as a tin. About 13% described a kerosene bottle as 'like a tube', 'like a funnel', narrow on top and wide at bottom. About 18% did not describe the shape of volume measure, whereas 22% did not describe the shape of kerosene bottle. (Table 6.3)

Items 8 and 9 are sitting plank and a bench top. Both are rectangular in shape. As both square and rectangle are four cornered, respondents used these terms interchangeably, and they readily made it a point to indicate the four corners before actually naming the shape. The sitting plank was seen as a rectangle or a square by a larger proportion of the respondents (about 62%) than the bench top (about 52%). About a fifth could describe the shape only in terms of the edge. A small percentage (about 7%) described the surface and called it 'flat'. About 8% described it in terms of size, height, width etc. About 6% did not describe the sitting plank and about 12% did not describe the shape of the bench top. (Table 6.4)

The responses varied with sex and caste in the case of the sitting plank. A larger percentage of men than women and other castes than SC/STs described it as rectangle or square. A larger percentage of women than men, and SC/STs than other castes described it in terms of edge and surface. In the case of the bench top, more men than women and more other castes than SC/STs described it as square, rectangle or by the edge. More women and SC/STs described them in terms of surface, that is 'flat'. More women and SC/STs compared to men and other castes did not describe the shapes of these objects.

Items 10,11 and 12 are a roof of a hut, a temple tower and a flame. They are triangular, pyramidal or conical in shape. (Tables 6.5, 6.6)

The roof of a hut was more readily described as a triangle or cone by the majority of the respondents (about 59%). About 9% saw only a slope or an edge. About 9% saw it as pointed, raised, nose-like, tent-like, roof or house supported on poles, flat surface. About 14% saw it as temple tower like. About 10% did not describe it.

More men and other castes than women and SC/STs described it as a triangle or by objects that are similar. More women and SC/STs described the shape as conical and the edge as a slope. More women than men and more Sc/STs than other castes did not describe the shape.

The description of the shape of the temple tower varied. Nearly 36% saw it as triangular or conical. About 28% called it temple tower itself. About 14% saw only the

straight edges, namely, the length, height, the slope. About 9% described it as pointed, corner to corner. A few described it as beautiful.

There was hardly any difference in the responses of the sex/caste groups. More women than men and more SC/STs than other castes did not describe the shape.

The shape of the flame as described by the respondents varied. About 13% described it as conical or triangular. About 37% described it in terms of edges such as its length, height, or slope. A few described it as 'pointed'. A few described the circular face at the base. About 14% described it as a 'lamp burning', a wick burning, flame, needle like, 'tilak' like.

The responses did not vary sex-wise or caste-wise except that the shape of the flame was not described by more women than men, by more SC/STs than other castes.

Some conclusions

In general, the major findings are:

- People in rural Tamil Nadu seem to identify and describe shapes of objects more with reference to certain other objects. In other words, skill in identifying shapes of objects is object specific rather than shape specific.
- Some objects are described by names of shapes much more frequently than some other objects. For example, a dosai pan is less frequently described by its shape than a cart wheel or a pot or a marble; a volume measure is more frequently described by its shape than a kerosene bottle; the sitting plank is described more frequently by its shape than is the bench top; the roof of a hut is more frequently described by its shape than is a flame.
- Whenever the objects are more frequently described by shape, there were variations in the responses sex-wise and caste-wise. Whenever objects were described in other terms, the variations in responses of the two sex groups and the caste groups were negligible.
- Women and SC/STs seem to be more inclined to describe the shapes of objects by comparing them with other similar objects and also through describing edges, faces and corners of objects rather than by the names of the shapes themselves.
- The circular or spherical shapes were more readily identified than the angular shapes.
- The shapes marked by angles and corners were described in a variety of ways. The descriptions were in terms of the shapes themselves, or their faces, edges or corners. .

Implications of the findings for the adult education programme

Space is all pervading. It gets structured through the shapes of objects. In other words, objects are understood through their structures. The basic structures have names which are shapes. Exploring, understanding, using, controlling and manipulating objects would mean understanding their structures or shapes. It is a process of noticing the basic structures in the objects that one finds around himself or herself.

The process of learning to identify shapes is essentially a process of moving through the following stages:

Stage 1: **Recognition**: Perceiving objects and describing in a routine manner by naming objects that look similar or somewhat similar and describing that this object is like that one;

Stage 2: **Definition**: Beginning to perceive the structure of objects by seeing or describing either the edges or face or corners of objects;

Stage 3: Comparison: Noticing and describing shapes in some familiar objects;

Stage 4: Relationships: Noticing the specific shape wherever it occurs and also understanding the structuring of shape and its relationship to the design, maintenance and use of objects; and relationship of one shape to the other.

The present study of identification of shapes of objects in the environment suggested that many people of rural Tamil Nadu are moving back and forth from stage 1 to stage 3.

The educational programmes for adults in rural Tamil Nadu could help the learners to understand the process described by helping them in the following ways:

- Sharing their experiences with shapes of objects in their environment and discussing the similarities and variations in their perceptions;
- Systematizing their perceptions to recognize the meaning of their own perceptions in terms of their understanding of shapes;
- Discussing problems in day-to-day situations, if any, arising out of shapes of objects in space both on farm and at home;
- Trying to find solutions to the problems by relating shapes of objects concerned in the problem situation;
- Learning to represent or symbolize objects in the real world to help in understanding objects in space.

Table 6.1

Table: Sex-wise, caste-wise distribution of respondents according to their descriptions of shapes of objects

Objects	Shapes	Men	Women	Total	SC/STs	Other castes
1. Cart-wheel	Round/Circle	151 (19.90)	86 (74.96)	237 (77.96)	120 (77.92)	117 (78.00)
	Sphere	31 (16.40)	21 (18.27)	52 (17.10)	23 (14.93)	29 (19.33)
	Others	3 (1.58)	3 (2.61)	6 (1.98)	6 (3.90)	- -
	Not described	4 (2.12)	5 (4.33)	9 (2.96)	5 (3.25)	4 (2.67)
	Total	189 (100.0)	115 (100.0)	304 (100.0)	154 (100.0)	150 (100.0)
2. Pot	Round/Circle	31 (16.40)	15 (13.05)	46 (15.13)	22 (14.28)	24 (16.00)
	Sphere	118 (62.44)	70 (60.87)	188 (61.85)	98 (63.64)	90 (60.00)
	Others	20 (10.58)	12 (10.45)	32 (10.52)	11 (7.15)	21 (14.00)
	Not described	20 (10.58)	18 (15.63)	38 (12.50)	23 (14.93)	15 (10.00)
	Total	189 (100.0)	115 (100.0)	304 (100.0)	154 (100.0)	150 (100.0)
3. Marble	Round/Circle	20 (10.58)	14 (12.18)	34 (11.18)	12 (7.80)	22 (14.66)
	Sphere	156 (82.54)	83 (72.18)	239 (78.63)	124 (80.50)	115 (76.66)
	Others	5 (2.65)	4 (3.47)	9 (2.96)	4 (2.60)	5 (3.35)
	Not described	8 (4.23)	14 (12.17)	34 (7.23)	12 (9.10)	22 (5.33)
	Total	189 (100.0)	115 (100.0)	304 (100.0)	154 (100.0)	150 (100.0)
4. Dosai-pan	Round/Circle	127 (67.20)	68 (59.13)	195 (64.14)	94 (61.04)	101 (67.34)
	Sphere	24 (12.70)	7 (6.08)	31 (10.20)	12 (7.80)	19 (12.66)
	Others	21 (11.11)	25 (21.75)	46 (15.13)	30 (19.48)	16 (10.66)
	Not described	17 (8.99)	15 (13.04)	32 (10.53)	18 (11.68)	14 (9.34)
	Total	189 (100.0)	115 (100.0)	304 (100.0)	154 (100.0)	150 (100.0)

Table 6.2

Objects	Shapes	Men	Women	Total	SC/STs	Other castes
5. Lid of kerosene tin	Round/Circle	48 (25.40)	22 (19.14)	70 (23.03)	28 (18.18)	42 (28.00)
	Sphere	9 (4.76)	7 (6.08)	16 (5.27)	7 (4.55)	9 (6.00)
	Square	64 (33.68)	34 (29.56)	98 (32.23)	43 (27.92)	55 (36.68)
	Others	14 (7.41)	8 (6.96)	22 (7.24)	13 (8.45)	9 (6.00)
	Not described	54 (28.57)	44 (38.26)	98 (32.23)	63 (40.90)	35 (23.32)
	Total	189 (100.0)	115 (100.0)	304 (100.0)	154 (100.0)	150 (100.0)

Table 6.3

Objects	Shapes	Men	Women	Total	SC/STs	Other castes
6. Kerosene bottle	Cylinder	7 (3.70)	5 (4.34)	12 (3.97)	7 (4.55)	5 (3.33)
	Sphere	28 (14.81)	9 (7.83)	37 (12.16)	18 (11.68)	19 (12.66)
	Circle	13 (6.88)	5 (4.34)	18 (5.93)	4 (2.60)	14 (9.33)
	Lengthy/tall/ wide	87 (46.04)	46 (40.00)	133 (43.75)	69 (44.80)	64 (42.67)
	Others	23 (12.17)	14 (12.17)	37 (12.15)	11 (7.15)	26 (17.34)
	Not described	31 (16.40)	36 (31.32)	67 (22.04)	45 (29.22)	22 (14.67)
	Total	189 (100.0)	115 (100.0)	304 (100.0)	154 (100.0)	150 (100.0)
7. ~~Weight~~ Volume measure	Cylinder	22 (11.64)	10 (8.70)	32 (10.52)	20 (12.98)	12 (8.00)
	Sphere	64 (33.86)	37 (32.17)	101 (33.22)	41 (26.61)	60 (40.00)
	Circle	32 (16.93)	10 (8.70)	42 (13.82)	13 (8.45)	29 (19.33)
	Lengthy/tall/ wide	27 (14.29)	30 (26.10)	57 (18.76)	36 (23.38)	21 (14.00)
	Others	13 (6.88)	5 (4.33)	18 (5.92)	8 (5.20)	10 (6.67)
	Not described	31 (16.40)	23 (20.00)	54 (17.76)	36 (23.38)	18 (12.00)
	Total	189 (100.0)	115 (100.0)	304 (100.0)	154 (100.0)	150 (100.0)

Table 6.4

Objects	Shapes	Men	Women	Total	SC/STs	Other castes
8. Sitting Plank	Rectangle	19 (10.05)	10 (8.70)	29 (9.53)	13 (8.45)	16 (10.66)
	Square	115 (60.85)	44 (38.25)	159 (52.30)	61 (39.61)	98 (65.35)
	Lengthy	30 (15.88)	25 (21.75)	55 (18.10)	35 (22.73)	20 (13.32)
	Flat	8 (4.23)	12 (10.44)	20 (6.57)	16 (10.38)	4 (2.67)
	Others	10 (5.29)	14 (12.16)	24 (7.90)	16 (10.38)	8 (5.33)
	Not described	7 (3.70)	10 (8.70)	17 (5.60)	13 (8.45)	4 (2.67)
	Total	189 (100.0)	115 (100.0)	304 (100.0)	154 (100.0)	150 (100.0)
9. Bench Top	Rectangle	39 (20.63)	18 (15.66)	57 (18.74)	21 (13.64)	36 (24.00)
	Square	68 (35.98)	35 (30.43)	103 (33.86)	44 (28.57)	59 (39.32)
	Lengthy	44 (23.28)	20 (17.40)	64 (21.06)	39 (25.33)	25 (16.66)
	Flat	5 (2.65)	13 (11.30)	18 (5.93)	13 (8.45)	5 (3.35)
	Others	17 (8.99)	7 (6.08)	24 (7.90)	11 (7.14)	13 (8.67)
	Not described	16 (8.47)	22 (19.13)	38 (21.51)	26 (16.87)	12 (8.00)
	Total	189 (100.0)	115 (100.0)	304 (100.0)	154 (100.0)	150 (100.0)

Table 6.5

Objects	Shapes	Men	Women	Total	SC/STs	Other castes
10. Root of a hut	Triangle	78 (41.27)	26 (22.62)	104 (34.20)	41 (26.62)	63 (42.00)
	Cone	41 (21.69)	33 (28.70)	74 (24.34)	50 (32.47)	24 (16.00)
	Gopuram	26 (13.76)	15 (13.04)	41 (13.49)	12 (7.80)	29 (19.33)
	Slope	12 (6.35)	15 (13.04)	27 (8.89)	20 (12.98)	7 (4.67)
	Others	19 (10.05)	9 (7.83)	28 (9.22)	12 (7.80)	16 (10.67)
	Not described	13 (6.88)	17 (14.77)	30 (9.86)	19 (12.33)	11 (7.33)
	Total	189 (100.0)	115 (100.0)	304 (100.0)	154 (100.0)	150 (100.0)
11. Temple Tower	Triangle	26 (13.76)	10 (8.70)	36 (11.84)	14 (9.10)	22 (14.67)
	Cone	45 (23.81)	28 (24.34)	73 (24.00)	45 (29.22)	28 (18.67)
	Gopuram	53 (28.04)	31 (26.96)	84 (27.65)	38 (24.68)	46 (30.67)
	Lengthy/tall	24 (12.70)	13 (11.30)	37 (12.17)	15 (9.74)	22 (14.67)
	Slope	5 (2.65)	2 (1.74)	7 (2.30)	4 (2.60)	3 (2.00)
	Others	18 (9.52)	10 (8.70)	28 (9.22)	16 (10.38)	12 (8.00)
	Not described	18 (9.52)	21 (18.26)	39 (12.82)	22 (14.28)	17 (11.32)
	Total	189 (100.0)	115 (100.0)	304 (100.0)	154 (100.0)	150 (100.0)

Table 6.6

Objects	Shapes	Men	Women	Total	SC/STs	Other castes
12. Flame	Triangle	5 (2.64)	1 (0.87)	6 (1.96)	2 (1.30)	4 (2.67)
	Cone	20 (10.58)	14 (12.18)	34 (11.17)	12 (7.80)	22 (14.67)
	Gopuram	- -	1 (0.87)	1 (0.33)	1 (0.65)	- -
	Lengthy/tall	56 (29.63)	28 (24.34)	84 (27.65)	47 (30.92)	37 (24.66)
	Slope	15 (7.94)	12 (10.44)	27 (8.88)	17 (11.03)	10 (6.67)
	Others	32 (16.93)	11 (9.56)	43 (14.15)	13 (8.45)	30 (20.00)
	Not described	61 (32.28)	48 (41.74)	109 (35.86)	62 (40.25)	47 (31.33)
	Total	189 (100.0)	115 (100.0)	304 (100.0)	154 (100.0)	150 (100.0)

CHAPTER VII : MATHEMATICAL RIDDLES/PROBLEMS

The mathematical riddles that are listed below are mathematical problems in story forms narrated by the villagers. The learning of numeracy or acquiring basic mathematical skills for the villagers comes through addressing functional issues in their lives and finding relevant solutions. In other words, the life context of the learner plays a central role in the learning of numeracy and mathematical skills.

Mathematical riddles have been and are in vogue in rural Tamil Nadu. They are rich in the description of the life of the people and give us insights into their life styles and beliefs, the flora and fauna of the region. The riddles draw upon the daily life experiences of the villagers – feasts and celebrations, temple rituals, agricultural work and the like. The familiar contexts make them meaningful and interesting to the learners, young and old alike. These riddles deal with numeracy and computation skills and have questions related to quantification and the selection of appropriate strategies. Many of the riddles have multiple solutions, which keeps the learner engaged in his/her pursuit of multiple answers.

Numbers 1 to 14 have stories with numeracy and mathematical skills in-built for anyone interested to work on and develop computation skills; the rest are games requiring some numerical skills to resolve; all of these were collected from the villagers in the study villages. Observations in the villages showed that when people gathered for festivals and other occasions , some who are well versed in narrating stories with in-built numeracy and computation start relating them. Both adults and children are in the gathering. It is a social setting of home and neighbourhood and it is fun-filled. In the process, the participants are immersed in an environment where mathematical challenge comes naturally.

Clockwise: (1) women playing 'pallanguzhi' (2) men playing 'dayam' (3) women playing seven stones (4) men playing 'snakes and ladders'

A few of the games are being used in school text-books but not the mathematical riddles which bring in the whole life issues and challenges for the young and old to think through and find solutions.

1. **Flowers and the Bees**

In a village there was a lotus pond. In the pond, a few lotus flowers were in bloom. A few bees came humming. Each bee tried to sit on one flower. One bee was left without a flower. Hence, the bees sat in pairs on each flower. This time, a flower was left without any bees. In total, how many flowers were there? How many bees came?

2. Palmyrah Fruits

There lived in a village a person called Munuswami. He owned some palmyrah trees. One day he plucked 30 palmyrah fruits. A total of 60 seeds were there in these fruits. These fruits included one-seeded, two-seeded and three-seeded fruits. At the time of plucking, two other persons were with Munuswami. The fruits were to be divided

equally among the three persons. While dividing the fruits, the seeds inside the fruits should also get divided equally. The fruits should not be cut and given. How will you divide?

3. Sharing coconuts

There lived in a village two brothers. The younger one knew how to climb the coconut tree but the elder one did not know. The two brothers had agreed to share the coconuts from the coconut grove as follows: the elder to get two-thirds and the younger to get one-third. The younger one climbed the tree and plucked the coconuts. The elder one gave the younger one coconut in addition to his own share. Now, both get equal number of coconuts. How many coconuts were plucked ? What was the share of the elder brother ? What was the share of the younger brother? With an additional coconut given as a payment for climbing the tree, how many coconuts the younger brother got?

4. Broken Eggs

An egg trader was moving along a road selling eggs. An idler who didn't have much work to do started to get the egg trader into a wordy duel. This grew into a fight and he pulled the basket with eggs and dashed it on the floor. The eggs broke. The trader requested the panchayat (village council) to settle the dispute. The panchayat asked the trader how many eggs were broken ? He gave the following response
if counted in pairs, one will remain;
if counted in threes, two will remain;
if counted in fours, three will remain;
if counted in fives, four will remain;
if counted in seven, nothing will remain;

5. Plucked Lime Fruits

In a small town, there was a big house and a garden around it. The whole place had seven gateways. There were several lime trees in the garden. One day a person went to pluck lime fruits in that garden. The watchman at each of the seven gateways told him that he should give him half of the fruits that he collected. As he was returning, he gave each guard half of what he had. When he came out he had one lime fruit on hand. What was the total number of lime fruits he plucked?

6. A Flock of Sparrows

One sparrow was sitting on a branch of a tree. A flock of sparrows was flying above the tree. The sparrow that was sitting called out for the flock of sparrows: “Oh! One hundred sparrows ! Oh ! One hundred sparrows !! Where are you going ? come and sit on this tree and take rest and then continue your journey”. Hearing this, one of the sparrows from the flock said, "We are not hundred. We, a similar flock like us, one half of that, one half of that and you together will make one hundred”. If that is so, how many sparrows were there in the flock that was flying?

7. Feast

A couple in a house celebrated an ear-boring ceremony for their child. They had invited their relatives in their village for lunch. One hundred plantain leaves were laid for the feast. As one of the items for lunch, they had arranged to fry one hundred pappads. They served the pappads differentially among men, women and children. Each man was served three, each woman two and each child one half. A total of 100 persons ate in the feast. The 100 fried pappads have all been served. The persons and the pappads became even. Among those who ate, how many were men, how many were women and how many were children?

8. Trading in the Market Place

Kandan went to the market. Trading was on with all fervour. Kandan had Rs.100/- He wanted to buy one hundred things with the 100 rupees he had. He wanted to buy an elephant, and sugarcane and pumpkin. The cost of the elephant was Rs. 5/-; a bundle of sugarcane with 20 sticks one rupee and pumpkin one rupee each. How many of each of these he should have bought if he were to even out 100 things with 100 rupees?

9. Coconut offerings

In a village, there were three Ganesha temples. A devotee went to worship taking along a few coconuts with him. When he reached the first temple and looked at the coconuts, they had doubled in number. He took a few and offered them to the Lord by dashing them on the floor. From there, he went to the second temple. Here again the coconuts he brought had doubled. In this temple he offered the same number of coconuts he offered in the first temple. With the remaining coconuts he went to the third temple. Here again the coconuts doubled in their number. The number after doubling was the same as the number of coconuts he offered in temple one and again in temple two. He offered all the coconuts in hand and worshipped. How many coconuts did he bring in the beginning? How many coconuts he offered in each temple?

10. Worship in the temple with Flowers

In a village there were three temples. A devotee brought some flowers in a basket. When he reached the first temple, he immersed the basket with flowers in the temple tank and lifted it. The flowers in the basket doubled in their number. He took out some flowers from the basket and worshipped the God. He came to the second temple. Here again he put the basket with flowers in the tank and took it out. The flowers doubled in number. He took out the same number of flowers he offered in the first temple and worshipped the Lord. He then started off and went to the third temple. The remaining flowers in the basket were taken to the temple tank, immersed in the tank and taken out. The number of flowers got doubled. He offered all the flowers in the basket and worshipped. The number of flowers offered was the same as the number offered in the first and second temple. How many flowers did he bring in the beginning? How many flowers did he offer in each temple ?

11. Oil Merchant

In a village, there lived an oil merchant, who used to crush oil seeds, extract oil and sell it. After several days of hard work, he got ready to take the extracted oil to the market. On his way to the market he came across a vinayaka temple. He entered the temple and prayed, "Today, if my business goes well, on my way back, I will light the lamps in the temple using one measure of oil".

He moved on. As he went further, he saw a temple of a Goddess. He went in and again prayed the same way he prayed to Vinayaka. He continued his journey and reached the Ayyanar temple at the village limits. He again prayed the same way.

He went to the market. He had good business that day. In the evening as he was returning, he took sufficient quantity of oil in a pot to fulfil his vow in the three temples. He reached the Ayyanar Temple. He saw a small tank of water near the temple. He kept the pot on the tank-bund and he got into the tank in order to wash his feet, hands and face. At that time, a crow came and sat on the pot and tilted it. The oil flowed out on the ground. The merchant came running and straightened the pot. A small quantity of oil remained in the pot. A good quantity of oil was spilt on the ground.

With the quantity of oil left in the pot, the merchant went to the Ayyanar temple. He expressed his feelings of not being able to fulfil his promise. Ayynar sympathised with him and blessed him saying, "May the quantity of oil in the pot be doubled", and so it happened. The oil trader fulfilled his vow of lighting lamps in the temple using one measure of oil.

He went on and reached the temple of the Goddess with the pot containing a little quantity of oil. Here again he narrated the happenings and expressed that he felt sorry that he was unable to do what he vowed. Goddess blessed him and graced him by doubling the quantity of oil in the pot. The merchant took out one measure of oil and lighted the lamps and fulfilled his vow. A small quantity of oil was left in the pot.

The merchant walked further and reached the Vinayaka temple. With all devotion he narrated all that happened and expressed with sadness his inability to fulfil his vow. Vinayaka also blessed him with double the quantity of oil. The merchant took out one measure and lighted the lamps. The pot was empty now.

What was the quantity of oil in the pot when the merchant straightened the pot after driving the crow away?

12. Milk Vending

A milk vendor had several customers to whom he was selling milk everyday. He generally brought milk in big metal pots and measured with traditional standard volume measure and supplied any quantity between one measure to eight measures. One day he forgot to bring in his standard volume measure. The customers also didn't have any clean volume measure for him to use. The capacity of the two metal pots he had were in terms of three measures and five measures. He used these two metal pots and measured milk from one to eight measures. How did he do it?

13. Coins Given as a wage

One boy was working in a provision store. His daily wage was one rupee and fifty paise. In order for him to understand the coins and the pattern of change in transactions, the shop keeper was paying his wage in coins of 10 paise and above. How many ways he could give the coins?

14. Broken Weight Measure

A 40 *palams* (one v*iss*) weight measure dropped down and broke into four pieces. With these four pieces, it was still possible to weigh things from one palam to 40 palams. How much was the weight of each of the broken pieces?

15. Changing the linear dimensions of a plank

A plank was of 6 feet length and 3 feet width. It has to be made into a plank of 9 feet length and 2 feet width. It is to be cut along a single continuous line only. There should be only one joint. How to cut and join?

16. Eight Eights

There are eight eights. You can add them, subtract them, multiply them arranging them any way you like. The product you should get one thousand. Explain how you did it.

17. The Number in Your Mind

Think of a number within 10. You are taking a loan equivalent to the number in your mind. You add this loan to the number you had in mind. Give half of the added figure to the Lord. What is the remainder? I can tell you the number you had in your mind.

18. Which is the left out number?

Take any number with seven or eight digits (e.g. 5679432). Add the number in each digit to the number in the next digit and find the sum total of all the numbers (e.g.36). Speak out this number. Subtract this total from the original number taken e.g.5679432 - 36 = 5679396. Leave out the number of any one digit. The number you leave out should not be 1 or 9. If you speak out the remaining number, I can tell you the number left out.

19. Magic Square

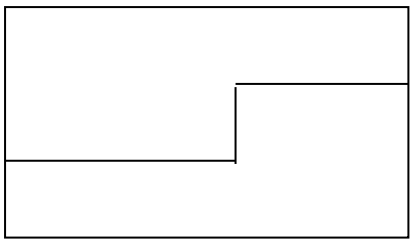
In a big square, there are nine small squares arranged in rows and columns of three squares each. Using numbers 1 to 9. fill in the squares in such a way that adding up from any row or column should bring a total of 15.

20. Goat, Tiger and a Bundle of Grass

A river was flowing on one side of a village. Once there were floods in the river. A villager had a goat, tiger and a bundle of grass which he wanted to take across the river. The facility available was only a small boat. At a time only two could travel. It is necessary to see that the bundle of grass should be saved from the goat and the goat from the tiger. How would the villager have taken all the three across the river?

SOLUTIONS FOR THE RIDDLES

1. 3 Flowers and 4 bees
2. Each one will get 10 fruits. One will get 10 two-seeded fruits; the other two will get five one-seeded and five three seeded fruits each.
3. Total coconuts plucked was 6,
   To the elder brother 4 –1 = 3
   To the younger brother 2 +1 = 3
4. 199 eggs
5. 128 lime fruits
6. 36 Sparrows
7. 72 children, 20 Women, 8 men
8. Sugar cane 80, pumpkin 1, Elephant 19
9. First temple 7+7 = 14 – 8 = 6
   Second temple 6 + 6 = 12 – 8 = 4
   Third temple 4 + 4 = 8 – 8 = 0
10. First temple 7 + 7 = 14 - 8 = 6
    Second temple 6 + 6 = 12 – 8 = 4
    Third temple 4 + 4 = 8-8 = 0
11. Seven eighth measure (7/8)
12. 1 measure = (2x3) – 5 = 1)
    2 measures = 5 – 3 = 2
    3 measures = 3 = 3
    4 measures = 2 (5-3)= 4
    5 measures = 5 = 5
    6 measures = 2 x3 = 6
    7 measures = 5 +(5–3) = 7
    8 measures = 5+3 = 8)
13. 33 ways
14. 1,3,9,27 palams
15. The plank can be cut along the line in the centre as shown in the figure and the lower piece is to be joined with the upper piece so as to make it a rectangle. It can be tried out with pieces of paper.



16. 888 + 88 + 8 + 8 + 8 = 1000
17. The number in your mind is the number that comes out as a remainder.

15. In order to find the number left out, subtract the total of the spoken out remaining number from the total of the number taken in the beginning

16.

15	15	15	
4	9	2	15
3	5	7	15
8	1	6	15

20.

This side	**Boat**	**That side**
a) Man, Goat, Tiger & Bundle of grass	Man and Goat	Goat
b) Tiger	Man and Bundle of grass	Bundle of grass
c) Goat	Man and Goat	Goat
d) Goat and Tiger	Man and Tiger	Tiger
e) Goat	Man and Goat	Man, Tiger, Goat and a Bundle of grass

APPENDIX A: DATA COLLECTION

Four investigators, in teams of two, conducted interviews after orientation and demonstration in conducting interviews. The data was collected from 9th July 1983 to 7th January 1984. A sample of seven villages was drawn from a total of 15,735 villages in 16 districts in Tamil Nadu. In drawing the sample, the following procedure was followed.

On the basis of the major dialects of Tamil Language, four dialect regions (Northern, Southern, Central and Western) and the districts that come under each of these regions, as identified by linguistic studies, were taken. Each region with its cluster of districts was made into two clusters making up a total of eight clusters of districts. From the eight clusters, seven districts with a higher percentage of Scheduled castes/Scheduled tribes (SC/ST) were selected.

A list of 1407 villages in the selected districts with a population between 5000 and 10,000 was made, to ensure representation of different occupations and different castes. Of these villages, those with a population of over 20 per cent of SC/STs were listed. The number of such villages varied with districts. Random sampling was made from these villages with a weighting given to villages with over 51% SC/ST population. The following chart presents the dialect regions, the districts, the taluks and the villages in the sample.

CHART : Dialect Regions, Districts, Clusters, Taluks, Villages

Dialect Regions	Districts & Clusters	Taluks	Villages
1. Northern	1. **Chengalpattu**, Chennai. 2. North Arcot*	Sriperumbudur Vellore	Mangadu Venkatapuram Alamelumangapuram
2. Southern	3. Madurai Tirunelveli **Ramanathapuram**	 Rajapalayam	 Chozhapuram
	4. Kanyakumari*	Agasteeswaran	Theroor
3. Central	**5. Tiruchi** Pudukkottai	Karur	Pavithram
	6. Thanjavur **South Arcot**	 Viruddhachalam	 M.Parur
4. Western	7. Coimbatore **Nilagiri**	 Gudalur	 Nelliyalam
	8. Salem Periyar Dharmapuri	Namakkal	Kollimalai (Ariyur Nadu)

* Districts indicated as exceptional from the point of view of dialects by the linguists. A pilot study was conducted in the villages indicated in North Arcot.

The total number of respondents was calculated on the basis of the population in the seven villages and the time required to conduct the interviews. The interviewees were selected at random; the number of adults per street was decided on the basis of the number of households. The total sample size was calculated to be 350. The sample size for each village was determined by the size of the population. The following table presents the details of the village, population, calculated sample size and the actual sample size.

Table 1 : The population and sample in the selected villages

Sample village	**Population**	**Calculated sample size**	**Actual sample size**
1. Mangadu	10,976	76	76
2. Chozhapuram	6,775	47	32
3. Theroor	8,914	62	40
4. Pavithram	5,575	38	40
5. M.Parur	5,314	36	25
6. Nelliyalam	10,221	71	68
7. Kollimalai	2,950	20	23
Total	50,725	350	304

In all, a total of 304 adults belonging to seven villages (Mangadu, Chozhapuram, Theroor, Pavitram, M.Parur, Nelliyalam and Kollimalai) in four regions based on four major dialects of Tamil language (Northern, Southern, Central and Western) were interviewed. The majority of the adults who participated in the study were agricultural labourers, were in the age group of 15 to 35 years, were married, were in the unitary families of the size ranging from 2 to 5 members, were residents of the village since birth / marriage, had limited communication with the outside world as judged from their travel outside the village and receipt of letters from outside. Care was taken to include both men and women, SC/STs and other castes, illiterates, semi-literates and literates with a majority having less than VIII standard education. Majority were Hindus, though there were some Christians and some Muslims.