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Water Resource for Economic Development in Vietnam and Implications for Developing Countries

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Water Resource for Economic Development in Vietnam and Implications for Developing Countries[1]

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I. Introduction

Although water resource of Vietnam has abundant volume, in fact, usable water resource is limited because of uneven distribution. Many areas are lack of fresh water for living resulted by pollution, flood, erosion, landslide, drought and other factors. Water quality is also degraded seriously making living environment being destroyed and pushing people closer and closer to dangerous risks. Vietnam's Ministry of Natural Resource and Environment estimated that about 37% of water loss was caused by wasting, even in some areas the ratio may be 50%. One of main reasons is that water resource in Vietnam depends much on rainfall and system of trans-boundary rivers, infrastructure of water supply is outdated because some of irrigation system which had been built since 1960s, 1970s now are degraded and damaged heavily. Water management is weak, process of rapid industrialization and urbanization in Vietnam is making demand for water increase higher and higher, whereas pollution of water source is also raised. The purposes of this article is to define potential and real status of water exploitation and usage in Vietnam, emerging issues which Vietnam faces in using water for economic development, therefore recommends some implications. Methodologies are surveys and investigations of 450 samples in provinces of Nam Dinh and Hanoi which are prone to big storms and have high level of rainfall about 1,750mm to 1,800mm, and in Ninh Thuan which is prolonged dry with rainfall about 400 mm to 700 mm, in combination with available statistic data of Vietnamese relevant ministries and agencies to evaluate research outcomes.

II. Basic Characteristics of Water Resource in Vietnam

a) Water Potential

Water resource in Vietnam is evaluated very diversified and abundant consisting of surface water and ground water in natural and artificial watershed areas like: rivers, springs, natural lakes, artificial lakes, wells, dams, ponds, swamps and aquifers. According to the report of the Ministry of Natural Resource and Environment (MoNRE), Vietnam has about 2,372 small and big rivers with the length of over 10 km in which there are 109 main rivers such as: Hong river, Thai Binh river, Bang Giang – Ky Cung river, Ma river, Ca river, Vu Gia – Thu Bon river, Ba river, Dong Nai river, Mekong river and 04 tributaries like Da river, Lo river, Se San river, Sre Pok river compassing huge catchment of over 10,000 square km, representing about 93% of total areas of river network in Vietnam. Besides, Vietnam has many natural lakes, dams, swamps, watersheds which their sizes are vary due to seasons. Some lakes are known as Lak lake in width of 10 square km in Dak Lak province, Bien Ho lake in width of 2.2 squared km in Gia Lai province, Ba Be Lake in width of 5 square km in Bac Kan province and Tay Lake in width of 4.5 square km in Hanoi. Big swamps are located in estuaries of middle coastal areas such as: Tam Giang, Cau Hai and Thi Nai. Vietnam has thousands of artificial dams with water capacity of 26 billion cubic meter in which there are 6 biggest dams with water capacity of over 1 billion cubic meter are exploited for hydroelectricity including Hoa Binh, Thac Ba, Tri An, Dau Tieng, Thac Mo and Ya Ly. According to the data by MoNRE, Vietnam has more

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than 3,500 storage lakes in which there are about 650 big and medium storage lakes for hydro power production, flood and drought control, navigation, irrigation and aquaculture. Apart from, ground water is source with huge potential, particularly in Northern and Southern deltas. Water resource in coastal and inland wet areas play important roles in conserving and sustaining function of ecosystem and biodiversity of wetlands.

b) Water supply and demand and effective elements

According to the Ministry of Natural Resources & Environment (MoNRE), Vietnam has about 840 billion cubic meter of surface water in which there is only 310 billion cubic meter supplied by rainfall in Vietnamese territory accounting for 37%, the rest is 63% depending on water runoff out of Vietnam. Total potential ground water exploitation excluding islands is estimated about 60 billion cubic meter. Water volume which is being investigated appropriate 8 billion cubic meter per year. [2] Due to the evaluation criteria of International Water Resource Association (IWRA), a nation which has water consumption per capita below 4,000 cubic meter/year is considered as water insufficient nation. In Vietnam, annual water consumption per capita is about 10,600 cubic meter in 2008, achieving average level in equivalent with the United States of America, however much lower than neighboring countries like Lao PDR, Cambodia, Malaysia, Myanmar, Indonesia. For the supply, water resource in Vietnam brings a lot of unsustainable elements. Over 63% of fresh water in Vietnam originates from outsides, on other hands from other countries. For example, Hong river basin has transboundary water accounting for 50% of total surface water; Mekong river basin has about 90% of total surface water originating from transboundary water. Inland water source of Vietnam is only about 3,600 cubic meter/capita/year[3], and if only accounting for inland water source, Vietnam ranks in the list of water lack nations in the world. Moreover, water supply of Vietnam isn't ensured by seasons because of unpredictable climate change, uneven geographical water distribution. In 13 main rivers and tributaries with basin area of over 10,000 cubic km, there are 10 transboundary rivers, three of them are upstream in Vietnam and downstream in neighboring countries and the rest are upstream in neighboring countries and downstream in Vietnam. That's why Vietnam is much depended on sharing water benefits with neighboring countries.

For water demand, Vietnam is increasing in water demand caused by population growth, unplanned deforestation, serious water contamination and rapid economic development. In 1943, demand for water consumption in Vietnam was 16,641 cubic meter/capita/year, in 2008 about 10,600 cubic meter and is proposed when Vietnam's population increases about 150 million people, its water consumption will be only 2,467cubic meter, nearly equivalent to scare water nations. According to the assessment result in 1999, total water demand of the whole country was represented about 8.8% of total annual water runoff in equivalent to the frequency of 75%, and then increased by 12.5% in 2000 and 16.5% in 2010. Total water for irrigation increased very quickly from 41 cubic km in 1985 (accounting for 89.8%) to 46.9 cubic km in 1990 and 60 cubic km in 2000. Water demand for dry season is huge, especially for agricultural production. For instance, demand for water usage in many places and catchments is able to be twice bigger than real demand resulting in difficulties of production and living. By impacts of global climate change, Vietnam is increasing in demand of water whereas supply of water has trend of decreasing because surface water is evaporated, water is salty and contaminated and conflict for water in Mekong river basin raises.

In general, characteristics of water resource in Vietnam are uneven geographical distribution. Total annual rainfall of Vietnam is high but uneven distributed by space and time. Some places have high rainfall like Bach Main Thua Thien – Hue province up to 8,000mm/year, whereas many areas such as Phan Rang in Ninh Thuan province, Phan Ri in Binh Thuan province, rainfall is very little from 400 mm to 700 mm per year. Distribution of rainfall by time is unbalanced, for example rainfall in dry season in Mekong river delta is less than 10% of total annual rainfall but prolongs nearly 7 months while the rest of 90% concentrates in 5 months of rainy season. Total surface water runoff changes clearly among every season in year in which 75% to 85% is in flooding season and the rest is divided into dry months. Mekong river is the largest river network in Vietnam accounting for nearly 60% of total national water volume, 54 times bigger than water volume in Northern region. Water flooding discharge of Mekong river is possible up to about 40,000m3 per minute, but in dry season, it sometimes decreases by 1,200 -1,700 m3 per minute causing prolonged dry and salty. Many rivers in Tay Nguyen nearly have not got water runoff in dry season. There appears big gap of ground water between dry and rainy seasons from meters to dozens of meters, especially in many places of Tay Bac and Tay Nguyen.

Furthermore, water resource in Vietnam also much depends on disasters and climate change. Storms and floods are considered as disasters causing greatest damages in Vietnam. Big floods damage human and prosperities, landslide, erosion and saltwater intrusion. In recent years, droughts also degrades water resource in Vietnam mainly caused by climate change and overexploitation of water resource.

[2] Ngo Dinh Tuan (2007), Suitable development and usage of water resource, Water Resource University, Workshop on biodiversity and climate change: relationship with poverty and sustainable development, Hanoi, 22-23 May 2007.

[3] Water resource in Vietna: both lack and weak, Ministry of Natural Resource and Environment, 30 August 2011.

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Vietnam locates in downstream of big river system in the region of Southeast Asia, 60% of water discharge depends on upstream out of Vietnam. Recently, upstream countries like China and Lao which are building projects to exploit and develop hydro power with huge scope in the upstream of Mekong river and Hong river make water discharge into Vietnam less and less. Raising up of sea water level make water resource worsen in quality resulting in simultaneously affecting ground water such as decrease in aquifers and salinization. Vietnam, particularly Mekong river delta is the "pivot area" of climate change and sea water raising, affecting much in fresh water resource for production and living.

III. The Survey Outcome and Assessment

Our research team had been carried out surveys of reality using water resource in Hanoi, Nam Dinh and Ninh Thuan. Survey samples were 450 people who reside in rural areas, of them 100 people in Hanoi, 100 people in Nam Dinh, and 250 people in Ninh Thuan. 43.8% of total surveyed people were female. Educational level of surveyed people were such as 54.8% of secondary school, 30.0% of high school and 14.7% of university degree. 75.6% of total surveyed people are local citizens.

Hanoi is the capital of Vietnam, locates in the center of Hong river delta. Thanks to alluvium, three quarter of natural area of Hanoi is delta, has big rivers passing through such as Hong river, Da river and a lot of other tributaries. Apart from, Hanoi has many lakes like Tay lake with width of 500 ha, Guom lake, Truc Bach lake, Thien Quang lake, Thu Le lake and big lagoons like Kim Lien, Linh Dam, Ngai Son, Suoi Hai, Meo Gu, Xuan Khanh, Tuy Lai, Quan Son. However, due to process of rapid urbanization since 1990, most of lakes and rivers in Hanoi have been seriously polluted.

Nam Dinh is coastal province locating in southern of Northern delta, has Hong river in downstream. This wetland is the professionally area for producing rice. Because of locating in Tonkin gulf, every year Nam Dinh is often affected by monsoons and tropical low pressure, in average from 4 to 6 storms a year.

Ninh Thuan is a province in South Middle. It has semi mountainous geography with two seasons: dry and rainy seasons. The province is famous place to grow grapes in Vietnam. It is assessed as the driest region in Vietnam, frequently meet a lot of heavy damages from drought.

The popular mistake in Vietnamese recognition is that Vietnam has abundant and infinite fresh water resource. Due to the wrong recognition on richness of water resource, Vietnam has no solutions to protect efficiently fresh water resource, loss and waste water negatively impacting on economic development. According to the survey outcome, people in Hanoi and Nam Dinh said that they were not lack of water for living and production, whereas in Ninh Thuan, 129/250 surveyed people said that they were lack of fresh water for living and 242/250 surveyed people said that they were lack of water for production. For water quality, according to the survey outcomes in three provinces and cities, most of people got water from dug wells (100 people in Hanoi; 30 people in Nam Dinh and 105 people in Ninh Thuan). Tap water were used parallel with well water (99/100 people in Nam Dinh; 5/100 people in Hanoi and 145/250 people in Ninh Thuan). The number of people who got water from rivers, lakes and ponds were very limited. It's concluded that water for living in three provinces in the basic is industrially processed in frame of tap water or self processed in frame of well water. Ability of assessment of these water sources is so easy that awareness of saving water is not high.

However, the biggest problem of water source for living and production in Nam Dinh and Hanoi is water contamination. In Nam Dinh, 39% of total surveyed people wished to be advised how to process polluted water source and 10% of total surveyed people would like to improve water quality. In Hanoi, 98% of total surveyed people said that water source for living and production was over polluted and had to be processed at once.

Regarding to water cost for living and production: According to the survey outcomes, 100% of total surveyed people in Nam Dinh and Hanoi said that water cost for living and production was very low and inconsiderable. 60% of total surveyed people in Nam Dinh and Hanoi said that water source was available in rivers and lakes, but there needed to use irrigation equipments for water into fields such as pumps, scoops.

Mean while in Ninh Thuan where is frequently dry, 129/250 surveyed people said that they were always lack of water for living and 242/250 surveyed people answered that they were always lack of water for production. Because of water scarity, 56.68% of surveyed people had to pay from 20% to 30% of their income for buying living water and 22% of surveyed people said that they have to spend 10 days a month to buy water for production with rather high cost (about from 20% to 30%). Drought occur frequently in Ninh Thuan, especially from summer in 2014 to the end of 2015 is making riverbeds, streams, lakes being run out of water. According to the People Committee of Ninh Thuan province, prolonged drought affected directly on people's living, for instance over 50,000 people were lack of food and water. Crop were damaged seriously, over 20,000 ha had to be stopped for production, at the same time, prolonged drought also affected directly thousands of livestock which were lack of water to drink resulting in nearly 500 cattle died. According to the survey outcome, up to 95.2% of surveyed people said that they had to leave land for cultivation because of

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drought and 99.2% of surveyed people answered that they became poorer and poorer because of frequently continued droughts.

Table 1 : Impacts of droughts and floods on livings of Hanoi's, Nam Dinh's and Ninh Thuan's people in the survey of 2015

Impacts (% surveyed people)	Droughts in Ninh Thuan	Floods in Hanoi and Nam Dinh
Being poorer and poorer	99.2%	75.4%
Loss of crops	96.0%	82.3%
Decrease in productivity	85.2%	67.7%
Influence in health	61.2%	40.3%
Leave land for cultivation	95.2%	42.3%
Change for employment	52.0%	41.1%
Non impacts	4%	14.9%
Total	250	250

Source: Survey outcome of IAMES, 2015.

Loss in economic development related to water source was warned by the World Bank in 2007. According to the assessment of the World Bank in 2007, every year Vietnam lost about 1.3 % of GDP resulting by water pollution equivalent to the Philippines, whereas Cambodia lost about 2.7% of GDP and Indonesia lost appropriate 2.3% of GDP. Regarding as real value, every year Vietnam lost about US$ 780 million because of economic damages resulting from water resource while Indonesia lost about 6.3 US$ billion, the Philippines lost US$ 1.4 billion and Cambodia lost 450 US$ million. Regarding as average income per capita, every year Vietnam lost about US$ 9.3/capita due to economic damages resulting from water resource[4]. Additionally, according to the survey, 85.2% of surveyed people in Ninh Thuan and 67.7% of surveyed people in Hanoi and Nam Dinh said that floods and droughts made productivities decrease. The most dangerous thing was that 95.2% of surveyed people in Ninh Thuan and 42.3% of surveyed people in Hanoi and Nam Dinh said that they had to leave land for cultivation because of droughts and floods. Water pollution affected health of 61.2% of surveyed people in Ninh Thuan and 40.3% of surveyed people in Hanoi and Nam Dinh.

In sector structure of water usage, agriculture accounted for 82% of total water demand in 2008 while industry and consumption only accounted for 18%. It is focused that water demand for agriculture has been huge without any great changes since 1990, for instance, in 1990 agriculture needed to use 91% of total water demand whereas industry and consumption was only 9%). However, water usage and exploitation are not reasonable and lack of sustainability that it has been caused decreasing in water resource while efficiency of water usage is still low, waste of water usage is popular in the whole country. For example, water demand for agriculture is the biggest in Mekong river delta and Hong river basin, representing up to 70% of total water demand in other provinces like Nam Dinh. In fact, real irrigation areas is much lower than planned irrigation ones, only 68% of total irrigation areas in the whole country. It's proven that efficiency of water usage for agriculture is not high, not gaining more active achievements for GDP growth. In aquaculture, waste water from aquaculture processing plants and pollution from aquaculture cause water contamination, especially in Hong river and Mekong river basins. According to data of Nam Dinh's and Hanoi's Departments of Environment in 2014, it's estimated that economic loss by air pollution impacted on local health, every year cost about VND 295,000 per capita. Total cost of cough people in internal Hanoi is up to VND 1,530 per capita every day. Regarding as industrial production, industrial waste water contain a lot of contaminated chemicals when wasting into environment will affect much on quality of water resource. The most polluted water industrial productions are paper, chemicals, textiles, painting… In the whole of Vietnam, there are 154 industrial parks and big sized processing areas, but there are only 43 ones having waste concentrated processing system in spite of only meeting the demand of current waste processing capacity of about 70%.

Apart from, exploitation of hydro irrigation lakes is causing a lot of problems like water control in upstream, water supply and sustains environmental water discharges of downstream because most of them are not designed to have mission for flooding water into downstream areas in dry season. Ninh Thuan is the locality having the poorest volume of ground water, coastal delta in Ninh Thuan has thin watershed and lot of danger of salinization, therefore main water supply for provincial production and living depends on Cai Phan Rang river. However, Ninh Thuan has not enough water storage lakes in rainy season to dry season to save water and drainage when having floods, therefore droughts and floods in Ninh Thuan are very hard. Surface water in Ninh Thuan depends on rainfall, so

[4] World Bank (2007), Economic Impacts of Sanitation in Southeast Asia, Water and Sanitation Programs – East Asia and Pacific (WSP-EAP), November.

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discharge in rainy season is very abundant but in dry season, discharge of rivers and streams is being dried. In rainy season, high rainfall concentrates in the area for short time resulting in serious floods in the whole Ninh Thuan province. Water storage lakes like Song Trau lake, Ho Cho Mo lake, Phuoc Trung lake and Thanh Son lake also small and outdated designed capacity without enough capacity to store water in dry season and have to drainage in rainy season. According to the survey in fact, Ninh Thuan has undergone serious floods in 2010 and 2015 damaging a lot of ha of rice, onion…, destroying and flooding many houses, jamming traffic transportation and great economic losses.

IV. Implication for Developing Countries

In recent years, awareness of great losses resulting from insecurity of water source, Vietnam begins to recognize more properly about it. To protect and manage water resource, Law on water resource was issued in 1998 and amended in 2012. Parallel with these, many important regulations to protect water environment such as: Degree No 67/2003/ND-CP on fee of environmental protection for sewage; Degree No 149/2004/ND-CP on permitting explosion, exploitation and usage of water resource, drainage of sewage into water resource; Degree No 34/2005/ND-CP on punishing administrative activities related to water resource; Degree No 88/2007/ND-CP on 28/5/2007 on urban and industrial drainage; Degree No 112/2008/ND-CP on integrated management, protection and exploitation of resources and environment of water storage lakes, hydro powers; Degree No 120/2008/ND – CP on river basin management; Decision No 15/2008/QD-BTNMT on issuing regulations on protection of ground water resource; Circular No 02/2009/TT-BTNMT on regulation on assessing waste water approachment of water resource…According to the survey outcomes, in all localities, 94.8% of total surveyed people said that local authorities also had propaganda to raise awareness of saving water. The main ones consisted of disseminating knowledge (93.9% of total surveyed people answered that); frequently checking (51.4% of total surveyed people answered that); informing cost of water (2.9%) and quota of water (2%). However, regarding to economics, water resource hasn't been fully assessed efficiency of water supply and demand, essential investment to ensure economic growth and sustainable development, real losses resulting from wasting and polluting water, essential economic institutions to ensure water security. Beside to juridical regulations on water ownership, protection and management, it should need to analyze, assess and explain comprehensively water resource in aspect of economic factor to ensure sustainable development. Most of total surveyed people in three provinces like Hanoi, Nam Dinh and Ninh Thuan recommended to build more tap water pipes (390/450 of total surveyed people answered that); advise to process water (272/450); improve water quality (249/450); support to dig wells (224/450) of which especially, constructing more tap water pipes and supporting to dig wells are very essential according to the evaluation of local people.

Due to the reality of water exploitation and usage in Vietnam, it should recommend some implications for developing countries.

Firstly, Vietnam is seen as the world hub of food, however it is able to cause into food crisis when loss of water if there is no solution to protect water resource reasonably. Global climate change is directly influenced all countries of which there is Vietnam. The United Nations awared that Vietnam is one of nations being affected the most by climate change and sustainable management of water resource is one of the most urgent issues.

Secondly, those who much depends on transboundary water resources like Vietnam and some different countries need to be positive to cooperate with neighboring countries to preserve water resource and create sustainable development for downstream ones.

Thirdly, target for economic development is essential but it should ensure water resource for sustainable development. The problems such as: health, diseases, poverty, social security are mainly related to water and expanded rapidly when water resource decrease. In the human history, there are a lot of conflicts and fights related to water among nations and communities. In the coming time, water is seen as the worthiest asset of every nation. That's why it's beneficial to invest into water to get "huge profits" for long time. In the past, Vietnam accepted to replace fresh environment by economic development, therefore it is facing a lot of challenges related to water resource for economic growth and development in the future.

Fourthly, water resource is not infinite and vulnerably effected by climate change, it have to be ready to response whenever having urgent changes. Vietnam is facing a lot of dangers of lossing water resource from inside and outside. Rising in earth temperature decreases surface water, it should be increase in exploiting replaceable ground water, rising in sea level make one part of inland flooded equivalent to limiting river network and saltination. Loss of water resource is in visionable danger. Parallel with different solutions to protect water resource, Vietnam has to make solutions to response negative impacts of climate change.

V. Conclusion

Thanks to the study and analysis, it's possible to say that water is not infinite resource. Scarcity of water or uncertainty of fresh water protection has been making Vietnam meet great challenges in socio-

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economic development. In principle, water resource is not considered as common asset, but also commodity with commercial and economic values. All localities and nations must have solutions for investment and exploitation, management of water sources reasonably to be able to meet demand for long time and stable development, mustn't gain achievement of growth at once by accepting trade-off of insecurity of water sources. Price for pay will be expensive for nations and future generations. Water management in accordance with laws, policies and local community participation will help nations to use water resources the most effectively for socio-economic development.

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