Emission Inventories for Smaller Cities in South-East Asia

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Background

Emission inventories (EI) are the basis for air quality management. They should identify the most important sources to be tackled in an air quality management programme, set priorities for improvement measures and should allow for sensitivity analysis of measures to be taken.

Most EI carried out in Asia with the help of donors are called "simple" by their authors, meaning a top-down approach derived from fuel consumption estimates. They contain a lot of uncertainties and show a considerable risk of double counting and overlap. They are usually not able to model individual measures at project level, i.e. closing roads, diverting traffic, switching from individual to public transport, etc.

The German technical cooperation financed by the German Federal Ministry for Economic Cooperation and Development (BMZ) through the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH promotes, among other activities, the development of EI in smaller cities in the ASEAN[2] region, using a bottom-up approach. This is part of the ASEAN-German Technical Cooperation Programme “Cities, Environment and Transport” (CET) and in particular of the programme module “Clean Air for Smaller Cities” (CASC). The module empowers smaller and medium-sized cities in the ASEAN region to develop and implement Clean Air Plans (CAP), in order to improve air quality. A smaller city in Asia is of different dimension than in Europe. The sizes of the 8-10 cities for which clean air plans shall be developed vary between 150,000 and 1.5 mill. inhabitants.

EI have been established already in 6 cities: Chiang Mai and Nakhon Ratchasima in Thailand, Surakarta (Solo) and Palembang in Indonesia, Cagayan de Oro and Iloilo in the Philippines. Work is under progress in Melaka/Malaysia, Vientiane/Lao PDR, and Bac Ninh in Vietnam. The first cities to develop EI’s were in Thailand which also hosts the regional Programme CET.

Emission inventory development

The basic idea for the EI development was to create ownership in the cities. It was clear from the beginning that expertise in the city administrations as well as with consultants was limited. But instead of contracting international consulting firms the project management decided to develop the capacities in the city administrations and with the local and national universities.

A time consuming approach! But it was worth it. Our international experts mostly from Germany were only involved in establishment of the workplan at the beginning, training of experts in the basics of EI and the application of tools, and quality control and assurance during the EI development process and in the final stages of the EI. Each of the universities involved nominated a team of experts and employed students as data collectors. The project co-financed the work, although considerable contributions were provided by the university institutes and their students free of charge. In most cases, several loops were necessary until the EIs were technically acceptable to form the input for CAPs.

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[2] Association of South East Asian Nations: Brunei, Cambodia, Indonesia, Laos PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam

The elements of our EI's

Our EI take into consideration the usual sources: Mobile (road and non-road), stationary and area sources. The mobile road sources were calculated by MOBILEV, using the Handbook Emission Factors[3] (HBEF), stationary sources where either based on CORINAIR, partly adopted to local circumstances, or nationally available emission factors (EF), if available. Thailand and the Philippines, for example, had undertaken considerable efforts to develop EF for motorcycles and jeepneys[4], respectively. For area sources, the participating universities mostly send out survey teams to collect activity rates for road-side cooking, local vehicle panel beating and paint shops, soldieries, bakeries and other relevant small sources. EF were either used from own scientific sources of the universities or internationally available sources.

The process of EI development

The project organised initial training-cum-planning workshops after the teams were formed in each city. During three to four days, representatives of each city administration and local universities were trained in EI in general and in the use of MOBILEV and CORINAIR, followed by the workplan development. The qualification and experience of the lecturers varied considerably. Most of the participants were engineers, chemists or physicists, but hardly any of them has ever been involved in EI development.

It was a cumbersome but fruitful process. Although the workplan was quite detailed, a considerable amount of time of our international short-term experts had to be invested in accompanying the works. The advantage was that only two cities were involved at the beginning, Chiang Mai and Nakhon Ratchasima in Thailand. They played the role-models. By supporting them through our international experts, they gained the experience to even train their colleagues from other universities in other countries, who joined in the project and started to develop their own inventories after about 6 months after the Thai experts started to work. Meanwhile, the regional experts' network consists of some 15, mostly university lecturers, of which at least three can easily run MOBILEV, understand the complexity of the HBEF and can train other experts in its application.

Some results

As widely expected the overwhelming source of particulate emissions is transport and in particular from pick-up trucks which operate both as passenger and freight carrying vehicles. SO_2 is rather emitted by area sources through cooking with charcoal than by industries since they usually do not play a major role in smaller cities (with some exceptions).

When the results were presented to mayors of the participating cities, it created already an immediate interest to act. It remains to see, how fast and, if at all, the cities implement the measures defined in the CAPs, based on the EI. The project is still around until end of 2015 to support implementation of the plans.

Benefits and lessons learnt

The project created for the first time in ASEAN a harmonised approach which makes EI comparable between cities in SEA. The bottom-up approach used here allows a more precise estimate of pollution loads than the usual top-down approaches. It also allows the simulation of emission loads for different measures taken to reduce air pollution. Combined with a transport model it can calculate different total emission releases for different measures or bundles of measures. But it could be used to quickly calculate emissions from different scenarios, if a transport model is not available.

[3] Infras: Handbook Emission Factors for Road Transport 3.1

[4] Jeepneys are a very widespread mode of public transport in the Philippines, which look like an extended version of an American jeep for some 25 passengers.

The project has created a network of EI experts in universities, mostly lecturers, who have started to integrate EI and air quality management in their curricula. Students are exposed to new topics and practical work when participating in data collection and evaluation.

Of course, the EI developed show deficiencies, mainly due to lack of sufficient input data from traffic counts or activity rates. They have been made transparent, thus, research work or data collection may be extended for up-dates of the EF. Also, sources have been identified which further need research on their EF.

Although, the approach was time consuming compared to contracting of international consulting firms (in some cases more than 18 months were needed to come up with the first results) but it resulted in a high ownership of the approach and the results by the municipalities and universities.