9 **Sustainable access to rural and urban land by integrating local perspectives**

The potential of using Information and Communication Technologies

Juan Miguel Rodriguez Lopez, Katharina Heider, Andrea L. Balbo, and Jürgen Scheffran

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Table of Contents

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Abstract

With fast growing human populations over the past decades, access to land has become an increasingly pressing issue. This is the case in urban as well as in rural spaces, and across both emergent and established economies. In this context, the management of land use and land ownerships, formal as well as informal, is of primary importance. Specifically, the balanced partition of land between public space (commonalities) and private property plays a key role in the achievement of sustainable land access policies. In this study, we explore the potential of Information and Communication Technologies (ICT) to promote stakeholder participation and achieve sustainable access to land. Based on research in two case study areas, we show that transdisciplinary ICT-based tools can help us and the local stakeholders to identify specific needs, capabilities and potentials, to analyze emergent patterns and to support the development of place-specific sustainable development strategies.

KEYWORDS: *Rural-urban spaces, sustainable access, participatory approach, Geographic Information Systems (GIS).*

Introduction

Based on our research experience in urban and rural contexts, in established as well as in emergent economies, we here advocate the potential of using Information and Communication Technologies (ICT) to promote stakeholder participation in the definition of innovative regulations for the access to land (Figure 1, Table 1). Our experience focuses on the use of Geographic Information Systems (GIS), which have become ubiquitous across the public and private sectors over the past two decades (Brown 2015; Garson 2003; Janssen 2017). Furthermore, we focus here on Volunteered Geographic Information (VGI) as a tool to promote participatory land use planning and monitoring to integrate the local perspective. The overarching scientific question for our research is how to use ICT to achieve a sustainable access to land. We examine two case studies where the access to and use of land is problematic.

In the following, we examine two case studies where the access to and use of land is problematic. The first case study is located in a conservation zone in the south of Mexico City. Here, informal urbanization is a major issue for urban as well as for ecological planning. This example links directly to the Sustainable Development Goal (SDG) 11: "Make cities and human settlements inclusive, safe, resilient and sustainable". In particular, it deals with a lack of inclusive and sustainable urbanization as well as a lack of participatory, integrated, and sustainable human settlement planning and management. Furthermore, safe, inclusive and accessible, green and public spaces are endangered by informal urbanization and its consequences (Table 1).

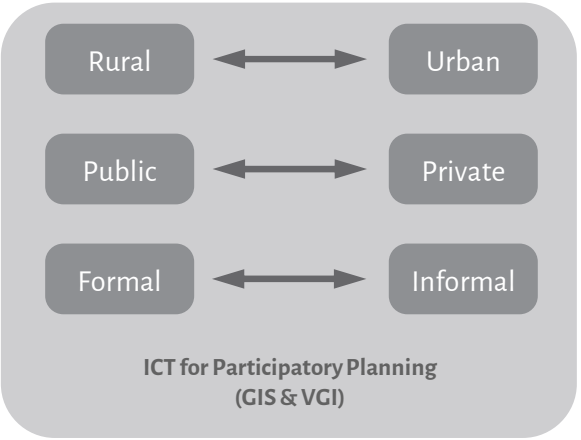

Figure 1: Contrasting tensions in access to land.

Sustainable Development Goal	Targets
2: End hunger, achieve food security and improved nutrition, and promote sustainable agriculture	2.3. By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists, and fishers, including through secure and equal access to land, other productive resources, and inputs, knowledge, financial services, markets, and opportunities for value addition and non-farm employment. 2.4. By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding, and other disasters and that progressively improve land and soil quality.
11: Make cities and human settlements inclusive, safe, resilient and sustainable	11.1. By 2030, ensure access for all to adequate, safe, and affordable housing and basic services and upgrade slums. 11.3. By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated, and sustainable human settlement planning and management in all countries. 11.7. By 2030, provide universal access to safe, inclusive, and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities.

Table 1: Sustainable Development Goals 2, 11, and specific targets. Source: UN 2017

The second case study represents an example from a rural area. This area is located in Ricote in the southeast of Spain. Here, the fragmentation of private agricultural parcels is problematic for sustainable and efficient land use. This example is connected to SDG 2, in particular to the promotion of sustainable agriculture and the target to double the agricultural productivity and incomes of small-scale food producers through secure and equal access to land and sustainable food production systems (Table 1).

Integrating local perspectives in two case studies

Case study 1: Informal urbanization in the conservation zone of Mexico City

In our first case study, we investigate informal urbanization in the conservation zone in the southern part of Mexico City (Heider et al. 2018a; Rodriguez Lopez et al. 2015, 2017a, 2017b). In Mexico, most of the population lives in cities with 80 % urban population (United Nations Population Division 2017). Informal settlements and poor neighborhoods comprise a large part of the newly built-up area (Rodriguez Lopez et al. 2017a). The aim of this part of the analysis is a comprehensive, robust, and valid research of urban dynamics as well as the examination of potential opportunities and future scenarios in both ecological and social aspects.

We propose an evaluated multi-method approach to better understand urbanization dynamics combining data provided voluntarily by individuals (VGI) as well as satellite data and official data (Figure 2, Rodriguez Lopez et al. 2017a, b). We use two forms of VGI in our studies: First, VGI in the form of complaints about informal settlements in Mexico City (Heider et al. 2018a; Rodriguez Lopez et al. 2017a) and second, OpenStreetMap data (Heider et al. 2018a). We describe this approach as a combination of human and remote sensing (Rodriguez Lopez et al. 2017a). Using this data, we perform a hot spot analysis of informal urbanization. The use of human sensing data allows the integration of local perspectives. Remote and human sensing are presented as important new sources of information, but several practical questions arise about the trustworthiness of these sources, which we address in more detail in our articles (Heider et al. 2018a; Rodriguez Lopez et al. 2017a).

The most important results of this case study in terms of a sustainable access to land and a sustainable management of property rights are: 1) Human and remote sensing data work well together and human sensing data can be used to integrate a local perspective promoting integrative management options (Heider et al. 2018a; Rodriguez Lopez et al. 2017a). 2) The main urbanization hot spots are found near the border of the conservation zone of Mexico City. 3) There is a strong correlation between the occurrence of informal urbanization hot spots and socioeconomic factors (Rodriguez Lopez et al. 2017a). 4) Access by roads from and to the city center is likely to be a major factor for informal urbanization in the conservation zone (Heider et al. 2018a).

It was necessary to investigate the driving forces behind this urban growth that usually leads to the loss of ecological areas in the urban periphery. In these places, low-carbon urbanization could be an important mitigation strategy. For example, the monetary compensation for mitigating emissions could create an opportunity for the

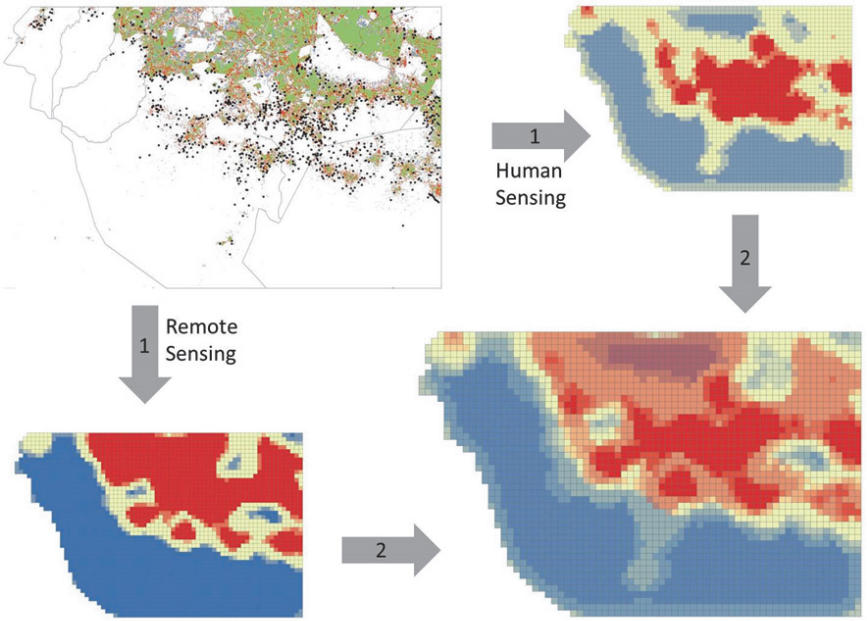

Figure 2: We combine information on urbanization from remote sensing (red pixels, map above left) and information on informal settlements from human sensing (black points, map above left) to detect informal urbanization patterns (steps 1 and 2) in a framework of hot spot-analysis Source: Source: Rodriguez et al. 2017a.

local population by empowering them with an asset of clear property rights and land distribution. In any case, it is a possibility and, at the same time, a risk for informal settlers to make use of their rights to achieve a life in dignity.

Our policy proposals are committed to an inclusive development towards sustainable urbanization, integrated planning. This includes the provision of green spaces and the mitigation of emissions (Table 1). In this context, it is fundamental for policy makers to understand the process of informal urbanization in order to manage this urban expansion. No solution for informal urbanization can be found without meeting the needs of the poor. As long as no affordable living space for the poor is available, informal settlements will continue to grow. Regarding urban planning, we argue that informal urbanization hot spots occur mainly close to major roads that enable access to the city or near existing settlements. Therefore, building social housing far away from the city and from jobs without proper public transportation (as happened in the past, see Connolly 2009) will not solve the problem of informal urbanization in the conservation zone.

Mexico City represents a case study area, in which similar characteristics are present that can be applied to other medium to large cities in developing countries in the coming years. These urban spaces represent a possible future for the urbanization processes in Africa and Asia since the urbanization rate in many cities of both continents is likely to increase rapidly (Davis 2004, UN-HABITAT, 2003, 2012a, 2012b, 2016). The proposed method could be readily used in these regions as well. However, there is a limitation concerning the existence of human sensing information in the form of georeferenced data on conflicts across different scales. Remote sensing data is available for a large number of countries and years, and although it is not always available free of charge, access to this data has become easier. Moreover, this research provides opportunities for the application of new forms of "big data" such as microblogging (e. g. Twitter).

Case study 2: Land fragmentation of historical field systems in Ricote, SE Spain

The second case study has a distinct rural perspective. Here, we focus on the excessive land fragmentation of historical field systems in Ricote, southeast Spain. One of the major issues affecting efficiency in communities of small farmers is the high fragmentation of agricultural land properties and the Valley of Ricote is a typical case for smallholder farming in highly fragmented traditional field systems in the Mediterranean region.

Although the clear definition of property rights is one of the most prominent solutions to the tragedy of commons (Hardin 1968, 1989), privatization can lead to high property partition due to heritages. This is problematic for overall efficiency as higher fragmentation of properties leads to increased transaction costs (Williamson 1981), for example, in the form of required infrastructure or distances that need to be traveled. In other words, if unregulated, the property rights solution for the tragedy of commons could generate a tragedy of property, similar to the "tragedy of the anticommons", which leads to non-use instead of over-use in the case of the tragedy of commons (Heider et al. 2018b; Heller 1998).

In this case, we apply a more transdisciplinary approach in southeast Spain including local stakeholders to address a sustainable social ecological system (Eriksson et al. 2014). The advantages of this approach concern the quality and durability of research (Reed 2008). Participation of local stakeholders encourages the success of the decisions made and promotes new forms of cooperative work (Richards et al. 2004, Stringer et al. 2006), which is a central goal of the project. This project should be seen

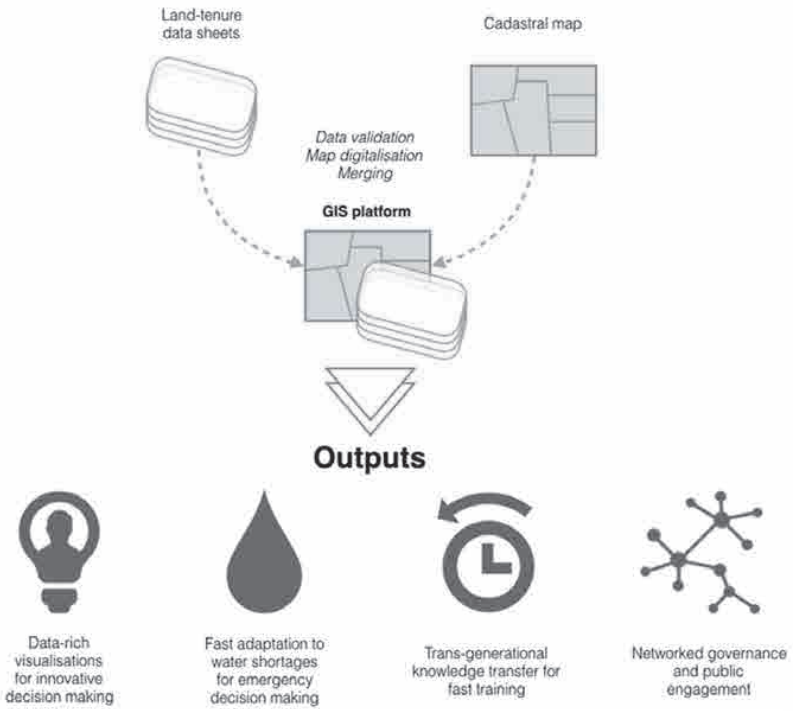

Figure 3: The concept of the GIS platform. Source: Heider et al. 2018b; icon credit: the Noun Project.

as a result of co-design of researchers with local stakeholders in order to understand the needs of the community, exchange knowledge, integrate local expertise, cooperate, and create acceptance for place-based sustainable solutions (Levidow et al. 2014; Reynolds et al. 2014; Scheffran and Stoll-Kleemann, 2003).

A science and stakeholder meeting took place in June 2017 in Ricote as a part of the stakeholder dialogue, on which we have relied on since the beginning of our research in this area in 2010. Members of the Irrigators' Community, politicians, and farmers of Ricote represented the core of the stakeholder group. After defining the priorities and possible pathways for sustainable development with local stakeholders, we introduced a GIS platform (Figure 3) as an interactive map for the community of Ricote (Heider et al. 2018b). The introduction of free and open source digital mapping technologies is suggested to alter efficiency in agriculture enabling in-house experimentation and implementation (Janssen et al. 2017; Wolfert et al. 2017). Moreover, one of the needs highlighted by the local community was that of reducing land fragmentation,

thus, promoting monetary savings (deployment and maintenance), and management simplification without weakening the stability of the system (Heider et al. 2018b).

The community has used the GIS platform as the basic tool to explore possible pathways for a sustainable land management and we applied a GIS analysis to assess land fragmentation in the specific context of drip-irrigated agriculture as result of our stakeholder workshop in 2017. Within this analysis, we developed a Fragmentation Index for Drip Irrigation and Distance Assessment (FIDIDA). FIDIDA quantifies farms considering their transaction costs. Based on these costs, FIDIDA brings together mean plot size, degree of separation (i. e. number of parcels per farm) and degree of dispersion (i. e. standard distance between parcels) of land parcels on farm level. FIDIDA generates a new hierarchy of farms that shows possibilities to reduce costs, time and to mitigate emissions by reducing the traveling distance between plots. The index can be used to compare the individual fragmentation of farms or the land fragmentation between different study areas. The definition of FIDIDA aims at supporting the management of reasonable land fragmentation thresholds in the context of communities made of traditional small farms, while suggesting possible pathways for a gradual inversion of land fragmentation trends through voluntary plot fusion where necessary (Heider et al. 2018b).

Further applications of the GIS platform in cooperation with local stakeholders (Figure 3) are planned. We believe that digital technologies have the potential to produce jobs in the countryside, which contributes to reach the targets of SDG 2.3 (Table 1). Furthermore, these technologies counter the loss of knowledge by the digitalization of information. In particular, GIS opens new planning possibilities for emergency water management, collective actions for the control of parasites, planning of ecological agriculture and tourist activities as well as the conservation of traditional knowledge (Figure 3) contributing to a more sustainable agriculture and an increase of income for farmers (SDG 2.3, Table 1).

Conclusions

In this article, we investigate the role of ICT for a sustainable access to land in two case studies. The first case study area in the south of Mexico City is located in an urban setting and describes a public space, in which informal urbanization prevents sustainable access to green spaces and challenges urban as well as ecological planning and management. The second case study area of Ricote is located in a rural setting in the southeast of Spain. It is characterized by a high fragmentation of small agricultural private properties, which leads to limited access to land as well as inefficient and unsustainable land use.

We have seen in these case studies that access to public space in Mexico City is easier and more informally regulated, while the usage of private space in Ricote is prohibited for non-owners. Thus, public space is more exposed to unsustainable usages. Nevertheless, excessive privatization of space can lead to equally unsustainable land use practices, as observed in Ricote. Although in our research cases a conflict of public space occurs in an urban area and a conflict of private space in a rural area, we do not understand these as fixed allocations. Problematic access and use of land can occur on every stage of the rural-urban continuum.

Our transdisciplinary approach proposes the exploration of the potential of ICT to integrate local perspectives and contribute to a more sustainable access to and usage of land. By using ICT in form of VGI (human sensing), a local perspective to locate informal urbanization hot spots in the conservation zone of Mexico City was added, making it possible to identify its drivers. Next to socio-economic factors, we assessed major roads as an important factor for the occurrence of informal settlements in the conservation zone of Mexico City. Human and remote sensing data work well together and human sensing data can be used to integrate a local perspective contributing to integrative management options connected to SDG 11 (Table 1). However, we argue that for sustainable management of property rights, causes and consequences need to be further investigated and research should be open to use new data forms like VGI promoting "bottom up" before "top down" approaches.

The development of transdisciplinary ICT-based tools can help us and the local stakeholders to identify specific needs, capabilities and potentials in different regions (Mediterranean Region, Latin America, and Middle East), to analyze emergent patterns and to support the development of place-specific sustainable development strategies. In order to find these strategies, it is a precondition to include local stakeholders and local knowledge in research.

This is shown in the Ricote case study. Local stakeholders participated from the beginning. In a workshop, they identified their needs. They wanted to address the problem of severe land fragmentation within farms. Thus, a GIS-analysis of land fragmentation in Ricote is our first attempt to support the development of place-specific sustainable development strategies and contribute to sustainable agriculture (SDG 2, Table 1). Moreover, to support in-house innovation, we introduced GIS techniques to the local smallholder community (Naldi et al. 2015; Heider et al. 2018b). The aim is to understand the biophysical as well as the cultural, social, and economic parameters, on which sustainable solutions in rural areas may be built. GIS techniques can help to plan and implement them. As we show in the example of our project in Ricote, local stakeholders need to be included in research as well as management approaches from the beginning to include local knowledge and find solutions in a framework of co-design and co-development.

In current research, we continue to work with SDG 2 (Table 1) and investigate sustainable agriculture in southeast Spain. One question that arises in the context of smallholder agriculture in the historical field systems of the Valley of Ricote is how to support the conservation and re-activation of traditional agrarian landscapes. These landscapes represent the outcome of a continuous co-evolution of humans and environment, which result in a stable and resilient system. In the past, farmers used traditional irrigation technologies like water wheels to transport water to the various heights of terraces. These technologies produced low emissions (Closas 2014) and characterize the landscape of the Valley of Ricote until today but they are hardly in use any more. However, they could be a part of a sustainable rural development strategy mitigating emissions and promoting rural tourism, thus, contributing to an increase of smallholder income and non-farm employment (SDG 2, Table 1).

References

Brown, G., 2015: Engaging the wisdom of crowds and public judgement for land use planning using public participation geographic information systems. Australian Planner, 52(3), 199–209.

Closas, A., 2014: Norias, boreholes and the role of the state during the groundwater 'silent revolution' in La Mancha, Spain. Hydrogeology Journal, 22(5), 1179–1192.

Connolly, P., 2009: Observing the evolution of irregular settlements: Mexico City's colonias populares, 1990 to 2005. International Development Planning Review, 31(1), 1–35.

Davis, M., 2004: Planet of Slums. Urban Involution and the Informal Proletariat. New Left Review, 26, 5–34.

Eriksson, M. G., L. J. Gordon, and J. Kuylenstierna, 2014: Cross-sectoral approaches help build water resilience – reflections. Aquatic Procedia, 2, 42–47.

Garson, G. D., 2003: Public information technology. Policy and management issues. Hershey: Idea Group.

Hardin, G., 1968: The Tragedy of the Commons. Science, 162, 1243–1248.

Hardin, G., 1989: Extensions of "the tragedy of the commons". Science, 280, 682–683.

Heider, K., J. M. Rodriguez Lopez, and J. Scheffran, 2018a: The potential of volunteered geographic information to investigate peri-urbanization in the conservation zone of Mexico City. Environmental Monitoring and Assessments, 190(4), 219.

Heider, K., J. M Rodriguez Lopez, J. M. García Avilés, and A. L. Balbo 2018b: Land fragmentation index for drip-irrigated field systems in the Mediterranean: A case study from Ricote (Murcia, SE Spain). Agricultural Systems, 166, 48–56.

Heller, M. A., 1998: The Tragedy of the Anticommons: Property in the Transition from Marx to Markets. Harvard Law Review, 111(3), 621–688.

Janssen, S. J. C., C. H. Porter, A. D. Moore, I. N. Athanasiadis, I. Foster, J. W. Jones, and J. M. Antle, 2017: Towards a new generation of agricultural system data, models and knowledge products. Information and communication technology. Agricultural Systems, 155, 200–212.

Levidow, L., D. Zaccaria, R. Maia, E. Vivas, M. Todorovic, and A. Scardigno, 2014: Improving water-efficient irrigation. Prospects and difficulties of innovative practices. Agricultural Water Management, 146, 84–94.

Naldi, L., P. Nilsson, H. Westlund, and S. Wixe, 2015: What is smart rural development? Journal of Rural Studies, 40, 90–101.

Reed, M. S., 2008: Stakeholder participation for environmental management: A literature review. Biological Conservation 141(10), 2417–2431.

Reynolds, H. L., A. A. Smith, and J. R. Farmer, 2014: Think globally, research locally. Paradigms and place in agroecological research. American Journal of Botany, 10, 1631–1639.

Richards, C., C. Carter, K. Sherlock, 2004: Practical approaches to participation, SERG Policy Brief No. 1, Aberdeen, UK: Macaulay Institute.

Rodriguez Lopez, J. M., K. Heider, and J. Scheffran, 2017a: Frontiers of urbanization. Identifying and explaining urbanization hot spots in the south of Mexico City using human and remote sensing. Applied Geography, 79, 1–10.

Rodriguez Lopez, J. M., K. Heider, and J. Scheffran, 2017b: Human and remote sensing data to investigate the frontiers of urbanization in the south of Mexico City. Data in Brief, 11, 5–11.

Rodriguez Lopez, J. M., P. Rosso, J. Scheffran, and G. C. Delgado, 2015: Remote sensing of sustainable rural-urban land use in Mexico City: A qualitative analysis for reliability and validity. Interdisciplina, 3(7), 1–20.

Scheffran, J. and S. Stoll-Kleemann, 2003: Participatory governance in environmental conflict resolution: developing a framework of sustainable action and interaction. In: K. Deb, and L. Srivastava, eds., Transition Towards Sustainable Development in South Asia. New Delhi: The Energy and Resources Institute, 307–327.

Stringer, L. C., A. J. Dougill, E. Fraser, K. Hubacek, C. Prell, and M. S. Reed, 2006: Unpacking "participation" in the adaptive management of social–ecological systems: a critical review. Ecology and Society, 11(2), 39–61.

UN, 2017: Sustainable Development Goals. https://sustainabledevelopment.un.org/sdgs, last accessed 8 August 2019.

UN-HABITAT, 2003: The Challenge of Slums: Global Report on Human Settlements. London: United Nations Human Settlements Programme.

UN-HABITAT, 2012a: Bridging the Urban Divide. London: Earthscan.

UN-HABITAT, 2012b: State of Latin American and Caribbean cities 2012. Nairobi: UN HABITAT.

UN-HABITAT, 2016: World Cities Report 2016 - Urbanization and Development. Nairobi: Emerging Futures.

United Nations Population Division, 2017: World Population Prospects 2017. https://population.un.org/wpp/DataQuery/, last accessed 8 August 2019.

Williamson, O. E. 1981: The Economics of Organization: The Transaction Cost Approach. American Journal of Socology, 87(3), 548–577.

Wolfert, S., G, Lan, C. Verdouw, and M. J. Bogaardt, 2017: Big Data in Smart Farming – A review. Agricultural Systems, 153, 69–80.