NOTE OF UNIT: III
RESEARCH AND RESEARCH ETHICS

Compiled by
Dr. Narendrasinh B. Chauhan
Professor and Head
Department of Extension Education
B.A.College of Agriculture, AAU, Anand

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INSTRUCTION FOR THE ASSIGNMENT TO BE SUBMITTED FOR THIS UNIT

1. **Followings are the questions for assignment to be answered and submitted to the course teacher in the handwritten form compulsorily on or before 15th April, 2012.**
   1. Write any five definitions of 'Research".
   2. Briefly describe the different steps involved in a research process
   3. What do you mean by research? Explain its significance in modern times.
   4. Distinguish between Research methods and Research methodology.
   5. Describe the different types of research, clearly pointing out the difference between an experiment and a survey.
   6. Write short notes on:
      - Design of the research project;
      - Ex post facto research;

- Motivation in research;
- Objectives of research;
- Criteria of good research;
- Research and scientific method.

7. "Empirical research in India in particular creates so many problems for the researchers". State the problems that are usually faced by such researchers.
8. "A research scholar has to work as a judge and derive the truth and not as a pleader who is only eager to prove his case in favour of his plaintiff." Discuss the statement pointing out the objectives of research.
9. "Research is much concerned with proper fact finding, analysis and evaluation." Do you agree with this statement? Give reasons in support of your answer.
10. It is often said that there is not a proper link between some of the activities under way in the world of academics and in most business in our country. Account for this state of affairs and give suggestions for improvement.

2. **At the end of this unit, objective types of questions with correct answers in multiple choice forms have been given for the semester end examinations. Students are informed to study them carefully.**

RESEARCH

MEANING OF RESEARCH

1. Research is a derivative of the French word; 'Researche' means quest, search, pursuit and search for truth.
2. Research in common parlance refers to a search for knowledge.
3. It is a careful investigation or inquiry especially through search for new facts in any branch of knowledge.
4. It is systematized effort to gain new knowledge.
5. According to Clifford Woody research comprises defining and redefining problems, formulating hypothesis or suggested solutions; collecting, organizing and evaluating data; making deductions and reaching conclusions; and at last carefully testing the conclusions to determine whether they fit the formulating hypothesis.
6. D. Slesinger and M. Stephenson in the Encyclopedia of Social Sciences define research as "the manipulation of things, concepts or symbols for the purpose of generalizing to extend, correct or verify knowledge, whether that knowledge aids in construction of theory or in the practice of an art."
7. Research is, an original contribution to the existing stock of knowledge making for its advancement. It is the detection of truth with the help of study, observation, comparison and experiment.
8. Research is the systematic approach concerning generalisation and the formulation of a theory.
9. The research refers to the systematic method consisting of enunciating the problem, formulating a hypothesis, collecting the facts or data, analysing the facts and reaching certain conclusions either in the form of solutions(s) towards the concerned problem or in certain generalisations for some theoretical formulation.
10. Research means mission, search, hunt, and exploration for truth. The purpose of research is to discover answers to questions or problems through the application of scientific procedures.
11. Scientific research is a systematic, controlled, empirical and critical investigation of hypothetical propositions about the presumed relations among natural phenomenon.

12. Research is a careful, critical and disciplined enquiry, varying in technique and method.
13. According to the nature and conditions of the problem identified, research is directed towards clarification or/and resolution of the problem. The purpose of research is to discover answers to questions or problems through the application of scientific procedures.

OBJECTIVES OF RESEARCH

The purpose of research is to discover answers to questions through the application of scientific procedures. The main aim of research is to find out the truth which is hidden and which has not been discovered as yet. Though each research study has its own specific purpose, we may think of research objectives as falling into a number of following broad groupings:

1. To gain familiarity with a phenomenon or to achieve new insights into it **(studies with this object in view are termed as exploratory or formulative research studies**);
2. To portray accurately the characteristics of a particular individual, situation or a group **(studies with this object in view are known as descriptive research studies**);
3. To determine the frequency with which something occurs or with which it is associated with something else **(studies with this object in view are known as diagnostic research studies**);
4. To test a hypothesis of a causal relationship between variables (**such studies are known as hypothesis-testing research studies).**

MOTIVATION IN RESEARCH

What makes people to undertake research? This is a question of fundamental importance. The possible motives for doing research may be either one or more of the following:

1. Desire to get a research degree along with its consequential benefits;
2. Desire to face the challenge in solving the unsolved problems, i.e., concern over practical problems initiates research;
3. Desire to get intellectual joy of doing some creative work;
4. Desire to be of service to society;
5. Desire to get respectability.
6. Curiosity about unknown
7. Desire to understand the cause and effect of wide spread social problems
8. Appearance of novel and unanticipated situations
9. Desire to discover new and test old scientific procedure as an efficient way to gain useful and fundamental knowledge.

However, this is not an exhaustive list of factors motivating people to undertake research studies. Many more factors such as directives of government, employment conditions, curiosity about new things, desire to understand causal relationships, social thinking and awakening, and the like may as well motivate (or at times compel) people to perform research operations.

TYPES OF RESEARCH

THE BASIC TYPES OF RESEARCH ARE AS FOLLOWS:

1. **Descriptive vs. Analytical:** Descriptive research includes surveys and fact-finding enquiries of different kinds. The major purpose of descriptive research is description of the state of affairs as it exists at present. In social science and business research we quite often use the term **Ex post facto**

research for descriptive research studies. The main characteristic of this method is that the researcher has no control over the variables; he can only report what has happened or what is happening. Most ex post facto research projects are used for descriptive studies in which the researcher seeks to measure such items as, for example, frequency of shopping, preferences of people, or similar data. **Ex post facto studies** also include attempts by researchers to discover causes even when they cannot control the variables. The methods of research utilized in descriptive research are survey methods of all kinds, including comparative and correlation methods. In *analytical research*, on the other hand, the researcher has to use facts or information already available, and analyze these to make a critical evaluation of the material.

2. **Applied vs. Fundamental:** Research can either be applied (or action) research or fundamental (to basic or pure) research. *Applied research* aims at finding a solution for an immediate problem facing a society or an industrial/business organisation, whereas **fundamental research** is mainly concerned with generalisations and with the formulation of a theory. "Gathering knowledge for knowledge's sake is termed 'pure' or 'basic' research." Research concerning some natural phenomenon or relating to pure mathematics are examples of fundamental research. Similarly, research studies, concerning human behaviour carried on with a view to make generalisations about human behaviour, are also examples of fundamental research, but research aimed at certain conclusions (say, a solution) facing a concrete social or business problem is an example of applied research. Research to identify social, economic or political trends that may affect a particular institution or the copy research (research to find out whether certain communications will be read and understood) or the marketing research or evaluation research are examples of applied research. Thus, the central aim of applied research is to discover a solution for some pressing practical problem, whereas basic research is directed towards finding information that has a broad base of applications and thus, adds to the already existing organized body of scientific knowledge.

3. **Quantitative vs. Qualitative:** Quantitative research is based on the measurement of quantity or amount. It is applicable to phenomena that can be expressed in terms of quantity. Qualitative research, on the other hand, is concerned with qualitative phenomenon, i.e., phenomena relating to or involving quality or kind. For instance, when we are interested in investigating the reasons for human behaviour (i.e., why people think or do certain things), we quite often talk of 'Motivation Research', an important type of qualitative research. This type of research aims at discovering the underlying motives and desires, using in depth interviews for the purpose. Other techniques of such research are word association tests, sentence completion tests, story completion tests and similar other projective techniques. Attitude or opinion research i.e., research designed to find out how people feel or what they think about a particular subject or institution is also qualitative research. Qualitative research is especially important in the behavioural sciences where the aim is to discover the underlying motives of human behaviour. Through such research we can analyse the various factors which motivate people to behave in a particular manner or which make people like or dislike a particular thing. It may be stated, however, that to apply qualitative research in practice is relatively a difficult job and therefore, while doing such research, one should seek guidance from experimental psychologists.

4. **Conceptual vs. Empirical:** Conceptual research is that related to some abstract idea(s) or theory. It is generally used by philosophers and thinkers to develop new concepts or to reinterpret existing ones. On the other hand, empirical research relies on experience or observation alone, often without due regard for system and theory. It is data-based research, coming up with conclusions which are capable of being verified by observation or experiment. We can also call it as experimental type of research. In such a research it is necessary to get at facts firsthand, at their source, and actively to go about doing certain things to stimulate the production of desired information. In such a research, the researcher must first provide himself with a working hypothesis or guess as to the probable results. He then works to get enough facts (data) to prove or disprove his hypothesis. He then sets

up experimental designs which he thinks will manipulate the persons or the materials concerned so as to bring forth the desired information. Such research is thus characterised by the experimenter's control over the variables under study and his deliberate manipulation of one of them to study its effects. Empirical research is appropriate when proof is sought that certain variables affect other variables in some way. Evidence gathered through experiments or empirical studies is today considered to be the most powerful support possible for a given hypothesis.

5. **Some Other Types of Research:** All other types of research are variations of one or more of the above stated approaches, based on either the purpose of research, or the time required to accomplish research, on the environment in which research is done, or on the basis of some other similar factor. Form the point of view of time, we can think of research either as **one-time research or longitudinal research**. In the former case the research is confined to a single time-period, whereas in the latter case the research is carried on over several time-periods. Research can be **field-setting research or laboratory research or simulation research**, depending upon the environment in which it is to be carried out. Research can as well be understood as **clinical or diagnostic research**. Such research follows **case-study** methods or **in-depth approaches** to reach the basic causal relations. Such studies usually go deep into the causes of things or events that interest us, using very small samples and very deep probing data gathering devices. The research may be **exploratory** or it may be **formalized.** The objective of exploratory research is the development of hypotheses rather than their testing, whereas formalized research studies are those with substantial structure and with specific hypotheses to be tested. **Historical research** is that which utilizes historical sources like documents, remains, etc. to study events or ideas of the past, including the philosophy of persons and groups at any remote point of time. Research can also be classified as *conclusion-oriented* and decision-oriented. While doing conclusion oriented research, a researcher is free to pick up a problem, redesign the enquiry as he proceeds and is prepared to conceptualize as he wishes. Decision-oriented research is always for the need of a decision maker and the researcher in this case is not free to embark upon research according to his own inclination. Operations research is an example of decision oriented research since it is a scientific method of providing executive departments with a quantitative basis for decisions regarding operations under their control.

RESEARCH APPROACHES

The above description of the types of research brings to light the fact that there are two basic approaches to research, **viz., quantitative approach and the qualitative approach.**

1. The quantitative approach involves the generation of data in quantitative form which can be subjected to rigorous quantitative analysis in a formal and rigid fashion. This approach can be further sub-classified into **inferential, experimental and simulation approaches** to research.

   - **The inferential approach's** purpose is to research is to form a data base from which to infer characteristics or relationships of population. This usually means survey research where a sample of population is studied (questioned or observed) to determine its characteristics, and it is then inferred that the population has the same characteristics.
   - **Experimental approach** is characterised by much greater control over the research environment and in this case some variables are manipulated to observe their effect on other variables.
   - **Simulation approach** involves the construction of an artificial environment within which relevant information and data can be generated. This permits an observation of the dynamic behaviour of a system (or its sub-system) under controlled conditions. The term 'simulation' in the context of business and social sciences applications refers to "the operation of a numerical model that represents the structure of a dynamic process. Given the values of initial conditions, parameters

and exogenous variables, a simulation is run to represent the behaviour of the process over time."5 Simulation approach can also be useful in building models for understanding future conditions.

2. **Qualitative approach** to research is concerned with subjective assessment of attitudes, opinions and behaviour. Research in such a situation is a function of researcher's insights and impressions. Such an approach to research generates results either in non-quantitative form or in the form which are not subjected to rigorous quantitative analysis. Generally, the techniques of focus group interviews, projective techniques and depth interviews are used. All these are explained at length in chapters that follow.

SIGNIFICANCE OF RESEARCH

"All progress is born of inquiry. Doubt is often better than overconfidence, for it leads to inquiry, and inquiry leads to invention" is a famous Hudson Maxim in context of which the significance of research can well be understood. Increased amounts of research make progress possible. Research inculcates scientific and inductive thinking and it promotes the development of logical habits of thinking and organisation.

The role of research in several fields of applied economics, whether related to business or to the economy as a whole, has greatly increased in modern times. The increasingly complex nature of business and government has focused attention on the use of research in solving operational problems. Research, as an aid to economic policy, has gained added importance, both for government and business.

Research provides the basis for nearly all government policies in our economic system. For instance, government's budgets rest in part on an analysis of the needs and desires of the people and on the availability of revenues to meet these needs. The cost of needs has to be equated to probable revenues and this is a field where research is most needed. Through research we can devise alternative policies and can as well examine the consequences of each of these alternatives.

Decision-making may not be a part of research, but research certainly facilitates the decisions of the policy maker. Government has also to chalk out programmes for dealing with all facets of the country's existence and most of these will be related directly or indirectly to economic conditions. The plight of cultivators, the problems of big and small business and industry, working conditions, trade union activities, the problems of distribution, even the size and nature of defense services are matters requiring research. Thus, research is considered necessary with regard to the allocation of nation's resources. Another area in government, where research is necessary, is collecting information on the economic and social structure of the nation. Such information indicates what is happening in the economy and what changes are taking place. Collecting such statistical information is by no means a routine task, but it involves a variety of research problems. These days nearly all governments maintain large staff of research technicians or experts to carry on this work. Thus, in the context of government, research as a tool to economic policy has three distinct phases of operation, viz., (i) investigation of economic structure through continual compilation of facts; (ii) diagnosis of events that are taking place and the analysis of the forces underlying them; and (iii) the prognosis, i.e., the prediction of future developments.

Research has its special significance in solving various operational and planning problems of business and industry. Operations research and market research, along with motivational research, are considered crucial and their results assist, in more than one way, in taking business decisions. Market research is the investigation of the structure and development of a market for the purpose of formulating efficient policies for purchasing, production and sales. Operations research refers to the application of mathematical, logical and analytical techniques to the solution of business problems of cost minimization or of profit maximization or what can be termed as optimization problems. Motivational research of determining why people behave as

they do is mainly concerned with market characteristics. In other words, it is concerned with the determination of motivations underlying the consumer (market) behaviour. All these are of great help to people in business and industry who are responsible for taking business decisions. Research with regard to demand and market factors has great utility in business. Given knowledge of future demand, it is generally not difficult for a firm, or for an industry to adjust its supply schedule within the limits of its projected capacity. Market analysis has become an integral tool of business policy these days. Business budgeting, which ultimately results in a projected profit and loss account, is based mainly on sales estimates which in turn depend on business research. Once sales forecasting is done, efficient production and investment programmes can be set up around which are grouped the purchasing and financing plans. Research, thus, replaces intuitive business decisions by more logical and scientific decisions.

Research is equally important for social scientists in studying social relationships and in seeking answers to various social problems. It provides the intellectual satisfaction of knowing a few things just for the sake of knowledge and also has practical utility for the social scientist to know for the sake of being able to do something better or in a more efficient manner. Research in social sciences is concerned both with knowledge for its own sake and with knowledge for what it can contribute to practical concerns. "This double emphasis is perhaps especially appropriate in the case of social science. On the one hand, its responsibility as a science is to develop a body of principles that make possible the understanding and prediction of the whole range of human interactions. On the other hand, because of its social orientation, it is increasingly being looked to for practical guidance in solving immediate problems of human relations.

In addition to what has been stated above, the significance of research can also be understood keeping in view the following points:

(a) To those students who are to write a master's or Ph.D. thesis, research may mean a careerism or a way to attain a high position in the social structure;
(b) To professionals in research methodology, research may mean a source of livelihood;
(c) To philosophers and thinkers, research may mean the outlet for new ideas and insights;
(d) To literary men and women, research may mean the development of new styles and creative work;
(e) To analysts and intellectuals, research may mean the generalisations of new theories.

Thus, research is the fountain of knowledge for the sake of knowledge and an important source of providing guidelines for solving different business, governmental and social problems. It is a sort of formal training which enables one to understand the new developments in one's field in a better way.

RESEARCH METHODS VERSUS METHODOLOGY

It seems appropriate at this juncture to explain the difference between research methods and research methodology. *Research methods* may be understood as all those methods/techniques that are used for conduction of research. *Research methods or techniques**, *thus*, *refer to the methods the researchers* *At times, a distinction is also made between research techniques and research methods. *Research techniques* refer to the behaviour and instruments we use in performing research operations such as making observations, recording data, techniques of processing data and the like. *Research methods* refer to the behaviour and instruments used in selecting and constructing research technique. For instance, the difference between methods and techniques of data collection can better be understood from the details given in the following chart use in performing research operations.

In other words, all those methods which are used by the researcher during the course of studying his research problem are termed as research methods. Since the object of research, particularly the applied research, it to arrive at a solution for a given problem, the available data and the unknown aspects of the problem have to be related to each other to make a solution possible. Keeping this in view, research methods can be put into the following three groups:

1. In the first group we include those methods which are concerned with the collection of data. These methods will be used where the data already available are not sufficient to arrive at the required solution;
2. The second group consists of those statistical techniques which are used for establishing relationships between the data and the unknowns;
3. The third group consists of those methods which are used to evaluate the accuracy of the results obtained. Research methods falling in the above stated last two groups are generally taken as the analytical tools of research.

	Type		Methods	Techniques
1	Library research	i.	Analysis of Historical records	Recording of notes, Content analysis, Tape and Film listening and analysis
		ii.	Analysis of documents	Statistical compilations and manipulations, reference and abstract guides, contents analysis.
2	Field Research	i.	Non-participant direct observation	Observational behavioural scales, use of score cards, etc
		ii.	Participant observation	Interactional recording, possible use of tape recorders, photo graphic techniques
		iii.	Mass observation	Recording mass behaviour, interview using independent observers in public places.
		iv.	Mail questionnaire	Identification of social and economic background of respondents.
		v.	Opinionnaire	Use of attitude scales, projective techniques, use of socio-metric scales.
		vi.	Personal interview	Interviewer uses a detailed schedule with open and closed questions.
		vii	Focused interview	Interviewer focuses attention upon a given experience and its effects.
		viii	Group interview	Small groups of respondents are interviewed simultaneously.
		ix.	Telephone survey	Used as a survey technique for information and for discerning opinion; may also be used as a follow up of questionnaire.
		x.	Case study and life history	Cross sectional collection of data for intensive analysis, longitudinal collection of data of intensive character.
3	Laboratory Research		Small group study of random behaviour play and role analysis	Use of audio-visual recording devices, use of observers, etc

From what has been stated above, we can say that methods are more general. It is the methods that generate techniques. However, in practice, the two terms are taken as interchangeable and when we talk of research methods we do, by implication, include research techniques within their compass.

Research methodology is a way to systematically solve the research problem. It may be understood as a science of studying how research is done scientifically. In it we study the various steps that are generally adopted by a researcher in studying his research problem along with the logic behind them. It is necessary for the researcher to know not only the research methods/techniques but also the methodology. Researchers not only need to know how to develop certain indices or tests, how to calculate the mean, the mode, the median or the standard deviation or chi-square, how to apply particular research techniques, but they also need to know which of these methods or techniques, are relevant and which are not, and what would they mean and indicate and why. Researchers also need to understand the assumptions underlying various techniques and they need to know the criteria by which they can decide that certain techniques and procedures will be applicable to certain problems and others will not. All this means that it is necessary for the researcher to design his methodology for his problem as the same may differ from problem to problem. For example, an architect, who designs a building, has to consciously evaluate the basis of his decisions, i.e., he has to evaluate why and on what basis he selects particular size, number and location of doors, windows and ventilators, uses particular materials and not others and the like. Similarly, in research the scientist has to expose the research decisions to evaluation before they are implemented. He has to specify very clearly and precisely what decisions he selects and why he selects them so that they can be evaluated by others also.

From what has been stated above, we can say that research methodology has many dimensions and research methods do constitute a part of the research methodology. The scope of research methodology is wider than that of research methods. Thus, when we talk of research methodology we not only talk of the research methods but also consider the logic behind the methods we use in the context of our research study and explain why we are using a particular method or technique and why we are not using others so that research results are capable of being evaluated either by the researcher himself or by others. Why a research study has been undertaken, how the research problem has been defined, in what way and why the hypothesis has been formulated, what data have been collected and what particular method has been adopted, why particular technique of analysing data has been used and a host of similar other questions are usually answered when we talk of research methodology concerning a research problem or study.

Research and Scientific Method

For a clear perception of the term research, one should know the meaning of scientific method. The two terms, research and scientific method, are closely related. Research, as we have already stated, can be termed as "an inquiry into the nature of, the reasons for, and the consequences of any particular set of circumstances, whether these circumstances are experimentally controlled or recorded just as they occur. Further, research implies the researcher is interested in more than particular results; he is interested in the repeatability of the results and in their extension to more complicated and general situations."7 On the other hand, the philosophy common to all research methods and techniques, although they may vary considerably from one science to another, is usually given the name of scientific method. In this context, Karl Pearson writes, "The scientific method is one and same in the branches (of science) and that method is the method of all logically trained minds … the unity of all sciences consists alone in its methods, not its material; the man who classifies facts of any kind whatever, who sees their mutual relation and describes their sequences, is applying the Scientific Method and is a man of science." Scientific method is the pursuit of truth as determined by logical considerations. The ideal of science is to achieve a systematic interrelation of facts. Scientific method attempts to achieve "this ideal by experimentation, observation, logical arguments from accepted postulates and a combination of these three in varying proportions."9 In scientific method, logic aids in formulating propositions explicitly and accurately so that their possible alternatives become clear. Further, logic develops the consequences of such alternatives, and when these are compared with observable phenomena, it becomes possible for the researcher or the scientist to state which alternative is most in harmony with the observed facts. All this is done through experimentation and survey investigations which constitute the integral parts of scientific method.

Experimentation is done to test hypotheses and to discover new relationships, if any, among variables. But the conclusions drawn on the basis of experimental data are generally criticized for faulty assumptions, poorly designed experiments, badly executed experiments or faulty interpretations. As such the researcher must pay all possible attention while developing the experimental design and must state only probable inferences. The purpose of survey investigations may also be to provide scientifically gathered information to work as a basis for the researchers for their conclusions.

The scientific method is, thus, based on certain basic postulates which can be stated as under:

1. It relies on empirical evidence;
2. It utilizes relevant concepts;
3. It is committed to only objective considerations;
4. It presupposes ethical neutrality, i.e., it aims at nothing but making only adequate and correct statements about population objects;
5. It results into probabilistic predictions;

6. Its methodology is made known to all concerned for critical scrutiny are for use in testing the conclusions through replication;
7. It aims at formulating most general axioms or what can be termed as scientific theories.

Thus, "the scientific method encourages a rigorous, impersonal mode of procedure dictated by the demands of logic and objective procedure."10 Accordingly, scientific method implies an objective, logical and systematic method, i.e., a method free from personal bias or prejudice, a method to ascertain demonstrable qualities of a phenomenon capable of being verified, a method wherein the researcher is guided by the rules of logical reasoning, a method wherein the investigation proceeds in an orderly manner and a method that implies internal consistency.

Importance of Knowing How Research is done?

The study of research methodology gives the student the necessary training in gathering material and arranging or card-indexing them, participation in the field work when required, and also training in techniques for the collection of data appropriate to particular problems, in the use of statistics, questionnaires and controlled experimentation and in recording evidence, sorting it out and interpreting it. In fact, importance of knowing the methodology of research or how research is done stems from the following considerations:

(i) For one who is preparing himself for a career of carrying out research, the importance of knowing research methodology and research techniques is obvious since the same constitute the tools of his trade. The knowledge of methodology provides good training especially to the new research worker and enables him to do better research. It helps him to develop disciplined thinking or a 'bent of mind' to observe the field objectively. Hence, those aspiring for careerism in research must develop the skill of using research techniques and must thoroughly understand the logic behind them.

(ii) Knowledge of how to do research will inculcate the ability to evaluate and use research results with reasonable confidence. In other words, we can state that the knowledge of research methodology is helpful in various fields such as government or business administration, community development and social work where persons are increasingly called upon to evaluate and use research results for action.

(iii) When one knows how research is done, then one may have the satisfaction of acquiring a new intellectual tool which can become a way of looking at the world and of judging every day experience. Accordingly, it enables use to make intelligent decisions concerning problems facing us in practical life at different points of time. Thus, the knowledge of research methodology provides tools to take at things in life objectively.

(iv) In this scientific age, all of us are in many ways consumers of research results and we can use them intelligently provided we are able to judge the adequacy of the methods by which they have been obtained. The knowledge of methodology helps the consumer of research results to evaluate them and enables him to take rational decisions.

RESEARCH PROCESS

Before embarking on the details of research methodology and techniques, it seems appropriate to present a brief overview of the research process. Research process consists of series of actions or steps necessary to effectively carry out research and the desired sequencing of these steps. The chart shown in Figure 1.1 well illustrates a research process.

The research process consists of a number of closely related activities. The following order concerning various steps provides a useful procedural guideline regarding the research process:

1. **Formulating the research problem**
2. **Extensive literature survey**
3. **Developing the hypothesis**
4. **Preparing the research design**
5. **Determining sample design**
6. **Collecting the data**
7. **Execution of the project**
8. **Analysis of data**
9. **Hypothesis testing**
10. **Generalisations and interpretation**
11. **Preparation of the report or presentation of the results, i.e., formal write-up of conclusions reached.**

A brief description of the above stated steps will be helpful.

1. Formulating the research problem: There are two types of research problems, viz., those which relate to states of nature and those which relate to relationships between variables. At the very outset the researcher must single out the problem he wants to study, i.e., he must decide the general area of interest or aspect of a subject-matter that he would like to inquire into. Initially the problem may be stated in a broad general way and then the ambiguities, if any, relating to the problem be resolved. Then, the feasibility of a particular solution has to be considered before a working formulation of the problem can be set up. The formulation of a general topic into a specific research problem, thus, constitutes the first step in a scientific enquiry. Essentially two steps are involved in formulating the research problem, viz., understanding the problem thoroughly, and rephrasing the same into meaningful terms from an analytical point of view.

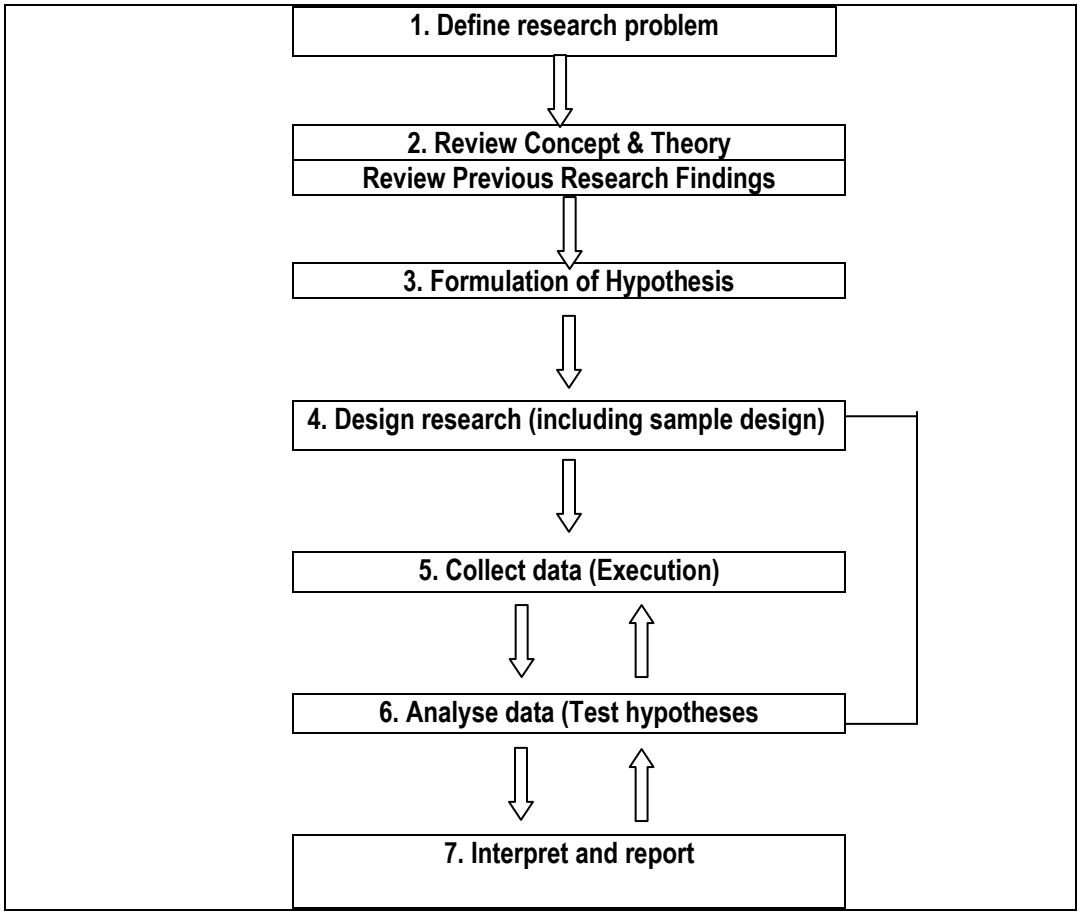
The best way of understanding the problem is to discuss it with one's own colleagues or with those having some expertise in the matter. In an academic institution the researcher can seek the help from a guide who is usually an experienced man and has several research problems in mind. Often, the guide puts forth the problem in general terms and it is up to the researcher to narrow it down and phrase the problem in operational terms. In private business units or in governmental organisations, the problem is usually earmarked by the administrative agencies with which the researcher can discuss as to how the problem originally came about and what considerations are involved in its possible solutions.

The researcher must at the same time examine all available literature to get himself acquainted with the selected problem. He may review two types of literature—the conceptual literature concerning the concepts and theories, and the empirical literature consisting of studies made earlier which are similar to the one proposed. The basic outcome of this review will be the knowledge as to what data and other materials are available for operational purposes which will enable the researcher to specify his own research problem in a meaningful context. After this the researcher rephrases the problem into analytical or operational terms i.e., to put the problem in as specific terms as possible. This task of formulating, or defining, a research problem is a step of greatest importance in the entire research process. The problem to be investigated must be defined unambiguously for that will help discriminating relevant data from irrelevant ones. Care must; however, be taken to verify the objectivity and validity of the background facts concerning the problem.

The statement of the objective is of basic importance because it determines the data which are to be collected, the characteristics of the data which are relevant, relations which are to be explored, the choice of techniques to be used in these explorations and the form of the final report. If there are certain pertinent terms, the same should be clearly defined along with the task of formulating the problem. In fact, formulation of the problem often follows a sequential pattern where a number of formulations are set up, each

formulation more specific than the proceeding one, each one phrased in more analytical terms, and each more realistic in terms of the available data and resources.

RESEARCH PROCESS IN FLOW CHART



2. Extensive literature survey: Once the problem is formulated, a brief summary of it should be written down. It is compulsory for a research worker writing a thesis for a Ph.D. degree to write a synopsis of the topic and submit it to the necessary Committee or the Research Board for approval. At this juncture the researcher should undertake extensive literature survey connected with the problem. For this purpose, the abstracting and indexing journals and published or unpublished bibliographies are the first place to go to. Academic journals, conference proceedings, government reports, books etc., must be tapped depending on the nature of the problem. In this process, it should be remembered that one source will lead to another. The earlier studies, if any, which are similar to the study in hand, should be carefully studied. A good library will be a great help to the researcher at this stage.

3. Development of working hypotheses: After extensive literature survey, researcher should state in clear terms the working hypothesis or hypotheses. Working hypothesis is tentative assumption made in order to draw out and test its logical or empirical consequences. As such the manner in which research hypotheses are developed is particularly important since they provide the focal point for research. They also affect the manner in which tests must be conducted in the analysis of data and indirectly the quality of data which is required for the analysis. In most types of research, the development of working hypothesis plays an

important role. Hypothesis should be very specific and limited to the piece of research in hand because it has to be tested. The role of the hypothesis is to guide the researcher by delimiting the area of research and to keep him on the right track. It sharpens his thinking and focuses attention on the more important facets of the problem. It also indicates the type of data required and the type of methods of data analysis to be used.

How does one go about developing working hypotheses? The answer is by using the following approach:

(a) Discussions with colleagues and experts about the problem, its origin and the objectives in seeking a solution;
(b) Examination of data and records, if available, concerning the problem for possible trends, peculiarities and other clues;
(c) Review of similar studies in the area or of the studies on similar problems; and
(d) Exploratory personal investigation which involves original field interviews on a limited scale with interested parties and individuals with a view to secure greater insight into the practical aspects of the problem.

Thus, working hypotheses arise as a result of a-priori thinking about the subject, examination of the available data and material including related studies and the counsel of experts and interested parties. Working hypotheses are more useful when stated in precise and clearly defined terms. It may as well be remembered that occasionally we may encounter a problem where we do not need working hypotheses, especially in the case of exploratory or formulative researches which do not aim at testing the hypothesis. But as a general rule, specification of working hypotheses in another basic step of the research process in most research problems.

4. Preparing the research design: The research problem having been formulated in clear cut terms, the researcher will be required to prepare a research design, i.e., he will have to state the conceptual structure within which research would be conducted. The preparation of such a design facilitates research to be as efficient as possible yielding maximal information. In other words, the function of research design is to provide for the collection of relevant evidence with minimal expenditure of effort, time and money. But how all these can be achieved depends mainly on the research purpose. Research purposes may be grouped into four categories, viz., (i) Exploration, (ii) Description, (iii) Diagnosis, and (iv) Experimentation. A flexible research design which provides opportunity for considering many different aspects of a problem is considered appropriate if the purpose of the research study is that of exploration. But when the purpose happens to be an accurate description of a situation or of an association between variables, the suitable design will be one that minimises bias and maximises the reliability of the data collected and analysed.

There are several research designs, such as, experimental and non-experimental hypothesis testing. Experimental designs can be either informal designs (such as before-and-after without control, after-only with control, before-and-after with control) or formal designs (such as completely randomized design, randomized block design, Latin square design, simple and complex factorial designs), out of which the researcher must select one for his own project.

The preparation of the research design, appropriate for a particular research problem, involves usually the consideration of the following:

(i) The means of obtaining the information;
(ii) The availability and skills of the researcher and his staff (if any);
(iii) Explanation of the way in which selected means of obtaining information will be organised and the reasoning leading to the selection;
(iv) The time available for research; and

(v) The cost factor relating to research, i.e., the finance available for the purpose.

5. Determining sample design: Sampling is the process of selecting units (e.g., people, organizations) from a population of interest so that by studying the sample we may fairly generalize our results back to the population from which they were chosen.

Population is the set of individuals, items, or data from which a statistical sample is taken it is also called universe. **Sample** is representative part of the population which contains each characterizes that entire population possesses.

Researchers rarely survey the entire population for two reasons. The cost is too high, and the population is dynamic in that the individuals making up the population may change over time. The three main advantages of sampling are that the cost is lower, data collection is faster, and since the data set is smaller it is possible to ensure homogeneity and to improve the accuracy and quality of the data.

All the items under consideration in any field of inquiry constitute a 'universe' or 'population'. A complete enumeration of all the items in the 'population' is known as a census inquiry. It can be presumed that in such an inquiry when all the items are covered no element of chance is left and highest accuracy is obtained. But in practice this may not be true. Even the slightest element of bias in such an inquiry will get larger and larger as the number of observations increases. Moreover, there is no way of checking the element of bias or its extent except through a resurvey or use of sample checks. Besides, this type of inquiry involves a great deal of time, money and energy, not only this; census inquiry is not possible in practice under many circumstances. For instance, blood testing is done only on sample basis. Hence, quite often we select only a few items from the universe for our study purposes. The items so selected constitute what is technically called a sample.

The researcher must decide the way of selecting a sample or what is popularly known as the sample design. In other words, a sample design is a definite plan determined before any data are actually collected for obtaining a sample from a given population. Thus, the plan to select 12 of a city's 200 drugstores in a certain way constitutes a sample design. Samples can be either probability samples or non-probability samples. With probability samples each element has a known probability of being included in the sample but the non-probability samples do not allow the researcher to determine this probability.

Probability samples are those based on simple random sampling, systematic sampling, stratified sampling, cluster/area sampling whereas non-probability samples are those based on convenience sampling, judgement sampling and quota sampling techniques.

A brief mention of the important sample designs is as follows:

A. Deliberate sampling/ Purposive sampling: Deliberate sampling is also known as purposive or non-probability sampling. This sampling method involves purposive or deliberate selection of particular units of the universe for constituting a sample which represents the universe. When population elements are selected for inclusion in the sample based on the ease of access, it can be called *convenience sampling*. If a researcher wishes to secure data from, say, gasoline buyers, he may select a fixed number of petrol stations and may conduct interviews at these stations. This would be an example of convenience sample of gasoline buyers. At times such a procedure may give very biased results particularly when the population is not homogeneous. On the other hand, in *judgement sampling* the researcher's judgement is used for selecting items which he considers as representative of the population. For example, a judgement sample of college students might be taken to secure reactions to

a new method of teaching. Judgement sampling is used quite frequently in qualitative research where the desire happens to be to develop hypotheses rather than to generalize to larger populations.

B. Simple random sampling: This type of sampling is also known as chance sampling or probability sampling where each and every item in the population has an equal chance of inclusion in the sample and each one of the possible samples, in case of finite universe, has the same probability of being selected. For example, if we have to select a sample of 300 items from a universe of 15,000 items, then we can put the names or numbers of all the 15,000 items on slips of paper and conduct a lottery. Using the random number tables is another method of random sampling. To select the sample, each item is assigned a number from 1 to 15,000. Then, 300 five digits random numbers are selected from the table. To do this we select some random starting point and then a systematic pattern is used in proceeding through the table. We might start in the 4th row, second column and proceed down the column to the bottom of the table and then move to the top of the next column to the right. When a number exceeds the limit of the numbers in the frame, in our case over 15,000, it is simply passed over and the next number selected that does fall within the relevant range. Since the numbers were placed in the table in a completely random fashion, the resulting sample is random. This procedure gives each item an equal probability of being selected. In case of infinite population, the selection of each item in a random sample is controlled by the same probability and that successive selections are independent of one another.

C. Systematic sampling: In some instances the most practical way of sampling is to select every 15th name on a list, every 10th house on one side of a street and so on. Sampling of this type is known as systematic sampling. An element of randomness is usually introduced into this kind of sampling by using random numbers to pick up the unit with which to start. This procedure is useful when sampling frame is available in the form of a list. In such a design the selection process starts by picking some random point in the list and then every *n*th element is selected until the desired number is secured.

D. Stratified sampling: If the population from which a sample is to be drawn does not constitute a homogeneous group, then stratified sampling technique is applied so as to obtain a representative sample. In this technique, the population is stratified into a number of non-overlapping subpopulations or strata and sample items are selected from each stratum. If the items selected from each stratum is based on simple random sampling the entire procedure, first stratification and then simple random sampling, is known as stratified random sampling.

E. Quota sampling: In stratified sampling the cost of taking random samples from individual strata is often so expensive that interviewers are simply given quota to be filled from different strata, the actual selection of items for sample being left to the interviewer's judgement. This is called quota sampling. The size of the quota for each stratum is generally proportionate to the size of that stratum in the population. Quota sampling is thus an important form of non-probability sampling. Quota samples generally happen to be judgement samples rather than random samples.

F. Cluster sampling and area sampling: Cluster sampling involves grouping the population and then selecting the groups or the clusters rather than individual elements for inclusion in the sample. Suppose some departmental store wishes to sample its credit card holders. It has issued its cards to 15,000 customers. The sample size is to be kept say 450. For cluster sampling this list of 15,000 card holders could be formed into 100 clusters of 150 card holders each. Three clusters might then be selected for the sample randomly. The sample size must often be larger than the simple random sample to ensure the same level of accuracy because is cluster sampling procedural potential for order bias and other sources of error are usually accentuated. The clustering approach can, however, make the sampling procedure relatively easier and increase the efficiency of field work, especially in the case of personal interviews.

Area sampling is quite close to cluster sampling and is often talked about when the total geographical area of interest happens to be big one. Under area sampling we first divide the total area into a number

of smaller non-overlapping areas, generally called geographical clusters, then a number of these smaller areas are randomly selected, and all units in these small areas are included in the sample. Area sampling is especially helpful where we do not have the list of the population concerned. It also makes the field interviewing more efficient since interviewer can do many interviews at each location.

G. Multi-stage sampling: This is a further development of the idea of cluster sampling. This technique is meant for big inquiries extending to a considerably large geographical area like an entire country. Under multi-stage sampling the first stage may be to select large primary sampling units such as states, then districts, then towns and finally certain families within towns. If the technique of random-sampling is applied at all stages, the sampling procedure is described as multi-stage random sampling.

H. Sequential sampling: This is somewhat a complex sample design where the ultimate size of the sample is not fixed in advance but is determined according to mathematical decisions on the basis of information yielded as survey progresses. This design is usually adopted under acceptance sampling plan in the context of statistical quality control.

In practice, several of the methods of sampling described above may well be used in the same study in which case it can be called mixed sampling. It may be pointed out here that normally one should resort to random sampling so that bias can be eliminated and sampling error can be estimated. But purposive sampling is considered desirable when the universe happens to be small and a known characteristic of it is to be studied intensively. Also, there are conditions under which sample designs other than random sampling may be considered better for reasons like convenience and low costs.

The sample design to be used must be decided by the researcher taking into consideration the nature of the inquiry and other related factors.

6. Collecting the data: In dealing with any real life problem it is often found that data at hand are inadequate, and hence, it becomes necessary to collect data that are appropriate. There are several ways of collecting the appropriate data which differ considerably in context of money costs, time and other resources at the disposal of the researcher. **Primary data can be collected either through experiment or through survey**. If the researcher conducts an experiment, he observes some quantitative measurements, or the data, with the help of which he examines the truth contained in his hypothesis. But in the case of a survey, data can be collected by any one or more of the following ways:

(i) By observation: This method implies the collection of information by way of investigator's own observation, without interviewing the respondents. The information obtained relates to what is currently happening and is not complicated by either the past behaviour or future intentions or attitudes of respondents. This method is no doubt an expensive method and the information provided by this method is also very limited. As such this method is not suitable in inquiries where large samples are concerned.

(ii) Through personal interview: The investigator follows a rigid procedure and seeks answers to a set of pre-conceived questions through personal interviews. This method of collecting data is usually carried out in a structured way where output depends upon the ability of the interviewer to a large extent.

(iii) Through telephone interviews: This method of collecting information involves contacting the respondents on telephone itself. This is not a very widely used method but it plays an important role in industrial surveys in developed regions, particularly, when the survey has to be accomplished in a very limited time.

(iv) By mailing of questionnaires: The researcher and the respondents do come in contact with each other if this method of survey is adopted. Questionnaires are mailed to the respondents with a

request to return after completing the same. It is the most extensively used method in various economic and business surveys. Before applying this method, usually a Pilot Study for testing the questionnaire is conduced which reveals the weaknesses, if any, of the questionnaire? Questionnaire to be used must be prepared very carefully so that it may prove to be effective in collecting the relevant information.

(v) Through schedules: Under this method the enumerators are appointed and given training. They are provided with schedules containing relevant questions. These enumerators go to respondents with these schedules. Data are collected by filling up the schedules by enumerators on the basis of replies given by respondents. Much depends upon the capability of enumerators so far as this method is concerned. Some occasional field checks on the work of the enumerators may ensure sincere work.

The researcher should select one of these methods of collecting the data taking into consideration the nature of investigation, objective and scope of the inquiry, financial resources, available time and the desired degree of accuracy. Though he should pay attention to all these factors but much depends upon the ability and experience of the researcher. In collection of statistical data commonsense is the chief requisite and experience the chief teacher.

7. Execution of the project: Execution of the project is a very important step in the research process. If the execution of the project proceeds on correct lines, the data to be collected would be adequate and dependable. The researcher should see that the project is executed in a systematic manner and in time. If the survey is to be conducted by means of structured questionnaires, data can be readily machine-processed. In such a situation, questions as well as the possible answers may be coded. If the data are to be collected through interviewers, arrangements should be made for proper selection and training of the interviewers. The training may be given with the help of instruction manuals which explain clearly the job of the interviewers at each step. Occasional field checks should be made to ensure that the interviewers are doing their assigned job sincerely and efficiently.

A careful watch should be kept for unanticipated factors in order to keep the survey as much realistic as possible. This, in other words, means that steps should be taken to ensure that the survey is under statistical control so that the collected information is in accordance with the pre-defined standard of accuracy. If some of the respondents do not cooperate, some suitable methods should be designed to tackle this problem. One method of dealing with the non-response problem is to make a list of the non-respondents and take a small sub-sample of them, and then with the help of experts vigorous efforts can be made for securing response.

8. Analysis of data: After the data have been collected, the researcher turns to the task of analysing them. The analysis of data requires a number of closely related operations such as establishment of categories, the application of these categories to raw data through coding, tabulation and then drawing statistical inferences. The unwieldy data should necessarily be condensed into a few manageable groups and tables for further analysis. Thus, researcher should classify the raw data into some purposeful and usable categories. **Coding** operation is usually done at this stage through which the categories of data are transformed into symbols that may be tabulated and counted**. Editing** is the procedure that improves the quality of the data for coding. With coding the stage is ready for tabulation. **Tabulation** is a part of the technical procedure wherein the classified data are put in the form of tables. The mechanical devices can be made use of at this juncture. A great deal of data, especially in large inquiries, is tabulated by computers. Computers not only save time but also make it possible to study large number of variables affecting a problem simultaneously.

Analysis work after tabulation is generally based on the computation of various percentages, coefficients, etc., by applying various well defined statistical formulae. In the process of analysis, relationships or differences supporting or conflicting with original or new hypotheses should be subjected to tests of significance to determine with what validity data can be said to indicate any conclusion(s). For instance, if there are two samples of weekly wages, each sample being drawn from factories in different parts of the same city, giving two different mean values, then our problem may be whether the two mean values are significantly different or the difference is just a matter of chance. Through the use of statistical tests we can establish whether such a difference is a real one or is the result of random fluctuations. If the difference happens to be real, the inference will be that the two samples come from different universes and if the difference is due to chance, the conclusion would be that the two samples belong to the same universe. Similarly, the technique of analysis of variance can help us in analysing whether three or more varieties of seeds grown on certain fields yield significantly different results or not. In brief, the researcher can analyse the collected data with the help of various statistical measures.

9. Hypothesis-testing: After analysing the data as stated above, the researcher is in a position to test the hypotheses, if any, he had formulated earlier. Do the facts support the hypotheses or they happen to be contrary? This is the usual question which should be answered while testing hypotheses. Various tests, such as Chi square test, *t*-test, *F*-test, have been developed by statisticians for the purpose. The hypotheses may be tested through the use of one or more of such tests, depending upon the nature and object of research inquiry. Hypothesis-testing will result in either accepting the hypothesis or in rejecting it. If the researcher had no hypotheses to start with, generalisations established on the basis of data may be stated as hypotheses to be tested by subsequent researches in times to come.

10. Generalisations and interpretation: If a hypothesis is tested and upheld several times, it may be possible for the researcher to arrive at generalisation, i.e., to build a theory. As a matter of fact, the real value of research lies in its ability to arrive at certain generalisations. If the researcher had no hypothesis to start with, he might seek to explain his findings on the basis of some theory. It is known as interpretation. The process of interpretation may quite often trigger off new questions which in turn may lead to further researches.

11. Preparation of the report or the thesis: Finally, the researcher has to prepare the report of what has been done by him. Writing of report must be done with great care keeping in view the following:

1. The layout of the report should be as follows: (i) the preliminary pages; (ii) the main text, and (iii) the end matter.

In its preliminary pages the report should carry title and date followed by acknowledgements and foreword. Then there should be a table of contents followed by a list of tables and list of graphs and charts, if any, given in the report.

The main text of the report should have the following parts:

- **(a) Introduction:** It should contain a clear statement of the objective of the research and an explanation of the methodology adopted in accomplishing the research. The scope of the study along with various limitations should as well be stated in this part.
- **(b) Summary of findings:** After introduction there would appear a statement of findings and recommendations in non-technical language. If the findings are extensive, they should be summarized.
- **(c) Main report:** The main body of the report should be presented in logical sequence and broken-down into readily identifiable sections.

(d) **Conclusion:** Towards the end of the main text, researcher should again put down the results of his research clearly and precisely. In fact, it is the final summing up.

(e) **At the end of the report,** appendices should be enlisted in respect of all technical data. Bibliography, i.e., list of books, journals, reports, etc., consulted, should also be given in the end. Index should also be given specially in a published research report.

2. Report should be written in a concise and objective style in simple language avoiding vague expressions such as 'it seems,' 'there may be', and the like.

3. Charts and illustrations in the main report should be used only if they present the information more clearly and forcibly.

4. Calculated 'confidence limits' must be mentioned and the various constraints experienced in conducting research operations may as well be stated.

Criteria of Good Research

Whatever may be the types of research works and studies, one thing that is important is that they all meet on the common ground of scientific method employed by them. One expects scientific research to satisfy the following criteria:

1. The purpose of the research should be clearly defined and common concepts be used.
2. The research procedure used should be described in sufficient detail to permit another researcher to repeat the research for further advancement, keeping the continuity of what has already been attained.
3. The procedural design of the research should be carefully planned to yield results that are as objective as possible.
4. The researcher should report with complete frankness, flaws in procedural design and estimate their effects upon the findings.
5. The analysis of data should be sufficiently adequate to reveal its significance and the methods of analysis used should be appropriate. The validity and reliability of the data should be checked carefully.
6. Conclusions should be confined to those justified by the data of the research and limited to those for which the data provide an adequate basis.
7. Greater confidence in research is warranted if the researcher is experienced, has a good reputation in research and is a person of integrity.

In other words, we can state the qualities of a good research as under:

1. **Good research is systematic:** It means that research is structured with specified steps to be taken in a specified sequence in accordance with the well defined set of rules. Systematic characteristic of the research does not rule out creative thinking but it certainly does reject the use of guessing and intuition in arriving at conclusions.
2. **Good research is logical:** This implies that research is guided by the rules of logical reasoning and the logical process of induction and deduction are of great value in carrying out research. Induction is the process of reasoning from a part to the whole whereas deduction is the process of reasoning from some premise to a conclusion which follows from that very premise. In fact, logical reasoning makes research more meaningful in the context of decision making.

Problems Encountered by Researchers in India

Researchers in India, particularly those engaged in empirical research, are facing several problems. Some of the important problems are as follows:

1. The lack of a scientific training in the methodology of research is a great impediment for researchers in our country. There is paucity of competent researchers. Many researchers take a leap in the dark without knowing research methods. Most of the work, which goes in the name of research, is not methodologically sound. Research for many researchers and even to their guides, is mostly a scissor and paste job without any insight shed on the collated materials. The consequence is obvious, viz., the research results, quite often, do not reflect the reality or realities. Thus, a systematic study of research methodology is an urgent necessity. Before undertaking research projects, researchers should be well equipped with all the methodological aspects. As such, efforts should be made to provide short duration intensive courses for meeting this requirement.
2. There is insufficient interaction between the university research departments on one side and business establishments, government departments and research institutions on the other side. A great deal of primary data of non-confidential nature remains untouched / untreated by the researchers for want of proper contacts. Efforts should be made to develop satisfactory liaison among all concerned for better and realistic researches. There is need for developing some mechanisms of a university—industry interaction programme so that academics can get ideas from practitioners on what needs to be researched and practitioners can apply the research done by the academics.
3. Most of the business units in our country do not have the confidence that the material supplied by them to researchers will not be misused and as such they are often reluctant in supplying the needed information to researchers. The concept of secrecy seems to be sacrosanct to business organisations in the country so much so that it proves an impermeable barrier to researchers. Thus, there is the need for generating the confidence that the information/data obtained from a business unit will not be misused.
4. Research studies overlapping one another are undertaken quite often for want of adequate information. This results in duplication and fritters away resources. This problem can be solved by proper compilation and revision, at regular intervals, of a list of subjects on which and the places where the research is going on. Due attention should be given toward identification of research problems in various disciplines of applied science which are of immediate concern to the industries.
5. There is no existence of a code of conduct for researchers and inter-university and interdepartmental rivalries are also quite common. Hence, there is need for developing a code of conduct for researchers which, if adhered sincerely, can win over this problem.
6. Many researchers in our country also face the difficulty of adequate and timely secretarial assistance, including computer assistance. This causes unnecessary delays in the completion of research studies. All possible efforts be made in this direction so that efficient secretarial assistance is made available to researchers and that too well in time. University Grants Commission must play a dynamic role in solving this difficulty.
7. Library management and functioning is not satisfactory at many places and much of the time and energy of researchers are spent in tracing out the books, journals, reports, etc., rather than in tracing out relevant material from them.
8. There is also the problem that many of our libraries are not able to get copies of old and new Acts/Rules, reports and other government publications in time. This problem is felt more in libraries which are away in places from Delhi and/or the state capitals. Thus, efforts should be made for the regular and speedy supply of all governmental publications to reach our libraries.
9. There is also the difficulty of timely availability of published data from various government and other agencies doing this job in our country. Researcher also faces the problem on account of the

fact that the published data vary quite significantly because of differences in coverage by the concerning agencies.

10. There may, at times, take place the problem of conceptualization and also problems relating to the process of data collection and related things.

RESEARCH ETHICS

Objectives in research ethics

1. The first and broadest objective is to protect human participants.
2. The second objective is to ensure that research is conducted in a way that serves interests of individuals, groups and/or society as a whole.
3. Finally, the third objective is to examine specific research activities and projects for their ethical soundness, looking at issues such as the management of risk, protection of confidentiality and the process of informed consent.

Introduction: Research ethics involves the application of fundamental ethical principles to a variety of topics involving scientific research.

The application of fundamental ethical principles to a topics like

1. The design and implementation of research involving human experimentation, animal experimentation
2. Various aspects of academic scandal, including scientific misconducts (such as fraud, fabrication of data and plagiarism),
3. Whistle blowing (wrongdoing within an organization to the public or to those in positions of authority); regulation of research, etc. Research ethics is most developed as a concept in all the scientific research.
4. Research in the social sciences presents a different set of issues than those in medical research.

The scientific research enterprise is built on a foundation of trust. Scientists trust that the results reported by others are valid. Society trusts that the results of research reflect an honest attempt by scientists to describe the world accurately and without bias. But this trust will endure only if the scientific community devotes itself to exemplifying and transmitting the values associated with ethical scientific conduct.

There are many ethical issues to be taken into serious consideration for research. Sociologists need to be aware of having the responsibility to secure the actual permission and interests of all those involved in the study. They should not misuse any of the information discovered, and there should be a certain moral responsibility maintained towards the participants. There is a duty to protect the rights of people in the study as well as their privacy and sensitivity. The confidentiality of those involved in the observation must be carried out, keeping their anonymity and privacy secure. As pointed out in the BSA for Sociology, all of these ethics must be honoured unless there are other overriding reasons to do so - for example, any illegal or terrorist activity.

Most people learn ethical norms at home, at school, in temple, in church or in other social settings. Although most people acquire their sense of right and wrong during childhood, moral development occurs throughout life and human beings pass through different stages of growth as they mature. Ethical norms are so everywhere that one might be tempted to regard them as simple commonsense. On the other hand, if morality were nothing more than commonsense, then why are there so many ethical disputes and issues in our society?

One reasonable explanation of these disagreements is that all people recognize some common ethical norms but different individuals interpret, apply, and balance these norms in different ways in light of their own values and life experiences.

Most societies also have legal rules that govern behavior, but ethical norms tend to be broader and more informal than laws. Although most societies use laws to enforce widely accepted moral standards and ethical and legal rules use similar concepts, it is important to remember that ethics and law are not the same. An action may be legal but unethical or illegal but ethical. We can also use ethical concepts and principles to criticize, evaluate, propose, or interpret laws. Indeed, in the last century, many social reformers urged citizens to disobey laws in order to protest what they regarded as immoral or unjust laws. Peaceful civil disobedience is an ethical way of expressing political viewpoints.

Another way of defining 'ethics' focuses on the **disciplines that study** standards of conduct, such as philosophy, theology, law, psychology, or sociology. For example, a "medical ethicist" is someone who studies ethical standards in medicine. One may also define ethics as a **method, procedure, or perspective** for deciding how to act and for analyzing complex problems and issues. For instance, in considering a complex issue like global warming, one may take an economic, ecological, political, or ethical perspective on the problem. While an economist might examine the cost and benefits of various policies related to global warming, an environmental ethicist could examine the ethical values and principles at stake.

Many different disciplines, institutions, and professions have norms for behavior that suit their particular aims and goals. These norms also help members of the discipline to coordinate their actions or activities and to establish the public's trust of the discipline. For instance, ethical norms govern conduct in medicine, law, engineering, and business. Ethical norms also serve the aims or goals of research and apply to people who conduct scientific research or other scholarly or creative activities. There is even a specialized discipline, research ethics, which studies these norms.

There are several reasons why it is important to adhere to ethical norms in research. First, norms **promote the aims of research**, such as knowledge, truth, and avoidance of error. For example, prohibitions against fabricating, falsifying, or misrepresenting research data promote the truth and avoid error. Second, since research often involves a great deal of cooperation and coordination among many different people in different disciplines and institutions, ethical standards promote the **values that are essential to collaborative work**, such as trust, accountability, mutual respect, and fairness. For example, many ethical norms in research, such as guidelines for authorship, copyright and patenting policies, data sharing policies, and confidentiality rules in peer review, are designed to protect intellectual property interests while encouraging collaboration. Most researchers want to receive credit for their contributions and do not want to have their ideas stolen or disclosed prematurely. Third, many of the ethical norms help to ensure that researchers can be held **accountable to the public**. For instance, federal policies on research misconduct, conflicts of interest, the human subject protections, and animal care and use are necessary in order to make sure that researchers who are funded by public money can be held accountable to the public. Fourth, ethical norms in research also help to build **public support** for research. It is seen that people more likely to fund research project if they can trust the quality and integrity of research. Finally, many of the norms of research promote a variety of other important **moral and social values**, such as social responsibility, human rights, and animal welfare, compliance with the law, and health and safety. Ethical lapses in research can significantly harm human and animal subjects, students, and the public. For example, a researcher who fabricates data in a clinical trial may harm or even kill patients and a researcher who fails to abide by regulations and guidelines relating to radiation or biological safety may jeopardize his health and safety or the health and safety of staff and students.

CODES AND POLICIES FOR RESEARCH ETHICS

Given the importance of ethics for the conduct of research, it should come as no surprise that many different professional associations, government agencies, and universities have adopted specific codes, rules, and policies relating to research ethics. Many government agencies, such as the National Institutes of Health (NIH), the National Science Foundation (NSF), the Food and Drug Administration (FDA), the Environmental Protection Agency (EPA), and the Department of Agriculture (USDA) have ethics rules for funded researchers. Other influential research ethics policies include the Uniform Requirements for Manuscripts Submitted to Biomedical Journals (International Committee of Medical Journal Editors), the Chemist's Code of Conduct (American Chemical Society), Code of Ethics (American Society for Clinical Laboratory Science) Ethical Principles of Psychologists (American Psychological Association), Statements on Ethics and Professional Responsibility (American Anthropological Association), Statement on Professional Ethics (American Association of University Professors), the Nuremberg Code and the Declaration of Helsinki (World Medical Association).

The following is a rough and general summary of some ethical principals that various codes address*:

1. **Honesty:** Strive for honesty in all scientific communications. Honestly report data, results, methods and procedures, and publication status. Do not fabricate, falsify, or misrepresent data. Do not deceive colleagues, granting agencies, or the public**.**
2. **Objectivity:** Strive to avoid bias in experimental design, data analysis, data interpretation, peer review, personnel decisions, grant writing, expert testimony, and other aspects of research where objectivity is expected or required. Avoid or minimize bias or self-deception. Disclose personal or financial interests that may affect research.
3. **Integrity:** Keep your promises and agreements; act with sincerity; strive for consistency of thought and action.
4. **Carefulness:** Avoid careless errors and negligence; carefully and critically examine your own work and the work of your peers. Keep good records of research activities, such as data collection, research design, and correspondence with agencies or journals.
5. **Openness:** Share data, results, ideas, tools, resources. Be open to criticism and new ideas.
6. **Respect for Intellectual Property:** Honor patents, copyrights, and other forms of intellectual property. Do not use unpublished data, methods, or results without permission. Give credit where credit is due. Give proper acknowledgement or credit for all contributions to research. Never plagiarize.
7. **Confidentiality:** Protect confidential communications, such as papers or grants submitted for publication, personnel records, trade or military secrets, and patient records.
8. **Responsible Publication:** Publish in order to advance research and scholarship, not to advance just your own career. Avoid wasteful and duplicative publication.
9. **Responsible Mentoring:** Help to educate, mentor, and advise students. Promote their welfare and allow them to make their own decisions.
10. **Respect for colleagues:** Respect your colleagues and treat them fairly.
11. **Social Responsibility:** Strive to promote social good and prevent or mitigate social harms through research, public education, and advocacy.
12. **Non-Discrimination:** Avoid discrimination against colleagues or students on the basis of sex, race, ethnicity, or other factors that are not related to their scientific competence and integrity.
13. **Competence:** Maintain and improve your own professional competence and expertise through lifelong education and learning; take steps to promote competence in science as a whole.
14. **Legality:** Know and obey relevant laws and institutional and governmental policies.
15. **Animal Care:** Show proper respect and care for animals when using them in research. Do not conduct unnecessary or poorly designed animal experiments.

16. **Human Subjects Protection:** When conducting research on human subjects minimize harms and risks and maximize benefits; respect human dignity, privacy, and autonomy; take special precautions with vulnerable populations; and strive to distribute the benefits and burdens of research fairly.
17. There are many other activities that do not define as "misconduct" but which are still regarded by most researchers as unethical. These are called "other deviations" from acceptable research practices and include:

- Publishing the same paper in two different journals without telling the editors
- Submitting the same paper to different journals without telling the editors
- Not informing a collaborator of your intent to file a patent in order to make sure that you are the sole inventor
- Including a colleague as an author on a paper in return for a favor even though the colleague did not make a serious contribution to the paper
- Discussing with your colleagues confidential data from a paper that you are reviewing for a journal
- Trimming outliers from a data set without discussing your reasons in paper
- Using an inappropriate statistical technique in order to enhance the significance of your research
- Bypassing the peer review process and announcing your results through a press conference without giving peers adequate information to review your work
- Conducting a review of the literature that fails to acknowledge the contributions of other people in the field or relevant prior work
- Stretching the truth on a grant application in order to convince reviewers that your project will make a significant contribution to the field
- Stretching the truth on a job application or curriculum vita
- Giving the same research project to two graduate students in order to see who can do it the fastest
- Overworking, neglecting, or exploiting graduate or post-doctoral students
- Failing to keep good research records
- Failing to maintain research data for a reasonable period of time
- Making derogatory comments and personal attacks in your review of author's submission
- Promising a student a better grade for sexual favors
- Using a racist epithet in the laboratory
- Making significant deviations from the research protocol approved by your institution's Animal Care and Use Committee or Institutional Review Board for Human Subjects Research without telling the committee or the board
- Not reporting an adverse event in a human research experiment
- Wasting animals in research
- Exposing students and staff to biological risks in violation of your institution's biosafety rules
- Rejecting a manuscript for publication without even reading it
- Sabotaging someone's work
- Stealing supplies, books, or data
- Rigging an experiment so you know how it will turn out
- Making unauthorized copies of data, papers, or computer programs
- Deliberately overestimating the clinical significance of a new drug in order to obtain economic benefits

These actions would be regarded as unethical by most scientists and some might even be illegal. Most of these would also violate different professional ethics codes or institutional policies.

Promoting Ethical Conduct in Science

Many of you may be wondering why you are required to have training in research ethics. You may believe that you are highly ethical and know the difference between right and wrong. You would never fabricate or falsify data or plagiarize. Indeed, you also may believe that most of your colleagues are highly ethical and that there is no ethics problem in research.

If you feel this way, relax. No one is accusing you of acting unethically. Indeed, the best evidence we have shows that misconduct is a very rare occurrence in research, although there is considerable variation among various estimates. The rate of misconduct has been estimated to be as low as 0.01% of researchers per year (based on confirmed cases of misconduct in federally funded research) to as high as 1% of researchers per year (based on self-reports of misconduct on anonymous surveys).

Clearly, it would be useful to have more data on this topic, but so far there is no evidence that science has become ethically corrupt. However, even if misconduct is rare, it can have a tremendous impact on research. Consider an analogy with crime: it does not take many murders or rapes in a town to erode the community's sense of trust and increase the community's fear and paranoia. The same is true with the most serious crimes in science, i.e. fabrication, falsification, and plagiarism. However, most of the crimes committed in science probably are not tantamount to murder or rape, but ethically significant misdeeds that are classified by the government as 'deviations.' Moreover, there are many situations in research that pose genuine ethical dilemmas.

Will training and education in research ethics help reduce the rate of misconduct in science? It is too early to tell. The answer to this question depends, in part, on how one understands the causes of misconduct. There are two main theories about why researchers commit misconduct. According to the "bad apple" theory, most scientists are highly ethical. Only researchers who are morally corrupt, economically desperate, or psychologically disturbed commit misconduct. Moreover, only a fool would commit misconduct because science's peer review system and self-correcting mechanisms will eventually catch those who try to cheat the system. In any case, a course in research ethics will have little impact on "bad apples," one might argue. According to the "stressful" or "imperfect" environment theory, misconduct occurs because various institutional pressures, incentives, and constraints encourage people to commit misconduct, such as pressures to publish or obtain grants or contracts, career ambitions, the pursuit of profit or fame, poor supervision of students and trainees, and poor oversight of researchers. Moreover, defenders of the stressful environment theory point out that science's peer review system is far from perfect and that it is relatively easy to cheat the system. Erroneous or fraudulent research often enters the public record without being detected for years. To the extent that research environment is an important factor in misconduct, a course in research ethics is likely to help people get a better understanding of these stresses, sensitize people to ethical concerns, and improve ethical judgment and decision making.

Misconduct probably results from environmental and individual causes, i.e. when people who are morally weak, ignorant, or insensitive are placed in stressful or imperfect environments. In any case, a course in research ethics is useful in helping to prevent deviations from norms even if it does not prevent misconduct. Many of the deviations that occur in research may occur because researchers simple do not know or have never thought seriously about some of the ethical norms of research. For example, some unethical authorships practices probably reflect years of tradition in the research community that has not been questioned seriously until recently. If the director of a lab is named as an author on every paper that comes from his lab, even if he does not make a significant contribution, what could be wrong with that? That's just the way it's done, one might argue. If a drug company uses ghostwriters to write papers "authored" by its physician-employees, what's wrong about this practice? Ghost writers help write all sorts of books these days, so what's wrong with using ghostwriters in research?

Another example where there may be some ignorance or mistaken traditions is conflicts of interest in research. A researcher may think that a "normal" or "traditional" financial relationship, such as accepting stock or a consulting fee from a drug company that sponsors her research, raises no serious ethical issues. Or perhaps a university administrator sees no ethical problem in taking a large gift with strings attached from a pharmaceutical company. Maybe a physician thinks that it is perfectly appropriate to receive a $300 finder's fee for referring patients into a clinical trial.

If "deviations" from ethical conduct occur in research as a result of ignorance or a failure to reflect critically on problematic traditions, then a course in research ethics may help reduce the rate of serious deviations by improving the researcher's understanding of ethics and by sensitizing him or her to the issues.

Finally, training in research ethics should be able to help researchers grapple with ethical dilemmas by introducing researchers to important concepts, tools, principles, and methods that can be useful in resolving these dilemmas. In fact, the issues have become so important that the NIH and NSF have mandated training in research ethics for graduate students

ANIMAL USED IN RESEARCH

Animals play a significant role in research. They are used in a variety of ways by researchers, such as for testing new pharmaceuticals, as teaching tools for medical students and as experimental subjects for new surgical procedures. Research with animals is necessary and vital to biomedical research because animal research is frequently a necessary first step towards research involving new medical treatments and pharmaceuticals intended for human use.

Many dedicated organizations and individuals are interested in protecting and safeguarding animal subjects as regards their use in research. Some organizations are interested in eliminating the use of animals in research. Others consider research with animals a necessary evil to the advancement of medicine, but still aim to eliminate unnecessary suffering, pain and poor facility conditions for animal subjects.

To protect animals, research projects that use animals have to be reviewed. These review processes assess the risks and benefits of using animals in research. This can prove difficult for project reviewers and often makes for intense debates and arguments about the appropriate use of animal subjects, particularly because the animal subjects usually bear all the risks while human beings realize all the benefits. Debates also center on judging how much pain is too much, whether or not animals experience pain in the same way that humans do and whether or not these ideas should even factor into the debate at all.

To assure that research with animals is conducted ethically and responsibly, the government has created regulations involving the use and care of animals involved in teaching, testing, and research.

Animals are used for many purposes within schools, universities and research establishments. Others are studied within their natural habitats. The purposes for which they are used and the impact on these animals themselves varies considerably. In all cases, it is essential that the individual animal is treated in humane and considerate manner.

Regulation and Controls

Research and teaching using animals may only be performed when they are essential:

- To obtain and establish significant information relevant to the understanding of humans and/or animals;
- For the maintenance and improvement of human and/or animal health and welfare;

- For the improvement of animal management or production;
- To obtain and establish significant information relevant to the understanding, maintenance or improvement of the natural environment; or
- For the achievement of educational objectives.

Projects using animals may only be performed after a decision has been made that they are justified, weighing the predicted scientific or educational value of the research against the potential effects on the welfare of the animals.

Investigators and teachers must submit a written proposal to an Animal Ethics Committee for all animal projects which must take into account the expected value of the knowledge to be gained, the justification for the project and all ethical and animal welfare aspects taking into account the 3RS - Replacement, Reduction and Refinement as outlined in the Australian Code of Practice for the Care and Use of Animals for Scientific Purposes.

In South Australia compliance with the Australian Code of Practice for the Care and Use of Animals for Scientific Purposes (the Code) is mandatory and a legal requirement. Breaches of the Code can incur penalties under the *Animal Welfare Act 1985*. The purpose of the Code is to ensure the ethical and humane care and use of animals in research and teaching. The principles set out in the Code are for guidance of investigators, teachers, institutions, Animal Ethics Committees (AECs) and all people involved in the care and use of animals for scientific purposes.

The Code emphasizes the responsibilities of investigators, teachers and institutions using animals to ensure that the use of animals is justified, that the welfare of the animals is always considered, to promote the development of techniques that replace the use of animals, to minimise the numbers of animals used and to refine procedures to avoid pain or distress in animals.

The 3 Rs: Replacement, Reduction and Refinement

Encapsulated in the code of practice for the care and use of animals for scientific purposes is the **requirement** for scientific and teaching activities to consider the **3Rs.**

1. Replacement: Techniques that totally or partially replace the use of animals for scientific purposes must be sought and used wherever possible.

2. Reduction: Each project must use no more than the minimum number of animals necessary to ensure scientific and statistical validity. The principle of reducing the number of animals used should not be implemented at the expense of greater suffering of individual animals. Scientific and teaching activities involving the use of animals must not be repeated unless essential for the purpose or design of the project. Teaching activities must involve no more than the minimum number of animals required to reach the educational objectives. Overproduction of animals bred for scientific purposes should be avoided so that the need to kill healthy animals is minimized.

3. Refinement: Animals must be suitable for the scientific purpose taking into account their biological characteristics including behaviour, genetic attributes and nutritional, microbiological and general health status. The design and management of animal accommodation should meet with species-specific needs. Special consideration is required where this is precluded by the requirements of the project. Animals should be transported, housed, fed, watered, handled and used under conditions that meet species-specific needs

The welfare of the animals must be a primary consideration in the provision of care, which should be based on behavioural and biological needs. Wildlife should not be taken from natural habitats unless animals bred

in captivity are not available or are not suitable for the specific scientific purpose. Investigators and teachers who use animals for scientific purposes must employ the best available scientific and educational techniques and be competent in the procedures they perform or must be under the direct supervision of a person competent in the procedure.

Projects should be designed to avoid both pain and distress in animals. If this is not possible, pain or distress must be minimized. Pain and distress cannot be evaluated easily in animals and therefore investigators and teachers must assume that animals experience these in a manner similar to humans unless there is evidence to the contrary. Decisions regarding the animals' welfare must be based on this assumption. An animal with signs of pain or distress not predicted in the proposal must have the pain or distress alleviated promptly. Alleviation of such pain or distress must take precedence over completing the project. If this is not possible the animal must be euthanized without delay.

Scientific and teaching activities that may cause pain or distress of a kind or degree for which anesthesia would normally be used in medical or veterinary practice must be carried out using anesthesia appropriate to the species and the procedure. Pain management appropriate to the species, the procedure and the circumstances must be provided. The use of local or general anesthetic, analgesic or tranquilizing agents must be appropriate to the species, and should at least parallel their use in current medical or veterinary practice. Where it is established that the purpose of the project precludes the use of anesthetic or analgesic agents to alleviate pain, the planned endpoint of the project must be as early as feasible to avoid or minimise pain or distress in the animals. Neuromuscular blocking agents must not be used without appropriate general anesthesia, except in animals where sensory awareness has been eliminated. If such agents are used, continuous or frequent monitoring of paralyzed animals is essential to ensure that the depth of anesthesia is adequate to prevent pain or distress. Death as an end point must be avoided wherever possible. Scientific and teaching activities involving the use of animals must be of minimum duration compatible with the objectives of the project.

ETHICAL ISSUES IN AGRICULTURAL RESEARCH

1. **Sustainability:** The ethical dilemmas arise when short term problems are preferred over long term ones. Institutional capacities to address long term problems require different kinds of reinforcement than otherwise. Ethical dilemma also arises when certain sectors, segments, social classes and seasons are preferred over others while choosing problems, or locating them, solving them or diffusing the solutions obtained. Inter species and inter sectoral concerns also influence the sustainability of the outcomes. Not all local practices need to be sustained. Sustainability is as much about continuity as about discontinuity (that is innovations or fundamental change in values).
2. **Eco system health:** When scientists know about the concomitants of the eco system health and yet develop technologies which impair the health, they are not only making a trade off but also passing a value judgment. Transferring costs of near term trade offs over the longer term stakeholders may neither be ethical nor economically very judicious. Eco system health is also affected when long term consequences of certain chemical inputs are known or anticipatable, and yet these are continued to be used. Judgments are involved when chemicals banned in western countries are allowed to be used in developing countries, when the precautionary principle is applied or not applied, and while technologies are transferred to countries which may or may not have capacity to assess the consequences.
3. **Responsiveness:** In any context, not everybody's problem is equally important. Michael Lipton once drew attention to the biases that existed in favour of interesting pests' vis-à-vis the relevant ones. When certain problems remain unsolved or unaddressed for centuries, surely it says something about the dominant ethics in the society which does not generate a dilemma or a discomfort despite sustained inertia and indifference. A good example is the cooking stove used by millions of women or carrying water pots on the head for long distance, transporting grass or twigs on head on the hill slopes by women or transplanting paddy by keeping feet under water and thus getting fungal infections, etc.

4. **Accountability:** Researchers seldom share their findings with the people from whom they collect the data. Not only that. They often do not even calibrate their criteria of relevant or not so relevant research by involving the users of research in calibration. Ethical dilemma also arise when a large multi national corporations inform the consumers of its chemical inputs about a desirable resource use practice in west but which they do not share in the developing countries. The community of corporations has to evolve its own code of conduct censoring such behaviour.
5. **Capacity building:** Any society which has to grapple with risk and uncertainty inherent in agricultural resource management has to learn to create capacity not only to anticipate but also address the future problems. The education and training of young minds thus becomes a very important determinant of the capacity to face emerging challenges in future. When the education system does or does not include content or pedagogical means which make a potential leader aware of the challenges, an ethical judgment has been made. When certain crops and/or other agricultural products are deliberately portrayed as inferior in the educational curriculum, on cultural grounds rather on nutritional or other scientific grounds, values have already been expressed. Lack of periodic review of the skills that are being developed to address such concerns about externality, diversity, inter sectoral linkages, etc., invariably involve making trade offs about what should be told and what should young people learn on their own.
6. **Location specificity:** It is well known that agro ecological environment in rainfed regions is much more heterogeneous. Developing technologies which would diffuse only in a small region poses an institutional challenge apart from technological challenge. Organization incentives are often provided, commensurate with the diffusion or potential reach of a solution. If a technology is addressing problems of small community, it may not invoke a significant encouragement or incentive. Consequently, either such problems don't get addressed or the people who address such problems become marginalized. In either case ethical judgments have to be made by the decision makers. When research infrastructure, allocation of human resources and priority in research are biased in favour of better endowed regions and communities, the ethics of neglecting the bypassed communities and regions has to be made explicit. When hand tools receive less attention than energy intensive technologies, judgments have been made.
7. **Asymmetry in rights of and responsibilities towards knowledge holders:** No agricultural research council in developed or developing countries ever requires the asymmetry between rights and responsibilities towards the knowledge holders of informal sectors be deliberately overcome. The respondents in research with communities are not acknowledged, do not receive the findings of the research for which they provide data and do not receive any share in the benefits that are generated from the application or commercialization of the knowledge provided by the respondents/knowledge providers.
8. **Empowerment of informal innovators and knowledge holders:** It is obvious that creativity exists in formal as well as informal sectors. Just as the scientists can generate a creative and innovative solution to a problem, a farmer or an artisan can too[1]. The global bias against innovations in informal sector is very obvious. Inability of formal research system to listen to and learn from informal innovators not only deprives the organized sector of agricultural research and technology of the insights from the margin but also prevents it from being inspired by the values of many of the grassroots innovators.

The ethical trade offs in such matters invariably affect the efficiency, equity, excellence and environmental consequences of resource and institutional management.

Short Question with answers

1	Word 'Research" is derived from this language A. French B. Latin C. Sanskrit D. German	A
2	Research is a derivative of the word; 'Researche' which means A. quest B. search for truth C. pursuit D. All mentioned here	D
3.	Research studies to gain familiarity with a phenomenon or to achieve new insights into it can be termed as A. Exploratory research study B. Formulative research study C. Answers A and B D. None of above	C
4.	Research studies to portray accurately the characteristics of a particular individual, situation or a group can be known as A. Exploratory research study B. Formulative research study C. Answers A and B D. Descriptive research study	D
5.	Research studies to determine the frequency with which something occurs or with which it is associated with something else can be known as A. Exploratory study B. Formulative research study C. Diagnostic research study D. Descriptive research study	C
6.	Research studies to test a hypothesis of a causal relationship between variables can be known as A. Exploratory study B. Formulative research study C. Diagnostic research study D. Hypothesis-testing research study	D
7.	The possible motives for doing research may be A. Desire to be of service to society B. Desire to get respectability C. Curiosity about unknown D. All mentioned here	D
8.	The possible motives for doing research may be A. To know consequential benefits B. solving the unsolved problems C. to get intellectual joy of doing some creative work D. All mentioned here	D
9.	The basic types of research are A. Descriptive vs. Analytical B. Applied vs. Fundamental C. Quantitative vs. Qualitative D. All mentioned here	D
10.	The basic types of research are A. Field-setting research or laboratory research B. Historical research C. One-time research or longitudinal research D. All mentioned here	D
11.	The types of research approaches are A. The quantitative approach B. Qualitative approach C. Answers A and B D. None of them	C
12.	Sample is which. A. Representative part of the population B. It contains each characterizes that entire population possesses C. It is any part of population D. Answer A and B	D
13.	The main advantages of sampling are that, data collection is faster, and since the data set is smaller it is possible to ensure homogeneity and to and quality of the data. A. The cost is lower B. Fast data collection C. improve the accuracy D. All mentioned here	D
14.	Statistically Population is. A. The set of individuals, items, or data B. Total units from which a statistical sample is taken C. It is also called universe	D

	D. All mentioned here	
15.	Probability samples are drawn based on A. Cluster/area sampling B. Systematic sampling C. Stratified sampling D.	D
16.	Non-probability samples are drawn based A. Convenience sampling B. Judgement sampling C. Quota sampling D. All mentioned here	D
17.	This sampling method involves purposive selection of particular units of the universe for constituting a sample which represents the universe A. Deliberate sampling B. Simple random sampling C. Systematic sampling D. All mentioned here	A
18.	This type of sampling is also known as chance sampling where each item in the population has an equal chance of inclusion in the sample. A. Chance sampling B. Simple random sampling C. Probability sampling D. All mentioned here	D
19.	This procedure of sampling is useful when sampling frame is available in the form of a list. The selection process starts by picking some random point in the list and then every *n*th element is selected until the desired number is secured. A. Chance sampling B. Simple random sampling C. Probability sampling D. Systematic sampling	D
20.	This sampling involves grouping the population and then selecting the groups rather than individual elements for inclusion in the sample. A. Chance sampling B. Cluster sampling C. Sequential sampling D. Systematic sampling	B
21.	Primary data can be collected either through A. Experiment B. Survey C. As mentioned in A & B D. None of these	C
22.	In the case of a survey, by which ways data can be collected? A. Observation B. Personal interview C. Telephone interviews D. All mentioned here	D
23.	Which of the following is face to face method of data collect5ion? A. Questionnaires B. Interview schedules C. Telephone interviews D. All mentioned here	B
24.	Hypothesis-testing results A. In accepting the hypothesis B. In rejecting the hypothesis C. Hanging the hypothesis D. Answer given in A and B	D
25.	Consideration of 3Rs for the care and use of animals for scientific purposes and teaching activities are Replacement, Reduction and …. A. Refinement B. Retirement C. Rational D. Rotation	A
26.	Which of the following is against the research ethics? A. Fabrication of data B. Misrepresent data C. Deceive colleagues, granting agencies, or the public D. All mentioned here	D
27.	Which of the following is against research ethics? A. Bias in experimental design B. Self-deception C. Personal interests D. All mentioned here	
28.	Which of the following acts are considered as unethical in research A. Publishing the same paper in two different journals without telling the editors B. Destroy research data immediately after research C. Avoid reporting an adverse event in a human research experiment D. All above	D

29.	Which of the following acts are considered as unethical in research A. Using a ethnically prejudiced epithet in the laboratory B. Sabotaging someone's work C. Stealing supplies, books, or data D. All above	D
30.	What are the criteria of Human Subjects Protection in research? A. Minimize harms and risks B. Respect human dignity C. Respect human privacy D. All above	D