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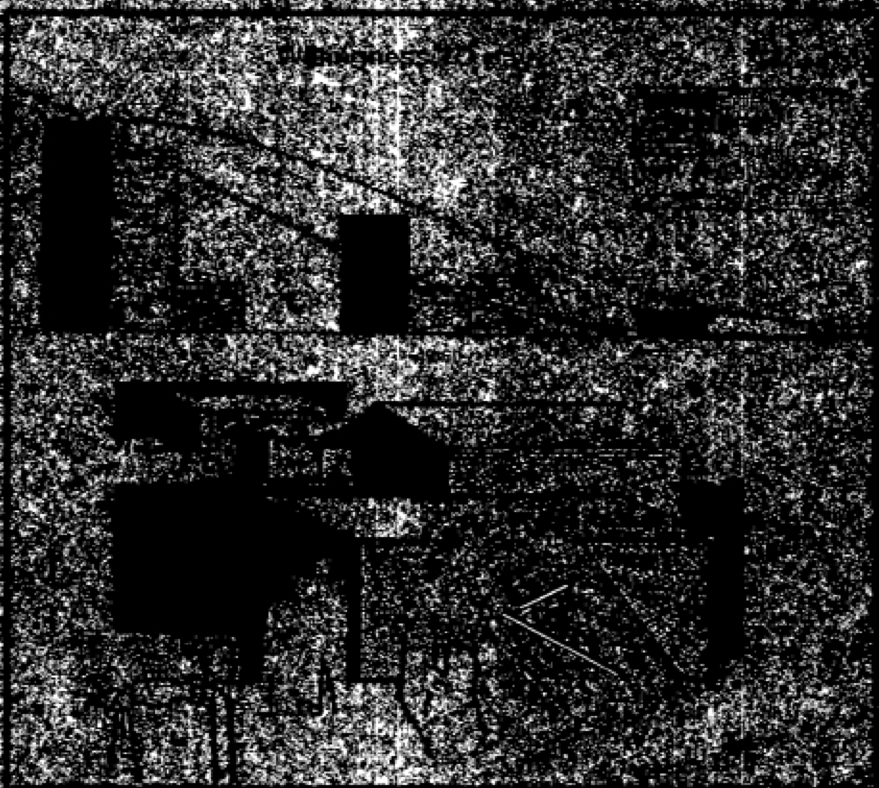

Evaluation of Rural Water Supply ...

EVALUATION OF RURAL WATER SUPPLY PROJECT

UTTAR PRRDESH , INDIA

A Thesis submitted to the Environmental Engineering Department at International Institute for Infrastructural, Hydraulics and Environmental Engineering

For

Master of Science
In
Sanitary Engineering

Submitted
By
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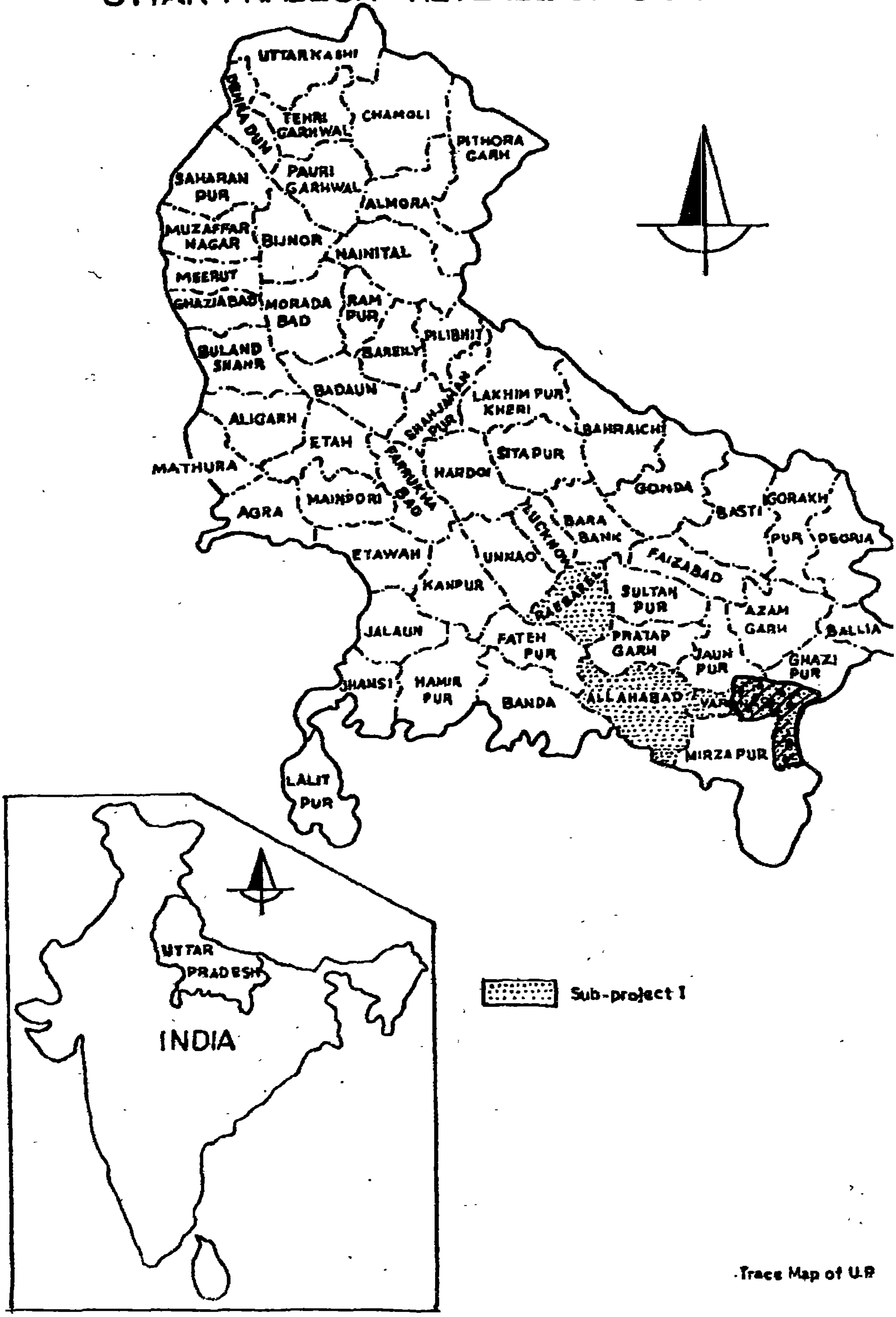
Dellft, The Nether Lands,
April ,1998

UTTAR PRADESH - REVENUE DIVISIONS



Trace Map of U.P

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ABSTRACT

With an objective to provide safe drinking water to all, the Government of India has come up with Accelerated Rural Water Supply Programme to assist the State Government Also, under bilateral agreement foreign assistance are available to the safe drinking water supply projects. Studies show that investment alone can not give a solution to the water supply problem The operational efficiency of a project plays an important role towards sustainability of a project There are adequate guidelines on how to make project implementation more efficient but a little on how to design an efficient project

The evaluation of different rural water supply projects (depending upon mode of supply and programme) in Varanasi Region (Chandauli and Varanasi districts) have been done with an objective to get a single efficiency measure of the project

For evaluation analysis model has been used To assess the service level (output) of water supply projects MEP procedure has been adopted, and to assess the economic value of water, willingness to pay has been assessed using Contingent Valuation Method A multi stage stratified random sampling is done to generate the database To find the relative efficiency of the different projects the technical, financial, institutional, economic and social as input factor and reliability and utilisation as output factor has been taken. The Data Envelopment Analysis has been used as a statistical tool to find the relative efficiency.

The outcome of the study indicates that the conceived objective of the water supply project i e safe water to all was not obtained The field results show that against 100% coverage utilisation of safe water point is 75% only Almost all the project suffers operation and maintenance problem and show poor reliability Though the performance of the project implemented under various programme does not differ significantly, but Data Envelopment Analysis results show that India-Mark-II hand pump projects and small piped water supply projects are found to be relatively more efficient The field found to be addressed is economic, financial and institutional It is also concluded that Data envelopment Analysis technique may be used to get the relative efficiency of the project to find the field of inefficiencies and thus is a useful tool to the managers in water supply sector for identifying efficient water supply project

ABBREVIATIONS

ARWSP	-	Accelerated Rural Water Supply Programme
CVM	-	Coningent Valuation Method
DEA	-	Data Envelopment Analysis
DMU	-	decision making nits
FC	-	Fully Covered
GDP	-	Gross Domestic Product
GOI	-	Government of India
HH	-	Household
HHA	-	Health and Hygiene Awareness
HRD	-	Human Resource Development
HS	-	higher secondary
IDC	-	Indo-Dutch Cooperation
IRS	-	International Reference Center
lpcd	-	Litre per capita per day
LSGED	-	Local Self Engineering Government Department
MEP	-	Minimum Evaluation Procedure
MNP	-	Minimum Need Programme
NAP	-	Netherlands Assisted Programme
NC	-	Non-Covered
NGO	-	Non Government Organisation
O & M	-	Operation and Maintenance
PC	-	Partially Covered
PHED	-	Public Health Engineering Department
PSU	-	Project Support Unit
RGDWM	-	Rajiv Gandhi Drinking Water Mission
Rs.	-	Indian Rupees (1US$ ≅ 40 Rs.)
SC	-	Schedule caste
SIDA	-	Sweden International Development Agency
ST	-	Schedule tribe

TACH	-	Total Annual Cost per Household
TM	-	Technology Mission
TU	-	Technical University, The Netherlands
U.P	-	Uttar Pradesh
UPJN	-	Uttar Pradesh Jal Nigam
UN	-	United Nations
W/S	-	Water Supply
WASP	-	Water and Sanitation Project
WEDC	-	Water Engineering development Center
WSSCC	-	Water Supply and Sanitation Co-ordination Committee
WTP	-	Willingness To Pay

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CHAPTER - I

Introduction

1.0 INTRODUCTION

Since the development of civilisation, water is considered to be one of the most important commodities. Most of the people believe that water is a natural gift and is available in abundance. However, with passes of time, scarcity of safe drinking water is realised by the people. The first world pandemic of Asiatic cholera (Bengal 1817) showed how important water supply and sanitation could be for human health. Chadwik remarked that the expenses of public drainage, of water supply laid on in the houses and of means of improved cleansing would be of pecuniary gain, by diminishing the existing charges attended on sickness and premature mortality (Aziz et al, 1990). The research of William Farr and John Snow, also supported the Chadwic view by showing how water supply could serve to control the disease. Thus '**safe water and sanitation for all**' became a global aspiration.

With an objective to provide safe water and sanitation to all the 'International Drinking Water Supply and Sanitation Decade' was launched in 1980 The significant advances have been made and a lot of efforts have been made in the past to improve water supply facility in the rural sectors. Since 1980, the share of people with access to water has more than doubled in rural areas and expanded considerably in the urban areas. In total, access to safe drinking water in developing countries rose by more than half, from 41 percent to 69 per cent (Vision 21: Water Sanitation and Global Well being – WSSCC draft report). But the pace of progress has fallen far short of that hoped for. The Ministerial Conference about Water Supply and Sanitation of March 1994, in the Noordwijk concluded that sustainability and effectiveness in the water supply and sanitation leaves much to be desired (Water Supply and Sanitation for All, IRC 1995). Other causes of concern were population growth and limited financial resources. Projections reveal that aiming for universal coverage by 2010 would mean providing 165 million people a year with water and 200 million people with sanitation for which the finances needed could be approximately between US$31 to US$35 billion whereas the United Nations Development. Program (UNDP) suggests that perhaps US$ 15 to US$ 20 billion might be available annually. This calls for much more efficient approaches and better management of resources (Jan Teun Visscher et al, 1994).

More appropriate technologies have helped to accelerate the accessibility to the safe drinking water source. Also management approaches are being adopted to improve the efficiency of supply – oriented approaches with users involvement. However, it is learned from the past experiences that investment alone cannot give a solution to the water supply problem. The operational efficiency of a project plays an important role towards sustainability of a project. It is estimated that by optimising operational efficiency a saving of $ 55 billion per year can be done. With this saving over a period of three years, 1 billion could be provided with safe drinking water at a cost of $ 150 per person (World Development Report –1994). Hence it is obvious that just providing a water supply facility is not sufficient to achieve the desired goal of health improvement.

1.1 WATER SUPPLY IN INDIA

1.1.1 Demographic and Socio–Economic Feature of India

India is one of the oldest civilisations with kaleidoscopic variety and rich cultural heritage. It covers an area of 3.3 million km^2 extending from snow covered Himalayan height to tropical rain forest of south. It has a population approx. 850 million (as per 1991 census) second in size to China. About 74.2 % of its total population reside in rural areas. Annual population growth during the last decade averaged 2.1 %. Though most of the population still reside in villages, much of the growth is concentrated in the urban areas. The average population density is 267 persons per sq. km. ranging from10 person per sq.

km. in Arunanchal Pradesh to 6,352 in Delhi (India census – 1991) The adult literacy rate is 52.2 % whereas among women in rural areas it is only 39.3 %.

The average growth of gross domestic product (GDP) in seventh five-year plan grew at the rate of 5.6%. The per capita annual income is Rs. 8,237 (1994 - 95). The World Bank estimated that about 40% of the population lived below the poverty line.

1.1.2 Policy and Planning in Water Supply Sector

Planning in India drives its objectives and social promises from Directive Principle of the State Policy enshrined in the constitution. Public and private sectors are viewed as contemporary. Individual efforts and private initiatives are considered necessary and desirable in national endeavour on development with optimum of voluntary co-operation. Although in the past, economic policy did envisage a growing public sector with massive investments in the basic and heavy industries, now emphasis on the public sector is less pronounced. The Protectionism and inefficiency of the operation have been the striking features during the last two decades. In 1991 the Government of India introduced economic reforms leaving far more scope for investment, transfer of technology and privatisation of public sector

Provision of drinking water supply in rural areas is the responsibility of the States and funds have been provided in the State budgets right from the First Five-Year Plan under. Moreover, the Union Ministry of Health announced the National Water Supply Programme in August 1954 as part of the Health schemes under the plan and made specific provision to assist the States in the implementation of their urban and rural water supply schemes. In spite of efforts by the State Government, it was observed in mid sixties that the coverage of rural population is quite slow. The Government of India, therefore, come forward to help the State Government and introduced Accelerated Rural Water Supply Programme in 1972-73 to implement the water supply project in villages without suffering from water supply problem. But in 1974 – 75 with the introduction of Minimum Need Programme at State level, the Accelerated Rural Water Supply

Programme was withdrawn. However, it was reintroduced in 1977-78 as it was found that the coverage of problem villages is not as per expectations

In August 1985, the subject of rural water supply and sanitation was transferred from Ministry of Urban Development to the Ministry of Rural Development, with an objective of securing quick implementation and better integration with other rural development programmes. The National Drinking water Mission was launched in 1986, aiming at 100% coverage of problem villages (a village having no source of safe drinking water supply within 1.6 km.). Latter, in 1991, the National Drinking Water Mission is renamed as Rajiv Gandhi Drinking Water Mission. The Rajiv Gandhi Drinking water Mission Authority headed by Prime Minister with other concerned ministers/ officials is set up to review the progress and give the directive principles and policy guide lines for implementation of programme.

1.1.3 Role of Foreign Assistance in Water Supply Sector in India

Various foreign agencies play an important role to promote water supply programme The major resources of assistance that India receives from the external funding agencies are from the Netherlands Government (Indo – Dutch Co-operation), United Kingdom (Overseas Development Administration), Sweden (SIDA), Denmark (DANIDA), Federal Republic of Germany, World Bank. The bilateral assisted projects in water supply sector are implemented in 8 States, namely Andhra Pradesh, Kerala, Karnataka, Maharastra, Tamilnadu, Orissa, Gujarat, and Uttar Pradesh. Though the financial assistance (about 6% of National investment) received by the donor agencies may not be considered very significant, its role is significant concept wise. Now, in water supply and sanitation sector, there has been a shift from conventional top–down approach with an integrated approach focusing particularly on the greater involvement of the people ensuring access to the scheme for poor, on construction of water supply and sanitation facilities, on improved operation and maintenance along with cost recovery, on health education and strengthening implementation capacity at the local level.

1.1.4 Norms For Identification of Problem Villages and Coverage

As per norms stated by Rajiv Gandhi Drinking water Mission a village is identified as problem village if:

- There is no assured source of drinking water supply within 1.6 km. in plains and at 100 meter elevation difference in hilly
- The sources are endemic to water borne diseases i.e. cholera, typhoid and guineaworm
- The water source suffer from excess of salinity, or iron or fluoride

For coverage of problem villages the following guidelines are declared by RGDWM

- Safe drinking water source should be available within 1.6 km. in plain area and within an elevation difference of 100mts in hilly area.
- Source should be capable to supply a minimum 40 litre per person per day
- Under Desert Development Programme an additional 30 litre per capita per day should be available for cattle
- Water should be free from biological contamination (guineaworm, cholera,typhoid etc.) as well as chemical contamination such as excess fluoride, excess iron, brackishness, arsenic, nitrate etc.

1.2 EXISTING WATER SUPPLY STATUS

Before the Fourth Five-year Plan (1974-75), rural water supply projects were undertaken as part of the programme of local development programme and welfare of downtrodden classes. For the Fourth five-year Plan, it was envisaged that the bulk of the provision under rural water supply and sanitation projects would be utilised in areas where there is a water scarcity and other areas would meet their need from local government development programme. Initially only piped water supply to a group of villages from a single or a multiple sources was envisaged under this programme. However, in the latter stage keeping in view the huge coverage target with restricted resources India Mark – II was introduced as a low cost solution.

1.2.1 Problem Villages and Coverage Status

A survey was conducted in 1972 and 1985 to identify problem villages. In all 1,61,722 problem villages, including spill over problem villages from Sixth Five Plan, remained on 1 April 1986 to be in Seventh Five Year Plan i.e. 31 March 1990. Out of these 1,16,602 problem villages were covered up-to 31 March 1996 leaving a balance of 120 problem villages A fresh survey on drinking water facilities in rural habitations were conducted during 1991-94. As per final result, the position of habitation as on 1April 1994, is as under shown in table 1.1

COVERAGE STATUS OF HABITATION

Table – 1 1

STATUS	MAIN HABITATION	OTHER HABITATION	TOTAL
Not Covered (**NC**)	24,113	1,16,862	1,40,975
Partially Covered(**PC**)	1,98,166	2,32,211	4,30,377
Fully Covered(**FC**)	3,37,274	4,10,073	7,47,347
TOTAL	**5,59,553**	**7,59,146**	**13,18,699**

During 1994-95,70,200 (NC) and PC villages /habitation were provided with safe drinking water facilities During 1995-96, 81,966 NC and PC villages were provided safe drinking water facility. The Government of India has targeted to cover all NC and PC in 1997-98. 82% population of India (1991 census) was covered by 31 March 1996. The balance population is targeted to be covered during Eighth and Ninth Five- Year Plan.

1.2.2 Financial Outlay

The Government concern could be seen from the massive investment in the drinking water sector as it has increased from 0.18 % to 2.32 % of the total public sector plan outlay during First To Eighth Five Year Plan. The total outlay provided for rural water supply programme during Eighth Five-Year Plan is Rs 51,000 million under the Central sector and Rs. 49,545.2 million under the State /UT's (total Rs. 100,545.2 million). In 1995-96 the expenditure was Rs.9, 850 million under the state MNP and Rs 10,400 million utilised under TM / ARWSP. An outlay of Rs. 11,600 million has been provided under central sector and Rs. 12,550 million under State sector. In 1996-97 under the existing guidelines, the first source of drinking water has to be provided in SC/ST locality and at the time of formulation of project; coverage of SC/ST habitation should be given first priority. From 1990 on wards, a minimum of 25% of ARWSP fund have earmarked for provision of water supply to SC and 10% of ST. Such funds cannot be diverted for any purposes.

1.2.3 Implementation of the Programme

The rural water supply programme is implemented by the respective States/ Union Territories through State Public Health Engineering Department. Planning, investigation and State level design were undertaken by the implementing agencies, at the end financial and administrative approval is granted by central government for ARWSP projects. Later in order to cope with the expanded work load and new financing arrangements, autonomous statutory board / corporations, empowered to float loans, levy cess were set up at State level for effective management of water supply projects.

While making the allocation of the fund to the States, weightage is given to the size of rural population and poverty in the rural areas. Under ARWSP, the first priority is given to the down trodden habitations. Priority has, also, been given to cover spill over 'no source' problem villages (NC)

1.2.4 Operation and Maintenance

Project planning and implementation were the responsibility of the State level Engineering organisation, and after the commissioning of project the project will be taken over by the local bodies / Gram punchayat for operation and maintenance. Except in case of urban water supply project, local bodies/ gram punchayat were declined to take over the project and so they are maintained by PHED itself.

10 % of ARWSP fund released to the States/ Union Territories are earmarked for operation and maintenance of water supply projects. This is to be supplemented by another 10 % of State sector MNP It is experienced that O & M aspect is badly hampered as

- Capital investment has always received priority
- Sector thrust is more on funding new projects than to augment the defective existing projects

However, now, for effective operation and maintenance efforts are being made to train the local persons and providing support services for monitoring/ major repair involving the local community person.

1.3 WATER SUPPLY IN U.P. - AN OVERVIEW

1.3.1 Demographic and Socio-economic features

Tibet and Nepal flank Uttar Pradesh, lying between latitude of 24^0 to 31^0 north and longitude of 75^0 to 84^0 east, in north, Himanchal Pradesh in northwest, Hariyana in west, Madhya Pradesh in south and Bihar in east. The whole state can be, further, divided into three regions depending upon topography: (a) northern Himalayan belt (2) Gangetic plain and (3) southern Vindhyan belt.

Uttar Pradesh is one of the most populous States with a population of 1,39,112,887 (about 16.5 % of country population), covering an area of 2,94, 411 sq. km. The population density is 473 person per sq.km. The population growth is 2.29% (1981-91) slightly greater than all India figure.

The literacy rate in Uttar Pradesh is 41.6%, which are almost 11% lower to the national figure. It further drops down to 36.7% in rural belt. Agriculture is the main occupation of 78% of population, indicating its dominant rural nature. The State is the largest producer of food grains, sugarcanes and oil seeds. Human Development Index, based on life expectancy, educational attainment and income, is 0.29 (source: Economic Survey and World Human Development Report) which is more or less matching the National figure of 0.30

1.3.2 Administrative Structure of the State Government

For administrative control state is organised on the following line

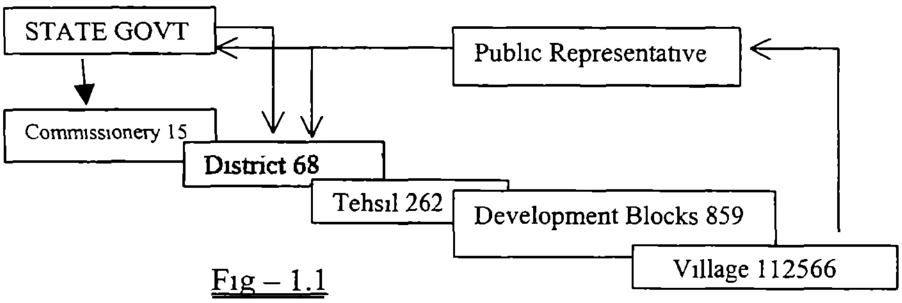


Fig – 1.1

Village is the smallest unit, while for all administrative control the State Government takes district as the unit. The villagers can be represented either through their representative at the state as well at district level or through a long hierarchic chain.

For development work, different state level organisation such as irrigation, electricity board, public works department, U.P. Jal Nigam etc, also, exist and work under the concerned Ministry. At the state level Ministry of Urban Development is responsible for development of water supply and sanitation sector Under the directive of Ministry of Urban Development, U.P. Jal Nigam, a public undertaking is made responsible for the preparation and implementation of water supply and sanitation plan.

1.3.3 Water Supply Sector coverage status of rural area

The programme for water supply in the rural areas started in the post –independence era. In 1947, only 27 water works existed in the state of Uttar Pradesh. But the water supply got the momentum in 1969, after facing an acute shortage of drinking water during summer. Though, water supply is the state responsibility, central government assisted the U, P State Govt under Accelerated Rural Water Supply Programme to combat with the drinking water problem. In 1971-72, in a survey 35,506 villages were identified as the problem villages and it was expected by central government to cover all the problem villages by 1981-82. The Government of Uttar Pradesh, however, ultimately decided to cover all the problem villages by the end of Sixth Five-Year Plan [1984-85]. (source: Evaluation of Sub-Project –1, UPDESCO Report)

Till 1981-82, out of 35,506 only 8,783 villages were reported to be covered [Seventh Five Year Plan document] by piped water supply project. In 1985, in another survey, further, new 42,544 problem villages were identified Therefore, in line with Government of India policy, installation of India – Mark –II hand pump has been decided to speed up the work as well achieve the target of coverage with restricted resources. Out of 1,12,566 about 97% [1,09,287] villages was covered till March 1995 (Source: Jal Nigam)

In the year 1990-91, with the inception of, Rajeev Gandhi Drinking Water Supply Mission, the habitation was taken as the unit in place of village. According to 1992-93 survey there are total 2,74,641 habitations. Till March 1997, about 72% habitation [1,97,657] was fully covered. All the habitations have to be covered by the year 1997-98, but due to difficult geographical terrain, especially in hilly terrain, target is set to cover by the year 2000.

The coverage status of the habitation, as on 1.4 .1997 are shown in the table 1.2

COVERAGE STATUS AS ON 1.4.1997

Table 1 2

Status of Coverage	Plain	Hilly	Total
Not Covered	10,299	4,452	14,651
Partial Covered (<10 lpcd)	2,471	27	2,498
Partially Covered (10-40 lpcd)	58,825	910	59,735
Fully Covered	1,72568	25,089	1,97,657
Total	**2,44,163**	**30,478**	**2,74,641**

(Source : U.P. Jal Nigam)

1.4 RURAL WATER SUPPLY AND SANITATION PROJECTS IN U.P.

1.4.1 Programme Supporting Rural water Supply Projects

Water Supply Projects

In rural areas, mainly two type of projects, depending on mode of supply, are executed

- Comprehensive piped water supply
- Drilled bore well fitted with India Mark –II hand pump

So far, 1,870 piped water supply projects and about 54 million hand pumps have been installed under various programmes.

Sanitation

To promote "Environmentally clean village" rural sanitation the Government has launched programme. Under this programme, villages are provided with technical and financial assistance to build their own house latrine and stop open defecation

The projects are financed under State Government as well as Central Government Plan. Also, foreign assistance has been received to support water supply and sanitation. In the subsequent paragraph, only water supply will be discussed, as sanitation programme is not the part of study.

Accelerated Rural Water Supply Programme (ARWSP)

The Government of India launched Accelerated Rural Water Supply Programme in 1972 –73 to provide financial assistance to the State water supply plan but withdrawn in 1974 after coming up of the Minimum Need Programme fully financed by State programme. But further, introduced in 1977-78 as 100 % grant-in-aid to the State to provide financial support to cover all the problem villages within the shortest possible period preferably by 1981-82. In the beginning conventional piped water supply project were implemented by engineering department at the State presuming it as an improved technical solution Latter, installation of India –Mark –II, which is an improvement over traditional shallow hand pump, was promoted to expedite the coverage target within the limited resources. Piped water supply projects were allowed only in those cases where there is a quality problem with a restriction of rate of water supply as 40 lpcd and no house connection. The idea was to "**provide some to all not all to some.**"

Minimum Need Programme

The water supply and sanitation is the State responsibility and for its, funds were made available in the Normal State Budget Plan. But not much emphasis was laid till 1967. After facing 1967 and 1969 sever draught the State Government paid special attention to water supply sector. Minimum Need Programme was started in 1974 to provide the safe drinking water to the draught prone areas Under this programme 75% of the finance is provided as grant-in-aid and 25% as loan to the local bodies. Latter, a matching fund with ARWSP was earmarked to cope up with the target to provide safe drinking water to all by installing India –Mark –II hand pump. The rate of water supply in MNP project has taken as 70 litres per capita

Dutch Credit Programme

The Royal Netherlands Government has been engaged since 1978 in the Rural water supply and sanitation sector in Uttar Pradesh with an objective of poverty alleviation, and an assistance to provide safe drinking water to all by providing a sustainable water supply system. Though in beginning all the projects were formulated in conventional way i.e. top down approach but latter in line with Netherlands Government's "Integrated Approach" of community participation was incorporated after 1987. In Indo Dutch co-operation the project expenditure has to be reimbursed by the Netherlands Government. It means, first, the state has to arrange funds from his plan work. That way it could not provide the financial relief to expedite the progress. However the Netherlands Assisted Programme have added value to the development programme. Under the NAP and assistance of Rs. 550.3.million (including Rs. 2.85 million for training) for water supply and Rs.91.8 million for rural sanitation programme have been provided by the Netherlands Government.

In line with the policy of 'Integrated Approach' to develop capacity building at village level, a non-governmental organisation PSU Foundation was engaged. A task force at state level, constituting the representative of the organisation, UPJal Nigam and PSU Foundation, is established to provide and direction and policy support. At the crucial district level, the district co-ordination committee comprising of PSU district level official and Jal Nigam district level officials who are involved with the implementation of activities has continued to grow as an integrating platform. The term of reference and finance for NGO is decided by the Netherlands Government, which is independent to UP Jal Nigam allocation.

Other Programmes

Water supply projects are being executed under Special Component Programme, Tribal Sub-Plan, Harridan Drinking water Supply Schemes, Primary Pathshala etc. These programmes are in one or other way part of the Hand Pump Project under Minimum Need Programme or Accelerated Rural Water Supply Programme. The only difference is that they earmark the location/habitation such as a Hand Pump Project sanctioned under Harijan Basti Programme will be installed in the Harijan Basti only. Similarly, if a hand Pump Project is sanctioned under Primary Pathshala it will be installed in the premises of school campus. In field, also, it is difficult to distinguish between the hand pump installed under different project. Therefore, further, this programme will not be discussed separately.

1.4.2 Guide lines for Water Supply Project

GUIDELINES FOR W/S PROJECT PREPARATIONS — *Table 1 3*

PARAMETERS	MNP	ARWSP	NAP
OBJECTIVE	safe and sufficient drinking water to scarce area	safe and minimum water required for drinking to all	safe and sufficient water easily accessible to the user
APPROACH	Top-down technical approach	Top down least cost approach	Top –down technical approach supported by integrated approach for community capacity building
TECHNICAL			
Rate of w/s	70 litre per capita / d	40 capita / day	70 litre per capita /day
Design period	30 years	15 years	30 years
Water point	House connection and stand post @ 250 per person	one water point for each 250 person or one source in each habitation	House connection and stand post @ 250 per person easily accessible to the users preferably within 250 m
FINANCIAL			
Agency	U P State Government	Government of India	The Royal Netherlands government
Mode of finance	budget allocation in state plan	budget allocation in centre plan	through reimbursement

The design criteria for the project formulation is set by Jal Nigam depending upon the guide lines issued by the funding agencies. The different funding agencies have issued different guidelines keeping in view their objectives. The main parameters where it differ to the other agencies are summarised in table 1.3

1.5 IMPLEMENTING METHODOLOGY

In Uttar Pradesh, responsibility of water supply and sewerage is being carried out since 1927 by PHED subsequently renamed as LSGED. Further, considering the importance of safe water supply and to meet the national /international objective to provide everybody safe drinking water facility, Uttar Pradesh legislation passed an act known as Uttar Pradesh Water Supply and Sewerage act 1975[Act No.43 of 1975]. Under this act Uttar Pradesh Jal Nigam was created and the then existing technical and non-technical staff of Local Self Engineering Department was absorbed. The U.P. Jal Nigam is essentially a design and construct organisation with powers to raise the loans and fund for implementation of water supply projects. At the same time the State legislation created Jal Sansthans, which are operational units able to promote schemes under the Jal Nigam. Any loans incurred by the Jal Sansthans are obtained by Jal Nigam and transferred to Jal Sansthan as an asset in the form of water supply facilities. Jal Sansthan has yet not been set-up to cover entire region. However, "Jal Sansthans" for operating and maintenance of the water supply and sewerage in Garhwal, Kumaun and Jhansi revenue divisions of U P., covering 13 districts and five KAVAL (Kanpur, Allahabad, Varanasi, Agra, Lucknow) towns having Municipal Corporations, have been created and functioning.

1.5.1 Implementing agency- U.P. Jal Nigam

The U.P. Jal Nigam consists of a board, having a Chairman appointed by the State Government as administrative head of the organisation. Other than Chairman, the board constitutes of a senior technocrat responsible for internal management of organisation called as Managing Director, Finance Director (responsible for internal financial management) and secretaries from finance, urban development and health and family welfare ministry of State Government as ex-officio along with three elected heads of local bodies nominated by state government. Under the Managing Director (MD), there is a large hierarchical system of engineers such as chief engineers, superintending engineers, executive engineers, assistant engineers, junior engineers and other ministerial staff. The head office of U.P. Jal Nigam is at Lucknow, capital of U.P. and is organised into 6 geographical areas headed by zonal chief engineers. The Organogram of U.P. Jal Nigam is annexed (annexure – Ia). At present, total 40 circles headed by superintending engineers and 177 divisions headed by executive engineers are working. In all 4,665 technical staff and 5,043 non-technical staffs are employed against a sanction post of 5,299 and 5,454.

Keeping in view the growing stress on community participation for sustainability of water supply and sanitation services, Human Resource Development Cell has been established in 1997 under the administrative control of U.P. Jal Nigam by Government of India. The HRD cell constitutes of an Executive Director (head of the office), director, deputy directors, assistant directors, field officers, and other office staff. Most of the staff will be adjusted from the Jal Nigam existing strength. The basic function of the HRD cell will be to arrange gross route training at village level and trained the motivator to organise health and hygiene awareness programme at village level. Also, this cell will provide training to the technical staff.

Function, Powers and Main Activities

The main function of the Jal Nigam is to prepare State Plan for water supply and sewerage as per State government directive; to provide all necessary services regarding waters supply and sewerage to the Sate government, local bodies and to the private institution, also, on demand; and to establish standards for water supply and sewerage arrangement. Jal Nigam, also, organise training required for development of technical manpower. Jal Nigam advice the State Government on tariff for water supply and sanitation in rural areas as well as urban areas.

Jal Nigam is a public undertaking and hence has power to prepare and approve its annual budget, fix and charge the fees for services rendered to other agencies, and has all power to execute agreement / contract with any firm / institution which is essential to carry out his duties.

Jal Nigam is, basically a technical department, involved with project preparation, execution and operation and maintenance of water supply and sewerage services in rural and urban areas. However in some cases, local bodies and other government department's e.g. Rural Development are also carrying out some water supply and sewerage work under district/state plan. U.P. Jal Nigam Plan allocation for VII and VII plan are depicted in table 1.4

UP JAL NIGAM PLAN ALLOCATION

Table 1 4

Description	**VII PLAN (Rs. In million)**		**VIII PLAN (Rs. In million)**	
	Actual	percentage	Actual	percentage
Urban Water supply	1090	16	3200	22
Urban sewerage	110	1	900	6
Total	**1200**	**17**	**4100**	**28**
Rural water supply	5570	80	10250	71
Rural sanitation	230	3	150	1
Total	**5800**	**83**	**10400**	**72**

(Source Report on Study of Operation and Maintenance Costs By A F Ferguson & Co,1993)

In addition to Plan work Jal Nigam executes the non-Plan work e.g. draught relief work, emergency water supply during Mela and other occasions as and when asked by the government One wing of the Jal Nigam works on commercial pattern and engaged with deposit works.

Financial Status

The U.P. Jal Nigam essentially depends on the state government through MNP and central government through ARWSP for financing new projects. In addition, funds are obtained under NAP for implementation of water supply and sanitation projects in rural areas. For O & M of water supply projects and hand pumps funds are received from

- water charges recovery
- percentage of plan funds allocated by govt for O &M (10% of plan fund under MNP & ARWSP)
- government subsidy

UP Jal Nigam overall financial position is shown in table 1.5

FINANCIAL PERFORMANCE OF UPJN

Table 1 5

Years	Income	% increase	Expend .	% increase	Deficit	% increase
1984-85	193		338		145	75
1985-86	305	58	395	17	90	29
1986-87	316	4	447	13	131	41
1987-88	352	11	525	17	173	49
1988-89	407	16	664	26	257	63
1989-90	391	(-)4	724	9	333	85
1990-91	326	(-)17	948	31	622	191
Average		11		30		

(SOURCE Report on Study of Operation and Maintenance Costs By A F Ferguson & Co,1993)

From the above table it can be seen that the UPJN is not only in deficit but deficit percentage is also increasing.

1.5.2 Implementation Procedure

The priority area is selected as per directive of State / National Government and project are identified and formulated as a top down approach. U.P. Jal Nigam's district level division headed by an executive engineer is the primary unit to formulate detailed technical and economical aspect of a project as per norms / design criteria lid by the Jal Nigam headquarter. After the appraisal and technical approval of the project by the Jal Nigam's competent authority, the projects are sent to the concerned funding agency for administrative and financial approval. The Jal Nigam takes up the execution work after getting the clearance of the project from the funding agency. The mode of execution may be departmental / agreement with local or global contractors depending upon the nature of work.

1.5.3 Operation and Maintenance

Jal Nigam, at the time of creation, was basically an implementing agency and Jal Sansthan and local bodies were supposed to take over the projects after completion. But except at 7 places, where Jal Sansthans are functioning, in rest area Jal Nigam is operating and maintaining water supply projects as per State Government directive. Jal Nigam internal management has no separate structure for operation and maintenance except in some districts where a separate operation and maintenance divisions have been created exclusively for O&M works. The O& M work, in all the cases where there is no specific arrangements are being carried out by the divisions, which are involved with implementation of projects.

NORMS FOR O&M EXPENDITURE

Table 1.6

Type of Projects	Annual O & M expenditure
India – Mark II hand pump	Rs 400-500 per HP
Piped water supply in plain area	5% of the project cost excluding electricity cost
Gravity feed water supply in hilly terrain	7% of the project cost excluding electricity cost

(Source: UP Jal Nigam)

No separate allocation for operation and maintenance of a water supply project is received by Jal Nigam except 10% of Plan work under Minimum Need Programme and Accelerated Rural Water Supply Programme. Norms for annual operation and maintenance expenditure is given in table 1.6

The allocation for 1997 – 98 for O & M of water supply projects is Rs. 500 million which is only 70% of the required budget, excluding electricity cost.

1.5.4 Cost Recovery Policies

A low water tariff has been levied in piped water supply projects, but water collection from India-Mark hand pump is kept free of charge hypothecating the affordability and willingness to pay of beneficiaries. House holds having a yard connection is charged at a fixed rate of Rs 20 per month per connection Though there was a provision to charge Rs 2 per household per tap for community stand post under piped water supply projects, but in practice in most of the cases, it could not be implemented. House hold having yard tap also pay for house hold connection charges along with a deposit varying from Rs300-500 at the time of house connection. In general cost recovery is poor only 20-30%, which is not sufficient to cover the operation and maintenance cost

1.5.5 Monitoring and Evaluation

Regular progress reports are sent to the government through district administration and implementing agencies for monitoring and evaluation of the physical and financial progress and fund utilisation status. Some times field visits by the high power committee constituted by the funding agencies are organised for physical verification of works implemented.

Time to time studies, by the various institutions is also conducted for project evaluation with particular term of reference. Mostly these studies are conducted by foreign donor agencies to get feed back, how their money is being utilised during implementation of project.

1.5.6 Community Participation

There is no active participation of the community in the project formulation and identification in past except in India- Mark –II hand pump programme where Gram Pradhan (village leader) is involved to select hand pump site at the time of execution. With the inception of need of 'Integrated Approach' for a sustainable water supply, Non Governmental Organisation e.g. PSU Foundation has been engaged for capacity building at gross route level and implementation of community participation component in foreign assisted water supply projects.

Human Resource Development unit of U P. Jal Nigam has started training programme to promote the technical skill at gross route level by involving NGOs and promoting building capacity at village level.

1.6 PROBLEM EXPERIENCED IN WATER SUPPLY SECTOR

Most of the project identified and formulated by the U.P Jal Nigam are based on top down approach and are predominantly technical. The economic feasibility has been worked out on the basis of assumed level of service and cost recovery.

No separate allocation for operation and maintenance of a water supply project is received by Jal Nigam except 10% of Plan work under Minimum Need Programme and Accelerated Rural Water Supply Programme. Norms for annual operation and maintenance expenditure is given in table 1.6

Evaluation studies conducted for Netherlands Assisted Programme conclude "*piped water supply schemes do not operate properly due to low pressure*, leakage, missing *of stand post taps, and irregular electricity supply. The large majority of hand pumps, however functioning fairly well*" Operation Review Unit Report-1992). ORU, also, found that even though 50-75% O & M funds are made available, users are not inclined to operate and maintain the facilities or pay for it as they were not involved in the planning or implementation resulting poor cost recovery.

The main argument put in favour of India –Mark –II hand pump is (a) it is a least cost solution (b) minimum operating cost (c) no dependency on electricity. But contrary to its minimum operating cost, the result of an study conclude that "........compared to the much lower costs required for hand pump schemes, however, the net subsidy required is roughly the same when expressed in percentage of capital cost" (U.P. Mission Report-18). Also, an evaluation report on Accelerated Rural Water Supply Programme conclude that though there is safe drinking water source but about 12% population continue to use private or traditional source due to inconvenience, longer time of waiting, irregularity in water supply etc. (Programme Evaluation Organisation Report-1997)

From the above it may be derived that

- A large number of water supply projects faced severe operation and maintenance problem, even if it has been installed successfully and thus become unreliable
- Even if project has not suffered from the poor maintenance, the projects are not utilised to the extent it is intended to be due to one or other reason.

It can also be observed that though nature of the problem affecting the performance e.g. cost recovery, community indifference attitude, users inconvenience, etc are known, but could not be used at the planning are project identification level. The reason for it may be

- Absence of link between evaluation activity and project planning activity as two different agencies are carrying out the work with different term of reference
- Absence of an analytical tool to combine input and out put of water supply project and to identify the most efficient system
- Absence of good management information system

1.7 RELEVANCE OF STUDY

To day in India, Government is basically responsible for the development of water supply projects in rural as well as urban sector. In case of rural water supply that has a complicated production, service and amenity functions, the factors leading to success are less well established. Therefore, the improved feedback information from currently operating water supply schemes, in line with new managerial aspect, is a growing need of to- day.

1.8 MOTIVATION FOR THE STUDY

It is experienced that operation and maintenance aspect of the rural water supply project has drawn the attention of most of the studies. But a little has been done to integrate the users' convenience and willingness to pay with available resources to formulate a sustainable and effective water supply system. Dr. Akosa's work on "Efficiency of Water Supply and Sanitation Project in Ghana" is a pioneer work in water supply sector to translate the input and output of a water supply and sanitation project into a single efficiency measure using DEA technique. Hence DEA technique reduces the subjectivity may be used as a tool by the water sector managers to chose the most efficient project.

1.9 OBJECTIVE OF THE STUDY

The main objective of the study is to search for an analytical tool to find out the most efficient water supply project in particular socio-economic set up.

1.9.1 Scope of The work

The scope of the work is defined as

- to assess the degree of functioning of completed water supply project

- to assess the degree of utilisation of completed water supply projects
- to find the key factor responsible for selecting a drinking water source for their use
- to assess the willingness to pay for a demanded water supply system
- to rank the various water supply projects using Data Envelopment Analysis

1.9.2 Hypothesis

It is hypothecated that mode of supply, type of programme and size of project will affect the performance of different rural water supply projects. Also, convenience and willingness to pay are important factors to decide the utilisation of water supply projects and users' felt need respectively.

In present work, an attempt has been made to evaluate various water supply projects in one of the district, Varanasi, lying in northern part of India. Most of the district area lies in Indo – Gangetic Alluvial plain except some part of Chakia tehsil, which lies in Vindhyan range. Before 1982-83 comprehensive piped water supply projects were the only solution to provide drinking water facility to the problem villages. However with the introduction of India – Mark – II hand pump targeting at maximum coverage with restricted financial resources, comprehensive pipe water supply project did not get much promotion. Under the rural water supply programme the district Varanasi (now divided in two districts Chanduli and Varanasi) covers 960 villages through 49 pipe net works project (comprehensive pipe water supply project) and rest 1662 villages through 11580 India – Mark –II hand pumps. The comprehensive piped water supply projects include 1to 75 villages in one net work. These projects are financed under State Plan (Minimum Need Programme), Central Government Plan (Accelerated Rural Water Supply Project and Netherlands Assistance Programme. The India-Mark-II hand pump programme covers 250 persons per hand pump. The hand pump has been installed under various state and central government plan. The existing water supply project has been categorised into different sub-groups study the success and shortcoming of implemented water supply projects and get a feed back information which can be used for future planning and identification of projects.

1.10 STRUCTURE OF THE STUDY REPORT

The study report has been organised in seven chapters. The brief contents of the chapters are as follows:

Chapter -I	*Introduction,* - Water supply in India – an overview, relevance of study, Water supply in Uttar Pradesh – an overview, Organisational structure of implementing agency, problem experienced and objective of the study.
Chapter -II	*Research Methodology* - selection of water supply projects, methodology opted for data collection
Chapter- IV	*Technical, Financial and Institutional Analysis of water supply projects*- Introduction to study area, brief description of selected projects, technical financial and institutional of water supply project in study region
Chapter – V	*Performance of water supply project at micro level*- analysis and discussion of data and users perceptions about the implemented projects with reference to utilisation, dependability, willingness to pay etc
Chapter – VI	*Data Envelopment Analysis* –Introduction, theoretical back ground, analysis and discussion of results
Chapter – VII	Conclusion and recommendations

CHAPTER – II

Literature Review

2.0 INTRODUCTION

In this chapter an attempt has been made to explain, briefly, what is a project and what does evaluation mean? Also, a critical review of the notions, practices and methodologies available for evaluation with a special reference to water sector has been discussed in this chapter. This chapter includes four sections. The first section briefly defines the project evaluation. An overview of the literature concerned with project evaluation has been summarised in second section. Section three deals with the critical review of various methodologies used in the evaluation of water supply sector. The chapter concludes with the evaluation methodology adopted for the present study.

2.1 WHAT IS PROJECT EVALUATION?

Project is defined as a *set of activities*, which is implemented to provide a stipulated level of service for the presumed period to achieve the *intended objective* within a geographical frame with the allocated resources. Thus each project has *inputs* as technical, financial, human resource, etc. an *out put* in the form of services to the user/customer, repayment from the user against the services used and indirect benefit to the public within the project area termed as *impact*. *Evaluation* is a process which ascertain that to what extent the *objective* of a project is *achieved*. Depending upon the different stage of project, evaluation may be identified as (1) planning and feasibility studies (2) in-project evaluation during implementation (3) project performance evaluation after commissioning of the project. Here, project performance evaluation, which is relevant with the present study, has been taken up.

After several decades of experiences in financing, designing and managing the development projects Governments as well as International Agencies found that many projects still fail to achieve their objectives. The performance of the project deteriorated steadily. During 1981-1991, such projects having major problem increased from 11 percent to 20 percent (World Bank Report-1991). These figures may not reflect the true magnitude of problem, as they refer to the implementation stage problems and say a little about the how well projects are able to sustain over time or to produce their intended impacts. Therefore, it became essential to analyse the factor leading to success or failure of a project and monitoring and evaluation have been made an integral part of a project cycle (fig-1)

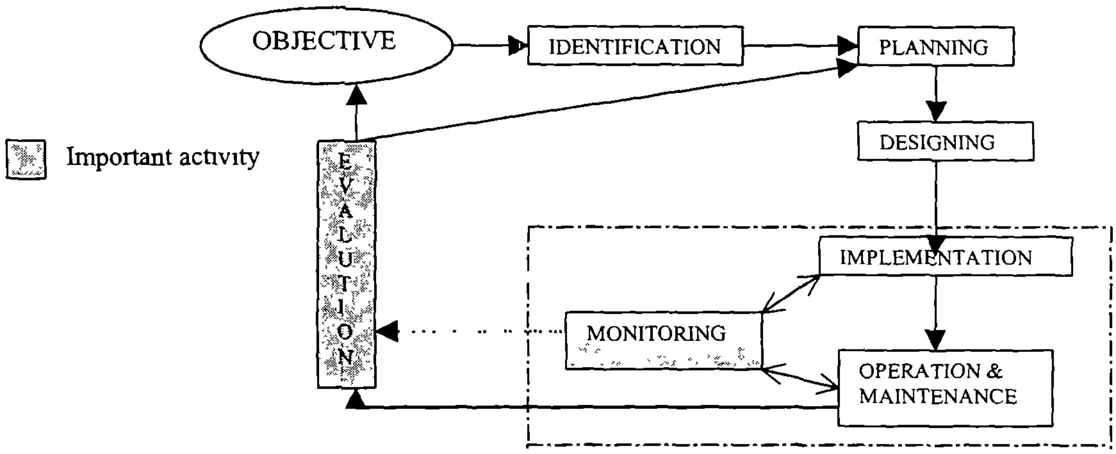


Fig -2 1 Project Cycle

2.2 LITERATURE OVERVIEW

Monitoring and evaluation are practical tools that form an essential part of good management practice. *Monitoring* is an internal part of the project activities which ascertain the physical and financial progress of project i.e. (a) whether project resources (money, material and staff etc.) are being delivered and used in accordance with the approved budget and time limit (b) whether the intended physical output i.e. activities are being completed timely in cost effective manner. Thus, it is a tool, which assesses the efficiency of project implementation and used to get the effectiveness of resource utilisation.

On the other hand, the basic purpose of an *evaluation* is (a) to assess the extent to which the intended impacts have been produced by the project i.e. to what degree project is able to meet the objective for which the project was formulated (b) to compare the cost effectiveness of a project with possible alternatives, considering the impact (output) of the project. Studies show that even the most carefully designed and efficiently implemented project could not produce the impact, which were intended to be. In such cases, also, evaluation is helpful to assess the possible shortcomings of the planning / project identification. Moreover, most projects are part of an ongoing development programme in which lessons from one project are used as inputs in the design of the subsequent projects which can be produced by a well designed evaluation systems.

It is rightly stated in a recent article in the European bulletin on Environment and health "Evaluations comes in many forms and sizes – the diversity seems endless." Various publications from The American organisation WASH, the World Bank, World Health Organisation and others have worked on the development of notions and methodologies for the evaluation of impact assessment of different development projects project. In the past World Bank and other International Development Agencies adopted quasi-experimental evaluation technique to assess the *impact of development projects* (World Bank Technical Paper – 53, 1986). In this evaluation technique, before and after measurements were being conducted on a sample of participants and control group to measure the net impacts on predetermined variables. Some of the problems realised with such type of evaluations are (a) it is a long term and so not helpful to the managers to improve the performance of their projects. Consequently additional ad-hoc studies had to be carried out to get a rapid feed back (b) how comparable were the experimental and control groups, at the start of the project. Even if the groups were matched, it is questionable to control for differences in variables such as motivation etc during the period (c) question do arise as to the validity of information obtained through formal quantitative survey approaches.

To overcome the above problem qualitative ethnographic technique such as evaluator's observations in which evaluators lived in among the beneficiaries and sought to understand the ways in which the intended beneficiaries perceived and responded to the projects, were advocated. In favour of these approaches it is argued that they are much more flexible, produce results more rapidly, able to investigate delicate or conflicting issues, able to produce more reliable data and are able to study processes as well as outcomes (Michael Bamberger et al, 1986). The strongest argument attached to this technique is that this technique evaluates the projects from the point of view of the intended beneficiaries Contrary to its strength of being more realistic and rapid feed back, this technique, too, possess some limitations. In order to evaluate impacts and to compare different groups, it is necessary to have some basis for comparison and quantification, which cannot be achieved, with most of the qualitative approaches. This limits the generalisation from the particular cases studied.

This is a continuing discussion among evaluation practitioners as to whether qualitative or quantitative methods are better. The debate is often conducted in quite heated terms as it involves philosophical and ethical issues as well as methodology However, it is clear that each evaluation technique has its strength and limitations. An evaluation, which realise on only one technique will inevitably give a limited and possibly biased perspective, that, too, in a water supply or health projects where social objectives requires the regular presentation of socio-economic indicators.

Based on a number of studies on the evaluation by Wholey, New comer and Associates (1989); Osborne and Gaeber (1992); Rust (1990); and Bark Doll and Bell (1989), Joseph Valodez and Michael Bamberger recommended the following approach for an evaluation:

- It is essential to involve all major stakeholders in evaluation process from initial stages for identifying the need for studies and defining objectives
- Without, of course, eliminating input and process evaluation, much greater attention should be given to the evaluation of outputs and products
- An effective evaluation programme must provide policy maker and managers with constant feed back to the extent these objectives are being achieved and on the factor that are interesting with the endeavour

- Greater attention must be given to assess the quality of programme rather than simply examining the quantitative indicators of inputs and outputs

It may not be possible for an evaluator to incorporate all the above aspects as most of the evaluations are conducted with specific term of reference and it also depends on

- the nature and type of project to be evaluated
- agency asking for evaluation
- purpose of the evaluation

2.2.1 *Lesson learned from the past experiences*

Impact of Water Supply and Sanitation Projects on Health Improvement

In 1842, the campaigner Edwin Chadwic argued that the public investment in improved water and sanitation would be justified through the growth of more healthy and productive population (Chadwick, 1842). More than a decade latter, at the beginning of the International Drinking Water Supply and Sanitation Decade (1981-1990), an United Nations report expressed much the same hope (Falkenmark, 1982). Hence, the most water supply and sanitation projects have been justified on the ground of public health improvement for resource allocations by national government and international agencies. But studies suggest that there is very tenuous link between improvement in health and investment water supply and sanitation services (Churchil, et al, 1987). A case study of rural area of Uttar Pradesh (Verma et al, 1990) concluded that controlled field trial can establish the measurement of the personal cost of illness due to some major water related diseases and so economic value can be assigned to improved water supply. However, in such studies relating diseases exclusively to water is difficult due to involvement of large number of variables and also methodological deficiencies in these studies (Feachem et al 1983) raise doubt on their validity. However, health benefits are deemed to follow from the water supply that are used regularly (Esrey and Habicht, 1987) where necessary ingredient of health education is also introduced (Aziz et al, 1990).

Though health benefits do not flow directly and automatically from improvement in water and sanitation facilities, it may be deemed by regular use of facilities. Hence, health benefit from the improved water supply and sanitation need to be explicitly defined as a goal of water supply and sanitation project and equally explicitly pursued by support agencies, most crucially of all, by users.

Sustainability of water supply project

Sustainability of a project means, the project is able to deliver a perceived level of service to the target group for a stipulated period of time after the withdrawal of major financial, technical, managerial and technical assistance from the external-funding agency. In past, for identification and formulation of water supply project the per capita cost is adopted as one of the most significant criteria. In other terms least cost technical solutions are considered at planning and appraisal stage for resource allocation. It has been observed that most of the project formulated on the least cost solution was not found sustainable due to one or other reason. Contrary to least cost solution hypothesis, a case study of Northern Thailand project (Box – 1), where villagers preferred costly water supply scheme with house connection over a cheap hand pump solution and ready to pay for it, (Briscose et al 1988) fully support the above view that low cost system is always not the best choice as usually being done at planning stage. In some cases the benefit cost analysis are used at planning and appraisal stage to justify the investment of resources for water supply projects assuming the level of service which can be provided. However the presumption to fix the degree of utilisation leads to ad-hoc procedure for deciding such vital issues (Briscose et al, 1988).

The UN Secretary General's end-of-Decade report to the General Assembly stated:
"Since financial resources for the sector are extremely limited in most countries, and because radical shifts in the sector allocations are unlikely in the foreseeable future, the conclusion is increasingly being reached that project beneficiaries should participate in the cost recovery if service coverage is to be extended" (UN General Assembly, 1990).

BOX –1 Case Study of Northeast Thiland: The lessons of experience

The Northeast Thialand project, funded b the U S Agency for International Development, was initiate to improve the health of the rural people by providing safe alternatives to the to contaminated water obtained from unprotected traditional sources The Northeast was a priority for government because it is one of the poorest areas in the country. So when the first project was designed in the early 1960's, it was assumed that could and would pay a little an improved supply. Accordingly, the target was to provide protected water at minimal cost Since groundwater was in abundant in the region, the technology chosen was handpump Five years latter the project was evaluated. Most of the hand pumps were not working, and people's use habits are largely unchanged Consistent with conventional assumptions, the failure was attributed to a technology that was too difficult for the villagers to maintain and inability of poor to pay for improved water supplies

In a follow- up phase, motor pumps provided piped water at community standpipes Again, the project failed Five years after implementation. 50 percent of the systems were not working at all and another 25 percent operated only intermittently The problem was again initially put down to complex technology, weak institutions and an ability to pay

Gradually, however, it became apparent that the main problem was not the capabilities of the villagers, but the fact that the service being offered was not that they wanted. They did not want hand pumps, which were not considered any significant improvement over the commonly used rope and bucket. Standpipes were no closer than their traditional sources and so offered no obvious benefits. Only water piped to yards could meet the people aspirations, as time saved in collecting water and the apparent high quality of the service were thought to be worth paying for

Potential problem in providing the higher level of service were clear: the system would be more complex and more difficult to manage and maintain, the price to be paid for the water would be high – even more per litre than people paid in Bangkok. Project staff were surprised when villagers responded that they could an would pay the amounts required, that diesel fuel could be purchased and pumps maintained, and that trained people would run the systems if they were adequately paid and were supported by the local government water officials.

The level of service was changed. Yards were allowed, with the users paying the full costs of connection Five years latter, the verdict was in: 90 percent of the systems were functioning reliably; 80 percent of the people were served by yardtaps, large economic benefits were perceived, such as time savings, gardening and livestock raising, pumps, treatment works and distribution system were maintained, and locally adapted financing systems had been developed with meters installed and regular payments Sufficient to cover operation and maintenance costs, major repairs and some degree of depreciation Not only had the systems been maintained, but also because the service was so popular, many systems had extended distribution lines to previously unserved areas

(Source Briscose et al, 1988)

Studies in Tanzania, Thialand and else where suggested that the water supply system which provide the most sustainable and reliable service were those where communities not only contributed to the operation and maintenance costs, but met them in full (Dworkin, 1980a, 1980b, and 1982). Against free water supply service, it is argued that subsidies deny the opportunity to users to exercise their power as consumer to demand for a better service (Churchil, 1987).

In developing countries, however, subsidies and free or low tariff for water supply are justified on public health ground and other economical factors. So, "…..low level of cost recovery…. remain the rule" in the water supply and sanitation sector and financial self sufficiency remains a distant goal (Baun and Tolbert, 1985) Rural areas are particularly problematic, due to low income, the absence of industrial and commercial uses and the attachment of villagers to their traditional free sources of supply. Therefore, during planning it is presumed that rural population is not able to pay. Contrary to it, studies of various rural areas about willingness to pay conducted in Kerala, India (Singh, B. et al, 1993), Punjab, Pakistan (Atlaf, M.A. et al 1993), Nepal and Bolivia (Jerri, K et al, 1987), Esmeraldas state of Northwest Ecuador (Hardner, J.J., 1996) clearly state that by making few critical policy changes higher tariff is possible and villagers are ready to pay for reliable and adequate water supply.

Properly implemented water supply should always lead to the direct and immediate advantages such as more quantity of water, closer to home and on more reliable basis, better quality etc. Studies in Tanzania, Thialand and elsewhere suggested that the users are ready to pay for a convenient and reliable system which leads to efficiency and sustainability. Thus beneficiaries payment for water use is seen as a means

BOX-2 A case Study of Ghana, Handpump fees –A Management Problems

Attempts by the Ghana Water and sewerage Corporation (GWSC) to introduce user charges for handpump water supplies after almost 30 years of free service provide a sobering example of the difficulties to be overcome in both changing policy a managing a fee collection.

Since independence in 1950, the government of Ghana had provided basic water supplies to the rural communities free of charge Under the conditions of an IMF/World Bank structural loan package however, this policy had to be reversed in an attempt to make GWSC fully self-financing In the Upper east and Upper West regions, where a programme of a sector assistance was bein supported by the Canadian International Development Agency (CIDA), charges for handpump maintenance were introduced i May 1985, with fee payments being backdated to the beginning of that year According to a report published three years later in 1988, the attempt largely failed and had potentially damaging consequences for the region s water supply programme.

Fees were set at a flat rate of 500 cedis per pump and abruptly introduced The response from the user communities was very mixed, with a marked seasonally evident in payment patterns and high level of delinquency. Many communities defaulted on payments on fell back on traditional unprotected sources. Prospects for success were not helped by a series of major increases in the fee during the first two years or so of operation In the Upper East region, fees were raised from 500 cedis to 1000 credis in Marc 1986 and to 1250 cedis in September 1987 In the Upper West, the corresponding increases were to 1300 cedis and then to 1550 cedis. In spite of this increase, the fee level was still only adequate to meet 50% of maintenance costs As the fees rose, willingness to pay declined. At one point, GWSC field staff were spending as much as 50% of their time trying to explain the necessity of the tariffs to the users

The CIDA-funded project had been attempting to introduce strong elements of village level operation and maintenance into th progamme, and was seeking t foster a sense of ownership and responsibility among user communities. The introduction of fees substantially undermined these objectives, with communities which were paying regarding maintenance an exclusively government responsibility Community demand for concrete pads and stock-watering troughs (for which they had previously been making a significant contribution) dropped dramatically. Delinquency on payments was so bad that GWSC had to resort to strong arm tactics, including the disconnecting of handpumps

(Source: Wood, 1988)

of protecting system from the uncertainties from the government financing and making system more likely. It may also increase the commitment of beneficiaries to the sound management and use of systems. Contrary to it, poor planning and inadequate consultation can create for more problems than the collection of revenue can solve

(Paying The Piper, Occasional Paper –18, IRC) as is evident from a case study of hand pump maintenance in Northern Ghana (Box-2)

The issues of cost recovery produce many dilemmas. Although the arguments for higher levels of contribution from users are strong, applying this principle in practice is far from easy. Many more factors than financing alone come into play in achieving the long-term sustainability of improved services. The WHO Working Group, composed of representatives of both donor agencies and developing countries, identified the ten key elements of sustainability Box-3. These elements of sustainability are broadly based, covering technical, non-technical, quantitative and qualitative, factors. Cost recovery is not explicitly referred to in the WHO document as a key element of sustainability, while the need for user contribution is frequently referred to.

BOX-3 THE TEN KEY ELEMENTS OF SUSTAINABILITY

• Enabling environment	• Expertise and skill
• Health awareness	• Appropriate service level
• Felt need	• Appropriate technology
• Supportive attitude	• Materials and equipment
• Strong Institution	• Support Service
- community	- customer relations
- agency	- community support
- interest group	- O & M support

(Source· WHO, 1990b)

2.3 EVALUATION / VALUATION TECHNIQUE COMMONLY USED FOR WATER SUPPLY AND SANITATION PROJECTS

The American organisation WASH, the World Bank, World Health Organisation and others have worked on the development of notions and methodologies for the evaluation of Water Supply and Sanitation projects. However, on 'Evaluation of Rural Water Supply Planning'' except the publication number 15 of IRC in its technical paper series of 1979, a good manual is yet to be required.

2.3.1 The Minimum Evaluation Procedure (MEP)

The Minimum Evaluation Procedure (MEP) for Water Supply and Sanitation projects of World Health Organisation (1982) gives detail attention to evaluate project effectiveness. As this document does not include detailed guidelines on the design of impact studies it has been labelled as "Minimum Evaluation Procedure". It is perceived that the improvement over health, welfare and economic status of users, which are the objectives of water supply and sanitation projects, cannot be fully achieved unless the facilities are functioning, firstly, in correct way and secondly it is utilised by the beneficiaries. Thus, the MEP is designed to evaluate functioning and utilisation and concludes with a discussion of impact study methodology and findings from documented impact studies.

The reports goes beyond suggesting specific indicators to show how these can be used to analyse problems and it also, provides a checklist of possible action to take if evaluation exercise show that a water supply is not functioning as intended (annexure-IIa). Hence MEP underlines the basic principle that evaluation activities are undertaken to enable analysis of problems and are able to facilitate decision making. However, the reasons for low effectiveness are external to the methodology. Evaluation of a particular stage is found difficult if it call for an improvement in the input of that stage or output of the previous stage.

The indicators defined for the evaluation of water supply functioning and utilisation such as water quantity, water quality, reliability and proportion of HH using the facilities etc are quantifiable and hence may be used effectively in a quantitative evaluation. Also, this method is a generalised and simple with limited indicator. Hence it can be effectively used in a situation where there is time and resource constraint prevails.

2.3.2 DANIDA Guidelines

Danish Aid Agency for the evaluation of drinking water supply projects has developed DANIDA guidelines. The guidelines are based on the Logical Framework Approach, which is used for DANIDA project documents.

The Danish method deviates only slightly from the MEP. Here sustainability of a project is a measure for the benefits at consumer level and these benefits are measured with the indicators: quality, quantity, proximity, continuity, predictability, reliability, and price Though the method is simple and well defined to get the efficient functioning of a project but does not focus effective use of the system by the beneficiaries. Secondly, this method is proposed for specific project, keeping in view the donor's point of view. Therefore, it cannot be adopted for every water supply project

2.3.3 WASH evaluation methodology

The WASH evaluation methodology is more extended, in addition to use of the water points it also considers the O & M, village committee and impact. According to WASP report (1990) the development of WSS facilities would be realised when the facilities continue to function after the aid agency depart and communities are in control of their own affairs. It further adds that the sustainable development is more likely to occur if each of the key participants (community and agency) recognises and assumes its appropriate role and shoulders its responsibilities. The limitation of this method is that it requires very skilled evaluator vast amount of information and several personmonths. This methodology is normally used for final evaluation of a project as it requires interdisciplinary team to assess the impact on health, economic and social aspects etc. As such, most of the approaches for a final evaluation can be selectively applied to any of the forms of the evaluation if desired.

2.3.4 Participatory evaluation technique

Participatory evaluation is based on the principle that the role of development is to assist beneficiaries to become self-reliant. Therefore, they should evaluate themselves according to their own criteria and use the result to improve or expand their participation in the project.

Deepa N.Parker in her paper "Sustainability and the Human Factor" quote, " the sustainability is just not the measure of the system function at a time or failure at others. That is just the static measure. Sustainability is rather the measure of the changing atmosphere e.g. in matter of increased confidence, competence, pride, ability to self diagnose, ability to the new initiatives and so on. The dynamic measure is a subject to change depending on the type of programme and the political, economic and institutional context."

The argument put in favour of Participatory Evaluation Technique (Deepa Narayan, 1993) is that it incorporates the users view and able to indicate the factors which are of importance to make water supply system more effective and thus make the evaluation more realistic. However, it presumes that the beneficiaries have the necessary analytical skills, time and interest for the evaluation and have been substantially involved in the project activities. Without some training and understanding of basic principles of participatory approach, it loses the credibility otherwise participation runs the risk of becoming of pure tokenism (Rebien, 1996). The pertinent questions related to the use of the approach still remains unsolved: who should participate? Who defines whom should participate? What degree of stakeholder involvement is required for the evaluation to be called participatory?

2.3.5 Contingent Valuation Method

Water supply is a *social service* rather than a *private goods* (Franceys, 1994a). Therefore, it is difficult to measure the economic value of a water supply service at consumer end and so, it cannot have an established market price (Sam M.Kayaga, 1997). However, the willingness to pay can be used as a measure for the acceptability and demand of a system. In the recent years there has been renewed interest in developing practical methods to find out what services people really want and how much they are prepared to pay for them. Two basic methods have been developed. The first, the *indirect method,* involves analysing what others in similar circumstances to the target population are already paying for services and the second, *direct method*, referred as contingent valuation involves asking people to say what they would be prepared to pay in the future for improved services.

In spite of its big advantage that data are drawn from actual practices, it run the risk the discrepancies between the apparent value of a service and the amount that individuals are actually prepared to pay. Also, it is a top-down approach, which deign for rather than with the community (Briscose and de Farranti, 1988). Whereas argument against the direct method is that the answer to willingness to pay question may be misleading due to one are other reasons. In1976, World Bank concluded that using the direct method for rural water supply was "virtually useless". Contrary to it, supporter of CVM states that though the direct method may not be perfect and may be subjected to biases and distortion, it may provide legitimate 'core values' (Randall et ai, 1983). Franceys (1995a) do support the CVM technique by perceiving it as a most appropriate technique currently available for estimating Willingness to Pay for a water supply services (WEDC Report, 1997). Further, a pilot study conducted in Esmerldas State of Northwest Ecuador to estimate the willingness to pay for potable drinking water, test the potential of the CVM.

2.4 FINDINGS AND APPROACH TO PRESENT EVALUATION

It is obvious from the above study that every methodology has its own merits and demerits. *MEP*, *Participatory Evaluation technique* and *WASH* methodology are more or less output oriented and does not consider the input of water supply project. Contrary to it *Cost Benefit Analysis*, which is mostly used for project appraisal is input oriented and presumes the service level. It is ,also, observed that the evaluation technique in practice involves a greater degree of subjectivity and possibility of biases cannot be overruled depending on Term of References of evaluation.

The research studies aimed at defining and advocating new methodological approaches for monitoring and evaluation of rural water supply and sanitation projects, examined the three major themes (a) health (b) community participation and (c) willingness to pay. Also, the message from the studies is that for a better resource allocation, a sustainable and efficient water supply system is a need of the day.

Therefore, in present study mix approach has been adopted to link the service output to the input of water supply project. To assess the service level (functioning and utilisation) MEP has been used due to its simplicity and generalised feature; CVM has been used to assign the economic value of water supply service. An attempt has also been made to find single efficiency measure using a Data Envelopment Analysis technique (an analytical tool) considering technical, financial, social, economical and institutional as input and reliability and utilisation as output of a water supply project

Data Envelopment Analysis

The Data Envelopment Analysis technique (Charnes et al, 1981) is designed to measures the relative efficiency in situation where there are multiple input factors used and differing benefits achieved (multiple output). DEA is based on the economic notion of Pareto optimality, whereby an allocation of resources is said to be efficient if it is not possible, through some alternative allocation of resources, to increase the desired aggregate output without detracting from any single output. The usual output/input ratio measure of efficiency is formulated in terms of a fractional mathematical programming model. Dr. Akosa (1995) used Data Envelopment Analysis to lessen subjectivity in performance evaluation of water supply and sanitation project and make it more effective and responsive, and decision making tool for policy maker. Considering social, technical, economical, financial, institutional and environmental suggested by Franceys (1989) and reliability, utilisation and convenience as output factors as a substitute for health impact, Dr. Akosa found the single efficiency measure of different water supply projects and ranked for allocation of scarce resources.

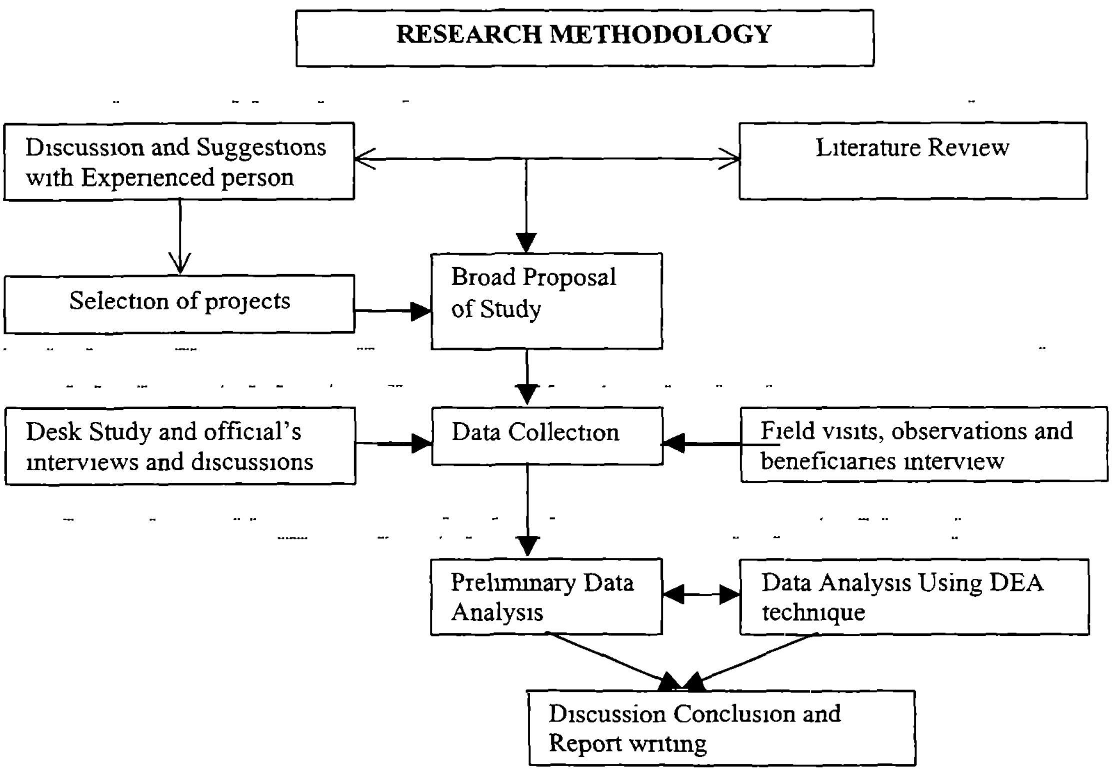
Though the above method is able to provide the single efficiency measure of a project and thus providing greater degree of objectivity, but it remains subjective in the choice and measurement of some of input and output factors. (Akosa el al, 1995).

CHAPTER –III

Research Methodology

3.0 INTRODUCTION

To meet the objectives, the evaluation study required information on technical, financial, institutional, social, and economical aspect of a project as inputs to the project and reliability, utilisation, cost recovery etc. as output of a project. The secondary data available was not adequate to fulfil the study requirements. Therefore, the necessary data was generated through conducting interviews, discussions and observations with beneficiaries, officials during field study and office visits. The schematic representation of overall approach to the study is depicted in fig-3.1



Based on the review of the literature available and initial discussions a detailed questionnaire was designed which posed specific and pointed structured questions on all relevant issues in connection to rural water supply to generate quantitative data. To make it understandable to the beneficiaries the questionnaires were translated into local language, Hindi. The villagers were interviewed by the author with the help of two persons having done his graduation and not connected with water supply field. Before start of the work author trained them.

Further, in the subsequent section, selection of study area and water supply projects for field collection has been discussed in section one and two respectively. Section three deals with desk study and indicators selected for data collection. Field study and sampling technique has been discussed in section four. Limitation of the field study and hypothesis for statistical significance of the fieldwork has been discussed in section five.

3.1 SELECTION OF STUDY AREA

District Varanasi (recently divided into two separate district namely *Chandauli* and *Varanasi* for administrative reasons) lying in the eastern part of Uttar – Pradesh, is selected considering the following points:

- Historical and religious importance
- Involvement of foreign donor agencies in water supply sector along with State and Central Government
- 100% coverage of the problem villages
- availability of different categories of project for comparative study
- last but not the least, the authors acquaintance with the area

The study area i.e. the district Chandauli and Varanasi will be termed region in rest of the text

3.2 SELECTION OF WATER SUPPLY PROJECTS

Piped water supply net works and bore well fitted with India-Mark-II hand pumps are the dominant modes of safe drinking water supply provided to the villagers, under the study region. In addition to it privately owned traditional sources such as wells and shallow hand pumps are, also, in existing in the area. The following net work of safe drinking water supply source have been provided to cover the entire population in the study region:

- 49 net works of comprehensive pumping piped water supply projects in rural area covering 960 villages
- 12 net works of pumping piped water supply in urban area covering 12 towns
- 11,580 spot source (bore well fitted with India-mark-II Hand Pumps) covering 1662 villages

Urban water supply projects have been excluded, as the present study concentrates on the rural area.

The general guidelines for the project implementation and operation and maintenance are the same, as agency involved is the same in all projects i.e U.P. Jal Nigam. However, it is hypothesised that the performance of rural water supply projects at micro level is likely to be affected by the mode of water supply, criteria adopted for project preparation, implementation, operation and maintenance management and socio economic set up of the area due to one or other reason. Hence, for the comparative performance study, and provide homogeneity for the sample selection, the population under study was further classified into two sub sets: one falling under comprehensive piped water supply projects and other one falling under spot sources (India-Mark –II hand pump) project.

3.2.1 Comprehensive piped water supply projects

The comprehensive piped water supply projects financed under different programmes with different design criteria cover 1 – 74 villages in one net work of distribution system. Therefore, to study the comparative effectiveness of various project, further sub classification were made considering the type of programme and number of villages covered by one net work

Norms for sub classifications of the comprehensive piped water supply projects are as follows:

According to net work size

1- *Large Projects*- more than 30 villages are covered in a distribution net work
2- *Moderate* - 10-30 villages are covered in a distribution net work
3- *Small* - less than 10 villages are covered in a distribution net work

According to the programme

M- project implemented under *Minimum Need Programme*(MNP), solely State financed programme; criteria adopted for project preparation - rate of water supply 70 litres per person per day, design period 30 years, provision for House connections to meet O & M cost

A- project implemented under *Accelerated Rural Water Supply Programme* (ARWSP), financial assistance obtained from Government Of India; criteria adopted for project preparation- rate of water supply 40 litres per person per day, design period 15 years, only stand posts no provision for House connections

N- project implemented under *Netherland Assistance Programme* (NAP), financed by Netherlands Government under IDC; criteria adopted for project preparation- rate of water supply 70 litres per person per day, design period 30 years, provision for House connections but more emphasis to make it accessible to maximum number of people by providing more public stand post to promote utilisation.

The matrix of the comprehensive piped water supply scheme is shown in the table 4.1

MATRIX OF PIPED NET WORK PROJECT

Table 3.1

SIZE	LARGE (1)		MODERATE (2)		SMALL (3)		TOTAL	
	No of net work	No of villages included	No of net work	No of villages included	No of net work	No of villages included	No of net work	No of villages included
PROGRAMME								
MNP (M)	3	110	9	140	10	58	22	308
ARP (A)	2	80	5	33	7	79	14	192
NAP (N)	6	308	7	152	0	0	13	460
Total	11	498	21	325	17	137	49	960

In case of Large MNP project, one project, has reservoir as source of supply and lies in plateau region; therefore, it has been put in different category for comparative study.

3.2.2 Spot source (India-Mark - II)

Most of the India – Mark – II have been installed under MNP and ARWSP. But in the field it is not possible to single out the village, which is exclusively covered by any one programme. Hence topography i.e. plain and rocky was considered for classification of India – Mark - II Hand Pump as in both the cases cost per Hand Pump and constructional technology differ considerably. The sub classification of the spot sources is as follows

H-1 -Bore well constructed manually in the *Gangetic plain region* and fitted with India- Mark –II hand pump; criteria one spot source for each 250 persons or in each habitation, cost per hand pump Rs. 17,800.

H-2 -Bore well constructed with the special rig machines in the *plateau region* fitted with India- Mark-II hand pump; criteria on e hand pump per 250 population or in each habitation, cost per hand pump Rs. 33,500

The detail of classified project is annexed (**annexure – IIIA)**

So as to keep a homogeneous group and study the relative performance of different category of project, 10% (subject to a minimum one project) was selected from each category randomly by lottery method. The project falling in each category was enumerated and number of each project was written down on a slip. Then, all the slips were put on a cardboard box and a child (my daughter) was asked to take out one slip. Corresponding to the slip number, project from the list was selected for study. Same procedure was repeated for other project selection.

Thus in all 20% comprehensive project covering 258 villages were selected for study. Detail of selected project is annexed (annexure **–IIIB**). In case of spot sources (India – Mark –II HP) considering the homogeneity in installation and service condition, 10 hand pump from plain and 5 hand pump from rocky area have been selected, considering each hand pump as a net work.

3.3 DESK – STUDY

Desk study were conducted to get acquainted with the available evaluation procedures, to select the indicators and sub indicators for field study and also to get the secondary data about the projects. The desk study includes

- A review of literature in the libraries of IHE, IRC and TU was done in order to get acquainted with the evaluation technique in practice.
- Consultation with the staff and agencies involved / experienced in the field of evaluation
- Office visit and study of the available reports, discussion / interview with officials of implementing agencies

3.3.1 Indicators selected for data collection

To evaluate the performance indicators and sub indicators were selected using the MEP guidelines. Thus, to assess the functioning of a project the following the following sub-indicators were selected for data collection

- quantity of water supplied a day
- quality of water supplied
- numbers of days per annum water supply is stopped
- hours of supply per day
- collection of water charges over operation and maintenance cost

And, to assess the effectiveness the following sub indicators are selected

- Number of person using the facility provided

Also, to assess the felt need the contingent valuation technique is used to measure willingness to pay (WTP)

To study the compare the relative efficiency of project DEA technique is used. The project-input parameters were chosen to include technical, financial, economical and social and institutional factors (excluding health and Environmental), for the present study. Environmental and Health factors were not considered because for the author it is difficult to measure. For choosing the measurements for the indicators, the main point considered is attainability rather than aiming for unattainable accuracy.

The measure for technical factor was chosen as electric power consumption per person, keeping in view the shortage of electric power in rural area. Also, it indicates the technical complexity, requirement of skill person. The financial factor was estimated as the deficit on full cost recovery per person. Staff per thousand-water point has been adopted as a measure of institutional factor. Internal rate of return and net present value was proposed for measure of economic factor. However, in absence of adequate secondary data to derive IRR and NPV, in the analysis it is not included. For rough estimation of economic value Willingness to Pay has been used. A score reflecting community literacy, economic status and awareness for health hygiene, felt need for an improved water supply system, measured the social factor

Project output parameters were taken as reliability and utilisation. For reliability percentage use of alternative source, no. of days per annum facility is not available were taken as the measure. While in case of utilisation percentage household using the facilities was taken as measure.

The selected indicators and sub indicators are given in **annexure-III C**

3.4 FIELD STUDY

The available secondary data is not adequate to meet the study evaluation requirements. Therefore, to generate the necessary database for study, the author conducted field survey during the period 5th November 1997 to 25th January 1998 in the study region.

In order to obtain the quantitative information from the field study a closed-ended questionnaire (except HHA and Village level developed skill and supportive attitude) were to interview members of randomly selected household in the project areas. Evaluation objectives and Minimum Evaluation Procedure guided the selections of the questions. The questionnaires thus aimed to collect the data about

- to assess the functioning level of project
- project achievement in terms of percentage of population using the provided facility
- assessment of felt need of community
- willingness to pay using contingent evaluation technique
- villagers socio-economic level and awareness about health and hygiene

The sample sheet of questionnaire is annexed (annexure – III D)

3.4.1 Sampling Technique

To get a representative sample from the project area, two level sampling techniques was adopted

- ***Village Level:*** In case of *comprehensive piped water supply projects* depending upon the size of project 10-15% villages subject two a minimum two were selected randomly from the selected projects In selection of villages the project area is divided in three concentric zone depending upon their distance from the main supply point However, in case of small projects only two concentric zone were considered From each zone randomly 1-2 villages depending upon the size of project are selected for HH selection. In case of *India- Mark-II hand pump* each hand pump is considered as a net work. Hence randomly 10 villages from plain area and 5 villages from the rocky area is selected randomly.

- ***House Hold level:*** 25-30 house hold (HH) per comprehensive water supply project. For selecting respondent household (HH) stratified sampling technique (schedule caste and general strata) with proportional allocation were proposed. While in case of spot source, stratified random sampling with equal allocation to general and schedule caste habitation was adopted to select the hand pump. For each HP, 10 HH are selected randomly.

Altogether 302 HH from 45 villages were interviewed for comprehensive piped project performance evaluation and 105 HH from 11 villages are interviewed for spot sources performance evaluation

3.4.2 Field Observations

To assess the actual population and distance coverage of spot sources (India – Mark –II HP two India Mark –II HP were observed and recorded from 6.00 am to 6.00 pm, one each in general and schedule caste habitation.

3.4.3 Limitations of the field survey

- The villagers were generally not able to indicate the quantum of water used by them and their annual income. These figures are only indicative and can not be taken exact.

- Proportionate allocation of SC in piped net work was found difficult as the houses are not well allocated.
- About the assessment of quality, physical appearance as perceived by villagers are considered and recorded.
- About the breakdown and time laps in repair, the figures told by villagers are not exact, just only indicative.
- Coverage of large data range, limited the in depth observations.

3.4.4 *Hypothesis for Statistical Significance*

For test of significance, a hypothesis based on the previous result and experience is made and tested by finding the confidence interval by applying t- test

In present study, it is hypothesised that about 60% villagers take convenience as a key factor to use a particular water supply source and normally about 70% house hold are using the safe water source. For a sample of size 30, and confidence level 90%, and degree of freedom 29, t=1.7

Therefor,

$$\text{Confidence interval} = 60 \pm 1.7\sqrt{\{60*(100-60)/30\}}$$

$$= 60 \pm 15.2$$

It indicate that if hypothesis is valid then there in 90 percent cases the field observation will lie within 45-75%, if the data is collected taking the different sample.

4.4.1 Testing of the field data

From the field survey, it was found that on an average out of 30, 17 household ask for an improved water supply system due to convenience. Thus the percentage comes out to be 57% which lies between the range 45 – 75%. Therefore, the hypothesis is valid and field data is significant.

CHAPTER – IV

Technical, Financial, &Institutional Analysis of Water Supply Projects

4.0 INTRODUCTION

Following from the description of Water Supply Sector in Uttar Pradesh (Chapter I) this chapter deals with the brief background of the area as well as the rural water supply project implemented in the study region The chapter has been divided in four sections. General topography and present set up for health and hygiene promotion, which has a close link with objective of the safe drinking water supply, has been mentioned in brief. Section two deals with policies and planning adopted for project formulation. In third section, brief descriptions of the project under study area have been mentioned. The chapter concludes with the summary of the strategy adopted in study project formulation and key technical and financial details of the project under study.

4.1 ABOUT THE AREA

4.1.1 General Topography and Demographic Detail

The study region Varanasi , situated in the eastern boundary of the Uttar Pradesh, lies between a latitude of $24^{0}\ 50^{/}$ to $25\ ^{0}35^{/}$ North and $82^{0}\ 14^{/}$ to $83^{0}\ 14^{/}$ East. The Holy river Ganga flows into the District from western side that from district Allahabad and leaves from its eastern boundary to enter the district Ghazipur. The district head quarter lies at the bank of Holly River Ganga. The most of the area lies in Indo Gangetic plain except 40% part of one of the sub division named Chakia lying in district Chandauli, which falls in Vindhyan range and is rocky.

Varanasi is one of the oldest cities, said to be Shiva (God of welfare) Nagari (city). It is a place of high spiritual values and famous pilgrimage for Hindus and Buddhas.

The total area of the region is 5,092 sq. km having a total population of 48,60,582 as per 1991 census. The population density of the region is 955 persons per sq. km. The literacy rate is 47.7 %. Recently for administrative purpose the whole region (the Old Varanasi) is divided into two districts namely Chandauli and Varanasi. It is further divided in four Tehsil (sub divisions) and 17 development blocks. There are 12 cities / towns and 2964 revenue villages out of which 342 villages are un-inhabitated (1991 census). The block wise population detail is annexed herein (Annexure-IVa)

All the villages of the block Naugarh, and about 15% of block Sahabganj and 5% of block Chakia fall under rocky terrain. Urbanisation of the area is coming up fast, specially in the district Varanasi

4.1.2 Organisational set up for health education and Hygiene Practices

All health programmes, including their health education components are implemented through the State Health Departments. At the district level there is a district Health Education and Information Officer and District Extension Educator for Health Education activities.

At the Block/ Public Health Centre there is a Block Extension Educator and Health Supervisor who also carries out health education work. At the sub centre level there is a male multi-purpose worker and a female multi-purpose worker, who, besides their routine primary health care services, are supposed to do health education work in community. A sub- centre has a population of about 5000 in the plains and about 3000 in rocky and difficult areas. At the village level there is a volunteer village health guide (specially female) for about 1000 population, trained in basic health activities.

Though every health functionary are suppose to do health education work in the community, but due to much involvement with target oriented programme such as family planning and immunisation, the health education work related to safe drinking water could not get the due attention.

4.2 POLICIES AND PLANNING IN WATER SUPPLY SECTOR

All the plans for water supply sector in study region are drawn in accordance with State / Central Government policies fixed for water supply sector. At the district level, the nodal division of U.P. Jal Nigam prepare the water supply plan for the region and get it finalised with district magistrate (administrative head of district and a state administration representative)

In the Varanasi region the U.P.Jal Nigam formulates all the water supply projects as a top- down approach keeping technical aspect only. Local divisions headed by executive engineer frames the project as per design criteria laid by the U.P. Jal Nigam headquarter taking coverage as the main criteria. Before 1982-83, only comprehensive water supply projects were promoted but after that all the emphasis was put to the maximum coverage by installing India-Mark-II hand pump under State and Central Government funding. All the rural water supply projects are executed and being maintained by U.P. Jal Nigam.

In Varanasi 12 piped water supply projects are financed by the Netherlands Government under subproject– I and Sub Project–IV. There is no difference in the project formulation strategy except providing more water point to access most of the users even if they don't have the house connection. Also, there is regular evaluation by the Dutch –Mission and on the basis of recommendation of mission addendum is incorporated time to time to make. These projects, too, are being maintained by Jal Nigam, by its own resources.

4.3 WATER SUPPLY PROJECTS IMPLEMENTED IN THE AREA

In the region Varanasi as per 1972/85 out of 2,622 inhabited revenue villages, 1,737 villages were identified as problem villages. Till 1981-82, comprehensive water supply schemes were perceived as the most economical technical solution and hence were executed to provide drinking water facilities to the scarcity areas. However, with the introduction of International Drinking Water and Sanitation Decade, to achieve the target of providing each village, at least one safe drinking water source, installation of India –

Mark –II hand pump was taken up under the rural water supply programme. So far total 49 comprehensive piped water supply schemes covering 960 villages have been implemented under State financed Minimum Need Programme, GOI assisted Accelerated Rural water Supply Programme and The Netherlands Government assisted Indo- Dutch Programme. Rest 1,662 villages have been covered by India- Mark-II hand pump under MNP and ARWSP financed by State and central government respectively. The details of village coverage are shown in table 4.1

PROJECTS IMPLEMENTED UNDER

Table 4 1

DESCRIPTION	PIPED WATER SUPPLY PROJECTS				IM – II HP
	MNP	ARWSP	NAP	Total	
Nos. of W / S net works	22	14	13	49	11,980
Nos. of villages covered	308	192	460	960	1,662

4.3.1 Brief description of the selected water supply projects

Naugarh Group of Villages (MNP Pipe – 45L)

The project area lies in the southeast part of the study region in block Naugarh, tehsil Chakia of district Chanauli (newly created). It is about 80 km away from the district head quarter i.e. Varanasi. The whole of the command area of the project lies in plateau region and faces an acute shortage of drinking water during summer. The project area covers a population of 29,412, which includes about 40% schedule cast / schedule tribe (down trodden) population as per 1991 census.

The Naugarh Group of Villages water supply project was framed in 1972-73, amounting Rs. 55.25 lacs (Rs 262.4 lacs-1997), to supply safe drinking water to 45 revenue villages of tehsil Chakia @ 45 litres per person per day and commissioned in 1978. The raw water from the Bhainsod reservoir is pumped to one mld conventional treatment plant consisting of sedimentation and filtration and chlorinating unit. Further, the treated water is supplied through 69 km long distribution net work. To take care of fluctuations in demand a 250Kl balancing overhead reservoir is also provided. The whole of the area is served through 37 community stand post and 339 house connections.

Due to poor O & M and financial constraints, the project was supplemented through 183 nos India-Mark – II HP after year 1989 to take care of break down and cover the habitation which are presently not covered by piped supply due to one are other reason.

Chahania Group of Villages (MNP pipe-70L)

The project area lies in the north of the study area and falls in Gangetic alluvial plain. Chahania group of villages, situated in block Chahania, Chanduli Tehsil, covers 32 villages of tehsil Chaundauli in district Chandauli. The project area is 38 km from the old district head quarter. The total population covered in the project area is 23,380 including about 24% Schedule caste / schedule tribe as per 1991 census.

The project costing Rs.11.03 lacs (Rs 52.4lacs-1997) was framed in 1972-73 and commissioned in 1978. Two nos. Tube Wells have been bored and the drinking water, after chlorinating, is supplied to the villagers through a net of 45 km long distribution net work @ 70 lpcd The water points in the area are 12nos. public stand post and 850 nos. house connections In addition 36 nos. India- Mark-II hand pumps have, also, been provided in the command area of the project.

Sakaldeeha Group of Villages (MNP pipe-70M)

The project area, covering 26 villages of block sakaldeeha, tehsil chanduli, lies in north-east part of the study region. The whole of the area falls in Gagetic alluvial plain. The total population covered in the project area is 29,018 out of which 24% population belongs to the down trodden section i.e. schedule caste / schedule tribe (1991 census). The area is about 26 km from the Varanasi.

The project amounting Rs 13.43 lacs (Rs. 54.80wlacs-1997) as framed in the year 1975-76 and commissioned in 1980. The source of water supply ground water. Two no. Tube Wells have been bored to supply drinking water at the rate of 70 lpcd. After dis-infection the drinking water is supplied to the villagers through 16km pipe net work. To meet the peak hour demand 310 kl capacity balancing reservoir has, also, been constructed. The beneficiaries are getting drinking water through 960 house connections.

Additional, 46 nos. India- Mark –II hand pump have been installed after 1992 as an alternative source for safe drinking water, in case of break down.

Cholapur Group of Villages (MNP pipe-70 S)

The project area lies in west of the study area in Block Cholapur, tesil Sadar of district Varanasi at a distance of 20 km from the district had quarter. The project area covers 7 villages which falls in alluvial plain. The total population covered under the project area is 12,576 including about 23% schedule caste / schedule tribe (1991 census).

The project was prepared in 1977-78, amounting Rs. 9.86 lacs (Rs.34.60 lacs-1997), and commissioned in 1982. The ground water is selected as source of water supply and two no. Tube Wells and 100 kl capacity balancing reservoirs have been constructed to provide safe drinking facility @ 70 lpcd. The drinking water is supplied, after dis infection to the consumer through 11 km long net work of distribution pipe. The water points in the area are 16 nos. stand post and 148 nos. house connections.

To supplement the water supply during breakdown and left out habitation 61 nos. India – Mark –II hand pumps have been provided after 1992.

Chaubeypur Group of Villages (ARP-40L)

The project area, covering 35 villages of block Chiraigaon, tehsil Sadar district Varanasi, lies in the north west part of the study region and is about 28 km from the district head quarter. The project area falls in alluvial plain. The total population covered under the project area is 30,126 including about 22% schedule caste / schedule tribe (1991 census).

The project was prepared in 1986-87, amounting Rs. 54.84lacs(Rs.87.20-1997), and commissioned in 1992. The ground water is selected as source of water supply. The project was framed under Accelerated Rural Water Supply Programme to meet the minimum requirement of safe drinking water through community stand post without house connections. The rate of water supply adopted in the project preparation is taken as

40 lpcd and two no. Tube Wells and an 800kl capacity balancing reservoir has been constructed to provide safe drinking facility. The drinking water is supplied to the consumer through 51km long net work of distribution pipe. The water points in the area are 135 nos. stand post and 85nos house connections.

To supplement the water supply during breakdown and left out habitation 98 nos. India – Mark –II hand pumps have been provided after 1995.

Baragaon Group of Villages(ARP pipe-40M)

The project area lies in north-west of the study area in Block Pindara, tesil Sadar of district Varanasi at a distance of 24 km from the district head quarter. The project area covers 23 villages, which falls in alluvial plain. The total population covered under the project area is 34,261 about 15% schedule caste / schedule tribe (1991 census).

The project was prepared in 1975-76, amounting Rs. 16.5 lacs (Rs.67.30lacs-1997), and commissioned in 1980. The ground water is selected as source of water supply and two nos Tube Wells and 700kl capacity balancing reservoir have been constructed to provide safe drinking facility @ 40 lpcd assuming no house connections. The drinking water, after chlorinating, is supplied to the consumer through 39km long net work of distribution pipe. The water points in the area are 50nos. Stand post and 1149 no. house connections.

To supplement the water supply during breakdown and left out habitation 43 nos. India – Mark –II hand pumps have been provided after 1992.

Lohata Group of Villages (ARP pipe-70S)

The project area lies in the west of the study area within 12 kms from Varanasiand falls in Gangetic alluvial plain. Lohatagroup of villages, situated in block Sewapuri*, Tehsil Sadar of district Varanasi, covers 3 villages. The total population covered in the project area is 14,536 including about 14% Schedule caste / schedule tribe as per 1991 census. It is very well connected to the Varanasi commercial centre. It is also one of the important weaving centre and area is developing fast.

The project costing Rs. 3.2 lacs (Rs.15.20-1997) was framed in 1972-73 and commissioned in 1977-78. One no. Tube Wells have been bored and the drinking water are supplied, after chlorinating, to the villagers through a net of 45 km long distribution net work @ 40 lpcd. Further, it is augmented with one more tubewell. The water points in the area are 6nos. public stand post and 1,532 no. house connections.

In addition 19 nos. India- Mark-II hand pumps have, also, been provided in the command area of the project.

Kandava Group of Villages (NAP pipe-70 L)

The project area lies in south of the study area and covers 49 villages of Kashi Vidyapeeth block, tehsil sadar of district Varanasi. It is situated at the out skirt of Varanasi town. The total population covered is 61,045 that include about 13% population of schedule caste/ schedule tribe.

The project was formulated 79-80 and constructed in 1985-86 amounting Rs. 86.0 lacs (Rs.223.60 lacs-1997) under sub-project-I, supported by Netherlands Government. The ground water was taken as source of supply and two no. Tube Wells along with 1000kl balancing overhead reservoir have been constructed. After dis- infection, drinking water is supplied to the users through a net work of 95 km pipeline with 210 public stand post and 1214 house connections. To reduce the interruption in water supply due to erratic electricity, independent electric feeder main has been provided.

Further, the project was supplemented with 116 nos. India-Mark –II hand pump to cover the left out habitation with a concept to make it accessible to all.

Jansa Group of Villages (NAP pipe-70M)

The project area, covering 21 villages of Sewapuri block, tehsil Sadar, lies in western part of the district Varanasi at a distance of 30 km from the district headquarter. The geological topography is almost plain. The project covers 17,410(1991) population including about 15% population of schedule caste.

The project was formulated under Indo-Dutch co-operation programme and included in sub-project-IV. The project costing Rs84.61 lacs (Rs.134.50 lacs-1997) was commissioned in 1990 with the construction of two no. two nos. Tube wells and other allied works along with a storage tank of 800 kl capacity. The drinking water is being supplied through a net work 49 km long pipeline after chlorinating. The existing water point in the area 497 house connection.

Additional, 89 India – mark-II hand pump have been installed provided as supplementary source to safe drinking water.

Tikari Group of Villages(NAP pipe-70M)

The project area covers 27 villages of Kashividyapeeth block , tehsil Sadar of district Varanasi and lies in the south of Varanasi and is a peri urban area lying at the periphery of the Varanasi city. The project covers 56,920(1991 census) population including about 14% population of schedule caste.

The project was framed in 1979-80 and included in sub-project –I. The project has been commissioned in 1985, amounting Rs.94 lacs(Rs.244.40lacs-1997). Two Tubewell and 1200kl capacity balancing overhead reservoir have been constructed. The drinking water is supplied through a net work of 65 km pipeline with 15 nos stand post and 1530 nos. house connections. To check the failure of water supply due to electric supply independent feeder main has been provided.

This project has been further strengthened in sub-project IV by providing India-Mark-II hand pumps to cover the left out habitations.

India-Mark-II hand pump-Alluvial Strata(HP-Plain)

The hand pump programmes, in alluvial plain, cover 1535 villages almost in all Blocks of the region It covers total population 1,33,7606. Including 22 % schedule caste /schedule tribe.

11,532 India-Mark-II, amounting Rs.2018 lacs (1997) have been installed since 1984-45 under various state and central government programme. One India-Mark-II hand pump, amounting Rs. 17,600, has been installed to cover 250 population or one habitation which ever is smaller. The method of construction of hand pump in plain area is, mostly, manually.

India-Mark-II hand pump -Rocky Strata (HP-Rocky)

The area under rocky strata lies in the Southeast part of the study region. It covers 127 villages of in tehsil chakia. The total population covered 88,153.including 39% schedule caste /schedule tribe

448 nos. of India-Mark-II hand pump, amounting Rs.149 lacs (1997) have been installed with the help of special rig machines The criteria for hand pump was same i.e. one hand pump per 250 person or habitation which ever is smaller.

4.3.2 Institutional, Technical and Financial Parameter of the Implemented Water supply Projects

INSTITUTIONAL ANALYSIS

U.P.Jal Nigam is a semi-autonomous government parastatal with its own board of directors. As water supply and sanitation is a government priority, the influence of political system on the institution may not be denied. No data for the assessment of degree of impact of external environment over the organisation has been obtained. However, author has experienced that political set up and financial resources in the State as well at centre affects the organisational policy and planning to a great extent.

Autonomy, Commercial orientation, and consumer orientation

To assess the performance category of U.P. Jal Nigam, data on organisational autonomy, commercial orientation and consumer orientation (indicator suggested by WASH report 37) was collected through a set of questionnaire. Total 12 officials were interviewed (two belongs to top management, three belongs to middle order management and six belongs to the base level management. The out come of the survey is given in table 4.2

To get an idea of commercial orientation, questions were asked by the official regarding meeting the operating expenditure, cost recovery to meet the operating expenditure etc. In response to question almost 80% are of the opinion that institution's commercial orientation is poor so far water supply sector is concerned.

AUTONOMY OF THE INSTITUTION

Table 4.2

INDICATORS	Jal Nigam	State Govt	Jointly	Overall rating
Organisational Autonomy				
sets goals and policies	30%	30%	40%	poor
approve capital & operating budget	40%	50%	10%	poor
adaptation to change organisational set up	40%	60%	0	medium
approval to tariff	50%	50%	0	medium
OVERALL RATING				poor

During visit to the office and discussion with the staff author got a feeling that most of the field staff responsible for operation and maintenance of the water supply project is indifferent towards there duty. This view may be supported by the officials' response to the question, 'how quickly the consumer's complaint rectified' which is said to be normally 7 to 15 days. At the division level there was no clear provision for handling consumer suggestions as no such record was available at the division level. However, the officials are in direct touch to the consumer (inference from the survey). Overall the consumer orientation may be rated as poor.

These information are neither sufficient to judge the overall organisational performance nor it is part of this study, but it may be use to indicate the organisational behaviour.

Staff Productivity Index

To measure the operational efficiency of various projects, staff productivity index was adopted as the number of staff per thousand per water point. Here water point was selected against house connection as hand pumps too were situated in the project area. The staff productivity index for different project is calculated and given in annexure Vb. From the table we can see that four water supply projects, namely Naugarh (pipeMNP-45L); Chaubeypur (pipeARP-40L); Cholapur (pipeMNP-70M); and Hand Pump (rocky) have a staff productivity index more than 10.

TECHNICAL ANALYSIS

Almost all the projects are formulated as a top down approach as per directive and guidelines received by the funding agency. To study the relative performance of the different project, electrical energy consumption /m3 /household was taken as measure of technical input. The concerned office did not maintain the actual data for water production and energy consumption. However, data for actual running of pump and details of pumping plants are available so on the basis of available data the water production and actual electrical consumption of the different project was derived and summarised in the table 4.3

TECHNICAL INDICATORS

Table 4 3

TYPE OF PROJECT	PRESENT POPULATION	NO.OF HOUSE HOLDS	ANNUAL ELECTRICAL ENERGY CONSUMPTION in KWh/HH	ANNUAL WATER PRODUCTION in million litres/HH	ENERGY CONSUMPTION KWh/M3/HH
PipeMNP-45L	33294	4161	125	1667	0.075
PipeMNP-70L	26466	2036	81	867	0.093
PipeMNP-7oM	32848	3650	52	858	0.061
PipeMNP-70S	14234	1780	41	385	0.107
PipeARP-40L	34103	3790	26	473	0.054
PipeARP-40M	38783	4310	38	788	0.048
PipeARP-70S	16455	1176	111	630	0.176
PipeNAP-70L	69103	7678	43	1471	0.029
PipeNAP-70M	19708	2190	163	1471	0.110
PipeNAP-70M	64433	5370	70	1471	0.047
HP-plain	1514170	168241	0	42100	0
HP-rocky	99709	16618	0	1635	0

From the above table in can be seen that Lohata (pipeARP-70S) shows the maximum o.176 KWh/m3/HH annual electrical consumption and Kandava (pipeNAP-70L) requires the lowes0.029 KWh/m3/HH out of comprehensive pipe water supply scheme. The hand pump programme requires no electrical energy. Therefore, it may be presume that independence to electrical energy will provide a reliable system for a rural area.

FINANCIAL ANALYSIS

For comparative performance study, the Total annual cost per household, and subsidy per household was taken as the measure of the financial indicator.

Total Annual Cost Per Household

For a sustainable system, Total annual cost/household is the amount, which should be recovered every year. In the present case, Total annual cost per house hold has been calculated by updating the project cost to base year 1997 by adopting average annual inflation factor 7.9 for the period 1978 to 1990 and 9.7 for the period onwards (World development report; 1986,1992,1996). The updated cost of the project is multiplied by the cost recovery factor assuming an annual interest rate 10%. O & M cost was available since 1989-90(except 1992-93) On the basis of available data average annual cost for the base year 1997 was calculated. The O & M figure received from the office does not include electrical expenditure and indirect expenses. Annual electrical energy expenditure was derived from the annual electrical consumption multiplied by the rate of electrical charges Rs.2.0 per kWh. However indirect expenditure was not calculated as no separate staff is engaged for maintenance staff.

Annual Subsidy per household

Subsidy per household will also indicate the sustainability of the system, as for a system to be sustainable its operating cost should be fully recovered. As mentioned above average annual income is derived from the available past data and using the average annual operating cost derived for the base year 1997, annual subsidy per house hold was calculated.

Total annual cost per household and subsidy per household is given in table 4.4

FINANCIAL INDICATORS

Table 4 4

TYPE OF PROJECT	NO.OF HOUSE HOLDS	CAPITAL COST RECOVERY(Rs in lacs)	ANNUAL MAINTENANCE COST (Rs. in lacs)	TOTAL ANNUAL COST /HH	ANNUAL INCOME (Rs. In lacs)	ANNUAL SUBSIDY/ HH
PipeMNP-45L	4161	35.71	18.10	1293	2.20	382
PipeMNP-70L	2036	7.16	5.80	637	1.10	231
PipeMNP-7oM	3650	7.79	6.20	383	1.30	134
PipeMNP-70S	1780	6.34	4.60	615	0.65	222
PipeARP-40L	3790	15.64	4.20	524	0.15	107
PipeARP-40M	4310	10.66	6.00	387	1.20	113
PipeARP-70S	1176	2.42	5.80	699	2.25	302
PipeNAP-70L	7678	28.71	12.50	537	2.30	133
PipeNAP-70M	2190	18.20	9.10	1247	0.65	386
PipeNAP-70M	5370	31.95	14.10	857	1.50	233
HP-plain	168241	264.4	34.60	178	0	21
HP-rocky	16618	19.50	2.30	131	0	14

From the above table it is obvious that the total annual cost per house hold for the hand pump in rocky area is minimum and requires the least subsidy of Rs 14 per house hold. The Naugarh group (pipeMNP-45L) and Jansa group (pipeNAP-70M) shows the highest total annual cost per house hold i.e. about Rs 1300 and also maximum subsidy which is about Rs 400 per household.

4.4 SUMMARY

From the above it can be seen that though the all the projects were prepared and implemented by single agency U.P. Jal Nigam as a top down technical but they differ with each other as the strategy adopted for the formulation of each project differ to each other.

Project finance under Minimum Need Programme is formulated assuming that sufficient revenue may be collected from the house connection. These programmes were implemented in the draught prone areas. Therefore, concept of adequate water supply was adopted to formulate the project

Accelerated Rural Water Supply Programme is based on the concept 'some to all not all to some' and so rate of water supply in the project is kept just sufficient for house hold use and so only community water points were proposed. Maintenance cost is to be subsidised by the government. Coverage of the maximum population, with an intention to provide at least one safe drinking water source for every 250 persons.

Netherlands Assisted Programme, too, adopted the top down approach in sub project –I and IV with interim evaluation of project implementation and addendum thereupon. In the latter phase i.e. year 1991, concept of integrated approach to involve the beneficiaries were adopted in project preparation and sub-project V, for rural sanitation in Tikari village, one of the village already included in water supply project, were formulated to promote house hold latrine. To bring up the community participation in the Varanasi region one of the NGO is also engaged by the Netherlands Government. This is working independently.

Table 4.5 shows the various aspect of the project in study

DIFFERENT PARAMETERS OF THE W/S PROJECT UNDER STUDY

Table 4.5

PROJECT TYPE	Funding agency	Rate of water supply in litres/ capita	SC/ST population covered	Water supply point	Water tariff Rs Per month	Topography	Development of the area	Per capita cost in Rs. (1997)	Design period
MNP pipe-45 L	State Govt	45	40%	SP and HC supplemented with IM-II	20	Plateau	undeveloped	788	30
MNP pipe-70 L	State Govt	70	24%	SP and HC supplemented with IM-II	20	plain	Under development	198	30
MNP pipe-70M	State Govt	70	24%	SP and HC supplemented with IM-II	20	plain	Near market	167	30
MNP pipe-70S	State Govt	70	23%	SP and HC supplemented with IM-II	20	plain	Under development	243	30
ARP pipe-40L	Central Govt.	40	22%	SP supplemented with IM-II hand pump	0	plain	Developing	256	15
ARP pipe-40M	Central Govt	40	15%	SP supplemented with IM-II	0	plain	Developing	174	15
ARP pipe-70S	Central Govt.	70	14%	SP and HC supplemented with IM-II	0	plain	Urbanisation coming up fast	92	30
NAP pipe-70L	Netherlands Govt.	70	13%	SP and HC supplemented with IM-II	20	plain	Peri urban	324	30
NAP pipe-70M	Netherlands Govt	70	15%	SP and HC supplemented with IM-II	20	plain	Under developed	682	30
NAP pipe-70M	Netherlands Govt	70	14%	SP and HC supplemented with IM-II	20	plain	Peri urban	379	30
HP-plain	Central Govt	40	22%	IM-II hand pump	0	plain	Under developed	140	15
HP-rocky	Central Govt.	40	39%	IM-II hand pump	0	plateau	undeveloped	161	15

CHAPTER – V

Performance of Water Supply at Micro level

5.0 INTRODUCTION

The analysis of the field data and findings has been discussed in the present chapter. The complete analysis has been divided into six sections. Section one discus the general profile (literacy, health hygiene awareness and economic status) of the household to assess the socio-economic status of the project area. Section two deals with the users preference to use the safe drinking water facility in their area. Section three deals with functioning and reliability of water supply project in the area. The quantity of water collected for household purposes, quality of water supplied and use of alternate drinking water source in case of break down of the existing source have been analysed and discussed in this section. Operation and maintenance aspect such as breakdown period, time laps to restore the existing water supply and the cost recovery have been discussed in section four. The villager's preference for an improved water supply system and their willingness to pay for a reliable and regular supply has been assessed in section five. The findings of the field survey have been summarised in the last section.

5.1 SOCIO-ECONOMIC STATUS

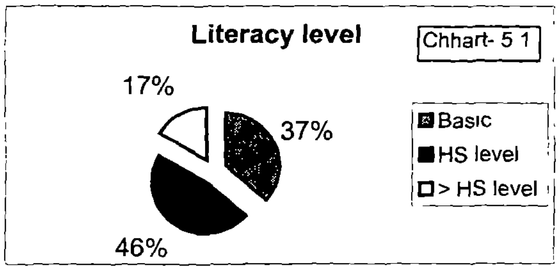
To know the general profile of House Hold total 407 households (302 from comprehensive piped water supply project and 105 from hand pump project) were interviewed about their education level, awareness about health and hygiene, with specific reference to safe drinking water, and income level of the family. The general details of the household surveyed are summarised in the following table- 5.1

DETAIL OF THE HOUSE HOLD SURVEYED *Table-5.1*

W/S System	Nos of HH Surveyed	Male	Female	General	SC/ST	Basic	HS	Above HS
piped	302	252	50	111	191	94	149	52
HP	105	95	10	60	45	52	38	14
TOTAL	407	347	60	171	236	146	187	66

The out come of the survey result is tabulated in annexure Va.and briefly discussed as follows

5.1.1 Literacy



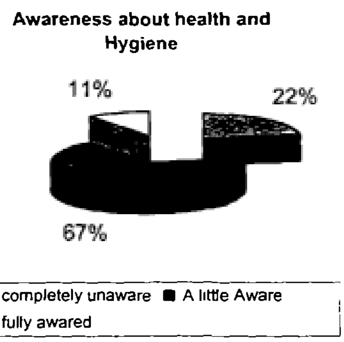
Out of 407 House Hold surveyed, the level of literacy found in the area is shown in the chart **5.1** It is obvious from the chart that about 37% population is either illiterate or know a little about reading and writing. However, about 63% population has adequate literacy i.e. higher secondary level or above higher secondary. The literacy below higher secondary varies between 14% lowest in Chahania group of villages (pipeMNP-70L) to 77% in Hand pump project (HP-rocky) in plateau region. Further, it may be observed from the table that the population is more literate (about 69% population is above Higher secondary level) in plain reason While, on the other hand, only 32% population has a literacy level above Higher secondary level in plateau region

Inference: *Literacy is poor in the plateau as compared to the gangetic plain. It may play an important role to understand the health and hygiene aspect and so use of safe water source from health point of view.*

5.1.2 Health and Hygiene Awareness

In the study region, only 11% are fully aware of the importance of safe drinking water and its link with disease in one are other way. It is evident from the **chart 5.2** depicted,

Chart 5.2



herein, that 67% household know a little about the importance of safe water. The household are aware of some of hygiene practices as washing the hand before taking food, to keep the drink water closed etc. (concluded the discussion with the villagers during survey) but not aware of the link between water and related diseases.22% of the household surveyed showed their complete ignorance. Programme wise health hygiene awareness is given in the table 5.2 below. From the table it can be seen that health and hygiene awareness among the villagers is more or less same in all projects except in HP rocky projects where only 3% users are fully aware of the health hygiene aspect of the drinking water.

HEALTH HYGIENE AWARENESS IN DIFFERENT PROGRAMME

Table 5 2

Health Hygiene Awareness	Piped water supply projects under			India – Mark –II HP	
	MNP	ARP	NAP	HP- plain	HP- rocky
Unaware	25%	21%	24%	20%	17%
A little	69%	65%	63%	67%	80%
Fully aware	7%	14%	8%	13%	3%

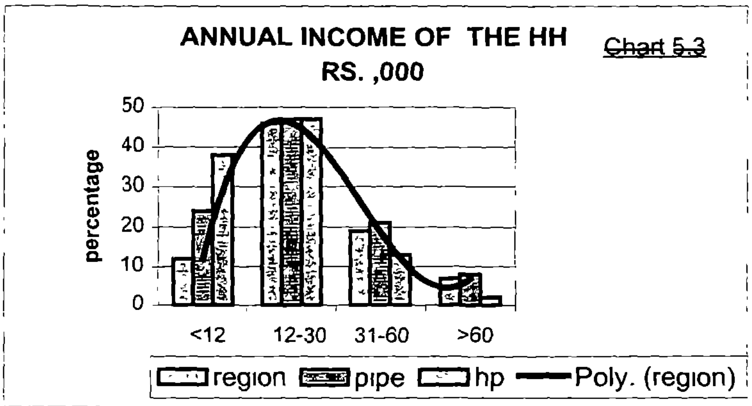
The study outcome establish that the there is a large area (about 89%) where villagers are either ignorant about how health is affected by drinking water or in absence of factual knowledge, misconceptions and vague guesses are used to explain the health problem due to unsafe water.

In Netherlands Assisted Programme PSU foundation, an NGO, was involved to promote the community development and awareness but no data could be obtained from the concerned agency to substantiate the effect of the same on water supply.

Inference: *Comparing the outcome of the present survey with that of a previous survey result conducted by UNICEF, which states that 88-95% people believe that bad drinking* *water causes health problem but unaware of the type of problem (Ghosh et al, 1995), it may be inferred that not much attention has been paid to promote health hygiene awareness. From table 5.2 it can also be concluded even after being convinced with the importance of health hygiene promotion for a effective use of safe drinking water, no programme has put a significant effort to bring up the health and hygiene awareness amongst the villagers.*

5.1.3 Economic Status

The annual income of the individual household was asked to assess the economic level of the beneficiaries. The annual income was assessed as told by the beneficiaries. However, in some cases it is assessed by the interviewer through indirect question/discussions/observations where villagers were not coming up with the straight answer due to one or other reason. The respondent has been categorised as very *poor* if his annual income is less than Rs 12,000; *poor* if his annual income falls between Rs. 12,000 – 30,000; *average* if his annual income is in between Rs31, 000 – 60,000; *above average* if annual income is greater than Rs 60,000. Though these values may not be true but gives an indication of economic status.



Out of 407 households about 30% belongs to the very poor category, while about 50% fall into the poor category. Table 5.3 shows the percentage of households falling under different category in piped water supply project and hand pump projects.

ECONOMIC STATUS OF HOUSE HOLDS				*Table 5 3*
Annual Income (RS)	<12,000	12000-30000	31000-60000	>60000
Piped	24%	47%	21%	8%
Handpump	38%	47%	13%	2%

The above table indicates that about 75% population belongs to the poor /very poor category and average annual may be taken as Rs 20,000. Further, project wise analysis shows that the in Lohata group of villages (pipeARP-70S), where weaving is coming up as a cottage industry, households have the best economic status i.e. about 50% belongs to the moderate or high income and average income per house hold may be taken as Rs.60000. In Tikari group of villages (pipe NAP-70M covering most of the peri urban villages), about 45% households have average income about Rs.40000. While households in Jansa group of villages (pipeNAP-70M) and India-Mark-II HP (rocky) project area shows the lowest income level where about 90% the people belongs to poor or very poor category.

Inference: *The above finding indicates that the general economic condition of the plateau region is very poor as compared to the plain area. The economic status of the area may determine the paying capacity of the people in the area and this along with other factors may determine the people's demand for a improved and convenient system. The case of Lohata group of villages (pipeARP-70S) where about 90% households have opted for house connections supports the above view. No doubt along with economic value others factors do affect the house connection.*

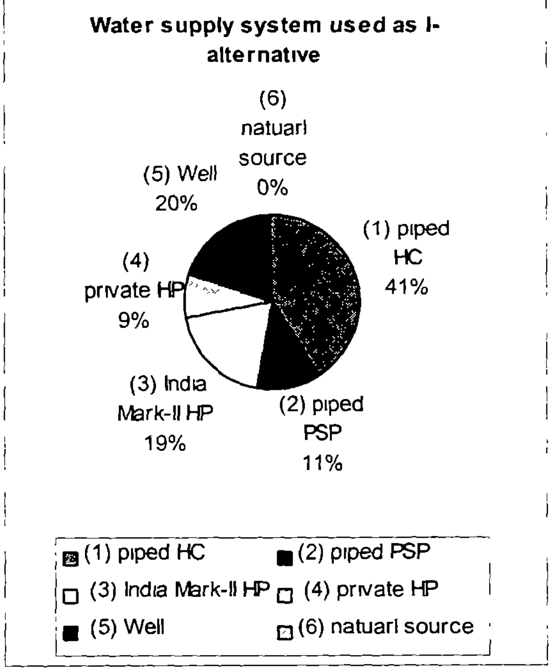
5.2 UTILISATION

Available drinking Water Sources and users Preferences in water supply projects are shown in the table 5.4. The number of house holds using safe source for drinking water in the Varanasi region is 311 out of 407 household [74%]. The use pattern of the different water supply mode in piped water supply project is depicted in Chart 5.4 which shows that 124 out of 302 household [41%] house holds use house connection and 34 out of 302 households [11%] people use to take dnnking water from stand post.

USE PATTERN OF THE DRINKING WATER SOURCE. *Table-5.4*

Type of System	Total HH surveyed	Existing source used				
		HC	PSP	IM-II	Pvt.HP	Well/river
Piped W/s	302	124	34	58	26	60
I.M-II HP	105	0	0	95	6	4
TOTAL	407	124	34	153	32	64

Chart 5 4



Thus total 158 households [52%] are using piped water supply facility while58 households [19%] are using India-Mark – II HP. Only 29% households are still using traditional source/shallow private hand pump, which may not be taken, as safe source. Thus in pipe water supply project against 76% coverage [205 villages out of 268 villages which are being supplied by the pipe net work actually] about 52% house holds are using the piped water supply source of drinking. To cover the rest 24% the piped water supply projects were supplemented by India Mark Hand pump. Now, taking the both safe mode of supply (pipe as well as Hand Pump) the utilisation of safe source goes up to 71%.

In case of piped water supply projects (table 5.5) most encouraging result is from small piped water supply project where out of 59 households 48 [81%] households are using the piped water facility as compared to 40% lowest in the large piped water supply projects. The highest utilisation of piped water facility without supplemented by India – Mark –II HP is Lohata group of villages (pipe ARP-70S) where 95% house hold are using safe source of drinking water supply. Contrary to it only 48% households are using safe source for drinking water in Chaubeypur group of villages (pipe ARP-40L) water supply project. Now, if we further, examine critically, the possible factors may be

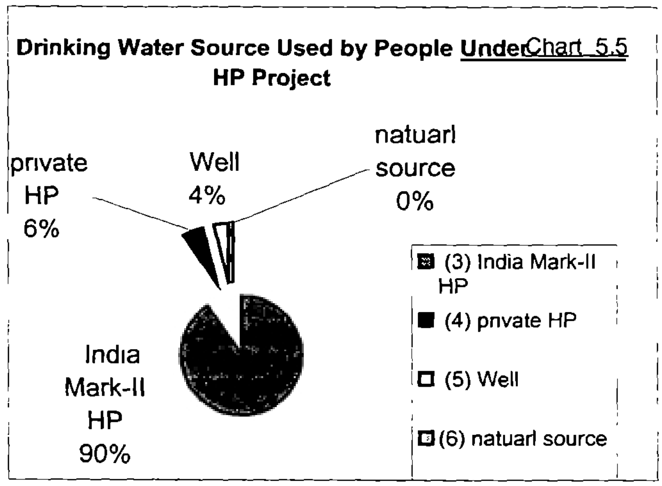
- The rate of water supply 40 litre per capita per day is not sufficient for a piped water supply project that too where there is no specific measure has been introduced to check the leakage.
- The criteria not to provide the house connection were not strictly followed due one or other reason.
- The small project may be managed in a better way with comparatively less efforts and less operative expenditure

Table-5.5

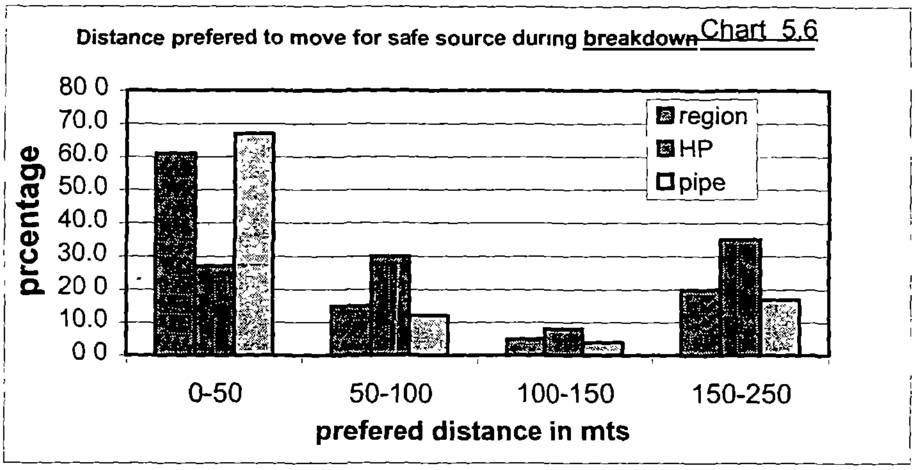
HOUSE HOLD USING THE DIFFERENT MODE OF SUPPLY IN THE PROJECT AREA

Size of project	Household surveyed	Water Supply In Use in				
		HC	SP	IM-II HP	Pvt HP	Well/River
Large	127	30	9	21	14	25
Moderate	116	34	17	22	6	21
Small	59	78	3	7	2	7

The use pattern of the existing water supply source in the in area covered under hand pump programme is shown in chart 5.7 which indicate that about 90% hand households falling under hand pump programme is using the facility provided. The most encouraging result is found in the HP-rocky programme where almost 100% households use the India Mark-II handpump for the drinking purpose. The one of the reason for such a high percentage may be



- The scarcity of water in the area



- Poverty of the region which motivate to use the community water point

Inference: *The above findings indicate that the utilisation of safe source for drinking purpose in the region Varanasi is 74%, varying between 48% to 95% in various projects. In may, also community stand post draw the least attention in piped water supply project. Pipe water supply without house connection could not adhere to the design norm. Also, the rate of water supply affects the availability of the water at consumer end. The utilisation of the service provided also, depend on the scarcity of water source in the area. Looking at the chart 5.5 it may be inferred that villagers prefer to a safe drinking water source within 50 meters.*

5.3 FUNCTIONING

5.3.1 Quantity of water collected and users perception about quality of water

QUANTITY

The water collection and users perception about quality is shown in the table 5.6. The villagers on average collects 20 litres per capita per day for household purpose including drinking. The water collection varies between 9 litre per capita per day from hand pump in rocky area (H-2) to 30 litres per capita per day in moderate piped water supply project under MNP.

VILLAGERS PERCEPTION ABOUT QUALITY OF WATER SUPPLIED | Table 5.6

Type of Project	Water collected l/c/d	Quality of water			Functioning of System		
		Good	Smelling/bad taste	Dirty	Good	Satisfactory	Poor
Pipe	20	76%	8%	10%	9%	30%	53%
HP	14	79%	5%	16%	14%	48%	38%

Comparing the water collection in piped water supply project, we find that Chaubeypur group of villages (pipe ARP-40L) ranks first where collection is about 68% of the designed rate of water supply and it is minimum in Lohata group of villages (pipe-ARP-70) where it is only 20%of the designed rate of supply. First hand it gives an impression that the efficiency of distribution net work may be more. But considering the number of water point in the system, it may be seen that first hand conclusion is not true because of the fact that total water delivery from the system is dependent of water point. Also, if we compare it from the 70 litres per capita per day, which is for house connection we, may see that it is around 40 %. The low percentage of water collection in Lohata group of villages may be interpreted as availability of fewer water supplies to the consumer end.

QUALITY

The user perception about quality of water is based on physical parameters such as taste, odour and colour. From the above table it seems that about 80% HH receive the good quality of water. Only about 20% complaints of bad taste / bad odour. In general water quality seems to be good but if we consider the individual project, we may see that Jansa group of villages and Naugarh group of villages under piped group and India Mark-II handpump (rocky) show some quality problem where people are complaining of odour problem and physical problem. The author could not record though further reason for it, but it can be suspected that the water may be dirty for the two reasons. It may be due to the improper functioning of treatment plant in Naugarh group of villages having a surface source and a filtration unit and other reason may be leakage in the distribution net work. While in handpump case it is due to high iron content, as staining of some hand pump platform was observed by author during the visit to the site.

Inference: *The quantity of water collected varies 9 to 30 litres per person in the region. The water collection in case of piped water supply project normally 50% more than that of spot sources indicates that water collection is a factor of distance of the safe source from the house. In general it may be concluded that in the Varanasi region except plateau region, the water point is able to supply apparently good quality of water. However, further reconfirmation of quality of water is essential by conducting biological, as contamination may not be ruled out in an intermittent piped water supply.*

5.3.2 Villagers perception about functioning of projects

So far functioning is concerned, out of 302 households surveyed in the comprehensive piped water supply project, 160 [53%] households rate the functioning of piped water supply project poor while 27 [9%] rate it as good. Further scrutinising the different projects we find that the functioning of Naugarh group of villages (pipeMNPs-45) is worst where about 90% users rate it poor. Next to it is Baragaon group of villages (pipe ARP-40M) where about 70% rate it as poor. Under Hand pump programme India Mark-II hand pump in plain area (H-1) scores the minimum only 24% so far poor functioning is concerned next to it stands the small piped water supply project which score 36% and 42% respectively.

Inference: *No water supply project is functioning well. The large projects' functioning is very poor. However, comparatively the small project and hand pump in the plains is providing better service where more than 50% accepts it as satisfactory.*

5.3.3 Dependability on supplementary water supply source

The table 5.7 shows the alternate source from where the beneficiaries collect water during breakdown of the system they use

HOUSE HOLD USING THE ALTERNATE W/S SOURCE DURING BREAKDOWN Table 5.7

Mode of supply	Nos. of users	Alternate source of for drinking water used			
		Solely depends on the system provided	India-mark-II pump	Pvt Hand pump	Well/River
Piped	158	22	36	32	68
India Mark-II	95	31	0	5	59

From the above table it is obvious that only 14% households fully depends on the piped water supply and 33% depends on the hand pump programme solely. Moreover piped water supply is backed up by 23% and thus overall 37% households use the safe source of water supply in piped water supply region. About 65% households use the traditional source during the breakdown period. If we compare it from the utilisation of safe source in normal period we may find that about 50% switch over to the traditional sources.

A system will be said more reliable if household within the project area who is using the safe mode of supply does not switchover to the alternative source. Therefore to assess the reliability of a system, percentage switchover from the safe mode of supply may be taken as a measure for reliability. Table 5.8 shows the percentage households using the safe source during the breakdown.

Though overall percentage adhering to the safe source is about 35% in both HP and piped water supply, but if compare the individual project we find that under hand pump programme the hand pump in the rocky region is not reliable. The main reason for this is drying up of the handpump bore-well during the summer [Information given by villagers, who could not be verified at site as the survey was done in the winter season]. In piped water supply project four projects namely pipeMNP-45L, pipe ARP-40L, pipeNAP-70L and pipeNAP-70M show remarkable shift from safe source to the private /traditional source. If we examine further, we find that except NAP-70M (Tikari group) all the three projects belong to large group and are covering more than 35 villages. MNP-45 (Naugarh group) falls in rocky terrain and area's socio-economic condition is poor. The

PERCENTAGE USE THE SAFE MODE OF SUPPLY

Table 5.8

PROJECT TYPE	% USING SAFE MODE OF W/S		RELIABILITY
	Normal situation	Breakdown	
Pipe MNP-45L	65	25	38
Pipe MNP-70L	85	50	59
Pipe MNP-70M	65	45	69
Pipe MNP-70S	85	50	59
Pipe ARP-40L	50	20	40
Pipe ARP-40M	65	35	54
Pipe ARP-70S	95	55	58
Pipe NAP-70L	45	25	56
Pipe NAP-70M	90	65	72
Pipe NAP-70M	75	20	27
Hand Pump - plain	95	35	37
Hand Pump -rocky	80	0	0

area is scattered also where safe sources are scattered therefore, distance may be one of the reason to switchover the nearest source. (Chart 5.6) ARP-40L (Chaubeypur group) lies in gangetic plain where wells and private hand pumps are available in vicinity. NAP-70 L (Kandava group) lies at the out skirt of Varanasi City. Though a large number of hand pumps have been provided to supplement the breakdown period but it is found that out of 12 only 3 users moved to the safe source (India-Mark-II) which is within 50 meters. The result of NAP-70M somewhat surprising as this area has got much attention under the Netherlands programme. In addition to water supply, rural sanitation programme has, also, been implemented in this area. To support the programme community participation and health hygiene aspect has been integrated with the rural sanitation programme. Even though people are not very particular to use the safe source for drinking purpose. The area is close to the City Varanasi; even some of the area is in the municipal limit, which shows the urban nature of area where higher literacy and health hygiene awareness is seen. It further strengthens that in piped water supply convenience is not only one of the factors but plays a dominant role. Villagers prefer a source near their house whether hand pump or a house connection, (based on some of the conversation with the villagers during survey.]

Inference: *From the above it may be concluded that in piped water supply India-Mark-II hand pump provides an additional support and thus strengthen the reliability of water supply system in project area to some extent. While hand pump programme has no such scope. It may also be perceived from the above that user's convenience is one of the key factor for utilisation of any water supply system.*

5.4 OPERATION AND MAINTENANCE

5.4.1 Breakdown Period and time laps in repair

AVERAGE SUPPLY HOUR

The average water supply period, break down period and time laps in restoring the facility as perceived by the users are shown in the table 5.9 Water supply hours varies between 2 hrs to 6 hrs in comprehensive piped water supply project. The users of Lohata group of villages (ARP-70S) receive the maximum water supply for 6 hrs while about two hours water supply is received in large water supply project (MNP-45L and NAP-70L). From the hand pump round the clock supply is available However, during the visit users informed that in general hand pump remains in use for about 12 hrs

BREAK DOWN PERIOD

The breakdown period is between16 days to 177 days. The minimum breakdown period of 16 days reported by users was observed in hand pump in plain area and maximum 177 days in large piped water supply project Naugarh group of villages. The main cause of the break down was reported to be electric failure in the piped water project while in HP project it is due to the mechanical wear and tear or drying up of the source (informed by villagers during interview). To get the official figure, logbook that keeps the records of water supply hours, electricity and pump operation was seen. In most of the cases water supply was held up due to electric failure, which ranges between 13 to 56 days during the period July1996-June 1997. And rate of water supply varies between 4 to 9 hours perday

In case of hand pump the laps period in restoration of break down ranges from 1 day to 90 days. Upper limit is only in the case of hand pump in rocky region(H-2) where during summer drying up the source is main cause which is restored after first rain(information received from villagers at formal talk). The normal time laps in hand pump restoration falls between 1 to 15 days. In piped water supply electric failure is the main cause for laps of longer period to restore the water supply. According to Jal Nigam officials involved with the maintenance work, in hand pump case normally repair is carried out within a day or two, but they accept that in some cases if due to communication gap some hand pumps remains non functioning for 10-15 days.

Time laps in repair is an indicator of regular water supply while hours but day is an indicator of uniform supply. During formal discussion villagers shows there satisfaction if they may get a regular fixed hours water supply

AVERAGE W/S Hrs /DAY ANNUAL BREAK DOWN, TIME LAPS IN REPAIR Table 5.9

Type of project	Average hrs of W/S supply per day	Annual break down	Time laps in restoration
Pipe MNP-45L	1.7	177	5-90
Pipe MNP-70L	3.2	112	3-20
Pipe MNP-70M	3.7	114	2-10
Pipe MNP-70S	2.4	118	2-30
Pipe ARP-40L	2.5	101	1-10
Pipe ARP-40M	3.5	123	3-20
Pipe ARP-70S	6.4	87	2-10
Pipe NAP-70L	2.2	118	2-15
Pipe NAP-70M	1.7	143	2-10
Pipe NAP-70M	3.3	175	1-8
Hand Pump - plain	24	16	1-10
Hand Pump -rocky	24	60	30-60

Inference: *No piped water supply project is able to supply water regularly and uniformly The main reason for irregular and non uniform water supply is erratic nature of electric* *supply in the rural area While in rocky area hand pump programme, the drying up of the source is a big problem. It may also be observed that in rural area of Varanasi region 24 hours water supply is not an issue. In rural area fixed hour supply is an issue. This may be one of the reasons for satisfactory rating for functioning of pipe water supply project Comparing the respondent figure for break down with official figure there is a big discrepancy between the two. The field data may be some what exaggerated One of the reasons may be consumer's dissatisfaction with the present functioning of piped water supply project.*

5.4.2 Reason for unsatisfactory working of water supply project

Villagers perception for poor functioning of water supply projects are shown in table 5.10

USERS PERCEPTIONS FOR POOR FUNCTIONING OF PROJECTS *Table* 5.10

Mode of supply	Highly Technical	Poor maintenance	Poor management	Demand/local reason	No response
Piped w/s	44	83	103	10	62
IM-IIHP	19	19	54	0	13

The total respondent in the survey area was given multiple choices to identify the probable reason for poor functioning of the projects. The results show that, in case of comprehensive piped water supply projects, 186[61%] households feel that poor maintenance and poor management as a key factor. Only 15% of household consider technical factors for poor performance of the present system.

In case of India –Mark-II hand pump 69% house hold consider the poor maintenance and management is responsible for management. 18% of households consider technical factor that too in rocky region where it is drilled by special rig machine.

Author contacted the division level responsible agency and tried to collect some information about the operation and maintenance system. The U.P. Jal Nigam carries out only break down maintenance work because no sufficient fund is available for the operation and maintenance of piped water supply projects. There are some guidelines issued by the UP Jal Nigam for operation and maintenance of handpump and piped water supply projects but there is no set norms. The divisions responsible for capital work also look after the maintenance work, so it becomes the secondary work as compared to the target oriented capital works, which draw more attention of the agency.

Inference: *The above analysis indicates that operation and maintenance work has not been emphasised by the implementing agency due to one or other reason.*

5.4.3 Present payment status

Water tariff is levied at the rate of Rs.20 per month with a rebate of 10% rebate for timely payment in water supply projects. The percentage of households presently paying for water in comprehensive piped water supply projects are given in table 5.11

USERS PAYING FOR WATER

Table 5 11

Project	MNP-45L	MNP-70L	MNP-70M	MNP-70S	ARP-40L	ARP-40M	ARP-70S	NAP-70L	NAP-70M	NAP-70M
HH surveyed	28	36	29	26	29	29	33	34	30	28
HH paying	4	17	9	14	3	8	27	5	8	11
Percentage	14	47	32	54	10	28	82	18	28	39

Out of 59 household of small water supply project 41 households [70%] are paying. While in moderate and large water supply projects out of 243 households only 64 [26%] households are paying for water. No household is paying for communities stand post. In hand pump projects no water tariff is levied. To know the reason for no payment the households were interviewed with multiple choices. About35% household said that water supply is not reliable and regular while 30% said that they do not demand the system. Only 18% said that water supplied is not adequate and unimproved. In case of India mark –II HP, out of 105 households surveyed, 43 [41%] said that the hand pump location is not as per demand and due to one are other reason they are not using, so why should they pay. Unreliability and irregular supply was not even the issue in this case only one household responded this reason. About 28% household considers the hand pump as unimproved system.

Inference: *In piped water supply projects only 35% are paying for the services. The smaller projects show a better response where 54-82 % is paying for the water indicates the users felt need for piped water supply But if we look from the cost recovery aspect, we find that only14% of the annual maintenance cost (including electricity charges) is being realised.*

The total annual cost per house hold in different piped water supply projects vary from Rs380 to 1300 while tariff is only Rs 240per annum per household indicate no project may run without external support

5.5 FELT NEED AND WILLINGNESS TO PAY

5.5.1 Villagers Felt Need For Improved System

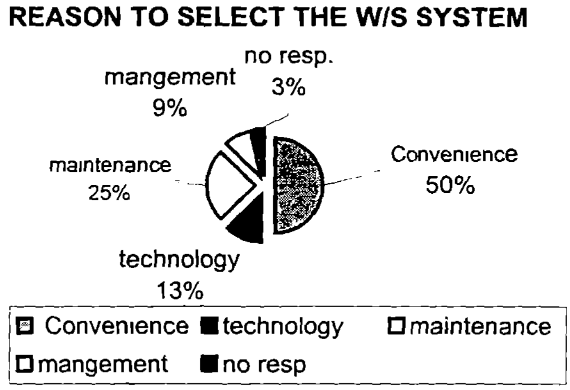
(a) Felt Need

Table 5.12 shows that out of 407 households surveyed 204 (50%) households opted for a regular and uniform piped water supply system with house connections, while 144(35%) households preferred India Mark-II handpump. The demand for public stand post in piped water supply is only 4%. About 8% households showed their interest for protected well. As they feel that they can draw water from the well for irrigation, too,

WATER SUPPLY SYSTEM DEMANDED — *Table 5.12*

Type of Project	Improved Water Supply Demanded				
	Pipe HC	Pipe SP	IndiaMark-II HP	Protected.Well	No response
Piped	137	11	115	31	8
India Mark-II	67	4	29	3	12
Total	204	15	144	34	20

Chart 5.7



Reason to Chose

The convenience seems to be one of the important factor to chose the project, as is clear from the adjacent chart 5.7 which depicts that about 50% house hold chose the system for his convenience. About 25% households are in favour of a system, which should be easy in maintenance. While technological factor contributes only 13%, from user point of to select a system. Further, It may also be inferred that, presently, local management is not a key issue for villagers for selection of type of project, as only 9% responded for an easily manageable system. However, if we combine it with maintenance aspect, which too is a part of management, the figure comes out to be 34%, which may play a significant role in selection of project?

Distance travelled to collect the safe water is taken as indicator for convenience and to get a field data two community hand pump (India-Mark-II) were observed for continuously for twelve hours. The result is summarised in table 5.13

WATER USED AND DISTANCE COVERAGE-IM-II

Table 5.13

	Total HH	Water collected in 12 hrs	Gender		DISTANCE TRAVELLED			
			Male	Female	0-10 m	10-30m	30-60m	60-100m
GENERAL BASTI	65	1022	39	26	21	28	16	0
HARIJAN BASTI	98	1540	65	33	6	51	38	3

From the table 5 14 it is clear that, in general basti, about 75% is moving a distance of 30 m from his house. While in case of scheduled caste (down trodden) about 55% users lie within a distance of 30m, about 40% residing within 30-50m and only about5% people prefer to a distance 50-100m. Though this observation is very small and belongs to a village in plain region and which is fully covered with India – mark –II hand pump, that too in winter season, it gives an indication of villagers preference to travel a distance for collecting safe water. This figures more or less support the figure obtains from the field survey.

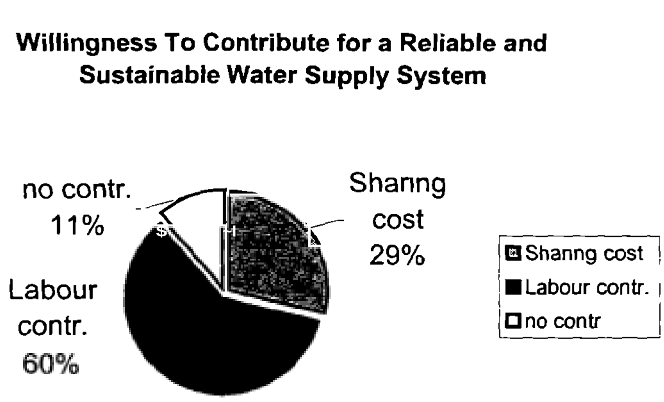
Further, from the data sheet it may be seen that out of 63 house hold in the rocky region, 51[80%] house hold took convenience as the factor for water supply project as compared to about 50% in plain area. In plain area about 50% of house holds stress maintenance and management aspect.

Inference: *The hand pump and piped water supply is the only system, which is in demand. For selection of type of system two issues have come–up; first one convenience and other factor is operation and maintenance. The water supply system should be convenient to the beneficiaries and easy in operation and maintenance.*

5.5.2 Willingness to contribute

For a reliable and sustainable system, willingness to contribute to the project demanded is depicted in chart 5.8. Out of 407 households 226[60%] are willing to contribute by providing labour at the time of implementation. About 29% are ready to share capital cost and 11% are not ready to contribute. Though villagers are ready to contribute but they were not ready to commit the amount, which they will contribute.

Chart 5.8



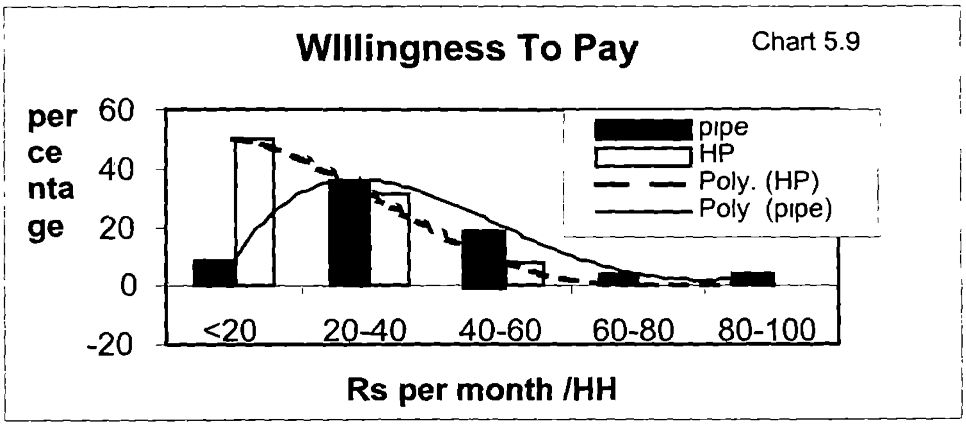
During informal discussion they open out with a rough estimate of 1-2% of their income in case of capital sharing and 1-2 person per house for 15 to 20 days.

The willingness to contribute is as high as 90 % in large piped water supply projects against an overall 80% in piped water supply projects. In plateau region it goes to 99%, where out of 63, 62 are ready to contribute either by capital cost sharing or by labour contribution. The project wise detail has been shown in annexure Vb

Inference: *The above analysis shows that villagers are ready to contribute for a piped water supply. The present survey seems to be very encouraging but author feel that in the real term first hand 80to 90% people may not come up for contribution. The reason behind it is that during data collection authors tried to get a figure about what they can contribute but villagers were not ready to commit any figure. Experience too shows that such a massive support in rural sector in present set has never been encountered. However, it clearly indicates that users will welcome contributory approach and they may be brought to self-help model with some motivation and software approach.*

5.5.3 Willingness To Pay for Water

An attempt was made to know the villager's willingness through a bidding game to explore the affordability of cost of water and their willingness to pay. The results are summarise in table 5.14 and graphically represented in chart 5.9



WILLINGNESS TO PAY FOR WATER USED

Table 5.14

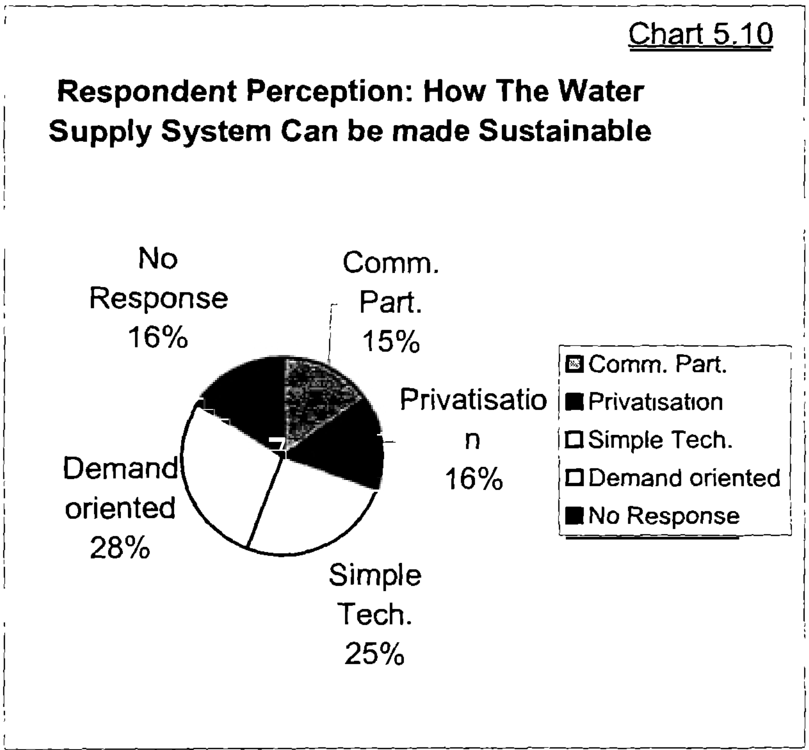
	Willingness to pay for a reliable and convenient system (R s /month)						
	80-100	60-80	60-40	40-20	<20	Cann't pay	No response
Pipe w/s	12	13	60	110	69	26	12
IM-II HP	0	0	9	33	52	10	1
Total	12	13	69	143	121	36	13

Against the present tariff Rs 20 per month in piped water supply projects and no payment in India mark-II HP,37% of the households may afford up to Rs 40 per month and about 25% may afford above Rs.50 per month. If we further analyse, we find that in the HP project area, 50% are ready to afford Rs 20 are less per month. The household response to pay more than Rs 100 per month carry some exaggeration while amount less than Rs 20 per month shows some reservations of the villagers. (An observation during study). The reason may be the present service level and their ids-belief in the system.

If we look into the individual project figure (annexure Vc) we find that in pipe project area users are ready to pay Rs 240 to 600 per annum while in case of hand pump it varies between Rs 60 to Rs200per annum. House holds of Kandava(pipeNap-70L), Tikari(pipe-NAP-70M) , and Lohata(PipeARP-70S) are ready between Rs.400 to 600 while wants to pay more or less the tariff imposed i.e around Rs 240 per month.

***Inference**: It is clear from the above analysis that users are ready to pay more than the present tariff they are assured to get a regular water supply. The observations of the willingness to pay seem to be affected by the present low tariff, which gives a base to the respondent move around. However, these results show that the present tariff is low and higher water tariff can be imposed, if a regular and fixed hour supply can be insured. It is also concluded that villages at lying the fringe of town and having better socio-economic status are ready to pay more for water supply services.*

5.5.4 Villagers' Perception for a Sustainable Water Supply System



From the adjacent chart 5.13 that 15% feel that community partition can provide sustainability to the water supply project. While 28% are of the opinion that a system which as per demand of the beneficiaries will be more sustainable. 16% feel that for sustainability and reliability the private agencies should be engaged. In comprehensive piped water supply project, in Naugarh group of villages (pipeMNP-45L) which lye in rocky terrain and large project, the highest about 40% households were of the opinion that community owned system will be more sustainable. Next to it about 30% again, a large piped water supply project, namely Kandawa group of villages. Technological issue was given much importance in Jansa group of villages, a moderate piped water supply project under NAP. However, exceptionally low only 7% households gave weightage to the demand oriented approach. Contrary to it about 50% households in Chahania (pipeMNP-70L), Cholapur (pipeMNP-70S) and Lohata (pipeARP-70S) support the demand-oriented approach for sustainability.

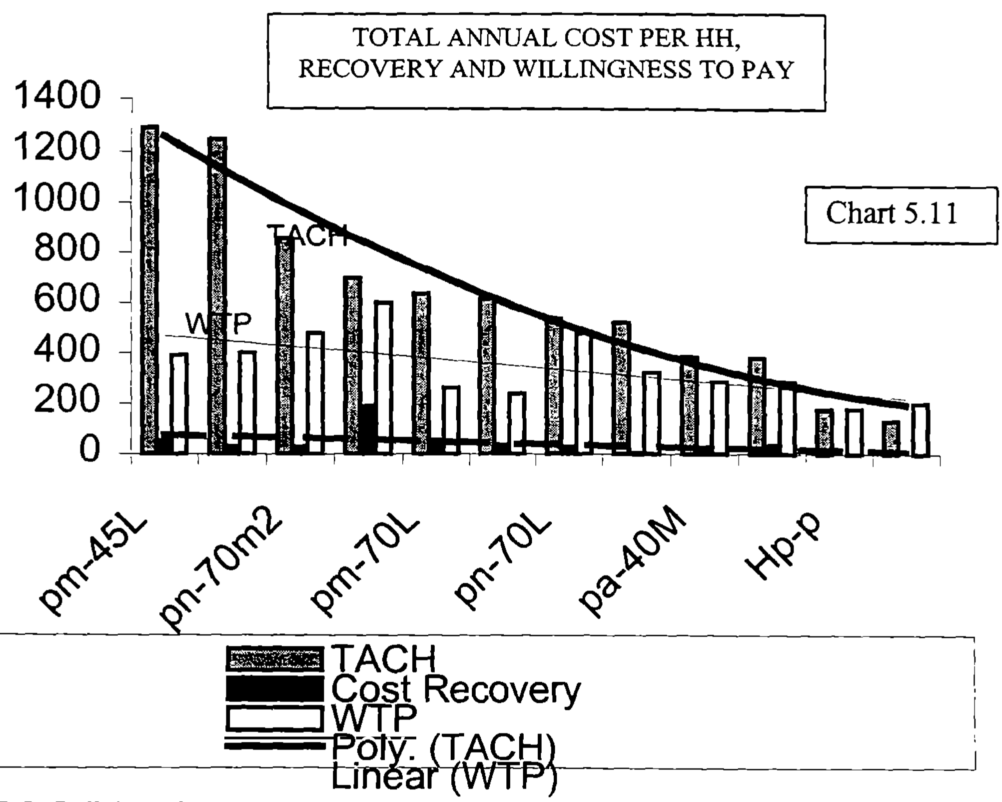
Inference: The result of survey gives a mix opinion and does not show any significance relation with the different type of project. However, it is seen that demand oriented approach and users involvement is the two main issues need to be addressed.

5.6 SUMMARY

The region's socio-economic condition is poor. The utilisation of piped water supply projects vary between 45% to 95% (on average75%), but only 35% are in continuous use of safe water source. Convenience is found to be one of the key factors for using a water supply source. Villagers prefer to have a source within 60 metres.

For poor functioning erratic electric supply is one of the most important factors in piped water supply project while drying up the source is crucial in hand pump in rocky terrain.

Cost recovery is 14% of the annual maintenance expenditure (including electricity) which put a question mark on sustainability of water supply project. The water tariff imposed is Rs.240 per month while the total annual cost per house hold varies from Rs.390 to 1300 in case of piped water supply project and Rs130-180 in hand pump project where no tariff is imposed. Comparison of willingness to pay and total annual cost (chart 5.11) clearly indicate that technology need to be given considerable thought as no project seems to be sustainable. The topography, size of the project and urbanisation do affect the water supply project.



CHAPTER - VI

Data Envelopment Analysis

6.0 INTRODUCTION

This chapter comprises of five sections. The first section deals with 'what DEA mean' and background. The second section deals with basic theory used to develop DEA technique its application along with case study. The selection of inputs and out puts has been discussed in section three and analysis has been discussed in section four. The chapter ends with conclusion

6.1 BACKGROUND

The production function can be stated simply as the relationship describing the flow of output for any given in-flow of resources. The production function can be interpreted as the purely mathematical relationship, which defines efficient transformation possibilities. Based on this concept, Data Envelopment Analysis is an optimisation technique used to measure the public sector efficiency which identifies the sources and amounts of in-efficiency and / or provides a summary measure of relative efficiencies (Charnes et al, 1983). DEA is based on the economic notion of Pareto Optimality which states that an allocation of resources is said to be efficient if further increase in desired output is not possible through some alternate allocation, without dropping out any single output. The DEA technique is developed using Farrel frontier methodology. It is essentially an empirical calculus deriving from the implementation of relatively straightforward linear programmes.

In the past, considerable works have been carried out in the development of a set of technique which have come to be known by various names - input-output analysis, linear programming and programming inter dependent activities etc. Linear programming is concerned with finding a mathematical solution of complex interdependent activities in the best possible fashion i.e. mathematical optimisation.

Production and cost functions have been estimated using Ordinary Least Square regression analysis which is simple to implement and is frequently used in evaluation (Hammond, 1986; Tyler and Lee, 1979: Lee and Tyler, 1978). For the purposes of efficiency measurement the resulting *average* function, used in least square regression analysis is a mis-leading indicator of the efficient production possibilities in both theory and practice. Furthermore, an average production function is inconsistent with the theoretical notion of a boundary function, which reflects on maximising behaviour. Thus Ordinary Least Square analysis implies a non-maximising assumption such as 'satisfying' behaviour. (Hammond 1986)

Frontier performance comparisons flow directly from the definition of the production function itself, in which inputs are combined to generate output. Predicted rates of output corresponding to given rates of factor input may then be said to represent a technical maximisation problem.

Development of 'simplex technique' by Detzig, Order, Charnes and other has now made this method generally applicable to the all type of linear - programming problems. However, difficulties in performance evaluation of public sector organisation are experience due to lack of any acceptable aggregate performance indicators, problem with combining multiple performance measures and relating multiple output measure to multiple input factors. The data envelopment analysis (DEA) models addresses managerial and economic issues and provides useful results where there are different types of resources used and differing type of benefits achieved. Data Envelopment Analysis also, yields an objective evaluation of efficiency where there is no objective way of aggregating either input or output factor into a meaningful index of productivity. (Akosa et al, 1995).

6.2 BASIC THEORY

The production function, which defines efficient transformation possibilities, establishes the relationship between production and costs. For a given factor prices, the cost function must be interpreted as a frontier function, because it is impossible to achieve costs lower than the minimum input requirements implied by the production frontier. The word 'frontier' is applied in either case because the function sets a bound on the range of possible observations. Thus production may take place below the frontier but at no points above it; analogously, costs can be observed above the cost frontier but not below it. The amounts by which an organisation lies below its production frontier or the amount by which it lies above its cost frontier, can be regarded as measure of relative efficiency

Farrel first considered, overall efficiency into two multiplicative components:

$$OE \equiv TE.AE$$

Where TE is technical and AE is allocative efficiency. Each of these can be defined in terms of a production frontier as the ratio of potential and actual performance.

As an example if an organisation consuming two inputs, A and B, producing an out put Z. Then production function, assuming constant return to rate i.e proportionate increase in out put, if input increases can be written as

$$y = f\ (A, B)$$

Or $$1 = f\ (A/Z, B/Z)$$

Now the frontier technology can be characterised by the unit isoquant II in fig 6.1

In this fig, an organisation is producing Unit output at point C. Its technical efficiency (TE) is the ratio of potential to actual consumption. This is the radial measure OB/ OC, which in this case is less than unity.

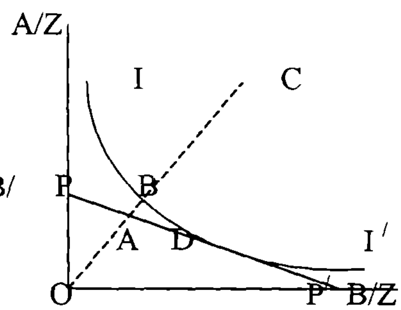


fig 6.1

Now for optimal efficiency

$$OB = OC$$

As the distance of an observation from the frontier increases performance worsen and the technical efficiency ratio falls towards zero. Like wise, as performance improves, the efficiency ratio rises in value to unity.

In the similar way Farrel also included an allocative efficiency ratio within his framework. At a point B in the fig 6.1 AE = OA/OB where PP' is the isocost line defined by the ratio of factor prices. Allocative efficiency is significant in that it emphasises that boundary production per se is not sufficient to minimise the costs The full efficiency requires simultaneous technical and allocative efficiency i.e AE=TE = 1.0 which obtains at point D in fig 6.1

Now, if inefficiency is possible, the production function may be may be written as an inequality:

$$y_i \leq f(X_i ; \beta)$$

where y_i is observed output at the establishment *i,* and X_i is a vector of inputs and β a vector of parameters which describes the transformation process. *F (.)* is the production function and has the interpretation of a frontier, or y_{max} At inefficient operations potential output (y_{max}) will exceed observed performance (y_i). Hence technical in efficiency implies ($y_i - y_{max}$) is negative The difference between observed and potential performance can be treated as a residual in the production, which is equivalent to the technical efficiency ratio. If these residuals are denoted ξ_i

$$\xi_i = y_i / f(X_i ; \beta)$$

to preserve the frontier interpretation of *f(.)* the ξ_I are always non positive. This ensures that observed output cannot exceed potential and that the distribution is one sided. The addition of efficiency residuals balances the production function i.e.

$$y_i = f(X_i ; \beta) - \xi_i \qquad \xi_i \leq 0 \text{ for all i}$$

The technical efficiency ratio, ξ_i can be estimated econometrically.

An analogous interpretation can be given to inefficiency in the cost function. If excess costs are possible the cost function may be written as an inequality:

$$c_i \geq (z_i , \alpha)$$

where c_i represents average cost at establishment I z_i are determinants of α a vector of parameters. *g(.)* has a frontier interpretation denoting minimum costs, c_{min} The efficiency ratio is defined by the residuals, θ_i, in the cost function. That is,

$$\theta_i = (z_i, \alpha) / c_i$$

which is equivalent to the ratio of potential to observe costs where there is inefficiency , costs are greater than potential and the efficiency ratio is less than unity. This means that that efficiency residual θ_i is positive. Since the boundary costs are minimum feasible, observed costs cannot fall below minimum costs, i.e. $c_I > c_{min}$. This is essential to preserve the frontier interpretation of the cost function and implies that the residuals in the cost function are non-negative:

$$c_i = (z_i, \alpha) + \theta_i \qquad \theta_i \geq 0 \text{ for all I}$$ The θ_I can be estimated by choosing an explicit distribution form for cost in efficiency and estimating a statistical frontier. DEA is used for estimation of frontier efficiency.

With this basic theory, application of DEA technique is discussed in the following section

6.2.1 Application of Data Envelopment Analysis

DEA is based on the economic notion of Pareto Optimality which states that an allocation is said to be efficient only when it is not possible to increase the desired aggregate output without detracting from any single output through some alternative allocation of resources. Now, assume that there are ***n*** decision making units(DMU) to be evaluated. Each project consumes ***m*** different inputs to produce ***s*** different outputs. It can be expressed as DMU_j consumes amounts $X_j = \{x_{ij}\}$of inputs where $i = 1,\ldots\ldots, m$

and produces amounts $Y_j = \{y_{rj}\}$of outputs where $r = 1,\ldots., s$

For these constants which generally takes the forms of observations, we assume $x_{ij} > 0$ and $y_{rj} > 0$. The ***s x n*** matrix of out put measures are denoted by Y and the ***m x n*** matrix measures is denoted by X. Various DEA models are developed and each seek to establish which subset of ***n*** DMUs determine parts of an *envelopment surface* .The geometry of this envelopment surface is prescribed by the specific model employed. In the present study The CCR Ratio Form Model (Charnes, et al, 1978) has been used. The essential characteristic of the CCR ratio construction is the reduction of the multiple output-multiple-input situation to of a single "virtual" output and a single "virtual" input. The ratio of this single virtual output a virtual input provide a measure of efficiency for each WSP which is function of multiplier. This efficiency which is to be maximised, forms the objective function for the particular DMU being evaluated. (J.A.Galney et al)

6.2.1 Some Case Studies

Measurement of Hospital efficiency

The study examined the decomposition of overall efficiency into its component parts- technical and allocative - for a sample of non-profit hospitals operating in California. The hospital data used in this study are obtained from the California Health Facilities Commission survey for the fiscal year 1983. The sample was limited to 123 community non-profit hospitals having organisational differences. The three outputs, medical-surgical acute discharges; medical surgical intensive care discharges; and maternity discharges and six inputs, registered nurse; management and administrative personnel; technical service personnel; aides and orderlies; and licensed practical nurses are specified. The relative measure of overall cost minimising efficiency; allocative efficiency and technical efficiency were calculated by using DEA technique. The findings of the result states that overall efficiency in this total cost minimising framework is approximately 0.61. On average, inefficient hospitals would have needed to lower operating costs by 39% in order to perform as well as other similar best practice hospitals in the sample. Only six of 123 hospitals operated at minimum cost. From the analysis result it could be found that inefficiency is allocative, the hospital employed the wrong input mix, so that their costs were higher than the cost minimising level. Finding of this study illustrates that this technique can be used as managerial tool that would identify efficiency in the hospital (Patricia Byrnes et al)

Measurement of Educational Efficiency

The DEA technique was used to measure the efficiency of educational production in English local education authority (U.K). Standard references containing educational performance data give an extremely weak and equivocal indication of local education authority. For example pupil teacher ratio used as a simple measure of pupil throughput is misleading. The DEA model contains three outputs and five input variables. The input variables include four socio-economic data, which are uncontrollable from the local education authority. Each variable has been chosen to reflect important characteristics of government policy. The input minimisation version of the DEA program has been adopted in place of its output maximisation. The out come of the analysis reflects an initial emphasis in the Government efficiency policy in the U.K on the input dimensions of policies and suggested that input side of efficiency is more important in the public sector where output are often disputed. (J.A.Ganley et al).

Efficiency measurement of Water supply project-Ghana

The DEA technique was used to measure a single efficiency score for ten water supply projects in Ghana by using technical, financial, economic, institutional, social and environmental factor as input and utilisation, reliability and convenience as the output. Different combinations of the projects and inputs were considered and it was found that DEA can be applied to get efficiency as a single measure to rank the water supply and sanitation projects. Moreover, the methodology can also be used for project feasibility studies comparing inputs and predicted outputs of new projects with existing project in similar fashion (. Akosa, Franceys, Barker and Weyman-Jones, 1995).

The present study hypothesise that different water supply project based on different approaches will perform differently. Akosa et al used the DEA technique and found the relative efficiencies to rank the different type of project. Therefore in the present study it is relevant the use the DEA technique to find the relative efficiency of the different water supply project to find the relative performance of water supply projects.

6.3 DATA ENVELOPMENT ANALYSIS

6.3.1 Factors Considered For Selection of Inputs and Outputs

The following points should be kept in point to select the units

- the units selected for comparison should be sufficiently similar but performing sufficiently differently so these can be discriminated.
- the unit selected should perform the same tasks with similar objectives
- the unit selected should be defined by particular boundaries which might be organisational, physical or regional.
- consideration needs to be given to the time period selected for comparing the units. Too long a time period may hide important changes taking place in the performance of units.

For selection of input and output indicator of a unit the point to be considered are as below

- any factor for which either data is not available readily or data is unreliable should not be included in the analysis
- only factors contributing to the set objectives set for the units should be included in the analysis
- factors conveying the same information as other factors should be excluded
- all factors used should have numerical values
- the data values for inputs and output must be positive

Selection of Units

For the present study rural water supply projects which are intended to serve the rural population in the Variance region have been selected.

Assumption

Though implementing agency at the state level is U.P.Jal Nigam, it is assumed that the size of the project, programme and mode of supply will discriminate the performance.

Selection of Input and Output factors

Data collected in the field investigation were used for data envelopment analysis based on Akosa et al. As the projects are rural base having erratic electric supply, so electrical consumption per m^3 per household has been taken as the measure for a technical parameter. Total annual cost per household is taken as the measure for financial indicator. Willingness To Pay has been taken the economic value of the water supply services. While the social factor has been assessed on a scale of 10 based on socio-economic status of the project area. Reliability measured as the percentage shift to traditional source during break down of water supply, and utilisation measured as the percentage household using the services. As survey was conducted in the month of December and January which peak winter season in the region so time value/convenience could not be assessed and not included in the analysis. The input and out put factor are shown in table6.1 and 6.2 respectively

INPUT DATA

Table6.1

TYPE OF PROJECT	TECHNICAL	FINANCIAL		INSTITUTIONAL	ECONOMIC	SOCIAL
	Kwh/hh	Subsidy/huh	TACH	Staff/1000	WTP	social
Pipe MNP-45L	0.075	382	1293	40	360	5 5
Pipe MNP-70L	0.09	231	637	6	288	6 7
Pipe MNP-70M	0 061	134	383	7	288	6 2
Pipe MNP-70S	0 107	222	615	16	348	5 2
Pipe ARP-40L	0.054	107	524	32	288	5 8
Pipe ARP-40M	0.048	113	387	7	276	5.3
Pipe ARP-70S	0.176	302	699	6	408	6.7
Pipe NAP-70L	0 029	133	537	4	588	5.9
Pipe NAP-70M	0 11	386	1247	11	396	4 9
Pipe NAP-70S	0 047	233	857	5	432	5 9
HP-plain	0	21	178	5	264	5.6
HP-rocky	0	14	131	15	240	4.7

OUT PUT DATA

Table 6 2

Type of project	Reliability	Utilisation
Pipe MNP-45L	0 38	0 65
Pipe MNP-70L	0.59	0 85
Pipe MNP-70M	0 69	0 65
Pipe MNP-70S	0 59	0 85
Pipe ARP-40L	0.40	0 5
Pipe ARP-40M	0.54	0 65
Pipe ARP-70S	0.58	0.95
Pipe NAP-70L	0.56	0 45
Pipe NAP-70M	0.72	0.90
Pipe NAP-70S	0.27	0.75
HP-plain	0.37	0 95
HP-rocky	0.0	0.80

The above data was analysed with the help of Banaxia software package, developed by Frontier Analyst, on a desktop computer.

6.4 ANALYSIS AND DISCUSSION OF RESULTS

6.4.1 Limitation

The number of unit to be included needs to be sufficiently large so that discrimination between them is possible. If the number of units relative to the number of inputs and outputs used is small then it is likely that many of the units will be found to be 100% efficient. This may be because any unit, which performs the best on one particular ratio of output to an in put, will be found efficient. Therefore to reduce the tendency to rate all the projects 100% efficient, the maximum number of input and output has been restricted to 50% of the number of units (Bowlin, 1987).

6.4.2 Analysis

Keeping in view the above limitation, to select the combination of input parameters, correlation of various inputs and outputs parameter was found. The correlation of the various units is depicted in table 6.3

CORRELATION BETWEEN THE MEASURES

Table 6.3

	Energy consumption/m³/HH	Subsidy per HH	Total annual cost per HH	Staff per 1000 water points	Willingness to pay	Social
Energy consumption/m³/HH	1	0.76	0.54	0.01	0.22	0.41
Subsidy per HH	0.76	1	0.95	0.25	0.39	0.15
Total annual cost per HH	0.54	0.95	1	0.38	0.43	0
Staff per 1000 water points	0.01	0.25	0.38	1	0.22	0.28
Willingness to pay	0.22	0.39	0.43	0.22	1	0.19
Social	0.41	0.15	0	0.28	0.19	1

The analysis carried out is based on the input minimisation and two parameters showing the strong correlation have not grouped together. One analysis has also been carried on output maximisation to compare the results with minimisation. The different combinations used in the analysis are as follows

I- **input**-*financial*. **output**-*reliability* and *utilisation*

II-**input**- *technical, financial* ; **output**- reliability, and *utilisation*

III-**input**-*technical, institutional, economic;* **output-** ***utilisation***

IV-**input**-*financial, institutional, social, Economic;* **output**-*utilisation, reliability*

In the I, II, and III case minimisation model and in IV case maximisation model is used.

From the table it can be observed that relative efficiency of the hand pump programme and pipeARP-70S is 100%. The reason may be the lowest total annual cost/household, which about Rs180 in hand pump project while in case of pipeARP-70S it

RELATIVE EFFICIENCY OY THE PROJECTS

Table 6.3

Type of project	RELATIVE EFFICIENCY OF THE PROJECT			
	Input Minimisation			*Output Maximisation*
	I	II	III	IV
Pipe MNP-45L	***14.26***	***14.67***	***13.73***	69 84
Pipe MNP-70L	82.81	82 65	88 04	100
Pipe MNP-70M	100	100	69 50	100
Pipe MNP-70S	85 77	86	***32.97***	98 75
Pipe ARP-40L	***37.64***	***29.53***	***30.10***	66 05
Pipe ARP-40M	74.14	75 21	76 42	100
Pipe ARP-70S	100	100	90 00	100
Pipe NAP-70L	55.81	100	100.00	100
Pipe NAP-70M	100	100	***49.25***	100
Pipe NAP-70M	*19 29*	*21 28*	88 30	81 33
HP-plain	100	100	100	100
HP-rocky	100	100	100	100

is due its high utilisation, which is 95%. Contrary to it the relative efficiency of pipeMNP-45L and pipeARP-40L is about 15% and 35%. The total annual cost per household in case of pipe MNP-45L is around Rs1300 and seems to be the more dominant for the poor performance. In case of pipeARP-40L, the reliability and utilisation that are less than 50% may be the cause. The common in the two is low rate of water supply and size of project. Contrary to the other medium size scheme pipeNAP-70M (Tikari group) which is medium size shows an efficiency of 20%. One of the reasons may be non-acceptance of supplementary source (India-Mark-II HP) which was not taken as a convenient system in peri urban area.

Further if we compare the result of the three option we find that efficiency of pipeMNP-70M reduces from100% in case I to 70% in case III. The reason may be low willingness to pay, which is Rs 288 per house hold. The efficiency of pipe MNP –70S reduces from 86% to 33%. Though willingness to pay is Rs 348 more than the previous case, the staff productivity index, which is a measure of institutional efficiency, is 16. Therefore institutional factor may be considered dominant in this case. The above view is further being supported by the case of pipe NAP-70L (relative efficiency increases from 56% to 100%) where staff productivity index is 3.6 and willingness to pay is Rs 588 per month and pipeNAP-70M (relative efficiency decrease from 100% to 59%) where staff productivity index is 11.

Comparison of the result of maximisation model analysis shows the efficiency varies between70 to 100%. This indicates that there is little scope further to increase the efficiency i.e. to increase the output. However the result of minimisation model indicate the wide variation in the efficiencies. This indicates that projects are differing to use other depending on their resource allocation. However, with the limited scope of time further analysis to understand the field of inefficiency could not be assessed.

6.5 CONCLUSION

The DEA analysis confirms that the subjective finding, that project are functioning more or less in a similar way if we consider the output of the scheme. However, the results of the analysis obtained from the input minimisation model states that chosen project perform differently. We may conclude from the above result that size and rate of water supply differentiate the project performance and supports the hypothesis for categorisation.

The result obtained from the data envelopment analysis establishes the importance of institutional and economic parameter, which are not considered in the project formulation.

This study analysis concludes that the Data Envelopment Analysis can be used as a tool at planning to identify the various alternatives for allocation of limited resources in water supply sector for a sustainable system. However, further studies are required to identify more specific indicators and field of inefficiencies, which need particular attention.

CHAPTER VII

Conclusion & Recommendation

The Varanasi region with population density 955 person per square km, is basically a plain area except for southern part, under Vindhyan plateau. The general socio-economic condition of the rural is poor and income is mainly based on agriculture.

Out of 2,622 inhabited villages, 37% villages are covered under 49comprehensive piped water supply projects and rest by Installation of 11,980 India- Mark-II hand pump. The water supply project were intended for 100% coverage presuming that it will be used by everybody. The out come of the field survey, shows that 96 households out of 407 [25%] households were still using traditional/ private shallow hand pump, which indicates that providing the facility is not sufficient to achieve the objective, " *safe drinking water to all*" The findings of the survey outcome is in line with the Briscose(1988) finding that presumption to fix the degree of utilization leads to ad-hoc procedure for deciding such a vital issue.

The hand pump projects, where utilization is 90% is said to be more successful as compared to the piped water supply projects, where utilization is only 70%. However, the result of pipeARP-70S (Lohata group), having utilization as 85% indicates that small piped water supply project is more successful in the area lying at the fringe of urban sector.

An observation of the India –Mark-II hand pump use, indicates that the villagers prefer a safe water source within 60m. However, they may go to a maximum distance of 100m. The survey was conducted in the winter season, when there was no shortage of drinking water. To get a more realistic picture of the maximum possible distance for a beneficiary to fetch safe drinking water, period covering summer season will have to be included for study. However, the preferred distance indicates that present coverage distance criteria i.e. 250m needs revision to ensure the utilization the safe drinking water sources.

Throughout the study no water supply project is found functioning well. The electric power supply in the piped water supply project and source component in hand pump project specially in rocky area are the most striking factors observed (observed breakdown period varies from 16 to 177 days), denying adequate reliability to the system. Power generators were provided in some of the project to supplement the power failure. But element of sustainability is missing due to cost factor(author's field experience). In the rural area, it is observed that villagers are ready to accept fixed hour regular water supply.

Cost recovery aspect is not adequately incorporated in the project on a realistic ground as most of the projects provides only 20-35% of household connection. The rest to be fed by stand post which does not collect any revenue. A large cross subsidy, which is not available to the U.P. Jal Nigam, is an important factor contributing to the poor functioning of projects. It implies that operation and maintenance aspect, which is one of the important parameters to be considered for sustainability was completely overlooked at the planning stage.

Against the hypothesis that different water supply project based on different approaches will perform differently, significant difference could not be observed to establish a set pattern. However, better utilization and functioning of hand pump projects and some of piped water supply projects indicate that topography, development of area and size of the project and rate of supply has some effect on the performance of water supply projects. However, different programme could not show any significant different performance. The reason may be the no difference in funding pattern and implementation procedure except for some conceptual difference at planning level.

Against a water tariff levied Rs240 per annum in case of piped water supply projects and no tariff for hand pump projects, 'willingness to pay' study shows that villagers are ready to pay around Rs.400-500 per annum per house hold for a regular uniform and demanded water supply system. The result of the study supports the findings of studies of Singh, B et al (1993). However if we compare this figure with the total annual household cost (vary between Rs 390 to Rs 1300, based on 1997 price) which is a key parameter to be addressed for the sustainability of a project, we found that majority of the project fall out of the range. Hence it is concluded that the problem of water supply projects are more related to its financial and economic value which are being least stressed at the planning stage.

Though the implementation of projects is not significantly differing to each other, Data Envelopment Analysis results shows that the comparative efficiency of water supply project varies between 15% to 100%. The relative efficiency of the large water supply project and project having rate of water supply 40-45 lpcd ranges between 15 % to 35% as compared to the 100% efficient hand pump projects and small piped water supply projects The DEA results confirm the subjective inference drawn from the field result that size, type and topography of the project affects the project performance and able to tell the relative efficiency. Hence DEA may be used effectively to rank the different water supply projects.

Using the Data Envelopment Analysis it is also, possible to locate the area of inefficiencies, which can be further, improved to get the optimum efficiency of a water supply project. DEA technique also indicates the effect of willing ness to pay and institution on the efficiency. Thus it may be concluded that for a comparative performance evaluation of water supply project and to allocate a restricted resource, DEA technique is an appropriate tool at management level.

At last, the study concludes that the conceived objective of the water supply project is not achieved to the level intended for due to one or other reason. The coverage is a mis-leading indicator in water supply project. Operation and maintenance aspect is not stressed up on at any level of project cycle. The cost of the project implemented is not affordable and it leads to unsustainable system. The users are not involved at any stage and no effort ever has been made to link up the gross route users with the project activities, though there is a scope for the same.

RECOMMENDATION

Policy and Planning

- The government as well as implementing agency should stress the sustainability of the water supply project at the formulation and clear guide lines should be documented to insure the technical , social and financial success of the projects.

- legal provisions and regulations and other means to change the role of community, from receiver to an active partner should be promoted

- 'free water' concept should not be promoted by the government as every service cost, and for sustainability its operating cost should be met by the user.

Choice of Technology

- Appropriate technology based on the users felt need, demanded level of service and willingness to pay should be adopted

- Sophisticated technology, which are basically for high standard of convenience, should not be adopted for rural sector where even basic need is yet to be fulfilled.

- Labour intensive, with least operating expenditure technology is to be promoted.

Financial Factor

- Before formulation of project, community financial resources should be explored in terms of labour / capital cost sharing

- Appropriate tariff should be levied to realise the operating cost so as to provide a sustainable system

- Tariff should be based on realistic survey defining the willingness to pay, and affordable by the recipient of the service

Institutional Factor

- Autonomy should be ensured in the truest sense at all stage.

- The services has to run in a businesslike manner where customer focus should be a key issue so water supply should be develop as a marketing good.

- Each employees job should be well defined and expectations and responsibilities matching with his ability and powers should be well established to monitor the performance.

- Technical and educational training should be organised for better performance of current job and to understand the organisational policies an$ procedure. Moreover, there must be sufficient motivation and/ or incentives to shoulder greater responsibilities as deficiencies in human performance are predominantly due to lack of these factors(Pickford J.,1991)

Management tool

- To make good decisions, readily available and reliable information are essential (Dixon R. 1990). It is therefore imperative for managers to have a Management Information System in which defined data are collected, processed and communicated to assist for the use of resources.

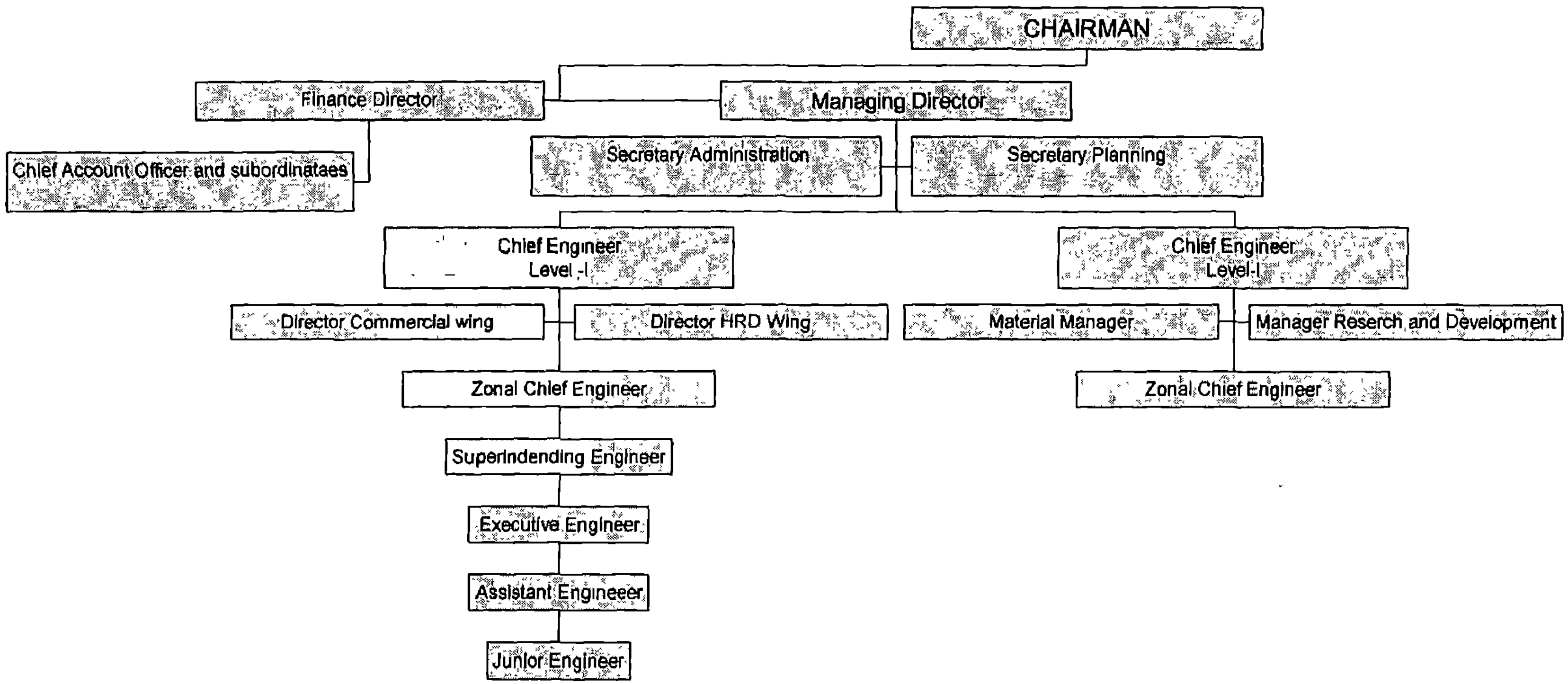
- To develop a project managers should use concept of project cycle management, which includes step by step picture of the programme, projects and processes.

SUMMARY

The water supply project implemented in the Varansi region is intended to supply safe drinking water to all. The approach of planning was top-down technology oriented. The out come of the study indicates that the conceived objective of the water supply project '*safe water to all*' was not obtained. Also the technology adopted was not appropriate and sustainable. The field found to be addressed is economic, financial and institutional aspect integrated with health and hygiene and operation and maintenance aspect. The Data Envelopment Analysis Technique used in this study may be used as one tool to identify an efficient water supply project at planning and policy level. However, it needs further study to establish some of the key indicators which are to be used at the policy making level.

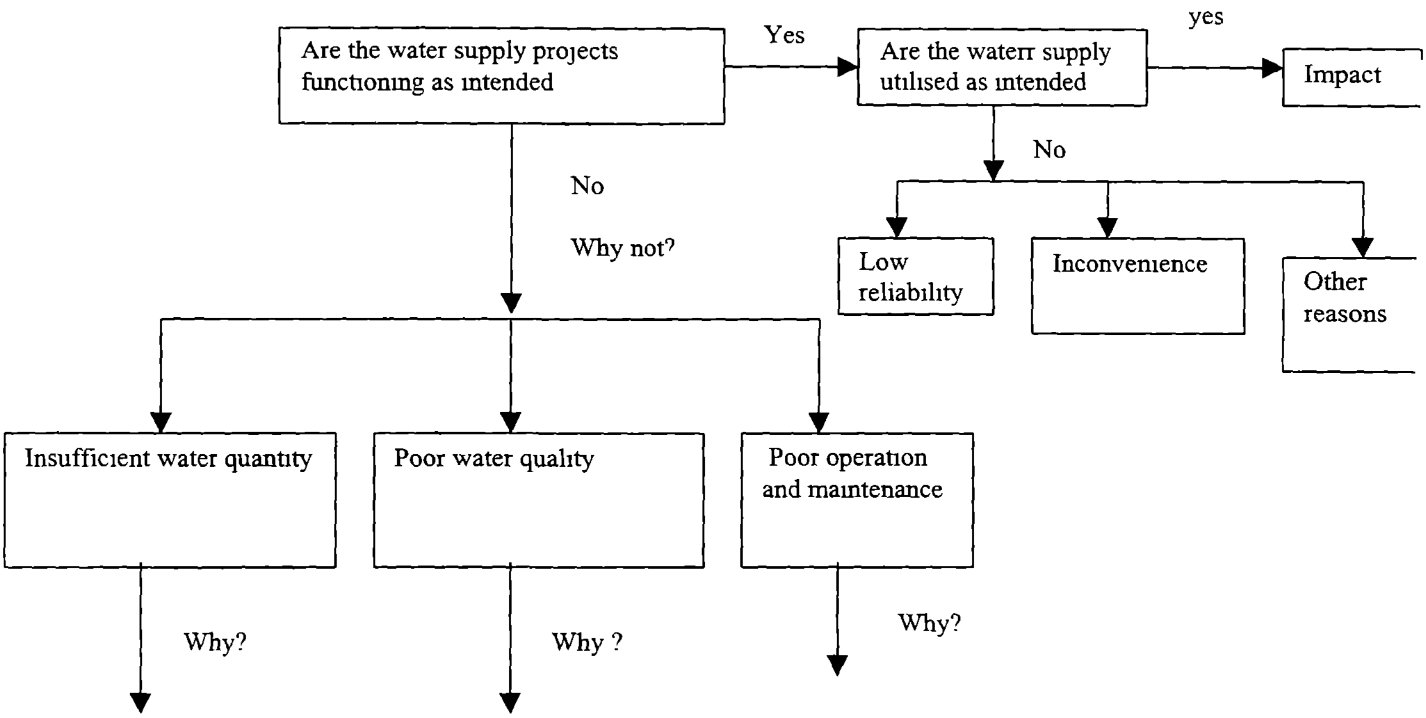
ORGANOGRAM OF UTTAR PRADESH JAL NIGAM

Annexure-I



Annexure -II

An Approach to Minimum Evaluation Procedure



Annexure -III A

CLASSIFICATION OF EXISTING WATER SUPPLY PROJECTS

S.N	Project Type	Supply source	financed by	nos. of net works	villages included
1	Large rural water supply project	Surface with HC and PSP	State (MNP)	1	45
2	Large rural water supply project	Tube well with HC and PSP	State (MNP)	2	65
3	Large rural water supply project	Tube well only PSP	Central(ARP)		80
4	Large rural water supply project	Tube well with PSP and HC	Dutch (NAP)		308
5	Moderate rural water supply project	Tube well with HC and PSP	State (MNP)	9	140
6	Moderate rural water supply project	Tube well with PSP	Central(ARP)	2	79
7	Moderate rural water supply project	Tube well PSP supplemented with H.P	Dutch (NAP)	6	147
8	Small rural water supply project	Tube well with HC and PSP	State (MNP)	10	58
9	Small rural water supply project	Tube well with PSP	Central(ARP)	7	33
10	Hand Pump project in rural area (India Mark II)	Conventionally drilled	Central/State	11132 Hand Pump	1535
11	Hand Pump project in rural area (India Mark II)	Drilled by special rig m/c	Central/ State	448 Hand Pump	127

Annexure -III B

DETAIL OF THE WATER SUPPLY PROJECTS SELECTED FOR STUDY

W/S project	Vill incl. uded	vill bene fitted	area cover. in hectare	Project detail	cost		Population Detail in the year				Rate of W/S in lpcd	Source
				year	total cost Rs.in lacs	E/M cost Rs.in lacs	1991cinsus		design	present		
							total	SC/ST				
Naugarh	45	25	8031	72-73	55.25	11.64	29412	11341	36930(99)	33294	45	reservoir
Chahania	23	28	3350	72-73	11 03	1 72	23380	5467	24820(10)	26466	70	TW-2nos
Sakaldeeha	26	22	3006	75-76	13.43	1.92	29018	6976	28200(01)	32848	70	TW-2nos
Cholapur	7	7	1028	77-78	9.86	3.09	12574	2837	15089	14234	70	TW-2nos
Chaubeypur	35	27	2781	86-87	54 84	4.05	30126	6737	32069	34103	40	TW-2nos
Baragaon	23	13	2316	75-76	16.5	2.38	34261	5155	43781	38783	40	TW-2nos
Lohata	3	3	336	72-73	3.2	1.32	14536	2089		16455	70	TW-2nos
kandawa	49	40	4175	85-86	86.00		61045	7800	67357(11)	69103	70	TW- 2nos
Jansa	21	17	1364	88-89	84.61	16.65	17410	2626	31270	19708	70	TW- 2nos
Tikari	27	22	4408	88-89	156.36		56920	7781	61000	64433	70	TW- 2nos
Hand Pump(plain)	1532	1532		96-97	2018	0	1337606	280230	2783000	1514170	40	conventionally driven bore hole
Hand Pump(rocky)	127	127		96-97	149	22.4	88153	43391	112000	99789	40	Mechanically driven bore hole

Annexure-IIIC

(A) DATA REQUIRED FOR INPUT FACTORS

Indicators	Sub indicators	Target group	Source
Technical	energy consumption per person	UPJN	Office record
	production capacity per person	UPJN	Office record
Financial	production cost / person	UPJN	Office record
	subsidy per person	UPJN	Office Record
	O & M cost over total cost	UPJN	Office record
Institutional	staff productivity index	UPJN	Office record
	trained person available at local level	UPJN/Villagers	Office record /field survey
	organisational autonomy	UPJN	Managers interview
	accountability	UPJN/ villagers	Inerview/ field survey
	supportive attitude	UPJN / villagers	Interview /field survey
Economic	Internal rate of return	UPJN	Office record
	economic value water	UPJN / villagers	Office record/ field survey
Social	Felt need	Villagers	field survey
	Literacy,Awareness about HH practices	Villagers	field survey

(B) DATA REUIRED FOR OUTPUT FACTORS

Indicators	Sub indicators	Target group	Source
Reliability	quantity of water supplied	Villagers	field survey
	quality of water supplied	Villagers	field survey
	Number of days /annum system is not working	Villagers	field survey
	average supply hours per day	Villagers	field survey
	use of alternate source	Villagers	field survey
Utilisation	distance from water point	Villagers	field survey
	HH using the facility	Villagers	field survey
	volume of water used for drinking	Villagers	field survey

Annexure IIID

FORMAT FOR PROJECT DATA COLLECTION

PROJECT…………..
PROGRAMME ……

(A) GENERAL

1 Agency Responsible for

Finance	Implemention	Operation & Maintenance

2. Design period and Rate of water supply

Initial year/ design year	design / present population	Rate of water supply

3 Coverage / water point

Villages included	Villages being served	Water point		
		PSP	H.C.	H.P.

(B) FINANCIAL

1 Estimated cost (Rs. In thousands)

Technical Component	Training Programme	HHA programme	Total

2. *Actual Expenditure (Rs. in thousands)*

Technical Component		Training Programme	HHA programme	Total
Total	E & M works			

(C) OPERATION AND MAINTENANCE

1. *Water Production*

Pumping hours	Nos. Of pump(H.P.)	Avg. discharge of pump	Production in m^3 / day

2 *Annual O & M expenditure*

Electrical energy		Spare part (H.P.) / PP repair(W/S)	Casual labour	Regular maintenance staff salary	
consumed kwh	cost				

3. *Annual O & M fund detail*

Budget Required	Received from			
	Water charges	from govt.	Other sources	Total

(D) ADMINISRATIVE DETAIL

1. Person Required for execution (mandays)

Technical			Accounts	General	Total
EE	AE	JE			

2. Maintenance Personnel (mandays) required

Technical			Accounts		General		
EE	AE	JE	Bill clerk	tax collector	skilled	unskilled	

2. Maintenance Personnel (mandays) employed

Technical			Accounts		General		Total
EE	AE	JE	Bill clerk	tax collector	skilled	unskilled	

Annexure IIID

QUESTIONNAIRE FOR VILLAGERS

(A) GENARAL INFORMATION

1 Whom to concern

<table>
<tr><td rowspan="2">Name of person</td><td colspan="2">where to belong</td><td colspan="2">S ex</td><td colspan="4">Age</td><td colspan="3">belong s to</td></tr>
<tr><td>village</td><td>habitation</td><td>M</td><td>F</td><td><15</td><td>16-30</td><td>31-50</td><td>>50</td><td>sc</td><td>st</td><td>gen</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

sc - Schedule cast, st - schedule tribe, gen - general

2 Occupation/Income/Literacys

<table>
<tr><td colspan="3">Family Members</td><td colspan="3">Sourceof Income</td><td colspan="4">Annual Income (Rs.)</td><td colspan="3">Literacy</td></tr>
<tr><td>M</td><td>F</td><td>C</td><td>Agric.</td><td>Service</td><td>Daily wage</td><td>Agr.</td><td>Salary</td><td>daily wage</td><td>Total</td><td>1*</td><td>2*</td><td>3*</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

1*- illeterate, 2* - below matricalation, 3* - above matriculation

(B) FELT NEED

1. What are the water supply sources available?

Name of the source	piped w/s	river	dug well	pond	community H.P.	Private H.P.	Any other
distance in mts.							

2. *Which source do you collect drinking water from?*

piped supply		Community H.P.	Dug well	River/Pond	Private H.P.
PSP	H.C.				

3. *what do you think of present water supply system?*

An improvement over traditional source		no difference

4. *Who demanded the present water supply system?*

Villagers	Influential person from the village	political leader	don't know

5. *Are you in need of a better water supply system?* Yes / No

6. *Which water supply sytem you choose as a better system?*

Improveddug well	India Mark-II H.P.	India Mark-III H.P.	Piped water supply	
			with PSP	With HC

7. *Why you do you choose the above one ?*

Convenience	improved technology	easy O & M	locally manageable

8. *Are you willing to contribute for an improved water supply?* Yes / No

9. *How can you contribute to built a better Water supply system?*

- share capital cost
- in terms of labour
- any other form

(C) AWARENESS ABOUT HEALTH AND HYGENE

1 *Why do you need good Quality Water?*
2. *Is there any relation in water and disease?*
3 *What do you do to keep water safe ?*
4 *Are you aware of Health Hygiene Awareness Programme?*
5 *What do you feel about HHA programme?*
6 *Which disease is caused due to unsafe water?*

(D) WILLINGNESS TO PAY

1 *Do you pay for your water?* Yes / No
2. *If yes, how much per annum you pay?(Rs.)*
3. *If no, who should pay for your water?*
4 *Why you should not pay ?*

supply is not good	supply is not regular	it is providers responsibility	you have not asked

5. *For which system areyou rady to pay for, if system is reliable and according to your choice?*

Piped supply through PSP	Piped Supply Through HC	India-Mark-II H.P.	India-Mark-III H.P.

6 *Are you ready to pay per month Rs*

QUESTIONNAIRE NO-2FOR FIELD DATA COLLECTION

- To know about the functioning and utilisation of existing Water SupplySystem.

(A) RELIABILITY

1. *What quality of water do you get from the existing system?*

Good	Turbid	Bad Odour	Metallic Taste

2. *How much drinking water every day you take from?*

PSP	HC	HP	river/pond	Total

3. *How many days in a month water supply is completely stopped?*
4. *What is the reason for break down?*

Water source	pipe line breakage	electric failure	pumping plant failure	Shortage of spare part	bore fail

5. *How long it take to restore the water supply from failure due to ?*

pipe line	electric	pumping plant	spare part for Mark-II	Spare parts for Mark-III

6. *How many hours a day you get water from?*

House connection	Public stand Post	India Mark-II	IndiaMark-III	Other sources

7 *In case of water supply failure from where do you collect water?*

Dug well	private hand pump	community hand pump	pond	river

8. *What do you think about the functioning of existing water supply?*

Good	satisfactory	poor

9. *Why the system is not performing to the level it is intended to?*

Costly technology	*poor maintenance*	*mis management*	*no felt need*

(B) VILLAGE LEVEL DEVELOPED SKILLED AND SUPPORTIVE ATTITUDE

1. *How many trained person available in the village?*
2 *Who trained them?*
3 *Whether they are involved with the water supply project ?*
4 *If yes, what they do?*
5. *If not, is there any problem?*
6. *Which activity can be done by* community?

Routine maintenance	pipe line repair	HP repair	daily operation

ANNEXURE-IVa

Block wise Distribution of Rural Population

N.	Name of District	Name of Tehsil	Name of Block	Population as per 1991 census	
				Total	SC/ST
A)	VARANASI	Sadar	Baragaon	1,61,843	29,380
			Pindara	1,96,025	35,945
			Cholapur	1,62,185	37,712
			Chiraigaon	1,85,521	38,044
			Harhua	1,66,466	29,379
			Sewapuri	1,58,541	27,673
			Arajiline	2,34,616	32,483
			Kashi Vidyapeeth	1,77,671	26,831
			TOTAL (A)	**14,42,868**	**2,57,447**
B)	CHANDAULI	Sakaldeeha	Chahaniya	1,42,622	28,752
			Dhanapur	1,52,822	36,111
			Sakaldeeha	1,70,066	45,398
		Chandauli	Niyamatabad	1,67,145	30,028
			Chandauli	1,31,797	34,808
			Barhani	1,25,068	27,525
		Chakiya	Chakia	1,17,566	31,615
			Naugarh	45,200	19,082
			Sahabganj	95,846	28,268
			TOTAL (B)	**11,48,132**	**2,81,587**
			TOTAL (A)+(B)	**25,91,000**	**5,39,034**

ANNEXURE - IVb

TECHNICAL DETAIL OF COMPREHENSIVE WATER SUPPLY PROJECTS

W/S project	Vill Included	vill benefitted	area covered in hect.	Project cost (Rs. Lacs) year	total cost	E/M cost	Population Detail in the year 1991 census total	SC/ST	design	present	Rate of W/S in lpcd	Source	Pumping details Nos	BHP	Annual water production capacity Million litres	Annual electrical consumption KWH	d/s net km	Bal. Res. in KL	Water supply points PSP	HC	IM-II
pipeMNP(s)-70 L	45	25	8031	72-73	55 3	11 6	29412	11341	36930	33294	45	reservoir	3,3	10,20	1667	1425	69	250	37	339	183
pipeMNP-70L	32	28	3350	72-73	11 03	1 72	23380	5467	24820	26466	70	TW-2nos	1,1	30,25	867	451	45	310	12	850	36
pipeMNP-70M	26	22	3006	75-76	13 4	1 92	29018	6976	28200	32848	70	TW-2nos	1,1	25,25	858	522	16	310	0	960	46
pipeMNP-70S	7	7	1028	77-78	9 86	3 09	12574	2837	15089	14234	70	TW-2nos	1,1	20,25	385	201	18	550	17	430	61
pipeARP-70 L	35	27	2781	86-87	54 8	4 05	30126	6737	32069	34103	40	TW-2nos	1, 1	20.20	473	268	51	800	135	85	98
pipeARP-70M	23	13	2316	75-76	16 5	2 38	34261	5155	43781	38783	40	TW-2nos	1,1	25,35	788	448	39	700	50	1149	43
pipeARP-70S	3	3	336	72-73	3 2	1 32	14536	2089		16455	70	TW-2nos	1,1	30,30	1471	358	16	250	6	1532	19
pipeNAP-70 L	49	40	4175	85-86	86 00		61045	7800	67357	69103	70	TW-2nos	1,1	35,41	1471	901	95	1000	210	1502	116
pipeNAP-70M	21	17	1364	88-89	84 6	16 7	17410	2626	31270	19708	70	TW-2nos	1,1	41,41	1471	978	49	800		497	89
pipeNAP-70M	27	22	4408	88-89	156		56920	7781	61000	64433	70	TW-2nos	1,1	45,41	1471	1027	65	1200	15	1530	140
HP plain	1532	1532			2018*	0	1337606	289241	2783000	1514170	40	Drilled bore	0	0	42100	0	0	0	0	0	11532
HP rocky	127	127			149*	22 4	88153	34380	11200	99709	40	Drilled bore	0	0	1635	0	0	0	0	0	448

* updated for 1996-97

ANNEXURE-IVc

THE FINANCIAL AND ECONOMICAL DETAIL

Project	Year and Project cost (Rs. Lacs)			Design period	Capital cost recovery in Rs lacs			Annual Maintenance cost required [1]			Total Annual Cost per HH in Rs	Actual Maintenance Expenditure and revenue realisation Rs. In lacs (Year 1996-97) & Staff detail			
	year	total cost base year 1997	Cost for supl. source		Main Project	Supplementary Source	Total	Main Project	suppl source	Total		Annual Maintenance expenditure	Annual Billing In Rs.Lacs	Reven realisation	Operating Staff /1000 water points
pipeMNP-70L	72-73	262.4	60.39	30	27.8	7.91	35.71	17.16	0.92	18.08	1293	3.15	2.5	1	40
pipeMNP-70L	72-73	52 4	11 88	30	5.6	1.56	7 16	5.64	0 11	5 75	637	1 86	2 6	1 3	6
pipeMNP-70M	75-76	54.8	15.18	30	508	1.99	7.79	6.10	0.14	6.24	383	1.38	2 9	1 2	7.6
pipeMNP-70S	77-78	34.6	20 13	30	3 7	2.64	6 34	4 4	0 18	4 58	615	2.21	1 6	0 6	16
pipeARP-70 L	86-87	87.2	32 34	15	11 4	4.24	15.64	3 92	0 29	4 21	524	1 84	0 4	0.3	32.4
pipeARP-70M	75-76	67 3	14 19	15	8 8	1 86	10 66	5.86	0.13	5.99	387	2 24	8	0 7	7 0
pipeARP-70S	72-73	15 2	6.27	30	1.6	0.82	2 42	5 77	0 06	5.83	699	2.95	7 4	2.6	6.0
pipeNAP-70 L	78-79	223 6	38 28	30	23 7	5.01	28 71	12.13	0.35	12 48	537	4 32	5.1	3 5	3.6
pipeNAP-70M	85-86	134.5	29.37	30	14.3	3 85	18 2	8.8	0.27	9.07	1247	2 34	2.3	1.8	10.6
pipeNAP-70M	78-79	244 4	46.2	30	25.6	6 05	31 95	13.72	0 42	14.14	857	4 62	7.8	2.3	5 3
HP plain		2018	0	15	264 4	0	264 4	34 60	0	34 6	178	3 61	0	0	5.4
HP rocky		149	0	15	19 50	0	019.50	2.24	0	2 24	131	0.36	0	0	15 46

* updated cost foe 1996-97 cost of India –Mark-II hand pump , [1] – maintenance cost of Pipe project is taken as 5% of updated cost for the year1996-97 and in case of

Note the design period of India Mark-II hand pump is assumed as 15 years

Annexure-Va

HOUSE HOLDS GENERAL INFORMATION , LITERACY, HEALTH HYGIENE AWARENESS AND INCOME LEVEL

Type of Project	HH survey	total person/	Avg person/HH	Litera			Health Hygiene Awarenes			Annual income (Rs. ,000)			
				Basic	HS leve	<HS lev	Unawar	a little	awared	<12	12-30	31-60	>60
pipeMNP-45 L	28	223	8	12	12	4	11	13	4	7	15	5	1
pipeMNP-70L	36	457	13	5	16	15	1	33	2	6	16	7	7
pipeMNP-70M	29	249	9	8	14	7	4	23	2	3	17	6	3
pipeMNP-70S	26	216	8	7	16	1	14	12	0	7	11	7	1
pipeARP-70 L	29	257	9	8	16	4	9	17	3	7	13	6	3
pipeARP-70M	29	275	9	10	17	0	8	18	3	8	16	4	1
pipeARP-70S	33	466	14	10	17	6	2	24	7	1	15	12	5
pipeNAP-70 L.	34	322	9	12	12	9	6	23	5	9	15	9	1
pipeNAP-70M	30	272	9	12	16	1	8	21	1	17	11	1	1
pipeNAP-70M	28	324	12	10	13	5	8	14	6	7	13	5	3
TOTAL	302	3061	10	94	149	52	71	198	33	72	142	62	26
HP plain	70	618	9	25	31	13	14	47	9	23	33	13	1
HP rocky	35	209	6	27	7	1	6	28	1	17	16	1	1
TOTAL	105	827	15	52	38	14	20	75	10	40	49	14	2

Piped													
Average	30.2	306	10.0	9.4	14.9	5.2	7.1	19.8	3.3	7.2	14.2	6.2	2.6
Std. Dev	2.5	69	1.7	1.9	1.7	3.2	3.1	5.0	1.8	2.5	1.8	2.0	1.6

HP project													
Average	52.5	414	7.4	26.0	19.0	7.0	10.0	37.5	5.0	20.0	24.5	7.0	1.0
Std Dev	17.5	205	1.4	1.0	12.0	6.0	4.0	9.5	4.0	3.0	8.5	6.0	0.0

Overall													
Average	33.9	324	9.6	12.2	15.6	5.5	7.6	22.8	3.6	9.3	15.9	6.3	2.3
Std Dev	6.6	95	1.6	4.6	3.3	3.8	3.2	6.9	2.2	4.8	3.1	2.7	1.6

Annexure - Vb

FELT NEED , REASON TO CHOSE , AND WILLING NESS TO CONTRIBUTE

Type of Project	W/S System chose				Reason to chose				Willingness to contribute		
	Pipe	Pipe	Im-II	P.Wel	Conv	Techn	Maint	mana	Sharing	Labour	No contr.
pipeMNP(s)-70	17	0	6	5	17	1	7	3	11	16	1
pipeMNP-70L	21	0	14	0	22	2	8	3	17	17	2
pipeMNP-70M	17	1	8	2	15	5	7	1	6	17	6
pipeMNP-70S	9	1	13	1	8	6	7	2	7	13	3
pipeARP-70 L	5	3	19	2	10	4	10	5	6	18	3
pipeARP-70M	12	3	14	0	12	8	7	2	6	17	4
pipeARP-70S	29	0	3	0	28	1	3	0	11	14	4
pipeNAP-70 L	12	1	13	8	12	5	12	4	8	22	0
pipeNAP-70M	3	1	17	7	3	4	15	6	4	13	8
pipeNAP-70M	12	1	8	6	17	1	4	5	6	15	2
TOTAL	137	11	115	31	144	37	80	31	82	162	33
HP plain	32	4	29	3	25	14	23	5	19	38	9
HP rocky	35	0	0	0	34	0	0	0	9	26	0
TOTAL	67	4	29	3	59	14	23	5	28	64	9

Piped											
Average	13.7	1.1	11.5	3.1	14.4	3.7	8	3.1	8.2	16.2	3.3
Std Dev	5.8	0.8	4.2	2.7	5.4	2.0	2.6	1.5	2.9	2.0	1.8

HP project											
Average	33.5	2	14.5	1.5	29.5	7	11.5	2.5	14	32	4.5
Std Dev	1.5	2	14.5	1.5	4.5	7	11.5	2.5	5	6	4.5

Overall											
Average	17	1.25	12	2.8	17	4.3	9	3	9.2	19	3.5
Std. Dev	8.2	1.0	5.8	2.5	6.9	2.8	4.3	1.7	3.6	4.9	2.3

Annexure -Vc

WILLINGNESS TO PAY FOR A RELIABLE AND CONVENIENT SY	HOW A SYSTEM CAN BE MADE SUSTAINABLE

Type of						Amount in Rs.p	Total	Comm.	Privat-	Simplr	As pe	No	Total
Project	100-8	80-60	60-40	40-20	<20	Cann'	No re	HH	Partici.	sation	Techn.	Dem	Respo.	HH
pipeMNP(s)-70	2	1	4	6	15	0	0	28	11	5	1	8	3	28
pipeMNP-70L	0	0	7	10	15	4	0	36	3	5	9	19		36
pipeMNP-70M	0	1	5	7	11	3	2	29	0	3	8	9	9	29
pipeMNP-70S	0	3	5	5	9	2	2	26	0	5	10	11	0	26
pipeARP-70 L	0	0	4	14	5	6	0	29	5	3	10	4	7	29
pipeARP-70M	0	0	4	11	9	5	0	29	1	2	8	5	13	29
pipeARP-70S	0	1	12	15	1	2	2	33	8	7	2	15	1	33
pipeNAP-70 L	6	6	10	7	0	1	4	34	10	6	7	8	3	34
pipeNAP-70M	3	0	6	12	4	3	2	30	4	4	15	2	5	30
pipeNAP-70M	1	1	3	23	0	0	0	28	3	10	4	6	5	28
TOTAL	12	13	60	110	69	26	12	302	45	50	74	87	46	302
HP plain	0	0	7	24	29	9	1	70	14	10	13	16	17	70
HP rocky	0	0	2	9	23	1	0	35	0	3	13	19	0	35
TOTAL	0	0	9	33	52	10	1	105	14	13	26	35	17	105

Piped														
Average	1 2	1 3	6 0	11.0	6.9	2 6	1.2	30.2	4.5	5	7 4	8 7	5 111	30.2
Std. Dev	1.5	1 3	2.2	4.0	4.9	1.6	1.2	2.5	3.2	1.6	3 12	3 84	3 037	2.48

HP project														
Average	0	0	4.5	16.5	26	5	0.5	52 5	7	6.5	13	17.5	8 5	52.5
Std. Dev	0	0	2.5	7.5	3	4	0.5	17.5	7	3.5	0	1.5	8.5	17.5

Overall														
Average	1	1.1	5.8	11.9	10.1	3.0	1.1	33.9	4 9	5.3	8.3	10 2	5 7	33 9
Std. Dev	1.3	1.1	2.2	4 7	7 1	2 0	1.1	6.6	4.9	5.3	8.3	10 2	5 7	33 9

ABSTRACT OF HOUSE HOLD SURVEY

DESCRIPTION	TYPE OF	net k	Net work	village	house hol	GENDE		CASTE			LITERACY		HH Awareness			WATER SUPPLY SOURCE				
	PROJEC	Wo	survey	surve	surveye	mal	femal	SC/S	Gener	Basi	HS lev	> HS le	No	A little	Fully	HC	SP	I.M-II	Pvt H	Well
Large Piped Surface (MN	pMNP-45L	1	1	6	28	21	7	13	15	12	12	4	11	13	4	9	2	7	2	8
Large Piped (MNP)	pMNP-70L	2	1	6	36	28	8	12	24	5	16	15	1	33	2	18	2	10	3	3
Moderate Piped(MNP)	pMNP-70	9	1	6	29	25	4	6	23	8	14	7	4	23	2	9		10	3	7
Small (MNP)	pMNP-70	10	1	3	26	22	4	13	13	7	16	1	14	12		18	2	2	1	3
Large Piped (ARP)	pARP-70	2	1	4	29	26	3	12	17	8	16	4	9	17	3	3	4	7	5	10
Moderate Piped(ARP)	pARP-70	5	1	3	29	17	12	12	17	10	17		8	18	3	9	8	1	3	8
Small (ARP)	pARP-70S	7	1	2	33	25	8	5	28	10	17	6	2	24	7	28		4		1
Large Piped (NAP)	pNAP-70	6	1	6	34	33	1	19	15	12	12	9	6	23	5	8	4	3	8	11
Moderate Piped(NAP)	pNAP-70	6	1	3	30	28	2	12	18	12	16	1	8	21	1	5	10	12	1	2
Moderate Piped(NAP)	pNAP-70	1	1	6	28	27	1	7	21	10	13	5	8	14	6	17	2	2		7
India-Mark-II HP(Plain)	HP-Plain		7HP	7	70	61	9	33	37	25	31	13	14	47	9	0	0	66	3	1
India-Mark-II HP(Rocky)	HP-Rocky		4HP	4	35	34	1	27	8	27	7	1	6	28	1	0	0	29	3	3
TOTAL	Mean			5	34	29	5	14	20	12	16	6	8	23	4	10	3	13	3	5
	Std DEV			1.5	6.6	6.9	3 2	6 0	5.8	4.6	3 3	3 6	3 2	6 9	2 1	6.6	2.5	11.6	1.3	3 2
Gmprehensive piped proje	Mean			4.5	30.2	25.2	5.0	11.1	19.1	9.4	14.9	5.8	7.1	19.8	3.7	###	4.3	5.8	3.3	6.0
	Std DEV			1.5	2.5	3.2	3.0	3.1	3.9	1.9	1.7	3.1	3.1	5.0	1.6	6.3	2.4	3.4	1.6	3.0
India Mark-II HP Project	Mean			5.5	52.5	47.5	5.0	30.0	22.5	26.0	19.0	7.0	10.0	37.5	5.0	0.0	0.0	47 5	3.0	2.0
	Std DEV			1.5	17.5	13.5	4.0	3.0	14.5	1.0	12.0	6.0	4.0	9.5	4.0	0.0	0.0	18.5	0.0	1.0

Alternative Source used during break down						Villagers perception about syste			System Introduced due to				FELT NEED FOR IMPROVED W/				Reason to choos	
piped	piped	I.M.-II	Pvt H	Well	river	Improve	Tradit.bett	no differenc	Villager	Infl.perso	polatical w	not known	piped H	piped S	I.M-II	Prot. Well	convenience Impr	Tech.
0	0	6	2	11	0	11	1	12	2	4	9	11	17	0	6	5	17	1
1	0	9	2	11	0	22	1	13		18	11	6	21	0	14		22	2
0	1	7	0	6	0	11	7	11	6	6	12	5	17	1	8	2	15	5
0	0	13	2	7	0	14	2	10	5	12	5	4	9	1	13	1	8	6
0	0	4	2	6	0	12	6	11	6	11	3	9	5	3	19	2	10	4
0	0	11	4	4	0	9	6	13	5	7	9	7	12	3	14		12	8
0	0	18	6	8	0	28	0	1	10	10	11	1	29	0	3	0	28	1
0	0	7	7		0	21	8	5	9	6	7	12	12	1	13	8	12	5
0	0	14	1	6	0	20	7	3	10	6	4	10	3	1	17	7	3	4
1	0	5	6	9	0	12	7	5	3	3	4	17	12	1	8	6	17	1
0	0	23	5	37	0	42	8	20	13	33	10	13	32	4	29	3	25	14
0	0	0	0	11	21	16	2	16	4	7	6	18	35	0	0	0	34	0
0	0	10	3	11	2	18	5	10	7	10	8	9	17	1	12	3	17	4
0 3	0.2	5.0	2.1	5.1	3.2	7 0	2 8	4 3	2 8	5 5	2 8	4.1	8.2	1 0	5.8	2 5	6.9	2 8
0.2	0.1	9.4	3.2	7.6	0.0	16.0	4.5	8.4	6.2	8.3	7.5	8.2	13.7	1.1	11.5	3.9	14.4	3.7
0.3	0.2	3.7	2.0	2.0	0.0	5.4	2.8	3.9	2.3	3.6	2.9	3.6	5.8	0.8	4.2	2.6	5.4	2.0
0.0	0.0	11.5	2.5	24.0	###	29.0	5.0	18.0	8.5	20.0	8.0	15.5	33.5	2.0	14.5	1 5	29.5	7.0
0.0	0.0	11.5	2.5	13.0	###	13.0	3.0	2.0	4.5	13.0	2.0	2 5	1.5	2.0	14.5	1 5	4.5	7.0

e the system		Willingness to contribute by shari			Quality of water received				Quantity	Annual brea	Time laps	Average hrs	Reason for break down		
maintenance	Managemen	Capital	labour	no contributi	good	dirty/colou	bad odou	bad taste	coleected(	down in (	to restore	of supply/d	electric failur	D/S net work	mechanical f
7	3	11	16	1	14	4	0	3	16	177	5-90	1 7	129	108	40
8	3	17	17	2	34	1	0	0	17	112	3-20	3 2	64	44	4
7	1	6	17	6	20	4	1	1	37	114	2-10	3.7	77	32	28
7	2	7	13	3	24	2	0	0	21	118	2-30	2.4	62	44	42
10	5	6	18	3	25	3	0	0	27	101	1-10	2.5	76	35	0
7	2	6	17	4	28	1	0	0	20	123	3-20	3.5	84	33	6
3	0	11	14	4	33	0	0	0	10	87	2-10	6.4	86	35	10
12	4	8	22	0	27	4	1	0	21	118	2-15	2 2	74	65	60
15	6	4	13	8	3	8	15	0	19	143	2-10	1 7	89	46	40
4	5	6	15	2	23	3	1	1	20	175	1-8	3 3	94	66	27
23	5	19	38	9	62	6	1	1	17	16	1-10	24	0	0	0
0	0	9	26	0	21	11	1	2	9	60	30-60	24	0	0	0
9	3	9	19	4	26	4	2	1	20	112		7	70	42	21
4.3	1.7	3.6	4.9	2.3	8.9	2.3	2.2	0 8	4.9	30 7		5 8	25.4	19 8	18.1
8.0	3.1	8.2	16.2	3.3	23.1	3.0	1.8	0.5	20.9	126.8		3.1	83.5	50.8	25.7
2.6	1.5	2.9	2.0	1.8	6.5	1.6	2.6	0.7	4.6	22.9		1.0	12.9	17.3	16.6
11.5	2 5	14.0	32.0	4.5	41.5	8.5	1.0	1.5	13 0	37.9		24.0	0.0	0 0	0.0
11.5	2.5	5.0	6.0	4.5	20.5	2.5	0.0	0.5	4.0	22.1		0.0	0.0	0.0	0.0

	Villagers perception about functionl			Reason for unsatisfactory working				% paying in	Reason not to pay				Willingness to pay for	
HP spare/s	good	satisfactory	poor	highly techni	poor mal	poor manag	no demand	present s	Inadeq. w/s	unreliable &	Unimproved	Not demand	Rs. 80-100	Rs. 80-6
0	0	4	24	6	9	8	0	14	3	11	3	3	2	1
0	5	14	17	5	7	10	0	47	0	18	8	4	0	0
0	4	8	16	5	7	9	0	32	0	8	6	0	0	1
0	3	10	11	5	3	13	0	54	0	5	0	8	0	3
0	4	4	15	4	3	10	4	10	5	3	3	12	0	0
0	1	8	18	5	7	10	0	28	2	7	3	7	0	0
0	1	20	12	0	23	10	0	82	7	6	6	0	0	1
0	1	8	21	6	9	13	3	18	7	7	3	12	6	6
0	3	8	16	4	8	11	1	27	9	3	1	11	3	0
0	5	8	10	4	7	9	1	39	6	8	2	8	1	1
16	14	39	17	0	19	38	0	0	0	1	13	43	0	0
60*	1	11	23	19	0	16	0	0	19	0	16	0	0	0
1	4	12	17	5	9	13	1	29	5	6	5	9	1	1
2.6	2 4	6 3	3 3	2.5	4.3	4 6	1 0	18.0	4 0	3 4	3.7	7.0	1.3	1 1
0.0	2.7	9.2	16.0	4.4	8.3	10 3	0.9	35.1	3.9	7.6	3.5	6.5	1.2	1.3
0.0	1.6	3.3	3.2	1.1	3.2	1.2	1.1	16.3	2.9	2.9	1.9	3.8	1.5	1.3
16.0	7.5	25.0	20.0	9.5	9.5	27.0	0.0	0.0	9 5	0.5	14.5	21.5	0.0	0.0
0.0	6.5	14.0	3.0	9.5	9 5	11.0	0 0	0.0	9.5	0.5	1.5	21.5	0.0	0.0

nd reliable water supply system				Villagers perception for a sustainability			
Rs 60-4	Rs 40-2	Rs. < 20	no payme	Comm part.	privatisation	Simple tech	Dem.orient.
4	6	15	0	11	5	1	8
7	10	15	4	3	5	9	19
5	7	11	3	0	3	8	9
5	5	9	2	1	5	10	12
4	14	5	6	5	3	10	4
4	11	9	5	1	2	8	5
12	15	1	2	8	7	2	15
10	7	0	1	10	6	7	8
6	12	4	3	4	4	15	2
3	23	0	0	3	10	4	6
7	24	29	9	14	10	13	16
2	9	23	1	0	3	13	19
6	12	10	3	5	5	8	10
2.2	4.7	7.1	2.0	3.8	2 0	3 3	5 0
6.0	11.0	6.9	2.6	4 6	5.0	7.4	8.8
2.2	4.0	4.9	1.6	3.1	1.6	3.1	4.0
4.5	16.5	26.0	5.0	7 0	6.5	13.0	17 5
2.5	7.5	3.0	4.0	7.0	3.5	0.0	1.5

INSTITUTION LEVEL INFORMATION

Designat. of official	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
Chief Engr	1*	1	2	1	2	2	1&5	2	3	2	1	2	5	3	1	2&3	1	1	5
Mat. Mang	2	2	2	2	2	4	1&5	2	1&2	2	1&4	0	0	0	0	0	0	0	0
EE1	1	1	2	2	2	2	1	2	2	2	1	2	5	1	1	1	1	1	2
EE2	2&3	2	2	2	2	1	1&5	2	1&2	2		3	5		1		1&2	1	4
EE3	1&2	2	2	1	2	1	1	2	3	2	4	2	2	3	2	2&3	1	1	2
AE1	1	3	2	1	1	4	1	2	2	2	3	3	3	2	2	2	2	1	2
AE2	2	2	1	2	2	4	1&4	2	2	2	3	2	1&2	2	1	4	2	1	2
AE3	1*	1*	1	2	2	4	1	1	2	2	1&4	3	2	2&3	1	2	1	1	2
AE4	1	1	1	2	2	4	1	2		2		2		2	1		2	1	2
AE5	1*	1	2	1	1	4	4	1		2	4	2	2&3	2&3	1	2	1&2	1	3
AE6																			
JE1												2	1&2	3	1	4	4	1	2
JE2												2		3		4	1	1	2

DESCRIPTION	CODE 1	2	3	4	5
A : Agency to set goal and policies	JNM	State G	GOI	NR	
B : Agency to approve OPEX & CAPEX	JNM	State G	GOI	NR	
C : Whether budget is consonant and adequate	Yes	No			
D : Agency authorised to change organisational	JNM	State G	GOI	NR	
E : Agency to approve the tariff for water supply?	JNM	State G	GOI	NR	
F : Record of obtaining tariff approved?	Norm a	app wit	rarely a	NR	
G : How does the project and activities approved	fit with c	IRR	Size	Cons D	PH risk
H : Is it an commercial organisation?	Yes	No			
I : How do the operating expenditure meet out?	Cost re	Govt.su	Capital fund		
J : level of revenue received for OPEX	Adequa	Inadequate			

DESCRIPTION	CODE 1	2	3	4	5
K : way to maximise the cost recovery?	Promot.	Reduc	Comme	PA & P	NR
L : How do the water supply function?	Succes	Satisfac	poor		
M: Reason for performance not being upto	Lack of	Lack of	SOA	LPP	OPEX FC
N : How the performance can be improved	Imp IM	DOA	Improv	PA	
O : Do you interact directly to the consumer	Yes	No			
P : How operating expenditure can be redu	PP	Reduc	Automa	Cann't redu	
Q : Most responsible person for operation a	Oper S	JE	AE	EE	
R : Do you receive consumers complaints?	Yes	No			
S : How quickly their problem is rectified?	24 hrs	7 days	15 days	30 days	>30 days
S : How quickly their problem is rectified?	24 hrs	7 days	15 days	30 days	>30 days

SOA · Supply Oriented Approach
LPP : Lack of people's participation
DOA : Demand oriented approach
PA People Awareness
IM : Internal Management
OPEX FC· financial constraints for operating expend

GENERAL INFORMATIONAND COVERAGE STATUSOF THE VILLAGE SURVEYED AS PER RGDWM REPORT

Village name	Census code 1991	Pop as per 1991 ce Total	Pop as per 1991 ce SC/ST	No, of habitation	W / S facility available in the village SP WOT	PSP WT	Pvt HC	HP IM-II	Pop Covered Total	Pop Covered SC/ST	% Cover
Tikari											
Suswahı	1296	2357	219	4	8	0	146	8	2357	219	100 0
Saraı Dengan	1314	2253	144	4	5	0	24	3	1133	144	50.3
Muradeo	1313	2240	148	2	7	0	34	3	2240	148	100 0
Kurhuwan	1312	1347	126	4	8	0	19	3	1347	126	100 0
Bachchhav	1305	4832	823	8	13	0	49	4	3204	823	66.3
Dafi	1323	798	0	5	7	0	92	4	772	0	96.7
		13827	**1460**	**27**	**48**	**0**	**364**	**25**	**11053**	**1460**	**79.9**
Kandava											
Jalalıpattı	1285	2587	131	2	0	3	215	4	1500	131	58.0
Kakarmatta	1232	3342	250	1	2	3	72	6	2750	250	82 3
Nasırpur	1295	1793	218	4	0	2	0	4	1330	318	74 2
Kashıpur	1204	1018	199	3	0	3	19	2	1018	199	100 0
Nıdeora	1202	279	0	1	0	0	32	1	250	0	89 6
Karanadandı	1199	1967	33	9	0	6	32	3	1766	33	89 8
Rampur	1209	587	8	2	0	4	12	1	587	8	100.0
		11573	**839**	**22**	**2**	**21**	**382**	**21**	**9201**	**939**	**79.5**
Cholapur											
Dharsauna	445	3546	1116	3	3	0	51	14	3546	1116	100.0
Katarı	437	4174	1389	4	3	0	53	20	4174	1389	100 0
Bhawanıpur	444	760	0	4	0	2	24	4	760	0	100 0
		8480	**2505**	**11**	**6**	**2**	**128**	**38**	**8480**	**2505**	**100.0**
Jansa											
Jalalpur	1041	1150	215	2	5	0	7	7	1150	215	100.0
Mohd,pur	1045	1390	253	3	3	0	32	2	1241	253	89.3
Jansa	1049	2143	105	5	8	0	48	8	2143	105	100 0
		4683	**573**	**10**	**16**	**0**	**87**	**17**	**4534**	**573**	**96.8**
Baragaon											
Gopalpur	306	453	123	2	5	0	3	2	453	123	100 0
Babatpur	291	1384	554	1	4	0	31	5	1384	554	100 0
Sısawan	56	2103	673	2	9	0	19		2103	673	100.0
		3940	**1350**	**5**	**18**	**0**	**53**	**7**	**3940**	**1350**	**100.0**
Chaubeypur											
Kauwapur	469	788	130	3	0	0		5	788	130	100 0
Paranapur	467	1123	345	4	0	0		7	368	250	32 8
Sungulpur	476	1663	426	4	8	0		9	1563	391	94 0
Gauraupanw	478	2671	679	5	7	0		13	2537	679	95.0
		6245	**1580**	**16**	**15**	**0**	**0**	**34**	**5256**	**1450**	**84.2**
Lohata											
Lohata		12394	618	1	5	0	678	7	8780	618	70 8
Mahmoodpur	1222	2997	625	1	0	0	153	8	2000	625	66.7
		15391	**1243**	**2**	**5**	**0**	**831**	**15**	**10780**	**1243**	**70.0**
HP plain											
Bhimchandı	1144	293	293	1	0	0	0	11	293	293	100.0
Deepapur	1146	1082	0	1	0	0	0	4	1000	0	92.4
Dhadhorpur	1156	1291	218	1	0	0	0	6	1291	218	100 0

		2666	**511**	**3**	**0**	**0**	**0**	**21**	**2584**	**511**	96 9
Pakhopur	155	768	207	2	0	0	0	3	578	177	75.3
Kavar	154	1447	347	2	0	0	0	4	1000	234	69.1
Naraıcha	1092	619	328	2	0	0	0	2	619	328	100.0
Ramdeeh	822	920	340	3	0	0	0	3	750	340	81 5
		3754	**1222**	**9**	**0**	**0**	**0**	**12**	**2947**	**1079**	**78.5**
HP rocky											
Jamsotı	480	457	381	1	0	0	0	4	457	381	100 0
Lauwarıkala	488	132	128	1	0	0	0	3	132	125	100 0
Lauwarıkhurd	489	284	201	1	0	0	0	3	284	201	100.0
		873	**710**	**3**	**0**	**0**	**0**	**10**	**873**	**707**	**100.0**
Chahania											
Chahanıya	76	912	162	3	3	0	162	0	578	162	63 4
Gurera	92	655	96	2	1	0	34	1	655	96	100 0
Kalyanpurkala	87	672	0	1	1	0	11	0	672	0	100 0
Derawakhurd	67	634	202	2	0	0	0	2	421	202	66 4
Saraı	73	1713	731	4	1	0	24	2	1713	731	100 0
Suratapur	113	1522	437	3	1	0	13	6	1477	437	97 0
		6108	**1628**	**15**	**7**	**0**	**244**	**11**	**5516**	**1628**	**90.3**
Naugarh											
Majhagavan	569	1698	611	12	0	0	0	10	1301	506	76.6
Baravadad	567	153	134	1	0	0	0	4	153	134	100 0
Devara	566	768	257	2	0	0	15	2	500	172	65 1
Naugarh	535	546	8	1	0	0	58	3	546	8	100.0
Bagahı	534	2076	658	1	0	0	117	20	2076	658	100 0
Bharvatıa	541	732	233	1	0	0	0	7	732	233	100.0
		5973	**1901**	**18**	**0**	**0**	**190**	**46**	**5308**	**1711**	**88.9**
Sakaldeeha											
Sakaldeeha	328	4982	1135	2	2	2	538	9	2750	1135	55 2
Belpur	359	810	354	2	1	2	112	5	810	354	100 0
Bishunpur	341	701	101	4	0	0	98	1	397	101	56 6
Hariharpur	323	418	257	2	0	0	0	4	418	257	100 0
Tajpur	331	2323	696	4	0	0	68	7	1815	696	78 1
Chakaria	362	363	85	2	0	0	0	2	363	85	100 0
		9597	**2628**	**16**	**3**	**4**	**816**	**28**	**6553**	**2628**	**68.3**
HP rocky sonbhadra with hha											
Dighul	168	2403		8	0	0	0	6	1500		62.4
Khokhar	126	296		2	0	0	0	5	296		100.0
Manvansa	135	876		4	0	0	0	5	750		85.6
		3575	**0**	**14**	**0**	**0**	**0**	**16**	**2546**	**0**	**71.2**
HP plain Ballia with hha											
Khejuri	182	7222	937	12	0	0	0	51	7222	937	100.0
Masumpur	138	2896	458	5	0	0	0	21	2896	458	100.0
Pandaha	136	3631	974	7	0	0	0	30	3631	974	100 0
		13749	**2369**	**24**	**0**	**0**	**0**	**102**	**13749**	**2369**	**100.0**

ANNEXURE-D

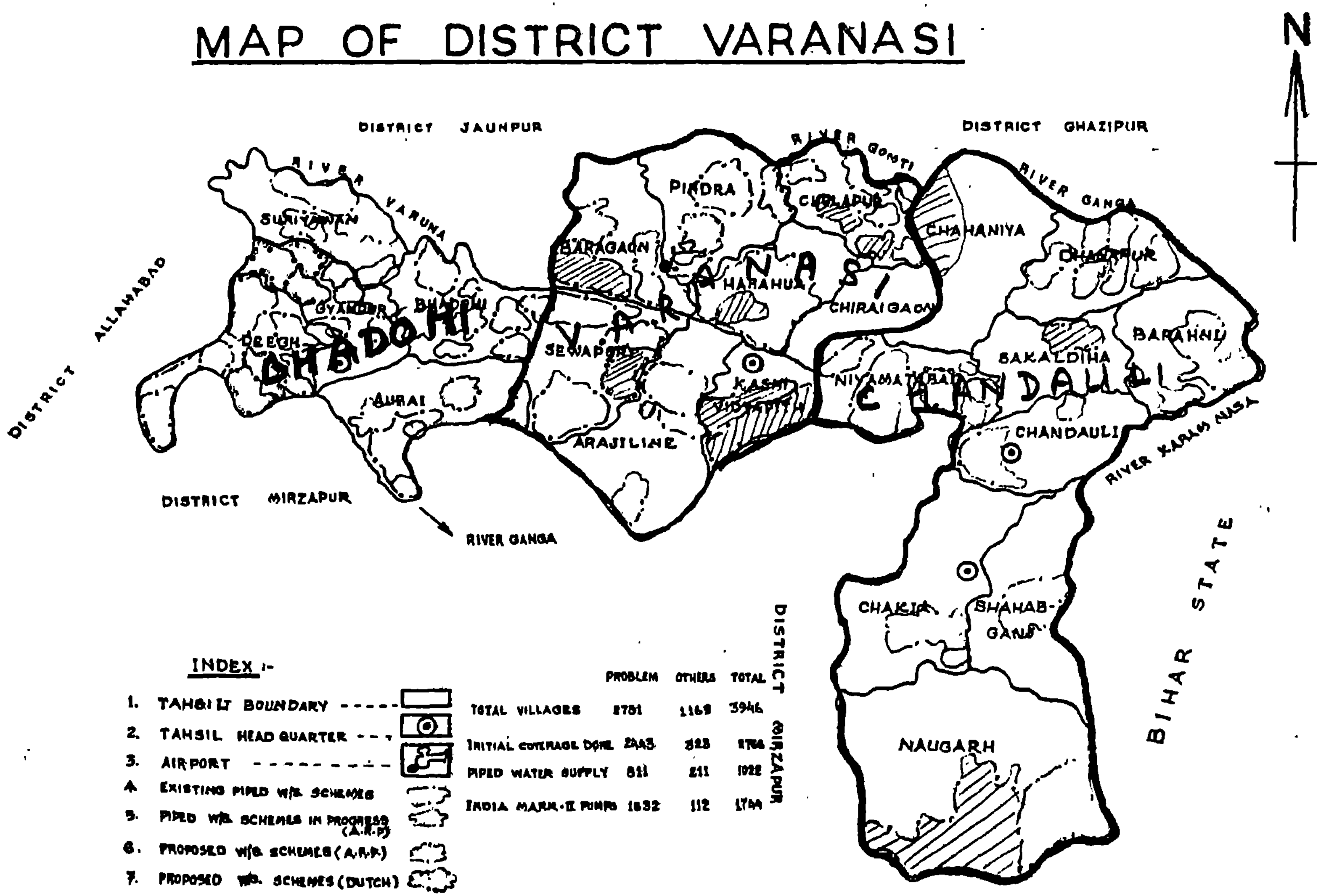
OBSERVATIONS FROM INDIA-MARK-II HP

WATER COLLECTION AND DISTANCE TRAVELLED FOR WAIER COLLECTION

Time	6-7A.M		7-8 AM		8-9 AM		9-10AM		10-11 AM		11-12 Noon		12-1PM		1-2PM		2-3PM		3-4PM		4-5Pm		5-6PM	
Distance	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
General Basti																								
0-10m	2	30	2	45	3	40	0	0	3	54*	2	30	1	20*	0	0	1	10	2	30	1	10	4	60
10-30m	3	42	4	70	8	140	0	0	1	21*	0	0	4	40	0	0	0	0	0	0	1	10	7	105
30-50m	0	0	3	65	0	0	5	110	0	0	3	40*	0	0	0	0	1	10	2	20	1	20	1	10
50-100m	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
100-150m	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
150-250m	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	5	72	9	180	11	180	5	110	4	75*	5	70	5	60	0	0	2	20	4	50	3	40	12	175
Harijan Bsti																								
0-10m	2	30	0	0	1	20	0	0	0	0	2	30*	0	0	0	0	1	20	0	0	0	0	0	0
10-30m	7	100	8	140	4	70	4	60	4	60*	5	70*	1	20	1	20	5	60	7	90	2	40	3	30
30-50m	4	80	1	10	6	100	7	110	7	100	0	0	2	40	3	60	1	20	0	0	1	10	7	110
50-100m	0	0	0	0	2	40	0	0	0	0	0	0	0	0	1	20	0	0	0	0	0	0	0	0
100-150m	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
150-250m	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	11	120	9	150	13	230	11	170	15	160	7	100*	3	60	4	80	7	100	7	90	3	50	10	140

A- number of person came collected water ; B – quantity of water collected in litres

MAP OF DISTRICT VARANASI



REFERENCES:

1. Akosa,G.; Franceys, R.; Barker,P.; Jones, T.M. "*Efficiency of Water Supply and Sanitation Project in Ghana*" . Journal of Infrastructure Systems, Vol.1 No. 1, March 1995.
2. Asthana, A.N.; "*Household Choice of Water Supply Systems*"; 23rd WEDC conference ; 1997
3. Atlof, M.A. ; Whitton,D.;Jamal,H,;Smith,V.K., "*Rethinking of Rural Water Supply Policy in Punjab*"; Pakistan." Water Resource Research WRERAQ; vol. 29 ,No.7, July 1993
4. Aziz,K.M.A.;Hoque, B.A.;Huttly,S.; Minnatullah,K.M.;Hassan ,Z,;Patwary,M.K; rahman,M.M.; Cairnocross, S.; "*Rural Water Supply, Sanitation and Hygiene Education*" ,UNDP-World Bank Water sanitation Programme, Washington D.C. 1990
5. Bamberger, m.; and Hewitt, Eleanor; Monitoring and Evaluation, "*Urban Development Programmes*"; World Bank Technical paper No.53, 1986
6. Baum,W.C.; Tolbert,S.M.; "*Investing in Development-Lessons of World Bank Experiences*"; Oxford, U.K., oxford press,1985.
7. Briscose,J.; Ferranti,D. "*Water for Rural Community; helping people themselves* " World Bank, Washington D C.,1988
8. Cairncross,S.; Carruthers,I,; Curtis,D.: Feachem,R.; Bradely,D., Bldwin,G.' "*Evaluation For Village water supply Planning.*" WHO-International reference Centre for community water supply.
9. Churchill,A.; "*Rural Water Supply and Sanitation; time for a change*" Washington, DC, USA, World Bank, 1987.
10. Corrie,R.K.; " *Project Evaluation*" Thomas TelfordLtd London.
11. Dworkin,D.; "*Rural Water Projects in Tanzania; Technical, Social and Administrative Issue*" (AID Evaluation special study; No. 3) Washington, DC USA. 1980a
12. Dworkin,D ; "*The Potable Water Project in Rural Thialand*" (AID Project Impact Evaluation Report No.3) DC,USA, 1980b
13. Dworkin,D; "*Community Water Supply, Evaluation Summary*" conference working paper, Washington, DC , USA, 1982.

14. Esrey; Steven, A.;Habicht; Jean Pierre; "*Epidemiologic Evidence for Health Benefits from Improved Water and Sanitation in Developing Countries*" Epidemiologic Review, vol. 8; p.117-128, 1986

15. Evaluation Report On Accelerated Rural Water Supply Programme; Programme Evaluation Organisation; Government of India; September 1996.

16. Falken, Mark, M.; "*Rural Water Supply and Health, the need for a new strategy*"; Summary of papers and discussions from the United Nations international seminar on rural water supply , Uppasala, Sweden, 6-17 October 1987.

16 Feachem, R.;Mc garry, M.; Mara,D."*Water Waste and health in hot climates*". Awiely Interscience Publications.

17 Final Report on study of Operation and Maintenance Cost-March 1993.

18 Financial Indicators- Water and Sanitation Utilities-TUWUS – world Bank June 1994

19 Financial management of Water Supply and Sanitation; A hand Book; WHO

20 Franceys,Richard;"*anagement of Water Utilities in Low Income Countries, India and Uganda*" Unpublished MBA thesis, Loughborough University of Technology, U.K., 1994a

21 Franceys, Richard; "*Community and Management*" unpublished lecture notes, WEDC, Loughorough University of Technology, U.K.,1994b.

22 Franceys, Richard; " *Management and Administration*" Unpublished lecture notes, WEDC, Loughborough university of Technology, U.K, 1995a

23 Franceys, R.W.A; "*Management, Maintenance and operation of Rural Water Supply and Santation Systems*"; world Health Organisation, Alexandia, Egypt; 1989.

24 Ganley, J.A.; Cubbin, J.S.; "*Public Sector Efficiency Measurement*" Queen Mary and Westfield College, Univercity of London, U.K.

25 Gosh,G.;Mazumdar,K.; Dubey, A.K; chander,J.; "*Water Supply in Rural India*" New Delhi-1995

26 Guidelines for project evaluations- United nations 1972

27 Guide lines –Water and Waste Water Institution-WASH Technical ReportNo.37 , Feb 1988

28 Hardner ,J.J. ;'*Measuring the Value of Potable Water in partially monetized Rural Economics*';Water ResourceBulletin, vol.32 No.6. Dec 1996

29 Indo – Dutch Review Misson—Report-17and U.P. –37; 1989,1996

30 Jurg,A.; Alfonso,J.F.; Reiveld,L.C.; *"Water Supply and Health Benefits; Explorıng The Vıews of Potentıal Users of Rural water Supply Systems"* Water Supply,vol.14 No.3-4 ,1996

31 Kayuga, sam K.; *"Marketıng of Watsan Services"*; NWSC ., Uganda"; Water Engineering and Development Centre, Loughborough University, U.K.; 1997

32 Kiya,a.; Hardin,S.; *"Functıonıng and Utilisatıon of Rural water Supply in Sarak Malasia'"* Bulletin of WHO,A6; vol,70 No.1992

33 Michael,Q.P.; *"Qualıtatıve Evaluatıon and Research Methods."* SAGE Publications

34 Minimum Evaluation Procedure(*MEP*) for the water supply and sanitation projects- WHO,

35 Narayan,D.; *"Partıcıpatory Evaluatıon- Tools ın Managıng Change ın water and Sanitatıon,* The World Bank;

36 Nicolas , P.; *"Socıal Survey Methods- A field Study Guıde for Development workers",* Oxfam , Oxford,1991

37 Pant,S.K.; *"How Relevant Are the Water Supply Programme?"* Economıc and Political Weekly, December,1996

38 Patricia Byrnes; Vivian Valdmanis; *"Analysıng Technıcal and Allocatıve Efficıency of Hospıtals"*

39 Performance Indicators for selected water supply and sanitation Utilities ın Ecuadors. WASH, field report No. 376, Nov. 1992

40 Pyakural,D.C.; *"Strategies for System Sustaınabılity Of Larger Water Supply wıth reference to case studies ın Nepal."* M.Sc. Thesıs EE-58(1992)

41 Randall,A.; Hoelan,J. and Brookeshire,D., *"Contingent Evaluatıon Survey for Evaluating Environmental Assets";* Natural Resources Journal No. 23, 1983

42 Rebein,C.C.; *"Partıcıpatory Evaluatıon of Development Assistance-Dealıng wıth Power and facılitatıve Learnıng."* Evaluation vol. 2(2), 1996.

43 Schaik,H.P.J.van; *"Monıtoring and Evaluating Sector Actıvitıes."* Lecture Note IHE Delf,1996-97

44 Sarswat,R.D., *"Evaluatıon of Quality parameters and possibilitıes of community management ın gravitry fed rural water supply scheme in Garhwal(Indıa)".* M.Sc.Thesıs.EE-159(1994)

45 Shadish, W.R.; Cook, T.D.; Leviton,L.C; *"Foundation of Programme Evaluation"* SAGE Publication

46 Singh,B.; Ramasubban, R.;Bhatia,R.;Briscose,J. Griffon, C.C.; *"Rural water supply in Kerala, India- How to Emerge from the Low Level Equilibrium Trap."* Water Resource Research WRRERAQ ; vol29, No. 7, july 1993

47 Smith V.K.; Desvonges, W.H.; *"Measuring Water quality Benefits"* Kluer Nijhoff Publishing,1986

48 Valdez, Josef, Bamberger,M.; *"Monitoring and Evaluation of Social Programme in Developing Countries"*; The World bank Washington. D.C. (1994)'

49 Verma,B.L.; Srivastava,R.N., *"Measurement of Personal Cost of Illness Due to Some Major Water Related Diseases in an Indian Rural Population"*. International Journal Of Epidemiology vol. 19, No1; 1990

50 Warner, D.B.; *"Rural water supply and sanitation planning- the Use of socio Economixc precondition in project identifications"*.Journal of hydrology vol. 68,1984

51 Whittington , D. briscse, J.;Mu,X.:;Baron,W.;Duuval J.M;. *"Willingness to pay for Water in Rural areas; Methodological Approaches and an Application in Haiti"* WASP field Report No.213,Sept 1986

52 White ,J.; *"Evaluation Synthesis of Rural Water supply and Sanitation Project"* Evaluation Report EV 596,U.K. ,1997

53 World Development report; 1986

54 World Development report; 1992

55 World Development report; 1996

56 Young,R.A. ;*'Measuring Economic Benefits for water Investment and policies"*; world Bank Technical paper no 338, Washington, DC, USA, 1996