Preface

Nutrients in phosphorus (P) fertilizer which are completely (100 %) utilized by crop plants without (Zero) contaminating the soil with environmentally relevant substances is a future concept for P fertilization in agriculture. P scarcity is one of the major challenges for agriculture in the near future. The waste of the nonrenewable resource P, which is mainly consumed for fertilization is of major concern for a sustainable development and there is no doubt that P fertilization strategies require significant advances towards sustainability. Pessimistic assessments see world P reserves last only for another 50–150 years. In industrial countries agriculture uses more P for fertilization than it exports with agricultural products. Some uncertainty in practical P fertilization derives from the fact that there are no experimental means to estimate the true long-term utilization of fertilizer P. The traditional concepts (differential and radioisotope method) suggest that on an average only 75 % of the fertilizer P applied is finally used by plants, implicating that always more P has to be fertilized than will be recovered by agricultural products. Next to P scarcity, excessive P loads on soils with intensive livestock farming and use of P sources, which are not completely available for plant result inevitably in a dissipation of this nonrenewable resource. Yet, another problem is the guidelines for site-specific P fertilizer recommendations in relation to land use systems.

The breakthrough towards an understanding for the prerequisites for a complete P utilization and thus also a complete recycling of fertilizer P came with an empirical approach published in 1965 by the Finnish scientist Armi Kaila (1920–2003), for which the term "apparent utilization" has been coined. Based on Kaila's hypothesis, P fertilization concepts can be designed, which warrant a full utilization of fertilizer P in agriculture. This book agglomerates the basic knowledge required to target a 100 % P utilization which comprises the basic concept of "apparent utilization", the fundamental principles of P turnover in soils and plants, the evaluation of the P nutritional status, and characteristics of fertilizers and fertilization concepts whereby the latter is addressed on national level.

Second to the goal of a 100 % utilization of fertilizer P is the objective to avoid or at least to limit the soil contamination and accumulation of hazardous inorganic

and organic substances coming with the various types of P fertilizers. What seems like cutting the Gordian knot may be a challenge for future development in fertilizer manufacturing technology, energy neutral P fertilizer production using high-temperature nuclear reactors, where the energy required to make a clean fertilizer comes with the raw material.

Last but not least, this book addresses one of the first not only basic issues of sustainability of P fertilization but also its socio-economic aspects and proposed governance instruments.

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