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## SHORT REPORTS

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### STUDY ON ORGANOCHLORINE PESTICIDES RESIDUES IN THE MEKLONG RIVER

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(Received 20 May 1997)

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#### ABSTRACT

Study on organochlorine pesticides residues in the water samples of the Meklong River were carried out during March 1995 to February 1996. The water samples were collected every month at 15 stations. Eleven organochlorine pesticide residues were determined by Gas Chromatography.

Ten organochlorine pesticide residues have been determined from 180 water samples, these are; *o,p'*-DDT, heptachlor, *p,p'*-DDT, *p,p'*-DDD, dieldrin, *p,p'*-DDE, lindane, *o,p'*-DDD, heptachlor epoxide and aldrin with the averages of 0.068, 0.118, 0.023, 0.074, 0.058, 0.021, 0.003, 0.016, 0.004 and 0.002 ppb. with the percentage of each pesticide found as 60.0, 52.22, 51.11, 48.88, 47.22, 39.44, 26.67, 22.22, 10.56 and 1.11 respectively. The organochlorine pesticides found could be divided into four group, these include ; total DDT, heptachlor group, drin group and lindane group with their average of 0.201, 0.118, 0.059 and 0.003 ppb respectively. There were no significant difference of the pesticide residues among the 15 stations at 95% confidence interval. And it seems to be higher residues during the rainy season than the dry season with significant difference at 95% confidence interval in heptachlor and total DDT. Heptachlor group in rainy season and dry season were 0.088 and 0.030 ppb, while total DDT were 0.153 and 0.048 ppb, respectively.

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#### INTRODUCTION

The Meklong River is one of the most important rivers among the four rivers in the Central Plain of Thailand. It occurs from the merging between the big and small River Kwae at Ban Pakprak, Kanchanaburi Province, then flows through Ratchaburi Province and Samut Songkhram Province to the Gulf of Thailand with the total length of 145 kilometers.

The Meklong River has a tremendous benefit to the community where it flow through not only used for human uses but also for agricultural uses.

Recently, the river has a severe problem due to the fact that people are routinely dumping their waste directly into the river without prior treatment. Also in the upper part of the river there is a large plantation area for sugarcane, maize, rice, cotton, etc. especially in Kanchanaburi Province which of course applied a huge quantity of pesticides every year.

Similar to many others rivers, Menasveta et. al. (1979) found the residue of DDT at the estuary of Chao Phraya River between 0.01-0.15 ppb. Sombatsiri et. al. (1988) studied the residue of an organochlorine insecticide in five major river basins namely Ping, Wang, Yom,

Nan and Chi in the Northern Parts of Thailand and found that insecticide residues most commonly detected in these river basins were dieldrin and total DDT, the others were at a too low concentration to be detected. Dieldrin found in these five river basins were 0.143, 0.23, 0.012, 0.033 and 0.058 ppb. while total DDT were 0.075, 0.01, 0.007, 0.008 and 0.217 ppb., respectively. Kachakul (1985) found the residue of dieldrin in Prachin Buri, Nakhon Nayok, and Bang Pakong Rivers at the average of 0.037, 0.022, and 0.002 ppb respectively. Tangtrongkitwong (1991) analyzed the water samples from the rivers in Southern Part of Thailand and found the dieldrin residue of 0.007 ppb and DDT 0.005 ppb. Supanpaiboon (1993) studied the Loei River and found DDT residue in the range between 0.068-0.323 ppb, dieldrin 0.014-0.034 ppb, heptachlor 0.003-0.088 ppb, and alpha-BHC 0.001-0.019 ppb. Adulsuttanon (1994) studied the Meklong River during 1989-1990 and found 9 types of organochlorine pesticides, among them were heptachlor, dieldrin, aldrin and DDT with the average of 0.045, 0.062, 0.018 and 0.385 ppb respectively.

Therefore, the accumulation of pesticide residues are expected to be higher in the living organisms due to the biological magnification process. The objective of this study consists of several purposes, these include ;

1. To study of the type and quantity of each pesticide in the organochlorine group in the Meklong River.
2. To compare the type and quantity of each pesticide found among the 15 sampling stations.
3. To study the influence of seasonal variation on the quantity of the residue.
4. To acquire data necessary to plan for water quality management in the Meklong River.

## MATERIALS AND METHODS

### 1. Sampling areas :

Fifteen locations along the Meklong River were chosen as the representative sampling stations as shown in Table 1.

### 2. Sampling method :

One liter polyethylene bottles have been used to collect the water samples from the mid depth level at the central of the river from each station, kept at 4°C in the dark and analyzed within 14 days.

### 3. Analysis for organochlorine pesticides

The analytical methods of APHA-AWWA-WPCF (1975) and Tayapat, *et al.* (1979) have been employed as the following :

#### 3.1 Sample extraction

A 1,000 mL separatory funnel was filled with 800 mL water sample and extracted with n-hexane three times at five minutes each using 100, 50, and 50 mL respectively. Combined the n-hexane together and filtered through sodium sulfate then evaporated the solvent via vacuum evaporation at 40°C till almost dried.

#### 3.2 Sample clean up

A preparative column was packed with deactivated alumina and prewet the packing material with 5 mL n - hexane. The column was loaded with 0.5 mL sample after rinsed the sample's bottle three times with n - hexane. Samples were eluted with n - hexane until the total volume of 8.5 mL contained both solute and solvent have been obtained and then vacuum dried the solvent.

### 3.3 Gas chromatographic analysis

The dried solutes were redissolved with n - hexane then adjusted volume to 1 mL each and quantitatively analyzed by comparing with eleven external standards as mentioned earlier.

## RESULTS AND DISCUSSIONS

The results from the 180 water samples of the Meklong River sampling from the 15 stations between March 1995 until February 1996 could be summarized as the following :

1). Ten pesticide residues were found , they were ; o,p'-DDT, heptachlor, p,p'-DDT, p,p'-DDD, dieldrin, p,p'-DDE, lindane, o,p'-DDD, heptachlor epoxide and aldrin with the average of 0.068, 0.118, 0.023, 0.074, 0.058, 0.021, 0.003, 0.016, 0.004 and 0.002 ppb with the percentage of 60.0, 52.22, 51.11, 48.88, 47.22, 39.44, 26.67, 22.22, 10.56 and 1.11 respectively as shown in Table 2. These values when compared with Adulsuttanon (1994) revealed that the trend of chlorinated hydrocarbon pesticide residue were decreased except heptachlor. The results it might be of the ban on import of some chlorinated hydrocarbons into the country since 1983. Heptachlor, aldrin and dieldrin were banned since 1988.

2). The organochlorine pesticides found can be classified into four group, they are; total DDT, heptachlor group, drin group and lindane group with their average of 0.201, 0.118, 0.059 and 0.003 ppb respectively as shown in Table 3, Figure 1 and 2.

The average values found were below the surface water quality standards (Table 4) but most still higher than the safe level recommended by USEPA for freshwater and marine animals (Boyd 1989).

3). There were no significant differences of the pesticide residues among the 15 stations at the 95% confidence interval.

4). There seemed to be higher residues during the rainy season than the dry season (Figure 3) with significant difference at 95% confidence interval for the heptachlor group and total DDT. The average concentration of heptachlor group in the rainy season and dry season were 0.088 and 0.030 ppb, while total DDT were 0.153 and 0.048 ppb, respectively.

**Table 1** Sampling stations in the Meklong River.

Sampling station	District	Location Amphoe	Province
1. The estuary of the river	Rakyat	Muang	Samut Songkhram
2. Amphoe Muang	Rakyat	Muang	Samut Songkhram
3. Amphoe Amphawa	Suanluang	Amphawa	Samut Songkhram
4. Amphoe Bang Khonthi	Bangnokkwak	Bang Khonthi	Samut Songkhram
5. Amphoe Muang	Bangnokkwak	Muang	Ratchaburi
6. Amphoe Photharam	Bangnokkwak	Photharam	Ratchaburi
7. Amphoe Ban Pong	Tapa	Ban Pong	Ratchaburi
8. Waineaw Temple	Waineaw	Tha Maka	Kanchanaburi
9. Tonramyai Temple	Banmai	Tha Muang	Kanchanaburi
10. Fishery Center	Muangchum	Tha Muang	Kanchanaburi
11. Tamsuar Temple	Muangchum	Tha Muang	Kanchanaburi
12. Ban Pakprak	Pakprak	Muang	Kanchanaburi
13. Pobpeon Restaurant	Pakprak	Muang	Kanchanaburi
14. Army's Animal Center	Korsamsong	Muang	Kanchanaburi
15. Nongbua Temple	Nongbua	Muang	Kanchanaburi

**Table 2** Type and number of sample containing pesticide found in the Meklong River during March 1995 - February 1996.

Station	Number of sample	Lin dane	Hep ta chlor	H.E.	Al drin	Diel drin	o,p DDE	p,p DDE	o,p DDD	p,p DDD	o,p DDT	p,p DDT
1. The estuary of the river	12	3	6	1	0	3	0	2	4	2	6	4
2. Amphoe Muang Samut Songkhram	12	2	4	2	1	6	0	4	4	6	3	8
3. A. Amphawa	12	4	6	0	0	6	0	6	1	4	7	7
4. A. Bang Khonthi	12	3	5	2	0	5	0	6	0	6	7	6
5. A. Muang Ratchaburi	12	3	7	1	0	4	0	3	2	4	5	5
6. A. Photharam	12	3	8	1	0	8	0	5	3	6	8	5
7. A. Ban Pong	12	5	6	2	0	7	0	7	3	6	9	8
8. Waineaw Temple	12	3	6	1	0	5	0	7	2	5	7	6
9. Tonramyai Temple	12	3	7	1	0	5	0	6	4	6	8	4
10. Fishery Center Kanchanaburi	12	4	7	4	0	5	0	2	3	5	7	3
11. Tamsuar Temple	12	5	5	0	1	5	0	3	3	10	7	8
12. Ban Pakprak	12	4	7	1	0	7	0	7	3	9	9	7
13. Pobpeon Restaurant	12	2	5	0	0	4	0	3	3	6	6	5
14. Army's Animal Center Kanchanaburi	12	1	7	0	0	7	0	5	2	10	10	8
15. Nongbua Temple	12	3	8	3	0	8	0	5	3	9	9	8
<b>Total sample</b>	<b>180</b>	<b>48</b>	<b>94</b>	<b>19</b>	<b>2</b>	<b>85</b>	<b>0</b>	<b>71</b>	<b>40</b>	<b>88</b>	<b>108</b>	<b>92</b>
<b>Percentage</b>	<b>100</b>	<b>26.67</b>	<b>52.22</b>	<b>10.56</b>	<b>1.11</b>	<b>47.22</b>	<b>0</b>	<b>39.44</b>	<b>22.22</b>	<b>48.88</b>	<b>60.00</b>	<b>51.11</b>

**Table 3** Average concentration of pesticide found in the Meklong River from 15 stations.

Station	Concentration ( ppb )			
	Lindane	Heptachlor group	Drin group	Total DDT
1. The estuary of the river	0.007	0.229	0.023	0.121
2. Amphoe Muang Samut Songkhram	0.002	0.087	0.060	0.120
3. A. Amphawa	0.004	0.128	0.243	0.081
4. A. Bang Khonthi	0.002	0.021	0.020	0.126
5. A. Muang Ratchaburi	0.005	0.139	0.073	0.237
6. A. Photharam	0.002	0.180	0.062	0.226
7. A. Ban Pong	0.006	0.024	0.047	0.271
8. Waineaw Temple	0.004	0.153	0.042	0.197
9. Tonramyai Temple	0.002	0.122	0.027	0.160
10. Fishery Center Kanchanaburi	0.004	0.118	0.011	0.094
11. Tamsuar Temple	0.002	0.019	0.054	0.250
12. Ban Pakprak	0.003	0.022	0.031	0.143
13. Pobpeon Restaurant	0.001	0.009	0.019	0.314
14. Army's Animal Center Kanchanaburi	0.004	0.429	0.106	0.350
15. Nongbua Temple	0.003	0.090	0.074	0.326
<b>Average</b>	<b>0.003</b>	<b>0.118</b>	<b>0.059</b>	<b>0.201</b>

**Table 4** Surface Water Quality Standards and Safe level recommended by USEPA.

Standard	Concentration (ppb)			
	Lindane	Heptachlor group	Drin group	Total DDT
Surface Water Quality Standard	0.02	0.2	0.1	1.0
Safe level recommended by USEPA	-	0.001	0.004	0.001

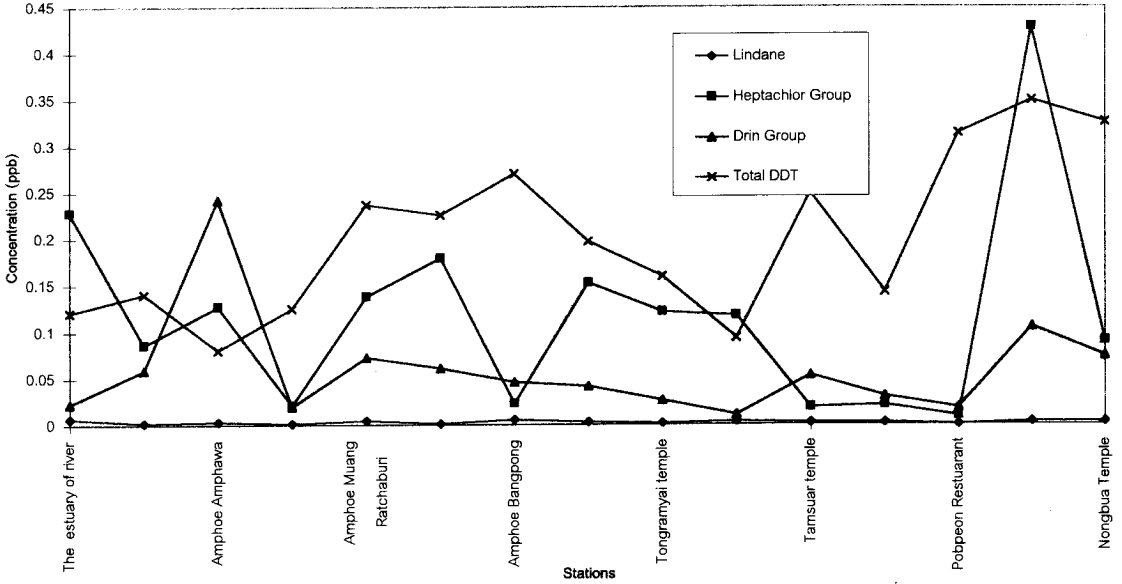


Fig.1 Average concentration of pesticides found in the Meklong River at 15 stations from March 1995 to February 1996.

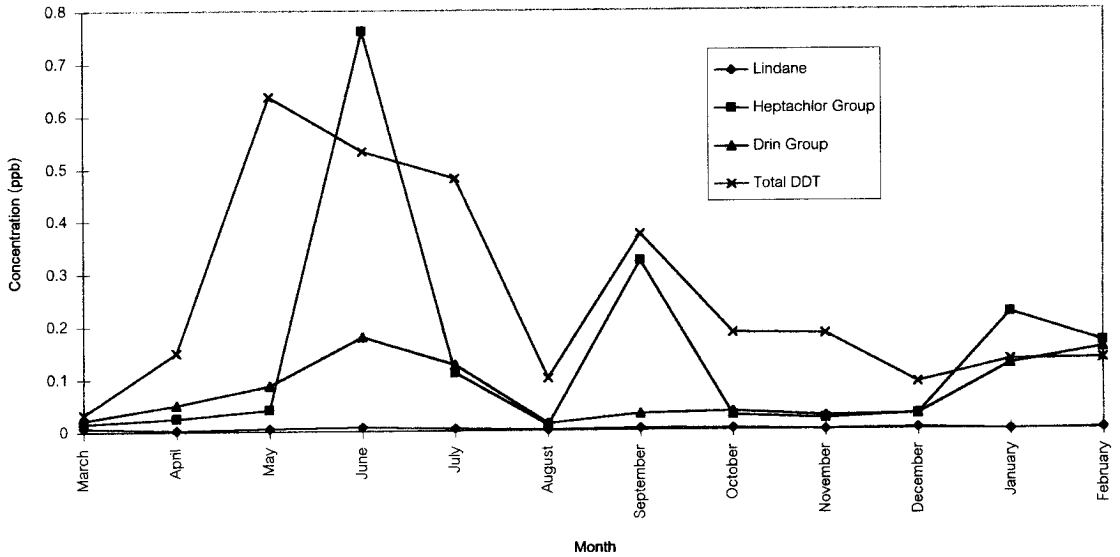


Fig.2 Average concentration of pesticides found in the Meklong River from March 1995 to February 1996.

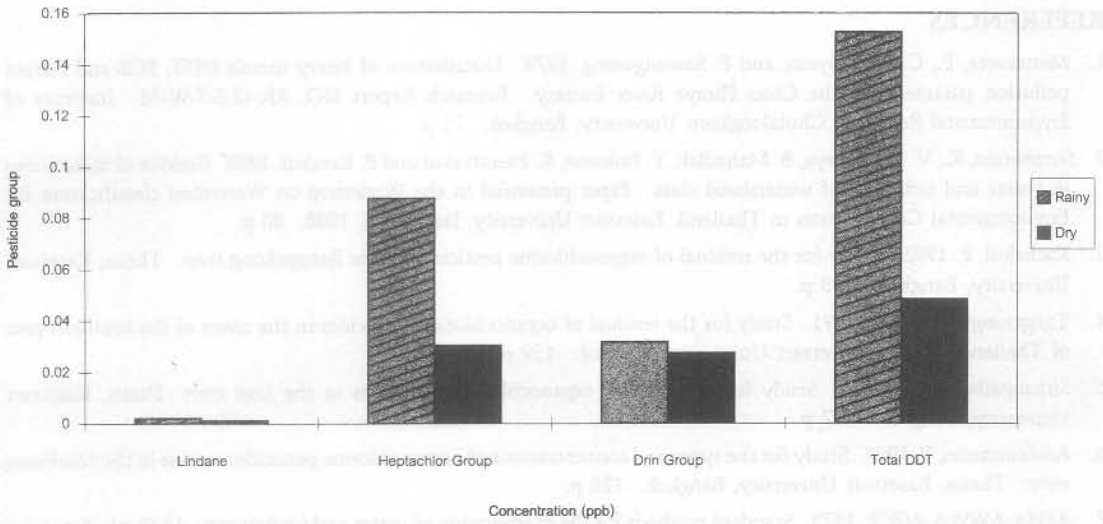


Fig.3 Average concentration of pesticides found in the Meklong River between rainy season and dry season.

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## บทคัดย่อ

การศึกษาพิษตกค้างของสารปราบศัตรูพืชกลุ่มออร์กาโนคลอรีนในน้ำ แม่น้ำแม่กลอง ทำการศึกษาชนิดและปริมาณของสารปราบศัตรูพืชตั้งแต่เดือนมีนาคม พ.ศ. 2538 ถึงเดือนกุมภาพันธ์ พ.ศ. 2539 โดยเก็บตัวอย่างตลอดแม่น้ำ 15 สถานี เก็บตัวอย่างทุกเดือนเพื่อนำมาวิเคราะห์สารปราบศัตรูพืชกลุ่มออร์กาโนคลอรีน ทั้งหมด 11 ชนิด โดยวิธีแกสโครมาโตกราฟี

สารปราบศัตรูพืชกลุ่มออร์กาโนคลอรีนที่ตรวจพบในน้ำจาก 180 ตัวอย่างมี 10 ชนิด คือ ออโธ, พารา-ดีดีที เฮปตาคลอไรด์ พารา,พารา-ดีดีที พารา,พารา-ดีดีดี ดีลคริน พารา,พารา-ดีดีดี ลินเดน ออโธ,พารา-ดีดีดี เฮปตาคลอไรด์เอพอกไซด์ และอัลคริน ปริมาณที่พบโดยเฉลี่ยคือ 0.068, 0.118, 0.023, 0.074, 0.058, 0.021, 0.003, 0.016, 0.004 และ 0.002 ppb. คิดเป็นร้อยละของตัวอย่างที่พบ 60.0, 52.22, 51.11, 48.88, 47.72, 39.44, 26.67, 22.22, 10.56 และ 1.11 ตามลำดับ ปริมาณสารปราบศัตรูพืชที่พบในน้ำจำแนกตามกลุ่มได้แก่ ดีดีทีรวม กลุ่มเฮปตาคลอไรด์ กลุ่มคริน และลินเดน โดยมีปริมาณเฉลี่ยเท่ากับ 0.201 0.118 0.059 และ 0.003 ppb ตามลำดับ เมื่อเปรียบเทียบปริมาณสารปราบศัตรูพืชทั้ง 4 กลุ่มในน้ำทั้ง 15 สถานี พบว่ามีความแตกต่างกันอย่างมีนัยสำคัญ ที่ความเชื่อมั่นร้อยละ 95 และความสัมพันธ์ระหว่างปริมาณสารปราบศัตรูพืชในน้ำกับฤดูกาล พบว่า มีความแตกต่างกันอย่างมีนัยสำคัญที่ความเชื่อมั่นร้อยละ 95 ในกลุ่มเฮปตาคลอไรด์รวมและดีดีทีรวม กลุ่มเฮปตาคลอไรด์ในฤดูฝนและฤดูแล้งมีค่าเฉลี่ย 0.088 และ 0.030 ppb ขณะที่ดีดีทีรวมมีค่าเฉลี่ย 0.153 และ 0.048 ppb ตามลำดับ