

**VIET NAM – NETHERLANDS PARTNERSHIP  
WATER FOR FOOD AND ECOSYSTEM (WFE)**

# **FINAL REPORT**

**Additional case study # 2**

**Impact of Rural water supply system to livelihood  
and environment in Nam Hong commune ,  
Nam Truc district , Nam Dinh province.**



**Ha Noi, May 2008**

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# IMPACT OF RURAL WATER SUPPLY SYSTEM TO LIVELIHOOD AND ENVIRONMENT IN COMMUNE NAM HONG, DISTRICT NAMTRUC, PROVINCE NAM DINH

## I. PROJECT INTRODUCTION

### I.1. Geographic location

Commune Nam Hong (in district Nam Truc, province Nam Dinh) is one of 21 communes of district Nam Truc which lies in the East of district Nam Truc, 105 km South of Ha Noi, 15 km South of Nam Dinh city and along national road No 21. The commune surrounds by commune Tan Thinh in the North, commune Nam Hoa and Nam Loi in the West, commune Nam Thanh in the South and Red river in the East (as map below). This is a large commune of district Nam Truc that is unified by communes Nam Hong and Nam Trung.

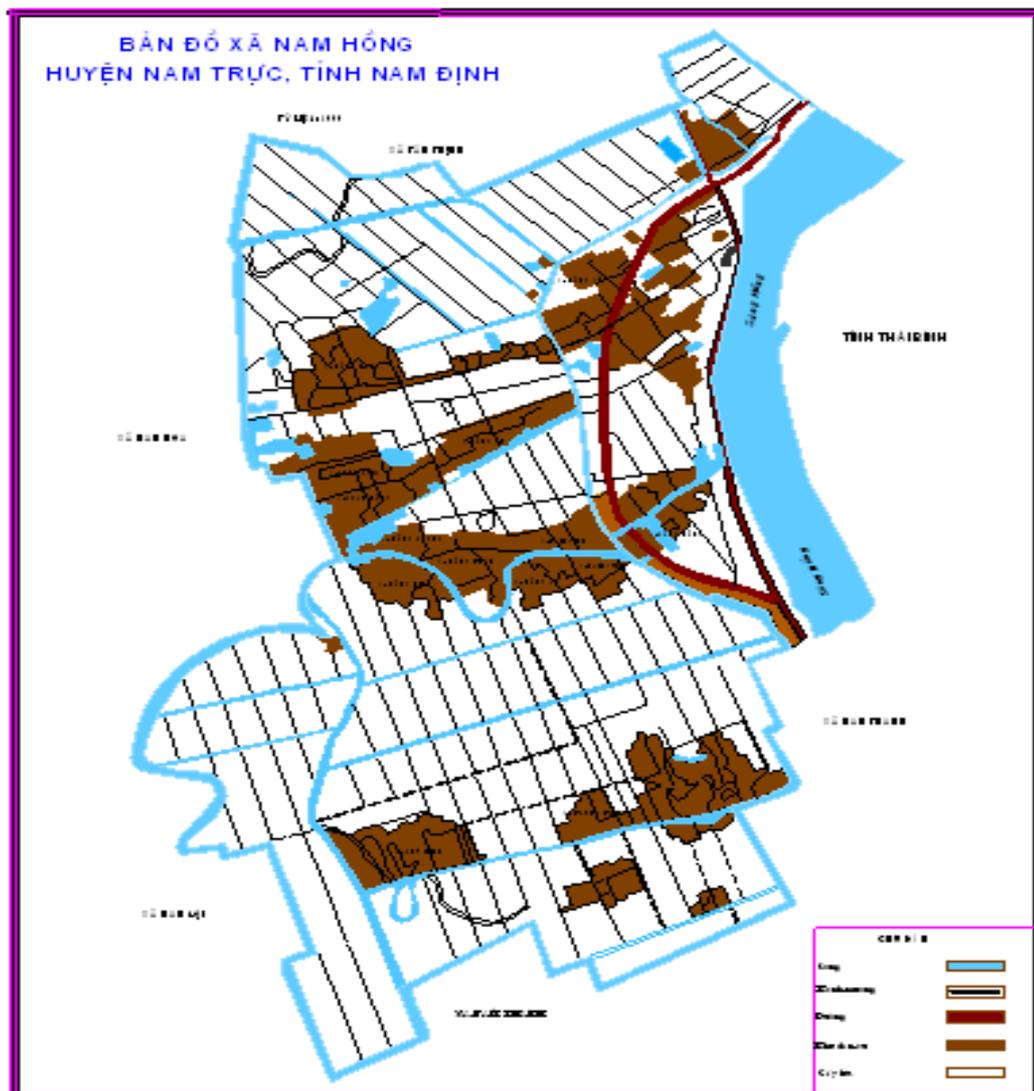


Figure 1: Map of commune Nam Hong



## **I.2. Population**

Total area of commune Nam Hong is 791.1 ha, population of 12000 habitants in 3000 households. The population is distributed mainly in 3 areas: area 1 lies along of the so-call road Yellow, area 2 lies along the so-call White road and last one covers the whole village Lien Tinh. The areas mentioned above are divided into the hamlets as a administrative unit of the commune. There are 21 hamlets in commune Nam Hong such as Phuc Duc, Hong An, Doai Bang, Hong Phong, Hong Ninh, Hong Thai, Hong An, Nam Vuot, Hong Trung, Hong Dong, Hong Tien, Hong Doan, Hong Dai, Hong Cat, Hong Thuong, Hong Long, Phu Binh, Trung Tinh, Phu Tinh, Dong Thanh and Tien Lang, out of which there are 3 hamlets in outside of Red river dike.

In the commune there are 3 primary schools, 2 pre-secondary schools and one medical station. Their houses are built steadily. Many hamlets are awarded the title “Cultural hamlet”.

## **I.3. Production service activities**

- Usually, the cropping parttern is that two crops are grown in year, paddy is main crop. Bisides, many households in area 1 and 2 have grown the third crop like vegetable, maize, potato, groundnut etc. where the soil is suitable. Therefore, agricultural production is dominant and is the key income of people.

- Only some hóueholds in the commune have get a little income from the small-scale production as traditional textle handicraft, carpentry, mason etc..

- Income per capita in the commune is not high, average food per capita is increasing and reaches 560 –570 kg of paddy in 2007.

## **I.4. Infrastructure**

- All households are supplied the electric power from the electric line system.

- The road transport network is in good condition, road between hamlets, villages and neighboring communes are covered by asphalt, bridges are steady in long – live service, the road within the each hamlet are strengthened with the concrete.

- The wastewater collection ditches are also built in some hamlets and wastewater is directly discharged into channel. As a result the water is seriously polluted and is effected the habitat of people.

- All houses of schools and medical station were constructed that satisfied enough the demands of local people.

## **I.5. Clean water supply**

The clean water supply is becoming the actual demand of people. The People's committee of commune Nam Hong pays the great attention to this issue so that to improve the livelihood as well as health of people. The reason is that the traditional domestic water supply is the custom to take from ponds, lakes, wells etc. Meanwhile these sources are polluted and increasingly degraded.

During the period 1987 – 1988, in assistance of the authorities of commune Nam Hong the clean water supply station of small scale was built to provide the clean water for around 100 households. This station nowadays stops working due to the raw water for the station to be polluted and insufficient. It is clear that the convey channel runs through the population settlement area on both sides of channel, people discharge the waste water and throw garbage illegally into channel. The flow in channel during the dry season is too low and depends on the operation of culvert under Red river dike.

Facing with the urgent demand of clean water supply the People's council of Nam Hong commune fully agreed to invest in construction of clean water station that is in accordance with the Decision of Nam Hong commune People's council discussed on 4 its sessions in 2003 and 2004. The finance of the construction was mobilized from the provincial, communal budget and contribution of people in its commune.

The clean water station of commune Nam Hong was started in 2004 and completed to put into operation at the end of 2005. The station is of treatment capacity 60 m<sup>3</sup>/h, storage tank of treated clean water 200 m<sup>3</sup>, total length of pipe 51763 m, the raw water is pumped directly from Red river. This is a reliable source of an abundance of water in river and sufficient quality for purpose of domestic water supply. At present this station provides the clean water for 2000 households with 7000 people.

## **II. OBJECTIVE AND ACTIVITIES**

### **II.1. Objective**

Study, assess the effectiveness of management model for rural water clean supply system at commune Nam Hong, district Nam Truc, province Nam Dinh;

propose an appropriate model for the locality and potential replication to other regions in Red river delta and its neighboring areas.

## **II.2. Project activities**

- Investigation on general information of project area;
- Investigation on the current situation of piped water supply management unit;
- Investigation on the scheme's scale, criteria for evaluating the effectiveness of rural water supply model;
- Study, assessment on water quality;
- Investigation on beneficiaries;
- Analysis, assess and proposal of an appropriate model of piped water supply model.

## **III. INVESTIGATION RESULT**

### **III.1 Investigation and assessment methodology**

Based on the desk (indoor) activities, field survey and investigation of the prepared questionnaire that were designed for 2 target groups. The first target group is the management unit of clean water and the second target group is the households of clean water use. The questionnaire is that they have to compose all necessary information to give sufficient and accurate data for the further use (see annex 1, 2). Total amount of questionnaire have got 211 composing 1 questionnaire from management unit and 210 questionnaires from clean water users. At the same time the meeting with households of no using the clean water of clean water station commune Nam Hong also was held to get more necessary information.

### **III.2 General introduction of water station**

The clean water station of commune Nam Hong is located in right bank of Red river, at Bach Tinh village. It started constructing in August 2004, completed and has provided clean water to households since December 2005. This is a typical clean water piped system in district Nam Truc.

Total cost of construction by balance sheet is 4.780.000.000 VND distributed as below:

- From provincial budget: 1.910.000.000 VND
- From communal budget and households: 2.870.000.000 VND.

The fact is that amount of clean water users is estimated until 2020 in determination of design capacity of the station to be 21958 people. This value is available on the current population and population increasing rate in the commune Nam Hong. Norm of water supply is taken as 80 liter/day per capita. Other stakeholder – users (schools, medical station, organizations within the commune) are also included in determination of capacity of the station. As result, the capacity of clean water station is estimated as 1.120 m<sup>3</sup>/day. With this calculation the conflict on clean water can be avoidable in future. However, at the moment of designing the norm of clean water supply is chosen 80 litter/day per capita is rather high than that is noted in National program on rural clean water and Sanitation.

All head components as primary pump, reaction tank, vertical accumulation tank, raw tank, clean water storage tank and waste residual storage pond are arranged in separated and high place so that to command the water supply. This place previously was a pond, so there is no need to have additional cost for payment of land use.

### **III.3. Construction formality**

- In accordance with the policy the households are mainly stakeholder for responsibility of sustainable development of the rural infrastructure. The State only plays role in assistance and makes the favor conditions for the clean water supply development. In the decentralized administration and strengthening the role of commune authorities, before implementing the clean water station the People's committee of commune Nam Hong has carried out the meeting to discuss the construction of clean water station as the big measure of improving livelihood of people. The people in the commune discussed and gave the opinion to the clean water station. This fact shows the democracy in such way that all people know, discuss, do and control. Consequently, households will be actively participated in construction of clean water station expressed in contribution of their money and labor to the management and operation.

- The clean water station at commune Nam Hong refers to the group of capital infrastructural construction, so it has the investor- stakeholder to be pointed. Usually, the rural clean water station just as the station at commune Nam Hong is of small scale. Regarding to the decentralized administration the investor-stakeholder of this station is the People's committee of commune Nam Hong.

- To construct the station the confirmation document on land tenure under head components also issued.

- Following the request of commune Nam Hong, the constructing the clean water station has been fulfilled the following administrative formalities:

+ Decision No 1322/2004/QD-UB on 9 June 2004 of People's committee of province Nam Dinh on approval of technical design and total cost estimation of water supply system at commune Nam Hong, district Nam Truc, province Nam Dinh.

+ Decision No 2059 /2004/QD-UB on 16 August 2004 of People's committee of province Nam Dinh on approval of bid result of constructing the water supply system at commune Nam Hong, district Nam Truc, province Nam Dinh.

+ Decision No 633/2006/QD-UB on 3 March 2006 of People's committee of province Nam Dinh on approval of balance sheet of capital investment of construction of clean water supply system at commune Nam Hong, district Nam Truc, province Nam Dinh.

+ Permission letter on exploitation of surface water of 1727/GP-STNMT on 29 December 2006 of Department of Resources and Environment of province Nam Dinh.

+ Warning sign for waterway has been put up for reminding boats run in Red river not to damage the suction tube.

#### **III.4. Current physical situation of system**

The piped clean water supply at commune Nam Hong has composed of the following items:

- Primary pump station;
- Reaction tank;
- Vertical deposit tank;
- Preliminary purification tank;
- Gravity filtration tank (sand-filtration tank);
- Clean water storage tank;
- Secondary pump station, and
- Conveyance pipe system.

##### *Primary pump station*

The primary pump station lies in the right out bank of Red river that pumps water into the reaction tank, then flows into the deposit tank. Due to avoid the submerge of pump set including the electrical motor during the flood season, the pump set has been laid on the concrete frame (annex 3) The primary pump station consists of 2 sets of Italian manufacturer type CN 50 –100 with the technical

specifications  $Q = 60 \text{ m}^3/\text{h}$ ,  $H = 20 - 25 \text{ m}$ ,  $N = 7.5 \text{ KW}$ , suction and pressure tube is steel of diameter  $D = 150 \text{ mm}$ .

#### *Reaction tank*

This tank is arranged at center of the vertical deposit tank, the chemical used for the deposition of suspended matter is the precipitator APC or alum. Its dose depends on the content of alluvium in water. In the flood season the dose is rather than in the dry season respectively 35 mg/liter and 10 mg/liter.

#### *Vertical deposit tank*

The aim of this tank is that it reduces the suspended substance before the water flows into the sand-filter tank. This tank has 4 sections, each section is of dimensions  $1.75 \times 1.75 \times 4.0 \text{ m}$ .

#### *Gravity filtration tank*

This tank is consists of 4 sections , each section is of dimensions  $1.75 \times 1.75 \times 4.0 \text{ m}$ . Especially, the sand used here is the quartz sand.

#### *Clean water storage tank*

This tank is necessary for any clean water station to keep clean water after treatment of the raw water. This tank has volume of  $200 \text{ m}^3$  in 4 sections, each section is of dimensions  $8.4 \times 8.0 \times 4.0 \text{ m}$ .

#### *Secondary pump station*

This station has 3 pumps (see annex 4) of which 2 pumps directly discharge the clean water into pipe system from the storage tank. These 3 pumps are also manufactured in Italy, technical specifications  $Q = 92 - 107 \text{ m}^3/\text{h}$ ,  $H = 32 - 28 \text{ m}$ ,  $N = 15 \text{ KW}$ . The other pump is used for cleaning the tank, technical specifications:  $Q = 150 - 180 \text{ m}^3/\text{h}$ ,  $H = 20 - 15 \text{ m}$ ,  $N = 15 \text{ KW}$ .

#### *Disinfection*

To disinfect the treating water the chlorine is used that is injected into flowing water by injector on connector pipe.

#### *Electric power*

The clean water station has no its own transformer. The electric power is supplied and transmitted from the common multi-purpose transformer at distance of 500 m away by electric line AC – 50.

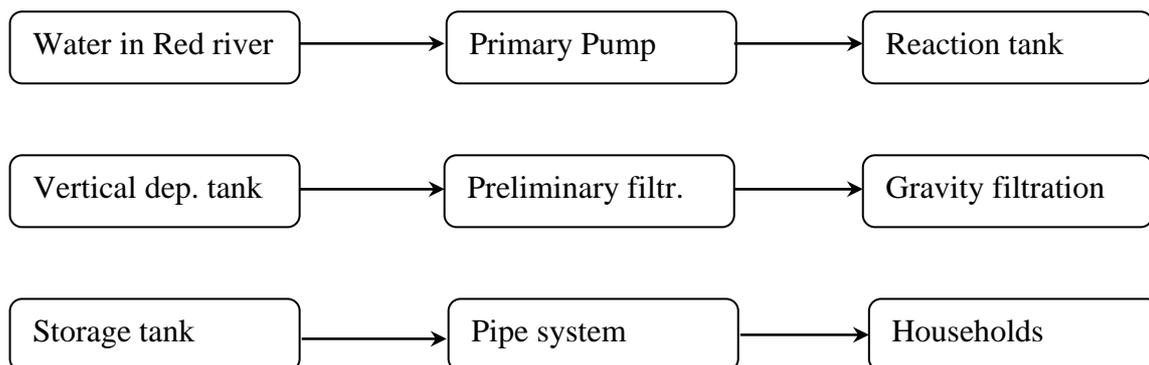
### *Waste residue accumulation pond*

Any clean water station always requires the sufficient volume of the residual substance accumulation after treating the raw water. This requirement is for purpose of environment protection. That is why the pond of volume of 4100 m<sup>2</sup> is reserved nearby for the residual substance accumulation.

### Pipe system

The pipe system of clean water supply station is different in diameter and its material, mainly PVC, PE. The diameter is determined by the hydraulic formula, total length is 51.5 km , of which main pipe of diameter D = 200-140 mm, 4.5 km long; pipe of diameter D = 140 –125 mm, 3.5 km long; pipe of diameter D = 90 – 76 mm, 5.8 km long; pipe of diameter D = 63 – 50 mm, 15.3 km long; pipe of diameter D = 32 mm, 21.8 km long and the main pipe 0.6 km long.

Water treatment technology scheme is described as below:



It is seen that all items of clean water supply system of commune Nam Hong have been constructed in integrated way, it just put into operation since December 2005. In other words this system has been operated for 26 months. During the period of construction, the People’s committee appointed some people to work together the supervision consultants to supervise the construction works as well as to get experience.

The operation of the clean water supply system follows strictly the procedures. In addition, all staff and technicians of the management unit have worked with high responsibility that each person is in charge of his own task. Therefore, the system now is in good condition and has a long time in service in comparison with the design service life as below:

Items	Design service life (year)
Pump	10 – 20
Pump house	20 – 25
Plastic pipe	15 – 20
Water treatment station	20 – 25

The fact is that the pressure along the pipe is high because of direct pumping that the pipe is designed to choose the plastic pipe (PVC), so the broken pipe occurred at the beginning of operation. To avoid this breaking the management unit repaired immediately to supply the clean water in time.

The broken pipe between villages or hamlets sometimes causes by people who excavates the ground for the certain aim. To remind people to be careful for pipe the management unit have to put the sign “Water pipe” above the pipe so that whenever every people must be kept out of water conveyance pipe (annex 5).

### III.5. Current situation of operation and management

#### III.5.1 Water supply

The clean water supply system has been designed to provide clean water to all households in the commune, capacity of 1120 m<sup>3</sup>/h. In fact, the current investigation data (table 1) shows that there are 2000 households to use clean water from the water station of commune Nam Hong, 973 households still use the well water and other 27 households are using the clean water from the neighboring water station of commune Nam Thanh.

Table 1 Use of clean water at Nam Hong

No	Hamlet name	Number of households	Number of people	Number of households used water of station Nam Hong	Number of households used well water	Number of households used rain water	Number of households used water of station Nam Thanh
1	Phuc Duc	107	462	84	23	0	0
2	Hong An	187	697	113	74	0	0
3	Doai Bang	112	482	89	23	0	0
4	Hong Phong	118	463	101	17	0	0
5	Hong Ninh	100	392	85	15	0	0
6	Hong Thai	113	429	96	17	0	0
7	Hong An	64	295	45	19	0	0

Management model of clear water at commune Nam Hong *continued*

No	Hamlet name	Number of households	Number of people	Number of households used water of station Nam Hong	Number of households used well water	Number of households used rain water	Number of households used water of station Nam Thanh
8	Nam Vuot	151	551	125	26	0	0
9	Hong Trung	101	395	88	13	0	0
10	Hong Dong	105	399	85	20	0	0
11	Hong Tien	149	601	107	42	0	0
12	Hong Doan	86	374	57	29	0	0
13	Hong Dai	160	280	15	145	0	0
14	Hong Cat	125	450	69	56	0	0
15	Hong Thuong	120	620	51	69	0	0
16	Hong Long	244	1227	90	154	0	0
17	Phu Binh	275	1129	181	94	0	0
18	Trung Thinh	206	871	159	47	0	0
19	Phu Thinh	133	563	93	40	0	0
20	Dong Thanh	177	674	131	31	0	15
21	Tien Lang	167	646	136	19	0	12
	<b>Total</b>	<b>3000</b>	<b>12000</b>	<b>2000</b>	<b>973</b>	<b>0</b>	<b>37</b>

As discribed in rules of clean water supply system of commune Nam Hong, all households have to install the water meter if they want to use the clean water. The cost of the water meter installation bears on the water user. The technicians of the management unit will complete the installation of water meter that the water meter is protected in the lid box (annex 6), meanwhile talking to some households using the clean water from station of neighboring commune Nam Thanh, it is known that they desire to replace the use of clean water of station of Nam Thanh commune by the clean water of station of commune Nam Hong because of better water quality, even though the water price is rather high than the water price in clean water supply system at commune Nam Hong .

Clean water supply system at commune Nam Thanh was constructed in 2003 and put into operation to provide the clean water for households in 2004. The design capacity of this system was estimated 600 m<sup>3</sup>/day, serving 1000 households. The financial inviestmnet in constructing the system were mobilized from the agricultural production cooperative (APC), budget of the authorities and contribution of people, in which the contribution of APC accounted for the main proportion. At present the

actual exploitation capacity of the system reach capacity of 500 m<sup>3</sup>/day (around 85 % design capacity). The water price is fixed as 3000 VND/m<sup>3</sup> that is rather higher than water price is applied in clean water supply system at commune Nam Hong. The payment for clean water use is done by the reading of water meter. The clean water management unit composes 7 people as the unit head, technicians, cashier and accountants.

It is realized that the amount of households used the well water for the daily domestic water use account for the big portion, around 1/3 of total households the commune. The reasons are that they have the practice to use the well water in traditional manner. Furthermore, they have difficulties in economy that have not enough money to pay for the water metter installation and monthly use of clean water.

The volume of used clean water is also different in each household. The much or less volume of clean water in households depends on the economic availability as well as water use purpose.

The investigation data of 21 hamlets that the maximum volume of clean water reaches the value of 111 litter/day per capita, otherwise the minimum volume of clean water use in 9 litter/day per capita. The household use the less volume of clean water because they still use the part of rain water, well water for hygiene and washing, the clean water only use for the food preparation and drinking.

The household uses the much volume of clean water because they have to use the water for other activities for breading, traditional handicraft, food service etc... Sometimes same pupils live in their home for study.

At present, the volume of clean water use is estimated to be 45 liter /day per capita on average. Off course, this value is less than the norm noted in the National program on rural clean water supply and environment, 60 liter/day per capita respectively.

The amount of clean water use given by the management unit of clean water station is 56 liter/day per capita on average. It seems that this value could be acceptable because it includes the loss value.

In general it could be said that almost households carefully use the clean water less than the standard norm noted in the National program on Rural clean water supply and sanitation (period 2000-2005) the number of household of clean water use in variation 40-60 lit/day per capita is prevailing and accounts for 58% or 122/210 investigated households, number of household of clean water use of more 60 liter/day per capita only accounts for 12.85% (respective 27/210 household). The remain number of less 40 lit/day per capita is 29% (respective 61/210 investigated household).

The investigation results are given that the household at present does not use the clean water for the standard toilet. It hopes that if the household uses the standard toilet in future, the volume of clean water use will certainly be increased. From the investigation results the use of clean water can be grouped in table 2.

Table 2: Grouping of water use level

No	Norm of water use (lit/day per capita)	Households	Percentage (%)	Remarks
1	< 40	61	29.05	
2	40 – 60	122	58.10	Accepted
3	> 60	27	12.85	Exceed norm noted in National program
	Total	210	100	

The characteristic of clean water supply system of commune Nam Hong is that the clean water is pumped directly into conveyance pipe by pump of high pressure (28 ÷ 32 m of water head) installed in the secondary pump station. In this case the traditional water tower was not applied. The pressure of pump in the secondary pump stations is high enough in order to water flows to the place where the household is living. The evidence is seen that the water can reach the remote households in Hong Tien hamlet or Phu Binh hamlet in sufficient quantity. At present the households in these two hamlets the volume of clean water on average is in variation of 30 ÷ 40 liter/day per capita.

There is no occurrence of conflict on the clean water between households in particular and between hamlets and areas in general. Especially, the clean water is distributed in equality, no locally.

The remark is drawn that the clean water stations of commune Nam Hong so far has not reached the design capacity, the surplus water can be supplied to

household in neighboring commune that not effected the water supply of household in commune Nam Hong.

Clean water is pumped twice per day in the early morning and the afternoon. Each pumping is around 2 hours and convenient to the living habit of rural people. This is time that the demand in water is high. To have the clean water use in the non-pump time the household stores water in small tank of 2 ÷ 3 m<sup>3</sup> or water jar.

Besides supplying clean water for household in the commune, the clean water supply system of commune Nam Hong supplies the water for each primary school 30 m<sup>3</sup>/month, for each pre-secondary school 35 ÷ 40 m<sup>3</sup>/month, for office of People's committee of the commune and medical station 10 m<sup>3</sup>/month on average. This is in accordance with National program on Rural clean water and Sanitation that the clean water is available in sufficiency for all kid gardens, schools, medical station, public office.

The clean water supply system commune Nam Hong provides to 12 households in neighboring commune Nam Hoa. This water supply will be extended if other households have request on the clean water in future. Besides, the organizations are present in the commune as branch of Agriculture and Rural development bank also get the clean water 20 m<sup>3</sup>/month, Post station and regional telecommunication station each one get 10 m<sup>3</sup>/month on average.

### **III.5.2. Water quality**

- The questionair (211 questionair) shows that the households are satisfied with the quality of the clean water. To obtain such quality the water treatment technology chosen at the clean water supply at commune Nam Hong is appropriate through the chemical analysis of water sample available in 2006 for example. This is evident that the raw water pumped from Red river also has the good quality. The investigation on water quality analysis just carried out will be presented later.

- In principle, the water sample is regularly checked. The water sample is sent to the Center of Rural clean water and sanitation of province Nam Dinh to carry out the analysis. The quality of clean water has to be assessed on the criteria 1329 BYT 2002 of Ministry of Health. The set of criteria composes of 17 criteria that their criteria do not exceed the authorized value.

### III.5.3. Management organization

- At the beginning of the clean water supply project preparation, the authorities of the commune has visited and made investigation to find out the best advantages of the existing clean water supply system in and outside of province Nam Dinh to set up the optimum management model in their own commune.

- In decentralized administration, the clean water supply station at Nam Hong commune run by People's committee of the commune. In fact, the people's committee of commune Nam Hong has not set up the independent management board of the clean water supply station that one deputy-chairman of PC commune Nam Hong is appointed to be in charge in common activities of the clean water supply system.

- Each member of the management at present is taking his own responsibility as bellows:
  - + Head of the unit is responsible for the general works;
  - + 4 technicians – members is responsible for the operation of headwork station and guard function of headworks;
  - + 1 professional accouter;
  - + 1 semi-professional cashier (this cashier works at the same time for the cashier of People's committee of the commune;
  - + 21 heads of hamlet is responsible for the managing the pipe, writing the indicator on water metter and money collection of payment of used clean water within its hamlet.
- The Center of Rural clean water and Sanitation of province Nam Dinh participates as state-managing function.

Therefore, the number of member in the management unit of the commune is 6 professional people, remain people have worked as semi-professional. All these people mentioned above have paid the salary in various ammount. For example, the unit head, technician and accountant have got a salary of 550.000 VND per month, in addition the unit head have the extra money as responsibility payment. The cashier has got only a half salary in comparison with the professional. Meanwhile, the hamlet head have got salary in another way that depends on total volume using by households in hamlet by fixed rate tariff 100 VND per 1 m<sup>3</sup>. It is clear that the heads of hamlet have different salary.

- Regarding to the knowledge of operating and managing the clean water supply system there are only 2 people have participated in 2-year course on operation and management of system.

- The equipment are supplied as starter-pump 7 KW, shovel, mattock, plastic welding machine etc. are available. These tools are necessary in case whenever the broken pipe need the immediate urgent repair, and fill up the suction pipe of the primary pump station.

#### **III.5.4. System operation**

- Clean water is pumped by the fixed schedule that all households have known so they will themselves arrange the works.

- The water source of the clean water station is the surface water pumped from Red River. As known that the hydrological regime in Red River is separated two clear seasons: flood season and dry season. During the flood season the content of alluvium in water is high, otherwhile in the dry season the content of alluvium is low. Therefore, in order to operate and manage it effectively the clean water supply of commune Nam Hong has the procedures in such way that each 40 hours of working in flood season the washing up of filtration tanks is carried out and respectively each 60 hours of working in dry season. The washing up of tanks is done by pump in secondary station (see annex 4). Consequently, the waste deposit is moved into accumulation pond nearby.

- The operation of clean water station is implemented by 4 technicians of management unit that works professionally and handle of guard's task.

- The management unit is responsible for the repair, maintenance. Off course the technicians have taken these responsibilities.

- The water loss of any clean water supply system is foreseen. But the portion of water loss possibly is high or low depends on the management and the physical situation of the system. The head of hamlet as a member of management unit of clean water supply, so they know well how people in hamlet use the clean water. Actually, the illegal use of clean water without installation of water meter has not found.

- The data collected in investigation shows that the portion of water loss is 22%. This portion is high when the system has just put into operation even though this loss is in allowable variation. In coming time the checking water meter should be carried.

### **III.6. Clean water price and its payment**

- The water is not inexhaustible resources, especially the clean water is - considered as commodity, so the households have responsibility to pay the used volume of clean water by reading of water meter. The authorities do not subsidized for their clean water use. To increase the aware of people to save water, compensate the all expenditures of electricity, chemical, repair and payment of salary etc and not including of interest and benefit. The price of clean water is estimated as 2100 VND per m<sup>3</sup> and has been adopted in sessions of the People's council of the commune.

- This price is applied within the whole commune and the same for all households not distinguishing between households near or far from the station and more or less use. It also found that there are opinion on complain about the rather high water price, they want to reduce the water price and it should be subsidized because they have trouble in economy.

- Every two months the head of hamlet goes to households for reading value of the used volume and informs the households in order to they are ready to hand in to the hamlet head to deliver to the cashier with the legal bill issued by the authorities.

- People in the commune are well aware of significance of clean water so there is observation of the fact that there are no households not pay for the clean water use. It seems in practice there is no stopping the clean water supply in the commune when the household delay the payment of water.

## **IV. EFFECTIVENESS ASSESSMENT OF THE SYSTEM**

### **IV.1 Management organization and operation**

#### **IV.1.1 Management organization**

In fact, clean water supply model assessment after operation is a systematic method, a management tool which contributes to increase the efficiency of the system. In the case of commune Nam Hong, after two years of operation, the assessment is appropriate and necessary as followed:

- As far as we are concerned, commune is the lowest level in term of administrative office in which the People's Committee is the representative for users, social organizations (especially women's association). The key importance is that the

People's committee understands and accepts its role as a distributor and consultant for people. In the case of commune of much people, the People's Committee can make decision on establishment of the service team to serve the community better. As stated in the investigation results, Nam Hong People's Committee had visited the available clean water management models to choose the best one. After that, they assigned a vice chairman of People's Committee to be in charge of the commune's clean water management. This showed the care of the People's Committee for the clean water supply management, as well as a center to solve difficulties in management and exploitation of the clean water supply system. Besides, there is no decision document on the clean water management unit establishment though they started working right after the system operation. This is the limitation of this management model.

- Members of management unit are nominated that based on the professional capacity such as supervisors jointed in construction, also are in the list of training capacity plan. These members must agree to join the unit and approved by the commune People's Committee. As a result of being trusted by People's Committee, they will try their best in their work. The unit leader has a very important responsibility: (1) representative to the People's Committee and (2) responsible for all activities of the unit. The unit leader is nominated by the People's committee and supported by the unit. The unit members have discussion on the participation, definition of tasks and assignment. The unit establishment and unit leader is confirmed by the signature of unit members.

- Apart from those professional members, the heads of hamlets also participate in the clean water management unit by managing the pipe systems in the authoritative areas because hamlets are important connection between People's committee, water management unit and water users. Wherever water users are concerned about the water supply system, hamlets will be of course the units in the system and community mechanisms.

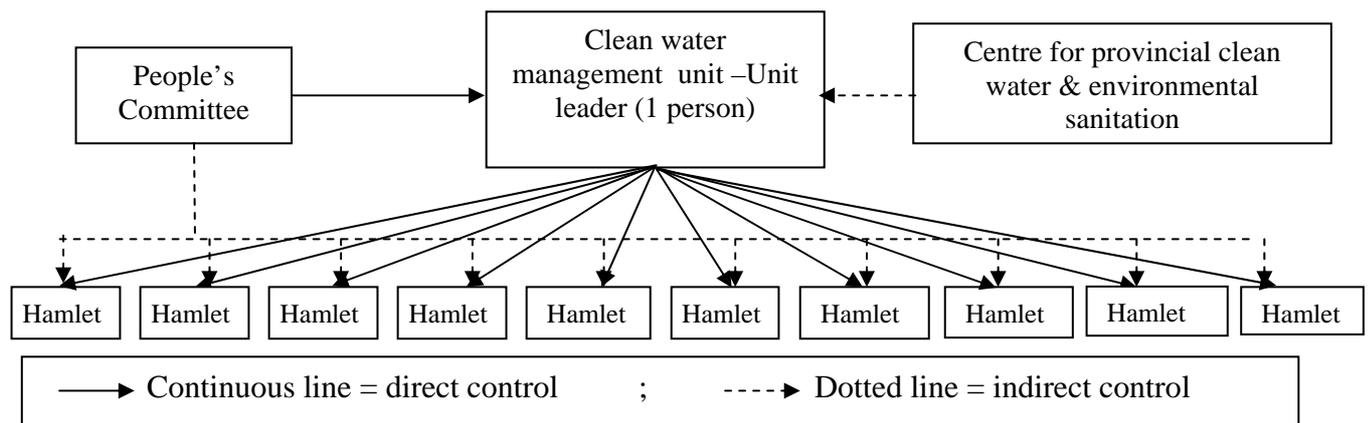
- The Representative of the water management unit submits the operation regulation; the regulation on water users' responsibilities; the regulation on pipe system protection in Nam Hong area to the People's committee. Protection, punishment for activities that harm the pipe system will be enforced following these regulations.

- The sample document on installing water meter is very detailed and specific. It showed the publicity, concrete responsibility of connectors and expenditures of construction, installation, materials, accessories, etc... which is listed in details in price and quantity so that people know.

- There is also agreement between water supplier (water management unit) and water users to guarantee the responsibilities of the two sides.

From all of the facts above, we can conclude that: the procedures of water-supply management unit establishment are based on the voluntary spirit and administrative characteristics. However, there are still some problems such as: i) no document on the transfer of property management, protection authority to the water management team; ii) no time limit for the unit operation; iii) task assignment has not been listed for professional and temporary staff; etc.... These points are not legally clear. If these problems can be solved, the sustainability of the water management unit and Nam Hong water station will be improved. It can also increase the effectiveness of water use, water supply service; spiritual life and rural sanitation condition.

b) The organization model of clean water management & supply team in Nam Hong Commune, which has 21 hamlets in total, is shown as follows (see figure 3):



**Figure 3 - Organization chart of management unit**

As can be seen from the diagram above, the People's Committee of the commune directly controls the clean water management unit and indirectly controls the hamlets through the heads of hamlets, that is to say the local authority has taken part in the management of clean water supply as a coordinator.

Total number of staff in clean water management unit is 7 people with the following duties:

- 01 unit leader, who has overall responsibility and in charge of monitoring 4 hamlets.

- 04 technical personnel, who are in charge of water treatment operation and concurrently, work as material warehouse keepers and headwork station guards, in charge of monitoring 2 - 4 hamlets.

- 01 accountant, in charge of monitoring 2-4 hamlets.

- 01 cashier who collects the money from head of hamlet. He works pluralistically for the water management unit, in which the main responsibility is the cashier of the hamlets.

In the clean water management unit, each member's responsibility is concretely and specifically assigned. The responsibilities of each staff - members are as follows.

- Unit leader: he is responsible to the People's Committee of commune for: the clean water supply, daily check on chemicals, general check on the pipeline, check on accounts, affixing the lead seal of the meters, purchase of chemicals for the treatment, operation of the water pumps by the correct procedure to meet people's demand in sufficient water, the repair of broken pipelines in time, and reading the water meter in 4 hamlets.

- Technical staff who is responsible for the operation of the head works station, and concurrently for the security of the station and the material warehouses during the daytime and at nighttime on each shift: to be constantly present at the water station on each shift; to be responsible for the quality of water pumped out; to purify the water tank periodically; to maintain and repair whenever necessary; to inform the vice chairman of the People's Committee of commune who is in charge of the water management unit and the unit leader about the problems appeared during the operation; to record a diary of the working shift and hand over to the next shift; to finalize the water meter in 2-4 hamlets.

- Accountants: to keep records of daily receipts and payments, to tabulate the monthly balance sheet; there must be 3 signatures in the invoices of the receipts, payments and material warehousing entries; to carry out monthly balance; to accompany the unit leader to check the water and electricity meters; to be in charge of the team administrative affairs.

- Unit cashiers: to collect the money for water from the head of hamlet and to spend the money within budget.

- The staffs who is in charge of the hamlets is the superintendent. He is responsible for the pipeline system management in the hamlets, for the acquisition of the demand for the installation of water meters and collects the money for water in order to hand over to the unit cashiers. The households hand over the head of hamlet

the money for water use, and in this way the households save the time because of no need going to the People's committee office.

Rights: All members of the clean water management unit are paid the salary according to the regulations of the People's Committee of commune. This money of salary is available from the money of water payment by the households.

- Unit leader is paid the salary corresponding to amount 550000 VND/month and the responsibility allowance (150000 VND/month);
- Accountant is paid the salary corresponding to amount 550000 VND/month;
- Technical staff is paid the salary corresponding to amount 550000 VND/month;
- Cashier is paid the salary corresponding to amount 275000 VND/month;
- Head of hamlet is paid at a fixed rate of 100 VND/m<sup>3</sup> corresponding to amount of the total volume of consumed water in the hamlet in month.

b) The relevance of the Center for provincial clean water supply and environmental sanitation: Responsibility in term of State management in the inspection and supervision of the quality, and of the organization of training for the operational personnel at water station.

*c) The responsibilities of the People's Committee:*

The People's Committee of commune builds the principles of working regulations of the clean water management unit in the People's Council of commune, rules of income and expenditures rates based on the total amount of clean water at the headwork station and the master valves for the hamlet and village branches, price of clean water. The public discussion on issues above was held between the People's Committee and People's Council of commune, the participation of the representatives of social organizations; the people also contributed their ideas directly to the leaders of the People's Committee of commune.

The foregoing is the most basic information on the organization model and the human resources in the management and operation unit of the water station at commune Nam Hong, district Nam Truc, province Nam Dinh. The following assessment can be made:

- The establishment of clean water management unit has been implemented fairly and methodically through the meeting. The personnel participating in the water management unit is highly specialized. They have worked professionally. Therefore they concentrate only on their given jobs.

- The responsibilities are clearly and concretely assigned to each position, which show the concrete responsibilities of each member with very detailed punishment mechanism.

- The right of each member is to be paid according to the regulations of the People's Committee of commune. The salaries on fixed rate of amount of clean water have not been paid yet. The new fixed rate is applied to the hamlet superintendents.

#### **IV.1.2. Assessment of current operation situation**

With the aid of the commune authority, the clean water management unit has built the operational procedures of the headwork station. The main content of the main tasks is as follows:

##### *a. Operation management*

- Taking notes and monitoring operation is implemented by means of the logbook on the operation of the pumps, station and the activities at the headwork station. The amount of water pumped from the station to the distribution system is logged and observed. All of these operations are performed regularly.

- The process of defining the pumping period for water supply is announced publicly so that all households can take the initiative in using clean water. Due to the household's demand on clean water use, the water station pumps clean water twice in the morning and in the afternoon everyday. In case the demand for water use increases, the water station will be pumped at midday, or the pumping period can be prolonged in order to meet the household's demand.

- The operation of distributing water to the households is currently even, there is no local distribution. In particular, there is no conflict between the households. The people are all aware of using clean water economically because they have to pay money corresponding to the water meter reading.

- The main purpose of the headwork station at commune Nam Hong is to supply clean water to all households designed up to the year 2020. At present, there are only 2000 households supplied with clean water. The problem, which has come up, is that there are 973 households have changed from using well water and rainwater instead of using clean water. However, there must be propagandizing persuasion and assistance policies on non-user of clean water in the commune.

- The power source supplied to the headwork station is the transformer station, which is far away (500m). Therefore, the voltage does not ensure the required technical performance and it has influence on the operational productivity. With the lack of electricity in current situation, the electricity at the headwork station

will also be cut off. Being not equipped with the spare power generator in case of prolonged power cut will have influence on the clean water supply to the people.

*b. Potential of headworks station capacity*

- As to the operational exploitation of headwork station capacity, the production statistics for the last periods show that the actual operational capacity (400 m<sup>3</sup>) at the headwork station accounts for only about 36% of the designed capacity (1120 m<sup>3</sup>/day). Accordingly, the headwork station has enough capacity for more water in case the demand for water use increases. It can be seen that the water supply capacity of the headwork station is still high, and so the problem needed to be solved at present according to the original design is how to improve the efficiency in operation and exploitation of the station. This problem requires the interest and direction of the People's Committee of commune in order to expand the water distribution system to households still no use clean water in the commune and in the neighboring communes as well as the production base located in the commune area in case they requests. The potential is that there are now 973 households using well water and rainwater in their daily life. Hoang Anh concrete manufacturing base, which is located near the headwork station, is the consumer with very high and constant demand for water use. The water demand for Hoang Anh Company is known as 400m<sup>3</sup>/day without high investment in building the pipeline. In order to solve the water supply problem for households using the well water and rainwater, it is necessary:

- (i) to propagandize the benefit of using clean water from the supply network;
- (ii) to manage to aid the households in having access to the clean water, i.e. to solve the problem of installing the water meters, because the installation requires an amount of about 2.2 – 2.5 millions VND according to the current price. In addition, the development of organization and qualification of the current clean water service management unit should be taken into consideration to establish a water company for in the future.

- The present average loss is about 22%, that is to say the actual capacity is approximately only 312 m<sup>3</sup>/day. The assessment has shown that 66% of households in the commune have access to clean water. In fact the statistical data has shown that on average each people consumes about 45 liters of water per day. This has shown that people seem to get used to consuming clean water, approximating to the norm set in the National Target Programma on clean water and rural environmental sanitation.

### *c. Assessment of technical qualifications*

So far there are 2 operational technical personnel jointed 2-year training course on the system operation management, the other new personnel are given short-term training course during the construction or during the system operation management. They get training on job on using and concocting chlorine chemicals during the treatment processes. However, the difficulty encountered is that the industrial chlorine is designed to be used in water treatment, but the chlorine cylinders can only bought very far away (about 200 km) and therefore sometimes the chlorine powder is used provisionally when the industrial chlorine cylinders are not yet available in time. Those are temporary solutions.

Being interested in learning, the other personnel who have no training course have acquired and broadened their experience through daily practical jobs. However, with present practical demand as well as the demand in the near future, the personnel in the hamlets will be able to meet the demand for the operation and maintenance of the waterworks station. Consequently, it is advisable to consider building up the staff that is in charge of the management and operation, especially the water treatment in headwork stations which needs the enhancement of qualifications in water treatment and concoction of chemicals with the right dosage; to raise awareness about techniques for the operation of and minor repair to the pumps, engines and about the sanitization of filtering equipments and materials...

However, for the last 2 years of exploiting operation of clean water supply system in commune Nam Hong, the unit staff has not get any failure that have impacts on the water supply to the households occur.

### *d. Operation of the pipeline system*

- Implementation of regular tasks such as repairing pipelines, broadening water usage objects, installing more water meters serving the people has been done fairly well and publicly.

- Operation of pipeline system: The whole water distribution pipeline system uses PVC, HDPE materials. Theoretically, these are cheap materials compared to metal pipes and they can exist long in natural conditions. However, when these are used in rural areas and also in commune Nam Hong, it can be seen that usage of these pipes must be reconsidered according to actual conditions. The reasons are that:

- The pipeline system running along the rural traffic routes is buried under the ground is frequently influenced resulting in the pipe burst due to mechanical actions, impact of local development process as well as the households.

- Use of heat welding techniques in order to handle the pipe leakage, burst or break is needed to be examined because the welds using heat welding techniques have rather low durability and short lifespan causing the water loss and increase of operational maintenance costs.

It can be seen that this is one of the causes of water losses, which is rather high (22%) at present. The losses may increase, as the pipeline system gets older.

#### *e) Equipment and documents*

In order to be convenient in reporting and work connection, the headwork station management unit has been equipped with the table telephone. At present, the unit is equipped with only some instruments and devices as mandril, mattock, shovel, etc. These are rudimentary equipment. The pipeline system in some hamlets was built prior to the construction of concrete roads, so it is difficult to do the repairs.

In the field survey, the water station staff also desires to familiarize themselves with the automatic water quality assessment devices. The difficulty encountered in is the high cost (about 70 millions VND according to current market price). The device has only 6 measuring index: pH, temperature, turbidity, conductivity, salinity and dissolved oxygen (DO). To be able to use these devices, they have to be examined regularly and the staff must have technical knowledge.

Although there are still some existing difficulties, it can be objectively assessed that the establishment and operation maintenance of the clean water supply management unit in Nam Hong commune has met the requirement, which is to exploit the waterwork which was built using government funds and money from the local people for the purpose of serving those. However, there should be some improvements in the organization model of the current water management unit in order to increase the legality of the unit and to progress to establish a company in the future.

## **IV.2. Financial assessment**

Financial problems, receipt and payment balance in any organization is especially important to the existence and sustainable development of the unit, organization, especially in the production process and service organizations. The clean water management team in commune Nam Hong is classified as a service organization, but it is a special service because of its productivity and State management of the products as to quality, quantity and price. Some problems of receipt and payment balance of the clean water management unit in commune Nam Hong are analyzed below in order to assess its sustainability.

The fixed rate mechanism has not been applied absolutely in the clean water management unit in commune Nam Hong. The unit staff is assigned the detailed salary level. Only the fixed paid rate is applied to the head of hamlet with the responsibility for collecting money from the households and for handing in the money to the cashier of the unit. The other payments can be done depending on the actual situation of activities of the unit.

The water price which is stipulated by the People's Committee of the commune and applied in the commune area is 2100 VND/m<sup>3</sup> of commercial water product (in short clean water after treatment). The issue of clean water price by People's Committee of the commune Nam Hong is consistent with the Authorization and followed the Joint - Document No 104/2004/TTLT/BTC-BXD on 08/11/2004 of Ministry of Finance and Ministry of Construction on "Guidelines of principles, method of estimation and decision authorization of clean water price at town, industrial area, and concentrated population settlement area". It is evident that this water price is not included profit because this is welfare construction and deal with the contribution of beneficiaries. This current price is applied to the households and schools, infirmaries, committee office. As to the units with business activities such as Agriculture and Rural development bank branches, post and telecommunication stations and a concrete plant which will come into operation with high demand for water in the future (400 m<sup>3</sup>/day), higher charges should be considered and by doing that the income of the water station will be very high. However it can be seen that the current price also need to be adjusted corresponding to the increase of input material price and the salaries of management unit staff. In the opinion of the rural clean water and environmental sanitation center of Nam Dinh province, the water price of 2100 VND/m<sup>3</sup> at the clean water supply station in Nam Hong commune is rather low in comparison with the water price at other clean water supply systems in province Nam Dinh.

The balance sheet after 2-year operation of the system (2006, 2007) is shown in Table 3 below.

**Table 3** Financial review

*Unit: 1000 VND*

No.	Contents	2006		2007		Notes
			%			
<b>I</b>	<b>Receipt</b>	<b>173.068</b>	<b>100</b>	<b>241.919</b>	<b>100</b>	
<b>II</b>	<b>Payment</b>					
1	Salaries	31.959	18.47	47.819	19.77	

2	Electricity payment	31.185	18.02	57.629	23.82	
3	Maintenance & repair	1.947	1.12	6.289	2.60	
4	Chemicals Purchase	10.430	6.03	13.980	5.78	
5	Budget payments	73.753	42.61	101.848	42.10	
6	Other payments	23.794	13.75	14.354	5.93	
7	Balance	0.00		0.00		
	<b>Total payment</b>	<b>173.068</b>		<b>241.919</b>		

It can be seen from the table above, the receipt in the next year is higher than that in the previous year, respectively 241.919 millions VND in 2007 and 173.068 millions VND in 2006. It is reasonable because the number of clean water – used households has increased. In early periods there were few households to use the clean water of the water station because they did not install the water meter and did not realize the efficiency of using clean water from the commune waterwork. It is sure that in the year 2008 and the next years the receipts will increase due to the expansion of the service objects.

The deduction for the People’s Committee payment in order to be used as a standby in case of repairing the main pipeline, replacing the equipment and major repair, with maximum real revenue proportion. They are on average equivalent in 2-year period, which is more than 42%; the electricity cost accounts for 23%; labour cost accounts for 19% and chemical cost accounts for 14%. The other payments are insignificant with decreasing trend, which is considered positive because the system is gradually getting stable. At the early stage when the system just comes into operation, off course there can be the several arisen expenses.

The payment for the clean water management staff is analyzed in more detail as follows:

- + Unit leader, concurrently in charge of reading water meter: 700.000 VND/month (23.333 VND/day);
- + Operational personnel, with the concurrent task of guarding and accounting: 550.000 VND/month (18.333 VND/day)
- + Cashier, with pluralistic tasks 275.000 VND/month (9.166 VND/day);

+ The fixed payment rate for the head of hamlet is 100VND/m<sup>3</sup> and therefore their salaries are different and they are dependent on the water usage rates in the hamlet. According to the figures of water management team, the total amount of clean water in the year 2007 is 115.214 m<sup>3</sup>, so the head of hamlet's finances are 11,521 millions VND. Therefore on average the head of hamlet will receive 45.700 VND/month, which is too low. In the other clean water supply system the fixed payment rate for the hamlet superintendents is 300 VND/m<sup>3</sup> for end-product. With the current water usage rate, the corresponding payment of the hamlet superintendents is nearly 150.000 VND/day.

Clearly, the payment for the clean water management unit staff including the head of hamlet is too low and it is not corresponding to their effort, especially the unit leader position. With regard to the senior executives in the People's Committee that are in charge of the clean water management without any payment, in principle he has to get salary because with their contribution they must have the right to reap the fruits of their labour.

Analysis of labour mechanism and labour consumption rate can be referred to some norms applied to the staff of the rural waterwork which is directly under the clean water and environmental sanitation center of Nam Dinh province from 2-3 people/1000 households. The unit leaders have the salary scale of 1,3; personnel have the salary scale of 1,0. If these scales are applied correspondingly, the water supply station of commune Nam Hong require a total number of about 6 personnel according to the number of water meters or number of households (1 water meter for each household). At present, the number of the clean water management unit staff of commune Nam Hong is appropriate.

Through the consideration of the payment sheet of the years 2006 and 2007, it can be seen that all of the clean water management unit staff has no payment of social insurance. It is a disadvantage to the clean water management team staff. Payment of insurance for the staff needs to be taken into consideration in the financial balance sheet in the year 2008.

From the financial activities table of the water supply system at commune Nam Hong, district Nam Truc, province Nam Dinh, it can be seen that in order to produce 1m<sup>3</sup> of clean water, it needs 123 VND for chemicals and 500 VND for the electricity. The potentiality of clean water usage is very high as from the year 2008:

- (i) 300 out of 973 households are using well water and rainwater in their daily activities and for drinking purposes. Also with the water usage of the households in neighbouring commune Nam Hoa, the

capacity of the headwork station will increase by 60m<sup>3</sup>/day corresponding to the current norm of water use;

- (ii) Hoang Anh concrete manufacturing base has very high demand for water use and they have requested a water supply rate of 400m<sup>3</sup>/day. It is supposed that the required immediate rate is 200m<sup>3</sup>/day for Hoang Anh concrete manufacturing base, therefore the total additional potential capacity will be increased by 260m<sup>3</sup>/day in next years.

With the applied current water price, the additional receipts are as follows:

+ From the households:

$$365 \text{ days} \times 60 \text{ m}^3/\text{day} \times 2100 \text{ VND/m}^3 = 45.990.000 \text{ VND}$$

+ From Hoang Anh concrete manufacturing base (calculated for the 5 working days per week):

$$200 \text{ m}^3/\text{day} \times 260 \text{ days} \times 2100 \text{ VND/m}^3 = 109.200.000 \text{ VND}$$

The total payment of chemicals and electricity cost is 46.039.700 VND, and therefore the real interest from the expansion of the water supply earned by the water management unit is 109.150.300 VND. This amount of money is very large and it needs to be cared in order to have more source of revenue for the commune, salary increase for the staff, investment in reproduction...

The results of surveying, collecting the documents related to the financial activities are shown fairly clearly, in detail and publicly. There is a public economic sheet which show the receipt and payment balance during the month.

### **IV.3. Water quality assessment**

Water quality assessment is considered as the minimum assessment indicator of a rural centralized water supply system, which has been mentioned in the publish by the World Health Organization (WHO) in year 1983. The assessment of water quality includes the quality of the source and water on the spot. Because at present many households in Nam Hong commune, Nam Truc district, Nam Dinh province are still using well-water and rainwater in their daily lives, which has a high proportion (937/3000 households in the commune), the water samples were also taken in the survey in order to assess the quality of well-water used as a base for the recommendation to the inhabitants. The water samples were taken on March 18<sup>th</sup> 2008 and were analyzed at the standard laboratory (Agricultural Laboratory No.18). In detail:

+ 01 sample from Red River – source of water;

- + 01 sample at the clean water tank after the treatment;
- + 02 samples of clean water taken from the households downstream (01 household in Hong Tien hamlet and 01 household in Phu Binh hamlet);
- + 01 sample of rainwater taken from the households;
- + 01 sample of well-water being used by the households.

\* Legal bases and analytical indicators:

The implementation of water sample taking, managing and analyzing conform to Vietnamese Standard:

- + TCVN 5993 – 1995: water quality, taking samples, guide on preservation and process of the samples;
- + TCVN 5997 – 1995: water quality, taking samples, and guide on sample taking for rainwater;
- + TCVN 6000 – 1995: water quality, taking samples, and guide on sample taking for groundwater;
- + TCVN 5992 – 1995: water quality, taking samples their techniques.

Based on the standard documents in Decision No. 09/2005/QĐ-BYT on 3<sup>rd</sup> November 2005 of Ministry of Public Health on the standards of clean water sanitation (water used for individual and family daily activity purposes only, not for directly drinking water purposes), 19 parameters (main standards) with detailed authorized values and required checks on water used for drinking purposes corresponding to the economical conditions of rural areas has been defined. The indicators are: pH, colour, smell, turbidity, hardness, oxidization (according to  $\text{KMnO}_4$ ), ammonia content (according to  $\text{NH}_4^+$ ), nitrite content (according to  $\text{NO}_2^-$ ), nitrate content (according to  $\text{NO}_3^-$ ), sulphur content, zinc content, ferrous content, manganese content, arsenic content, chlorine content, fluorine content, total dissolved solids (TDS), total coliform content, E.coli. However, the values in the previous standards in Decision No. 1329/2002/QĐ-BYT dated on February 18<sup>th</sup> 2002 of Ministry of Public Health basically have not changed excepting some indicators with increased authorized values but without influence on the quality of clean water supply.

- Analysis results

The results of sample analysis are shown in Table 4 below (detailed in annex 7).

**Table 4** Water quality of clean water supply at commune Nam Hong

No.	Indicator	Unit	Source of river water	Water in tank	Household M1	Household M2	Rain-water	Well-water	Authorize Standards
1	Ph	-	7.15	7.22	7.30	7.15	7.25	7.36	6.0 – 8.5
2	Colour	TCU	10.82	12.06	12.51	9.26	9.38	11.42	15
3	Smell	-	0	0	0	0	0	0	Không màu
4	Turbidity	NTU	27.71	0.15	0	0	0.20	24.02	5
5	Hardness	mg/l	102.25	93.01	84.15	92.87	106.29	294.09	350
6	NH <sub>4</sub> <sup>+</sup>	mg/l	0.54	<0.01	0.14	0.09	<0.01	2.70	3
7	Nitrate NO <sub>3</sub>	mg/l	1.24	0.59	3.80	2.95	0.62	0.04	50
8	Nitrit NO <sub>2</sub>	mg/l	0.049	<0.01	<0.01	<0.01	<0.01	<0.01	3
9	Chlorine	mg/l	8.76	8.51	5.39	5.54	11.34	229	300
10	Ferrous	mg/l	0.12	0.01	0.05	0.04	0.02	0.25	0.5
11	Oxidization	mg O/l	3.20	0.80	1.44	0.80	1.28	0.32	4
12	Total dissolved solids	mg/l	187.46	173.73	136.71	140,05	176.72	1112.24	1200
13	Arsenic	mg/l	0.003	0.002	0.003	0.002	0.003	0.005	0.05
14	Fluorine	mg/l	0.21	0.25	0.14	0.15	0.10	0.18	1.5
15	Manganese	mg/l	0.013	0.006	0.012	0.014	0.024	0.366	0.5
16	Zinc	mg/l	0.017	0.006	0.003	0.003	0.010	0.005	3
17	Sulphur	mg/l	0.15	0.05	0.05	0.04	0.10	0.20	-
18	Total coliform	MPN/100ml	790	82	110	130	170	190	50
19	E.coli	MPN/100ml	0	0	0	0	0	0	0

It can be seen from the analysis results of water samples:

- Water source: ensure quality, most of the indicator values is less than the authorized values excepting the total coliform indicator which has a high

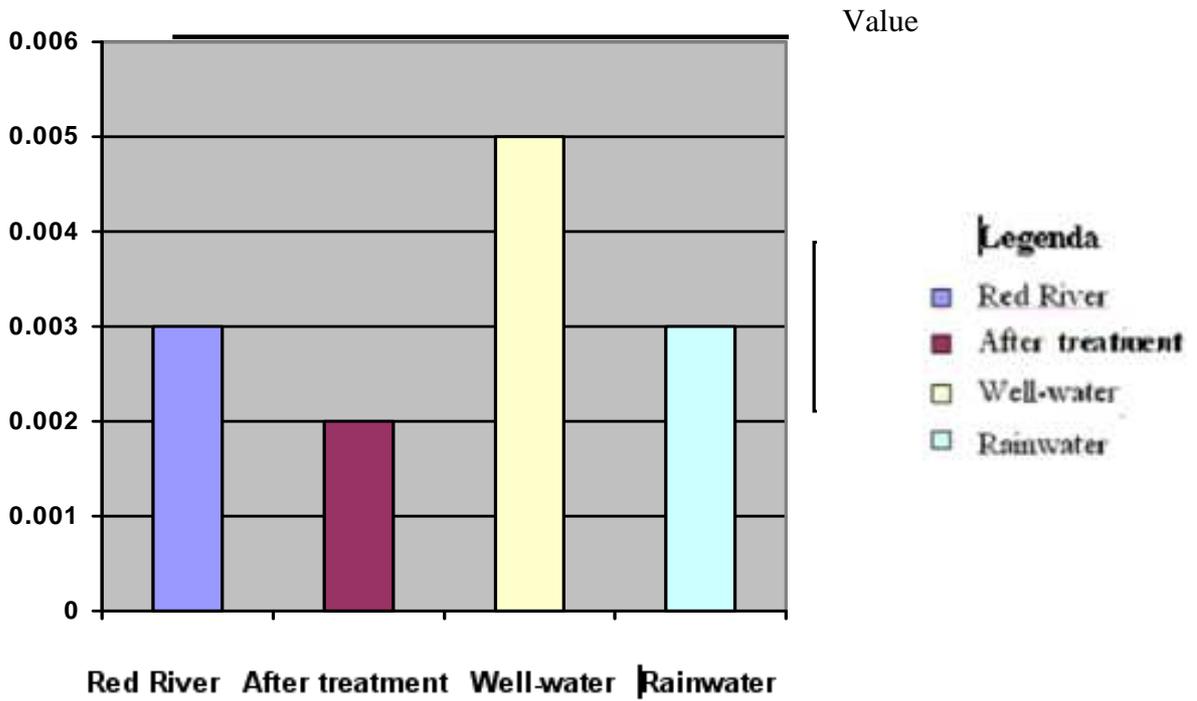
value (1790 MPN/100ml), and therefore it is needed to be treated without complicated treatment techniques.

- Water after treatment: the indicators are all less than the required standards of the Ministry of Public Health;
- Well-water: The indicators are less than the standards of Ministry of Public Health, but it can be seen that the sample taking is carried out in dry season but if the samples are taken in other periods such as rainy season, the water quality will be absolutely different, because the well-water is closely related to the surface water, dirty substances on the ground surface will penetrate into the groundwater layer and then into the wells. However, the manganese and total dissolved solid indicators are almost the same as the authorized values, recommendations should be made to the inhabitants for using water from the station.
- Rainwater: In general, the rainwater quality is acceptable but the coliform indicator value exceeds the authorized value. Because the rainwater is collected from the roof in rainy season, the people are recommended for taking the initiative in using clean water in daily activities.
- Water in the households: the clean water indicators in the households downstream are equivalent to those of water in the containers. This shows that the pipeline system is still in good status without the penetration of water outside the pipeline.

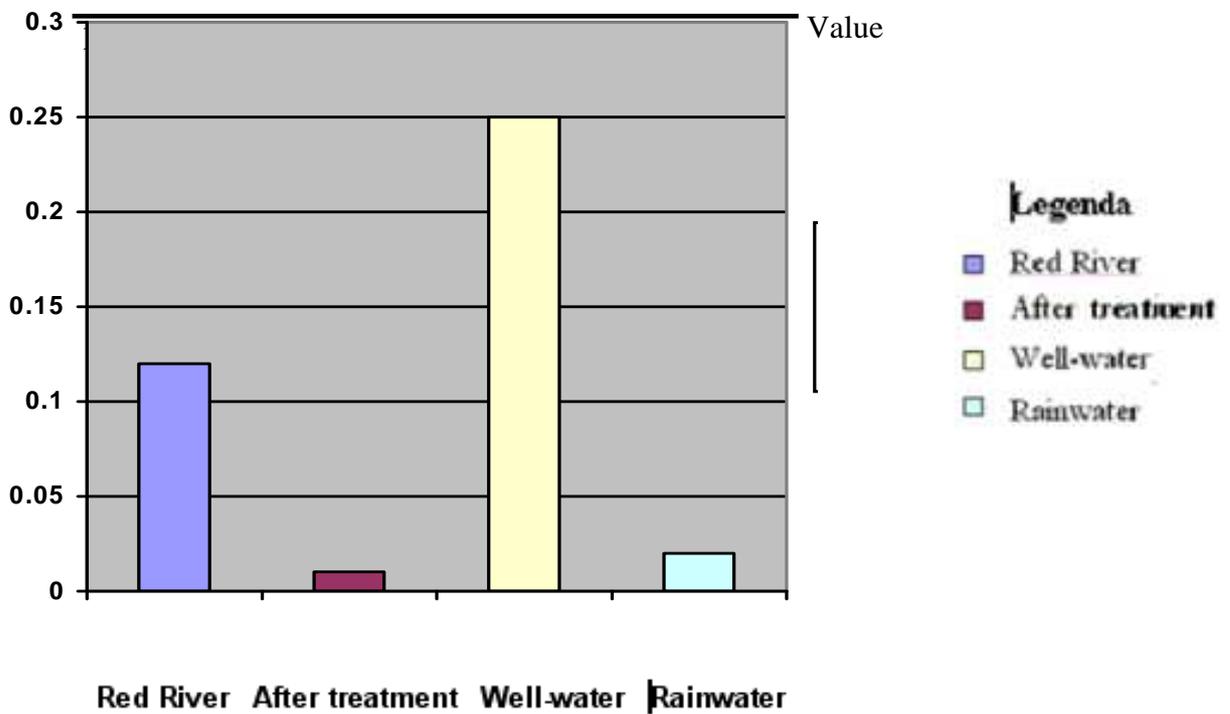
It can also be seen from the analysis results of water samples, the water treatment technology which currently applied in the water treatment station of the water supply system in commune Nam Hong, district Nam Truc, province Nam Dinh can be assessed as an appropriate one. The water quality after the treatment is improved significantly (especially the ferrous content and the total coliform) and it meets the clean water standards promulgated by the Ministry of Public Health. The chlorine content should be increased during the treatment process in order to reach the authorized values.

Some illustrative graphs of water quality in commune Nam Hong, district Nam Truc, province Nam Dinh are shown below.

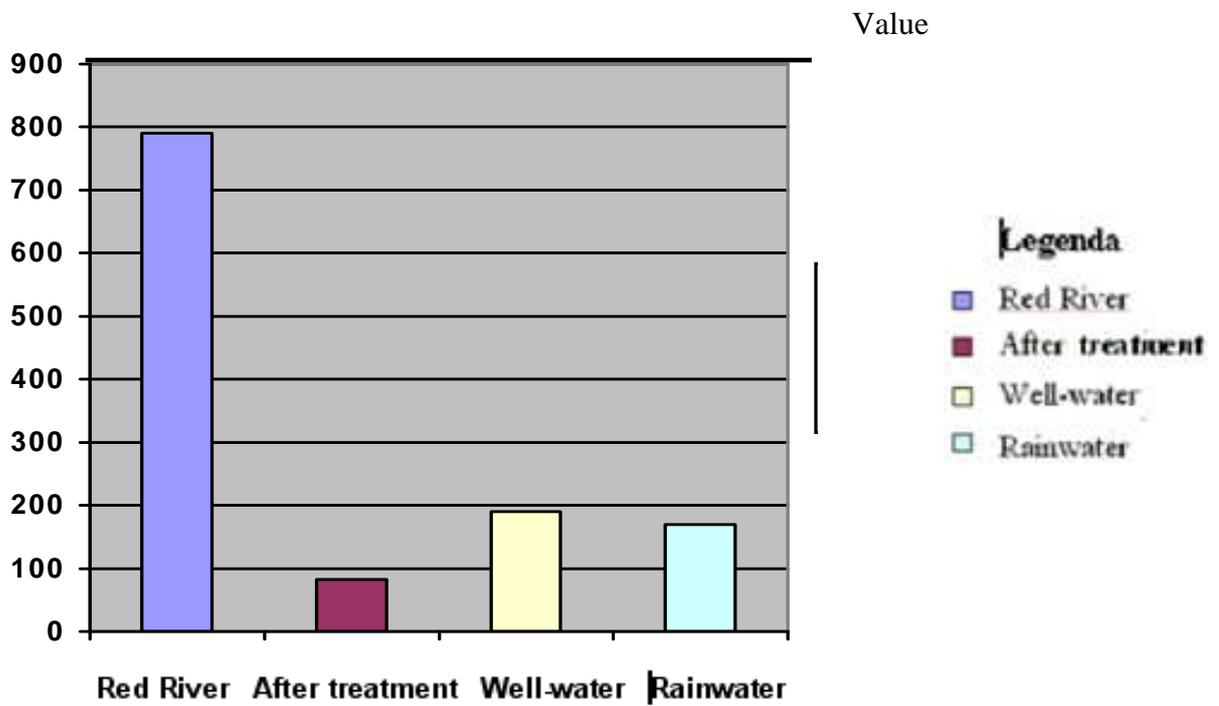
**Arsenic** (authorized value 0,05 mg/l)



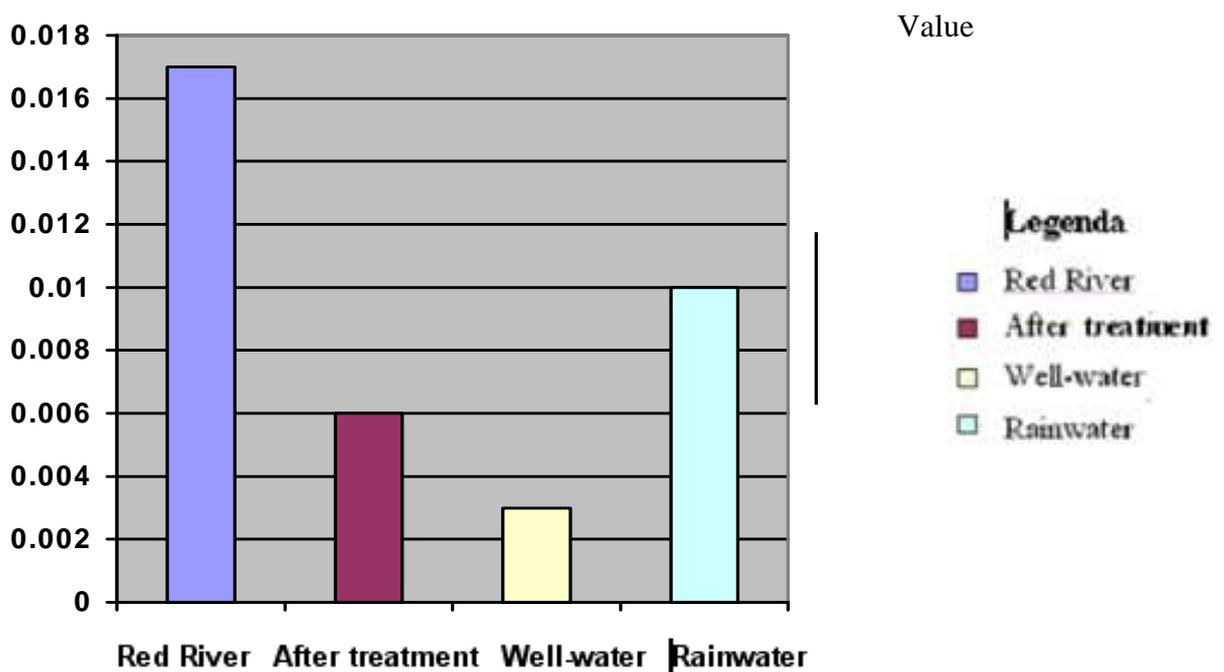
**Ferrous** (authorized value 0,5 mg/l)

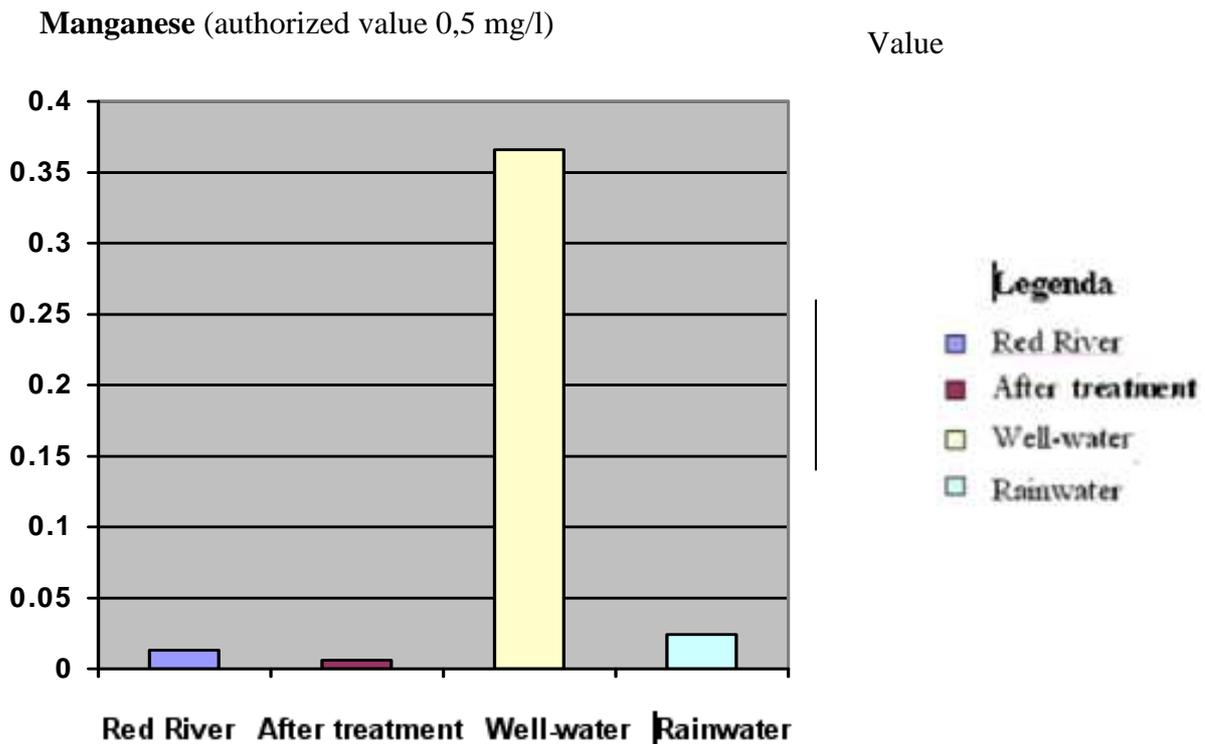


**Coliform** (authorized value 50 MPN/100 ml)



**Zinc** (authorized value 3mg/l)





#### IV.4. Environment

There are not household engaged in breeding as well as processing production of the traditional agricultural products. That is why this does not affect the environment. The matter has to be paid the attention to the domestic gabbage. At present the collection of gabbage including the organic and solid gabbage still is not organized and implimented meanwhile the people live in hamlet with high people density.

#### IV.5 . Society organization

The woman's union of the commune will be deal with hereby. This organization plays the important role in the clean water supply to improve the living standard. In this case the women union works as the coordinator to get money from the Social policy bank. The household can rent the neseccary amount of money from the bank for installing the water meter with the favour interest.

#### IV. 6. Effectiveness of water supply

- Health aspect

The clean water plays the important role in the health care. Regarding to the water field the diseases as cholera, dysentery, typhoid, and personal hygiene as trachoma, gynaecology at present does not appear in the commune. It could be said that this is success that the clean water supply is given the society.

- Society aspect

The regular supply and sufficient volume on demand of clean water in time, easily water available from the water station it could be said the livelihood is improving. The people in the commune are not nervous about the domestic water. The member in family does not spend much time and labor to bring water. In general, the children have more time to learn, other member have opportunities to take care the field – work and the others produce more the hand product. Especially, the women are free out of bringing water. The attention is paid that the people are nervous about the water quality.

- Economic aspect

The clean water is considered as commodity, the user is compulsory to pay for its use. At present the household each month spends around 20000 – 25000 VND on average in cash for payment of clean water. Generally, this amount of money is a little, but it is big amount of money for people involved in agricultural field in the rural area. Finally, they could get more food, in point of view of economy it is seen that the benefit is available from the clean water supply directly or indirectly is:

- + No expenditure on medical remedial purchase;
- + No payment on clean water purchase and transport from other place;
- + Increase the income from agricultural production and other producing activities.

## **IV.7. General assessment**

### **IV.7.1. Advantages**

- Number of personnel of the management unit are currently appropriate. When the number of households using clean water from the system increases, the only is that the salaries of members of the management unit need to be increased.

- Generally, the clean water management unit in commune Nam Hong is now being maintained fairly well in order to exploit the water station serving the local people, and to meet the growing demands for clean water for drinking purposes and daily activities.

- Extensive exploitation capacity in order to improve the usage efficiency is still very high.

- At present, the receipts and payments balance still can be done although the source of the receipts is still limited. The payment mechanism, especially the labour cost, depreciation cost in setting up the standby funds, big pipeline repair and equipment replacement is reasonable.

- The organization has been established on the voluntary basis of the staff member, therefore the enthusiasm in their works is put to the top.

- The organization can be classified as non-profit organization with the aim of serving the people as the main task.

- The source of receipts is still limited and most of the new source comes from the amount of water supplied to the people according to the price stipulated by the Commune People's Committee. The staff members' income from the water supply is still low. It can immediately solve the difficulties, but in long-term the sustainability is not high, especially the specialized operation during the processing, distribution and operational management of the water supply station serving the people.

#### **IV.7.2 Disadvantages of immediate improvement**

##### **a. Subjective problem**

- As to the legal mechanism, the activities of the unit is still administrative and as a result the legal validity is promoted. Through the regulations of the management unit, its operation and existence seem to be dependent on the support of local authority without being able to build up the unit staff on the basis of human resources in order to use in speeding up the service operations and extending the participatory ability of other local services. This will restrict the concentration of human resources to establish a local company in the future.

- To enhance the legality of the clean water management unit by means of improving the current organization in the direction of establishing the co-operative complex for the exploitation management of the rural clean water supply system according to the Decree No. 151/2007/ND-CP about organization and operation of the co-operative complex. If those can be done, it will create legal personality for the co-operative complex and they will be able to participate in different service activities in order to increase their income ensuring the legality of the implementation of the tasks and the legalization of legal papers on payments, balance sheet according to the State stipulation.

- Some positions require the responsibility such as team leader, operation of water treatment worker at the headwork station. The stability of the bases for them to have long-term participation, which is the social insurance, has not been done. In

order to solve this problem, the commune authority needs to have good care and there should be the cooperation between the clean water management unit and the agricultural service co-operative in order to make the insurance contract for some of those team members. It is the most basic demand of the people when they participate in the activities in local areas in order to make contribution to the building up the native land and to have long-term attachment to the jobs that are paid corresponding to their effort.

- It is necessary to build up the documents serving the management such as building the map of water supply system, the detailed map of water supply to each hamlet, so the manager can actively take control of the situation of the entire water supply network.

- It is necessary to standardize some steps in the operation process of the waterwork such as designing, readjusting operational records of the station, using chemicals, monitoring and preliminary assessment of the source water quality by means of observing in order to have timely countermeasures. Simultaneously, it is necessary to standardize the recording tasks in the financial operation of receipt and payment...

- As to the income of the clean water management team staff in Nam Hong commune, it is necessary to reconsider the payment mechanism of the team leader's salary, because s/he has relatively heavy responsibilities but the salary rate is still lower than that corresponding to the responsibilities of cashiers in the hamlets and other posts in the team.

#### b. Objective problems

- Other basic products such as electricity, fuel, chemical, labour, service payment, etc. have increased considerably in previous years, but the water price in the water service base has not increased. It is also a subjective cause that has negative impacts on the sustainability of the maintenance and sustainable development of the water supply serving the rural people not only in commune Nam Hong, but also in other parts all over the country.

- The subjective problem which has great influence on the operation of the team is the policy on water service charge. It can be seen that the policy on water service charges of the urban and rural areas is unreasonable, because in urban area the amount of water consumed and the service charge is high while the amount of water consumed is limited and the service charge is low in rural area. Whereas the government has hardly any supporting policies, and therefore many rural waterworks has had very low efficiency in exploitation after coming into operation. In many

places the receipt and payment balance cannot be performed, which has caused several difficulties for the managers.

- In the future, if the policy on water service charge is not updated corresponding the price increase of the other products, such receipt and payment rates will have great impacts on the receipt and payment balance. They can rock the viewpoints and consistency of the personnel in the clean water supply management team in particular, because in fact many people work voluntarily rather than for economic purposes.

### **IV.7.3 Assessment on management model selection**

At present, in Red River Delta there are many types of organization and management models for rural water supply. They are can be summarized as follows:

- Co-oprative model for management and exploitation of water supply service;
- People's Committee management model;
- Joint-stock co-oprative model;
- Hamlet community management model;
- Clean water service groups of rural clean water and environmental sanitation center;
- State-owned company model;

The selection of rural centralized water supply model has the following basic requirements:

- Necessity

Knowing the demands for clean water supply and the long lasting benefit of the clean water supply: economic benefit, health benefic, social benefit. Simultaneously, clean water supply for the households should be considered a representation of a civilized society.

- Reliability and sustainability in convenient water usage

In fact, there are some rural clean water supply systems after the design and construction processes cannot come into operation or cannot meet the required demands after a short period of operation due to many different causes. These causes can be the design and construction processes, which do not have technical assurance and are not synchronous, insufficient provision of materials, replacement equipment, shortage of chemicals, fuel and energy and without the participation of water service consumer or without paying the water service payment.

- Lower price, convenient maintenance

Investment rate of the clean water supply system has close relationship with the number of households using the clean water service. In the communes and hamlets with little number of households using the clean water, the investment rate is high and it has influence on the decision about construction investment. The scale of the water supply system also has influence on the operation, maintenance and payment ability on the water supply service. With high clean water price, the households cannot have access to clean water and refuse to use the clean water. Of course they will look for other replacements such as well-water, rainwater. As a consequence, the return of the investment will not be feasible.

- Appropriateness to the local conditions

It is the satisfaction corresponding to different service level and the demands of the households in accordandance with households of low income. There is a concentration of the population without dispersal. Such operations will attract the participation of the community

..

From the management model of the clean water system in Nam Hong commune, it can be summarized in Table 5 with the assessment indicators of rural centralized clean water supply system

**Table 5** *General assessment of clean water management model in commune Nam Hong*

No.	Items	Good	Inadequate	Remarks
1	With participation of the commune authority	X		
2	Operation regulations	X		
3	Structure quality	X		
4	Synchronization of system	X		
5	System operation on regulations	X		
6	Appropriate lay-out of system	X		
7	Water service payment	X		
8	Sufficient water supply	X		
9	Purchase of chemicals	X		Sufficient
10	Electricity supply	X		Depending on the transformer station
11	Maintenance & Repair	X		

Management model of clear water at commune Nam Hong *continued*

12	Participation of the people	X		Actively
13	Government support	X		
14	People's awareness of the structures before construction	X		
15	Appropriateness of the water service charge	X		According to the assessment of people
16	Quality of supplied clean water	X		
17	Quality of water source	X		
18	Return feasibility of investment	X		
19	Extension capacity possibility	X		
20	Professional training		X	All members of unit have to be trained
21	Salary of management unit		X	Low
22	Insurance payment		X	Not so far

The analysis of consideration above are mentioned in the assessment part. The clean water management model in Nam Hong commune, Nam Truc district, Nam Dinh province – The Commune People's Committee Model has put into operation for 2 years. It can be seen that this is a management model that has been assessed as a good model with efficient operation and capital preservation.

## V. CONCLUSIONS AND RECOMMENDATIONS

- In order to raise the sense of responsibility of the clean water management unit, the authority and people in commune Nam Hong; to maintain and promote the efficiency of the clean water supply station and to improve the quality of life and rural environmental sanitation in the commune; also to improve the sustainability in the organization and management of exploitation of the water station, the following proposals have been put forward:

i) To prepare and carry out the project aimed to build, to strengthen and to improve the clean water management unit in commune Nam Hong, according to the orientations in Decree No.151/2007/ND-CP following the contents mentioned in the concluding section above.

ii) To strengthen the propaganda campaigns in order to show people the advantage of using clean water; to stimulate the demand for water use, to improve the environmental sanitation and to improve the quality of life.

iii) According to actual data on the organization, management and exploitation of the rural water supply system, the proposals should be put forward to the State policy for the rural development, especially to assist research policies on the management of rural water supply system, and partial financial assistance for poor people in order to improve the hygienic conditions and the quality of their life. The reasons behind this proposal is that in the coming 5 years, 75% of rural population has access to clean water in accordance with the National Target Program, therefore this assistance will be one of good solution to implement the Party and State policy.

- Dealing with the effective operation and management of clean water supply system, sufficient provision of clean water of good quality as well as great potential in clean water demand and public financial activities it is seen that the clean water supply system at commune Nam Hong, district Nam Truc, province Nam Dinh will be increasingly developed.

- Comprehensive assessment of management model of rural centralized clean water supply is necessary to be carried out after the certain period of operation so that to enhance and to innovate the effectiveness, even to replace the existing management model in order to ensure the better clean water supply for people.

- Rural clean water supply at present is the actual matter and is paid the attention by various authorities as well as by the international organization with purpose of improving the living conditions. The rural people mainly refers to poor people, main income is available from the agricultural production, so the investment of construction of the clean water supply system in rural area needs the support and assistance for rural people in form of finance and policy.

- People considered, as beneficiaries has to contribute money and labor in construction of clean water supply system and actively participate in management and operation of the system. The system is operated and exploited effectively whenever people are aware of significance of the clean water supply.

- The suitable technology of water treatment, appropriate layout of head works (clean water station) will reduce the investment; the management unit must be of not so much as possible with the clear division of tasks for each member. Consequently the clean water supply will be developed stably.

- For the clean water supply system within the commune, the commune people's committee is of the great importance for construction, management and operation.

- The practice of clean water supply at commune Nam Hong district Nam Truc province Nam Dinh shows that this system has been provided good service in water supply for people engaged in. However, it is also requires to renovate the disadvantages in the model. Therefore, this model should be developed and extended for other area. In coming time, other communes have plan to construct new clean water supply or replace the current ineffective management model can be follow the experience of model of management unit at commune Nam Hong, district Nam Truc, province Nam Dinh.

- To avoid and to prevent the pollution of water source in channel due to garbage throwing in and to improve the habitat of people it is necessary to organize the garbage collection and its treatment as early as possible, immediately to establish the model at certain potential hamlet, the to develop in other hamlets as well as communes.

## VI. ANNEX



Full name	Job title and tasks

- Numbers of members of BOM, workers participated in a training course on clean water supply system operation and management: At least once: .....

- Demand for further training, education? Yes  No

- In which sector? Management  Engineering, operation planning, distribution...

**2. Draw the chart of the water supply management organization (including relation to upper, equal, lower levels and each level of staff)**

- Describe the relationship horizontally and vertically:

**3: Procedures, mechanism of water supply model establishment, operation, management, exploitation**

3.1 Foundation for rural water supply management organization ?

Free election  Tender  Proposer (*full name*).....

3.2 Who's in charge of preparing the operation regulations:.....

MB:  Local authorities  Higher authorities

3.3 Regulation building method (functions, responsibilities)

- Participation of water users in building the regulation? Yes  No

- Participation method? .....

3.4 Operation's regulation issued by whom:

.....

3.5 Edited into document? Yes  No

3.6 Public to the community? Yes  No

3.7 Describe the operation regulations

.....  
.....  
.....  
.....

3.8 People have been aware of the system construction? Yes  No

Information assessment method (source)?

.....

3.9 Discussion on the payment ? .....

3.10 Foundation for norm and prices related to rural water supply

- Water price: ..... VND/m<sup>3</sup> or ..... VND/household-month or  
..... VND/person-month

- Base for estimation of water price:

.....  
- Who approved the price: .....

3.11 Any account and seal of the organization in the bank? Yes  No

#### 4. Functions, responsibilities and authorities of the organization

4.1 Functions, responsibilities:

.....  
.....  
.....

4.2 Authorities on management, protection, punishment:

.....  
.....  
.....

#### 5. Relationship with households

- By service contracts: Yes  No  *Enclose a photo if available*

- Responsibilities of water supply organization

.....  
.....  
.....

- Responsibilities of water users:

.....  
.....  
.....

- Water users have any information on water-pumping time? Yes  No

#### 6. Management, operation

6.1 Operation process have been set on documents? Yes  No

6.2 Describe the operation process:

.....  
 .....  
 .....  
 .....

6.3 Difficulties in operation management process and solutions:

- Dispute on water: Yes  No  Solutions: .....
- Water stealing: Yes  No  Solutions: .....
- Payment delay: Yes  No  Solutions: .....
- System destruction: Yes  No  Solutions: .....
- Oppose to the authority: Yes  No  Solutions: .....
- Locality in distribution: Yes  No  Solutions: .....
- Others (*specified*) .....: Yes  No  Solutions:.....

6.4 Problems are solved adequately?

Yes  No

why?.....

6.5 Advantages, disadvantages in water distribution operation of the organization

a)  
 Advantages:.....  
 .....

b)  
 Disadvantages:.....  
 .....

6.6 Plan or proposal on improving the water distribution system to enhance the effectiveness of water distribution to users in the coming time :

.....  
 .....  
 .....

6.7 Equipment for management, operation, small repair

Equipment	Number	Purpose

Is there enough equipment for management, operation, small repair?

Yes  No

why?.....

### 6.8 Profile record

- Record of transfer document? Yes  No
- Record of construction completion document? Yes  No
- Record of investigation, engineering design document? Yes  No

## INVESTIGATION ON THE SYSTEM'S SCALE, CRITERIA FOR EVALUATING THE EFFECTIVENESS OF RURAL WATER SUPPLY MODEL

### A Information and effectiveness evaluation of rural water supply model

1. Headwork capacity: ..... m<sup>3</sup>/day Year of construction : ..... Year of completion .....

Current operation capacity: ..... m<sup>3</sup>/day

2. Number of water users of the system: .....Households; .....People

Water supply standard: Design: ..... litre/person-day Reality: ..... litre/person-day

3. Number of organizations using clean water (schools, clinics...):..... organizations

4. Is the location of the headwork suitable, Describe it?

.....

- Evaluate the effectiveness of the headwork: Good  Medium  Bad

Reason:.....

5. Describe the water distribution system

*Criteria for evaluating the current status:*

**Good:** *Endurable pipes to nature ( steel, HDPE plastic)good maintenance,operation*

**Medium:** *Normal PVC plastic pipes, good maintenance, occasional water shortage at the end of the system,*

**Bad:** *Any materials but bad maintenance, leaking, broken pipe, more than 50% loss,*

	Long (km)	Diameter (cm)	Material	Status			Reasons
				Good	Medium	Bad	
Main pipe							
Level 1							
Level 2							
Level 3							
Level 4							
Other levels							

Evaluating the water loss: ..... % (by dividing payment for headwork amount)

6. Describe water volume measuring method: Water meter  Based on the number of users   
Based on the number of households

**B. Finance effectiveness over the past 5 years and fixed assets evaluation**

1. Finance balance sheet (rural water supply)

1. Content \ Year	2004	2005	2006	2007	2008
A: Clean water revenue					
B: Expenses					
- Salaries					
- Insurance					
- Re-investment, large repair					
- Maintenance, small repair					
- Electricity payment					
- Bank interest					
- Depreciation for state budget					
- Tax					
- Other					
<b>Balance sheet</b>					

2. Any annual finance balance sheet ? Yes  No

3. Any participation of users in supervising receipts and expenses? Yes  No

4. Average salary of managers, staff

Manager of headworks, areas: ..... VND/month Insurance: Yes  No

Professional staff: ..... VND/month Insurance: Yes  No

Contracted workers: ..... VND/month Insurance: Yes  No

5. Salary evaluation (in comparison with the average living standard of local people)

Adequate  Rather low  Rather high  Too high  Too low

6. Fixed assets (millions of VND)

Assets	Original price	Remained value	Commune and provincial fund in %	People's contribution in %	Kind of contribution of people
Head works					
Pipe system					
Equipment					
Managers					

Number of water-meters for each household: .....water-meters Water-meter price  
.....VND/one

From: People's payment  Local fund  State fund

**INVESTIGATION ON ADVANTAGES, DISADVANTAGES, PROPOSALS**

1. Mechanism:

Disadvantages:.....

Advantages:.....

2. Construction:

Disadvantages:.....

Advantages:.....

3. Water users:

Disadvantages:.....

Advantages:.....

4. Proposing to which level of authority if facing difficulties ?

.....  
.....  
.....  
.....

5. Proposal of the direct manager to enhance the operation effectiveness and sustainable management of the rural water supply system

.....  
.....  
.....  
.....  
.....

*Surveyor*

*Confirmed by the surveyed organization*

## Annex 2. RURAL HOUSEHOLDS SURVEY

### A. General information:

1. Householder's full name:.....

Village:.....Commune:.....

2. District..... Province:..... Category: (Poor: No.1, Average: No.2, Rich: No.3)

Total number of people in family:

Where, the number of male:  female:

The number of main labors (age from 18 to 45):

When (which year) has your family been benefited from clean water supply system: .....

### B. Questions for evaluating the effectiveness of water supply system

1. The water resources that were used by the household before the supply of the clean water system constructed.

(Well: No.1; Pond and lake: No.2; Irrigation canal: No.3)  Other sources:

2. Is the amount of clean water from the supply system sufficient?

(Sufficient: No.1; Lack: No.2, Waterless: No.3)

3. Your evaluation about the quality of water: (Good: No.1; Not good: No.2)

If not, why?

.....

4. The monthly average charge for clean water, which your family uses: .....

VND/month

5. The current clean water charge per cubic meter: VND, or .....person

(household)/month.....

6. Is the water price appropriate? (Rational: No.1; Too high: No.2; Low: No.)

Why?

.....

7. Does your family satisfy with the construction of clean water supply system? (Yes: No.1; No: No.2);  If not, why? .....

.....

.....

8. Is the water supply on schedule? (Yes: No.1; No: No.2);

If not, why?

.....

9. What is the average amount of water your family monthly use? ..... m<sup>3</sup>

10. What is the water quality? Good  Bad

**C. Questions relate to environment and live activities in beneficiary areas**

1. Are there any improvements in the local hygiene conditions in comparison with before?  
(Yes: No.1; No: .2): If not, why?

.....

2. Are there any decrease in trachoma, diarrhea, skin disease in comparison with before?  
(Yes: No.1; No: .2); If not, why?

.....

3. Are there any improvements in the hygiene conditions for women in comparison with before?

(Yes: No.1; No: No.2); If not, why?

.....

4. Are there any major improvements in the hygiene conditions for children in comparison with before? (Yes: No.1; No: N);

If not, why?

.....

5. Are there any major improvements in the local living standard in comparison with before?

(Yes: No.1; No: No.2);

If not, why?

.....

Economic

.....

Society

.....

Other matters:

.....

6. Are there any improvements in environment of beneficiary areas?

(Yes: No.1; No: No.2); . If not, why?

.....

**D. Questions on the contribution for the water supply system**

**Did you or your family participate in any of the following activities?**

1. Did your family receive any information about the clean water supply project before its construction?

(Yes: No.1; No: No.2);  from which sources of information?

.....

2. Did your family participate in the discussion about the contribution for clean water supply project?

(Yes: No.1; No: No.2);  Form of contribution:

.....

- Money ..... VND

- Workday ..... days or other contribution.....

- Who pay for water meter? ..... What was water meter price? ..... VND

3. Did you or your family participate in the construction of the clean water supply project?

(Yes: No.1; No: No.2);

Description of the contribution:

.....

**E. Questions on the participation in organization, operation and maintenance activities**

**1. Did you participate in any of the following activities?**

1. Did you participate in the meeting for the establishment of clean water supply management committee, board or cooperative. (Yes: No.1;  No.2)

If not, why? .....

2. Did you vote for water utilize and service management board?

(Yes: No.1; No: No.2)

If not, why? .....

3. Did you vote for agricultural co-operative management board?

(Yes: No.1; No: No.2)

If not, why? .....

4. Do you have the knowledge about the operation mechanism of the clean water supply management committee?

(Yes: No.1; No: No.2)

If not, why? .....

5. Have you participated in the management, protection and discovery the issues of clean water supply system?

(Yes: No.1; No: No.2)

If not, why? .....

6. Are there any signs of water conflicts?

(Yes: No.1; No: No.2)

If not, why? .....

7. Are there any signs of water usage violation?

(Yes: No.1; No: No.2)

If yes, how frequently?

.....

8. Do your family have any unpaid bill for water charge?

(Yes: No.1; No: No.2)

If yes, why? .....

9. Are there any signs of derivation sabotage?

(Yes: No.1; No: No.2)

10. Are there any signs of partial water distribution?

(Yes: No.1; No: No.2)

11. When problems araised, does the person in charge (management board, co-operative) hand over the situation in time?

(Yes: No.1; No: No.2)

If not, why? .....

12. Do the local households receive information in the annual financial report of the clean water supply management committee (board or co-operative) every year?

(Yes: No.1; No: No.2)

If yes, how do you receive that information?

.....

.....

13. If there are difficulties, who will you express your concerns to?

.....

**2. Questions for evaluation of the current management tasks with the water supply model**

14. Do you satisfy with the current clean water supply service?

(Yes: No.1; No: No.2)

If not, why?

.....

15. How do you evaluate the clean water management tasks?

(Good: No.1, average: No.2, Dissatisfied: No.3)

Description:

.....

16. Is the managerial arrangement suitable? (Yes: No.1; No: No.2)

If not, what need to be changed or replaced?

.....

17. In your opinion, is the current management model suitable?

(Yes: No.1; No: No.2)

If not, why?

.....

What conditions are needed for maintenance and development of the management model and the organization?

.....

**3. Your assessment on the advantages and disadvantages in the operation of clean water supply.**

a) Advantages:

.....

.....

b) Disadvantages:

.....

.....

3) Your proposals to the authorities to improve the supply efficiency:

.....

.....

.....

.....

*Surveyor*



**Annex 3:** Primary pump station



**Annex 4:** Pumps in secondary station



**Annex 5:** Warning sign of water pipe under ground



**Annex 6:** Water meter at household

**Annex 7: ANALYSIS RESULTS OF WATER SAMPLES**

1. Water sample in Red river.
2. Water sample in storage tank after treatment.
3. Clean water sample in household (M1).
4. Clean water sample in household (M2).
5. Rainwater sample in household.
6. Well sample in household.