Example: Risk Assessment

An environmental scientist found the average concentration (C) of DDT contaminated in Prasak River 0.02 ng/mL and Chao Praya River 1.00 ng/mL. The people living near the river for 20 years (ED) usually use the water for cooking and drinking. From face to face interview, the average weight is 60 kg; the drinking rate (IR) is 1.2 L/day and the drinking frequency (EF) is 120 days/year. So they might be at risk associated with drinking water consumption from both rivers. You as a risk manager need to evaluate the exposure (ADD and LADD) and characterize the risk of both <u>non-carcinogenic and carcinogenic effects</u> from these rivers.

$$LADD_{POT\ drinking\ water\ ing} = \frac{C_{drinking\ water} * IR_{drinking\ water} * EF * ED}{AT} \qquad \text{(Eq. 8)}$$

where:

$LADD_{POT\ drinking\ water\ ing}$	=	potential lifetime average daily dose from ingestion of contaminated drinking water (mg/kg-day);
$C_{drinking\ water}$	=	concentration of contaminant in drinking water (mg/mL);
$IR_{drinking\ water}$	=	intake rate of drinking water (mL/kg-day);
EF	=	exposure frequency (days/year);
ED	=	exposure duration (years); and
AT	=	averaging time (days).

Note:
1. AT = averaging time (days) for non-carcinogenic effects, AT = ED and for carcinogenic effects, AT = 70 years or 25,550 days.
2. Unit: 1 ng/mL = 10^{-3} mg/L

<u>Prasak River</u>
<u>Calculation for non-carcinogenic</u>
<u>Exposure Assessment</u>
From the formula, ADD = [C × IR × EF × ED] / AT
For non-carcinogenic ED = AT
Therefore, ADD = C × IR × EF

Substitute,
ADD_{prasak} = 0.02 × 10^{-3} mg/~~L~~ × 1.2/60 ~~L~~/kg.day × 120 ~~days/year~~ × 1/365 ~~year/days~~
= 1.32 × 10^{-7} mg/kg.day

<u>Risk Characterization</u>
HI (Ratio) = ADD/RfD
RfD_{DDT} = 5 × 10^{-4} mg/kg.day

Substitute,
HI = (1.32 × 10^{-7} ~~mg/kg.day~~) / (5 × 10^{-4} ~~mg/kg.day~~)
= 2.64 × 10^{-4} or 0.0003
When HI < 1, therefore there is no risk for non-carcinogenic effect related to DDT in this case.

<u>Calculation for Carcinogenic</u>
<u>Exposure Assessment</u>
From the formula, LADD = [C × IR × EF × ED] / AT
Substitute,
$LADD_{prasak}$ = [0.02 × 10^{-3} mg/~~L~~ × 1.2/60 ~~L~~/kg.day × 120 ~~days/year~~ × 20 ~~years~~] / 25,550 ~~days~~
= 3.76 × 10^{-8} mg/kg.day
<u>Risk Characterization</u>
Risk = LADD × SF
SF_{DDT} = 3.4 × 10^{-1} per mg/kg.day
Substitute,

Risk = 3.76×10^{-8} ~~mg/kg.day~~ × 3.4×10^{-1} ~~per mg/kg.day~~
= 12.78×10^{-9}
= 0.012×10^{-6} or 0 person in a million

Therefore, there is no risk for carcinogenic effect related to DDT in this case.

<u>Chao Praya River</u>

<u>Calculation for non-carcinogenic</u>

<u>Exposure Assessment</u>

From the formula, ADD = [C × IR × EF × ED] / AT
For non-carcinogenic ED = AT
Therefore, ADD = C × IR × EF

Substitute,

ADD_{prasak} = 1×10^{-3} mg/~~L~~ × 1.2/60 ~~L~~/kg.day × 120 ~~days/year~~ × 1/365 ~~year/days~~
= 6.58×10^{-6} mg/kg.day

<u>Risk Characterization</u>

HI (Ratio) = ADD/RfD
RfD_{DDT} = 5×10^{-4} mg/kg.day

Substitute,

HI = (6.58×10^{-6} ~~mg/kg.day~~) / (5×10^{-4} ~~mg/kg.day~~)
= 1.316×10^{-2} or 0.013

When HI < 1, therefore there is no risk for non-carcinogenic effect related to DDT in this case.

<u>Calculation for Carcinogenic</u>

<u>Exposure Assessment</u>

From the formula, LADD = [C × IR × EF × ED] / AT
Substitute,

$LADD_{prasak}$ = [1×10^{-3} mg/~~L~~ × 1.2/60 ~~L~~/kg.day × 120 ~~days/year~~ × 20 ~~years~~] / 25,550 ~~days~~
= 1.87×10^{-6} mg/kg.day

<u>Risk Characterization</u>

Risk = LADD × SF
SF_{DDT} = 3.4×10^{-1} per mg/kg.day

Substitute,

Risk = 1.87×10^{-6} ~~mg/kg.day~~ × 3.4×10^{-1} ~~per mg/kg.day~~
= 6.358×10^{-7}
= 1 person in a million or 6 persons in 10 million

Therefore, there is a risk for carcinogenic effect related to DDT 1 person in a million or 6 persons in 10 million.
