



**AN ANALYSIS OF LAW ON GROUNDWATER
POLLUTION IN THAILAND AND MALAYSIA**

BY

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ABSTRACT

Groundwater resource is considered the largest water reservoir on the earth. It has become the main source of water supply for various purposes in many areas in the world. Groundwater quality is normally clean and less contaminated which can be used immediately upon abstraction. Rapid economic development and fast growing rate of the world population have led to the increased demand of water which leads to groundwater pollution. Groundwater is the main source of water supply in Thailand which is facing various environmental consequences due to exploitation. On the other hand, although Malaysia does not rely mainly on groundwater for public water supply and groundwater remains untapped except in certain regions like Kelantan and Sarawak, groundwater will be resorted to when surface water is in short especially during the draught season, and will be relied upon due to the increasing demand of water in the future. The purpose of this study is to analyze the law on groundwater pollution in Thailand and Malaysia as well as to examine factors which contribute to groundwater pollution. To achieve this, the study assesses the existing policies and laws relating to groundwater pollution of both countries. Thailand's main effort in controlling groundwater pollution is through the enactment of the Enhancement and Conservation of National Environmental Quality Act 1992 (ECNEQA) and the Groundwater Act 1977 as well the establishment of the National Environment Board (NEB) and the Department of Groundwater Resource (DGR) to enforce the Acts respectively. Malaysia applies legal strategies in controlling groundwater pollution by enacting the Environmental Quality Act 1974 (EQA) and establishing the Department of Environment (DOE) to enforce the Act. This study analyses the scope and strategy employed in ECNEQA and EQA as well as assesses the involvement of environment-related agencies in controlling groundwater pollution. The study concludes, among other things, that successful control of groundwater pollution depends on the elimination of the existing obstacles within the present legal instrument and minimisation of the limitations of the laws.

خلاصة البحث

يحصل الإنسان على احتياجاته المائية من مصدرين أساسيين، هما: المياه السطحية وتشمل مياه الأنهار والبحيرات والوديان، وثانيا المياه الجوفية وتشمل الآبار والينابيع والكهوف. فالمياه الجوفية تعتبر من أهم ما يحتاج اليه الانسان في العالم قديما وحديثا فالماء هو المصدر الأساسي في حياة الانسان ولا بد من استعماله في حياتهم اليومية تبعاً لمتطلباتهم المختلفة. وعلى العموم فإن المياه الجوفية يعد من أطيب أنواع المياه وأحسنها نظافة. بحيث لا يحتاج الى استعمال آلات التنظيف لتطهيرها. وعندما ازداد عدد السكان وكثر استعمالهم الآلات الحديثة في البناء والعمارة وانتشار استعمال المواد الكيماوية في الزراعة والحقول، أدى كل ذلك إلى تلوث المياه الجوفية بأنواع مختلفة من الملوثات كالمقذورات والسموم. تعتبر المياه الجوفية من أهم الثروة المائية التي تمتلكها تايلاند والتي تستخرج عن طريقة الآلات الحديثة في حفر الآبار العميقة. وهي تختلف عن ماليزيا التي لا يحفر فيها الآبار العميقة لأن معظم الأراضي في ماليزيا لا تزال خصبة لنزول المطر طوال السنة. وعلى الرغم من ذلك فإن دولة ماليزيا في حاجة الى استعمال المياه أكثر في المستقبل. وبحسب خبراء الطقس من المتوقع أن تواجه دولة ماليزيا انقطاع المياه في موسم الجذب لعدم نزول المطر. وهذا البحث العلمي هدفه دراسة القوانين المتعلقة بوقاية المياه الجوفية من التلوث المائية لكل من البلدين. فالنسبة لبلاد تايلاند فيعتمد على نظام المرسوم الملكي المشتتمل على الدعم والوقاية على أعلى مستوى الجودة للبيئة الطبيعية. وعلى نظام المرسوم الملكي المشتتمل على المياه الجوفية بالإضافة إلى تعيين اللجنة الوطنية للبيئة، وتكوين لجنة الجودة البيئية بتعيين قسم المياه الجوفية. أما دولة ماليزيا فيعتمد على نظام ما يسمى مستوى الجودة للبيئة الطبيعية المسمى قسم البيئة لتدبير المياه الجوفية. وخلاصة هذا البحث العلمي هي أن وقاية المياه الجوفية من التلوث أمر ضروري يحتاج إلى تعديل الشروط المكتوبة في الأنظمة والقوانين الخاصة بها في كل من البلدين.

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I hereby declare that this dissertation is the result of my own investigations, except where otherwise stated. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at IIUM or other institutions.

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Marine Department (Chantaburi Branch Office) Central Administrative Court Judgment No. A 448/2014

R v. Anglian Water Services [2003] All ER (D) 551

R (Edwards) v. Environmental Agency and another [2004] ENV LR 43

R v. Environmental Agency and another Queen's Bench Division (Administrative Court) 2005

Ta-kua (Lead) Concentrates Ltd Central Administrative Court Judgment No. 637/2012

Wax Garbage Recycle Centre [2009] unreported

Worldtext Management Ltd [2009] unreported

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The Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 2015 (Malaysia)
The Environmental Permitting Act 2010 (The United Kingdom)
The Senior Courts Act 1981 (The United Kingdom)
The Environmental Protection Act 1993 (Australia)

LIST OF ABBREVIATIONS

| | | |
|--------|---|---|
| DGR | : | Department of Groundwater Resources |
| DOE | : | Department of Environment |
| ECNEQA | : | Enhancement and Conservation of National Environmental Quality Act |
| EU | : | European Union |
| EQA | : | Environmental Quality Act |
| NEB | : | National Environment Board |
| PCD | : | Pollution Control Department |
| UNECE | : | United Nations Economic Commission for Europe |

CHAPTER ONE

AN ANALYSIS OF LAW ON GROUNDWATER POLLUTION IN THAILAND AND MALAYSIA

1.0 Background of the Study

Groundwater is the water which is found underneath the sub surface of soil, fractured rock and sandstone called aquifer, and it exists almost everywhere in the world.¹ The world water supply can be acquired from both surface water and groundwater. However, use of groundwater is preferable in many parts of the world as it offers fresher and better water qualities which require less treatment costs as compared to the surface water.²

Similarly, groundwater is one of the most reliable water resources in Thailand.³ The demand of water supply in Thailand is increasing due to the growing population and the economic development of the country. As a result, more than 200,000 groundwater well projects have been carried out by the government to supply the country's demand of water. There are also a number of groundwater wells that have been dredged by private sectors and individuals for industrial and domestic use.⁴

¹ Oliver Schemoll et. al., *Protecting Groundwater for Health*, (United Kingdom: IWA Publishing, 2006), 4-5.

² Charles W. Fetter, *Contaminant Hydrogeology*, (United State of America: Prentice Hall, 1999), 1-2.

³ "Report on the Survey of Groundwater Well and Evaluate the Use of Groundwater for the Management of Groundwater Resource in Thailand," Department of Groundwater Resource <<http://www.gwcr.org/projects/project51/pj06/pj06fi.pdf>> (accessed 25 February, 2015).

⁴ Ibid.

In Malaysia, on the other hand, the use of groundwater is only amounting to 2 percent of the total consumption of water. This is because Malaysia has abundance surface water in the form of rivers and lakes apart from efficient water supply service by the authority. However, the availability of surface water may be affected by climate change, and is vulnerable to potential pollution and toxic contamination. Despite the easy access to surface water, Malaysia from time to time experiences shortage of water supply, especially during the draught season. The increasing cost of surface water treatment further hurdles national water sector in supplying water. The demand for water which is increasing due to the growing number of population as well as the development in industrial and agricultural sectors has led to the need for the usage of groundwater as a supplement source of water supply.⁵

Similarly, groundwater which is the main source of water supply in Thailand also faces various threats including pollution. At present, human activities are the main cause of groundwater pollution which includes agricultural run-off, coastal aquaculture, industrial effluents and domestic sewage.⁶ These activities deteriorate not only groundwater condition but also that of river basins and sea water. Water courses from river and sea connect to groundwater by way of natural seepage process. Thus, polluted surface water will cause pollution to other adjacent groundwater.⁷ In addition, over extraction of

⁵ Saim Suratman, "IWRM: Managing the Groundwater Component in Malaysia," Minerals and Geoscience Department Malaysia, <[http://www.academia.edu/4155785/Minerals and Geoscience Department Malaysia](http://www.academia.edu/4155785/Minerals_and_Geoscience_Department_Malaysia)> (accessed 30 April 2015).

⁶ "State of Water Environmental Issue in Thailand," Water Environment Partnership in Asia, <<http://www.wepa-db.net/policies/state/thailand/thailand.htm>> (accessed 30 April 2015).

⁷ Richard C, Burton, "Pollution of Ground Water," <<http://heionline.org>> (accessed 1 May 2015).

groundwater to meet the increase demand of water further threatens groundwater resources.⁸

In the past, the Thai government did not give much concern about environmental issues as indicated in the National Economic and Social Development Plan (The National Plan). During the first and third National Plans, the emphasis was given only to the development of water access in order to meet economic achievement, particularly, in rice production while less attention was paid to water pollution issue.⁹ Only from the fourth National Plan onwards that those water pollution issues have been given greater attention by the government through a variety of strategies and guidelines for water management and conservation.¹⁰ Similarly for Malaysia, during her early development phase, environmental issues were not given much significant as compared to economic development which led to excessive exploitation of natural resources. Only after the implementation of the Environmental Quality Act 1974 and the succeeding establishment of the Division of Environment (now Department of Environment) that those environmental issues was recognized and given greater concern as to their effective management and conservation.¹¹

This study attempts to examine the law on groundwater pollution in Thailand which is based on the civil law system and the law on groundwater pollution in Malaysia which is based on common law. Groundwater pollution in Thailand is governed by the Enhancement and Conservation of National Environmental Quality Act 1975 where several provisions concerning pollution control can be referred to within the Act. In addition, the

⁸ Ibid.

⁹ See First, Second and Third Thailand Social and Economic Development Plans (1961-1976).

¹⁰ Sacha Sethaputra et. al., "Thailand's Water Vision: A Case Study," Regional Office for Asia and the Pacific, < <http://www.fao.org/docrep/004/ab776e/ab776e04.htm> > (accessed 25 February 2015).

¹¹ See Malaysia, Second Malaysia Plan 1971-1975, (Kuala Lumpur, National Printers, 1971), 218.

Groundwater Act 1977 deals specifically with the extraction of groundwater resources through licensing and charging strategies. In Malaysia, the law relating to groundwater pollution is regulated by the Environmental Quality Act 1974 which contains general provisions relating to environmental matters, and specific provisions on inland water pollution control which also includes the control of groundwater pollution. In addition, the extraction of groundwater is governed by the Geological Survey Act 1974.

In discussing the law on groundwater pollution in Thailand and Malaysia, this study will examine how the law deals with groundwater pollution. Furthermore, the research will try to find out whether existing laws in both countries are sufficient and effective to control groundwater pollution.

1.1 Statement of the Problem

In this research, the statement of problem can be elaborated into the following questions:

1. What are the laws in Thailand and Malaysia which deal with groundwater pollution?
2. What are the laws which govern the extraction of groundwater resources in Thailand and Malaysia?
- 3 Whether these existing laws on groundwater pollution are adequate to control groundwater pollution in both countries?

1.2 Hypothesis

The research is based on the hypothesis that:

1. The existing laws on groundwater pollution in Thailand and Malaysia are inadequate to control groundwater pollution especially on the discharge of waste into waterway.

2. The law on groundwater pollution in Thailand is more-established and should be followed by Malaysia.

1.3 Research Objectives

The research is undertaken based on the following objectives:

1. To evaluate factors that lead to groundwater pollution in Thailand and Malaysia.
2. To examine the law on groundwater pollution applicable in Thailand and Malaysia.
3. To examine the law governing groundwater extraction in Thailand and Malaysia.
4. To suggest possible improvement of the current law on groundwater pollution and groundwater extraction in Thailand and Malaysia.

1.4 Literature Review

This topic has been chosen for the research based on the observation from earlier studies relating to the legal protection of groundwater resource within Thailand and Malaysia. Often, the researcher found that there were limited studies conducted on this topic in Malaysia. This is due to the reason that Malaysia relies greatly on surface water for the

national water supply and groundwater resource remains untouched and out of concern.¹² Even though some writers have attempted to write about groundwater pollution in Malaysia, the writings are always limited to general discussion on causes of groundwater pollution whereby no extensive studies on legal protection of groundwater have been conducted. For example, Ahmad Faris Mohamed et. al.¹³ stated that the rapid economic and industrial development in Malaysia has resulted to increasing vulnerability of groundwater resource. This idea was supported by the finding of Ismail Yusuff et. al.¹⁴ which stated that the leachate from municipal waste landfill has contributed greatly to groundwater pollution in Malaysia.

Some writers have foreseen a significant contribution of groundwater in supporting economic and social development of the country. Like Saim Suratman,¹⁵ he is of the view that Malaysia will have to rely on groundwater in the future despite the omnipresent of surface water because Malaysia faces water shortage form time to time. Thus, shifting the water dependency to groundwater as a supplement source of water supply is a good step to achieve water supply security in the country. This view has been supported by Le Huu Ti and Facon¹⁶ where they stated that the water shortage is a result of population growth, economic development and the expansion of urbanization and industrialization which set

¹² Siti Halwani Mohamad Nor, "Spatial and Temporal Patterns of Groundwater Quality," (Unpublished report submitted for the bachelor degree of civil engineering, University Technology Malaysia, 2012), 4.

¹³ Ahmad Faris Mohamed et. al, "Groundwater and Soil Vulnerability in Langat Basin Malaysia," *European Journal of Scientific Research*, Vol.27, No.4 (2009): 629, <<http://www.eurojournals.com/ejsr.htm>> (accessed 30 March, 2015).

¹⁴ Ismail Yusuff et. al, "Assessment of Pollutants Migration at Ampar Tenang landfill Site, Selangor, Malaysia," *Journal of the Science Society of Thailand*, Vol. 39 (2013): 392, < http://www.scienceasia.org/2013.39.n4/scias39_392.pdf> (accessed 30 March, 2015).

¹⁵ Saim Suratman, "IWRM: Managing Groundwater Component in Malaysia," Mineral and Geoscience Department Malaysia, <academia.edu.my> (accessed 10 March, 2016).

¹⁶ Le Huu Ti and Thierry Facon, "From Vision to Action: A Synthesis of Experiences in Southeast Asia," Food and Agriculture Organization of the United Nations, < <http://www.fao.org/docrep/004/AB776E/ab776e01.htm> > (accessed 23 August 2015).

the demand of water at the increase. They put emphasize of changing situation of water resources in Malaysia from abundance to scarcity, and highlighted that it was high demand of water that have put pressures on water resources and lead to a more complicate water development and management. Be that as it may, there is a wide range development of groundwater resource in some areas in Malaysia. In this regard, Mazatun Akmar Aros¹⁷ found out that in the State of Selangor, groundwater has been greatly developed to supply the demand of water from industrial sector. Her finding also provides that excessive extraction of groundwater reduces extensively groundwater levels which can lead to groundwater pollution such as the decline in groundwater quality and seawater intrusion. Over extraction of groundwater is a concern because according to Bouwer,¹⁸ subsidence and lateral movement of the land surface resulted from over extraction of groundwater can lead to adverse impacts on the environment such as destruction of constructed buildings and other man-made facilities, increasing flood hazard of already low areas affecting the system of ecological balance.

Issues pertaining to the shortage of water supply in Thailand and the need to rely on groundwater have been examined by Sethaputra et. al.,¹⁹ in their study, they identified that Thailand also faces shortage of water despite the intensive reliance of both groundwater and surface water. They further argued that the increasing demand of water stemmed from the expansion of urbanization and industrialization which further threaten groundwater resources whereby a large scale extraction of groundwater has inevitably increased to meet

¹⁷ Mazatun Akmar Aros, "Groundwater Development in Selangor and Impact to Environment," (Paper presented at Groundwater Colloquium 2009 organized by Minerals and Geoscience Department Malaysia and Academy of Science Malaysia, Putrajaya, Malaysia, March 25-26, 2009).

¹⁸ Herman Bouwer, *Groundwater Hydrology*, (New York City: McGraw-Hill, 1978), 313.

¹⁹ Sacha Sethaputra et. al., "Thailand's Water Vision: A Case Study," Regional Office for Asia and the Pacific, <<http://www.fao.org/docrep/004/ab776e/ab776e04.htm>> (accessed 6 September 2015).

the water demand. This finding is coherent with the observation of Fornés and Pirarai²⁰ about the effect of over extraction of groundwater stating that the long term overdraft of groundwater can lead to groundwater pollution such as a decline in groundwater quality, aquifer depletion and saline water encroachment. Regarding with groundwater pollution in Thailand, the annual report from the Pollution Control Department²¹ shows that agricultural and industrial sectors are the major contribution to groundwater pollution caused by the discharge of solid and liquid waste into environment. Meanwhile, according to Siti Halwani,²² the major cause of groundwater pollution in Malaysia includes the discharge of wastewater from domestic sewerage plants, industrial waste and agricultural run-off. The delineated discussion also points out that the pollutants will first contaminate the surface water like rivers and streams before affecting the quality of groundwater. This finding corresponds with the proposition of the Environment Agency of United Kingdom²³ which stated that there is a direct interaction between surface water and groundwater known as the hyporheic zone which allows an exchange of particles leading to migration of pollutants into groundwater.

The earlier studies focused mainly on development and management of groundwater resources while less concern is given to the need for extensive study on the legal protection of groundwater. For example, Buapeng and Foster²⁴ identified that Thai

²⁰ Juan Fornés and Kriangsak Pirarai, Groundwater in Thailand, *Journal of Environmental Science and Engineering*, (2014): 308, <<http://www.davidpublisher.org>,> (accessed 10 September, 2015).

²¹ “Thailand State of Pollution Report 2010,” Pollution Control Department, <http://infofile.pcd.go.th/mgt/Report_Eng2553.pdf> (accessed on 19 June 2016).

²² Siti Halwani, 4.

²³ “Groundwater Protection: Principle and Practice,” Environment Agency United Kingdom, <https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/297347/LIT_7660_9a3742.pdf> (accessed on 19 June, 2016).

²⁴ Somkid Buapeng and Stephen Foster, “Controlling Groundwater Abstraction and Related Environmental Degradation in Metropolitan Bangkok – Thailand,” The World Bank Global Water Partnership Associate

government has resorted to the drilling of new groundwater wells to extend the yielding capacity of groundwater to cater the high demand of water especially during the dry season. This is coherent with the finding of Yunus and Muhammad Hatta²⁵ which provided that there is not much development in law for comprehensive management and conservation of groundwater resource in Malaysia. Norha²⁶ supported that Malaysia has yet to implement any specific law to govern groundwater related issues. The existing water-related legislations are mostly directed at surface water resources which address groundwater issues only in an accidental manner. Therefore, according to Nora,²⁷ the need to have a specific law concerning groundwater related matters must be recognized in order to avoid haphazard and inconsistent administration of groundwater resources. Her opinion is supported by Goldstein²⁸ who proposes that States have the responsibility to protect groundwater resources by enacting the law which controls the discharge of waste to prevent groundwater pollution. Bell et. al.,²⁹ are of the same view that to control groundwater pollution in an effective manner, it is important to implement the law which regulates the discharge of hazardous and non-hazardous waste into groundwater. The law must also place a duty on the Environment Agency to take all necessary measures to prevent the discharge of any pollutant into groundwater. Be that as it may, these suggestions are in favour of controlling groundwater pollution by way of compulsion whereby they neglect the

Program, <http://siteresources.worldbank.org/INTWAT/Resources/GWMATE_CP_20_Bangkok.pdf> (accessed 6 September 2015).

²⁵ Yunus Abd. Razak and Muhammad Hatta Abd. Karim, "Groundwater in Malaysia Context," Malaysia Academic Science,

< <http://asmic.akademisains.gov.my/download/water/GroundWater%20Colloquium%202009.pdf> > (accessed 23 August 2015.)

²⁶ Norha Abu Hanifah, "Groundwater Legal Protection in Malaysia: Lessons from UK Experiences," University Technology Mara Law Review 1 (2001), 44.

²⁷ Nora R. Pincus, "Groundwater and International Law: the Need for Specific Regulation," <<http://heinonline.org>> (accessed 9 March, 2016), 314.

²⁸ Joel B. Goldstein, *The ABC of Environmental Regulation*, (U.S.A: The Scarecrow Press, 2003), 97.

²⁹ Stuart Bell et. al., *Environmental Law*, (United Kingdom: Oxford University Press, 2013), 645.

significance of public participation in the control of groundwater pollution which may help to improve the quality of pollution control measures.

Some writers have foreseen the need to control groundwater extraction in order to prevent groundwater pollution. Like Wolf and Stanley,³⁰ they pointed out the need to have legal controls in relation to extraction of groundwater because over extraction of groundwater can cause groundwater pollution especially saline water encroachment into the aquifers. In this respect, Maizatun Mustafa,³¹ stated that groundwater extraction in Malaysia is regulated under the Geological Survey Act 1974 whereby a notification to the Director General of the Geological Survey is needed before one can extract groundwater. Meanwhile in Thailand, Buapeng³² states that the extraction of groundwater is governed by the Groundwater Act 1977 which imposes several requirements prior to the extraction of groundwater such as the requirement of license and the imposition of fee for groundwater extraction. Nevertheless, the discussion as to the effectiveness of such legal instruments in controlling groundwater extraction in Thailand has not been done.

From the above discussion of existing literatures, there is no empirical research conducted on the law of groundwater pollution control and its enforcement in Thailand and Malaysia as highlighted in this thesis. Even though some writers have attempted to touch on the legal aspect of groundwater pollution control but their discussion are confined to general management of the resource while they have ignored an analytical study on the

³⁰ Susan Wolf and Neil Stanley, *Wolf and Stanley on Environmental Law*, (London: Routledge, 2011), 175.

³¹ Maizatun Mustafa, *Environmental Law in Malaysia*, (Netherlands: Kluwer Law International, 2011), 80.

³² Somkid Buapeng, "Groundwater Resources Investigation, Assessment and Development in Thailand," the World Bank Global Water Partnership Associate Program, < http://siteresources.worldbank.org/INTWAT/Resources/GWMATE_CP_20_Bangkok.pdf> (accessed 23 August 2015).