Chapter 5
Systems Approach and Soft Systems Methodology of Organization and Management Studies

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5.1 Need and Importance of Systems Approach in Management and Social Research – Concepts, Theories and Ideas

5.1.1 Objectives

The present chapter deals with the essential aspects of systems approach and explains the concepts and ideas on the basis of systems thinking. The objectives of this chapter are given as follows:

- To give an idea of systems approach and its need in the modern world of complex problems
- To explain the various concepts underlying systems approach and systems thinking
- To appreciate the application of systems approach in solving complex real-world problems
- To explain the difference between soft systems and hard systems methodologies and in this connection to appreciate the beneficial effects of soft systems methodology in tackling complex, social, economic, management, and policy problems in the complex real world
- To expose the readers particularly with major tools, techniques, and diagrammatic methods of problem solving and problem structuring by adopting soft systems method

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- To illustrate the applications of systems approach and soft systems methodologies by means of various real-life case studies

5.1.2 Needs and Benefits of Systems Approach

The present chapter details the essential aspects of systems approach for conducting management, organizational, and socioeconomic studies. The term "systems" is derived from the original Greek word "synistanai." Synistanai basically means "to bring together and combine." "Systems approach" as a field of enquiry emerged as the real-life problems in the modern technological world started becoming too complex. It appeared as an affective approach to tackle complex problems of the real world. The approach basically has four ways or concepts (Checkland 1981):

- The larger system is divided into smaller components and subsystems are studied in a concentrated manner with adequate depth. This would require *specialization* to study individual components.
- In order to avoid greater complexity with greater level of specialization, various components and subsystems are grouped in the form of a discipline or subdiscipline. This is called the process of *grouping*.
- While generating groups and combining subsystems and components, it will be pertinent to coordinate interactions among various groups. Thus, systems approach requires *coordination*.
- In describing systems into subsystems, one must not forget to recognize that the system as a whole is greater than the sum of the parts and the system has a property which is not the property of the elements of the subsystem. This is called the *emergent property* of the system. We have further explained the property emergence later in this chapter.

Thus, specialization, grouping, coordination, and emergence are the four basic concepts constituting systems approach.

The group and interface between groups can be elements or processes. Thus, some elements or processes are grouped. There can be a variation within each group. Understanding these variations is critical to application of systems approach to problem solving.

Most research studies generally tend to apply the analytical reductionist approach, thereby only achieving partial solutions. Every problem depends on a large number of variables, and these are interdependent variables; often by taking only a few elements and subsystems into considerations, we tend to ignore affects by and on other subsystems and therefore the solution obtained are not wholly satisfactory. We can give a few illustrative examples of how partial consideration affects solution. In a transport study, we want to remove the congestion of a road. Widening of roads and building of overbridges and flyovers are suggested. However, it is often found that such solutions only remove congestion for a limited period. More vehicles get attracted with wider roads and often congestion reappears. This happens because of a narrow approach to the problem. It tends to ignore the effect of the widening of roads and creation of flyovers on volume of traffic and their resultant effects on congestion. Quite often, while trying to solve a problem in certain parts of the social system, we create a more intractable problem in some other parts of the social system.

As already pointed out, the present chapter details out the essential aspects of systems approach for conducting management and organizational studies. Most research studies generally tend to apply analytical reductionist approaches, thereby only attempting partial solutions. It is therefore necessary that for all real-life social, organizational, and management problems, we should complement analytical and reductionist methods through systems approach where aspects of bringing changes in any part of a system is considered on other relevant parts. Systems approach considered the total effects on all elements of a system and is not confined to a narrow partial solution. In this chapter we shall illustrate the approach along with soft systems methodologies of solution. Hard systems methodologies are already dealt with in other chapters of this treatise. For undertaking systems approach and soft systems methodology, understanding few basic concepts, ideas, and laws will be necessary. The chapter is therefore divided into three parts. The first part deals with some of the important concepts and their definitions. The second part outlines the basics, concepts, methods and available techniques which are normally used in a systems study of an organization and soft systems methodologies. The third part describes a few case studies.

5.1.3 Concepts and Definitions

The following concepts are quite often used in "systems analysis literature" and we propose to define these:

1. *System*

A system is composed of interrelated elements. Thus, we can have physical systems, natural systems, human-activity systems and so on. As far as we are concerned, we will be mostly dealing in human-activity systems. Elaborating further we may say that a system is a whole consisting of two or more parts that satisfies the following five conditions (Checkland 1981):

1. The whole have one or more properties or functions that define its character.
2. Each element or the part of the whole can affect the behavior or properties of the system (as a whole).
3. There are subsets of parts which are essential parts – without any one of these parts, the system cannot carry out its defining functions.
4. The essential parts (subsets described above) of a system form a connected set. The essential parts of a system necessarily interact either directly or indirectly.
5. The effect of any subset of the essential parts of the system as a whole depends on the behavior of at least one other subset.

Combining the above conditions we may reach the following summarized version.

“A system is a whole that cannot be divided into independent parts without loss of its essential properties or functions” (Ackoff and Emery 1972). Thus, we have financial system, environmental systems, water resource system, energy system and so on.

We thus consider system as a dynamic and complex whole, interacting as a structural functional unit.

Among its various elements, energy, material, and information flow to compose the system.

A system is situated within an environment.

Energy, material, and information flow from the environment to systems and from systems to the environment via the boundaries. (This is an open system as we have defined later.)

Systems constitute entities which are in equilibrium but can oscillate and exhibit a chaotic behavior.

A holistic system is a set of interdependent and interacting parts. When we study systems, we study the systems holistically.

It follows that if a research study on school education is done by applying a systems approach, then we can only study education imparted in a specific school only if we understand the working of the educational system as a whole in the total socioeconomic system. Whether we are interested in pure academic (Ph. D or M. Phil) research on education or sponsored research, systems approach in designing the problem and problem solutions will be more desirable. Therefore, in this approach every problem will be a subsystem of a larger system. Methodologically it will be appropriate to define the system under study and various important elements constituting the systems should also be identified. Broad aspects of the larger system of which the system under study is a part should also be specified. This will help us in specifying the boundaries and the relevant environment to be considered. Various elements and their interaction to be studied to understand the system will also become clear. Thus, if we are studying the performance of specific schools, elements contributing to the performance, like teachers (numbers, quality, qualifications, etc.), school infrastructure, and school management, educational processes and systems are all relevant elements. All of these are influenced by and have influence on the larger educational system and policies. These also have influence on (directly and indirectly) socioeconomic and political environment. In systems approach explicit considerations of these are important. Wherever certain assumptions are made regarding the behavior and characteristics of the larger containing system, for a good honest study it is necessary to specify these as clearly as possible. In many conventional academic researches, most of these aspects are taken as given and excellence of performance is related to the quality of learning or quality of teachers or qualifications of teachers. Seldom are the effects of other intervening variables taken into consideration. It is necessary in modern day’s research to recognize all important systemic aspects and variables and clearly specify how they are being dealt within the problem under study. It may be quite appropriate to assume certain specific characteristics for these, but they should be clearly detected and specified. Having clarified the importance of systems approach and definition of a system, we give below some more definitions. Some of the systems are called natural systems as they exist in this universe. So we have the solar system which is a natural system. Some of the others are created by human efforts; these are called humanly contrived systems. Thus, market system, educational system, healthcare system and corporate organization are all humanly contrived systems and can be effectively changed or redesigned with human effort. In addition, we give below more definitions of different systems.

2. *Open system*

An open system exchanges information with its environment. It therefore does not suffer from entropy. Those who are not familiar with the thermodynamics concept of entropy may note that entropy in our discussion is a measure of waste. Exchange of information and knowledge with and from the environment creates understanding and reduction of wastes. An open system takes enough inputs from its environment to offset outputs and material that are produced and are given to the environment. Thus, continuous inflows and outflows of goods, material, energy, and information are taking place. The steady state of the system is therefore not a static equilibrium. It is always in dynamic equilibrium.

An open system tends toward increased differentiation in functions/roles and responsibilities and therefore leads to complexities. All studies, be academic or sponsored in respect of management, sociology, economic, and social sciences, are basically studies related to an open system.

In case of an open system, the relevant environment under study should be clearly specified. Thus, in a study of a school educational system, socioeconomic condition of parents and guardians, general attitude toward education and education policies followed are relevant environment for the school education system.

How these variables interact and affect the functioning of the system under study should be clearly understood. Similarly for a healthcare system, the sanitation level of the area, socioeconomic conditions and quality of drinking water system, environmental pollution, and other related variables will interact with the healthcare system and will affect the system positively or negatively.

Thus, any study of an open system can call for:

1. Proper specifications of systems boundaries
2. Identification of necessary/relevant environmental variable
3. Understanding of interactions between elements of the system under study and various relevant environmental variables

3. *Hierarchies*

Most systems constitute a "nested system." That means there are subsystems within the system. Similarly many systems are subsystems of larger systems. Thus, a corporate organization is a subsystem of business system. Departments within the corporate organization are the subsystem of the corporate organization. Such nested systems can normally be considered as a hierarchy of systems. A hierarchical system has parallel, horizontal parts like private sector and public sector business organization, and it can also contain different divisions based on product processes or location.

Most systems studies must appreciate this hierarchical nature of systems in conducting studies based on systems approach.

4. *The state of the system*

The state of the system at a moment of time is the set of relevant properties which that system has at that time. The properties of a system derive from the interactions of its parts rather than their action taken separately.

From this definition it follows that by changing the interrelationships and interactions, the structure of relevant properties can be changed and the state of the system then also would undergo a change.

Let us assume that we are interested in an academic study suggesting the improvement of an educational system at primary school level. Here, we can suggest to change the quality of teachers in terms of educational background and training. These will have effect on the availability, budget and overall cost. These in themselves may not be adequate; school aids, teaching techniques, infrastructure, etc., and their interrelationships and their effects on the overall performance of the system have to be studied.

By changing only one aspect say entry qualification of teachers without corresponding changes in the relevant elements within the system, the desired improvement may not be achievable. Thus, for proper effective solutions, we should adopt in addition to analytical reductionist processes, methods relevant to systems approach.

5. *The environment*

The environment of a system is a set of elements and their relevant properties; these elements are not part of the system. Any change in these elements can result in the change of the structure and behavior of the system. Simply speaking the systems environment consists of all variables which can affect its properties and behavior. One has to be very careful in defining the environment while conducting a study of any problem. As all environments are related to the boundary, so once the boundary of the problem is properly defined, any variable outside the boundary which can significantly affect the properties of the system are called environmental variables. One can always question what is significant and what is not significant. Whenever significance can be assessed in an objective manner, the problem is not severe. But, in most human-activity systems, the effects of environmental variables could not very often be measured objectively. As such one has to depend on the subjective evaluation of significance, and this is a perfectly valid scientifically correct method. A diagrammatic technique called "systems map" is normally used for the specification of boundary and identification of relevant environmental variables and their degree of influence. This technique is further elaborated in Part II of this chapter.

In a research study on arsenic problem in drinking water, all aspects of neutralizing arsenic were studied; however, the solution derived can only be short lived because excessive drawing of groundwater and environmental effects are responsible for producing arsenic, and therefore, for sustainable solution, these aspects are also considered.

6. *A dynamic system*

This system is one which changes its structure or behavior or both over time. It means that its structural properties are changing over a period of time. A national economic system is a dynamic system. It is changing its characteristics over time; both its structure and behavior are changing over time. Most of the social, management, or economic systems with which we are concerned in our academic, social, management, or sponsored research are concerned with dynamic systems. Ceteris paribus (other things remain unchanged and only one variable changing) assumptions are almost always unrealistic in dealing with problems of real-world systems.

7. *A homeostatic system*

This is a stable system whose environments are dynamic. Thus, thermostat is homeostatic. Similarly, normal body temperature remains stable even when environmental temperature changes due to changes of season.

8. *Dynamic equilibrium*

Most of the problems that we study whether for research (for Ph. D or M. Phil or D. Phil) or for solving real-life organizations or social issues belong to dynamic systems. These dynamic systems are in equilibrium. Most of the real-life systems are in dynamic equilibrium. Real-life systems are dynamic and changing all the time; however, for becoming stable, all its elements are in perfect synchrony and therefore equilibrium is maintained. If any element within the system looses the synchrony, systems stability will be disturbed. Behavior of various elements of the system under study should be understood and a synchrony should be maintained in any changes proposed based on the research study. Real-life examples of dynamic systems are rotating tops, a moving train, and a moving airplane. All the observations mentioned earlier will be applicable to these cases. Rejecting the questions related to dynamic stability of human-activity system will not be appropriate in any meaningful research study of the social system.

9. *Synergy*

It basically means synthetic energy signifying that the whole is greater than the sum of the parts. Thus, the sum of the parts does not add up to the whole. Concept of synergy has a great relevance in management and social study. Any evaluation study on mergers and acquisitions must ensure that on the basis of such evaluation merger and acquisitions really produce synergy. Similarly part solutions of subproblems when applied and added together must produce synergy. In view of synergy pure reductionist solution may not be adequate for any real-life study of systems.

10. *Anergy*

This is negative synergy. If some parts of the system are in opposition of other parts, the integration of all parts is not simply the sum of the parts minus the negative contribution, and it can be more adverse than this.

Again the whole is not the algebraic sum of the parts. In many social science researches, it is necessary to ensure that solutions prescribed should not produce anergy to the system as a whole. Thus, in an exercise of allocation of funds for higher education, a higher financial allocation to this sector may deprive the lower-level, primary/secondary education. Over the years because of the reduced allocation of resources, the quality of primary and secondary education will suffer. As a result, the quality of candidates entering higher education and the performance of higher education will suffer in spite of higher allocation. Thus, it creates an overall anergy in the education system. Thus, for avoiding anergy we should encourage production of synergy in the system. The change in allocation pattern in various subsystems should be such that the total improvement of the educational system as a whole is more than the sum of the improvement of individual subsystems.

11. *Emergence*

Certain properties belong to the system as a whole and is not the property of the subsystems/parts or elements. Taken out of the system, the parts do not exhibit the property. A beautiful flower may be considered as an example. The beauty of the flower which is made up of a number of petals is not the property of the individual petals; individual petals may not be beautiful; however, the flower is beautiful. Thus, beauty is the emergent property of the flower as a whole and not of the individual petals. Beauty depends not on the beauty of individual petals but in the arrangement of petals to produce the flower.

Thus, property of emergence is a systemic property of the whole system and largely depends on the arrangement and interactions of the parts and not on the property of the individual parts. Any study of a system must therefore give attention to the emergent (property) of the system. The organizational effectiveness is the emergent property of the organization as a system and not totally dependent on the efficiency of each individual or departments constituting the organization. Property of emergence is the most important property that should be understood by all the researchers, scholars, policymakers and problem solvers in social, management, economic, and policy sciences. Quite often the emergent property which is a systemic property is treated as a property of the elements or parts. Gross domestic product is an emergent property of the economic systems as a whole, and it is not merely a property of investment policy. Confluence of various factors can converge to produce an overall growth of the economy. What combination of factors creates this emergence needs to be understood. Understanding the characteristics of an individual element like industrial growth, agricultural growth, and sociocultural changes is not good enough to study the emergent development of the socioeconomic system as a whole. In any effective study of social systems, we need to study these effects of changes on individual components, their inter relationships, and resultant emergence of the system as a whole. We should also study the overall effects of simultaneous and variable changes in the different subsystems. Emergence of qualities due to confluence of various factors should be studied and understood. Quite often we fail to grasp these systemic issues and try to solve the system problems by only taking individual components into consideration without giving attention to the interactions and interrelations among various components that created the emergent properties of the system.

Thus, attention on the growth of individual components, without attention to distributional effects and harmonious development of various components, can create dysfunctional emergence of serious law and order situation and serious complaints and dissatisfaction among various sections of the population. These are systemic properties and can seldom be tackled by tackling individual components separately.

12. *Efficiency*

In the engineering sense, it is the ratio of output to input. Efficiency is relevant to the elements of the systems and is concerned with doing things right. In a team individual players may be evaluated by their individual efficiency. In the modern world, we try to maximize efficiency. In a reductionist analysis, if all elements are efficient, the system as a whole will be efficient. In systems approach we have seen that this may or may not be true. Thus, in a football team all eleven players may be very efficient, but the team does not win games. The emergent property of the team reflects in its effectiveness which is not very good as the team members do not combine well. Our stress in research on efficiency alone is not adequate.

13. *Effectiveness*

Effectiveness is linked with doing the right things. Effectiveness is concerned with the performance of the system as a whole and a system may not be effective even though the individual members may be efficient. Effectiveness is thus a property of the system as a whole. Effectiveness emerges out of efficient combination and arrangements of the elements. This is a systemic property and in any research study should receive adequate attention along with improvement of efficiency. Thus, improvement of efficiency in tackling individual healthcare problems may be needed but may not be adequate in improving the effectiveness of the healthcare system which will depend on the proper arrangement and interrelationships among various elements of the healthcare system.

14. *A purposeful system*

A system that selects ends as well as means and displays "will" is a purposeful system. Human beings are the most perfect examples of this system. All organizations are humanly contrived systems and these are also purposeful systems. Thus, a bank, a corporate organization, a hospital and a government department are all purposeful systems.

15. *An ideal-seeking system*

This is a system which is purposeful and which on achievement of any of its goals or objectives seeks another goal or objective which more clearly approximates its ideal.

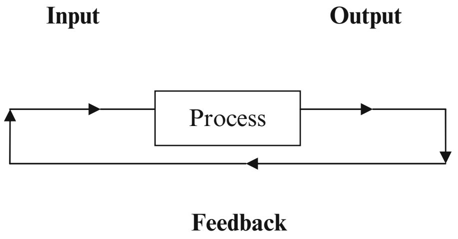

Fig. 5.1 Close loop coupling

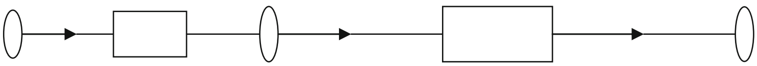

Fig. 5.2 Serial coupling

16. *Control*

An element or a subsystem controls another element or subsystem or itself if its behavior is either necessary or sufficient for subsequent behavior of the elements or the subsystems or itself. This subsequent behavior is necessary or sufficient for the achievement of one or more of its goals. More simply, control is any method or procedure designed to influence the behavior of the system. Control is a double-edged sword. It involves ensuring doing things right and also ensuring doing right things. It is therefore relevant both for efficiency and effectiveness. Control consists of monitoring, diagnosing, and initiating corrective actions to ensure that the system moves in the charted path. In relation to control, we have to understand a few more terms.

17. *Feedback*

Control can be affected through feedback (see Fig. 5.1).

This is known as control through close-loop coupling. Control can be affected through the interaction of various methods of coupling. In engineering science apart from feedback coupling, the following two couplings are important:

1. Serial coupling
2. Parallel coupling

In serial coupling the output of one unit becomes the input of the second and the output of the second becomes the input of the third and so on. If some of these outputs are again fed back as the input of the previous stage, then it becomes feedback coupling and close-loop coupling (see Figs. 5.2 and 5.3).

Parallel Coupling Here, the same types of provisions are done in two or more parallel channels (see Fig. 5.4).

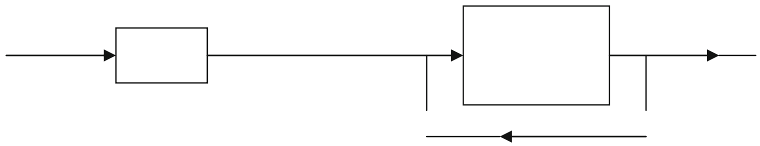

Fig. 5.3 Serial coupling – with feedback loops

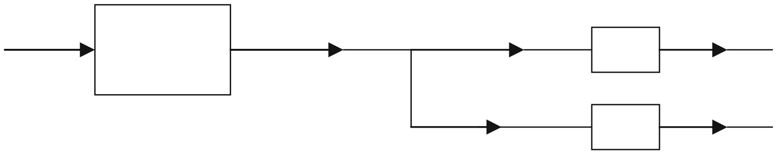

Fig. 5.4 Parallel coupling

In practice all types of couplings may occur simultaneously. In a large organization, the links among subunits typically form an exceedingly elaborate network. In this, again, some idea of effecting interaction and controlling interaction may be useful. Interactions take place because of the coupling. Sometimes interactions are transmitted through a common environment, for example, two or more branches of the same bank operating in the same urban area felt the necessity for interaction in preparing their performance budget. Moreover, some interactions may also stem from allocation of scarce resources. Even higher independent activities may draw upon the same pool of overall resources. Independent activities can be grouped into separate units.

The concepts and ideas of control and various types of control and coupling will be very useful in any study of manufacturing or service delivery systems. These can also be fruitfully applied in the study of networks and supply chains.

Further, concepts of control are very relevant in studying any socioeconomic system.

In any of our prescribed study, we should be careful to identify the control variable in the study; these aspects are related to the appropriate problem formulation discussed in detail in an earlier chapter.

Higher interacting activities should be grouped together. If interactions are kept to the minimum, then the design of the structure is facilitated. Structure and interactions are interrelated. It may be a golden rule to cluster activities in such a way that closely related activities are hierarchically near to each other. Weekly interrelated activities can be separately grouped. Unfortunately this principle is often difficult to apply in practice

In addition to the concepts above, we must also understand about certain terms in relation to systems methodology. These are given in the following section.

18. *Reductionism*

In this method the problem is analyzed and dissected to minute elements and the elements are then studied. This is the normal method of scientific study, principally in physical sciences. After studying the elements, the properties of elements are combined to understand the total problem. However, this method of analysis ignores the synthetic analysis required to understand the whole system.

19. *Holism*

In this the study of elements itself may provide an insight regarding the behavior of the whole system. So we have an approach of holism in systems analysis. The holistic analysis describes the synthetic view of the system as a whole. As contrary to the commonly held belief that the holistic thinking is a new space age phenomenon, it may be noted that this is also a very old method of enquiry. The Hegelian method (1779–1831) regarded the whole of reality as a system. As such reductionism and holism are well accepted principles for scientific enquiry for a long time, and in each stage of systems analysis, we have to use both these methods. It will be necessary before we close this section to clarify ideas conveyed by two other terms: systematic and systemic.

20. *The systematic*

The systematic method of enquiry is nothing but an orderly way of inquiry. Any inquiry having a method or plan is systematic, whereas a systemic thinking is a capacity of being able to perceive the system in a given situation. There are no clear-cut methods of achieving this insight. Perhaps an effort to look to the system as a whole may help in developing the insight.

In all normal research methodologies, we give stress on analytical and systematic processes. As explained earlier, these are necessary but not adequate in tackling complex problems, where understanding the emergence and problems of the system as a whole is equally important. Thus, for a good research study, we require both analysis and synthesis, a combination of systematic and systemic approaches which combines reductionism along with holistic integration. We therefore further define analysis and synthesis.

21. *Analysis*

To divide the whole into subparts and to study and treat the parts separately is called analysis. Thus, in "analysis" something that we want to understand is first taken apart and then an attempt is made to understand the behavior of each part of the system separately. Understanding of the subparts of the system is then aggregated in an effort to explain the behavior or properties of the whole. Analysis of a system exposes its structure and explains how it works. It provides appropriate knowledge to make it work efficiently.

Analysis generally provides knowledge about the behavior/characteristics of the system but does not provide us understanding about linkages with other parts of larger systems.

22. *Synthesis*

In synthesis the part of the system/systems that we want to understand is first identified as a part of one or more major systems. Further, in synthesis, efforts are made to understand the function of the larger system/systems of which the system studied (whole) is a part. The understanding of the larger containing system is then desegregated to identify/specify the role and function of the system under study. Synthesis is concerned with the effectiveness of the system. To enable a system to perform effectively, we must understand it. We must be able to explain its behavior, and this requires being aware of its functions in the large system of which it is a part.

5.1.4 Some Basic Laws of Systems

A system if not adequately attended to tends to deteriorates. Systems entropy tends to increase, and systems tend to become more complex:

Law of Equifinality A system can reach an equal final position starting from some initial position by following alternative routes. This principle is very relevant in strategic corporate planning. Selection involves selecting the optimal route to reach the final position.

Law of Requisite Variety A system that contains variety can only be appropriately controlled with variety of controls. The same number of controls is needed as there are a number of varieties. This important law suggests the futility to control different situations/environments by uniform policies/strategies.

In any research study, these laws should be kept in mind in terms of selecting alternative research methodologies for achieving the desired result. Similarly, tackling different variables by the same principle may not be feasible, and the researcher must be willing to use different methods for tackling different conditions. Further for conducting a complex research study, a variety of skills, approaches, and resources may be needed. These should be identified and resources acquired before undertaking the complex study.

Thus, these laws should guide the research at every phase of a complex and difficult research study.

5.2 Tools and Techniques for Systemic Research

5.2.1 Hard and Soft Systems

Before we proceed to describe certain techniques, it may be useful to differentiate between hard and soft systems.

Hard systems study involves modeling real-world problems by using simulations and computers and techniques and tools of operational research and management science. Hard systems methodologies are generally useful for problems that can justifiably be quantified. Through hard systems methodology it is normally very difficult to incorporate intangible and unquantifiable variables (like policy options, culture, emotions, etc.). These variables, even though important, tend to be ignored and have marginal effects on final solutions. Thus, it often tends to ignore the role of motivation, loyalty and group dynamics in improving productivity.

Soft systems are those which cannot be easily quantified. Particularly people systems having multiple and conflicting frames of reference are seldom tackled through hard systems methodologies. Soft systems methodologies are useful in understanding motivations, view points and interactions and also in getting insights into qualitative and quantitative factors. This methodology can deal both with the qualitative and quantitative dimensions of a problem situation. These methodologies were first promoted by Professor Peter Checkland of Lancaster University.

For conducting research study of real-world problems, it may be pertinent to mention that real-world problems contain both quantifiable and nonquantifiable variables, and both are important in arriving at a proper solution. Thus, along with scientific research methodologies and methodologies of hard system, we require application of soft systems methodologies and methods of qualitative research.

5.2.2 Steps in Soft Systems Methodology

Soft systems method is based on application of systems thinking in bringing about better understanding and insights into an unstructured complex problem situation. Some of these methods have been discussed while discussing problem formulation methods. Generally soft systems methodology consists of seven steps. The *first step* is concerned with the description of the problem situation. Here, we explore the general area of the problem that interests us. Let us take an example of a study of sustainable improvement of the economic conditions of poor tribal population in a backward area. Here, we have to first define the boundaries of the geographical areas under study and also population groups whose improvement we are looking for. We should then explore the meaning of improvement and sustainability. In exploring these issues, the following things must be understood:

Social/economic structure of communities
Processes and cultures
Overall climate in the area
Peoples' behavior
Issues that concern people
Conflicts that may surface

The *second step* is to put the above in some pictorial form. If these are expressed in the form of some diagram, it may help in further understanding.

The *third step* will be to identify and define the relevant system. Here, we may have to clearly define the concepts of improvement, culture, backward area and sustainability. In arriving at acceptable root definitions, we can consult with the local people and other experts.

The *fourth step* is to develop the model – a representation of the problem of the real world either through mathematical, logical, or graphical methods.

The *fifth step* is a checking device where we check the model structure with the real world. This can be done by unstructured discussion or structured questioning/developing scenarios by varying assumptions and conditions.

The *sixth step* consists of determining desirable and feasible interventions to bring the desirable transformations.

At this stage, the process is no longer sequential, and we suggest one method of intervention, assess its effects logically, discuss with the concerned groups and experts, modify the intervention, and proceed in the same way till we approach to solutions which are acceptable, feasible, and desirable.

The *seventh step* consists of actions to improve the situation. Again the methodology may revolve toward redefining, remodeling, and changing actions till satisfactory action programs are finalized.

It may be mentioned here that we here have sufficiently simplified the methodology of soft systems modeling. Methodological expertise can only be obtained through actual real-life problem solving. Nowadays large numbers of academic research projects are conducted by following soft systems methodologies; it is our view that no research methodology course can be considered complete without students being exposed to the ideas of soft systems methodology. Interested students and readers may supplement and complement their knowledge by referring to texts and references mentioned at the end of the chapter.

As we have seen, many techniques used in soft systems methodology are for problem structuring and getting insights about processes and systems. Many diagrammatic techniques can be helpful in the effort. In the rest of the section, we give details of some of the diagrammatic techniques.

5.2.3 Techniques of Soft Systems Methodology

We briefly enumerate the various techniques useful for systems analysis and soft systems study in the context of the study of organizations' social and management systems. The various techniques available have been grouped into two:

(a) Diagrammatic techniques
(b) Non-diagrammatic techniques

Here, we basically concentrate on diagrammatic techniques.

Diagrammatic Techniques These techniques are used in the analysis of human-activity systems. The techniques depend on the approach adopted for analysis. Approaches may be as follows:

5.2.3.1 The Pragmatic–Historical Approach

The human-activity system learns from its experience. As it grows, its activity set changes and the structure also changes. Organizations thus evolve over many years. Analysis of this evolution is very vital for any study of organizational problems. In order to study the organizational problem of Indian banks, it may be seen that most of the banks have structurally (formal and informal) evolved through time in a different manner and this aspect (which is often referred as organizational culture) has to be understood and studied before specific organizational studies can be taken up.

One can use descriptive verbal language for depicting historical growth; however, to obtain a quick view of the growth, some diagrammatic representation always helps. No specific method is available. What specific diagram will be drawn is left to the imagination of the analyst.

5.2.3.2 The Activity or Material Processing Approach

The basis of most human activities is the use of resources to meet ends. Usually a system takes certain materials (as inputs from outside itself) and converts them into outputs and services for which there is demand. Here the technique of drawing "flow-block diagram" is used (see Fig. 5.5).

In drawing a "flow-block diagram," it is very important to be consistent in the use of symbols and conventions. Wherever necessary, key to symbols used should be provided.

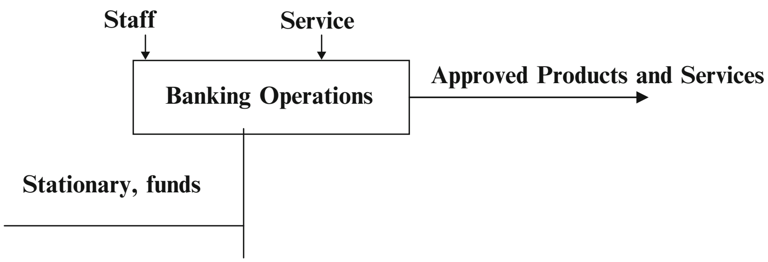

Fig. 5.5 Flow-block diagram (Note: *Plain arrow* shows material transfer or flows. Words in *rectangular boxes* (blocks) represent activities or processes. *Broken arrow* shows the use of human resources)

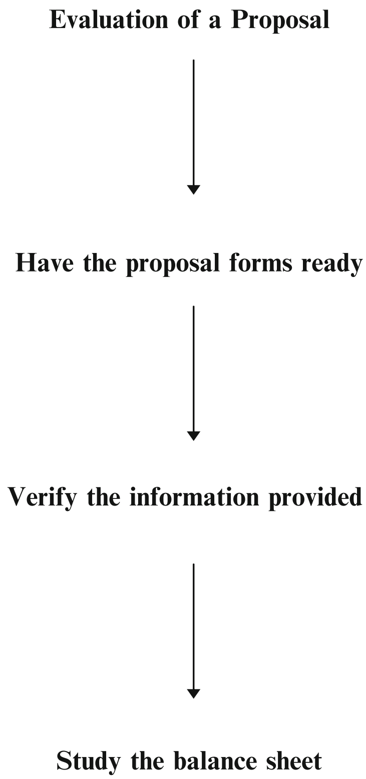

Fig. 5.6 Instruction sequence diagram

Instead of representing flows of materials, it can give sequences of activities and instructions to be taken in order (see Fig. 5.6).

The diagram above is not a flow-block diagram; the above is a process diagram. We should not mix up two types of diagrams because this can create confusion. It is particularly important to ensure that on the same diagram the same arrow representing the flow of materials and others representing control activities or simply the sequence of instructions are not used. For such purposes, different types of arrows have to be used and clear explanations or keys should accompany the use of different arrows.

The flow-block diagram is a basic analytical tool. The most obvious examples are in physical material processing, but as we have already seen, the same ideas may prove quite useful for service industries (say banks, insurance, or hotels) and for systems which process information.

5.2.3.3 The Social Structure of "Human Systems" View

Human activities are done by people. These people are grouped into human systems. Humans are related to each other in terms of authority, power, friendship, and so on

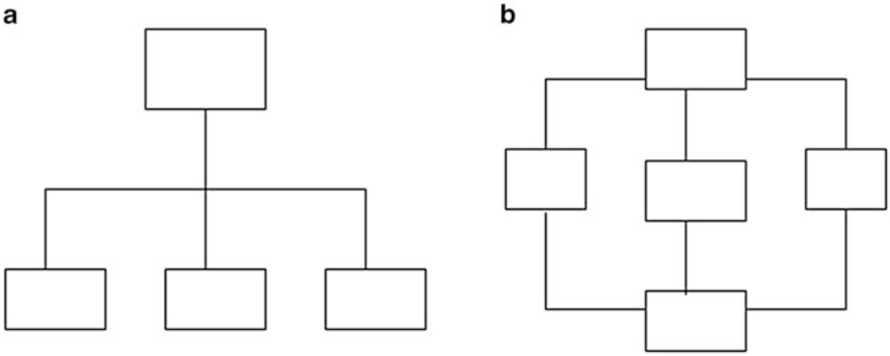

Fig. 5.7 (**a**) Hierarchy (**b**) Network

and are also connected through communication channels (informal and formal) and through the demand of the technological processes.

The total effect of all these relationships result in the formation of "social structure." In social structure diagrams, the elements of the diagrams are people (groups) and links usually represent both authority relationships and flow of information. The following two forms of a social structure diagram may be of interest:

An organization chart and family tree diagram are diagrams which represent hierarchal social structures. Hierarchal structures are related with concepts of *span of control*, *vertical line of communications*, etc. See Fig. 5.7a.

In Fig. 5.7b we have shown the network structure. Here the boxes represent the decision or information-processing nodes. These nodes are then connected to each other giving rise to a network of relationships.

5.2.3.4 The Total Systems Planning Approach

Activities and structures which are part of "human-activity" systems can be planned both internally within the organization and in relation to the external environment. We can look at the structural and functional subsystems specifically as "decision-making subsystem." Externally, the relationship of the system with other systems and influences of the environment on the system have to be studied.

The "decision-making subsystem" appraises both the internal and external situation, and on that basis, it plans for the whole system in relation to its environment.

This type of overall thinking may lead to two types of diagrams – systems maps and decision sequence diagrams.

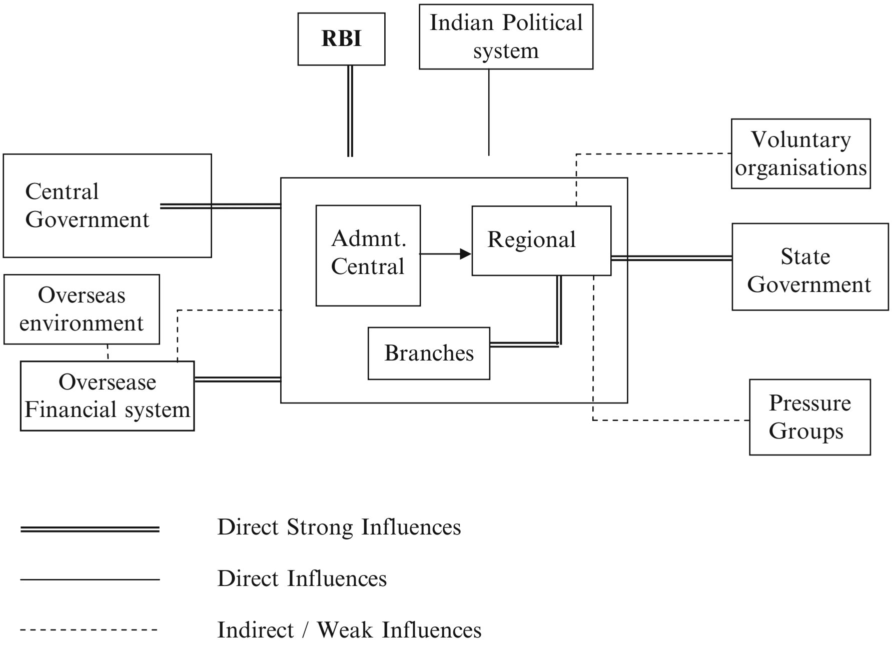

Fig. 5.8 Systems map of Indian commercial banks

5.2.4 Systems Map

Systems map are called "macro influence diagrams." It maps the influences affecting things on a macro scale.

In drawing such a diagram, we have to analyze the possible influences acting on the system. However, it is always difficult to include all influences. Some influences may be missed. It may be useful to prepare a list of all important influences. One can question the usefulness of drawing a diagram instead of listing the influences. It may be stressed here that a diagram shows the relationships of subsystems to the total system. A list does not show this (see Fig. 5.8). We have broadly drawn a systems map of a commercial bank in India in this diagram.

It is always advisable to draw a systems map in order to fix the boundaries and broad influence areas which have to be taken into consideration in studying a problem. Here, the thickness of lines indicates the degree of influence. Thus, to draw a systems map, the following steps may be adopted:

Step 1. Identify all environmental factors affecting the working of the systems understudy.

Step 2. Determine the degree of influence of the identified factors. Take only those influences which are relevant and which can affect the result of the study.

Step 3. Draw the systems map clearly showing the direction of influence by arrow and degree of influence by thickness of lines.

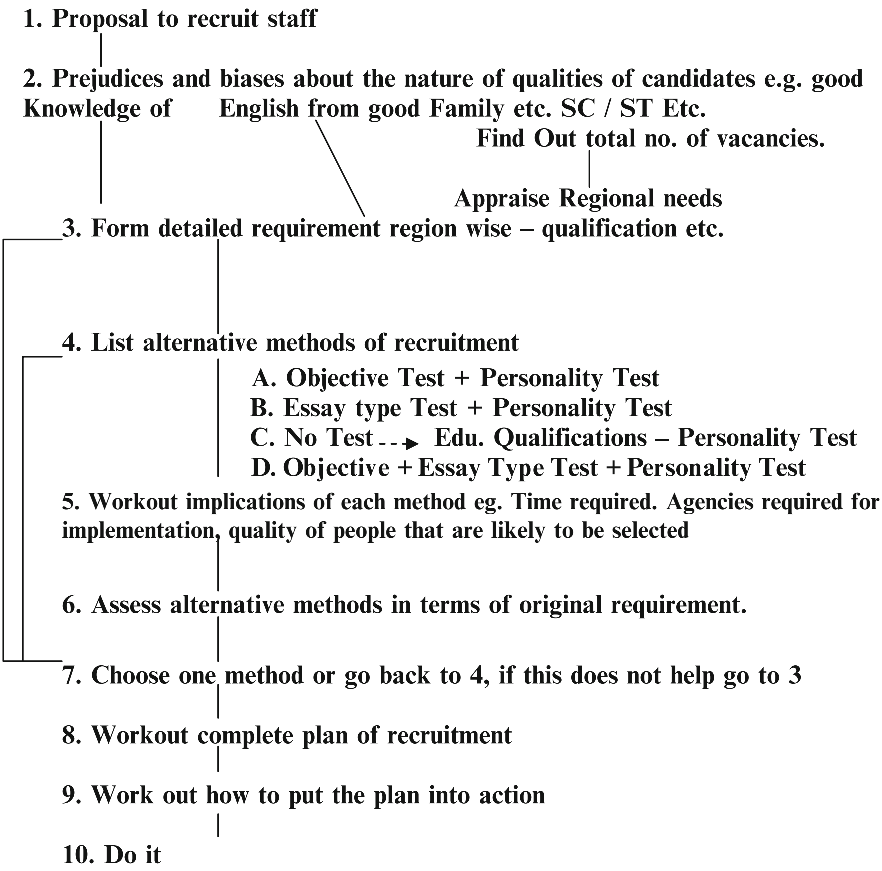

Fig. 5.9 Decision sequence diagram for a recruitment decision

5.2.4.1 Decision Sequence Diagram

A macro influence diagram or systems map is the first type of diagram that one can draw while adopting a Total Systems Planning Approach. The second type of diagram that we can draw is the decision sequence diagram. This type of diagram depicts the sequence leading to a decision or plan. These diagrams show information being processed in stages. See Fig. 5.9 where a decision sequence diagram depicts the various stages of activities for a recruitment decision. We show as an example the decision sequence diagram for recruiting staff. Here the first input is the proposal to recruit staff.

Decision sequence diagrams need not include every bit of details that are done for taking decisions, because that unnecessarily makes the diagram complicated without adding much to the understanding of the problem for the purpose of the analysis.

We have discussed about the four different types of systems diagrams for ease of reference; these are summarized below.

The ability to develop systems diagrams is invaluable in systems work in two ways. First, it concentrates the mind and assists the understanding of a situation through the process of having to order information and arrange it; and second, it can aid others to grasp quickly the essentials of a situation which one has to distill out of a mass of relevant and irrelevant details.

Trying to sort out and represent a new situation on paper seems to require imaginative new graphical ideas, whereas conveying the essentials of a situation to others requires a clear, disciplined use of particular convention. One has to use the familiar or variations of it to explain the unfamiliar. This is why the knowledge of particular types of diagrams is very useful although in any given situation the appropriate diagram is unlikely to be a pure version of any particular type.

1. The pragmatic–historical approach	←——→	No specific diagram types and the researcher is free to use his/her own imaginative ideas
2. The activity or material processing views	←——→	Flow-block diagrams
3. The social structure of "human systems" view	←——→	Social structure diagrams
4. The Total Systems Planning Approach	←——→	Systems maps: decision sequence diagrams

In addition to diagrammatic techniques, there are non-diagrammatic techniques which may be useful for analysis. We shall here discuss the techniques of developing of interaction matrices. Both diagrammatic and non-diagrammatic techniques may be used, these are mutually reinforcing in providing better insight in understanding the subsystems to be dealt with. Non-diagrammatic techniques are to be used at the end of a systems exercise.

5.2.5 Interaction Matrices

Interaction matrices are simple devices to understand the nature of interaction among various parts of a system or subsystem. These help to understand the problem in a specific situation. Though the solution is not guaranteed, the technique helps to develop a simple model of the system during the early phases of a study.

The following procedures may be followed in developing interaction matrices:

Step 1 Prepare a list of all the subsystems within the system, e.g. supposing we are studying the central office organization of a bank, various departments/cells in the central office may be the candidates for our listing. In case we are studying problems of rural healthcare, we have to study local sanitation, drainage, quality of available drinking water, environment and pollution, level of nutrition, economic condition and available healthcare facilities. All these interact with one another for a rural health situation.

Step 2 Arrange the components or subsystems in approximate order of importance (this order of importance is related to the purpose of the study in hand – there is no absolute ordering). Take the previous example. In reorganization of the central office perhaps according to our judgment, the department of operations may be the most important, second may be the priority sector advance, and third may be the personnel, and so on. In some other studies which are focused on personnel policy studies, the personnel department may be highest in importance. Say in healthcare, water quality, sanitation, and nutrition may be the order of importance in case of rural health.

Step 3 A simple matrix is then constructed: the procedure for construction of the matrix is as follows:

(a) All components/subsystems are listed in the same order as in step 2 both along the rows and column. The first component is in the first row and in the first column. Similarly, we have operations, priority, personnel administrative, and accounts and planning departments and each of these have subdepartments. So we have (say) OP_1, OP_2, OP_3, Pr_1, Pr_2, $Pers_1$, Adm_1, Adm_2, Plg_1, and Plg_2 arranged in the arrangement of the matrix will be as shown in Fig. 5.10.

Similar diagram can be drawn for a rural health study.

The matrix consists of rows and columns and cells which are to contain the interaction between the appropriate cells.

Before constructing the final interaction matrices, it is always useful to construct trial interaction matrices which can then be changed and modified to arrive at the final version. At this stage consultation with concerned decision-makers may be of help. As an example to determine the effect of the quality of drinking water on the prevalent diseases in the rural area, we have to discuss with public health experts.

Step 4 Having constructed the matrix, in each cell the links from a specific row to a specific column have to be indicated. For example, in the cell marked * we represent the links of OP to Pr. The links that pass in the opposition direction, that is, that pass from Pr to OP, are noted in the cell as **

In cells we can use signs or symbols, or we can use descriptions to denote interactions and their nature, etc.

Step 5 A "systems map" is drawn showing the main subsystems or components and the important links between them.

This is useful to find out whether all parts of the systems are adequately linked up. There may be discontinuities, and we may discover basic flaws in the systems structures.

Step 6 For major types of interaction in the matrix, steps 2–5 have to be repeated, till all major interactions are taken care of.

Thus, we have an interaction in respect of the flow of money, material, information, authority, etc.

	OP_1	OP_2	OP_3	Pr_1	Pr_2	$Pers_1$	Adm_1	Adm_2	Plg_1	Plg_2
OP_1				*						
OP_2										
OP_3										
Pr_1										
Pr_2	**									
$Pers_1$										
Adm_1										
Adm_2										
Plg_1										
Plg_2										

Fig. 5.10 Interaction matrix format

Step 7 Excluding all the links specified in step 6, steps 2–5 are repeated. This is a checking procedure to ensure no important link is missed.

5.2.6 Sociograms

Sociograms depict interactions among people. As an illustration consider the following example:

In a small organization consisting of seven workers, a question of discovering the appropriate supervisor from among those seven men arose. The investigator asked each worker to say which person in the group he would most like to work for. The results for the group of seven looked as below:

Person 1 named Person 3
Person 2 named Person 4
Person 3 named Person 1

Person 4 named Person 7
Person 5 named Person 3
Person 6 named Person 3
Person 7 named Person 2

The interaction matrix when drawn according to the step outlined (ordering according to the number preference obtained by each and arranged numerically where the same number of preference vote was obtained, we get: 3, 1, 2, 4, 7, 5, 5 and 6) will look as follows (Fig. 5.11).

We can construct the sociogram as shown below (Fig. 5.12).

	3	1	2	4	7	5	6
3		*					
1	*						
2				*			
4					*		
7			*				
5	*						
6	*						

Fig. 5.11 Interaction matrix (for supervision election problem)

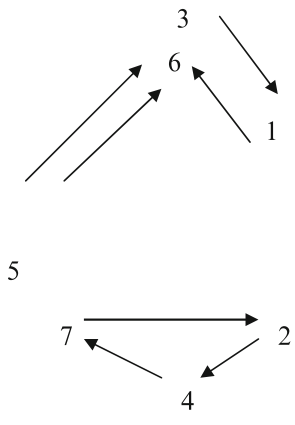

Fig. 5.12 Sociogram (*Arrow* (*solid line*) emerging from a number indicates the preference of that number)

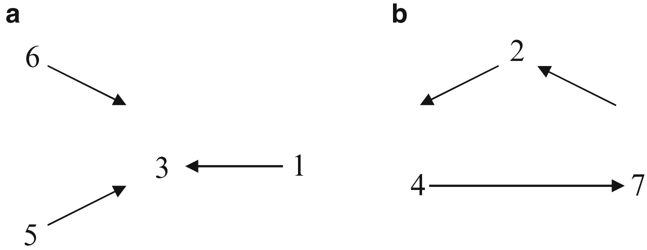

Fig. 5.13 Sociogram

To get a clearer view we can redraw the above sociogram (Fig. 5.13a, b).

It may be seen that persons 4, 2 and 7 form a clique among themselves and none of them is supporting 3. Thus, though apparently person 3 secures more preference votes, he may not be quite successful against the clique formation.

This diagram thus gives us better understanding of the situation than what we knew from simple counting of preferences. This is a simple illustration. The techniques discussed in this note may be fruitfully used in earlier stages of the study and specifically in getting better insight of the organizational processes and interactions.

5.2.7 Some Higher-Level Graphical Technique Like SODA, Cognitive Mapping and Strategic Choice Approach

5.2.7.1 SODA: Strategic Option Development Analysis

It can be used for solving complex messy problems and for strategy formulation. Thus, it can be very useful in any strategic research and in studying complex social or policy issues. For the students who want to do their doctoral research based on exploring feasible and applicable solutions to real-life organizational, managerial, and complex social problems, this technique may be found very useful. Exposure to this technique will be highly valuable to those who after the academic career want to be a part of an internal problem solving team in corporate organizations and want to take career options as consultants and advisors. In view of all these, we felt that it will not be proper in a modern textbook on higher-level research methodology to exclude an exposure to this very modern and useful technique.

SODA helps in structuring a messy complex problem; further it gives a new insight in understanding the various aspects of the problems under study and interactions of the components of the problem under study. It also helps in understanding the interrelationships of the system under study with various groups of stakeholders who will be affected by the proposed solution.

Generally SODA is complemented by the technique called Journey. Journey represents an acronym for jointly understanding reflecting and negotiating strategy. Let us take an example for the purpose of illustration. Any real-life problem of industrial location will involve the use of land for setting up industrial unit and related facilities. This will call for the diversion of the existing land from its present use for industrial purposes. The present use may be agricultural and the farmer owning the land may be completely dependent on that agricultural produce for sustainable living. By sacrificing the land for industrial use, the farmer will forfeit his/her means of livelihood. He/she will therefore be unwilling to part with the land unless suitably compensated for the loss of livelihood. Unless affected groups reach a consensus on land use or proposed diversion, the project may not at all be implemented. In India recent experiences into locating SEZ (special economic zones) in Maharashtra and locating the industry in Singur and Nandigram in West Bengal point out clearly the need for having appropriate methodologies for evolving negotiated consensus among all the affected and interested groups about the proposed land-use planning. Without such consensus the industrial development projects (just like Singur and Nandigram) may not see the light of the day. In reaching such consensus SODA or Journey may be highly useful.

In all such problems (SEZ location of industries, river valley projects, express-way construction, etc.), the aim should be to arrive at a consensus (rather than compromise). The process should generate active participation of all concerned groups and thereby these groups will have commitment toward the consensus solution arrived at.

SODA is particularly useful and applicable in the following situation:

- Consultants and researchers should be interested in working face to face with various groups of stakeholders. They try to influence the basic decision. Thus, in case of industrial location and land-use planning, the researcher has to personally interact face to face with all affected and interested groups. These groups may be affected whether positively or negatively.
- The researcher has to relate with a small number of significant personalities of concerned groups.
- The researcher/consultant will normally adopt a contingent or cyclical approach to working on the problem. The general approach is to proceed flexibly and experimentally from broad benefits to specific commitments. Thus, in an industrial location project, the researcher will present a map of future benefits of locating the industry and simultaneously will map the adverse effects of the transfer of lands and then will discuss various options of mitigation adverse effects so that consensus from the affected groups evolves over a period of time.
- Time and attention given by the researcher or consultant at this stage will save much disruption and distress later on, compared to what would have happened if the researcher concluded the location problem without going through the process of exploring a consensus.

There are four aspects to be considered in case of SODA techniques. These are (a) individual, (b) nature of the organization and social group, (c) method of conducting the consultancy or research, and (d) technologies or techniques used.

The approach is mainly based on subjectivism. Each group and its members have perceptions and subjective views of the real problem under consideration. By "cognitive mapping" these subjective views and perceptions are captured. A question arises – what is a cognitive map? A cognitive map is nothing but a model of a system of concepts used by the groups (affected groups or clients in consulting language) to communicate the nature of the problem. The model attempts to represent the meaning of the concepts by its relationship with other concepts through an action orientation. Thus, the concept of transfer of fertile land to industrial use and its effects on the loss of production and consequent loss of income have to be related to the gain of employment opportunities and other compensation along with the overall progress and economic improvements of the area through industrial development. All effects as expressed by groups are graphically represented through cognitive mapping and therefore all concerned people can see the meaning and effects of their subjective perceptions and because of this, negotiation and discussion can become more meaningful and consensus may often be achieved by flexible adjustment of action programs.

The SODA approach is aimed at producing a device that can be used to facilitate managing "messiness" of the decision situation and reach a definite consensus-based solution. Here, presenting appropriate views, analyzing relationships, and communicating through languages (verbal/non verbal) and specific tradeoffs can be attempted, and this can help in arriving at a negotiated solution. The process can be represented by the diagram as shown in Fig. 5.14.

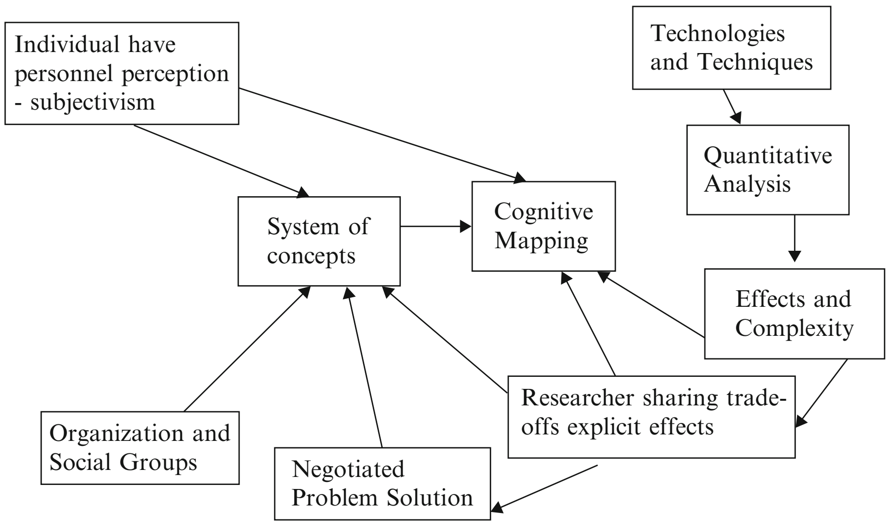

Fig. 5.14 SODA

This is a much simplified diagram of the total process. Basically perceptions of various individuals and groups are mapped; effects are analyzed both quantitatively and qualitatively. After that, tradeoffs are clearly specified in a language understood by all concerned. New concepts are often generated through mutual exchange of ideas and perceptions.

5.2.7.2 Cognitive Mapping

Cognitive mapping exists within the problem description in the SODA framework. It is nothing but a method of mapping a person's thinking within the field of psychological research or perception. Figure 5.15 shows a small cognitive map as an illustrative example (Eden 1987).

Figure 5.15 illustrates the urge of affected people for positive action to correct the problem of arsenic in drinking water. The above map can be further expanded to include more perceptions regarding possible action programs. The process of cognitive mapping thus helps to identify the people/organization to be involved in solving a real problem of the modern complex world.

The best way to develop a "cognitive map" is to obtain from the affected group a clear perception of their goals and objectives. After that steps are identified to deal with various groups and objects to achieve that goal.

Cognitive maps generally clarify goals, constraints, and options. Such maps also help in identifying actors that can help with the solution of the problem.

5.2.7.3 Strategic Choice Approach

In any real-world problem situation, if we want to resolve the problem effectively, we have to explicitly consider the various uncertainties involved. Even in solving academic-oriented problems, consideration of relevant uncertainties is very important.

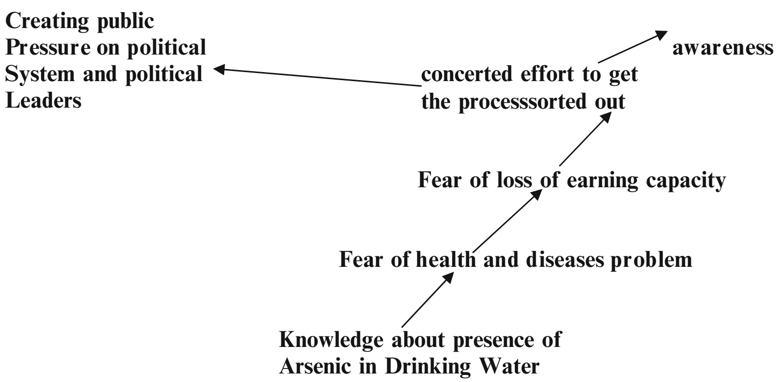

Fig. 5.15 Example of cognitive mapping for the problem of arsenic in drinking water

In the strategic choice approach, three types of uncertainties are identified. These are:

1. Uncertainties regarding the environment
2. Uncertainties about the guiding value
3. Uncertainties about choices and related agendas

Getting a clear idea about these at the beginning of any important research study will significantly help in mapping out future programs for solving the research problem. It helps in avoiding a lot of confusions later.

The strategic choice approach consists of the following steps: (1) a solution package and its action programs are designed in solving the problem. (2) The package is then given specificity by giving the details of designs and concrete shapes toward solution packages. (3) The effects of action programs are then assessed in terms of various preferences and uncertainties. (4) These were then compared with the desired outcome. The comparison is done on the basis of a likely outcome in following a specific action package. After this comparison if necessary, modifications are introduced in the action program package on the basis of the results of such comparison.

Following this method, the final package is selected. Such selection will be better than other available action packages. The final option (action) package selected conceptually in this fashion at the beginning of a study may be very useful in solving real-world problems. The public choice approach therefore will be useful in solving complex strategic problems.

Figure 5.16 illustrates the process of the strategic choice approach.

The design of option programs is based on issues and detailed shapes/structures of these problems and issues. However, a particular design and detailed shapes and structures can have effects on issues.

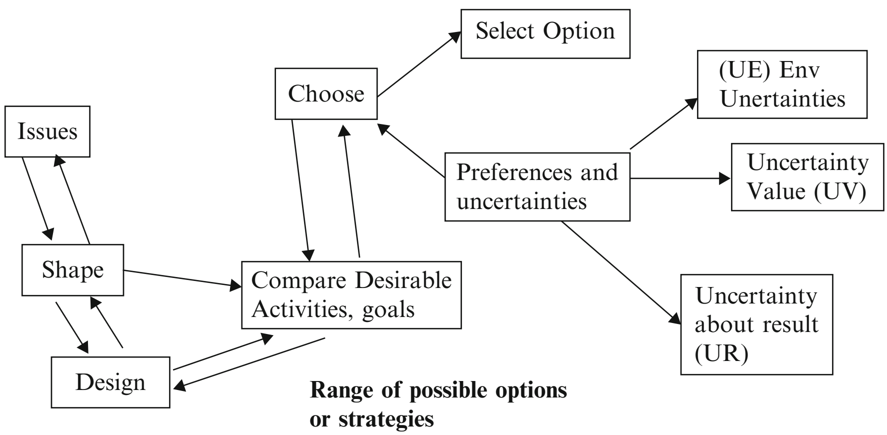

Fig. 5.16 Description of strategic choice approach

Selection is an iterative process. The process takes into consideration uncertainties involved. This is very important as all options have results in the future which are uncertain.

Selection of option cannot therefore be made sequential. Comparisons and modifications are carried out till an option likely to be successful is selected.

We have discussed a few techniques leading to a better understanding and better problem solution. These are brief descriptions; the idea is to expose the readers to these new series of ideas and techniques. Techniques are fairly straightforward, though the application will require practical exposure. Interested readers can gain more information by going through the references detailed in the end of the chapter.

In Part III of this chapter, we briefly discuss a few case studies as illustrations of application.

5.3 Case Examples

5.3.1 Case Studies

We briefly describe a few real-life case studies where soft systems methodology and combined soft and hard systems methodologies were used:

5.3.1.1 Case Study – 1

A problem of improvement of decision and information system in a government organization had to be resolved. Various decision systems and subsystems and roles and functions of different departments and subdepartments were identified. Actual details of information used, information flow, and decision problems were obtained. However, whereas some of the above were based on hard systems analysis methods, the role perceptions by different decision-makers and executives and perceptions of their information and resource needs were partly objective and partly subjective. Here, principles of cognitive mapping were found useful in mapping actions and perceived goals by different actors, and by explicit and open discussion, a consensus on an integrated picture regarding the roles, functions, decision allocation, and information needs emerged. Once the need was evident, the design of the relevant information system and related cost–benefit analysis of options were relatively logical and hard systems based. Thus, while for problem solving and getting insights into the problem we used soft systems methodology, for selecting the options of design we used a combination of soft and hard systems methodologies. All relevant aspects and impacts were considered, so it was based on the total systems intervention which included the restructuring of decision allocation, resource allocation and redefinition of roles, restructuring power, and authority structure. According to the new perception, training and cultural changes needed for making a system feasible were also prescribed. Thus, in systems approach no partial solution is acceptable. Results obtained were highly satisfactory, and since in the initial stage perceptions of all concerned executives and employees were used and understood, there was better profiling of the problem mapped. This also helped in soliciting better commitment of all during implementation.

5.3.1.2 Case Study – 2

This was a case study for improving economic conditions of backward areas which are forest infested, having no irrigation facilities and people are mostly tribal and scheduled castes and having no modern skills and attitudes. Standard solutions to such problem have been sought through a process of industrialization. The idea is to bring a large-scale industry in that area, which hopefully would be able to generate employment. The people of the area will be gainfully employed, and as economic conditions improve, education and health will improve, and the backward area will become progressive. This idea of creating a mother industry to develop an area had been adopted on a large scale for developing backward areas of an economy. By and large this strategy had failed everywhere. Basically it had failed because of a lack of systemic insight. The new industry based on modern technology would demand skills and sophistication from its employees which were not basically available in the local population; as a result, the employment generation would benefit the outsiders. Many people from outside the area would come to the area, and as a result, congestion and pollution would increase. A large chunk of local land resources would be used for the location of the industrial unit/units and to create townships for convenience of the outsiders. The local produce which used to be locally consumed were now quite inadequate to meet the demand and trade developed resulting in rising price for locally available goods and services. Poor people who did not get employment in the new factory, whose landed resources had been used for locating the industry or township, found it very difficult to survive, so instead of the improvement of the quality of life, the quality of life of the indigenous tribal and scheduled caste population deteriorates. Our research team from the study of literature and past experiences was convinced that the mother industry concept of creating large-scale industrialization was no longer a solution to the problem of improvement of backward areas and poor quality of life of local population. The team therefore had intensive participation and discussion regarding the changes that local people wanted and the way they wanted to bring about such changes. These discussions were based on previously discussed strategic choice methods and application of cognitive mapping techniques. These gave a much more clear idea of goals of the development of backward area and environmental uncertainties as perceived by the local population.

Discussions were also conducted with sociologists, technologists, development experts, and others and their perceptions were also mapped. On the basis of such two-way open discussions between the research team/experts and local population, a consensus regarding goals and available options emerged.

It became quite clear that the development of the area should be done in phases. The first phase should be planned based on the available skill locally, concentrating on productive activities which they (local people) can undertake with confidence and can perform well. Thus, stage 1 of development should be based on biomass generation and afforestation activities. By creating forest-based activities, employment could be generated and the local population would be directly benefited through employment in activities related to afforestation. They had adequate knowledge and skills for such activities. This would increase purchasing power, and demand for goods and services would increase. Slowly steps should be taken for skill improvement and education at the local level. The next step of development would be to create production activities based on forest-based products and wood-based manufacturing, production of simple tools, wooden furniture, toys, etc.

In the next stage when the local population would be skilled and sophisticated, they could then undertake activities related to production of chemicals, etc., from wood and forest products. The local population would evolve into skilled artisans and after that tiny/small/medium industrial units could be established and the local group could derive adequate benefit from such industrialization.

Thus, systems approach suggests better understanding of local needs and local capabilities. It is also necessary to understand that there is a hierarchy in the process of industrialization which should evolve in stages. The solution suggested and overall framework developed followed soft systems methodology; however, in stagewise optimization of resource, an allocation was attempted by adopting hard systems methodology. Interested readers may get further details of this case study in Bandyopadhyay and Datta[6].

Stages of development strategy for backward area development are shown in Figs. 5.17, 5.18, and 5.19.

5.3.1.3 Case Study – 3

This is a comprehensive research study undertaken as a doctoral research but rooted to a real development planning of a block (a combination of a group of villages). The process consisted of household-level planning which needed intense participation and understanding of issues of poverty and rural developments. At this stage, soft systems methodologies of systemic map, interaction matrix, and cognitive mapping were used. Land-use planning, energy balance planning and water balance planning for the generation of economic activities in the areas were undertaken.

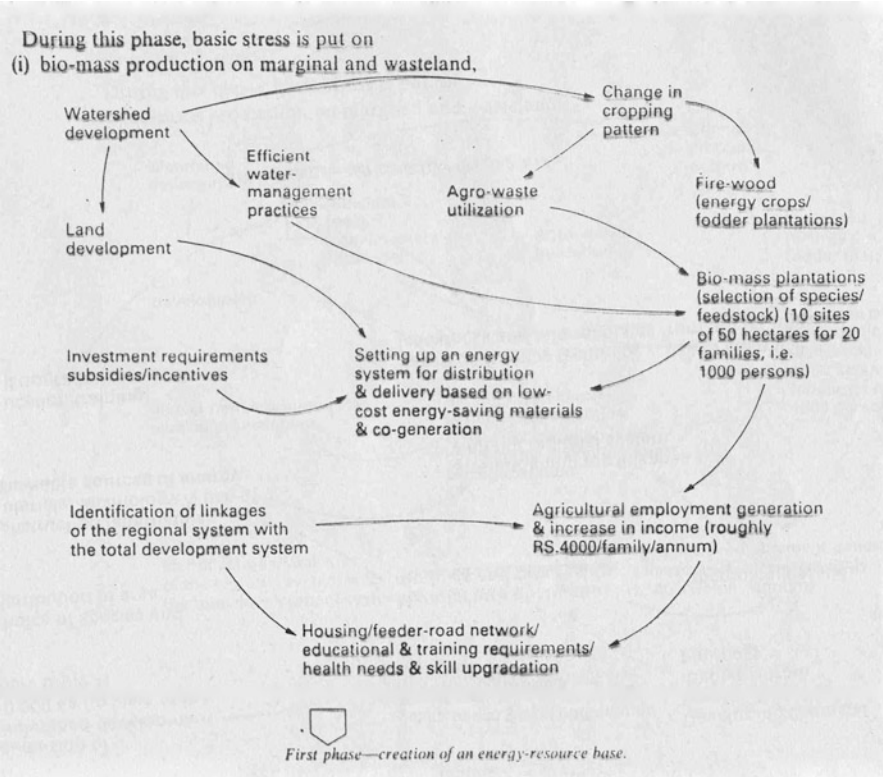

Fig. 5.17 Backward area development – first phase

Various options, their effects, tradeoffs, and uncertainties were demonstrated for the options available, and consensus regarding various aspects of balance was obtained from all concerned. The individual model of balance of resources used programming models of optimization of resource use. These required application of quantitative hard systems modeling methods.

Figure 5.20 depicts the detail of program for poverty alleviation and employment generation.

The various components and their interlinkage are shown in Fig. 5.21 where the integrated framework is shown.

These three case studies discussed here deal with real-life problems having sufficient conceptual depth to be classified as a high-level academic research. The methodologies followed in the case studies are a mix of soft and hard systems methodologies. The methodologies combine analysis with synthesis and holism and reductionism.

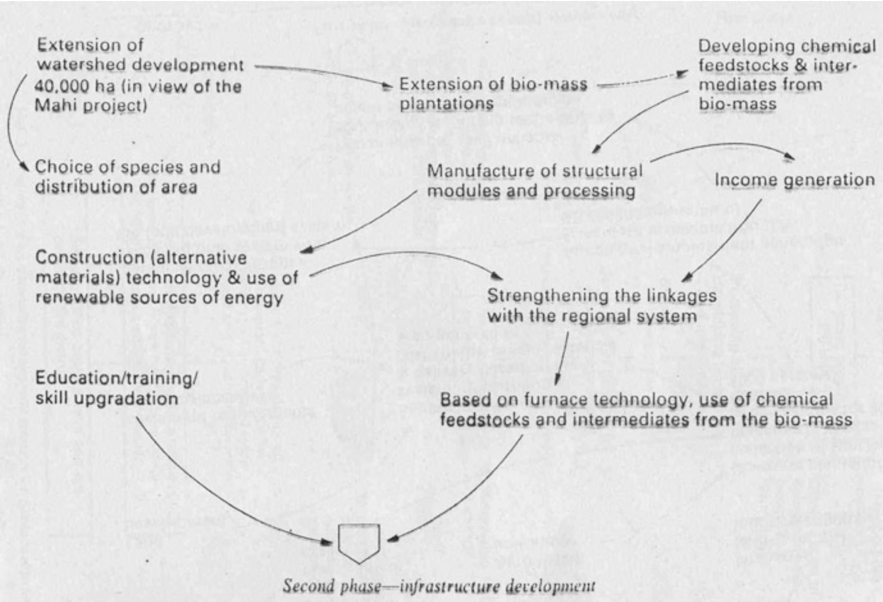

Fig. 5.18 Backward area development – second phase

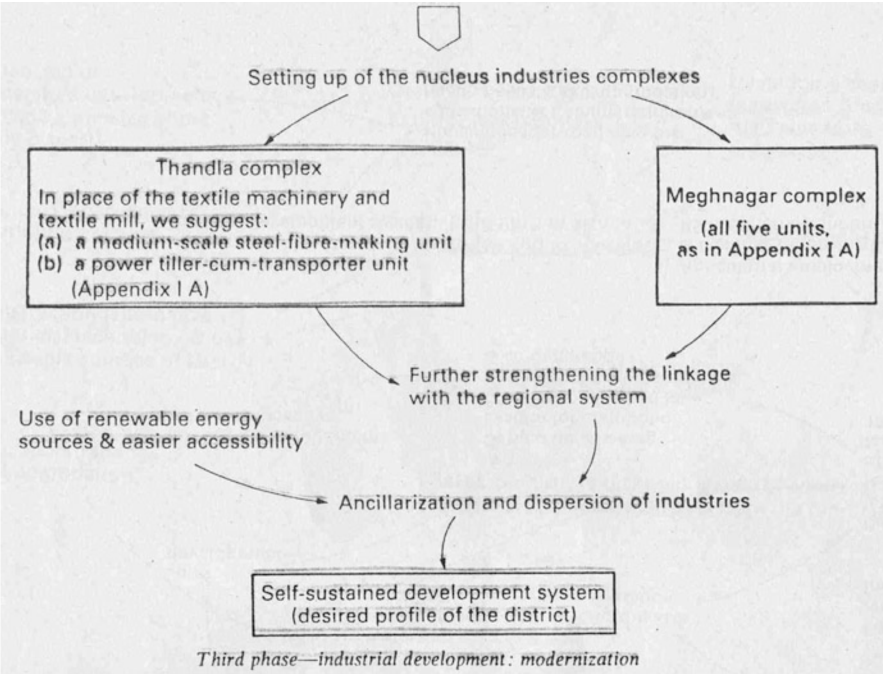

Fig. 5.19 Backward area development – third phase

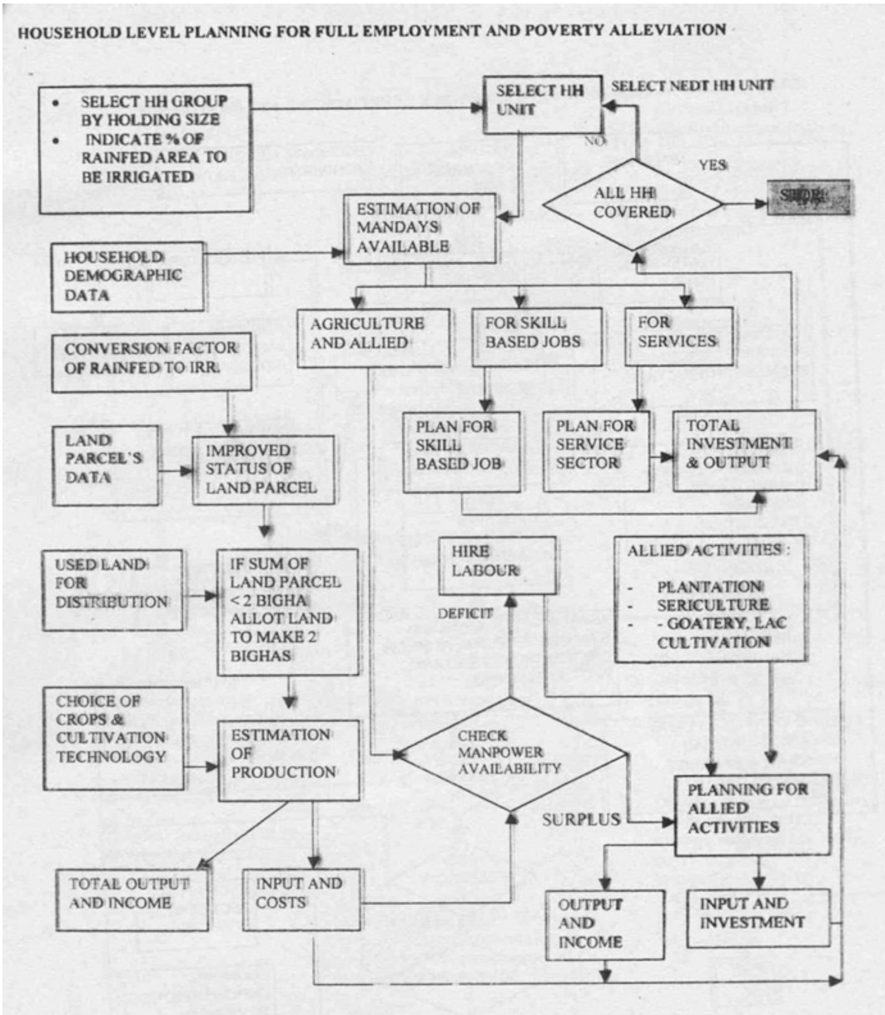

Fig. 5.20 Depiction of program for poverty alleviation and employment generation

5.4 Summary

There are large numbers of case studies undertaken by the author, and many case studies are also available in published literature describing the application of soft systems approach along with hard systems methodologies. Readers who are interested in pure academic type of researches should realize that most academic research problems should be properly defined and issues to be resolved should be adequately understood. For these discussions with guides, peer groups and experts

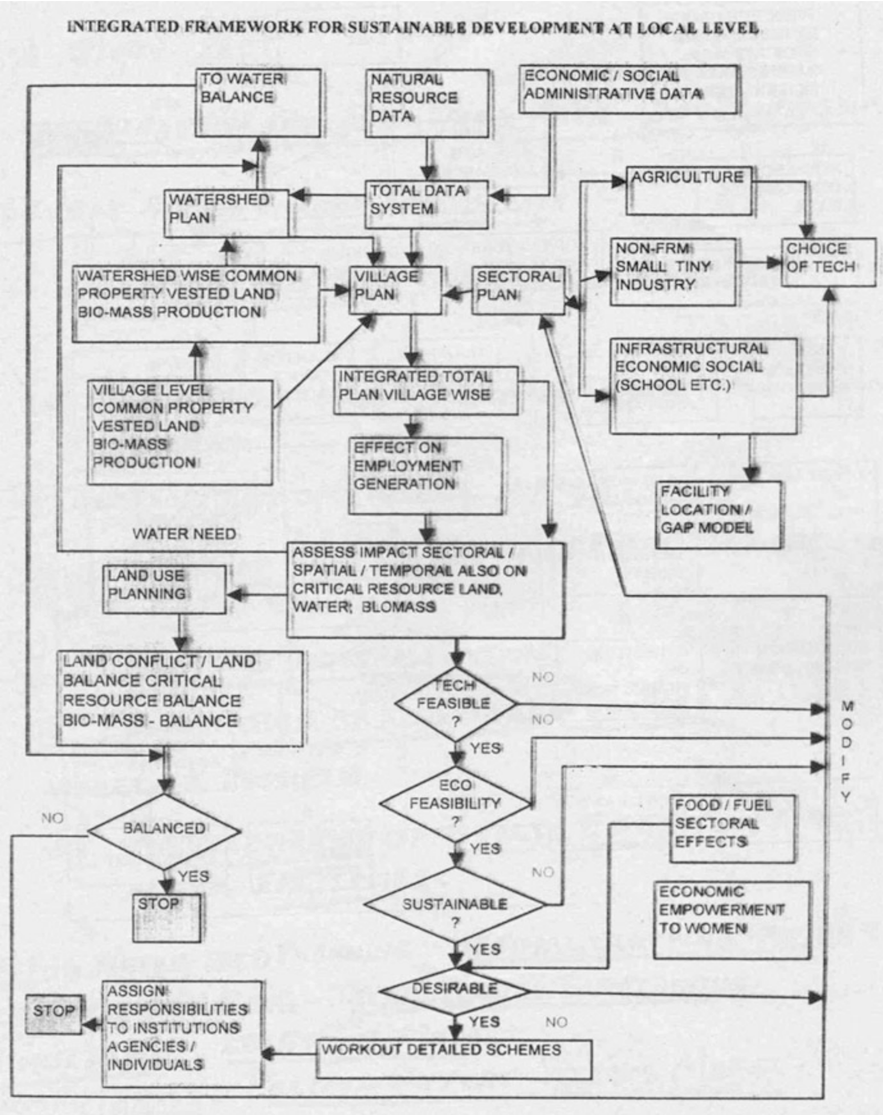

Fig. 5.21 Integrated framework for sustainable development at local level

may be useful. In doing this, the standard questionnaire method is not adequate and techniques like strategic approach and cognitive mapping can be fruitfully applied. However, more and more such research should be based on some real-world problems. Most management, social science, and organizational research should benefit immensely by following the methodologies described above.

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