

PRESENT IMPACT ASSESSMENT OF HERBICIDES/DIOXIN TO TRI AN RESERVOIR ENVIRONMENT

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Abstract

Tri An lake catchment area of about 14,900 km² had been sprayed the most amount of herbicides (including orange, green, white and other agents) of 2,525,816 gallons during war in South East zones causing strong impacts to water, sediment and land in it's catchment. Tri An lake has been very important for socio-economic development for Dong nai, Ba Ria Vung Tau provinces and Hochiminh City. Therefore, the study and evaluation of residues of herbicides/dioxin in the environmental components are very important and necessary.

Based on the studied and investigated results of the present residues of herbicides/dioxin in water, fishes and sediment environments in Tri An reservoir, the author has analyzed and computed the impacts of the residues of herbicides/dioxin to the environment. The analyzed results show that which were used during the war and it's catchment the auhor has analyzed and computed to issue the conclusions of the residual capacity of herbicides in the reservoir water, aquatic and sediment environments. The author has proposed the restrict and eliminative solutions of impacts of the herbicides/dioxin residues in the environments due to the socio-economic development in order to reduce the ricks of the large reservoirs which have its catchment were been sprayed herbicides during the war.

1. Introduction

The war passed over 30 years then the negative impacts of the herbicides and orange agent were sprayed in the forest areas in South Vietnam due to the war have been gradually mitigated in people memory. However, many people live in herbicides/orange agent sprayed areas as well as their children have been still suffered by fighting with their illness and disease. Many places in Dong Nai, Da Nang, Binh Phuoc provinces have been still discovered the residues of dioxin in the land and sediment samples over the allowed standard values for land and sediment environment.

Tri An lake with the storage capacity of 2.54 billion m³ and the catchment area of about 14,900 km² (Figure 1) is one of the largest in the South-East of Vietnam as well as its location on the last step of the water control system of Dong Nai and La Nga rivers (Figure 2). During the war from 1961 – 1972, there were 76 million liters of herbicides in which had 42 million liters of orange agent to be sprayed on Tri An lake catchment causing strong damage to the natural environment and human health. Therefore, study on the present impacts of herbicides/orange agent to the water, aquacultural life and sediment in Tri An Lake is very necessary and scientific significances for the purposes of making the plan and methods to mitigate these impacts to the environment.

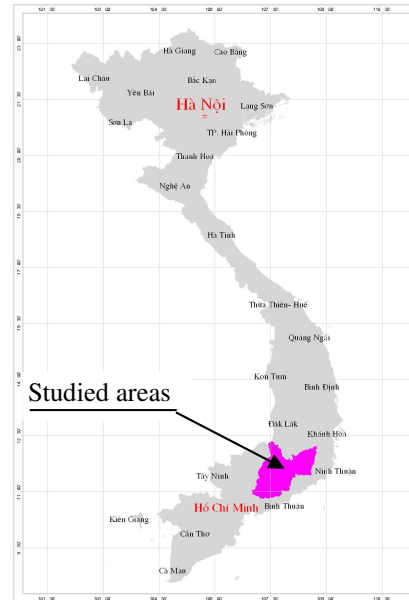


Figure 1: Studied areas in Vietnam map

The study will demonstrate the impact degree of herbicides/orange agent to the water, aquacultural life and sediment in Tri An lake in order to ensure the safe water use for development of socio-economic in its downward large areas such as Hochiminh City, Dong Nai, Long An and Ba Ria-Vung Tau provinces.

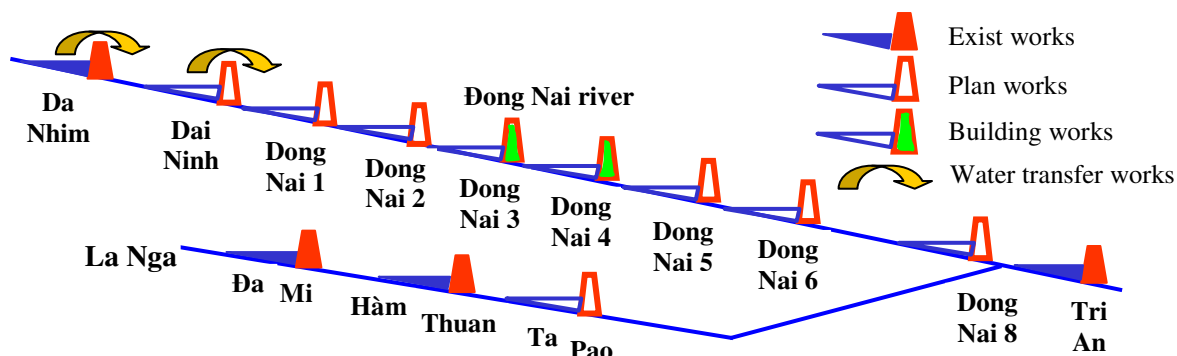


Figure 2: Water control plan in Dong Nai – La Nga rivers system to Tri An lake

2. Material and Methods

The sediment samples were collected at representative eighteen sites in Tri An bottom lake by the equipment of Piterson scoop and heavy gravitative tube with the depth of $0 \div 30\text{cm}$ and $31 \div 50\text{cm}$ from the downward mud surface of the lake. Fishes samples in the lake were collected by the natural source not in the feeding fish cage and to analyse both parts of meat and fat in the laboratory. Samples have been analysed by high resolution GC-MS method at Viet-Nga tropical center, Ha noi Vietnam.

Hydraulic mathematical model have been used to simulate the sedimentative deposits in the bottom lake and the erosion process in the catchment areas to transfer sediments as well as transfer herbicides and orange agents from the sprayed areas to the Tri An lake.

3. Results and Discussion

Tri An lake catchment includes the part or all of five provinces of Dac Lak, Lam Dong, Binh Thuan, Binh Phuoc and Dong Nai with the total of the herbicides/orange agent were sprayed in the catchment to be presented in the table 1 [5]. The listed results in the table 1 show that the total amount of sprayed herbicides in the Tri An catchment is very great of 2,525,813 gallons including 1,456,888 gallons of orange agent, 114,243 gallons of green agent, 913,430 gallons of white agent and 41,251 gallons of other agent.

The sprayed orange agent in Dong Nai province neaby the Tri An lake water surface area is up to 756,015 gallons can strong affect to water, aquaculture environment and especially strong affect/store for the sediment layers in the bottom lake.

3.1 Impacts of herbicide/orange agent for water quality

The analyzed results show that does not detect any concentration of dioxin and other agent in surface and ground water samples in Tri An lake and nearby areas. This means that Tri An lake water quality is not to be affected by the herbicides/orange agent were sprayed in its catchment during the war, although there were very large amount of the herbicides/orange agent to be sprayed on it during the war.

Table 1: Total amount of herbicides/orange agent were sprayed in the Tri An lake

No	Province		Sprayed herbicides in study areas			
			orange agent	Green	White	Other
1	Đac Lak	In all province	465,724	41,015	181,603	21,077
		In Tri An catchment	99,356	-	18,032	1,976
2	Lam Dong	All province	335,296	65,003	155,004	2,000
		In Tri An catchment	309,170	61,420	151,390	1,815
3	Binh Thuan	All province	418,761	35,694	98,457	12,550
		In Tri An catchment	48,980	22,797	6,827	11,956
4	Binh Phuoc	All province	1,268,987	44,293	1,005,940	26,143
		In Tri An catchment	243,367	3,764	198,880	2,518
5	Đong Nai	All province	1,297,552	46,741	941,010	64,889
		In Tri An catchment	756,015	26,262	538,301	22,987

Computed unit: Gallon

Source: Cau Dinh Hoang, 2000.

3.2 Impacts of herbicide/orange agent for aquacultural product in Tri An lake

There were 102 fishes species, 27 families belonging to 7 other orders to be found in the water places in the study areas before Tri An lake to be built, 1986 (see figure 2a). The analyzed results for fishes in Tri An lake in 2004, after seventeen years operation, to find 109 fishes species, 28 families belonging to 9 other orders (see figure 2b).

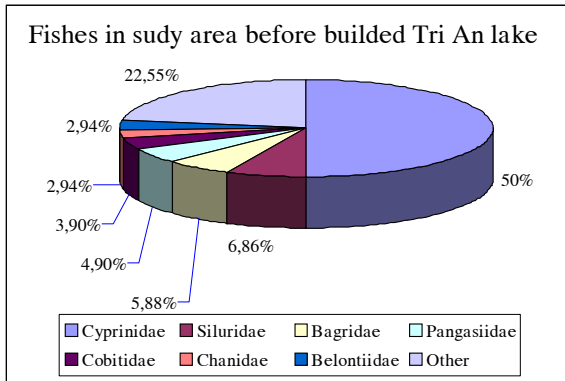


Figure 2a: Fish species in study areas in 1986

Source: Thanh Van Luong et al., 2004

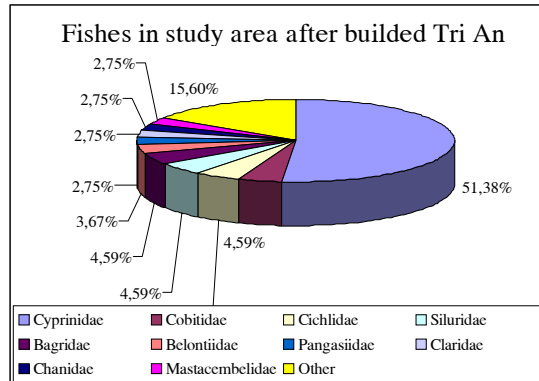


Figure 2b: Fish species in study areas in 2004

The increase of fish species, families and orders in Tri An lake after some decade years of water management due to the supplementation of the fish species by man-made for the lake. Annually fish products in Tri An lake for food are rather large amount of 3,350 tons to supply for Hochiminh City, Dong Nai town and surrounding areas.

The analyzed results show there are 9 fish samples to be found dioxin (2,3,7,8-TCDD) residue in the livers and fat with the concentration in the range from 0.60 to 2.75 ppt (ng/kg). The dioxin residue concentration in fish products are very low in comparison with its allowed corresponding threshold concentration of the meat of 11 ppt and the fish fat of 88 ppt (Russia allowed standard threshold values). Although, there are still some of fish species in Tri An lake to be contaminated by dioxin but these concentrations are very very not to be harmful to the food and health any

more. Therefore, all the aquacultural products from Tri An lake and its downward basin are not any affected by the sprayed herbicides/orange agent during the war.

3.3 Impacts of herbicide/orange agent for sediment in Tri An lake

Two dimension hydraulic model has been used to compute the sediment deposition for Tri An lake with the results of annual deposition for bottom lake changing from 1 to 6 cm and average value of 3 cm for each year. Therefore, (do vậy) the depth of raised sediment deposition bottom layer after 35 years is reached (đạt đến) from 35 to 210 cm with average depth of 105 cm.

The sediment samples were collected in Tri An lake bottom by Piterson scoop up to 30 cm depth and heavy gravitative tube tool up to 50 cm depth for the purpose of dioxin analysis. The analyzed results show that the concentration of 2,3,7,8-TCDD and 2,3,7,8-TCDF isome in the mud from 0 ÷ 30 cm were not found in the total of 16 sediment samples but only found the isomeric concentration of HpCDD (changing from 9.5 to 71.8 ppt) and OCDD (changing from 45 to 2,619 ppt).

The sediment samples analyzed results for 2,3,7,8-TCDD from the depth 30 ÷ 50 cm have been found the concentration from 0.8 ÷ 4.9 ppt and these values are still smaller than allowed standard threshold value (9.0 ppt) for the sediment not to be harmful for environment. Therefore, other concentration such as 2,3,7,8 TCDF, HpCDD and OCDD have been found in nearly all sediment samples of these depths, see table 2.

Table 2: The sediment samples analyzed results in Tri And lake in the depth of 30 to 50cm.

No	Sample sites	I-TEQ (ppt) conc.	Times with allowed values	Conc. of 2,3,7,8-TCDD (ppt)	Conc. of some other common isomes (ppt)			% rate 2,3,7,8-TCDD/I-TEQ
					2,3,7,8-TCDF	HpCDD	OCDD	
1	01	4.47	0.50	1.8	0.5	32.3	2,038	40.2
2	02	1.18	0.13	0.8	1.4	6.2	175	68.0
3	03	1.43	0.16	1.1	Kt	7.0	256	77.1
4	04	2.95	0.33	1.0	Kt	27.9	1,666	34.0
5	05	1.52	0.17	1.2	Kt	7.2	244	79.2
6	06	4.95	0.55	4.2	1.1	9.1	550	84.8
7	07	6.26	0.70	4.9	1.2	14.0	1,102	78.2
8	08	5.99	0.67	3.3	0.5	30.2	2,013	55.1
9	09	4.24	0.47	1.5	1.2	23.9	2,015	35.4
10	10	5.13	0.57	1.6	0.7	31.3	2,638	31.2
11	11	4.24	0.47	1.6	Kt	24.8	2,167	37.8
12	12	4.13	0.46	1.1	Kt	39.0	2,005	26.7
13	13	4.12	0.46	1.4	0.6	36.8	1,750	34.0
Average (n=13)		3.89	0.43	2.0	0.6	22.3	1,432	51.4

Source: Thanh Van Luong et. al., 2004.

Based on the analyzed results of sediment samples in the depth of 30cm to 50 cm we can zone the Tri An bottom layer to be three zones: (i) high concentration zon of dioxin and its isomes is located in the center with direction from North to the South, (ii) average concentration zon of dioxin and its isomes is located in the West – South of the lake and (iii) low concentration zon of dioxin and its isomes is located in the first part of lake belonging La Nga river and a part of area in the west of lake (see figure 3).

4. Conclusions

The overall study on the present residues of herbicides/dioxin in water, fishes and sediment in Tri An lake during the war from 1961 to 1972 in the South Vietnam in the condition of in status quo can be concluded as follows:

- The surface and ground water quality of Tri An lake and its downward basin areas are not affected by the sprayed herbicides/orange agent;
- Some of fishes species such as: *Channa micropeltes*, *Barbonymus gonionotus*, *Oreochromis mossambicus*,... to be found the present dioxin in the meat, liver and fat with the low concentration not to be harmful for foods and human life any more;
- The sediment layer from 0 to 30cm depth in Tri An lake now, is not found the present of dioxin and its isomers but in the layer of 31 to 50cm depth is still found the present of dioxin and its isomers with the values up to half of the allowed standard threshold values (table 2). This means that the dioxin and its harmful isomers concentration can be got higher values for the deeper layers of 50cm in Tri An bottom sediment.

Recommendations

- It needs to be supplementally studied on the residues of dioxin and its isomers in the sediment layers which is deeper than 50cm depth in the Tri An lake bottom sediment in order to show the satisfactory conclusions for the present residues of herbicides/dioxin in sediment in Tri An lake during the war from 1961 to 1972 in the South Vietnam
- If it is not to study more on the residues of dioxin and its isomers in the deeper layers of 50cm depth in the Tri An lake bottom sediment, these layers should be kept in status quo (undisturbed by sand exploitation, excavation) to avoid stir the dioxin and its isomers in sediment into water causing harmfully to the environments.

5. Acknowledgements and references

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