Yield gap monitoring: Opportunities for crowdsourcing approaches to collect farm level data for yield gap analysis

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Background
The world population is anticipated to reach 9.1 billion in 2050 and the challenge is how to feed this huge number of people without affecting other natural ecosystems. Different approaches have been proposed and closing the “yield gap” on currently available agricultural lands is one of them. Estimating the magnitude of the yield gap is the first step, but especially relevant is to reveal the underlying explanatory factors contributing to the yield gap. Identifying the factors which explained most of the yield gap in a specific location helps to provide recommendations on how to close the yield gap and increase productivity in a sustainable way. However, for a detailed analysis it is required to get an overview of the factors which need to be collected and considered for estimating and explaining the yield gap.

Objective
This research has the aim to assess data availability and gaps for global yield gap analysis. To address this objective the following objectives will be addressed:
• To provide an overview of the most considered and explaining factors for yield gap analysis
• To investigate regional similarities or differences for commonly considered and explained factors in yield gap analysis
• To identify the most common data sources for different factors considered
• To determine if data sources vary in the different regions

Methodology
A meta-analysis of 50 scientific papers about yield gap analysis at different scales has been performed. For each study the geographic coordinates of the study locations were recorded. Next, the considered and explaining factors for the yield gap were divided in four categories: edaphic, management, farm characteristics and socio-economic. All data were stored in a database. The count a factor was considered and the count it explained the yield gap when it was considered were used to calculate the considered and explaining percentage for a specific factor.

Results: Considered and explaining factors

Spatial distribution of considered and explaining factors
The edaphic factors are mainly important to explain the yield gap in Africa whereas the management factors are more important to explain the yield gap in Asia (Figure 4: left). Yield gap analysis studies from the different parts of the world considered edaphic, management and farm characteristics factors whereas socio-economic factors were mainly considered in Africa and Asia (Figure 4: right).

Figure 4: The top five factors for the four categories which explained much of the yield gap (left) and factors which were considered to estimate and explain the yield gap (right) and their spatial distribution.

Crop specific explaining factors in the different regions

Discussion and conclusions
• Most studies concentrate on considering factors from one or two categories (Figure 1). The reason for the less consideration of a specific factor for explaining the yield gap might be lack of availability of data. This information gap could be filled using bottom-up data collection approaches like crowdsourcing which might help to collect more of the explanatory factors at the farm level
• The results of this study show as the different factors from the edaphic, management, farm characteristics and socio-economic categories need to be collected for estimating and explaining yield gaps
• Explaining factors are clearly spatial explicit (Figure 5) and thus region specific approaches for data acquisition could be considered

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Figure 5. Location of some of the studies and the major crops considered during the analysis. The bar graphs show the most important explaining factors for a specific crop in a specific location.