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Correspondence: All correspondence should be addressed to: Editor, Bangladesh Sociological Studies (BSS), Bangladesh Institute of Social Research (BISR), 15/1/1 (3rd. floor), Zigatala, Dhaka-1209, Bangladesh. Telephone: +88-02-8612916; Fax: 88-02-8615128; E-mail: bisr@agnionline.com; khurshed@bkdc.net; Website: www.bisrbd.org

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Social Aspects of Water Management Engineering with Particular Reference to Bangladesh

Khurshed Alam*

Engineering intervention essentially emerges as technical solution(s) of some social problems, which frequently takes place based on some technical considerations of the problem. All engineering activities, therefore, have two dimensions: one may be described as technical aspect of the problem while the rest is social aspect. In the technical side water management engineering activities include planning, designing, implementation and operation and maintenance which have technical as well as considerable social dimensions. Experts and development practitioners are in opinion that all the time technical issues are not separable from the social issues, rather both are intertwined. Keeping that view in mind an attempt has been made here to identify and outline the social dimensions of the water management infrastructural development. An important finding of the present study is that the water management engineering often does not bring all expected and intended benefits which together entail users' dissatisfaction and in turn dissatisfaction of the funding agencies. It causes a vicious cycle of dissatisfaction. For that an EMA (Education, Motivation and Action) approach has been suggested to bring about a change in that process.

Introduction

Engineering intervention essentially emerges as technical solution(s) of some social problems, which frequently takes place based on some technical considerations of the problem. All engineering activities, therefore, have two dimensions: one may be described as technical aspect of the problem while the other may be called as social aspect. In the technical side engineering activities include planning, designing, implementation and operation and maintenance which have technical as well as considerable social dimensions. Experts and development practitioners are in opinion that all the time technical issues are not separable from the social issues, rather both are intertwined. Keeping that view in mind an attempt has been made here to identify and outline the social dimensions of the infrastructural development about which knowledge has been gathered from the field experience.

* Chief Executive, *Bangladesh Institute of Social Research (BISR)*, Dhaka, Bangladesh.
E-mail: khurshcd@bkde.net; bisr@agnionline.com

As the water management issue got new momentum in the recent years, this aspect has been surfaced infrequently. Nevertheless, the issue has not received much attention from different scholars who were involved in planning and designing of infrastructures in different countries in the world in general and Bangladesh in particular. As a result, very little literature has so far been developed on this issue which include Alam (1991a), Alam (1991b), BUET (n.d), Jaap (1996), Pineda and Alam (1997, 1998), DANIDA (September 2000), Rahman et al (n.d). All those literatures, which otherwise found important, mainly covered some aspects of people's participation in infrastructural development.

Objectives of the Study

The preeminent objective of the present study is to cover the social aspects of water management engineering in Bangladesh, which include:

a. social issues involved in identification of any water management infrastructure (WMI)
b. social issues that influence the engineering design, implementation, operation and maintenance of any WMI
c. technical solutions of a social problem and social solutions of a technical problem
d. human behavioral issues that have to be taken into account in the case of important WMI
e. social criteria to be used for assessing and selecting any WMI
f. What to do and what not to do during planning of any WMI

Methodology of the Study

As mentioned earlier, the issue has not been widely addressed by other scholars both in home and abroad and even most of the scientific engineering journals on the subject have not covered the issue and therefore little has been developed as standard method on the subject. Taking those into account, the present study has been pursued in the period of 1991-2007 on several occasions using several methods that include surveys, public consultations and case studies. Data which have been used here are mainly from Muhuri, Chandpur, Karnafuli, J-K, Teesta, Monu, Bhola irrigation projects, all beel projects of Chapai Nawabgonj, all Hoar projects of Sunamgonj district of Bangladesh. Details of those used methods have been noted below.

Survey Method

Under the survey method the researcher did inventory of problems with identification of visible and invisible causes of major Flood Control and Drainage (FCD) or Irrigation (FCDI) projects of Bangladesh where different operation, maintenance, design and implementation issues came up. Those issues were identified with the involvement of the system users (farmers and fishers) and system managers or agency officials. Under the inventory of the problems both technical and social issues were covered, e.g. embankment was cut by the local people which was identified as behavioral problem of the local people by the system managers. Upon investigation it was revealed that due to flooding in the project area farmers used to cut the embankment to protect their crops. Through the public consultations or case study it was revealed that the flooding caused due to bad operation of the sluice gates by the system managers as the sluice gates were enough to drain out the excess water only if those had been operated in time.

Consultation Method

The researcher also extensively used the public consultation method in all those projects where in each hydrological area or pocket area of the project extensive public consultations were carried out to know their opinions about usefulness and identification of the project, suitability of the design, use of participatory method such as public consultations and dissemination of information during identification and design of the project, conducting of social and environmental impact assessment, quality of implementation of the projects, and operation and maintenance needs and arrangement of the projects.

Case Study Method

Likewise, in the case of critical issues or hotspots some case studies were carried out on several occasions which include chronic flood prone areas, or area which has not been brought under irrigation, reasons of non-availability of water in certain areas during irrigation season and conflict of interest of fisher and farmers.

Observation Method

Observation method was also used as many of the generalisations have been made based on day-to-day observations made during the whole study period. Observations were made on the behaviour of both system managers and system users in addition to some observations on WMIs.

Brief findings of surveys, public consultations, case studies and observations have been presented in both tabular and descriptive forms. It has been prepared with the objectives of serving the planners and policymakers to take into account all those social issues during planning, design, implementation and operation and maintenance of different water management projects.

Identification of Schemes

Social Aspects of Identification

There are many issues that crop up during identification of each WMI. During identification of scheme the following issues need to be taken care of:

Table 1. Social Aspects of Infrastructure

Needs or Demand	FCD	FCDI	Regulator	Embankment	Cross dam	Bridge
Do they need it	√	√	√	√	√	√
Do the farmers want irrigation		√	√		√	
Do they have practice of irrigation		√	√	√	√	
Do they have other alternative means of irrigation		√	√	√	√	
Is there sufficient area that has to be irrigated		√	√	√	√	
Do they have practice of cultivation of HYV	√	√	√	√	√	

Table 1. *(Continued)*

Is it necessary for water management	√	√	√	√	√	√
What is the technical purpose of it	√	√	√	√	√	√
Do they have practice of constructing cross dam by themselves					√	
What are the difficulties with the present cross dam constructed by the users, if any					√	
Is there need of any structure (regulator/ embankment, bridge) to solve that problem	√	√	√	√	√	√
Is there any alternative solution of the problem	√	√	√	√	√	√
Is there any alternative road which is going to be developed in that area which may affect the needs of the structure				√		√
Is it going to be used by women and children	√	√	√	√	√	√
Is there sufficient number of users of the proposed bridge	√	√				√
Is there any alternative use of that embankment				√		
Feasibility						
Is it cost effective	√	√	√	√	√	√

Table 1. *(Continued)*

Is it possible to close the gap permanently					√	√
Is it going to connect different social and economic institutions of that area	√	√	√	√	√	√
Is there any possibility of further development of economic and social institutions	√	√	√	√	√	√
Is it possible to get it constructed by the users themselves				√	√	√
Is there any government land available for that	√	√	√	√	√	√
Who is going to arrange that land and how much is the cost	√	√	√	√	√	√
Is it possible to acquire land or is there possibility of resistance	√	√	√	√		
Is there enough preparation of farmers for irrigation		√	√		√	
Is there other canals which may affect water management	√	√	√	√	√	
Conflict and Unrest						
Is there any conflicting view centering the proposed structure	√	√	√	√	√	
Who can be winner and who can be loser	√	√	√	√	√	

Table 1. *(Continued)*

Is there any chance of developing conflict and unrest in the area centering that infrastructure	√	√	√	√	√	
Is there any marginal, excluded group or ethnic minority who may be adversely affected	√	√	√	√	√	√
Willingness to Pay						
Are the users willing to bear any construction cost	√	√	√	√	√	√
If yes, how much of the total construction cost	√	√	√	√	√	√
If no, what is the reason	√	√	√	√	√	√
Operation and Maintenance						
Are the users going to operate the WMI	√	√	√			
Are the users willing to participate in maintenance	√	√	√	√	√	√
Are the users going to maintain the irrigation facilities		√	√		√	
Is there any possibility of high rate of damage of infrastructure	√	√	√	√	√	√
Affect or Impact (Positive)						

Table 1. *(Continued)*

Is it going to increase the land value of the area	√	√	√	√	√	√
Is it going to protect live and crops	√	√	√	√	√	
Is it going to increase agricultural production	√	√	√	√	√	√
Is there possibility of settlement of landless on the embankment				√		
Is it going to contribute to flood control and drainage	√	√	√	√	√	√
Is it going to contribute to set up social and economic institutions in that area	√	√	√	√	√	√
Is it going to increase economic activities in that area	√	√	√	√	√	√
Is it going to increase the marketing activities in that area	√	√	√	√	√	√
Affect or Impact (Negative)						
Is it going to cause siltation in down stream or other side	√	√	√	√	√	√
Is it going to negatively affect fish production	√	√	√	√	√	√
Is it going to negatively affect river traffic	√	√	√	√	√	√

Table 1. *(Continued)*

Is it going to negatively affect the income or livelihood of any occupation group or community	√	√	√	√	√	√
What are the other possible negative affects of that structure including on other areas	√	√	√	√	√	√
Is it going to adversely affect flood management of that area	√	√	√	√	√	√
Is it going to affect the hydrological boundary and thus generate conflict	√	√	√	√	√	√

Table 2. Social Aspects of Infrastructures

Needs or Demand	Poldering	Small scale water management structure	Canal re-excavation	Protection work	Pump House
Do they need it	√	√	√	√	√
Is there any alternative solution of the problem	√	√	√	√	√
Is there any alternative use of that structure	√	√	√		√
Is it possible to get it constructed by the users themselves	√	√	√	√	√
Is it necessary for transportation	√	√	√	√	

Table 2. *(Continued)*

Is it necessary for water management	√	√	√		√
Is there any scope of surface drainage	√		√		√
Do the farmers want irrigation	√	√	√		√
Do the farmers have practice of irrigation	√	√	√		√
Is there sufficient area that has to be irrigated	√	√	√		√
Do they cultivate HYV	√	√	√		√
Do they have other means of irrigation	√	√	√		√
Feasibility					
Is it cost effective	√	√	√	√	√
Is it going to increase agricultural production	√	√	√		√
Is it going to protect live and crops	√			√	√
Is there government land for that	√	√		√	√
Who is going to arrange land and how much is the cost	√	√		√	√
Is it possible to acquire land or is there possibility of resistance	√	√		√	√

Table 2. *(Continued)*

Is there any space for depositing the soil			√		
Is it going to affect the traffic movement	√	√			√
What is the cost of the protective work				√	
How much it going to protect				√	
Is it a permanent solution of the problem				√	
Is it going to last for a considerable period				√	
Do the people support the work				√	
Is there any alternative solution of the problem				√	√
What is the cost effective solution of the problem	√	√	√	√	√
Is it due to bad design				√	
Is it due to bad operation				√	
Is it caused by bad implementation				√	
Is there anybody to look after maintenance	√	√	√	√	

Table 2. *(Continued)*

Is it cost effective or is it cheap to built a new one	√	√			
What is the land occupancy pattern	√	√	√		
Is there dominance of owner cultivator	√	√	√		
What is the affect of it on water management of the area	√	√	√		√
Is it going to affect the hydrological boundary of that area	√	√			√
What is the implication of that action on fisher and fish production	√	√	√		√
What is the use of that canal			√		
Is it used for irrigation or drainage purpose or both	√	√	√		√
Who are the user of that canal			√		
Is there any interest of fisher to clean that canal			√		
Is there any alternative canal that can serve the same purpose			√		

Table 2. *(Continued)*

Is there flow of enough water to serve the irrigation purpose	√	√	√		√
Is there any water hyacinth that may affect the water management system	√	√	√		√
Is there any aquatic weed or other trees			√		√
Is there any other permanent structure			√		
Do the farmers deposit soil and weeds in the canal	√	√	√		√
Conflict and Unrest					
Is there any conflicting view centering the proposed structure	√	√		√	√
Who is going to be winner and looser	√	√		√	√
Is there any chance of developing conflict and unrest in the area centering that infrastructure	√	√		√	√
Is there any conflict between fisher and farmers	√	√	√		

Table 2. *(Continued)*

Is there any marginal group or ethnic minority who may be adversely affected	√	√		√	√
Willingness to Pay					
Are the users going to pay for construction of the water control structure	√	√			√
Operations and Maintenance					
Is there any possibility of high rate of damage	√	√	√	√	√
Is there arrangement for maintenance of the structure	√	√	√	√	√
Do they have tradition of good maintenance of different infrastructures	√	√	√	√	√
Is it going to incur huge cost for maintenance	√	√	√	√	√
Are they going to maintain the irrigation facilities	√	√	√		
Are they going to operate the WMI	√	√	√		
Impacts (positive)					

Table 2. *(Continued)*

Is it going to increase the land value of the area	√	√	√	√	√
Is it going to protect live and crops	√	√	√	√	
What is the possible affect on navigation			√		
Is it going to increase agricultural production	√	√	√		√
Is there possibility of settlement of landless on the embankment	√				
Is it going to contribute to flood control and drainage	√	√	√		√
Is it going to contribute to set up social and economic institutions in that area	√	√		√	√
Is it going to increase economic activities in that area	√	√	√	√	√
Is it going to increase the marketing activities in that area	√	√	√	√	√
Impacts (negative)					
Is it going to negatively affect the fish production	√	√	√		√

Table 2. *(Continued)*

Is it going to affect the hydrological boundary and thus generate conflict	√	√	√		√
Is there any possibility of affecting other area negatively	√	√	√		√
What is the possible affect on navigation	√	√			√

Criteria to be Used for Judgment/Selection

For easy and fair judgment and decision-making with the use of checklist the following table with grading criteria may be used. Decision could be based on the total points achieved.

Table 3. Scoring with use of checklist

Question	A (10-9)	B (8-6)	C (5-4)	D (3-0)
Question Text				
Sum points				

In the case of different structures like river jetty and FCDI some criteria were used. For example, six criteria were used in the case of selection of a river jetty to be considered for development for loading and unloading purposes, which include: (i) risk of erosion; (ii) availability of water; (iii) natural slope at the river jetty point; (iv.) access to river jetty; (v) potential use; and (vi) lease value of river jetty. The first four were used as terminal criteria which were mainly technical. If there was lack of sufficient water for a considerable period of the year at jetty point or if there was risk of erosion that was also not considered because the permanent structure may be waste out within short period of time. If there is a natural slope then people can easily do loading and unloading works without any infrastructure or if there is no access to the river jetty point then also it becomes redundant to go for constructing any river jetty. Having fulfillment of all those technical criteria, sometimes one goes for constructing jetty without giving due consideration to the social criteria. Indeed, social criteria were also equally important, for example, if there was no potential user then it would not be worth of investment or if there is no scope to recover the cost of construction or

operation and maintenance of that again it becomes a challenge. Therefore, a need or demand for such infrastructure is to be assessed and identified very carefully using necessary and inseparable technical and social criteria.

In the case of FCDI, all the mentioned social issues are to be taken into account in addition to technical criteria. For example, if there is no demand for irrigation, then irrigation component of FCDI becomes redundant.

Some General Observations

There are some important issues that need to be mentioned here as those considerations heavily influence the identification of any infrastructure. The issues include:

a. pay more attention to the visible problems rather than invisible problems.
b. pay more attention to the technical problems rather than social problems.
c. look for technical solution of the technical as well as social problems.
d. often mix up the problem with the solution, e.g. ask for canal re-excavation instead of mentioning water management problem.
e. identify the scheme without preparing the comprehensive inventory of the problems and needs; and
f. often do not show sagacity in prioritizing scheme or needs.

Preparation of Design

Social Aspects of Design

Several social issues are there which have to be taken care of during preparation of WMI's design. In regard to that the following points need to be mentioned here:

Table 4. Social Considerations for Designing Infrastructure

Social Consideration	FCD/I	Regulator	Bridge	Embankment	Pump house
Water management needs	√	√	√	√	√
Types of crops to be produce	√	√		√	√
Farmers production behaviour	√	√		√	√
Financial capacity of the farmers	√	√		√	√

Table 4. *(Continued)*

Total area irrigated	√	√		√	√
Organisation of production	√	√		√	√
Fisher's demand	√	√		√	√
Transportation needs including navigation	√	√	√	√	√
Road users needs	√	√	√	√	
Drainage needs	√	√	√	√	√
Crop production needs	√	√		√	√
Maintenance needs	√	√	√	√	√
Institutional needs	√	√		√	√
Settlement needs	√	√	√	√	√
Land acquisition needs	√	√	√	√	√
Other infrastructural needs	√	√		√	√
Water use pattern	√	√		√	√
Social conflict that may arise centering water management	√	√		√	√
Users participation in operation and maintenance	√	√	√	√	√
Environmental needs	√	√	√	√	√
Future needs for development	√	√	√	√	√

Likewise, criteria for design of other WMIs may be considered which has not been outlined here as the abovementioned criteria show enough to have that kind of exercise by the planners/ designer.

Some General Observations on Design

a. Technical knowledge tells us how to do a thing, it does not adequately tell us what to do
b. Technical experts go for own-decision rather than collective decision (with the users and stakeholders)
c. know inadequately about the nature and dimension of the problem or the problem that people are facing
d. collects some information but not suggestion from the people
e. gives technical consideration rather than social consideration for design
f. looks for what is possible rather than what is desirable
g. consider participation as project work rather than as routine work for preparation of design
h. looks for what can be done rather than what should be done

i. looks even for uncommon solution of a common problem
j. looks for mega solution of a minor problem

Design Principles and Social Aspects

There are certain principles or criteria that need to be followed during preparation of design. In order to assess the actual needs of the users, Participatory Rural Appraisal (PRA) and survey methods may be used. The following issues need to be taken care of:

a. Users' demand or want
b. Users' needs (may be different from demand or want)
c. Women and children's needs
d. Disable's needs
e. Safety and security needs
f. Operational needs
g. Management needs
h. Maintenance needs
i. Financial needs
j. Rehabilitation needs
k. Behavioral needs
l. Environmental needs
m. Future needs for development

Implementation

Social Aspects of Implementation

The following are the social aspects of implementations which have to be taken care of. But this is not an exhaustive list rather it may vary depending on uniqueness of each case:

Table 5. Social Aspects of Implementation

Social Consideration	FCD/I	Regulator	Bridge	Embankment	Pump house
Water management needs	√	√	√	√	√
Farmers' needs	√	√	√	√	√
Fisher's demand	√	√	√	√	√
Transportation needs	√	√	√	√	√
Drainage needs	√	√	√	√	√
Resettlement needs	√	√	√	√	√
Land acquisition	√	√	√	√	√
Collection of soil	√	√	√	√	√

Table 5. *(Continued)*

Deposit of soil	√	√	√	√	√
Base or invert level of bridge and culvert	√	√	√		
Unfavourable water level	√	√	√	√	√
Farmers' resistance	√	√	√	√	√
Social conflict that may arise centering water management	√	√	√	√	√
Lack of space for depositing construction materials	√	√	√	√	√
Construction management problems	√	√	√	√	√

General Observations on Implementation

There are certain general issues that need to be mentioned here which include but not limited to the following sphere of social aspects. Issues include:

a. needs to prepare realistic implementation plan and to follow that plan
b. go for own-decision rather than collective decision (engineers, contractor and users)
c. solve the problem of implementation by instruction rather than persuasion
d. treat the users during implementation as beneficiary of development rather than as partner of development
e. more keen to conduct supervision rather than monitoring and follow-up
f. take more interest in implementation rather than proper planning and design
g. declare completion of works which often are questioned by the users
h. lack of trail run and adjustment (see Box - 1)

Box 1. An Example of Inconsistency in Implementation of Muhuri Irrigation Project

In the year 1994 the present author was involved in planning and implementation of operation and maintenance of Muhuri Irrigation Project along with some other FCDI projects of BWDB. In order to do that smoothly, a newsletter for the farmers was published from the technical assistance side of the project where a section

Box 1. *(Continued)*

was devoted exclusively on question-answer of the farmers. Under the question-answer section a question was raised by the editor for the farmers: What would be the water level in the canals of Muhuri Irrigation Project if those are at design level? Answer was not available. It was investigated with the technical section of the project where experts confirmed that it would be 6.5 feet if the water level at Feni Regulator remains full. But investigation of the present author showed that nowhere water level in the canals were more than 6 feet even where the canals were re-excavated as per design. It raised the question in the form that either the level of Feni regulator was wrong or levels of all canals of the project were wrong. The issue was brought to the notice of foreign and local water management experts of the project. They were requested to verify it and accordingly they checked it and found that the Feni regulator was constructed using the Public Works Department's (PWD) land level value and the canals were excavated using the Survey of Bangladesh's (SoB) land level value. It caused a level gap of almost 6 inches of water in 300 km. long canals of Muhuri Irrigation Project. This gives an example of how a social query can help to detect the technical defect of a project which was constructed under the direct supervision of many international and local experts at the cost of about BDT 1,700 million in 1985-86.

Operation and Maintenance

There are some important dimensions of operation and maintenance that need to be mentioned here. The significant dimensions are:

Social Aspects of Operations

a. Operation is primarily a social job, not a technical job.
b. Operation is users' need, responsibility mainly lies with the managers.
c. Operation often involves many parties but executed without involving them all.
d. Operation is not planned (decided in advance) but implemented.
e. The better is the operation, the better is the maintenance.
f. Proper operation extends life of structure, lack of operation leads to rehabilitation.

Social Aspects of Maintenance

a. Maintenance demands intensive planning and supervision

b. If maintenance is delayed, operation becomes difficult.
c. Construction is one time job, maintenance is a continuous job
d. Construction is accomplished adopting one method, maintenance is accomplished adopting many methods
e. Maintenance needs more social attention rather than technical attention
f. Technical officials in general show more interest in implementation and less interest in operation and maintenance.

General Observations

a. Construction is a prestigious job, maintenance is not – *a perceptive problem.*
b. Construction brings a sense of achievement, maintenance does not.
c. Construction is more rewarding than maintenance.
d. Maintenance is not seen, lack of maintenance is seen.
e. Operation is everyday need, maintenance is a periodic need.
f. Construction requires one type of skill, operation and maintenance require different types of skill.
g. Maintenance delayed, maintenance denied (rehabilitation invited).

Social and Technical Solutions of the Problems

Social Solutions of Technical Problems

There are certain technical problems that can be solved by social initiatives. People can take initiative to solve different kinds of problems such as water distribution at the field level, preventing of or protecting from the flood, drainage problem, road link to replace bridge, culvert, operation of small scale water management structure, canal re-excavation, etc.

Technical Solutions of Social Problems

There are some social problems that have to be solved technically. For example, on the highway drivers often stop the vehicle in the middle of the road to take passengers causing blockade to traffic movement.

There are many technical problems that can be solved socially and there are many social problems that can be solved technically. So, there is no reason to adhere to the principle that technical problem only asks for technical solutions and social problems only have to be solved by

social interventions alone. For example, if there is a tendency of damage of any embankment at a particular point by the people, that point may be made pucca.

Engineering Works and Human Behaviour

Water management engineers pay inadequate attention to the human behavioural issues in their everyday engineering activities. But all infrastructures influence the human behaviour vis-à-vis human behaviour influence the design, implementation, operation and maintenance of infrastructure. By and large, the following human behaviour influences engineering decisions and actions:

a. consumption behaviour influences production and production influences the requirement of the infrastructure.
b. life style of the users also influence the design, operation and maintenance.
c. male-female participation in public life also influence the design, operation and maintenance of the infrastructure.
d. community behavior, religious practices, demographic characteristics, education level, occupational structure, change in demand and supply, economic status, transportation and communication, etc. influence the design, operation and maintenance of the infrastructure.
e. pattern of individual and community behaviour also influences the design, operation and maintenance of the infrastructure.

Role of Engineers vs. Users: Vicious Cycle of Dissatisfaction

WMI users often express their dissatisfaction with the engineers and so the engineers with the users. Instead of helping each other, they often blame each other. Nevertheless, there are certain issues often raised by the WMI users such as:

a. Users are not been informed during identification of any WMI.
b. If they are informed they are not been consulted.
c. If consulted they are not being listened properly.
d. If they are listened their recommendations are not been recorded properly.
e. If their recommendations are heard that are not been taken into consideration during design.
f. If those have been taken into consideration during design that have not been implemented as per their desire.

g. If that has been implemented as per their desire after implementation some new issues come up.
h. If new issues come up nobody or no fund is available to address those issues.
i. If even somebody takes care of that still that does not take place as per comprehensive requirement (some cosmetic works may be done).
j. If that has been done as per need still users are not been involved with operation and maintenance of that WMI (e.g. Muhuri, Chandpur and Kamafuli Irrigation Projects).
k. If the users do not have any sense of ownership of the WMIs, it does not give expected and intended benefits.
l. If it does not give expected and intended benefits, users become dissatisfied, so the funding agency. All those cause a vicious cycle of dissatisfaction.

Other Important Observations

There are some other general observations that need to be mentioned here. These are:

a. four common mistakes are made such as bad identification, bad design, bad implementation and bad O&M;
b. need fund but do not take initiative to generate fund;
c. treat people as beneficiary of development while people like to be the partner of development;
d. do not take serious interest to identify requirement of any infrastructure;
e. person who identifies the scheme does not prepare the design;
f. person who designs does not implement, and vis-a-vis;
g. who completes implementation is not responsible for operation and maintenance;
h. does not give sufficient consideration for O&M during design;
i. does not give adequate consideration for O&M during implementation;
j. have more interest in office and resource management rather than scheme management;
k. gives more technical-view rather than social-view;
l. moves by self-interest rather than community interest;
m. slowly moves from technical effort to social effort;
n. conducts social work as part of construction management rather than social conflict management;
o. go for fund based budget rather than needs based budget;

p. feels more comfortable to solve the problem technically rather than socially;
q. more supply oriented rather than demand oriented;
r. have different biases such as: elite, urban, road, construction, implementation, male, self-interest, project and mega structure bias;
u. do not pay much attention to the environmental problems;
s. show more interest for rehabilitation rather than routine and periodic maintenance works;
t. sometimes do solution of the problem by dissolution of it; and
u. often produce fancy models but faulty structures.

What to Do and What Not to Do

Social aspects of engineering must be handled with due care and if possible with training without which it may turn into a matter of dissatisfaction and resulting social conflict. Keeping that view in mind, some important points have been suggested here to take care of:

Table 6. What to do and what not to do

What to do	What not to do
1. Help users to analyse the problem	1. Do not ask them leading or suggestive questions
2. During planning encourage the users to reach to a consensus	2. Do not express negative view to users' points even if that is not wise one
3. Allow them to pass their view on all relevant issues till they are satisfied	3. Do not collect conflicting views at one place if it is likely to generate social conflict
4. Ask them about negative consequences of the proposed solution	4. Do not encourage those people to discuss who have no proposal or vision to solve the problem
5. Give chance to make users' points very clear	5. Do not ask for solution if the person is not clear about the problem
6. Ask users to propose if they harp upon the same string	6. Do not ask only one occupation, income or religious group, ethnic group or community
7. Discourage them to deliver lecture during making any point	7. Do not take much time on history of the problem
8. Try to find out alternative views of all concerned on the proposed structure	8. Do not push through your own proposal
9. Assess the logic and consistency in the proposal	9. Do not let them know your view (but put suggestion) if they ask for
10. Know the history of the problem	10. Do not claim your expertise on the subject even if they pass on such remark
11. Try to articulate users' view	
12. Record each group's proposal clearly	11. Do not rely on information what you heard from one person
13. Prepare the list of possible questions in the form of a checklist	12. Do not try to know the problem of women from men, of children from adult, of differently able from able person
14. Do some homework on possible questions or problems	13. Do not forget that no solution is sometimes good solution of a problem as that can become further worse
15. Collect vital statistics on physical and social characteristics of the proposed structure	14. Do not promise all supports from government
16. Get view of women, children and differently able on the matter	15. Do not forget to give information if necessary
17. Ask for alternative solutions	16. Do not take up that issue which is beyond jurisdiction/ purview but suggest them ways for that
18. Check scope/ willingness to share responsibility	17. Do not let them understand your cross checking techniques
19. Collect information as well as suggestions from the users	18. Do not mix up with what they need and what they want
20. Collect information on willingness to share common resources	19. Discourage users to discuss partisan, religious, cultural or ethnically sentimental issues
21. Cross-check the information as maximum as possible	
22. Encourage community participation where necessary	

Table 6. *(Continued)*

Conclusions and Recommendations

Meanwhile some organisations have some achievements in the field with regard to taking care of social aspects of water management engineering. But all those are not considered sufficient by any standard and therefore, demand for further action to bring about a change in the condition is imperative to keep pace with the structure users' and managers' demands. To achieve this, the following actions may be made:

- technical professionals of those organisations need to be given extensive orientation on social aspects of engineering. Without that it would be unrealistic to expect them to pay due attention to social aspects of water management engineering.
- in order to make the orientation successful there need to have clear guidelines on social aspects of engineering.
- to prepare a comprehensive guideline more field view on the same WMI is needed so that the same is apposite to the needs of the users.
- participatory approach needs to be adopted widely and continually where necessary (in some cases it may not be

necessary), particularly in identification, planning, design, implementation and operation and maintenance of infrastructures.

- organisations need to follow EMA (Education, Motivation and Action) approach for bringing about a change in that.
- resource allocation for pursuing all those works needs to be made. Institutional arrangement for the same is to be made, if it does not exist there.
- proper monitoring of all activities needs to be there.
- from a culture of no participation to culture of people's participation needs to be established. It requires time for any organisation and that time has to be fixed from the very beginning of the work.

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