Journal of Energy Technologies and Policy
ISSN 2224-3232 (Paper) ISSN 2225-0573 (Online)
Vol.7, No.1, 2017 

# Industrial Water Management Policy Comparative Analysis & Comparison of Water Pricing

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**Abstract**
This study contributes comparative analysis and comparison of current water policy in the industrial sector. Current water policies fail to adequately address water use and pricing issue. This study concentrates on industry perspective questionnaires method; next we calculate water use in the industry during specific year plan from 1988 to 2013.Understanding the interactions of industry & water policies is crucial for achieving efficient management of water resources. Increasing population and economic growth continue to drive industries demand water resources. The interaction of these resources is particularly important in a textile sector where water resources are unevenly distributed, with limited availability in specific regions. The "3 Red Lines" water policies were introduced in 2011; one of their aims is to reduce industrial water use. Water is currently not valued correctly by stakeholders; this is a major problem in itself and contributes to misuse. This paper analyses current water withdrawals and consumption for China, Japan, Bangladesh, UK, USA and assesses the water pricing with the industrial water policy under different scenarios, considering potential future policy. It is therefore, an imperative for policy makers to coordinate their activities in such a way that adequate supply of water is provided and efficient use of it is made and to respond quickly and timely to the structural changes of the economy and to prevent a water crisis in the country. The purpose of this paper is to undertake a in the industry in order to understand this potential policy conflict. The paper aims to illustrate appropriate policy direction and management practices.
**Keywords:** Industry, textile industry, water management policy, water pricing, water conservation, water demand.

## 1. Introduction

This study is to describe the nature of present water pricing, water consumption, proportion of textile export and comparison of water policy in the China, Japan, Bangladesh, UK and USA in a manner that informs public officials considering policies that influence industry-level decisions regarding water use and water management decisions. Throughout human history, water resources have played a critical role in the development of advanced societies. In recent years, those involved in the development and use of water resources around the world have become increasingly concerned about the unintended effects of humanity's attempts to use these precious resources. The tough realities of competition for scarce water resources around the world have led to disagreements over goals and the degree to which goals can be achieved through proper management of water resources. To provide policy makers and planners facing these exceedingly complex and challenging challenges with maximum assistance within the confines of a single document, this paper addresses the evolution of water resources policy analysis in the area of the world where most of the available literature on this subject is available. The fresh water that sustains terrestrial life makes up less than 1% availability of an acceptable quantity and quality of water for health, livelihoods, ecosystems and production, coupled with an acceptable level of water-related risks to people, environments, and economies". Grey et al. (2013). For the existence of all living beings (human, animals, and plants), water is very crucial. Almost all human activities—domestic, agricultural and industrial, demand the use of water although water is nature's most excellent and abundant compound only less than 1% of the world's water resources are available for ready use. Hence it is required to use it carefully and economically. Water is vital for life on Earth. To safeguard sufficient of the total stocks of our 'blue' planet Grey et al.(2013). This must be carefully managed to ensure 'water security' for all. This complex concept can be broadly defined as: "The quantity and quality for both humans and ecosystems, we must carefully manage this precious resource, especially in the face of new challenges created by industrial growth. Textile manufacturing is amongst the largest industrial users of water and is poised for transformation. To inspire this change towards a water-wise future to move beyond anecdotes and share fact-based trends on how the textile industry is evolving in some key production centers based on data and information gathered, analyzed and collated from China, Japan, Bangladesh, UK & USA. The purpose of this paper is to undertake a detailed analysis of the uses of water in the industry to understand this potential policy conflict. The following section evaluates previous research on water management policy, to define the specific questions that need to be addressed by this analysis. In this paper, the introduction section describes the purpose of our research, the

previous study section reviews the literature related to consumption and water use in the textile industry, the methodology section describes the method used to calculate how water management policy works at the industry level, the data collection and processing section provides information section summarizes the results, and the final section presents the conclusions of the paper.

## 2. Previous studies

For industry, in particular Textile production, wastewater reclamation appears a technically feasible solution, whose interest is proved by the vast literature produced .Babuna (2011). Water scarcity and pollution, as well as climate change, are the most serious problem that human beings should take effective measures to solve. Especially in China, the percentage of the river water by water quality of drinking water is only 68.6%, and 14.9% of the river water cannot even be used for industrial production in 2013. Jiang (2015). The key focus of the National Water Initiative is Chinese water policy. As a politician, they would describe the purpose of the policy as to ensure that we have secure and sustainable water for the future. Zhang (2012). Some problems with Chinese laws include

1) Overly general laws: Many laws are written without a detailed explanation of the agencies responsible for certain activities. Lack of reference to implementation means that in many cases, no actor is appropriately assigned to oversee regulations. Additionally, a lack of clear definition of legal terms also allows agencies to avoid performing their duties. 2) Overlapping laws: Laws overlap when new regulations fail to replace old regulations, creating confusion and conflict. For example, the introduction in 1993 of a volume-based charge on industrial wastewater… did not replace the existing non-compliance charge. 3) Conflicting laws: Laws conflict when they are established by different organizations without consulting with each other. For example, some contents and articles in the Procedure for Water Use License System and Regulations of Water Quality Management for Water Use System promulgated by the MOWR directly Conflict with Regulations for Urban Water Demand Management and Regulations for Urban Groundwater Exploitation Management promulgated by the MOC Jiang (2015). 4) Poor promulgation: Poor promulgation and announcement of laws and legislation often mean that responsible agencies are not made aware of them. Often these laws are not even known to the legal profession and are even less well known to officials throughout the county who are responsible for administering them" .Alam and Quevauviller (2013). Bangladesh has various national policies for different key sectors to accelerate the balanced way of development. There are several policies and acts for formulating the rules and regulations on general usage on water. The major policies and actions are National Water Policy (1999), Coastal Zone Policy (2005), National Water Management Plan: Development Strategy (2011), Bangladesh Water Act 2013. The earlier plans were criticized for inadequate policy frameworks and supporting strategies and due to lack of holistic and participatory approach to the water resource planning and also for not addressing the social and environmental impacts of water resource development. Bipasha Dutta (2013). In Japan, the national government is responsible for formulating and implementing water resources policies at the national level. As the interest in water problems increase through out the world, Japan is expected to actively tackle the problems based on the technology and know-how it has accumulated through its experience. Japan, which was never a water-rich nation. The per capita water volume in Japan is ranked 91$^{st}$ among 156 countries in the world. Japan has never been rich in the water (1996). Industrial water use has also tended to decline, not only because Japan has suffered from sluggish economic growth, but also because the recycling rate has steadily increased. Firms have learned to use their wastewater more efficiently to save on the costs of raw water. Recycling facilities have also been developed alongside water treatment facilities as a result of the adoption of water recycling and cleaner technologies .Yamauchi, Miwa et al. (1989). The fragmentation of water policy and infrastructure will continue to pose challenges for the U.S. as the nation faces a variety of water problems .Christian-Smith, Gleick et al. (2012). These include growing scarcity concerns (O'Neill And Dobrowolski, (2005); Makar, (2006), the sustainability of surface and groundwater sources Alley, (2006; Schlager, 2006), diffuse and insidious pollution .Davidson et al.(2013). There is an increasing concern in water security and need for innovative and affordable solutions, evidenced by the volume of recent published reports reviewed in this study. The issues are complex and cover a wide range of political, social, environmental and technical challenges.

## 3.Water use in the textile industry

The textile industry and especially textile wet processing are one of the largest consumers of water in manufacturing and hence one of the leading producers of industrial wastewater. Also, since various chemicals are used in different textile processes like pre-treatment, dyeing, printing, and finishing, the textile wastewater contains many toxic chemicals which if not treated properly before discharging to the environment, can cause serious environmental damage. Also, in many countries, the charges for water supply and effluent discharge are increasing. Hence, for companies to save costs and remain competitive, they need to save water and address issues related to wastewater disposal. EIPPCB (2003) provides a good overview of water consumption and wastewater pollution for different textile wet-processing processes.

## 4. Methodology

This study concentrates on the textile industry perspective & is constructed by questionnaires. The study also employs qualitative & quantitative research method. Moreover, the questionnaires are used to gather water policy related knowledge in the field of textile industry in China, Bangladesh & Japan. Due to available source questioner were not sent to UK and USA that is the limitation of this research. Also the questionnaires were conducted in 2016 and the questionaries' link was forwarded to industry. Furthermore, the questionnaires included a question about water management policy in the field of textile & clothing industry. This study applies Likert scaling and qualitative methods and can be classified as a collective, which defined, by stake (2005). As Anttila (2006) points out, empirical data in a qualitative research method can be used not only as a basis for description of reality but also as a catalyst in the process of constructing a theoretical discussion, as we have done this study. When using data for this purpose it can be descriptive. Asked to rate industry effectiveness at water management on a scale from 1 to 5, Young, Shah et al. (2008), Program (2012)where 1 is Not relevant 2 is Under consideration 3 is In place but not yet implemented 4 is In place and partially implemented & 5 is Fully implemented, 3 is adequate, and 5 is very effective.

## 5. Data collection and processing

Data on each of the cases was collected using multiple sources. Web searches were conducted using Google. Documents including annual reports, published papers were also collected and analyzed. This study uses annual data on the proportion of Japan, China, Bangladesh, and UK & USA textile exports in the global textile exports. By looking at the exports of textile product, it is possible to calculate the virtual water flows into and out of the region that this trade represents. In water-scarce regions, it makes sense to focus upon the manufacture of products which use little water in the manufacturing process, and

Hence only to export products with a high water productivity. This minimizes the amount of virtual water, which is exported. Industrial water management policy with the intention to minimize water consumption and minimize wastewater generation, and to improve water productivity, can be either internal or external. Internal policy are those measures that are required to be taken at a factory level in order that water consumption and wastewater generation is controlled. These measures as described above can be taken more or less independently of external policy. The period we cover for each time series is from 2006 to 2015. Some countries have fewer observations, depending on data availability. Table 1 shows that in China, the percentage of total textile export is highest, USA is the second highest on the other side Japan, UK & Bangladesh textile export is very close to each other but lower than China & USA.

Table 1, Proportion of Japan, China, Bangladesh, UK & USA textile exports in the global textile exports (data source: ITC calculations based on UN COMTRADE statistics form 2006-2015)

| Year | Proportion of Japanese textile exports in the global textile exports | Proportion of China's textile exports in the global textile exports | Proportion of Bangladesh textile exports in the global textile exports | Proportion of UK textile exports in the global textile exports | Proportion of US textile exports in the global textile exports |
|---|---|---|---|---|---|
| 2006 | 1.97% | 17.37% | 1.45% | 0.72% | 12.65% |
| 2007 | 1.81% | 18.02% | 0.44% | 0.62% | 12.27% |
| 2008 | 1.64% | 20.18% | 0.15% | 0.57% | 12.55% |
| 2009 | 1.57% | 22.54% | 0.21% | 0.51% | 11.56% |
| 2010 | 1.16% | 22.41% | 0.19% | 0.41% | 12.94% |
| 2011 | 1.11% | 21.89% | 0.17% | 0.39% | 15.64% |
| 2012 | 1.08% | 22.16% | 0.07% | 0.39% | 12.37% |
| 2013 | 0.91% | 24.57% | 0.07% | 0.38% | 10.28% |
| 2014 | 0.93% | 25.45% | 0.06% | 0.48% | 10.18% |
| 2015 | 1.0% | 28.39% | 0.06% | 0.43% | 10.57% |

Figure1 shows the percentage proportion of five textile export in the global textile export among countries.

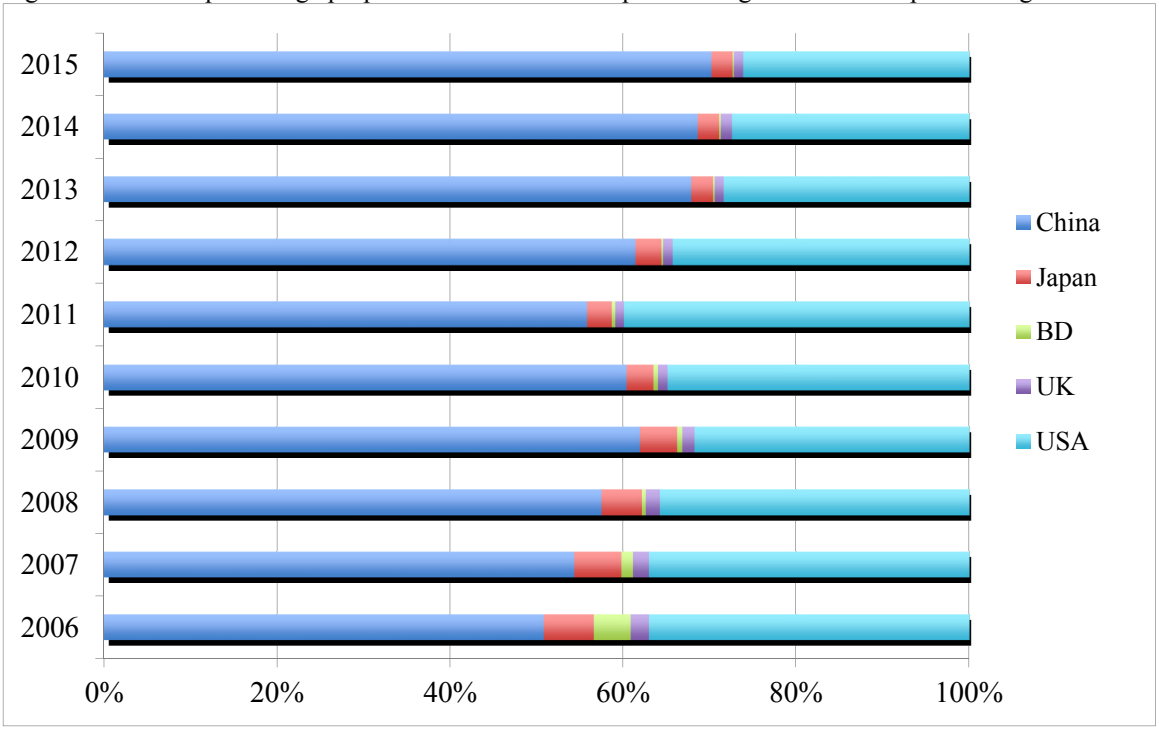
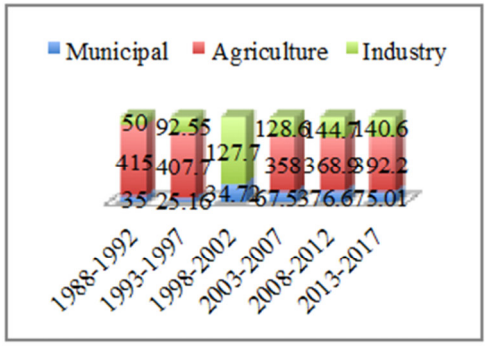



Figure: 1

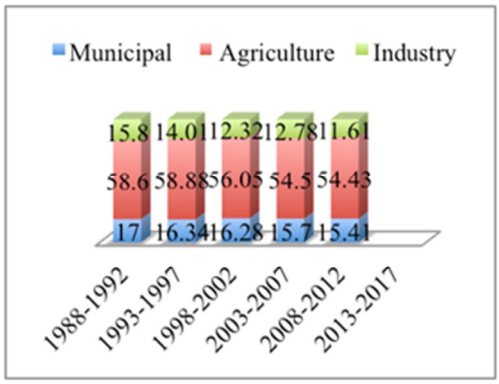
**6.Results and discussion**

Water use three sectors are presented below in Figure: 2. This figure indicate in industrial sector an average China used highest amount of water & Japanese is the second highest. In 1988-2002 specific year UK & USA industrial sector use higher than Japan but lower than China. As industry is a major water consumer, it is estimated in China will reach 818 billion m3 in 2030, driven by industrial as well as municipal demand. Koop and Leeuwen (2015). According to the water saving society in China, it is estimated that industry water saving reached 13.4 billion m3 under the eleventh Five year plan. Qin, Curmi et al. (2015)

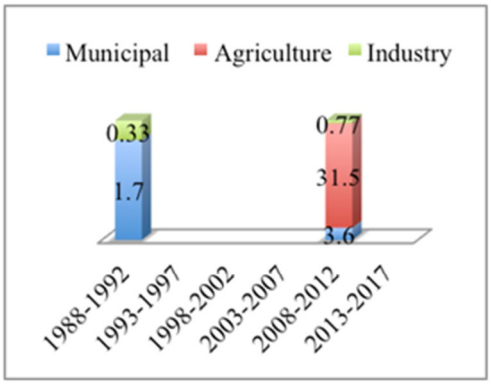
 



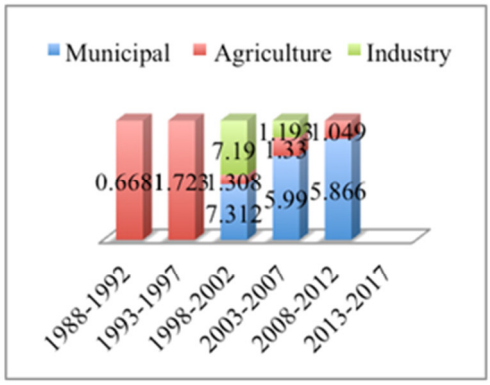

(A) China



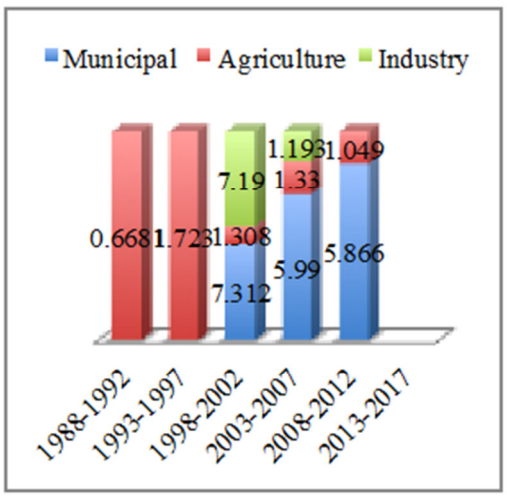

(B) Japan




(C) Bangladesh




(D) UK




(E)

Figure 2, Water uses all industries in (10^9 m3/year) [(A) China, (B) Japan, (C) Bangladesh, (D) UK, (E) USA] (data Source: FAO. 2016. AQUASTAT Main Database - Food and Agriculture Organization of the United Nations.) (FAO)

Note: a) 2013-2017 Japan, Bangladesh, UK & USA municipal, agriculture & industry data is missing.
B) 1993-2007 Bangladesh three sectors water data is missing
c) 1988-1992 Bangladesh agriculture water data is missing
d) 1988-1997 UK municipal & industry data is missing
e) 1988-1997 USA municipal & industry data is missing

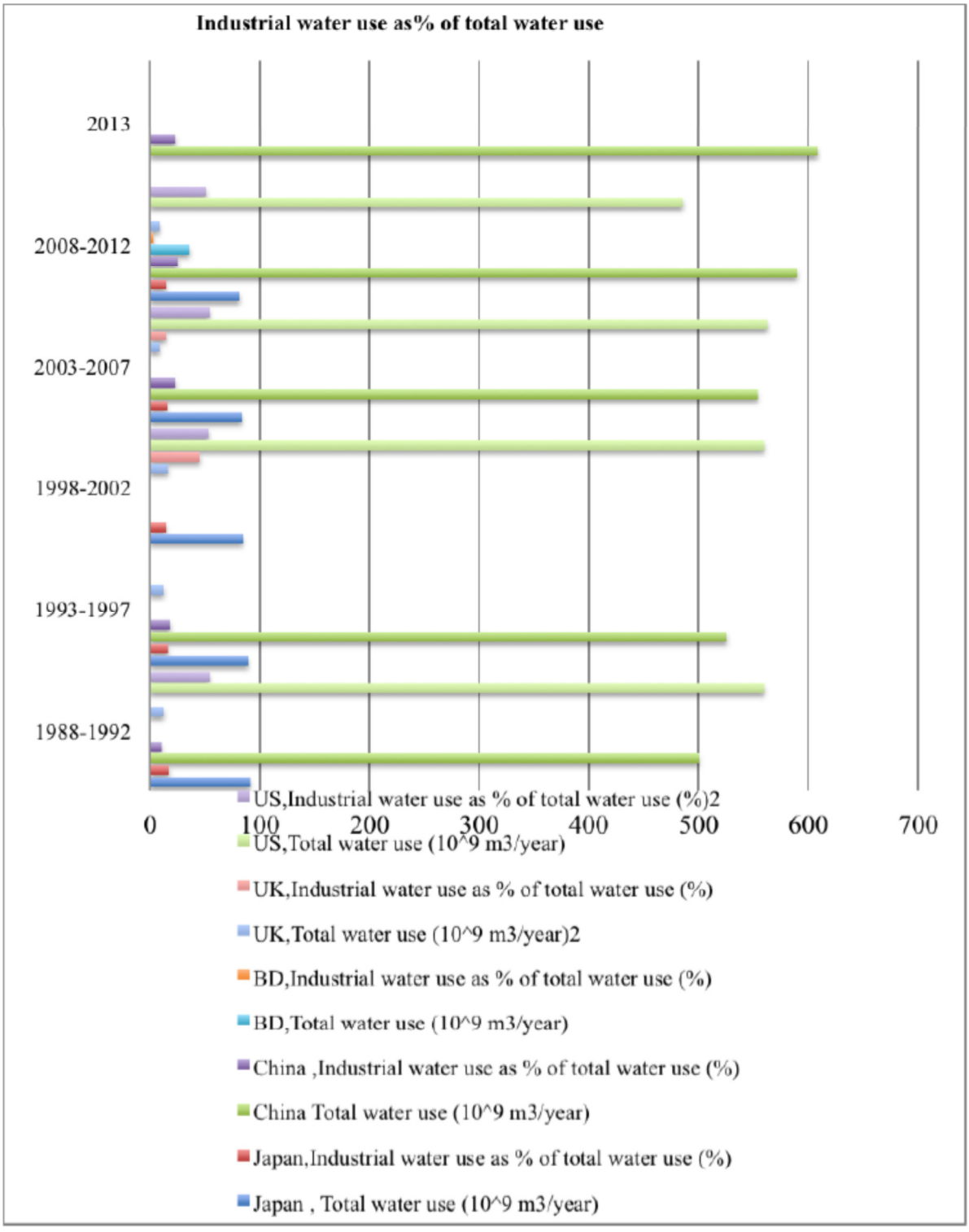



Figure: 3 Industrial water use as % of total water use

The industrial water use as a percentage of total water uses is summarized in Figure 3. Data from 1988 to 2013 were used.

Table 2, Comparison of water pricing (Unit per cubic meter)

| Country | Industry | Agriculture | Household | Location | Source |
|---|---|---|---|---|---|
| USA | $2.45 | $0.10 | $4.48 | Las vegas Arvin-Edison | Water Pricing and the Cost of Service in the United States SNWA2009 GAO1994 |
| UK | 1.7 Euro / $1.9 | 0.1 Euro/$0.11 | 2.3 Euro/$2.56 | | OECD 1999, 2000, 2001 |
| Japan | 158 Yen/$1.43 | | 749 Yen/$6.81 | Tokyo | Bureau of Waterworks, Tokyo Metropolitan Government |
| China | $0.60 | | $0.55 | Beijing | China Water.net Beijing Municipal Statistical Bureau, 2005 |
| | 0.12RMB/$0.01 | 0.04 RMB/$0.006 | 0.08RMB/$0.012 | Hubei | Water Resources Bureau 1998 |
| Bangladesh | $0.02 | $0.01 | $0.02 | BD(Pabna) | MDIP and PIRDP data |

Note: Agricultural sector in Japan and Beijing water pricing data is missing.

An indication of agricultural, industrial and household water prices for China, Japan, Bangladesh, UK and USA is given Table 2

However, policy makers should have water management plan to supply more water or decrease water use to keep the satisfied level of all users.

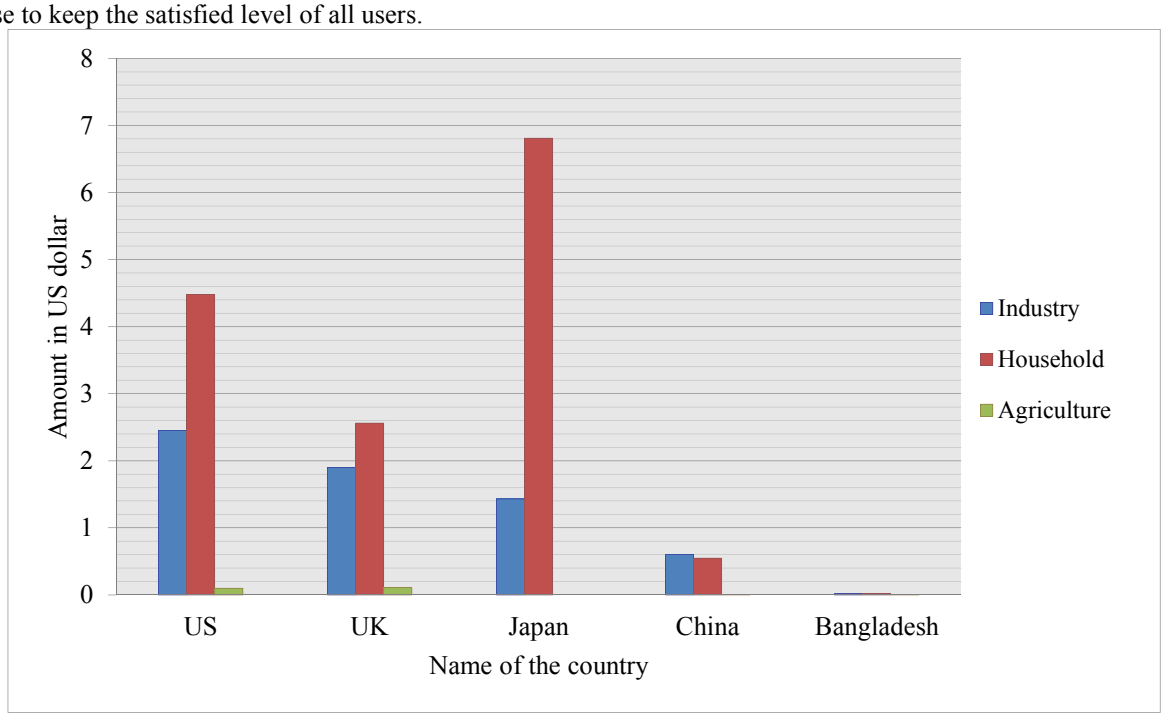



Figure: 4. Comparison of agricultural, industrial and household water prices in some countries.

There has been a general trend towards higher water price in terms throughout (e.g. household sector, Figure 4). However, direct comparisons are difficult due to the wide variations in water charges within and between individual countries or sectors. Price elasticity comparisons within each water sector are complex due to diversity of water pricing policies, water management systems and influence of other water demand management measures. Agricultural water prices are considerably lower than those in industry or households generally due to lower quality of water supplied and lower capital cost. The figure 8 shows that industrial water prices are highest in USA second highest in the UK and then chronologically Japan, China & Bangladesh. On the other side, household water price is highest in Japan among five countries.

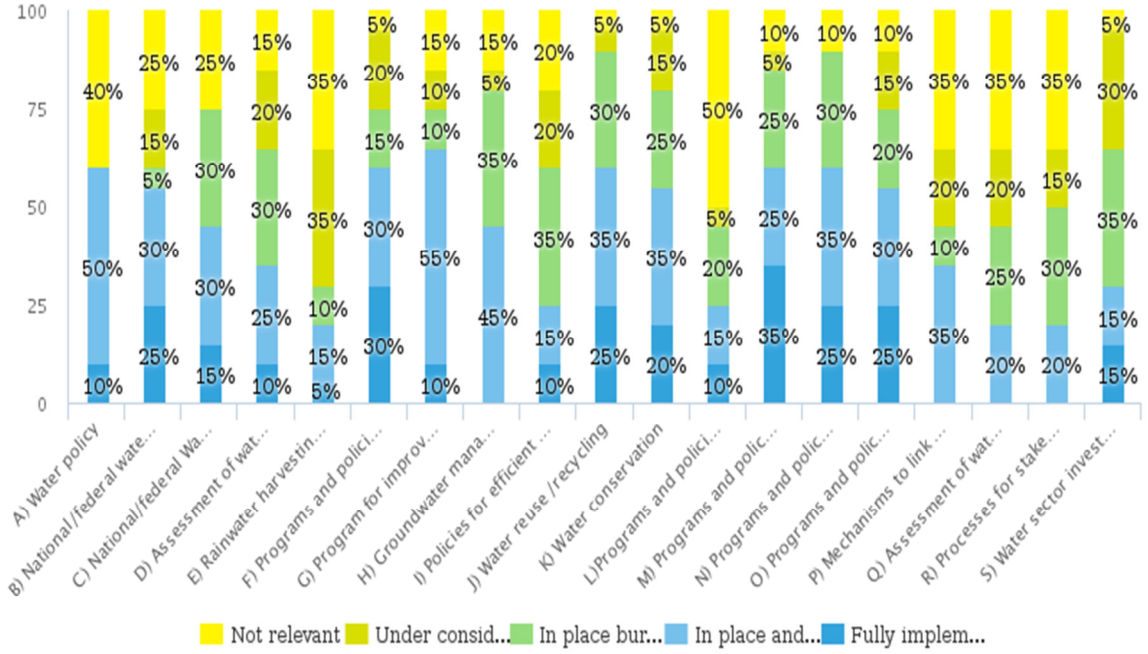



Figure: 5 Questionnaire survey

Based on both primary and secondary data, we find that mutual monitoring can improve the effectiveness of a water management and water policy in the industrial sector. Policy maker should consider the local condition. Local governments play important roles. Thus, policy maker should continue to rely on local governments to move the reform in a direction that can address water problems faster and better. Probably most significantly, water management reform alone is not adequate to address Chinese water scarcity problems. Institutional reform has not occurred in the most water-scarce parts of China .Huang, Rozelle et al. (2009). If the main policy goal is to save water, policy maker must look beyond water management reform. A more comprehensive strategy, which combines water management reform with other complementary policies, may be more effective. Questionnaire survey has also shown that for the proper implementation of water policy information, coordination and stakeholder participation is a must.

**7.Conclusion**

In this paper, we have proposed an industrial water demand & pricing policy to evaluate current industrial water pricing strategies. We have use questioner survey to estimate water policy using industry level. The essential purpose of water management analysis is to develop policies that lead to the management and allocation of water resources in a manner that maximizes contributions toward societal goals and aspirations. Our species, indeed our planet, requires that the overriding goal is one of long-term sustainability. While humanity faces unprecedented challenges resulting from unrestrained population growth, Industrialization, urbanization and environmental exploitation, we also have a much greater arsenal of tools and a larger-than-ever pool of experience with which to meet these challenges. Furthermore, there are additional tools on the horizon, such as effluent trading and the use of innovative economic incentives in water management policy, that have a promising potential for further assistance. To maximize our effectiveness in meeting the tremendously difficult challenges of water resource policy development, we must learn from the successes and failures of the past. The key to a water management policy future for water, the most precious of all commodities, lies in our ability to learn from our past and each other in such a manner that will allow us to focus our collective efforts in the most effective and efficient ways possible. Water management practices to reduce industry-operating costs. Thus, policy makers should have water management plan to supply more water or decrease water use to keep the satisfied level of the industrial user.

**8. Recommendation**

After the analysis of industrial water management policy in the possible scenarios related with textile & garments industry. Furthermore, the analysis of industrial questionnaire survey in this area by China, Japan & Bangladesh is one of the interesting methods to study how the industrial water demand change under the pricing policy. With the risk of water supply and limitation of the budget for more water infrastructure, the next interesting topic is how to decrease water demand in the textile industry. However, water management policies have to keep the target of high growth of economic activities by policy makers. Finally, the demand side

management should be considering with the supply side management to generate the situation of water in the future by using the plan of water infrastructure, risk analysis, and the other measures.

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