Chapter I

INTODUCTION

Background of the Study

The concept of mathematics was beginning from the very beginning of the human civilization with the passing of the time; the gradual development of mathematics took place. In the history of mathematics Babylonian civilization, Egyptian civilization, Roman civilization Greek civilization, Chinese civilization, Hindu civilization and Arabian civilization have played vital role in the development of mathematics and mathematics education become of excitingly separate branch of knowledge or discipline in today's world.

Mathematics is the branch of human inquiry involving the study of numbers, quantities, data, shape, and space and their relationships, especially their generalizations and abstractions and their application to situations in the real world. As a broad generalization pure mathematics is the study of the relationships between abstract quantities according to a well defined set of rules and applied mathematics is the application and use of mathematics in the context of the real world. Pure mathematics includes algebra, abstract algebra, calculus, geometry, number theory, topology and trigonometry. Applied mathematics includes mechanics, probability and statistics, quantum mechanics and relativity (Clapham & Nicholson, 2009).

The word mathematics comes from the Greek word “mathema”, which is the ancient Greek language, means “what one learns”, “what one gets to know”, hence also “study” and “science”, and in modern Greek just “lesion”. The word “mathema”

is derived from “manthano”, while the Modern Greek equivalent is mathaino, both of which means “to learn”. In Greece, the word for “mathematics” came to have the narrower and more technical meaning “mathematical study”, even in classical time. Its adjective is “mathematikos”, meaning “related to learning” or “studious”, which likewise further came to mean “mathematical”.

There is a definite need of mathematics in every body’s lifelong planning and day to day life. It is a system of conclusions, experiments and the result of application of objects in human life. It bridges between the necessity and cultural knowledge of different ethnic groups or castes. It plays a vital role in the organization and maintained of our social structure. Human beings are the most curious creatures to which mathematics are necessary in every moment of life.

Mathematics ideas such as measurement, counting, calculating etc. are created from the cultural activities of the people which may be in different nature in different cultural base. Today, this cultural based mathematics refers to a form of mathematics that varies as a consequence of being embedded in cultural activities whose purpose is other than doing mathematics. Ethno encompasses identifiable group such as labor group, students of certain ages, professional classes etc. and include their codes, symbols, myths and even specific way of reasoning and inferring.

The concepts of numbers and the process of counting developed so long before the time of recorded history. The earliest was of keeping account was by some simple tally-bar method employing the principle of one to one correspondence. Counts could also be maintained by making collection of pebbles or pieces of stones, by cutting notches in pieces of wood. Then the word “tally” was used against the

number of objects in a small graph. Early mathematics can be said to have originated in certain areas of the ancient orient primarily as a practical science to assist in agricultural and engineering pursuits (Eves: 1981).

Today's mathematics is symbolized, structured and systematic. The invention of symbols helped to develop math processes which utilize positional representation and operation of numbers. This made the math's process such as addition, subtraction, multiplication and division simple enough for common use. The number concepts, numeral system and math processes that we commonly use today look simple and perfect. But one cannot ignore the fact that the initial development of number counting and math processes was based on simple interaction between people with regard to physical objects in their environment.

Mathematics has been used as a powerful tool to solve human problem. The mathematical knowledge is discovered through the process of formal reasoning .It is true that mathematics exists at each and every social and cultural aspect of human civilization. In an occasion Pythagoras said that "the earth arose from the cubes, fire from the Pyramid (Tetrahedron), air from the octahedron, sphere of the universe from the dodecahedron" (Boyer, 1968). It means mathematics lies everywhere.

Mathematics is used in different discipline as different ways. Doctor , farmer , Carpenter, lawyer , engineer , teacher, and other professionals as well as educated people all have their own ways of mathematizing the world .Each person who involves in different occupation used different mathematical concepts knowing or unknowing to solve their life problems.

The term 'ethno mathematics' was introduced by the Brazilian educator and mathematician, D'Ambrosio in 1977 during a presentation for the American Association for the Advancement of science. D'Ambrosio(1985) defined ethno mathematics "as the mathematics practiced by distinct cultural group, identified as, indigenous societies, groups of workers, professional classes and groups of children of certain age group is the motive by which specific cultures developed over history, the techniques and the ideas to learn how to work with measures, calculations, inferences, comparisons classifications and the ability to model the natural and social environment in which we use to explain and understand phenomena i.e. mathematics.

Rosa and Orey (2000) stated, that Ethno mathematic intersection set between cultural anthropology and institutional mathematics and utilizes mathematical modeling to solve real world problem and translate them into modern mathematical language system. Ethno mathematics can be shown as the intersection of the three disciplines as below.

To understand the essence of mathematics we must take about society, culture and mathematics in brief. Society is the formal association of people with similar interest. It is an extended social group having a distinctive culture and economic organization. It forms to get the common goals of people of particular area. They share their Knowledge and cultures to develop norms and values among themselves.

Every person cannot live alone so that she/he joins in the society for having a community life.

The established values and norms in society are known as culture. Culture is a learning behavior of human beings. Without human beings , society does not build and culture does not exist Therefore , human beings is main factor of cultural transmission from generation to generation . According to Tyler “A culture is that complex whole which includes knowledge, belief, art, moral, law, custom and any other capabilities and habits acquired by men as a member of society.”

Most of countries in the world are multi-cultural, multilingual and multi-religious. Mathematics is now considered as social creation. Culture is the contributing factor for the development of mathematics. Mathematics plays a vital role in the development of culture and civilization. So, cultural diversity and the equity of learning opportunities have been considered as one of the major issues in mathematics education.

The term “mathematics” has been interpreted and explained in various ways. It is the numerical and calculation part of human life and knowledge. It explains that this science is a byproduct of our empirical Knowledge. It is also defined as the science of abstract form. According to John Luck, “Mathematics is a way to settle in the mind a habit of reasoning.”

Mathematics is the mirror of human civilization and it is directly associated with human life. It is believed that the development of mathematics and development

of human civilization can go along together. In the process of development of mathematics, ethno mathematics played a vital role till the late half of 20th century.

In the context of Nepal, it is a country with different castes, cultures, language and religion that they have different mathematical ideas and concepts that are used to solve their daily problems. Few studies have been done on ethno mathematics and mathematical concepts or ideas used by different occupation like as, carpenter, tailoring, mason etc. so I have attempted to identify the mathematical concepts and knowledge used by farmers in farming.

Statement of the Problem

Education develops the human resources which are interpreted as a process of increasing the knowledge, skill and capabilities of the all people in the country. But all people do not get the chance of formal education due to social, economical, geographical, and cultural barriers. Participation in education is an important dimension to assess the development of a society. Some of the gain knowledge from own creativity and some other from different culture, observation and own experiences.

This study was concerned with the study of mathematical knowledge and concepts used by farmers in farming in Siraha district. People use mathematical ideas and knowledge in their activities formally and informally. People learn and acquire mathematical knowledge from social activities and individual practices in their cultural and social environment through experience and interaction with social elements.

People who involve in farming need different type of mathematical concepts. In which they learn by seeing other, hearing and feeling. Therefore in this study I tried to find out the answer of the following research questions:

- What type of mathematical concepts do the farmer used?
- How does farmer acquire the mathematical concepts?
- How does his socio-cultural context effect on his mathematical thinking?

Objective of the Study

Objective is main body of research. The main objectives of this study are as follows:

- To find out the mathematical concepts used by farmers in their artifacts.
- To analyze the mathematical concepts practiced by farmers with respect to socio-cultural context.

Significance of the Study

Mathematics is one of the most important fields in today's society. Mathematics is becoming a focus of school education but student feel it as a complicated subject to grasp, mathematics plays vital role to change the society and technology and vice -versa. There are many more ethnic groups in our country. Every ethnic group has its own occupation. Among them, farming occupation where most of people are involved in our country. In this occupation farmer makes different types of farming instrument to product crops and use ideas to make more product, for which they need more mathematical concepts.

I believe that this study is important because the indigenous math's skills, concepts and process evolve from direct interaction of the people with their environment. They reflect the need of people and are essentially relevant to their practical life. This study would help the teachers, students and their parents to find the solution of "Are the math's concepts and knowledge taught in school communities relevant to their local environment and daily life need?"

This study would help to reveal hidden mathematical terms and concepts in farming. It would also help to search mathematical forms and concepts in other field. Mainly the significance of study were as follows:

- This study would help mathematics educators, mathematician, mathematics teacher and learner to understand the artifacts of farmers that how they use mathematical concepts.
- This study would help to promote ethno-mathematical knowledge and skills.
- This study would inform the formal and non-formal agency to provide mathematical knowledge for farmer.
- This study would help to find the difficulties of farmers due to lack of formal mathematical education

Delimitation of the Study

A delimitation is also called boundary condition, which specifies a region beyond which a theory or hypothesis is either changed or does not hold. Delimitations of the study were as follows

- This research is not a broad study.

- Only the researcher was involved in the data collection procedure.
- The study was from Dhangadhimai municipality of Siraha district,
- The researcher was taken one month to collect data.
- This study is based on qualitative research design.

Definition of Key Words.

Farmers: Those who work in farm. Farmer is a hard working person in the society and farming is one of the most considerable occupations.

Occupation: Occupation is taken as the principle area of working for earning money.

Practices: Systematic use by repetition in behavior. In this study practices means what types of activities do in their everyday activities.

Mathematical process: It refers to method of computing with numbers, making rules to compute e.g. addition, subtraction, multiplication, division etc.

Mathematical concept: Mathematical concept refer to the abstract idea and concept of counting, calculating , measuring etc.

Ropar: Person who re-plant the any kinds of seeds like as, paddy, cauliflower etc.

Measurement system: In this system it refers to the technique of measurement This includes: length, distance, area, volume and weight.

Constructivism: A theory theorized by Vigotsky which stresses on the creation of something from ideas, opinions and knowledge.

Ethnography: The scientific study of people and cultures.

Chapter II

REVIEW OF RELATED LITRETURE

In the research word literatures are the most important aspect. The literatures for research are authentic knowledge from various researches. The related studies construct the platform for standing to the research and periphery for the subject matter which gives the theoretical support for the study. The review of related literature helps to make the concept clear for the study and also directed to analyze and interpret the data. Some reviews of related literatures for the study of this topic were as follows:

Empirical Review

Several types of related literature were reviewed in this study, which helps to make the concept clear for the study and also direct to analyze and interpret the data. With this assumption some related literature were reviewed as follows :

Ambrosio (1984/85) father of Ethno mathematics has used the expression 'Ethno mathematics' refers to the forms of mathematics that was a consequence of the being embedded in cultural activities whose purpose is other than "doing mathematics". In everyday activities such as building houses exchanging money, weighting products, calculations and precise geometrical patterns are used. These applications of mathematics often look different from that use in school today. In the Kitchen we often measure volume with spoons and cups, where as in school activities students typically measure volume in liters or cubic centimeter or cubic meter. These differences may be perceived as deep or surface. Students differentiate depending on what view one holds of mathematics knowledge.

CERID (1990) studied on "Elementary process of learning mathematical concepts in Nepal: A study on math's concepts and process of Rasuwa Tamang" submitted to UNESCO\Bangkok. The main objectives of this study were to investigate the math's concepts and processes locally used by the Tamang people. The specific objectives are to study the basic math's concepts used by Tamang adults with no formal math education, to identify traditional Tamang methods of math operation and to find out the implications of Tamang processes and tone up the present learning situation. The project work has concluded that the Tamang people have their own numbers name in their native language, system of counting based on 20. Their geometrical concepts are based on the shapes and structure patterns of objects existing around. They measured lengths and breadths by using hand and fingers like as; Haat, Bitta, Aauri etc. Also they have their own system of area measurement, volume measurement, weight measurement, time measurement, mathematical process and concepts for calculation. This study has also showed that the situation of Tamang children into the formal schooling system. But it did not study the effect of ethno-mathematical practices in the classroom setting.

Millroy (1992) conducted an international research on "Ethnographic study of the mathematical ideas of group of carpenter". He conducted a six month ethnographic study as an apprentice carpenter in cape Town, South Africa to document the valid mathematical ideas that are embedded in the everyday wood working activities of group of carpenter. The methodology of the study was participant observation. He took sixty carpenters as the sample. The result showed that many conventional mathematics concepts are embedded in the practice of the carpenter. They made extensive use of such concepts as congruence, symmetry,

proportion. The result also should that the carpenter's mathematics has several unique. Carpenter's mathematics has several unique characteristics. There was tacit mathematical Knowledge in their action and reflection , on actions led them to concrete contextualized problematic and their ideas were framed by the context of the workshop and carpenters tolls. Comparison to measuring and usually resulted in optimal solutions.

Dhakal (2004) conducted a study entitled, "A carpenter developing mathematical concepts in his own surrounding." The study seeks to identify what types of mathematical concepts does the carpenter need, to identify how does the acquire the mathematical concepts on his mathematical thinking. His research tools were participant observation, interview and photographs. He took ten carpenters as a sample. The result shows that many conventional mathematical concepts are embedded in the practice of the carpenter. They made extensive use of such concepts as perpendicular, straight and parallel lines, area, plane, congruency, proportion in their everyday working.

Adhikari (2006) carried out a research entitled "A study on the masons developing mathematical concept in their surrounding." The objective was to find mathematical concepts of masons. The methodology was observation and interview. This study found that the mason used many conventional mathematical concepts that are embedded in the practice of the masons. Twelve masons were taken as a sample. They made extensive use of such concept as plane, perpendicular, straight lines, parallel lines, triangle and cube etc. In their daily work. The researcher also found that the society is a source of knowledge.

Paudel (2007) conducted a study on. “A study on the mathematical skills used in tailoring” with the objectives of mathematical concepts needed for tailor master and their acquisition of mathematical knowledge . The methodology of the research was participant observation. He took five tailor masters as a sample. The study found that many conventional mathematical concepts are embedded in the practice of the tailoring. Tailors use many mathematical concepts such ads plane , perpendicular straight line , parallel lines , area , ratio, proportional , congruency , similarity , circles , curves , oval shape parabola, midpoint mostly used to make different types of clothes. They use different tools as image table, cutting table, measuring tape, tailor squire, tailor chalk, scissor etc. which make them easier to use mathematical concepts.

Kunwar (2007) carried out a study in entitled, “Mathematical ideas uses in Tailoring: A case study of uneducated Pariyar in Tailor profession” to find out mathematical uses in Tailoring and process of acquiring mathematical concepts. The methodology of the research was participant observations and semi structured interview. The researcher had found that the Tailor acquired mathematical concepts through experiences and practice of Tailoring. The methods of learning mathematical concepts are learning by doing; observing and imitating. The researcher has also found that society was a source of knowledge in different manner.

Chhetri (2008) conducted a three month long study entitled “A study on mathematical ideas of sawyer”. The objectives of the study were identify the mathematical ideas used by sawyer and to identify the sawyers acquisition of mathematical knowledge. The methodology of the study was participant observation and interview. Five uneducated sawyers were taken as a sample. He found that the

sawyers used tacit mathematical ideas to solve their sawyers use mathematical concepts as straight lines. Parallel lines, cylinder, circle, bisector, perpendicularity, similarity, congruency, points, collinear point etc. He also found that the sawyer's knowledge acquiring system is social interaction, experience and working with adult group which is same as Vygotsky's Social constructivism.

Dahal (2010) studied “Basic mathematical concepts and process of Sherpa community in Solukhumbu district”. The design of this study was ethnographic in nature and data collection tools were observation and interview. He found that; Sherpa have no their own script. They have been following the Tibetan script. He found their specific symbols to represent the numbers from 1 to 10 only. They did simple mathematical operations orally. The mathematical process is based on traditional practices and they use it through physical object of the environment in particular situations. The counting system of Sherpa has gone by adding suffix for each 10, 20, 30 … 100 numbers. They measured lengths and breaths by using hands and figures. Amal, kuret, bitta and haat are the measuring units of length and breaths. The area measurement is reflected in construction of house and the area of house is measured in terms of haat. The units of volume measurement are Chimti, Muthi, Chauthi, Pala, Mana, Kuruwa, Pathi and Muri. The units of weight measurement are Pau, Bisauli, Dharni, Kg etc. He did not focus on the geometrical knowledge of Sherpa community.

The above review of related literature is important sources for further study of research work. The review of related literature is essential for guidance of research planning. Among these studies, some were directly related to learning strategies of mathematical concepts of different ethnic groups and some were related to mathematical concepts and knowledge used in different fields. The different ethnic

groups perform their mathematical concepts by their own way. So, the review of above literatures encouraged me to study the mathematical concepts used by farmers in farming.

Theoretical Review

In this chapter, the researcher would introduce the theoretical discussion, which is relevant for the interpretation of the findings of the study. There are various theories related to children's learning and development. They are classical conditioning, operant conditioning, Gestalt theory, ethnography and social constructivism and so on. For the study, some theoretical reviews of related literatures are as follows.

Constructivism

Constructivism is one theory among many forms a variety of disciplines that calls for us to question our ontological (to a position) and epistemological assumption we know that constructivism is a philosophy of learning and teaching of an object existing in the world . We can construct many kinds of knowledge or assuming of construction which we use to make sense of our experience. Therefore, it is simply the process of adjusting our mental, models to accommodate new experiences.

Upadhyay (2003) states that mathematics is and art, art demand creativity, creativity is an ideal art. Constructivism considers the every aspect of learner and tried to carry out his increase curiosity to the student about an object.

Psychologist Piaget, J.Bruner and Dinese provide three different postulates about construction of knowledge. They are as follows;

- Knowledge is physically constructed by learners who are involved in active learning.
- Knowledge is symbolically constructed by learners who are making their own representation of action.
- Knowledge is socially constructed by learners who convey their meaning making to other.

Constructivism is a theory among many basically a theory based on observation and Specific study about how people learn. It says that people construct their own understanding and knowledge of the world, through experiencing thing and reflecting on those experiences.

Constructivism holds that there is no knowledge that excites outside of the person, there is no objective reality. Constructivism claims that knowledge must be actively constructed by learners as they are already “Knowing beings” who bring previous knowledge and experience to any learning events (Acharya, 2015).

Social Constructivism (Vygotskian Theory)

He was Russian psychologist. He was born on November 5, 1896 in the town of Orsha, Northest of Mink in Byelorussia. In 1913, he completed gymnasium in Gomel with a gold medal. In 1917, of after graduating from Moscow University with specialization in literature, he began his literary research.

L.S Vygotsky was famous scholar who emphasizes on the social constructivism. Social Constructivism is a theory among several theories on constructivism. The researcher will be used Vygotsk's Theory for this study that every knowledge is socially constructed and children learn when they get contact with outer environment either verbally or observantly . Vygotskian theory is one of

them that regard social interaction between peers and adults as important aspects in creating meaning, making sense and conveying cultural within the shared context.

The social constructivism is the trend within the modern field of social knowledge. Social knowledge is an epistemological discussion of how knowledge is created and acquired. Social constructivism focuses on actual production of scientific knowledge. Therefore, it is not merely study of how social factor and practical experiences influence scientific facts.

Vygotsky theoretical discussion reveals the psychological perspectives and describes about the insides of the individual. In other words, it is more focused on the individual behaviors relation to society or groups. So Vygostsky's theory of ZPD was helpful for researcher to builds theoretical frame to know the mathematical concept of farmers. The researcher will be drawn the idea from DPD that human behaviors determined in the form of language , cultural situation , communication and social factors have influence in the human behaviors .

Vygotsky stresses that the child constructs the knowledge from maturation and culture. Here the external cultural knowledge is internalized with the help of their parents and the conservation of community, so the psychological functions in children originate in interacting with outer or inner personality and only later become interpersonal .

The following figures show the details description about ZPD.

Vygotsky's Theory of ZPD

On ZPD the child movies from

other regulation inter-Psychological

With

Skilled assistance from more knowledgeable other

(Peers and adults)

In

An enabling environmental

With

Appropriate materials, experience and activities

Combing.

Social cultural and historical influences

Acquiring

Tool for thinking and learning knowledge , Skill , process sense making capacities

Leading to

self regulation(Intra Psychological)

Source: Weed et al. 1996, play, learning and the early childhood curriculum.

I had selected ten uneducated farmers and collected their farming information including farming background . They learned farming skills from their small age. They observed their guardians activities and imitate it. They Observed and interact with their seniors. They could not learn alone but with the help of adults and more skilled peers and such kind of activity facilities ZPD as mentioned by Vygotsky. This theory gives an account about the learning from society, peer groups and adults

and to make believe to lead development forward. In the similar manner, other concepts from Vygotsky's social construction are useful to generalize the human behaviors about their mathematical concepts. So the ideas of Vygotsky's Social constructivism used as a means of viewing how an uneducated farmer uses mathematical concepts through social interactions.

Conceptual Framework of the Study

The following conceptual framework was developed by the researcher to fulfill the objective of the study:

(Conceptual Framework)

A conceptual framework is used in the research to outline possible courses of action or to present a preferred approach to an idea or thought. Conceptual framework is a type of intermediate theory that attempt to connect to all aspects of inquiry (eg. problem definition, purpose, literature review, methodology, data collection and analysis). It is the road map for conducting research.

Conceptual framework devised through the literature studies facilitated to attain research objectives, get the answer of the research question and carry out the research work as a whole smoothly (Acharya, 2015). Mathematics was originated along with the human civilization. Human begins themselves created mathematics in the field for application for counting, measuring and other concept of mathematics. Mathematics, culture and society are interrelated. Mathematics is developed in the culture. People and culture from the society. There can be found counting, measuring, calculating and other concept of mathematics knowingly or unknowingly which are the parts of mathematics. These activities can be found by observation and interview. In the above figure farmer's mathematical practices is the main issue of this study. Also it shows what my research design, tools for data collection is, theory which is blended in the study has shown clearly in the framework.

Chapter III

METHODS AND PROCEDURES

This chapter describes the design of the plan and procedure of study. This is really the heart of the study here the activities that used to complete the proposed study be described in detail. Research method and procedure is a plan, which determines how to complete the research systematically. The method applied in this study was discussed in the following sections: Research design, sample, tools, method of data collection and analysis.

Design of the Study

This study was based on the qualitative research design with ethnography approach. The qualitative design exploring meaning and the way people understand things. Qualitative research can be regarded as 'naturalistic inquiry' in a sense that it is conducted in natural setting by trying to avoid any intentional manipulation and distortion of the environment of the informants by the researcher (Tames W, Stigler & Michelly Perry, 1998). To study this problem, researcher use an emerging qualitative approach to inquiry, the collections of data in a natural setting sensitive to the people and places under study, and data analysis that is inductive and establishes patterns or themes. In ethnography approach the researcher collects the information in the natural setting without disturbing the system.

Ethnography

Ethnography literally means a portrait of people. Ethnography is a written description of a particular culture, the customs, beliefs and behavior based on information collected through field work (Johan Van Moenen 1996.)

Ethnography is a social science research method. It relies heavily on up-close personal experience and possible participant, not just observation, by researchers trained in the art of Ethnography. The Ethnographic focal point may include intensive language and cultural learning, operational and interview methods. Typical Ethnographic research employs three kinds of data: questions, description, and excerpts of documents resulting in on product narrative description. This narrative description often includes charts, diagrams, and additional artifacts that help to tell story. Ethnographic method can give shape to new construct or paradigms, and new variables for further empirical testing in the field through traditional, qualitative social science methods. Ethnography has its root planted in the fields of anthropology and sociology. Present day practitioners conduct Ethnographies in organization and communities of all kind. Ethnographers study schooling, public health, rural and urban development, consumers and consumers' goods, any human area.

As a set of methods, ethnography is not far removed from the sort of approach that we all use in everyday life to make sense of our surrounding. It is less specialized and less technically sophisticated than approaches like the experiment or the social survey, through all social research methods have their historical origin in the ways in which human beings gain information about their world in everyday life.

In terms of method, generally speaking the term “ethnography” refers to social research that has most of the following features (M. Hamersley, 1990)

- People’s behavior is studied in every context rather than under experimental conditions created by the research.
- Data are gathered from a range of sources, but observation or relatively informal conservations are usually the main ones.

- The approach to data collection in “unstructured in the sense that it doesn’t involve through a detailed plan set up at the beginning, nor are the categories used for interpreting what people say and do pre- given of fixed. This does not mean that the research is unsystematic, simply that initially the data are collected in as raw form and on as wide a front as feasible.
- The focus is usually a single setting or group of relatively small scale. In life history search the focus may even be a single individual.
- The analysis of the data involves interpretation of the meaning and functions of human actions and mainly takes the form of verbal description and explanations with quantification and statistical analysis playing subordinate role at most.

Naturalistic Inquiry

The aim of ethnography research is to capture the character of naturally occurring behaviors, and this can only be achieved by first hand contact with it, not by inferences from what people do inartificial setting like experiments or from what they say in interviews about what they do elsewhere. This is the reason that the ethnographers carry out their research in “Natural” setting. The important implication of naturalistic study is the study in natural setting of the behavior of the people being studied. This study is a qualitative research and is an exploratory in nature. This research is a form of inquiry that explorers phenomena in their natural setting.

Study Area

Siraha district is one of the districts among the seventy- seven districts of Nepal. The sirahadistrict is lies in the Terai part of Sagarmatha zone. Siraha is its district headquarters. It covers an area 1,188 km^2 and has a population 637,328 (national census report 2068). There are six municipalities in siraha district. Farmers are living in many villages and municipalities. Among these various places of farmers, this study was taken from "Jaypur" village of Dhangadhimai municipality in Siraha district.

There are several castes in this village. All people have their own occupation like doctor, teacher, carpenter etc. but farming occupation is more than other occupation. They have their own activities, living style, norms, belief. Jaypur is famous for farming (grow vegetable, paddy etc.) in Siraha district. Most of people (Mahato, Yadav, Chaudhary) involve in farming. They have own system of farming. So "Jaypur" village of Siraha district was essential for this study.

Sample of the Study

This study was based on qualitative research. So the sample size of this study was not fixed. According to Anderson, there are no rules for sample size in qualitative inquiry. I selected ten farmers by purposive sampling from Jaypur village which is in Dhangadhimai municipality, Siraha. Moreover, I discussed with other senior farmers as available and needed.

Tools for Data Collection

Data collection is the most important part of the study. On the basis of data collection techniques we can study and analyze aspect of the study. The consequences

of the study depend on technique of data collection. To collect the primary and secondary data, the following tools were used.

In-depth Interview

Interview is a process of data collection from face to face interaction. Interview is an oral questionnaire. Interview is a two way interaction between interviewer and interviewee in which interviewer creates situations that can attract the attentions of respondents for a enough period of time in asking questions and answering the questions which interviewee puts his/her understanding and meaning.

For this study researcher had asked more questions to get mathematical information from farmers with the help of semi open structured interviews. Since some questions were raised according to the situation available. I took in depth interview of farmers using interview guideline.

Observation

In this study, researcher had gone and observed the work place of farmers. It is qualitative research so observation is most frequently in this study. Participant observation is that in which the observer is familiar and participate with object of study. This study had been carried out as participation observation where researcher worked himself as an apprentice of farmer. Certain type of information could be best obtained through direct examination by the researcher. Observation helped to get that information which is not obtained from interview.

Photograph

Photographs are most important tools for every research. I took some photographs about the farming materials (eg. Halo, Palo, Kodalo, Hassiya).

Data Collection Procedure

There are many approaches for the qualitative research to get the information from the people about their ideas, experiences, skill, believes, histories and so on. At, first I visited the selected village and then discuss with the farmers. The sources of data collection were primary as well as secondary also. The data were collected by using the in- depth interview, digital photograph, observation and written documents as a secondary source like personal diaries, thesis, published and unpublished research documents related to this study. At that time I took photos and audio records.

Data Analysis and Interpretations

I had collected the information by using tools through field visit. I observed farming and taken interview according to objectives. Then the collected data was analyzed by the help of constructivism theory and Vygotskian theory. My analysis process started with my first observation in fieldwork. To make data analysis process easy, I tried to keep record of the primary data. After getting the information, I tried to summarize. I think the information again and again, and tried to make meaning from that. Before making the final summary for every concept, I observed again and again. I asked questions to my participants again to get the real context. These are the processes I followed during my field visit. I tried to sort out the information under different headings. Then I worked for my first objective to find out the mathematical concepts used by farmers in farming and at last I worked for my second objective to analyze the development of mathematical concepts of farmers with respect to socio cultural context.

Quality Standard

Lincoln and Guba (1985) propose for criteria for 'naturalistic' research. As their work to 'formalize rigor' has been particularly influential in the social science generally, and in the occupational therapy field specifically, it is worth focusing on their categories in depth. Interestingly, they link their criteria with four used conventional quantitative inquiry: those of internal validity, external validity, reliability and objectivity.

Credibility: Credibility achieved by addressing such aspects as immersion in the environment, accurate interpretation of the data, triangulation and member checking (Lincoln & Guba, 1985 as cited in myth, 2006). To maintain credibility of my research, I tried to spend more time with participants for the research. The data were collected from multiple sources such as observations and interviews and got several information related with research problem. After getting information, I again met participants to make results realistic in the perspective of participants about their farming when I got that participants were eager to hear their farming activities in the form of research.

Transferability: Transferability refers that findings of the research are applicable and similar to other educational setting. In the field of research, the data generating process can be useful and similar to other researcher in the similar area. To maintain transferability of the research, I captured the daily life activities, social activities, farming activities of farmers by observation, interview. Also this study encouraged to linking reader's mathematical knowledge is used every sector or occupation and made education process effective and object oriented through ethno mathematics.

Dependability: To maintain dependability, I had observed and taken interview with the participants and included in this study. If repeated the study, the result of research would be same from the involvement in same place, same participants and same methodologies, when social environment is changing due to modernism.

Conformability: For conformability, it is also important to ensure that the findings of the investigation are the result of the experiences and ideas of the participants and not the preferences and characteristics of the researcher (Shenton, 2004 as cited in Vandeleur, 2010, p. 127). So to the quality of the results produced by and inquiry in terms of how well they are supported by the members who are involved in the study and by the events that are independent of the inquirer. So all collected information was based on participant's views, ideas, experience and interpretation. Thus, this helps to make the research findings are true and exact on participant's practices. In this study, I had presented ideas, views and a practice of the participant's found same in their daily life activities.

Chapter IV

ANALYSIS AND INTERPRETATION OF DATA

This chapter deals with analyze and interpretation of the data collected field of observation, interviews and photographs. This, chapter is divided into two parts. First part describes with those mathematical concepts which are used by farmers in farming and the second parts deals about the way of acquiring mathematical concepts on their socio-cultural context.

Farmer's Mathematical Concepts

In this part, I have presented that type of mathematical concepts which is generally used by farmers. Nowadays to full fill each needs of human life, they need some mathematical concepts. They use mathematical concepts knowingly and unknowingly to solve their day to day farming problems. Most of them use their own conception and own mental schema in farming.

The field note of observation and interview show that many kinds of mathematical knowledge concepts were created through their experiments and practice. As the participation in observation, I taught them about these mathematical concepts were they were not clear. Sometimes they taught researcher through their own language about mathematical concepts.

Measurement System

The following measurement systems were practiced by farmers in their profession.

Weight Measurement

I asked the research questions to the respondent Ram Bilas Yadav by the help of interviews guidelines then he replied that any object or goods are measured by taraju. Measurement is mainly used to measure paddy, vegetable, corn, wheat etc. If there are not iron tools of measurement, they measure the weight using different measured sizes of stones. But young and educated people are slowly changing their measurement tools like digital taraju. The unit of weight measurement are: kilogram, gram, paseri, mann, quintal. They used the following measurement system:

1000gm	=	1kg
500gm	=	1/2kg
4kg	=	1paseri
40kg	=	1mann
100kg	=	1quintal

Measurement of Land for Farming

A respondent of the study Lakhan Mahato replied to my research questions that the farmland is usually measured in two ways: In terms of seed quantity required and in terms of ploughing. It is also measured in terms of grain yield. A paseri is the

unit of seed measurement of farmland. One paseri of paddy seed is sown in a land area 2 dhur. One ‘Halo’is the area ploughed in one day at normal ploughing speed and moorland is approximately 3 kattha, where one day is calculated between 6 am to 12 noon. The measurement unit of land are:Dhur, Kattha, Bigha, Lagi.

9 Haat	=	1 Lagi
1 Lagi× 1 Lagi	=	1 Dhur
20 Dhur	=	1 Kattha
20 Kattha	=	1Bigha

Measurement of Length and Distance

Two respondents of this research Ram Kishun Mahato and Shree Dev Chaudhary answered to my research questions that farmers still used their traditional measurement system. New generation use modern system of measurement tools to measure length and distance. But if they have to measure very short length of anything they use Auri, Bitta, Haat,Deg.

They use Bitta to measure short distance which is distance between the tips of the thumb to the tips of little finger which has shown in figure.

Fig. No.: 1 (Bitta)

Moreover, another measurement units is Haat and it is measured by the distance between elbows the tip of the thumb to the middle finger which has shown in figure.

Fig. No.: 2 (Haat)

Length Conversion

1 Bitta = 9 inch

1 Haat = 18 inch

2 Bitta = 1 Haat

They use the units as lengths to measure the lengths and breadth of house, land, etc. Sixty four years old sample person said to be time and distance used to measure the long distance by kosh. Kosh is a man travelling distance at one hour and a man travelling one day approximately ten kosh. If we don't have watch, we use shadow to guess time. When the shadow is going to near the object they think time is

closure to twelve o'clock and when sun is just above the man they also guess time is twelve o'clock.

Counting System

The concept of mathematics began with the concept of the counting in the ancient period. The people at that time might have used to count their family members and cattle by different things using one to one correspondence.

Mathematics is an important discipline to all human as they use it to solve their daily life problems. I asked research questions to JokhanMahato about counting system.

He replied that the counting system are; Ek, Dui, Teen, Char, Pach, Chha, Saat, Aath, Nau, Das etc. or Nepali counting system. They use more than twenty numbers such as

Twenty one	=	One bis one
Twenty five	=	One bis five
Forty	=	Two bis
Fifty	=	Two bis and one Das
Hundred	=	Five bis and so on

I also found that the farmers used the concept of fraction simply ½ which they called 'Aadha'. Except half other concept of fraction were not used in their practice.

Every occupation has some of its own language. Farmers use different language like; Mutha, Darjan, Sore.

Mutha	=	small quantity of seeds of paddy
Darjan	=	12 mutha
Sore	=	16 mutha

Geometrical Concepts Used by Farmers

Concept of Cylinder

It was found that farmers were using concepts of cylinder in their daily activity, to make Bhakari. They use Bhakari for keeping paddy. But they didn't know the meaning of cylinder. Following figure is concept of cylinder

Shape of Cylinder

Bhakari

Concept of Parallel Lines and Straight Lines

Within observation period, use of parallel line occurred much more than concept but sample population couldn't answer the question about parallel lines. It means that they have no terminology to speak for parallel lines. Despite of this situation, they use the concept of parallel lines in their daily activity. Following figure is concept of parallel lines and straight lines.

(Taat) **(Jafari)**

Fig. No.: 4 (Parallel lines, Straight lines& Shape of Triangle, Quadrilateral)

Concepts of Circle

I found that clear concept of circle of circle was assumed in farming (i.e. Supa) which is daily used tools for them. I asked the question about circle with sample person 'Do you know about circle?' they replied as didn't know about circle but he used the concept of circle in supa.

Distance between two points of rope in circumference, it is found that farmer is using the concept of circle with diameter even though they don't know the meaning of circle and diameter.

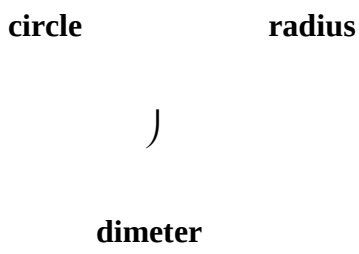

Fig. No.: 5 (Shape of Circle)

Tools Used by Farmers and Its Mathematical Concepts

All farmers used many kinds of farming tools to make more agricultural products. Some of them were made by themselves and other was brought from market. I found that mainly they used those farming tools like Halo, Palo, Chauki, Kodalo, Hasiya etc. Above mentioned tools and their utility is describe below:

Halo

Halo is most important tool in farming. It is used to plough the field. It is made by wood. I asked farmers that how could you determine the angle between Halo and Haris. All farmers have same answer that it is determined by length of Haris, height and length of ox.

The farmer said that the angle depends upon the size of ox. The height and length of ox are huge then the angle between Halo and Haris is big. The height and length of oxen are small then the angle between Halo and Haris is small.

` I concluded that from their answers, they used the concept of trigonometric ratios while using Halo. I compared their answer with hypotenuse, perpendicular and base as the length of Haris is hypotenuse, height of ox is perpendicular and base is length of ox.

Straight line **90^0**

Around 45^0

Fig. No.: 6 (Halo) **(Plough field)**

To construct halo they used the concept of angle, slope and perpendicularity. I found that it had around 45 degree angle between haris and phalli (iron stick) but handle was constructed around 150 degree angle. So, it provides the clear concept about angle, sum of angle, slope, straight lines and perpendicular line.

Paalo

Paalo is another tool of farmers. It is used to control oxen while plaughing the field. Left and right of the middle are to maintain the balance between two oxen. Paalo is to keep the relation with Halo. If the weak ox is in left side then the farmer keep the relation of Halo with right side of Palo. Finally, it shows that farmers have some knowledge about the equations to keep balance.

Fig. No.: 7 (Palo)

Hassiya

It is the most important tool of farmer. Handle of Hasiya is made by wood and remaining part is made by iron. It is used to cut the grass and crops. I asked them what about its shape. They replied ‘ghumal and terah’ to say mathematical curve and semi circle.

Fig. No.: 8 (Hassiya)

Kodalo

It is the most important tool of farmers. All farmers use it to dig up the field. Without kodalo farmers can’t do any work in their farm. Researcher asked them about relations of the angle between kodalo and its handle. They replied, the angle between kodalo and its handle is depending upon the body of farmers. When the inclination of body is less than the angle between them is small then the farmer had to incline more.

It shows that the farmers have mathematical knowledge about angle

Fig. No.: 9 (Kodalo)

Chauki

Chauki is also a major tool of farmer. It is also made by wood and bamboo. It is used to make the field plain. It shows that the concepts of plane are used by farmers when they used Chauki in farming.

Fig. No.: 10 (Making field plain)

Taal (Hay-rick)

Tall is that word which is used by farmers after harvest the paddy and collects it at the same place. From the interview, the researcher found out many more mathematical concepts are used by farmers while they make the Tall. Initial part of Tall they have to make approximately circular form. When they add another dry grass of paddy then the shape of Tall would be cylindrical form. Again the top of the Tall they make conical shapes to save the Tall from rains. It shows that farmer used

knowingly or unknowingly the mathematical concepts about circle, cylinder and cone.

Cone

Fig. No.: 11 (Taal)

Ropai

Ropar kept good line and length while re-planting the seeds of cauliflower. Most of the re-planted seeds approximately are as the form of quadrilateral. It showed that the farmers use knowingly and unknowingly the mathematical concepts about lines, parallel lines and quadrilateral.

Fig. No.: 12

Jabbi (Mukhauro)

I asked the research questions to farmers about geometrical concepts which used in their daily life activities by the help of interview guidelines. Then they replied

that the shape of this material was a semi-spherical and used to hang in oxen mouth when plowing field. It was constructed by the help of small splits of bamboo. Its upper parts are circular, some holes are regular hexagon and some are triangle in shape.

Fig. No.: 13 Jabbi (Mukhauro)

Bail gada

I asked the research questions to the respondent Ram Prit Mahato by the help of interview guidelines then he replied that bail gada is a two wheeled vehicle pulled by oxen. It is a means of transportation used since ancient times in many parts of the world. They are still used today where modern vehicle are expensive. It is used especially for carrying goods. The cart is attached to a pair of ox, but a rope may also be used for one or two ox. 10-15 years ago it is usually a slow trip through one village to another village or any places. I found that different mathematical concepts are used

in bail gada. Like as parallel lines, perpendicular lines, right angles, circle, circumference, raddi, diameter and center.

Fig. No.: 14 Bail gada

Observation and interview showed that the farmers used different type of mathematical concepts. They worked with applying those concepts, but they did not have any actual terminology and theoretical meaning formally. From this research, I got that fact farmers used knowingly and unknowingly many more mathematical concepts.

I argued that the farmer ‘do mathematics’ in the farming. Their mathematics has some unique characteristic that were different from the mathematics that we are seeing in textbook and formal class.

Unique characteristic of the farmer's mathematics is that explanation, discussion and problem solving activities were linked to concrete, contextual problematic that were used to provide physical prospective, mental models and analogies, and other unique characteristic is that a significant role was played by the farmers tools in the shaping of the mathematical ideas.

This shows that practice makes man perfect. My observation showed that many kind of mathematical knowledge were created through his experience and practice. Vygotsky's theory of social constructivism supports the above finding things

Practiced of Mathematical Concepts with Respect to Socio-Cultural Context

In this part, I have analyzed those facts that I have got from interview and observation to develop the mathematical concepts of farmer on his social cultural context. I tried to find the sources of mathematical knowledge of farmer, which they regularly use to solve their day to day problems in farming life.

All information was not possible to get easily. First of all, I asked questions about their economic background, formal education, and occupational background. After that I focused on collect mathematical information which I have needed. Farmers could not understand all the mathematical questions which I asked. So I have to provide some options for clear to them.

I asked them, when they started this occupation? Some of them started from childhood and some of them started young period. Again I asked my respondent Musaharu Yadav at the first time "Who taught you this farming?"

He replied some knowledge from their parents, uncle, elder brothers and some of them from neighbors, peer groups. At the first, I started my work slowly most of time is spent on entertainment. But practice makes man perfect so, my works was improved by day to day.

From this discussion it was found that practice makes man perfect so their works was improved by day to day works and mathematical knowledge was created through their experience and practice. This is supported by Vygotsky's theory of social constructivism.

According to my field notes of observation many kinds of mathematical knowledge were created through their practices and experiences. The farmers acquired some knowledge by seeing other do the works, by repeating the works with other and hearing what others say. These all information's were very close to the Vigotsky's theory of social constructivism.

For the next concept I asked question a respondent Ram Prakash Yadav to "How could you calculate the quantity of seeds and its productions?"

He replied that it depends upon the fertility of clay, quantity of rain, quality of seeds so we could not say actual quantity of productions.

It shows that the farmers had the mathematical concepts of different variables and effects.

I again asked questions related to the ideas to calculate the number of workers and Ropai to my respondents Jokhan Mahato and Palat Mahato.

Both of them had same answers that four – five years ago one Roper (person who plant the seeds of paddy) can plants paddy at least one kattha in one day. But now a day's one kattha land is planted by dorha Roper. There is 25-30 roper are required to plant one bigha land. For Ropai, Harbah (person who make ready the farm to plant paddy) dig up the field, made the field plane and ready to plant paddy on. After that Roper replanted the seeds about same line and length with equal distance. But it also depends upon seeds of paddy. The elder taught their younger how to do work and replant the seeds of paddy.

In this way they had used accurate number of workers to finish in time. It shows that the farmers had good calculation in their farming profession. Observation and interview should be vital to know their mathematical concepts. Co-operative activities also help to get extra concepts. They worked sometimes with their working groups and also through social interaction and speech helped to develop their some mathematical concepts or knowledge. Vygotsky say that the maturation also helps to get some mathematical concepts. They learned much in their everyday life through different ways socially.

Interviews and observation also showed they have good knowledge in arithmetic of practical life without all of them had not taken any formal education. All farmers frequently used numeric mathematical concepts to solve their daily life problems. I asked questions to my all respondents in group discussion "How you got the calculating knowledge without any formal education."

All respondents had replied that it was long experiences that make them more perfect and we realized and faced more difficulty due to lack of formal education.

We accepted that we take more times to calculate the simple mathematical problems. But, now a day we have used calculator machine to calculate some difficult mathematical problems.

I asked them "How they know to calculate the numerical problems from calculator machine."

Some of them replied they learned to calculate from their children who were studying in school\college level. Some of them replied the difficult mathematical calculation is solved by own children or family members who had knowledge of calculating on calculator. All of them accepted that the modern technology is also making in easier to solve the counting problems of farmers.

Farmers grow crops and sold their production, they sold those productions which produce more than they need like paddy, corn, wheat, potato, onion, different kinds of vegetables and fruits etc. they had to use numerical mathematical concepts. Then I asked Satrudhan Sada "What the selling price of paddy per qu."

He replied the rate of paddy is depending on different types of paddy. The rate of Mansuli paddy is Rs.2400, and sonamansuli is Rs.2200 per qu. and so on.

After that I asked questions related to the multiplication and division to him "How much rupees you have to pay to buy per k.g. of Mansuli paddy and one paseri of sonamansuli paddy?"

He immediately answered Rs.24 for one k.g. of mansuli paddy. And after some calculation he told Rs.88 for one paseri of sonamansuli.

Again I asked to him "How could make mathematical structure on your mind to calculate the numerical problems."

He replied that initially, it was very difficult and takes more time to calculate but now smoothly it was being easy and automatically occurs simple numerical mathematical concepts on their minds.

I showed that another way of achieving mathematical knowledge was marketing or shopping. Farmers need different types of farming instruments, different types of seeds and goods of daily use. For the shopping of these materials they discussed about its prices and discount rate. All of them had not any idea of discount about percentage but they requested to get the discount rate in rupees. In this way farmers had get mathematical concepts with respect to socio-cultural context.

Analysis of Farmer's Interaction for Learning Farming Skill

Interaction is a kind of action that occurs as two or more persons have an effect upon one another. It depends upon the personal intellectual capacity. According to constructivist approach learning takes place through co-operative sharing and adjustments. On the other hand, interactions help people in imitation of social model.

According to Vygotsky to promote cognitive development, social interaction must have certain feature. Children construct knowledge from the content and interaction with more knowledgeable others. Here, the knowledge acquired by child needs mediator like parents, adults, and peer to up lift their knowledge. In the case of farmers, I found from their interview that they had interacted with his parents, guardians and other fellows. Social constructivism theory state that knowledge is

socially constructed and children learn when they got contact with outer environment either verbally or observantly.

All farmers are uneducated person. Some of them can read and write slowly although they do not have any formal education. They can able to calculate that amount which is needed in their daily life activities. They have learned simply counting, addition and subtraction. All of the knowledge of farmers was acquired through their society, peers groups, adults, on their own thinking. Farmers got much mathematical knowledge as a farmer, as a teacher, as a learner, as a salesman. Co-operative activities and social contact also helped to get mathematical concepts.

Constructivist theory advocates that people construct their own understanding and knowledge of the world through experiencing and reflecting on those experiencing. Constructivism assumes that learners construct their own knowledge on the basis of interaction with their environment. Vygotsky stress that child construction of knowledge about the world is the mental process of child, which is highly influenced from the society and community. Therefore the finding of the study is similar to the Vygotskian theory of social constructivism.

Chapter v

FINDINGS, CONCLUSIONS AND IMPLICATIONS

In this chapter I had gone through my research objectives and the discussion on the findings of different domain of my study. I have established connection between the literature, theory and the analysis and interpretation of field data and findings of my study. During the analysis stages of my research in the previous chapter, I have answered to my research questions: what type of mathematical concepts does the farmer need? How does farmer acquire the mathematical concepts? How does his socio cultural context effect on his mathematical thinking? For this purpose, I visited farming, and then observed their work, their counting system and measuring system then took the interview with farmers. On the basis of their information and field data I have listed the following findings of my study:

Finding Related to Mathematical Concepts Used in Farming

Farmers use mathematical concepts in their daily farming works but they did not have actual meaning about mathematical terminology and its applied concepts. Farmers have own mathematical language to express different kind of formal mathematical terms such as; Gol to circle, Kon to angle, Ghumal to curve and so on. The farmers used different types of hidden mathematical terms. They used unknowingly the concept of sets, plane, area, circle, cone, cylinder, parallel lines, curves and simple numerical arithmetic calculations.

Finding Related to Mathematical Concepts Practiced by Farmers with Respect to Socio-Cultural Context

Farmers acquired mathematical knowledge as a learner, as a farmer, as a teacher and as a salesman. They learned mathematical concepts through their active participation and observation. All farmers learnt mathematics while facing their everyday life problems. They worked sometimes with their working groups and also through social interaction. They had interacted with his parents, guardians and other fellows. All the knowledge of farmers was acquired through their society, peers, groups, adults and on their own thinking.

Conclusions

Farmers need different type of mathematical concepts for their practical life and their farming life. This study totally concerned with those mathematical concepts which was used by the farmers in farming. It was concluded that the different types of mathematical terms and concepts is used in farming like; the concept of circle, angle, area, curve, cone, cylinder, plane, numerical calculation etc.

Mathematics is really important in wide range in the field of farming. In farming field accurate weather forecast is very much effective for farmers and they can predict the accurate weather. In case of soil analysis, like measurement acidity of soil, moisture content etc used are related to mathematics. Calculation of loss, profit is key terms of farmers. Mathematics makes chemical content analysis for fertilizers more accurate. Planning, plotting and improve estimates for expenditure.

Farmer achieved the mathematical concepts from different ways such as; from observing their guardians and neighbors, using experience and practices, reflections and interaction, art and individual creativity, to consult other farmers, to be as a farmer, as a teacher, as a learner, as a salesman.

Implications

The research was an ethnography study of uneducated farmers of Dhangadhimai municipality in Siraha who were involved in farming professions. The time of actual field work was one month. I had been practically involved in farming from my childhood it helped me to make open structure interview with those farmers for find the hidden mathematical terms in farming. The main implications of this study were as;

- Research in the field of farming and their ways of doing, learning, and teaching can facilitate to understand their ways and implement to the formal schooling.
- This research will be useful for local curriculum planner, teacher and book writers.
- A comparative study of educated and uneducated farmers in the achieving mathematical concepts.
- Socio-cultural context of mathematical thinking: a study of a group of farmers.
- This study was conducted in few days field work with little number of samples. So that future study can be done intensively with large number of samples.

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Appendix-I

Guidelines for Interview with Farmers

Name: Qualification:

Age: Farming Experience:

The interview with farmers was taken on the basis of following topic.

- Home environment
- Economic background
- Formal education
- Occupation background
- Mathematical concepts practiced by farmers

List of sample farmers

1. Musaharu Yadav
2. Ram Prakash Yadav
3. Jokhan Mahato
4. Palat Mahato
5. Satrudhan Sada
6. Shree dev Chaudhary
7. Ram Prit Mahato
8. Ram Bilash Yadav
9. Lakhan Mahato
10. Ram Kishun Mahato

Appendix-II

Questionnaires

1. When you started this occupation?
2. Who taught you this farming?
3. How could you calculate the quantity of seeds and its productions?
4. How could you calculate number of workers and ropai?
5. How you got the calculating knowledge without any formal education?
6. How you know to calculate the numerical problems from calculator machine?
7. What the selling price of paddy per qu.?
8. If the rate of mansuli paddy is Rs.2400 then how much rupees you have to pay to buy per kg of mansuli paddy?
9. If the rate of sonamansuli paddy is Rs.2200 then how much rupees you have to pay one paseri of sonamansuli paddy?
10. How could make mathematical structure on your mind to calculate the numerical problems?
11. How could you determine the angle between halo and harish?
12. How could you determine the angle between kodalo and its handle?

Appendix-III