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Studies on Potential of Water Quality Trading at Industrial Zone Palsana, Surat

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Abstract

In recent years the problem of pollution has become very acute. The emission trading program is introduced by applying market based technique instead of command and control technique to control the pollution. In this paper an attempt has been made to evaluate potential of water quality trading (WQT) as market based instruments for CETP, Palsana Gujarat India. The data of actual effluent released was collected for one hundred and eleven industries on daily basis for three months. In addition to this, the data of authorized quantity of effluent discharge (QED) for each industry and design capacity of CETP also was collected. Based on the studies, it was observed that as the effluent generation is below the authorized QED, WQT is not possible, however as the QED increases WQT can be implemented with cap and trade mechanism. In this study based on simulated data it is observed that, cap and trade mechanism may be feasible below the breakeven point, i.e. 85% of the authorized QED. Further, simulated results represents that as the authorized QED is lowered, the potential for WQT become more feasible. Thus, WQT with cap and trade seems feasible at CETP, Palsana.

Keywords: Water Quality Trading, Common effluent treatment plant

INTRODUCTION

Pollution is any discharge of material or energy into water, land, or air in such concentration that causes or may cause short-term or long-term adverse effect to environment or that decreases the quality of life [1]. The emissions trading programs for air pollutants were successfully implemented across the globe and thus, water quality trading (WQT) programs have been initiated to control a variety of water pollutants in United States [2, 3]. As the name suggests, market based instruments, are rules and regulations driven by scenario of market not like command and control for reduction of pollution.

Compared to command-and-control regulations, market-based instruments have the potential to provide attractive incentives for companies to adopt cheaper and better pollution-control technologies. This is mainly due to market-based instruments, always pays enough to firms to clean up if a sufficiently low-cost method (technology or process) of doing so can be adopted [4,5,6]. Water quality trading programs can reduce pollution at minimal cost to industry. Because more ambitious environmental goals are linked to broad flexibility in meeting them, these trading programs can promote both environmental quality and economic development.

LITERATURE REVIEW

Regulatory authorities have set the standards for reducing the adverse effect of pollution on environment, and thus they have two approaches to achieve these standards. One of them is command and control and another one is market based instruments. Both involve the limiting of emissions. However, market based instruments provides economic incentives for pollution sector to engage in mitigation, thereby making it the most efficient method of achieving an environmental target. So, in respect to market based system, emission trading concept is arriving in realization [2,3,7]. Water quality trading is a novel concept developed based on market based instruments, to manage pollution costs and to improve water quality. Its popularity is increasing, across the world because it is an effective and efficient method to comply with regulatory standards. The concept of water quality trading originates from the US Clean Water Act. The act established policies to restore and maintain the integrity of the US's waters. The practical application of these policies became more detectable through two events: the creation of the Environmental Protection Agency (EPA) and the 1972 Clean Water Act amendments [8].

The 1972 Clean Water Act amendments also prescribed the concept of Total Maximum Daily Loads (TMDLs). A TMDL is a 'calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources'. Allowable loads of a single pollutant from all contributing point and nonpoint sources are totalled with enough margins. TMDLs are like pollutant budgets for waterways that approximate the total pollutant loads a watershed or segment can assimilate while still meeting water quality standards [9, 10, 11]. Another consequence of the 1972 amendments was the creation of the National Pollutant Discharge Elimination System (NPDES). Under this system, all point source dischargers must obtain authorization or approval for the amount of pollutant that the discharger can deposit into an identified water body. Thus, NPDES is allocated from TMDL as it is heart of water quality trading mechanism [12,13].

Emission trading experiences across the globe indicates a numerous benefits in economic, environmental and social benefits. For example, Economic benefits such as, reducing the overall costs of achieving water quality objectives in a specified region; Environmental benefits such as, achieving water quality objectives more quickly with adoption of pollution prevention and innovative technologies and Social benefits such as, to promote productive communication among stakeholders with incentives based activity [14, 15, 16]. Considering the stated benefits, WQT programmes have been initiated across the world. It is reported that more than 50 water quality trading programs were initiated till the year 2008. However, among all the WQT programs, 26 programmes have finalized their trading program design and further initiated trading, 21 are under progress and 10 are inactive or are completed pilots which will not be taken up for future trades based on preliminary studies [17]. Out of all programs, majority of programs are placed in United States and none of the programme was initiated in India. In literature, it is reported that few studies in India also initiated for WQT [18]. However, the aim of this study to further strengthen the idea of market based instruments for CETP. Thus, In this paper, an attempt was made to bridge the gap of data pertaining to WQT and also to evaluate potential for further implementation of WQT

FIELD STUDIES AND METHODS

Palsana Enviro Protection Limited (PEPL) located at Block No 527-528, Near Kadodara cross roads, Mumbai-Ahmedabad NH No 8, Vill: Umbhel, Tal.: Kamrej, Dist Surat, Gujarat. PEPL is a company promoted by cluster of textile processing industries for setting up of Common Effluent Treatment Plant (CETP) for conveyance, treatment and disposal of waste water generated from the industries, which are located in the zone. These industries are located in area of approximately 100 Sq Km Area. PEPL has successfully installed and operated underground drainage collection system and CETP since 2008 with treatment capacity of 50 Million Liter per Day (MLD). After recent expansion, now the present capacity of PEPL is 150 MLD with recycling facility of 50 MLD for non-potable use.

Considering the fact that in industrial zone, if industries of different sectors are located then wastewater characteristics also vary and WT become difficult. Thus, for this study CETP Palsana was chosen as majority of industries are fall in textile processing sector. Field visits and sampling done at Palsana Industrial zone for three months. All the member industries of CETP Palsana were visited and before the sampling and data collection. Based on the analysis of daily effluent flow data from 111 industries over the period, the potential of water quality trading was evaluated.

RESULTS AND DISCUSSIONS

Preliminary data collection was done through CETP and it was observed that excessive flow of polluted effluent was one of the problem. If the flow exceeds the design capacity of the CETP, the CETP may not be able to effectively treat the effluent. Table 1 represents volume of effluent received at CETP, Palsana. As of now the design capacity of CETP Palsana is increased, but purpose of this study is to evaluate potential of water quality trading so in future if similar situation arises at different location then option of water quality trading may be implemented.

Table 1: Total volume of effluent received at CETP Palsana

	Per Day (ML)	**Per Month** (ML)
Total QED (as per CC&As)	65.6	3,633.5
Total effluent flow	53.2	3,193.7
Standard deviation of daily total flow	6.1	

The total QED is the total of all effluent volumes allowed to an industrial unit by the Gujarat Pollution Control Board (GPCB), as set out in the Consolidated Consent and Authorisation (CC&A) documents. This rarely varies and is shown in Table 1 for both daily and monthly terms. The total effluent flow is the estimated total of all effluent volumes currently flowing into the Palsana CETP, as estimated from the data. It can be observed from Table 1 that the total effluent flow is below the total QED, indicating that on an overall basis (though not individually), industries in the Palsana zone are in compliance with their CC&As. However, this total QED may or may not coincide with the design capacity of the CETP in the Palsana zone. If the design capacity is lower, the current daily flows may still be too large, despite the CC&A compliance. The standard deviation of daily total flow is a measure of the variability of the total flow over time. It is a small proportion of total effluent flow, indicating that total effluent flow does not vary a huge amount from day to day.

It was observed during field visits that the discharge of effluent from industries are intermittent due to variation in daily production, thus the average daily flow is calculated for each industry based on the total monthly discharge divided by 30, and the obtained data is depicted in Table 2. It can be seen from Table 2 that daily average flows across the 111 industries in the

Palsana zone vary from a minimum of 1 kL/day to a maximum of 1,500 kL/day, with a mean of 480 kL/day.

Table 2: Daily average flow of effluent across all industries

	Daily average flow (kL/day)
Total across industries	41,777
Number of industries	111
Mean across industries	376
Median across industries	409
Minimum across industries	1
Maximum across industries	1,511

Figures 1 represents the variability of total daily effluent flow to the Palsana CETP over the three months of available data. It is clear from the figure that total flow does not vary enormously on daily basis, on most days the total flow is between 45 and 60 ML. There may be a slight trend toward increasing effluent volumes throughout the months under consideration.

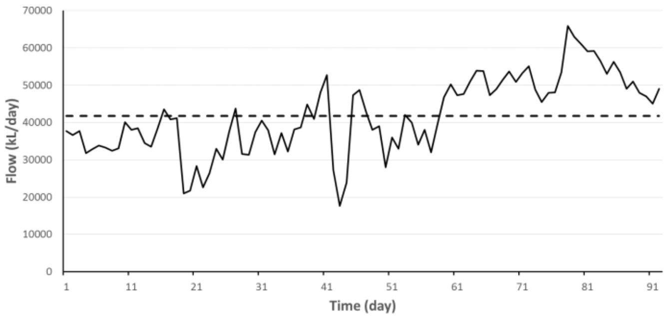


Figure 1: Variation in total effluent flow at CETP Palsana

Figure 2 shows the distribution of booking limits across industries. It is observed from Figure 2 that this distribution is skewed left means there are many industries with booking limits between 200 and 800 kL/day and very few with booking limits above 1000 kL/day. This observation indicates that large number of industries are small and medium scale, and few industries are large scale.

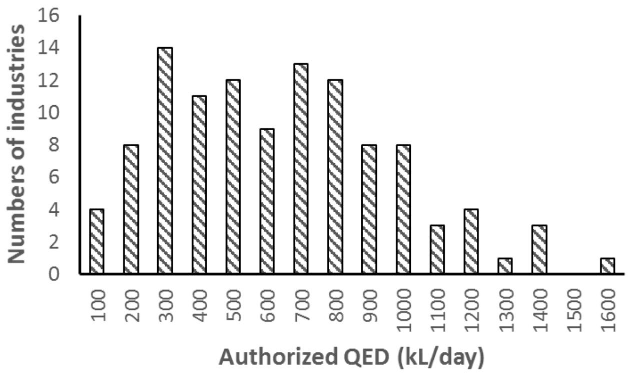


Figure 2: Industry wise distribution of authorized QED (Quantity of Effluent Discharge)

Further, Figure 3 depicts the distribution of proportions of total booking limit across industries. Each bar shows the percent of the total booking limit that is allocated to industries having that size booking limit. For example, comparing Figures 2 and 3, there are only three out of one hundred and eleven industries with a booking limit between 1300 and 1400 kL/day, but because this volume is so large, they make up nearly 7% of the total booking limit in the Palsana zone. On the other hand, there are also three industries with a booking limit below 100 kL/day, but because this volume is so small, they make up less than 1% of the total booking limit. Thus, Figure 3 depict crucial data which enable to target important industries related to WQT to get maximum leverage.

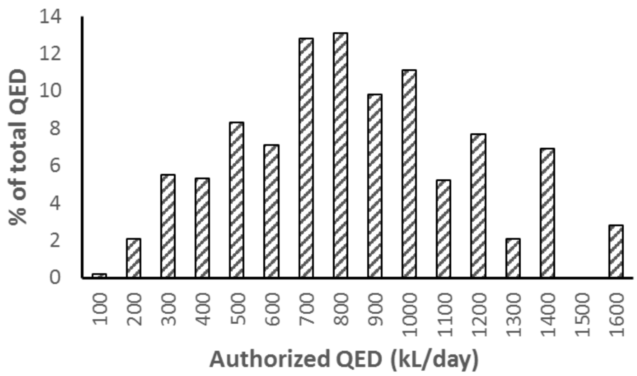


Figure 3: Percentage distribution of authorized QED

Figures 4 and 5 are similar to figures 2 and 3, but they reflects observed daily average flow volumes across industries rather than their booking limits. Comparing figures 4 and 5, it can be observed that relatively many industries produce daily average effluent flows of less than 300 kL/day, but these comprise a relatively small proportion of total flow in the Palsana zone, because these volumes are small. Similarly, relatively few industries produce effluent averaging more than 1000 kL/day, but those are responsible for a relatively large proportion of total flow, because these volumes are large.

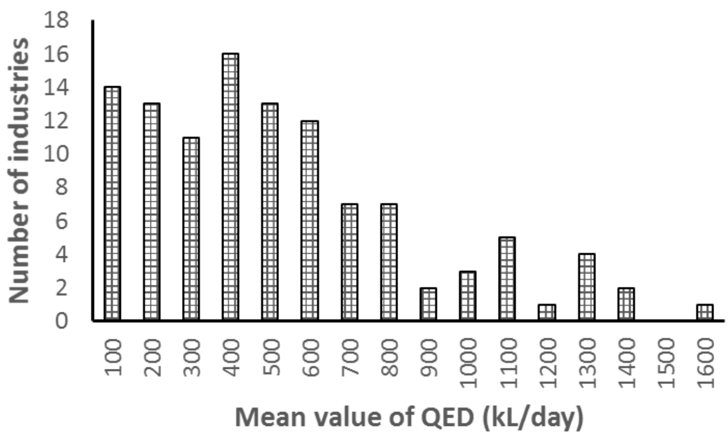


Figure 4: Industry wise distribution of mean value of QED

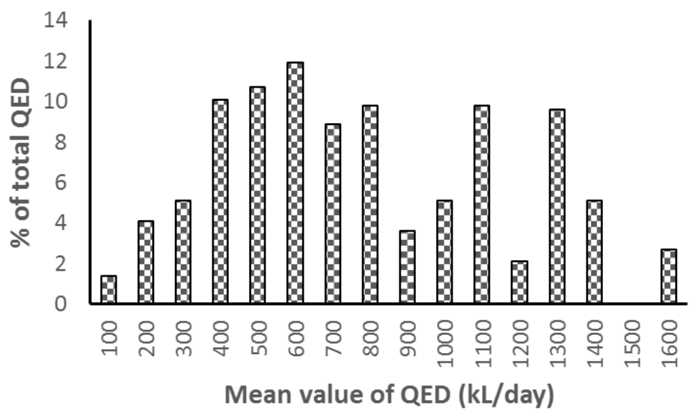


Figure 5: Percentage distribution of mean value of QED

Comparing figures 2 and 4 (or alternatively figures 3 and 5), it appears that the distribution of flow volumes is skewed more to the left than the distribution of booking limits. This suggests that industries with lower booking limits are producing more effluent relative to their booking limits than industries with higher booking limits.

Figure 6 compares daily average effluent flow volumes to daily booking limits. Industries are sorted by booking limit along the x-axis. The y-axis shows the difference between flow volume and booking limit. Positive values indicate that an industry is discharging more QED than the authorized, whereas, negative values indicate that on average an industry is discharging less QED than the authorized.

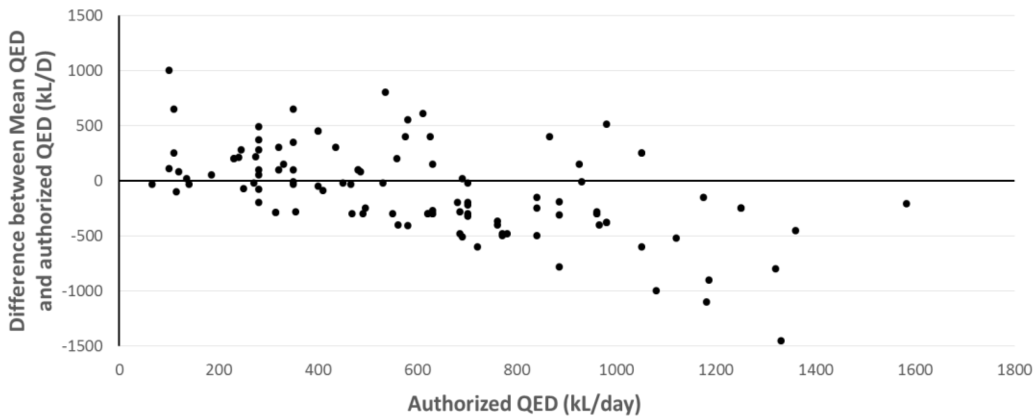
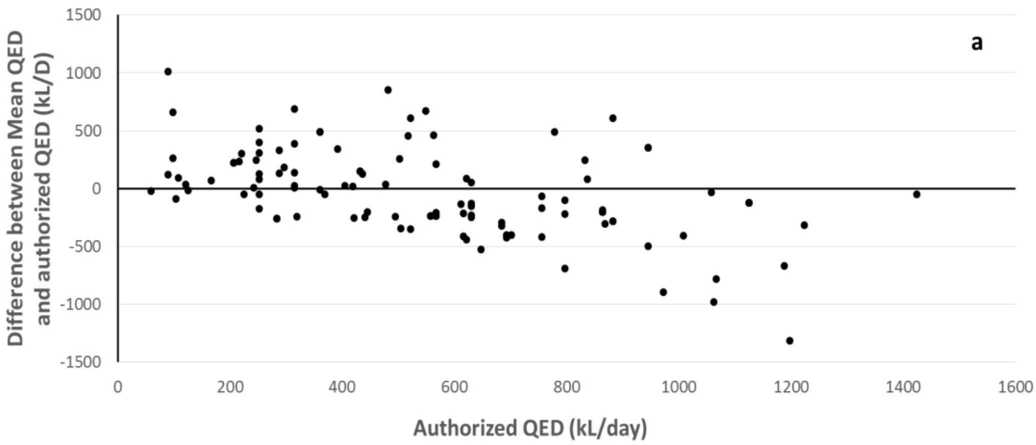
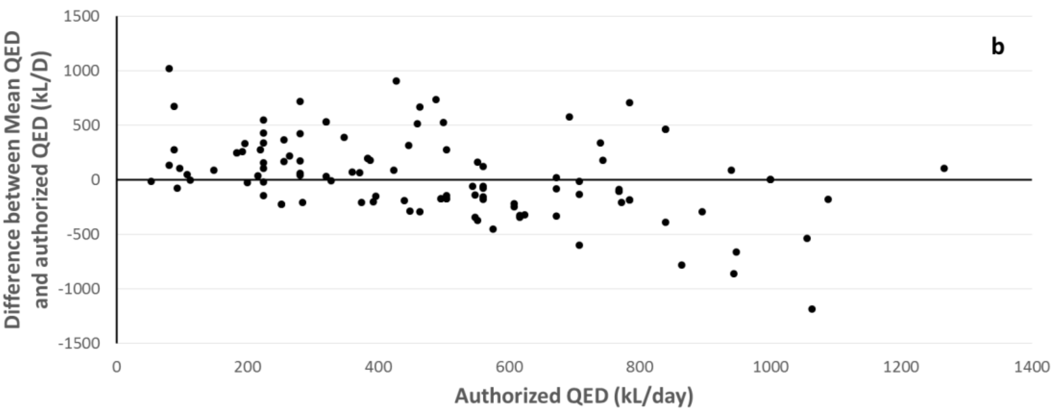
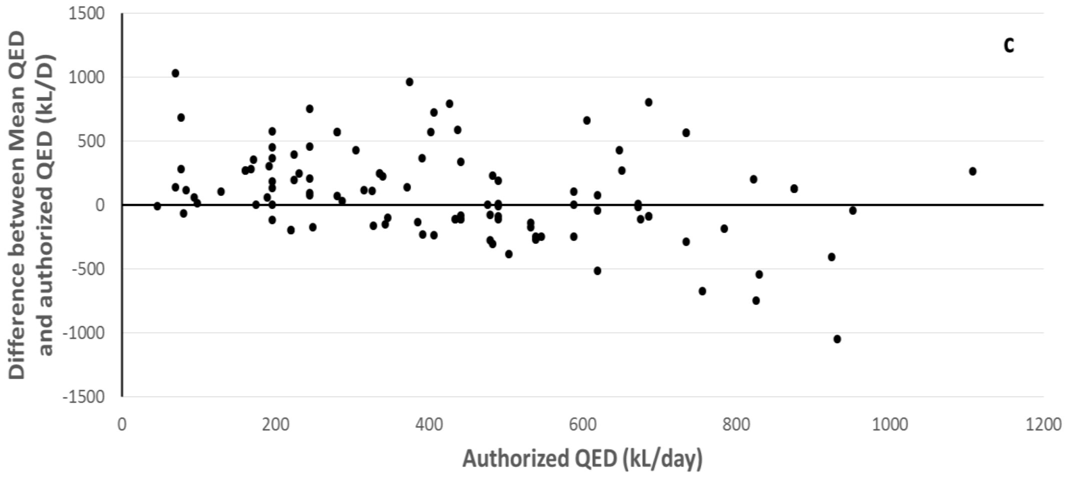


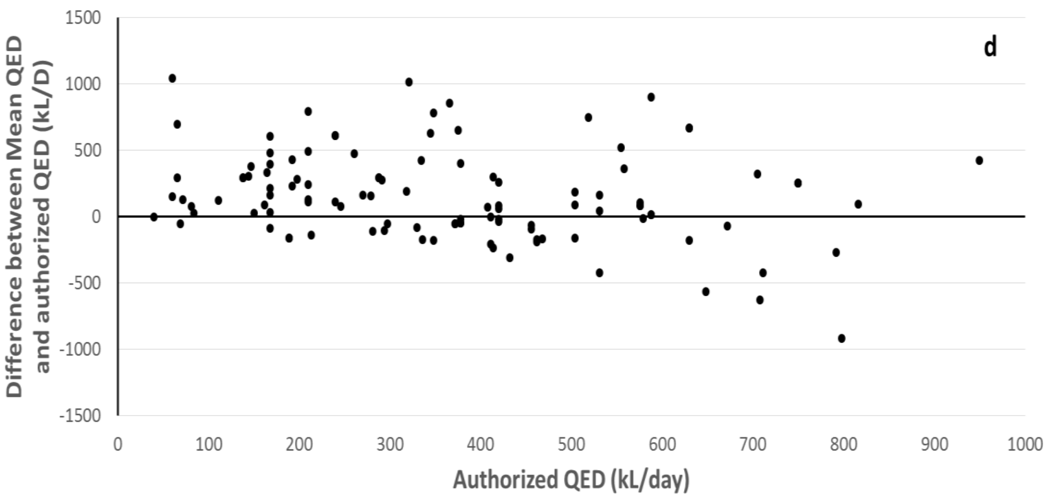
Figure 6: WQT market scenario at CETP Palsana without capping

The Figure 6 depicts that 69 industries are discharging less than and 42 discharging more than authorized QED. Thus, 42 industries may become buyers of credits if WQT is implemented with the basis of trade as effluent volume. In addition, industries with smaller QED are more often fall in buyer category, and industries with larger booking limits are more often in seller. Further, it is important to determine the design capacity of the CETP, the goal of trading, and the target total effluent limit. This implies that, if capping is implemented then WQT become more viable from the perspective of total quantity of effluent received by CETP. Means, if WQT with proper cap and trade mechanism may implemented than probably effluent received by CETP will meet the design capacity and over the period of time increase in the capacity of CETP may not require. Thus, data is simulated and potential of WQT was tested by employing cap at 90% to 50% with step of 10%. This data is depicted in Figure 7 a to d and Table 3.









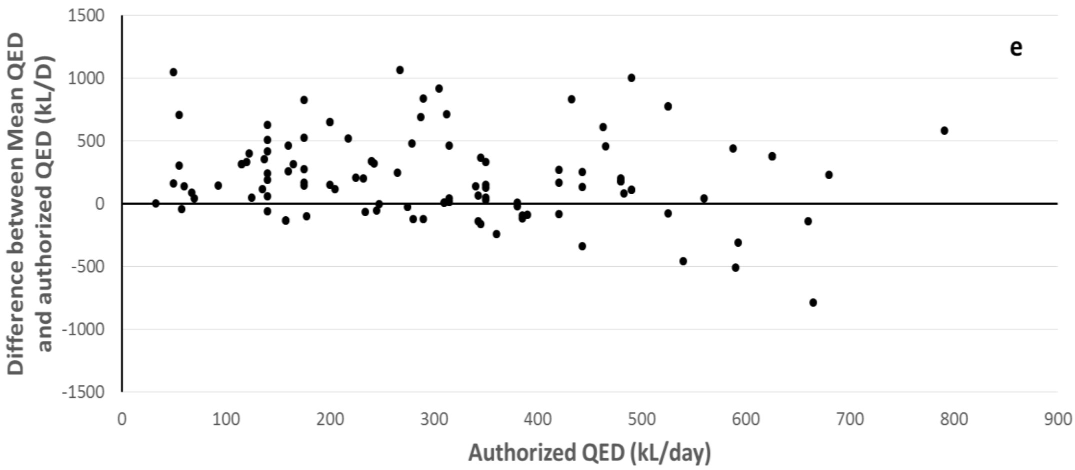


Figure 7 a to e: Proposed WQT market scenario at CETP Palsana for various capping, i.e., 90% of QED, 80% of QED, 70% 0f QED, 60% of QED and 50% of QED respectively.

Table 3: Data representing potential of WQT at CETP, Palsana under various Capping scenario

		QED as per existing Scenario	If authorized QED is capped to					
			90% of existing	85% of existing	80% of existing	70% of existing	60% of existing	50% of existing
Difference between Mean QED and authorized QED (kL/d)	Summation positive values	12380	14410	15568	16839	19951	23821	28355
	Summation negative values	-22595	-17794	-15537	-13392	-9674	-6712	-4416
	Net value	-10215	-3384	31	3447	10277	17108	23939
Number of companies with	positive values	42	50	53	54	65	73	85
	negative values	69	61	58	57	46	38	26

It can be observed that as the cap is increased more and more companies become buyers. If WQT implemented without capping than its seller driven market and proper incentives may not be received by sellers. Thus, for better incentives, the market should be buyer driven and to make the make the market buyer driven proper capping is crucial parameter. As it can be observed from Table 3, the net value of Difference between Mean QED and authorized QED (kL/d) is negative and after capping it becomes positive. At exactly 85% of capping both buyer and seller have equal credit. Thus, it can be concluded that below 85% of capping the WQT market at CETP Palsana becomes buyer driven and more and more industries become buyer.

For now it is suggested to tighten booking limits by 33%, from 3633.5 to 2,422 ML/month. Under this plan, the total effluent limit will equal two-thirds of the current total booking limit. Permits will be allocated to industries in proportion to their current booking limit. Afterward, industries will be allowed to trade amongst themselves, and they will be prohibited from discharging more effluent than the permits they hold.

Thus, with this study, it can be easily understood that vast scope for WQT at CETP Palsana. Further, at this point it is not possible to estimate the expected cost savings to various industries from the trading scheme. However, based on past experience in WQT, it can be assured. Further, it is a high priority to learn more about the production processes of the various industries at Palsana and their costs of reducing effluent flows, which will be useful to propose possible model of the trading scheme and generate predicted savings and permit sales.

CONCLUSION

There are several WQT programs have been implemented successfully to control a variety of water pollutants around the world. The study of one hundred and eleven industries at CETP, Palsana reflects that small and medium scale industries higher values of QED compared to large scale and large number of companies fall in this category. In existing scenario, WQT is possible but the market is seller driven and the market may not sustain in the long run. After employing cap and trade mechanism, the studies revealed that at 85% of cap, both buyer and seller have same quantity means it is the breakeven point. Further increasing the capping converts the market from seller driven to buyer driven. Thus, by changing the authorized QED, the scheme of WQT can be easily implement. Therefore, scope for WQT exists, however further detailed study for implementation is required.

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