Environment and Ecology 36 (4A) : 1245—1255, October-December 2018
Website: environmentandecology.com ISSN 0970—0420

Solutions to Climate Change to Rural Water Supply in Red River Delta

Luong Van Anh

Received 11 June 2018 ; Accepted 18 July 2018 ; Published on 13 August 2018

Abstract Red River Delta has 11,963,556 people using hygienic water from different water supply types: Public water supply facilities (PWSF), dug wells, wells, rainwater and other water sources. The trend of climate change as mentioned above will greatly affect the development of water supply in the whole Red River Delta in the coming time. Therefore, it is necessary to have solutions to the rural daily-life water supply in the Red River Delta in the context of climate change as a basis for management and investment in the rural daily-life water supply to achieve the pointed goals. In addition, it is necessary to assess the status of rural water supply in rural areas in the Red River Delta in the context of climate change and related issues, thus identifying objectives for timely guidance for the period up to 2020. In order to have a solution and achieve the target, it is necessary to divide the specific water supply area of the RRD basing on the reality of the region and the distribution scope of the river basins: Topographic, geomorphological features ; geological, hydrological features. Conditions for socio-economic development in each region and impacts of climate change on the regions.

Dr Luong Van Anh
Director, National Center for Rural
Water Supply and Environmental Sanitation
(NCERWASS), 73, Nguyen Hong-Dong Da-Ha
Noi-Viet Nam 100000, Viet Nam, Ha Noi
e-mail: luonganh75@mail.ru

Keywords Climate change, Public water supply facilities, Booster pump station, Wells, Global warming.

Introduction

Water is the central link in economic and social development: It is vital for maintaining health, growing food, energy production, environmental management and creating new jobs. From the rational use of water resources depends on where you are : Poor families, whether they meet the requirements for safe health conditions or poor settlements to withstand the consequences of floods or droughts (Arnell 2004).

According to Haddeland and Heinke (2014), water security is still considered one of the main global risks in terms of impact on the development process. It is also an integral part of the achievement of the sustainable development goals (LDCs). The world does not allow to solve the problems in the field of sustainable development of the 21st century: Development of human potential, creation of cities favorable for life, counteraction to climate change, provision of food and energy security, without improving the system of water resources management and providing access to reliable water supply and sewerage services.

However, to address complex issues, population growth, and economic growth support unprecedented pressure on water resources. According to the contract, 40% of the deficit of projected demand by 2030.

Today, 70% of the world's water abstraction falls on agriculture. Over the centuries, the Vietnamese have created an extensive network of dams and canals that help cope with the main danger from the rivers side– catastrophic floods. The mass of water coming from the north during the monsoon season is redistributed among countless rice fields (Porfirev 2009, Eldyshev 2007).

At present, Red River Delta has 3,189,549 people using water from PWSF, 1,000,586 people using water from dug wells, 6,082,614 people using water from normal wells, 3,143,989 people using rainwater, the others use water from the sources of local ponds, lakes, rivers, springs (NCRWSS 2013).

Up to the end of 2016, the National Target Program for Rural Water Supply and Sanitation (SMED) achieved 95.4% of the rural population in the RRDR, of whom 52.7% used water with QC 02-BYT, and will continue to experience difficulties. The evolution of climate change is very complicated such as saline intrusion, severe water shortage due to the prolonged dry season, floods–storms and storms with unusually high intensity and difficult to predict.

Recent research results show that climate change in Vietnam is basically in line with the trend of climate change happening in the world as well as in the region. Under the impact of climate change in the Red River Delta (RRD), there are some major manifestations: In the last three decades, the phenomenon of ENSO has had a strong impact on weather and climate in many parts of Vietnam. The Red River Delta will be affected: The temperature will increase to 0.30 C by 2010 ; to 1.10C by 2050 ; to 1.50C in 2070 and the rainfall in rainy season increased to 0–(+5)%. Cyclones tend to be slower, occurring more in low latitudes and especially in more severe storms. The rainy season comes later and ends sooner. The intensity of rainfall is concentrated in a short time causing local flooding in some localities in the Red River Delta.

The sea level is tending to rise, particularly in Vietnam by 2050 it is 30 cm and in 2100 it is 50 cm compared to the average of 1980–1999. With sea level rise, the salinity of 4% can go deep into the Red River and Thai Binh River more than 20 km, causing in undation of about 10.8% of the land area in the Red River Delta as well as increasing the demand for water. Operate QCVN 02 of people in the region to adapt to the weather changes. According to climate change scenarios, sea level rise of Ministry of Natural Resources and Environment shows that at present, in Vietnam, each scenario with high (A_2), medium scenario (B_2) and low scenario (B_1) is constructed. Fluctuation of temperature, monthly rainfall in the Northern Delta over decades (MNRE 2016).

Materials and Methods

It is necessary to assess the situation of water sources in terms of volume, quality, distribution of surface water and groundwater when climate change occurs, sea level rise, flood, water shortage as well as socio-economic conditions of each locality (Bobrov 2014, Loginov 2014). From there, appropriate measures for rural water supply in rural areas in the Red River Delta in the context of climate change. Propose implementation measures such as water use in the context of climate change and technology ; capital solution ; operational management ; socialization of water supply ; communication such as : to comprehensively study the natural, environmental and social conditions of the Red River Delta, ensuring the sustainable water supply in the context of climate change, the suitability with socio-economic development as well as the development trend of interregional water supply ; Water supply plans should be developed to ensure that the climate change scenarios developed by the Ministry of Natural Resources and the Environment in the Red River Delta in particular and the whole country in general and in line with the planning of the relevantsectors. Particular attention should be paid to linking this planning with irrigation planning as well as water resource development planning ; urban water supply planning ; new rural construction planning ; the goal of poverty reduction. Exploit and use economically, suitable for integrated use of water resources in river basins (Elpiner 2009), following steps should be taken : To study and apply diversified forms of water supply technology suitable to climate change conditions in each sub-region

; to make use of existing water supply facilities (CTCNs) to upgrade and expand and simultaneously seek solutions to exploit water sources in areas with special difficulties such as frequent water shortages, floods and saline invasions, mountainous ; to exploit and rationally use water sources with appropriate advanced technologies and raise the water quality by applying new technologies on the basis of prioritizing the application of scientific and technical advances in water supply and rationing, maintaining consistent traditional technology (Nazarova 2011, Belokonev 2012).

Researching options and solutions for rural water supply to adapt to climate change with different scenarios: Increasing temperature, sea level rise, salinity intrusion, water shortage, floods–impact on water supply and rural water supply.

Prioritize water supply for poor areas, areas with special difficulties, coastal areas, areas with frequent shortages of water, floods, and pollution. To prioritize the investment in the construction of large-scale information technology works in areas where water sources are available, regions with economically developed conditions and high population levels and high water demands (Orlov 2015).

Promote the socialization of the rural daily-life water supply sector such as consultations with beneficiaries and promote socialization, a public-private partnership from construction work, finance, management, operation.

Promote education and communication with the participation of all levels of government, socio-political organizations, especially the people in order to jointly implement the planning of the Red River Delta region.

Analysis, forecast, and evaluation of changes, changes in flow, quality and distribution of surface water resources in the context of climate change

Vietnam is one of the countries strongly affected by globalclimate change, in which the Red River Delta is one of the two most affected areas. Regional river systems in recent years also have abnormal changes in both quality and flow, flood season increased, dry season drastically reduced traffic and quality deteriorated. Low water levels in the dry season and rising in the rainy season so that the water capacity of the works is difficult. The sea water area of the river system is deeply submerged to the ground, which will affect the exploitation of water for daily life and irrigation (WWF 2015).

The surface water resources in the Red River Delta relatively abundant, but unevenly distribution by space and time. Water volume is mainly concentrated in the flood season (70—80%), the dry season is relatively low (20—30%).

The quality of surface water in the Red River Delta is generally good. However, due to the development of socio-economic development is faster, so the discharge of water into the water shortage control has caused local water pollution in some rivers. Moreover, the condition water loss, flow in the dry season has increased the level of pollution in the tributary. Saline intrusion often occurs on nearby tributaries sea door. With the participation of regulators of upper reservoirs such as Hoa Binh and Tuyen Quang, the saline intrusion has not occurred at a serious level and still lies in the controlled limit.

With the socio-economic development, the pressure on water sources is increasing. Demand Water tends to increase in both quantity and quality. However, the construction of the prize proper adaptation to ensure water security is a challenge great for the Red River Delta.

The mehod of managing the exploitation and use of unsustainable water sources is challenging to ensure water security in the Red River Delta. In the future, under the impacts of climate change, surface water resources in the Red River Delta are projected to be much stronger than currently.

The ability to exploit and use underground water for living in regions

Groundwater potential of the Red River Delta is plentiful but unevenly distributed and not easily exploited.

Table 1. Extreme average monthly water level over times (m). *Water level on ground.

Time	Deepest average monthly water level		Lowest average monthly water level	
	Level (m)	Location	Level (m)	Location
5/2017	12.65	W. Tu Lien, D. Tay Ho, Ha Noi (Q.67)	0.18	C. Son Dong, D. Hoai Duc, Ha Noi (Q.58)
Before (2016)	12.30	W. Tu Lien, D. Tay Ho, Ha Noi (Q.67)	0.09*	W. Hoang Liet, D. Hoang Mai, Ha Noi (Q.65)
Before (2012)	10.22	W. Tu Lien, D. Tay Ho, Ha Noi (Q.67)	0.08*	W. Hoang Liet, D. Hoang Mai, Ha Noi (Q.65)
Before (2007)	9.17	W. Tu Lien, D. Tay Ho, Ha Noi (Q.67)	0.18*	W. Hoang Liet, D. Hoang Mai, Ha Noi (Q.65)

Underground water is concentrated in the northwestern part of the delta, in which the richest areas in Hanoi. According to research data from scientific reports, the natural reserve of the Northern Delta is 7.18 million m^3 day ; in particular, the area of Hanoi to 3 million m^3 / person. Grade C2 reserves are approximately 3.85 million m^3 / day, which is considered to be the potential of light water of the Red River Delta. At present, there are 18 aquifers in the Red River Delta, but only two aquifers, qh and qp, are significant in exploiting underground water.

The ability to exploit surface water for daily life is absolutely guaranteed, but it is necessary to carefully identify the favorable location to exploit water up to the required quality standards. Climate change is characterized by erratic changes in the phenomenon of rain, wind, flood, drought, salt intrusion affect the quality and reserve of underground water, but need to have a plan to exploit safely to ensure stability and sustainability.

Status of exploitation and use of underground water resources in the Red River Delta

The Red River Delta has three main aquifers in use: Holocene (qh), Pleistocene (qp) and Pliocene (n^2) aquifers. The status of capture and potential reserves of aquifers have been reported and evaluated. According to the calculated statistics, compared with the potential exploiting reserves, the current water exploitation is only a small part. However, everywhere the water level and water quality are tending to decline. The water level in drilling wells is constantly decreasing ; in many places saline intrusion occurs, the area of pale water is narrowed. The situation of changes in groundwater resources in terms of reserves (water level) and water quality is specifically addressed to the major water storage units and initially identified the causes of fluctuations and solutions responding to mitigate adverse impacts on the use of groundwater resources.

Due to the impact of natural factors, due to the impact of economic activity of people in many areas (water exploitation, mining, construction works, urban on the ground and in the underground space) where groundwater resources are more volatile. Most of the fluctuations tend to deteriorate, as the area of distribution of the hopper decreases the groundwater level due to increasing water exploitation, the area of the supplementary area of the aquifer in the

Table 2. Average water level in May compared to the same time in previous years.

Time	Main trend	Lowest level		Highest level	
		Level (m)	Location	Level (m)	Location
Before (2016)	Summer	2.85	W. Mao Khe, Dong Trieu, Quang Ninh (Q. 141)	0.39	C. Viet Xuan, D. Vinh Tuong, Vinh Phuc (Q.2)
Before (2012)	Summer	2.43	W. Tu Lien, D. Tay Ho, Ha Noi (Q.67)	0.67	C. Viet Xuan, D. Vinh Tuong, Vinh Phuc (Q.2)
Before (2007)	Summer	3.48	W. Tu Lien, D. Tay Ho, Ha Noi (Q. 67)	1.91	C. Chuyen Ngoai, D. Duy Tiên, Hà Nam (Q.89)

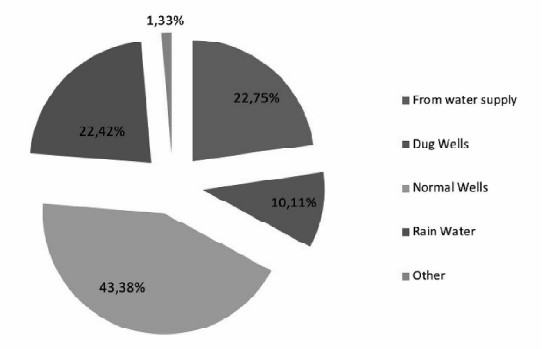

Fig. 1. The rate of water supply types using in RRD.

edge of the Red River Delta is narrowed (due to construction of urban areas, industrial zones), increased contamination on water exploitation areas. However, due to climate change, more rainfall increases the amount of access, some places the water has been expanded, and in the past years have discovered and confirmed a number of new aquifers (Hickey 2014, Ramstoff 2012).

Groundwater resources change in the Red River Delta

Fluctuations in water levels to see groundwater fluctuations, i.e. changes in groundwater reserves based on water monitoring data for decades. Across the region, water levels in the Pleistocene aquifer are continuously lowered due to water exploitation. From the dry season of 2005 to the dry season of 2012, the level of water level is about 2 m. The whole plain has formed 3 lowering centers, the largest water level reduces, the deepest is in Hanoi. In recent years, more centers have been built in Hai Phong and Nam Dinh.

The water level in the Holocene aquifer (qh) 5/2017

The average groundwater level in May 2017 compared with the same period last year, 5 years ago, 10 years ago has a downward trend and is shown in detail in Tables 1, 2 and Figs 1–3. The water level decreased the largest compared to the same period last year, five years ago, the previous 10 years is 2.85 m in MAO Khe Ward, Dong Trieu, Quang Ninh: 2.43 m and 3.48 m in Tu Lien ward, Tay Ho district, Hanoi.

The water level in the Pleistocene aquifer (qp) 5/2017

The average groundwater level in May compared to the same period of the previous year, five years ago, 10 years ago, tends to be lower and detailed in Tables 3, 4. Water level decreased the most compared to the same period last year., 5 years ago, 10 years ago was 6.70 m ; 9.75 m and 14.01 m in Phu Lam Ward, Ha Dong Dist. Hanoi.

Results and Discussion

Proposed solutions

On the basis of the National Target Program to cope with climate change, important projects and solutions must be developed in order to mitigate the damage. Provinces in the region will coordinate with relevant ministries and agencies to develop a climate change adaptation strategy for each locality.

In order to cope with climate change adaptation for the daily life of the Red River Delta, two main solutions will be studied: Water supply solutions for residential areas and solutions for treatment technologies (SRDWC 2003, Lenton 2003).

Survey and selection of water sources for safe living, far from areas affected by salinity intrusion or areas where the salt intrusion is the lowest possible.

In the process of designing the construction of the CNA, considering future forecasts caused by the climate change, so that the works can be operated in a sustainable manner so as to raise the capacity and raise the module for timely processing when the water quality is changed, meeting the effective operation when the quality of water sources are changed.

There are solutions to use integrated water resources between units, between branches and seasons of the year within the allowed limits.

Water source solution

To prioritize the combination between exploitation and supplementation between seasons in order to meet

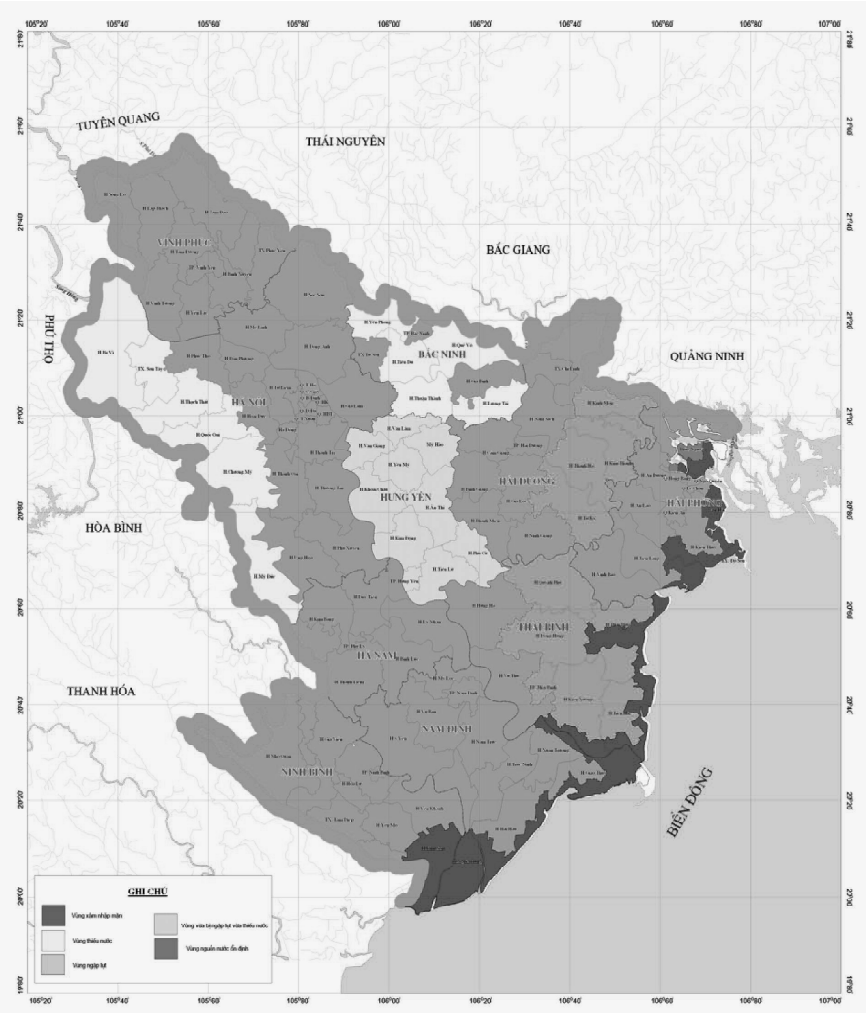

Fig. 2. Local zoning maps have water resources problems in the Red River Delta.

the exploitation of the supplied water source of each region, which is affected by climate change and the exploitation of water sources from adjacent areas.

Collecting and using rain water in all forms but having to process it before putting it into use. Artificial replenishment of underground water, restoration of polluted water, degradation, exhaustion, prevention and response when climate change occurs.

To protect water resources in all forms and to remediate thoroughly the issue of discharge of waste water and garbage into the environment. Development of rural water supply planning projects in each province in the context of climate change to identify the most appropriate water supply solution for each sub-region of the affected area.

Technology

Seeking, researching, using surface and groundwater treatment plants to ensure the water supply sys-

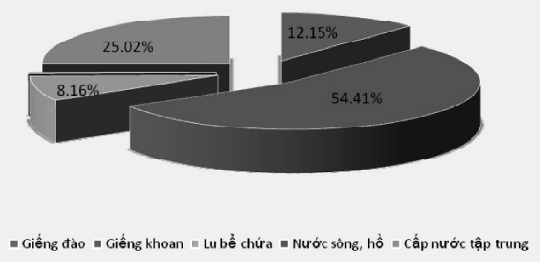

Fig. 3. Local zoning maps have water resources problems in the Red River Delta.

tem (CTCNNO) is sustainable in the future, can be treated when the source water quality changes.

In the localities where the CTCNN is inefficient or not yet fully designed, it needs to be restored, repaired, upgraded, renovated and expanded to increase its capacity. The management and operation units need to grasp low-level water treatment technologies that are ready to be deployed to provide water to people in case there is no alternative.

To apply appropriate technologies on the basis of prioritizing the application of scientific and technical advances in water supply under the conditions of climate change, maintaining traditional technologies suitable to the following types of state-owned transportations : To concentrate on building inter-commune and inter-regional water ways investment projects. The water supply network is designed in an inter-regional water supply for water-shortage areas as a result of climate change. The places to be connected, invest in the construction of new pump stations or renovate and repair the small and ineffective CTCNN to become a pump station. In special cases, the construction of the CTCNN is of a communal size (Shnitnikov 1969).

Provide water supply solutions in rural areas, prioritizing the delivery of water to communes, approved areas. The area under development and expansion of the water supply network in the future must have solutions to raise capacity at treatment stations, expand the water supply network in line with the socio-economic development and population planning. Urban adjoining urban areas do not have a water supply policy or have in the future to provide an easily accessible water supply alternation or conversion plan, as urban water supply is expanded or go through the network and connection to provide water for the people. Rural areas with clean water pipelines going through will also connect extensively from the main pipeline to supply water to the area (Shilov 2000).

Analysis of selected water resources in each region in the context of climate change

In order to adapt to climate change, it is necessary to set the target here to select appropriate water sources for each region divided into 3 below (Regions 1–3). From there, there is a specific water supply strategy for each sub-region to respond appropriately.

According to the average emissions scenario up to 2020, seawater can rise another 12 centimeters, and this means that a series of coastal lands are submerged

Table 3. Extreme average water level over time (m).

Time	Deepest average monthly water level Level (m)	Dia diem	Lowest average monthly water level Gia tri (m)	Dia diem
5/2016	29.18	W. Dich Vong, D. Cau Giay, Ha Noi (Q.63aM)	0.56	W. Le Hong Phong, C. Phu Ly, Ha Nam (Q.82a)
Before (2016)	28.75	W. Dich Vong, D. Cau Giay, Ha Noi (Q.63aM)	0.59	W. Le Hong Phong, C. Phu Ly, Ha Nam (Q.82a)
Before (2012)	28.52	W. Dich Vong, D. Cau Giay, Ha Noi (Q.63aM)	0.91	W. Le Hong Phong, C. Phu Ly, Ha Nam (Q.82a)
Before (2007)	27.13	W. Dich Vong, D. Cau Giay, Ha Noi (Q.63aM)	0.42	Commune Van Mon, D. Yen Phong, Bac Ninh (Q.36)

Table 4. Average water level in May compared to the same time in previous years.

Time	Main trend	Lowest level		Highest level	
		Level (m)	Location	Level (m)	Location
Before (2016)	Summer	6.70	W. Phu Lam, D. HaDong, Ha Noi (Q.69a)	1.91	C. Van Hoi, D. Tam Duong, Vinh Phuc (Q.4)
Before (2012)	Summer	9.75	W. Phu Lam, D. HaDong, Ha Noi (Q.69a)	1.74	C. Van Hoi, D. Tam Duong, Vinh Phuc (Q.4)
Before (2007)	Summer	14.01	W. Phu Lam, D. HaDong, Ha Noi (Q. 69a)	2.40	C. Le Loi, HD. An Duong, Hai Phong (Q.167a)

in water, the Red River system–Thai Binh River is deeply penetrating tens of kilometers (Region 1).

The choice here is to exploit the groundwater resources mainly, followed by thoroughly collecting rainwater. Surface water sources in areas prone to high salinity intrusion in the dry season shall be restricted from exploitation and use for daily-life activities and suitable exploitation sources for replacement and supplementation.

However, when exploiting the underground aquifers, it is necessary to carry out inventory and quality evaluation in order to have a plan to exploit water retention to ensure sustainable water supply. In addition, large-scale inter-communal water supply systems should be built, the pump station should be connected to the inter-commune and inter-district mass organizations in areas 2 and 3.

The area is prone to low salinity intrusion but is affected by water shortage and flood or surface water and groundwater are lowered (Region 2). According to the average emission scenario, by June to August, rainfall will increase by 2.9%. Therefore, zone 2 is the reserve area, the water quality varies markedly by season.

Selected water sources are surface water, underground water reserve for exploitation in the shortage.

Region 1. Areas affected by the climate change cause salinity intrusion.

No.	Province	Districts
1	Hai Phong	Tien Lang district with communes: Tay Hung, Dong Hung, Tien Hung, Vinh Quang, Hung Thang, Tien Thang. Kien Thuy district with communes: Kien Quoc, Tan Trao, Doan Xa, Dai Hop, Bang La, Hop Duc, Hoa Nghia, Anh Dung, An Hai. A part of Thuy Nguyen district with communes: Lam Dong, Hoa Dong, Tan Duong, Duong Quan, An Lu, Trung Ha, Thuy Trieu.
2	Thai Binh	Thai Thuy District with southern communes from My Loc to Thuy Tan. Tien Hai district with communes on the right side of Red River from Nam Phu commune to Dong Hai commune and communes on the left of Red River as Nam Hai, Nam Hong, Nam Hung. Kien Xuong district with communes adjacent to the left side of Red River as Binh Dinh, Hong Tien.
3	Nam Dinh	Nghia Hung district with communes from Nam Dien, Rang Dong town, Nghia Lac commune. Hai Hau district with communes on the left side of Ninh Co river (from Thinh Long town to Hai Giang commune) and seaside (from Thinh Long to Hai Phuc commune). Giao Thuy district with coastal communes (from Giao Lam to Giao Thien commune) and communes on the left side of Red River (from Giao Thien to Ngo Dong). Xuan Truong district: With communes on the left side of Red River from Xuan Tan to Xuan Chau.
4	Ninh Binh	With all about Kin Son district.

Region 2. Region under average effect and regions under the frequent effect of flood.

No.	Province	District
1	Bac Ninh	A mountainous landscape with Tien Du district and Que Vo district. Low-lying terrain with Gia Binh district, Luong Tai district.
2	Ha Nam	The western area adjacent to Hoa Binh (Kim Bang district).
3	Hung Yen	All districts: Van Lam, My Hao, Yen My, Van Giang, Khoai Chau, Kim Dong, An Thi, Tien Lu, Phu Cu.
4	Hai Duong	Chi Linh district: With 12 communes of mountainous terrain (An Lac, Bac An, Co Thanh, Dong Lac, Hoang Hoa Tham, Hoang Tien, Hung Dao, Kenh Giang, Le Loi, Nhan Hue, Tan Dan, Van Duc). Kinh Mon district: With 18 low mountainous terrain.
5	Hai Phong	Other remaining districts
6	Nam Dinh	Y Yen district ; Vu Ban district ; My Loc district ; Nam Truc district ; Truc Ninh district ; Xuan Truong district. Other remaining communes: Nghia Hung district, Hai Hau district, Giao Thuy district.
7	Ninh Binh	Southern West of Nho Quan district and Tam Diep town. West of Gia Vien district. Southern West of Hoa Lu district, Yen Mo.
8	Vinh Phuc	Lap Thach district, Song Lo district, Tam Dao district. 4 communes, districts: Binh Xuyen (Trung My, Thien Ke, Gia Khanh, Huong Son). Phuc Yen commune, Tam Duong district.
9	Hs Noi	The area with mountainous, Midland, low mountainous terrain as Ba Vi district, My Duc district, Soc Son district, Quoc Oai, Chuong My, Son Tay.

In this area should be combined with irrigation water collected in the reservoir to meet part of the demand for use during a prolonged water shortage. However, in localities where surface water is seriously polluted in excess of the permissible standards, underground water will be used for domestic water supply.

Areas where water is not impacted or low. The quality and reserves have met the demand for domestic water supply. In this area, it is possible to exploit both surface water and groundwater (Region 3).

However, to protect water resources for sustainable development in the coming time, priority should be given to the exploitation of surface water from the system of rivers and lakes of high quality. In areas near industrial parks, private production areas, the choice of underground water. Besides, the collection of rainwater in all forms is still applied in order to save water resources.

Conclusion

According to Krivenko (2003), when forecasting climate change at the global level, there is some uncertainty. Although this uncertainty is increasing significantly at the regional, national and local levels, it is at the national level that the most important deci-

Region 3. This is the regions under less effect of climate change.

No.	Province	Districts
1	Bac Ninh	Other remaining districts.
2	Ha Nam	Other remaining districts: Duy Tien, Ly Nhan, Binh Luc, Thanh Liem, communes of Phu Ly city.
3	Hai Duong	The districts have flat terrain, abundant water resources diversity: Thanh Mien, Cam Giang, Nam Sach, Thanh Ha, Tu Ky, Ninh Giang, Binh Giang and other communes, wards in Chi Linh and Kinh Mon districts.
4	Thai Binh	Other remaining districts: Hung Ha, Vu Thu, Quynh Phu, Thai Thuy.
5	Ninh Binh	Yen Khanh district, Kim Son district, and other communes.
6	Vinh Phuc	Other remaining districts with Vinh Tuong district, Yen Lac district.
7	Ha Noi	Other remaining districts in Ha Noi.

sions need to be made (Patz 2005). Increasing temperatures and decreasing precipitation can lead to a reduction in water supply and an increase in demand for water (Safonov 2006). This can cause a decrease in the quality of water in freshwater reservoirs and create even greater difficulties in the already volatile in many countries the balance between supply and demand (Kabat et al. 2002). Even where rainfall is possible, there is no guarantee that they will fall out at the time of the year when they can be used ; in addition, the probability of floods increases. Any increase in sea level often causes the intrusion of saline waters into river estuaries, small islands, and coastal aquifers, and flooding of low-lying coastal areas ; this threatens serious danger for countries located in lowland areas.

Monitoring of climate change and its impact on freshwater bodies should be carried out in close relationship with national and international environmental monitoring programs (Shabanov et al. 2001). In particular, those related to the atmosphere, which is dealt with elsewhere in the agenda for the 21st century, and the hydrosphere.

The assessment of the causes and consequences of global warming serves as a basis for prevention and adaptation actions at the level of states (Drozdov (1989), corporations and individuals. Many environmental organizations advocate action against climate change, mostly by private consumers, but also at the municipal, regional and governmental levels (Golub and Strukova 1999).

Water plans have been developed on the basis of climate change in accordance with Baits (2008). In order to achieve the objectives and be implemented in the life, it is necessary to study and propose implementation solutions as well as plans and plans for water supply and planning on paper for implementation with the reality of rural water supply in the Red River Delta in the context of climate change (MARD 2008a).

An overview of the situation of rural people in the Red River Delta using water from the current water supply. On the basis of clarifying the importance of water to the health of the rural population, the status of existing water supply systems in the Red River Delta. By analyzing the impacts of climate change on the issue of water supply: (1) The surface water, underground water, and rainwater are both in decline and quantity, (2) The water resources is declining and will not be able to meet water demand after 2020, (3) Surface water-groundwater in the areas adjacent to the sea will be seriously salinated when sea level rises by 12 cm, (4) The area will be seriously dehydrated when flooded in the country, (5) Responding to water supply for living with climate change is still not timely and timely measures, (6) From the beneficiaries, (7) Lack of coordination mechanism, constraints on protection and restoration of water resources, (8) The need to develop plans for rural water supply in rural areas in the Red River Delta in the context of climate change is the sustainable development.

Assessment of the status of rural water supply in rural areas in the RRD. Analyze the characteristics of natural and socio-economic conditions of the 10 provinces in the Red River Delta and draw comments on the advantages and dis-advantages to the daily-life water supply. Assess and identify areas that have difficulty in water supply, areas affected by salt water, floods, water shortages, and sea level rise. Difficulties in the exploitation of water resources and draw out the problems to study the solution to solve the efficiency of the Red River Cement industry is: Construction–improvement of water treatment line with the quality of water sources is changed ; the application of integrated water resources and the application of new treatment lines is highly applied, and the search for alternative water sources when the main water source is affected ; research, calculation and development of water supply for rural areas in the Red River Delta in the context of climate change (MARD 2008b).

Provide the results of research and propose measures to implement the rural water supply plan in the context of climate change, identify the views on rural water supply in the Red River Delta, the management model of IPR, thus offering solutions, specific partitions. The proposed solutions have followed closely the water policies of the party, the State and the socialization of rural water supply in line with peoples

living standards. This is a consultative basis for the Red River Delta provinces on the roadmap and steps to be taken in order to improve the efficiency of water supply for sustainable living in the context of climate change (VCS 2006).

The results and solutions are approved by the specialized appraisal board of the General Department of Irrigation. My 2014 and appraisal committee on environmental impact assessment of Ministry of Agriculture adopted date 2015 for application in Red River Delta.

References

Arnell NW (2004) Climate change and global water resources: SRES emissions and socio-economic scenarios. Global Environmental Change–Human and Policy Dimensions.

Baits BK (2008) Climate change and water.

Belokonev EN (2012) Wastewater and water supply. Moscow : Fenix.

Bobrov V (2014) World geography. Interesting facts in climate change. Moscow: Fenix.

Drozdov OA (1989) Climatology. St Petersburg: Gidrometizdat.

Eldyshev UN (2007) Climate change: Consequences and counteractions. Ekologiya I zhizn.

Elpiner LI (2009) Water resources, climate and health.

Golub AA, Strukova EB (1999) Nature resource economy. Moscow : Aspectpress.

Haddeland I, Heinke J (2014) Global water resources affected by human interventions and climate change.

Hickey GC (2014) Climate.

Kabat P, Schulze RE, Hellmuth ME, Veraart JA, Roberto L (2002) Climate variability and change-freshwater management. Int Rev Environm Strategies 3 (2) : In press.

Krivenko VG (2003) The forecast of climate change in Eurasia from the standpoint of the concept of its cyclical dynamics. Moscow.

Lenton R (2003) Water and climate variability: Development impacts and cropping strategies. Conf Proc, Stockholm Water Symposium.

Loginov VF (2014) Global and Zone climate change. Cause and effect. Moscow: TerraSistems.

Minister of Agriculture and Rural Development (2008a) Decision No. 3295/QD-BNN-TL dated October 27, 2008 of the Minister of Agriculture and Rural Development promulgating guiding documents for reviewing and adjusting the daily-life water supply and environmental sanitation village.

Minister of Agriculture and Rural Development (2008b) Decision No. 51/2008QD-BNN dated 14/4/2008 of the Minister of Agriculture and Rural Developmenton promulgation of the set of indicators for monitoring and evaluation of rural clean water and sanitation.

Ministry of Natural Resources and Environment (2016) Scenario of climate change, sea level rise. Hanoi.

Nazarova VI (2011) Modern water supply systems. Wells, boreholes and other water sources.

Orlov EV (2015) Water supply. Water intake facilities. Moscow.

Patz JA (2005) Impact of regional climate change on human health. Nature.

Porfirev B (2009) Global climate change: New risks and new opportunities for economic development.

Ramstoff Sh (2012) Global climate change. Moscow: OGI.

Safonov GV (2006) Dangerous effects of global climate change. WWW.

Shabanov VV, Vonalov DN, Orlov IS (2001) The need to assess natural resources and conditions as one of the main factors in the use of natural resources.

Shilov LL (2000) Ecology. Moscow: Vyshyaa shkola.

Shnitnikov AV (1969) Intraspecific variability of components of total hydration. Lviv: Nauka.

Synthesis Report of The Dialogue on Water and Climate (2003) Climate changes the water rules–How water managers can cope with today's climate variability and tomorrow's climate change.

The National Center for Rural Water Supply and Sanitation (2013) The Rural Water Supply Planning Project for the Red River Delta in the context of climate change in 2013.

Vietnam Construction Standard (2006) TCXDVN 33 : 2006 design standards for water supply–pipeline network and works.

WWF (2015) Climate change impacts in Vietnam.