

- Making a Difference -

Scientific Capacity Building & Enhancement for Sustainable Development in Developing Countries

**Developing chemical
analysis capability in
India and Pakistan and
risk perception of policy
makers and people in
Asia**

**Final Report for APN CAPaBLE Project:
CBA2007-04NSY**



**UNITED NATIONS
UNIVERSITY**

**United Nations University, Environment and Sustainable Development
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Project Title

Developing chemical analysis capability in India and Pakistan and risk perception of policy makers and people in Asia

CBA2007-04NSY

Final Report submitted to APN

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Overview of project work and outcomes

Non-technical summary

The main objective of this project is to provide basic trainings necessary for scientists in India and Pakistan to initiate their own efforts for enhancing POPs analysis capacity and to disseminate the POPs related information in Asia. Another objective is to disseminate to stakeholders in Asia project results and risk perception concepts, which are important for policy makers to be aware of in formulating such chemical pollution related policies. Two project trainees, a female doctor-course student from India and an analytical chemist from Pakistan, received POPs analysis training at the Korean Ocean Research Development & Institute (KORDI) that was organized as part of APEC activities. A project symposium was held in Indonesia with more than 160 people participants. Three international speakers (Australian researcher on Dioxin formation from forest fire, Swiss researcher on risk perception, and Japanese researcher on POPs management) and one USEPAM project key personnel from Denmark (DANIDA-supported project with AIT, and USEPAM stands for University Support to Environmental Planning and Management) were invited to the symposium and shared their expertise and networks with symposium participants as well as the project partners. A project expert visited the Indian partner for a follow-up onsite support as well as providing a series of lectures at a chemical analysis workshop involving academic researchers as well as governmental technical staff members. His visit to Pakistan has been cancelled due to a series of unfortunate incidents reported in the country.

Objectives

The main objectives of this part of the UNU's project are (1) to provide a basic training necessary for scientists in India and Pakistan to initiate their own capacity development efforts to acquire POPs analysis capability, and (2) to disseminate the latest POPs status in Asia using project results and refine risk perceptions of policy-makers and people in Asia.

Amount received and number years supported

The Grant awarded to this project was:

- USD 23,194 for Year1, 2007-2008

Work undertaken

[1] Chemical analysis capacity development in India and Pakistan: UNU has been implementing its project, "Environmental monitoring and governance in the Asian Coastal Hydrosphere" to help developing countries nurture their own capacity to analyze environmental chemicals mainly in coastal water bodies since 1996 with nine member countries involved, China, Indonesia, Japan, Korea, Malaysia, Philippines, Singapore, Thailand, and Viet Nam. From the fourth phase that started January 2006, a national university in India and a governmental research institute in Pakistan have joined this project. The starter-kit necessary for establishing POPs analysis capability have been already provided such as gas-chromatograph coupled to a quadrupole mass spectrometry (GC/MS), maintenance support in using the instrument, and chemical standards which are all provided for free to the institutes by this UNU project, except technical training of how to do the analysis. This first task intended to provide trainees from the project partner institutes in India and Pakistan with trainings followed by on-site follow-ups by experts.

[2] Symposium on Risk Perceptions: Disseminating the latest status of chemical pollution such as POPs in a comprehensible way directly from scientists to policy-makers and people is very critical for them not only to gain the latest and accurate knowledge but also to refine their risk perception. Trained risk perception allows them to make more sustainable decisions based on the acquired knowledge,

because the trained perception prevents them from spending more resources than necessary in reducing risks of what is just unknown and dreadful, and helps them use more appropriate cautions and a sense of balance in their decisions. UNU project has been disseminating its project results through symposiums held every year in different countries in Asia, but this element of refining people's risk perception had been missing in the previous events. This project attempted, at a symposium in Indonesia, to provide the audience with opportunities to have bird eye's view perspectives to look at various environmental risks against humans and ecosystems. A risk perception researcher was invited as a speaker who presented how risk perception responds to environmental issues on selected topics of heavy metal contamination, POPs, and nano-particles.

Results

Two project trainees, Ms. Bhuvaneshwari Rangarajan (a female doctor-course student from Bharathidasan University, India) and Dr. Zakir Hussain (an analytical chemist from Pakistan Council of Research in Water Resources, Pakistan), received POPs analysis training at the APEC Marine Environmental Training & Education Center (October 15-26, 2007), entitled "Analytical Chemistry of Agrochemicals in Environmental Safety" at KORDI, Geoje island, Korea.

<http://www.ametec.org/>

In order to follow up on the analytical skills acquired by the trainees, an expert from the UNU's project network, Prof. Mustafa Ali Mohd (University of Malaya, Malaysia) visited the Indian project partner's institute. Prof. Mustafa was invited as a lecturer at the National Level Training Workshop on Gas Chromatography Mass Spectrometry (GC/MS) in Environmental Analysis, January 22nd – 26th, 2008 hosted by the Indian project partner, Bharathidasan University, in Tiruchirappalli, India. The main focus of the workshop was to provide hands-on training for chemical analysis of chlorinated pesticides using GC/MS which has been made available by the UNU project. A total number of 26 people including 7 female trainees have been accepted for training out of 40 applicants. Most trainees are from universities and governmental institutes in the region of India.

<http://www.bdu.ac.in/twogame.htm>

An expert visit to Pakistan was cancelled due to unfortunate brutal incidents reported in the country at the very end of the year 2007.

UNU Symposium entitled "POPs: Global Transport, Best Environmental Practice, and Risk Perception" was held in November in Jakarta, Indonesia on 14 November, following the project meeting held on 13 November. More than 160 people attended the symposium from governments, academic institutes and business sectors, and very active discussions followed research and policy presentations given by invited international and Indonesian speakers. The concept of risk perception was introduced by Prof. Roland Scholz (ETH Zürich, Switzerland) as keynote speaker. His research results on people's risk perception on heavy metal contamination concluded that the illusion of controllability desensitizes risk perception of high exposed groups about their own risks. This seems to be applicable to other chemical pollutions including POPs contamination. The dioxin emission from forest fire was summarized by Dr. Mick Meyer (CSIRO, Australia). His presentation had many implications that are directly applicable to haze issues and dioxin emission from forest fire in Indonesia, which was recognized by comments from participants. Prof. Henning Schroll joined the project discussion at a project management meeting (closed event) to share his experiences to support academic activities in universities in the Asian region. The USEPAM project he is involved in, a DANIDA-supported project with AIT, University Support to Environmental Planning and Management for Viet Nam, LaoPDR, and Cambodia, has been completed recently. The project network could be shared with the UNU project in the coming years. More details are available at

<http://www.unu.edu/esd/manage/event/symposium2007.html>

Relevance to the APN CAPaBLE Programme and its Objectives

This part of the UNU's project is designed to develop scientific capacity sound chemical management in two emerging developing countries in South Asia. Acquiring domestic capability of measuring POPs is a basic step for policy-makers in developing countries in collecting data and taking actions to reduce POPs releases to the environment. All countermeasures planned for POPs reduction in agriculture, industries, and social infrastructures, without the capability to pinpoint where, how much, and which POPs are being released, would simply result in wasting resources which could be used to improve other aspects of sustainable development.

Self evaluation

The two trainees from Pakistan and India were given opportunities of chemical analysis training as well as access to academic information to which they cannot do so easily in their countries. The female trainee recently received Jawaharlal Nehru Fellowship to complete her Ph.D. course in recognition of her excellent academic records and experiences enhanced by joining the training. The Pakistani chemist is becoming one of the prominent organic chemists in the Pakistan Council of Research in Water and Resources which just recently opened its organic laboratory using the key instrument given by this UNU project. The symposium in Indonesia was attended by 160 participants up to the full capacity of the conference hall. POPs and risk perception presentation received more attention than expected, and the discussion following the presentations was very active. The feedbacks collected from the symposium participants in the form of surveys emphasized on the importance of such event held for the general public with strong interests in the related topics. The only point that could have been improved was to have another presentation on Best Environmental Practice for people who are not familiar with the concept adopted by the Stockholm Convention. This concept was introduced during the closing remark by the project leader by touching on haze issues as one of the critical regional environmental issues in Asia.

Potential for further work

Our project partners and trainees in India and Pakistan have learned analytical skills which were applied for collecting field data. Although a lack of well-trained human resources in the project partner institutes are an issue, these laboratories are expected to disseminate their monitoring data and function as regional centers of expertise on environmental pollutant analysis. The capacities built through this project will be highly expected to help their governments to implement their National Implementation Plans that will be submitted to the Stockholm Convention Secretariat.

As discussed in the symposium, the concept of risk is very primitive and has been subconsciously applied in many aspects of decision making for many years. However, the fact that risk perception of people on high and low risks could be distorted needs to be factored in when environmental policies are designed and implemented. Further policy monitoring and dissemination of effective application of risk perception/communication would help Asian countries to sharpen their implementation strategies of related policies.

Publications

UNU Symposium Proceedings, "POPs: Global Transport, Best Environmental Practice, and Risk Perception" 2007. Electronic version available at <http://www.unu.edu/esd/manage/event/symposium2007.html>

Technical Report

Preface

The mission of the United Nations University (UNU) is to contribute, through research and capacity building, to efforts to resolve the pressing global problems that are the concern of the United Nations, its Peoples and Member States. This reports, as part of a UNU's project with 11 Asian countries involved, the results of its capacity development efforts for research institutes and scientists in India and Pakistan on chemical analysis of Persistent Organic Pollutants (POPs) regulated by the Stockholm Convention. Provision of the scientifically objective information is critical to refining risk perceptions of policy-makers and people in developing countries.

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Introduction

The Stockholm Convention entered into force on 17 May 2004. The first meeting of the Conference of the Parties (COP1) was held between 2-6 May 2005 in Uruguay. Since its adoption in 2001, the Stockholm Convention has equipped each participating country with important legal and financial mechanisms. These mechanisms have provided National Implementation Plans (NIPs) and raised public awareness necessary to implement sound chemical management. Most pesticides listed in the Convention have been already banned. Several unintentional by-products from anthropogenic activities such as polychlorinated dibenzo-p-dioxins and dibenzofurans are known to be declining in industrialized countries.

Some might argue that all use and production of the POPs (Persistent Organic Pollutants), such as DDT, registered in the Stockholm Convention should be prohibited. However, a global and very delicate balance between the two trade-off endpoints needs to be addressed. For example, impacts of ecological risks and biodiversity issues posed by the use of DDT must be considered against the human health risks that could be minimized with the use of DDT. Furthermore, recent scientific progress and consensus in the field of risk assessment indicate that pursuing zero risk is theoretically impossible and would require infinite costs. In this sense, the current legal and financial mechanisms set by the Stockholm Convention, which do not blindly prohibit all POPs, are very practical to reach global sound chemical management.

Methodology

In order to make the most of such Convention mechanisms, the challenges the Convention and its Parties are facing must be addressed with continuous and sustained effort. Above all, monitoring data, particularly in developing countries, is one of the most important yet deficient information in determining risk reduction measures and policies to take in those countries. Article 16 of the Stockholm Convention calls for an effectiveness evaluation of the Convention by 2008 and again with certain intervals afterward. The lack of monitoring data could disable or invalidate the evaluation results. The item 2(b) under Article 16 touches upon a gap existing between the required POPs monitoring technologies and developing countries' chemical analysis capabilities by mentioning "(Arrangements to provide comparable monitoring data) May be supplemented where necessary, taking into account the differences between regions and their capabilities to implement

monitoring activities." The international scientific community on POPs monitoring simply tends to rely on high resolution gas-chromatograph / mass spectrometry (HRGC/MS) as the analytical instrument of choice. The HRGC/MS has the capability to detect low concentrations in background samples. The map of background sample concentrations could therefore illustrate global contamination levels because the background samples by definition are not contaminated by local emission sources but long-range transported pollutants. However, due to the high price and maintenance costs of this instrument as well as required operation skills, HRGC/MS is not a realistic choice for most developing countries.

Nevertheless, in developing countries, there are contaminated areas and regions as a result of environmental mismanagement, including improper pesticide use, poor domestic/industrial waste management and indiscriminate disposal of stockpiles. Those with possible high risks are local residents, ecosystems living in the downstream of the pollutants' flow in the environment, and regional residents taking in the food originated from the polluted local areas. Monitoring POPs contaminations in these local areas is more important than the background monitoring in terms of promoting risk reduction policy development and consequently reducing risks for people living in developing countries. More accessible technologies for POPs chemical analysis are available for those countries. One of them is quadrupole GC/MS (GC/MS). Recent quadrupole GC/MS is very sensitive and easy to use that could help developing countries equipped with a very strong and reliable tool to understand the level of the POPs contamination.

Training

Two researchers from India and Pakistan were invited to POPs analysis training at the APEC Marine Environmental Training & Education Center (October 15-26, 2007), entitled "Analytical Chemistry of Agrochemicals in Environmental Safety" at the Korean Ocean Research and Development Institute (KORDI), Geoje island, Korea.

In order to follow up on the analytical skills acquired by the trainees, an expert from the UNU's project network, Prof. Mustafa Ali Mohd (University of Malaya, Malaysia) visited the Indian project partner's institute. Prof. Mustafa was invited as a lecturer at the National Level Training Workshop on Gas Chromatography Mass Spectrometry (GC-MS) in Environmental Analysis, January 22nd – 26th, 2008 hosted by the Indian project partner, Bharathidasan University, in Tiruchirappalli, India.

An expert visit to Pakistan was cancelled due to unfortunate brutal incidents reported in the country at the very end of the year 2007.

Symposiums

UNU Symposium entitled "POPs: Global Transport, Best Environmental Practice, and Risk Perception" was held in November in Jakarta, Indonesia on 14 November, following the project meeting held on 13 November. More than 160 people attended the symposium from governments, academic institutes and business sectors, and very active discussions followed research and policy presentations given by invited international and Indonesian speakers.

Results & Discussion

Training at KORDI, Geoje island, Korea

The two trainees from India and Pakistan joined the training at AMETEC hosted by KORDI with other 8 trainees. Other trainees were from China, Papua New Guinea, Thailand, Philippines, Vietnam, Russia and Singapore. The entire training scheduled

has been attached as an Appendix.

Several lectures were also given by guest researchers and supervisors between sampling and analysis exercise. The following topics were covered.

- Environment Sampling
- Evolution of Analytical Methods for Pesticides and Related Compounds
- Good Agriculture Practice- Case Studies
- QA & QC Concern in Environmental Analysis
- Analytical Laboratory Management
- Trend Monitoring for Agrochemicals and Other Related Products
- Agrochemical Pollution in Korea
- Data Interpretation—Basic Statistical Tools
- Chromatography- the Art (Science) of separations

The training schedule included a field study at Masan bay, one of the most contaminated sites in the Republic of Korea that become anaerobic during summer. It is the most industrialized area and has the population of about one million. The water sample was collected using ocean test equipments, and sediment sample was collected using Van Veen grab. A CTD (Conductivity, Temperature and Density) measuring unit was placed to detect the CTD in a particular location.

Quality assurance and control aspects have been focused for some countries particularly India and Pakistan as new project members. To ensure the quality of the analytical activities, quality control indicators such as blank tests, injection repeatability tests and standard addition recovery tests were conducted by all project members as necessary, and DDT-¹³C₁₂ cleanup spike recovery ratios have been checked with 70-130% as its acceptable range. One of the two internal standards, phenanthrene-d₁₀ and chrysene-d₁₂, were chosen for the quantification of each POPs depending on its GC elution time. To determine instrument detection limit (IDL), five to eight times injections for the injection repeatability test were recommended. The number of repetition determines the coefficient to use in calculating detection limits, as can be seen below. $IDL = t(n-1, 0.01) \times \sigma$, where $t(n-1, 0.01)$ is a value of t-distribution at $\sigma = 0.01$ for one tail. More details are described in the UNU Project Quality Assurance Document.

Expert visit to India

Prof. Mustafa Ali Mohd travelled to Bharathidasan University to provide on-site support on chemical analysis for POPs using the project equipment, Shimadzu GC/MS QP-2010.

He was also invited to the opening ceremony of the National level training workshop on Gas chromatography-Mass spectrometry (GC/MS) in Environmental Analysis (TWOGAME'08) at the main auditorium of the Bharathidasan University. The opening was ceremonially done by the Registrar of Bharathidasan University Prof. Mustafa presented "Endocrine Disruptor Compounds with respect to environmental pollutants and contaminations." The talk covers the contamination of POPS as endocrine disrupting chemicals and their harmful effects on human and wild life. This also covers some new emerging POPS such flame retardants and PFOS. The talk was followed by Question and answer session, with several questions posed by the participants.



Part of the audience in the auditorium

Photo provided by Prof. Mustafa Ali Mohd (University of Malaya, Malaysia)

His second talk was given on “Analytical techniques for analysis of environmental pollutants and contaminants” This talk covered the introduction and the basics of some analytical techniques used to measure POPs in the environment with special emphasis on the use of GC/MS. The principles involved in GC/MS measurement are discussed and explained clearly with proper and appropriate diagrams. The question and answer session at the end of the talk received many questions.

He also gave a talk at the Department of Pharmaceutical technology, Anna University, Tiruchirapalli to about 100 academic staff and the students on “Traditional medicines: is there a need for a paradigm shift?”. After the talk, a discussion session was held with the academic staff and the Registrar on the subject matter.



Talk at Periyar College of Pharmaceutical Sciences for girls.

Photo provided by Prof. Mustafa Ali Mohd (University of Malaya, Malaysia)

Symposiums (<http://www.unu.edu/esd/manage/event/symposium2007.html>)

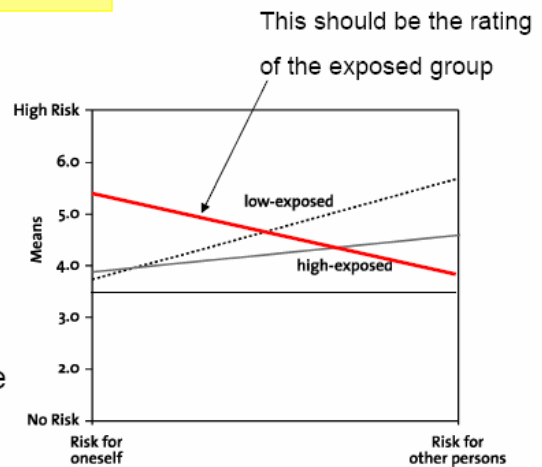
The symposium in Indonesia was opened by Mr. Arief Yuwono, the Executive Secretary of the Indonesian Ministry of State for Environment. It was attended by 160 participants at the conference hall's full capacity. POPs and risk perception presentation received more attention than expected, and the discussion following the presentations was very active. The feedbacks collected from the symposium participants in the form of surveys emphasized on the importance of such event held for the general public with strong interests in the related topics. The only point that could have been improved was to have another presentation on Best Environmental Practice for people who are not familiar with the concept adopted by the Stockholm Convention. This concept was introduced during the closing remark by the project leader by touching on haze issues as one of the critical regional environmental issues in Asia. Some of the presentations are highlighted below.

The concept of risk perception was introduced by Prof. Roland Scholz (ETH Zürich, Switzerland) as keynote speaker. His presentation title was "Low Risks, High Public Concern? – The Cases of Persistent Organic Pollutants (POPs), Heavy Metals, and Nanotech Particles." Introducing risk assessment concepts, he argued the concept of risk is very primitive, and risk judgement should be made by two main variants: losses/gains and the probability of their occurrence. However, his research results on people's risk perception on heavy metal contamination concluded that the illusion of controllability desensitizes risk perception of high exposed groups about their own risks. This seems to be applicable for other chemical pollutions including POPs contamination.

The Cases – Heavy Metals Risk Perception

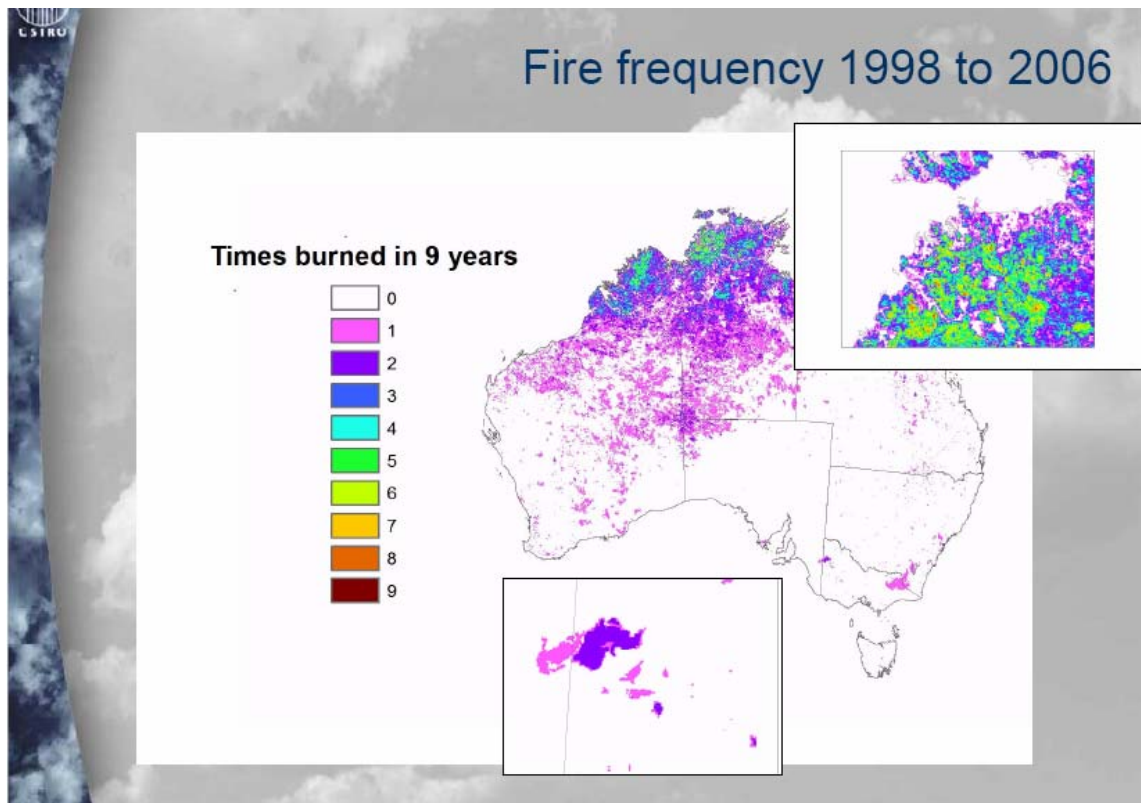
Critical questions investigated:

- Is the risk of heavy metals appropriately perceived?
- What characteristics are linked with heavy metals?
- How does the judgment of people concerned differ from the judgment non-concerned people?
- When do people become very sensitive?



Presentation Slide provided by Prof. Roland Scholz (ETH Zürich, Switzerland)

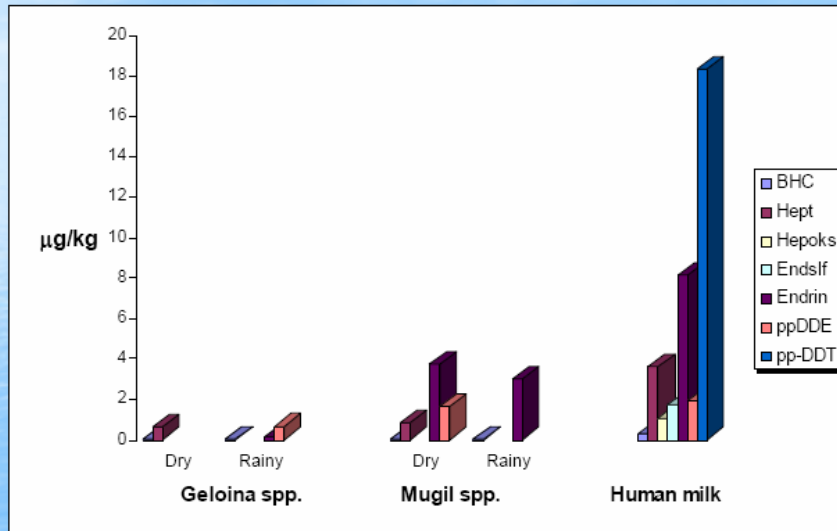
The dioxin emission analysis from forest fire in Australia was summarized by Dr. Mick Meyer (CSIRO, Australia). His presentation title was "Measurement of Dioxin Emissions from Bushfires in Australia." His research presentation guided the audience through a scientific process to understand bushfire impacts to the global environment. Basic understanding of forest / bush fire characteristics could be applied to estimate CO₂ emission, haze issues and dioxin emission from forest fire in Indonesia and other Asian countries, which was also recognized by comments from participants.



Presentation Slide provided by Dr. Mick Meyer (CSIRO, Australia)

Prof. Sri Noegrohati (Gadjah Mada University, Indonesia), as one of the local speakers invited to the symposium, presented her research results, entitled "Organochlorines Dynamics in Indonesian Tropical Climate – A Study in Segara Anakan Estuarine." Although all detected levels have been decreased, she concluded that p,p'-DDT is still detected from human milk at a level where further monitoring is necessary for risk assessment.

POPs Concentrations in local mussels, seawater spawning fishes and human milk



Ratio to estuarine water:

4 to 75

15 to 350

175 to 2976

Presentation Slide given by Prof. Sri Noegrohati (Gadjah Mada University, Indonesia)

Other presentation slides shown in the symposium are attached to this report as Appendices.



Symposium participant joining the panel discussion

Prof. Henning Schroll (Roskilde University, Denmark) joined the project management meeting held one day before the symposium. He shared his experiences to support academic activities in universities in the Asian region. The USEPAM project he is involved in, a DANIDA-supported project with AIT (Asian Institute of Technology), University Support to Environmental Planning And Management for Viet Nam, LaoPDR, and Cambodia, has been completed recently. The project network could be shared with the UNU project in the coming years.

Conclusions

The main objectives of the funded project were (1) to provide a basic training necessary for scientists in India and Pakistan to initiate their own capacity development efforts to acquire POPs analysis capability, and (2) to disseminate the latest POPs status in Asia using project results and refine risk perceptions of policy-makers and people in Asia.

The training and expert's on-site support funded by APN helped the project partners in India and Pakistan equipped with better analytical training skills of POPs in their initial period of starting-up their own POPs laboratories.

The two trainees from Pakistan and India were given opportunities of chemical analysis training as well as access to academic information to which they cannot do so easily in their countries. The female trainee recently received Jawaharlal Nehru Fellowship to complete her Ph.D. course in recognition of her excellent academic records and experiences enhanced by joining the training. The Pakistani chemist is becoming one of the prominent organic chemists in the Pakistan Council of Research in Water and Resources which just recently opened its organic laboratory using the key instrument given by this UNU project.

Those trainees are now key chemical analysts in their divisions and will contribute to collecting POPs monitoring data on aquatic organisms funded by UNU this year.

The symposium in Indonesia was attended by 160 participants up to the full capacity of the conference hall. POPs and risk perception presentation received more attention than expected, and the discussion following the presentations was very active. The feedbacks collected from the symposium participants in the form of surveys emphasized on the importance of such event held for the general public with strong interests in the related topics.

The only point that could have been improved was to have another presentation on Best Environmental Practice for people who are not familiar with the concept adopted by the Stockholm Convention. This concept was, however, introduced during the closing remark by the project leader by touching on haze issues as one of the critical regional environmental issues in Asia.

Regarding the outcome of this risk perception aspects to be reflected in POPs management policy, UNU will follow up on the Indonesian National Implementation Plan (NIP) for the Stockholm Convention by joining UNIDO's efforts on East-South East Asia Regional Forum on BAT/BEP (<http://www.unido.org/en/doc/69220>). Indonesian NIP is currently being drafted and will be uploaded to the Stockholm Convention website (<http://www.pops.int/documents/implementation/nips/submissions/default.htm>) as soon as it's finalized.

Future Directions

Our project partners and trainees in India and Pakistan have learned analytical skills which will be applied for collecting field data. Although a lack of well-trained human resources in the project partner institutes are an issue, these laboratories

are expected to disseminate their monitoring data and function as regional centers of expertise on environmental pollutant analysis. The capacities built through this project will be highly expected to help their governments to implement their National Implementation Plans that will be submitted to the Stockholm Convention Secretariat.

As discussed in the symposium, the concept of risk is very primitive and has been subconsciously applied in many aspects of decision making for many years. However, the fact that risk perception of people on high and low risks could be distorted needs to be factored in when environmental policies are designed and implemented. Further policy monitoring and dissemination of effective application of risk perception/communication would help Asian countries to sharpen their implementation strategies of related policies.

References

UNU Symposium Proceedings, "POPs: Global Transport, Best Environmental Practice, and Risk Perception" 2007. The electronic version is also available at <http://www.unu.edu/esd/manage/event/symposium2007.html>

Fukuya Iino, Zita Sebesvari, Fabrice Renaud, Takaharu Kitsuwa, Masatoshi Morita, Yasuyuki Shibata, Huang Yeru, Babu Rajendran Ramaswamy, Halimah Syafrul, Won Joon Shim, Mustafa Ali Mohd, Muhammad Aslam Tahir, Evangeline Santiago, Monthip Sriratana Tabucanon, Hian Kee Lee, Pham Hung Viet, "POPS ANALYSIS CAPACITY DEVELOPMENT AND MONITORING IN 10 ASIAN COUNTRIES ", Dioxin 2008 Proceeding, Submitted. <http://www.dioxin2008.org/>

Appendices

Conferences/Symposia/Workshops
AMETEC Training Schedule

UNU Symposium Proceedings, "POPs: Global Transport, Best Environmental Practice, and Risk Perception" 2007.

Funding sources outside the APN

Training provided by APEC Marine Environmental Training & Education Center (October 15-26, 2007), entitled "Analytical Chemistry of Agrochemicals in Environmental Safety" at KORDI, Geoje island, Korea.