

Table of Contents

Tables and figures	5
List of acronyms	6
Glossary.....	7
Summary	10
Zusammenfassung	15
1 General introduction	21
1.1 Societal and scientific relevance of the topic.....	21
1.2 Research needs.....	25
1.3 Subject and aim of the work.....	26
2 Method.....	28
3 State of knowledge – science, applications, and practical adoption	31
3.1 Challenges of farm management and decision support of farms – application potentials of digital systems	31
3.1.1 Technical support for farm management	31
3.1.2 Decision support systems (DSS) for management.....	33
3.1.3 DSS in agriculture	35
3.1.4 Evaluation of available DSS.....	41
3.1.5 Data networking in agriculture.....	42
3.1.6 Conclusion and evaluation	43
3.2 Challenges in nutrient management.....	45
3.2.1 Complex nutrient and data flows.....	45
3.2.2 Nutrient budgeting.....	47
3.2.3 Technical and technological developments	50
3.2.4 Necessity for system optimization.....	51

3.2.5 Conclusion and evaluation	52
3.3 Digital solutions for nutrient management	53
3.3.1 Digital systems for nutrient management.....	53
3.3.2 Interconnection of the systems and data	55
3.3.3 DSS for nutrient management.....	56
3.3.4 Data sovereignty and data security.....	58
3.3.5 Conclusion and evaluation	60
4 Publications	64
4.1 Conceptual Design of a Comprehensive Farm Nitrogen Management System.....	64
4.2 A Digital Advisor Twin for Crop Nitrogen Management	66
5 General discussion	68
5.1 Data networking to empower management decisions.....	68
5.1.1 Data networking on the farm	68
5.1.2 Widening the system boundaries of future nutrient management	70
5.2 Definition and introduction of a Regional Nutrient Management System (RNMS).....	72
5.2.1 System context and concept introduction	72
5.2.2 Technical requirements for a RNMS	76
5.2.3 Architecture of a RNMS	79
5.2.4 Cross-system nutrient management through a data space for agriculture	80
5.2.5 Data interlinking in agricultural value chains.....	85
5.2.6 Data interlinking in regional nutrient cycles and at the landscape level.....	88
5.3 Data-based decision support for nutrient management.....	95
5.3.1 Requirements for a DSS	95
5.3.2 Example of a DSS in organic farming	99
5.4 DSS and the practiced implementation of the decision – the human factor.....	102

6 Conclusion and outlook	106
7 References	109
8 Appendix.....	130
A. Acknowledgement	131
B. Academic Curriculum Vitae	132
C. Publication Reprints	134
Conceptual Design of a Comprehensive Farm Nitrogen Management System	135
A Digital Advisor Twin for Crop Nitrogen Management	160

Fabian Norbert Weckesser
Methodological Principles and Framework for the Development of Digital Nutrient Management
Systems on Farm and Landscape Levels
2024 / 184 Seiten / 19x27cm / 34,95 € / ISBN 978-3-96831-046-6

Gender note: The simultaneous use of the language forms male, female, and diverse (m/f/d) was omitted for better readability. All personal designations apply equally to all genders.