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Impact of pesticide use by smallholder farmers on water quality in the Wakiso district, Uganda

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As in many tropical countries, farmers of the Wakiso district rely on heavy use of pesticides to protect crops and animals. This may impair human and environmental health due to poor application techniques, misuse of pesticide bins or pesticide losses from the treated fields during intense tropical rainstorms.
The extent of pollution in different environmental compartments and effects on humans however, are generally only poorly documented. The same holds true for quantitative data on the relevance of different transport pathways of pesticides into the environment. Part of the limited knowledge is caused by the demanding sampling and analytical techniques that are necessary to obtain robust data on the actual pollution status. Especially in surface waters, pesticide concentration may vary rapidly in time such that grab samples may yield a very incomplete picture. This incompleteness was often enhanced because of limited analytical windows that covered only a small fraction of the pesticides actually used.
In this presentation, we describe an approach to overcome these limitations to a large extent by using three different passive sampling devices and two broad analytical techniques (GC-MS/MS, LC HR-MS). It allows the quantification of about 230 different pesticides. We will present how these approaches are implemented in the catchment area of the Wakiso district in Uganda. This area is intensively used by smallholder farmers who grow a large set of different crops. Diffuse losses are expected to occur mainly during the two rainy seasons (March to May and September to November). Accordingly, the study focus on this situation. A pilot study took place in March 2017. The main campaign for data collection was done from September to December 2017.
The water body analyzed in this study were the rivers and also the drinking water sources (springs, ponds and boreholes). The samples were taken in 5 sampling points in the rivers during 10 weeks with two-weeks exposure intervals. In order to have relevant results the drinking water sources were investigated twice during the pilot and three times during the main campaign. The first results from the pilot showed that up to 40 different pesticides were found in a drinking fetch ponds. In the river, up to 18 different pesticides were detected including. 2,4-D, acetamiprid, chlorpyriphos and atrazine.
During the main campaign, a survey with farmer was carried out. In the last 12 months, Glyphosate (55%) was the most used compound by the 298 participants. Cypermethrin (41.6%), mancozeb (38.3%), profenofos (33.9%) and 2,4-D (32.8%) were used at least once during the last year.

Rain data were collected daily during the 10 weeks of the campaign. First analysis show a wide distribution of the rain across the studied area. The flow and the water level of the rivers lead to the same conclusion, hence the concentration pattern of pesticides can also be related to this spatial distribution.