

LADM based models for sustainable development LA-DRM for disaster prone areas and communities (an example for SDG 1 and SDG 13)

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Key words: Responsible Land Administration, Disaster Risk Management, LADM, Data modelling, sustainable development goals

SUMMARY

The 2030 Agenda for Sustainable Development with its defined Sustainable Development Goals (SDGs), together with other policies such as the Sendai Framework for Disaster Risk Reduction, or the Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security (VGGT) stimulate innovative and transformative approaches to secure land and property rights for all.

In regard to SDG 13, the Sendai Framework specifically calls for investments in research and the development of a methodology and models for disaster risk management (DRM). Responsible land administration (LA) and DRM both focus on empowering vulnerable groups to become resilient communities. When LA is implemented responsibly, it underpins good land governance and ultimately supports sustainable LA by providing strategies and tools to document all people-to-land relationships. DRM and especially community-based DRM aims to evaluate and manage natural disaster risks at the local level – and highlight the role of communities when it comes to natural disasters. Disaster prevention, response and recovery require information about land tenure. Though, in many high-risk contexts, such records are non-existent or not up to date. A model, LA-DRM, linking the domains of LA and DRM – with the goal of supporting resilience against natural disasters and providing an approach for collecting data once and using it multiple times addresses this issue. A design approach was used to develop the model – with adaption of the international Land Administration Domain Model (LADM) standard, as published in (ISO, 2012) (Lemmen, 2012), (Hay, 2014), (Lemmen, et al., 2015), acting as a basis. Key features of the model include the support of interoperability through standardisation, the inclusion of all people-to-land relationships including those specific to disaster contexts, and the potential of the model to contribute to each of the disaster phases. The LADM model, and its aggregated models, such as the LA-DRM model, though is suggested to be highly applicable in any land related SDG context where no land tenure information exists, or the national mapping authority already uses a LA system compatible with LADM. Overall, the LA-DRM model is considered as a step towards an implementable strategy for applying responsible LA in e.g. the context of DRM and serves as an example of how to support other SDGs.

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1. INTRODUCTION

The increasing occurrence of natural disasters and the increasing demands for land tenure security are crucial global challenges that have received much attention over the past two decades. The 2030 Agenda for Sustainable Development with its defined Sustainable Development Goals (SDGs), together with the Sendai Framework for Disaster Risk Reduction, stimulate innovative and transformative approaches to secure land and property rights for all (UN, 2015). The Sendai Framework (WCDRR, 2015) specifically calls for investments in research and in the development of a methodology and models for disaster risk assessment. Hence, the integration of LA and DRM is gaining momentum amongst both theorist and practitioner communities with regards to policy creation, tool development and applications as published in (Mitchell, et al., 2015), (Mitchell, et al., 2014) (Griffith-Charles, et al., 2014). The lack of LA processes that are responsive to DRM needs, challenges the realisation of sustainable development especially in disaster prone areas. Unger, et al., 2017 established the links between the two domains through the identification of the global change forces (people, land, disaster) and the disaster risk drivers (vulnerability, exposure and hazard) (WB and GFDRR, 2012) and harmonized those concepts into a unified conceptual framework. The framework can reveal the extent and complexity of people-to-land relationships, and how those are intrinsically related to the occurrence of natural disasters. The paper of Unger, et al., 2019a was devoted to an analysis uncovering the specific data standards and tools used and developed in both LA and DRM domains. The knowledge was converted into a conceptual data model, linking elements of responsible LA and DRM, with the international LADM standard used as a basis. Further, an analysis of the potential of the LA-DRM model based on the disaster cycle and its phases was shown. Unger, et al., 2019b tested the application of the developed LA-DRM model and represented the findings of a case study conducted in one of the most severely affected regions of the 2015 earthquakes in Dolakha, Nepal. The methodology and land tools used for the Fit-For-Purpose Land Administration (FFP LA) application in a post-earthquake context were shown. The World Bank and FIG jointly promote the FFP LA approach that enables appropriate LA systems to be built within a relatively short time, at an affordable cost, and with the opportunity to upgrade when required. The FFP LA approach recommends the use of “visible boundaries” to identify the delineation of land rights and to achieve first complete coverage and, at a later stage, an incremental improvement of quality. Further analysis on the effects and hindrances of an incomplete LA system in a post disaster context were presented.

Synthesizing the above-mentioned research outputs, shows the potential of LADM based models to support the 2030 Agenda and its SDGs. Accordingly, the aim of this research is not to develop yet another data model, but to synthesis what is already developed and to assess the potential. Therefore, in this paper the experimental LA-DRM model which was presented in (Unger, et al., 2019a) is assessed on its support towards the SDGs. First, the motivation and background of the assessed model are provided. Subsequently, the section ‘Background Analysis’ examines existing research available. This leads to the assessment of ‘LADM for sustainable development’. The potential application of LADM based models in different contexts to support the SDGs is then explored. Finally, the conclusions draw the potential and limitations of a LADM based model, such as the LA-DRM model, and encapsulates future research opportunities.

2. BACKGROUND

The global land community has accepted that individual land titling on its own cannot deliver security of tenure to the majority of people in the world in a timely fashion (Antonio, 2011) (Deininger, 2003) (Jacoby & Minten, 2007) (Payne, 2002) (Payne, et al., 2009) (Undeland, et al., 2010) (Wehrmann & Antonio, 2011). Responsible approaches need to be adopted, and more importantly need to be integrated, with other domains such as DRM to address emerging global challenges (Mitchell, et al., 2015) (Mitchell, et al., 2014) (Griffith-Charles, et al., 2014). The aim of various researches was to close the gap of the missing linkages between LA and DRM. This gap was closed through the development of a conceptual framework, as shown in (Unger, et al., 2017) showing the need for the application of responsible LA in developing countries, which are prone to natural disasters. Therefore, the three global change forces (people, land and disaster), the interrelations between them, and the multifaceted relationship with land tenure and the three disaster risk drivers (vulnerability, exposure and hazard) was examined in (Unger, et al., 2017). The results were used to develop the conceptual framework showing, through a graphical representation, and describing this interrelationship and hence, fostering the emergent need of responsible LA in DRM. The components of the conceptual framework were the three global change forces and the three disaster risk drivers as well as the entry points for responsible LA approaches. The possible contribution of responsible LA to DRM was identified and classified in three categories: census data provision, gathered through, for example, participatory enumeration; tenure security gained through applying the continuum of land rights; and hazard risk assessment and mapping – linked to responsible LA. The possible contributions were underlaid through cases studied in literature from Kenya, the Philippines, India and Haiti. Within those, especially participatory approaches were identified as a critical aspect towards an implementable strategy for applying responsible LA technologies in the context of DRM. Participation and inclusion were identified as crucial enabling factors for the poor to minimise vulnerabilities and disaster risks.

The literature review of (Unger, et al., 2017) showed that land issues arising during a disaster are often addressed with ad-hoc legislative design, and tool development in separated approaches for different disciplines or domains. This led to the need to create a conceptual framework establishing a link between responsible LA and DRM as requested in (WCDRR, 2015). However, in order to administer natural disasters and govern the impact of any disaster, basic questions concerning, ‘What?’ ‘Where?’ and ‘How?’ need to be answered with regards to impacted individuals and communities, and also at an aggregated national level. Therefore, the need to access and share various information by interoperability and standardisation measures, demand for further facilitation. In order to realise this link, established at conceptual level, a literature review studying various tools and standards used in LA and DRM was conducted in (Unger, et al., 2019a). Within this literature study, no standard nor tool could be found which could be applied in both fields, therefore a new conceptual data model was designed. The developed and introduced LA-DRM model (Figure 1) aims to improve the management of land information when it comes to natural disaster contexts and to find its application at national, local and community level.

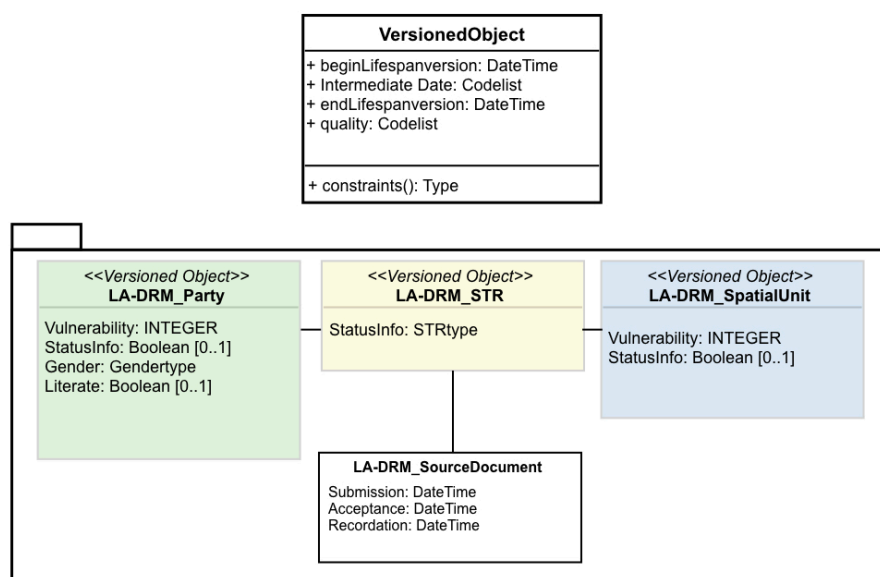


Figure 1: LA-DRM model as developed in (Unger, et al., 2019a)

The introduced LA-DRM model is based on the LADM/STDM concept, using the same classes (with different pre fixes, see below) with additional attributes describing the scale of vulnerability, hazard and exposure. The Social Tenure Domain Model (STDM) (was initiated by the UN-Habitat Global Land Tool Network (GLTN) and is based on the Land Administration Domain Model (LADM) (Lemmen et al., 2015). GLTN designed and developed the pro-poor and gender-sensitive land information management system in close cooperation with the University of Twente/ITC. The STDM can be used to support land administration of the poor in urban and rural areas, which can later also be linked or converted to the cadastral and land registry system. This is in support of the formal recognition of land rights and the integration of information into one system.

LADM and STDM provide a standard set of terminology, classes and associations. Nevertheless, both models are flexible and can accommodate other attributes and associations and are extensible to allow inclusion of other situations and disciplines. The core classes of LADM are the spatial unit (LA_SpatialUnit, this can be a parcel), the party (LA_Party, this can be a natural or non-natural person) and the rights, responsibilities and restrictions (LA_RRR), which links the two other classes (ISO et al., 2012). Those core classes of the LADM can also be found in the STDM, but are with different prefixes (LA-DRM) as they focus on a different context, SpatialUnit, Party and SocialTenureRelationship (STR) (GLTN, 2014). The difference in prefixes is based on the fact that the attributes in STDM describe legitimate rights instead of the statutory rights as in LADM (Zevenbergen et al., 2013). The SocialTenureRelationship is described through the continuum of land rights, as defined by (GLTN, 2014), to describe all people-to-land relationships. It can also be used to describe secondary use rights, overlapping rights or where people perceive their rights contradictory. The development of the LA-DRM is based on literature review, expert group discussions and field experiences from Nepal. Since the LA-DRM is based on the LADM/STDM all the requirements as defined in (Lemmen et al., 2015) are considered to be valid. Various requirements were adapted, and some additional ones were added as presented in (Unger, et al., 2019a). The LA-DRM model shows that it is possible to link LA and DRM, at the level of data capture, and that the occurrence of disasters is the most evident reason to include all people-to-land relationships in any LA system. Further the potential of the LA-DRM model in each of the DRM phases was described and graphically illustrated in Figure 2 to emphasise this linkage.

The conceptual data model development delivered a tool applicable in the field for assessing impact on tenure security and recording disaster risk elements, such as vulnerability and exposure. The model was tested in the post-earthquake setting of Nepal (Unger, et al., 2019b). This case study identified that vulnerable or at-risk groups are children, elderly, persons with disabilities, women, the poor and marginalized and especially people affected by tenure insecurity and hence could not receive reconstruction grants. The conditions for securing reconstruction grants were (1) a citizenship certificate, (2) an identity document, and (3) proof of landownership. Many earthquake victims could not meet one or more of these pre-conditions and were unable to access reconstruction grants.

The LA-DRM was used to map these vulnerable groups based on their needs, priorities and marginalization. The main purpose of this was to identify the level of tenure security; the scale of vulnerability, exposure and hazard; their grant status; basic household economy; and all related to the people-to-land relationship. Various queries could be generated with the LA-DRM model. The results and analysis were then further used to integrate and implement interventions for planning, response and relief processes. The research supported by LA-DRM highlighted that DRM policies have to be redirected towards tenure security, poverty and vulnerability reduction, instead of only short-term compensation, resettlement and relief responses. The importance of documenting all people-to-land relationships, as with LA-DRM, was proven in order to prepare, mitigate and respond to natural disasters. Further results of

(Unger, et al., 2019b) showed that through the documentation of all people-to-land relationships, efficient and effective land use planning can further mitigate disaster risks: backups of all documents, stored safe, can be used for an inclusive, participatory and transparent resettlement process.

Through the application of the LA-DRM model it is expected that a complete LA system creates opportunities to mitigate and prepare for disasters. This case study further validated a strong link between LA and DRM and the benefits of an integrated information system approach.

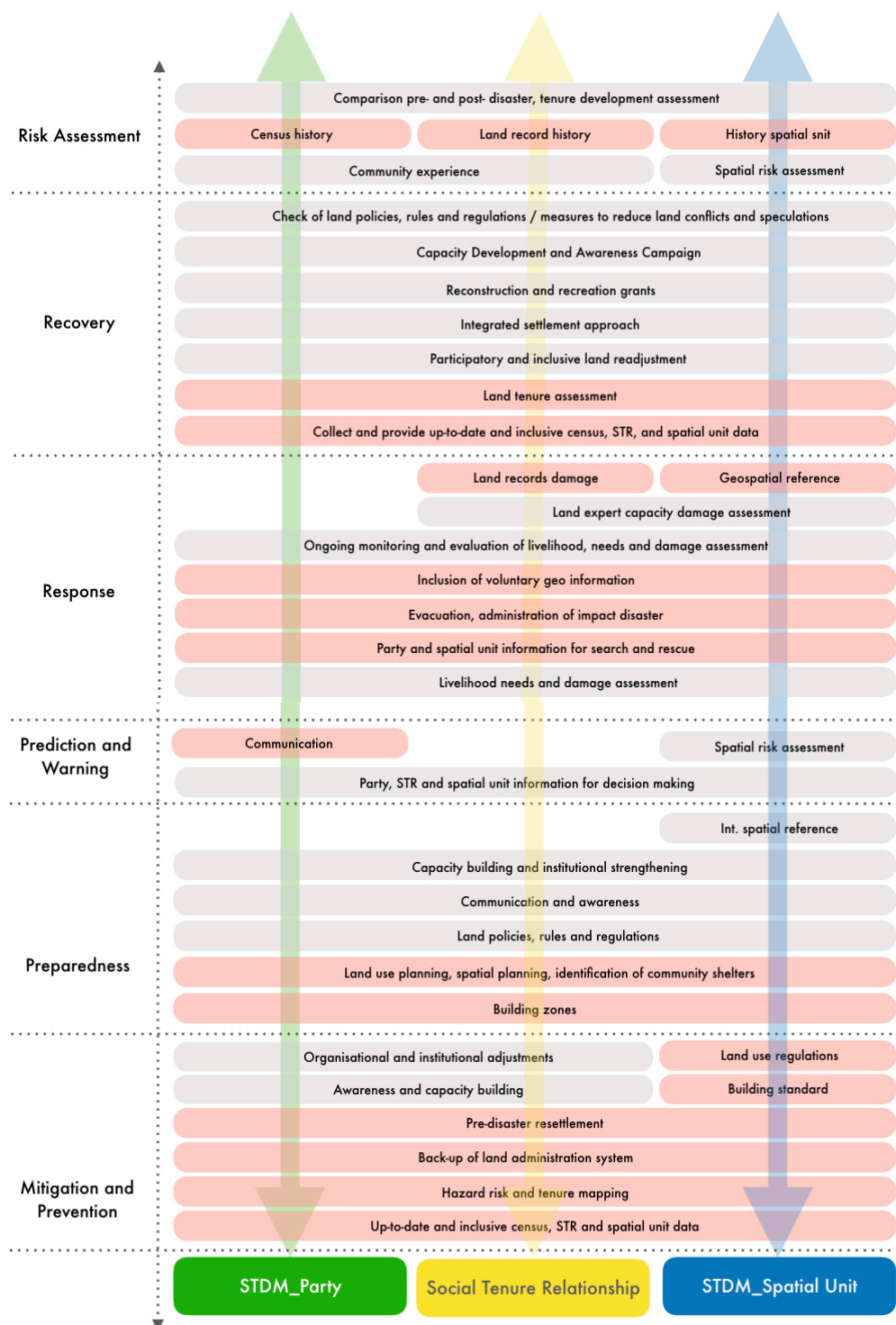


Figure 2: Potential of LA-DRM model as developed in (Unger, et al., 2019a)

3. BACKGROUND ANALYSIS

The theoretical basis for the work at hand, is drawn around two overlapping study concepts, see Figure 3, indicated through the numbers (1-3) in the graphic. The above-mentioned integration manifests itself in the related knowledge domains of LA (1) and DRM (2). As already mentioned (Unger, et al., 2017) developed a conceptual data model, using constructs and terminology common to both domains, creating a shared viewpoint and language for analyzing approaches that might better address the needs of the poor and vulnerable people living in disaster prone areas. Within (Unger, et al., 2019a) the conversion of the conceptual model into a data model, the LA-DRM model (3) is shown. This model is aligned to an internationally agreed standard, the Land Administration Domain Model (LADM) (Lemmen, et al., 2015).

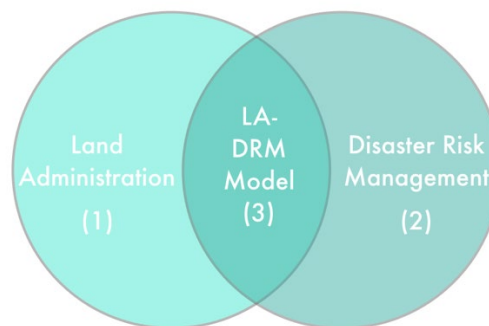


Figure 3: Research Setting: LA - DRM

However, whilst (Unger, et al., 2019b) demonstrated the benefits of tool linkage within LA and DRM for a specific case, the broader introduced challenges in regard to the 2030 Sustainable Development agenda remained to be tackled.

4. LADM FOR SUSTAINABLE DEVELOPMENT

As shown in different research articles, responsible LA can be directly linked and even integrated in DRM processes. This integration issue now gains more attention following the 2015 agreement on the SDGs and the recognition of many goals being cross-domain challenges.

Regarding an integrated approach for LA and DRM, previous research investigated different levels of integration: conceptual/theoretical, conceptual data models, and applications. Especially now, the interrelationship of LA with various disciplines reflected in the SDGs becomes visible. In regard to responsible LA and DRM, both disciplines are integrated and intrinsic to other fields of study including poverty reduction, food security, gender equality etc. The Venn Diagram as introduced in Figure 3 can be adapted for various LA related disciplines/domains or SDGs, and through the nature of a standardised underlying data model,

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such as the LADM, an integrated data capturing mechanism can be realised (Figure 4). Such standardised data models can support interoperability and the overall idea of ‘collect once – use multiple times’ but can also identify coordination problems and support their solution. Further, this research can contribute to the update and development of the LADM¹ (Lemmen, et al., 2019).

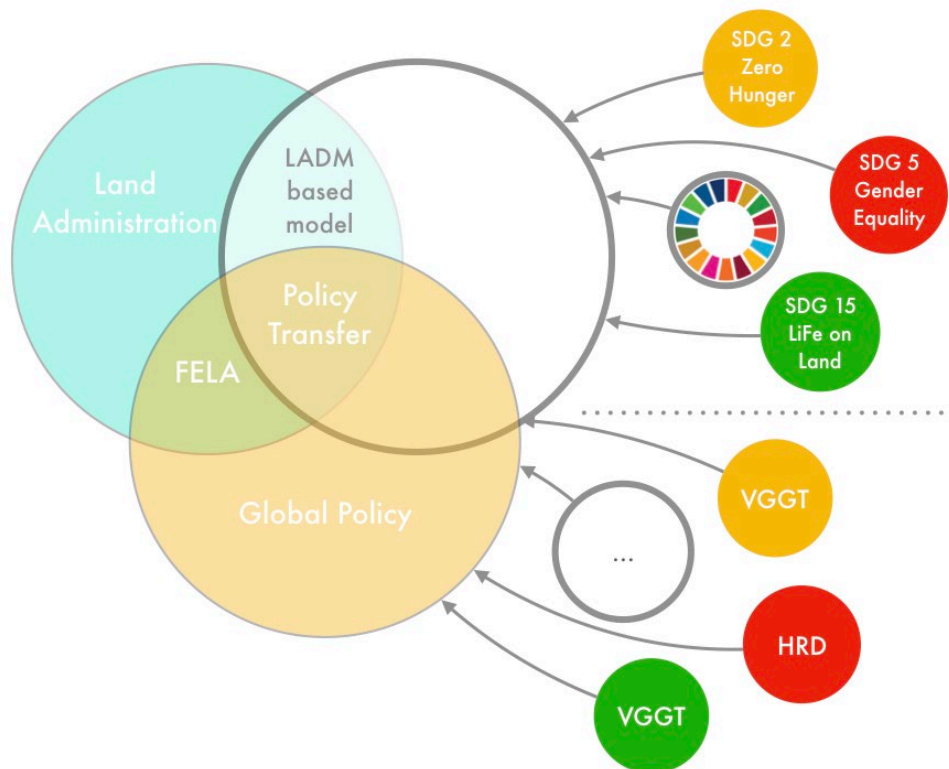


Figure 4: Integration with other SDGs

Considering that 70 per cent of people do not enjoy secure land tenure, but also an increasing number of people are affected by natural disasters, efforts to document, record and recognize all people-to-land relationships is becoming more urgent.

Further an attempt of the researchers to match the SDGs with the basic classes of LADM /STDM (GLTN, 2014) lead to the following result as shown in Figure 5. All the SDGs serve different purposes and hence have different targets and indicators. Nevertheless, the LADM/STDM basic classes could be matched with the SDGs and categorized into Party-centric, RRR-centric, and Spatial-centric SDGs. The aim of this figure is not to divide the SDGs but further highlight how essential a flexible basic data model, such as LADM, is in order to support the SDGs and deliver the information for their targets and indicators. A holistic approach strengthens the demand for, and also the possibilities of, interlinkages with

¹ June '19 OGC TC/PC Meetings - Leuven, Belgium, <https://www.opengeospatial.org/events/1906tc>

the 2030 Agenda for Sustainable Development and its 5Ps (People, Planet, Prosperity, Peace and Partnership) (UN, 2015) and the domain of LA.

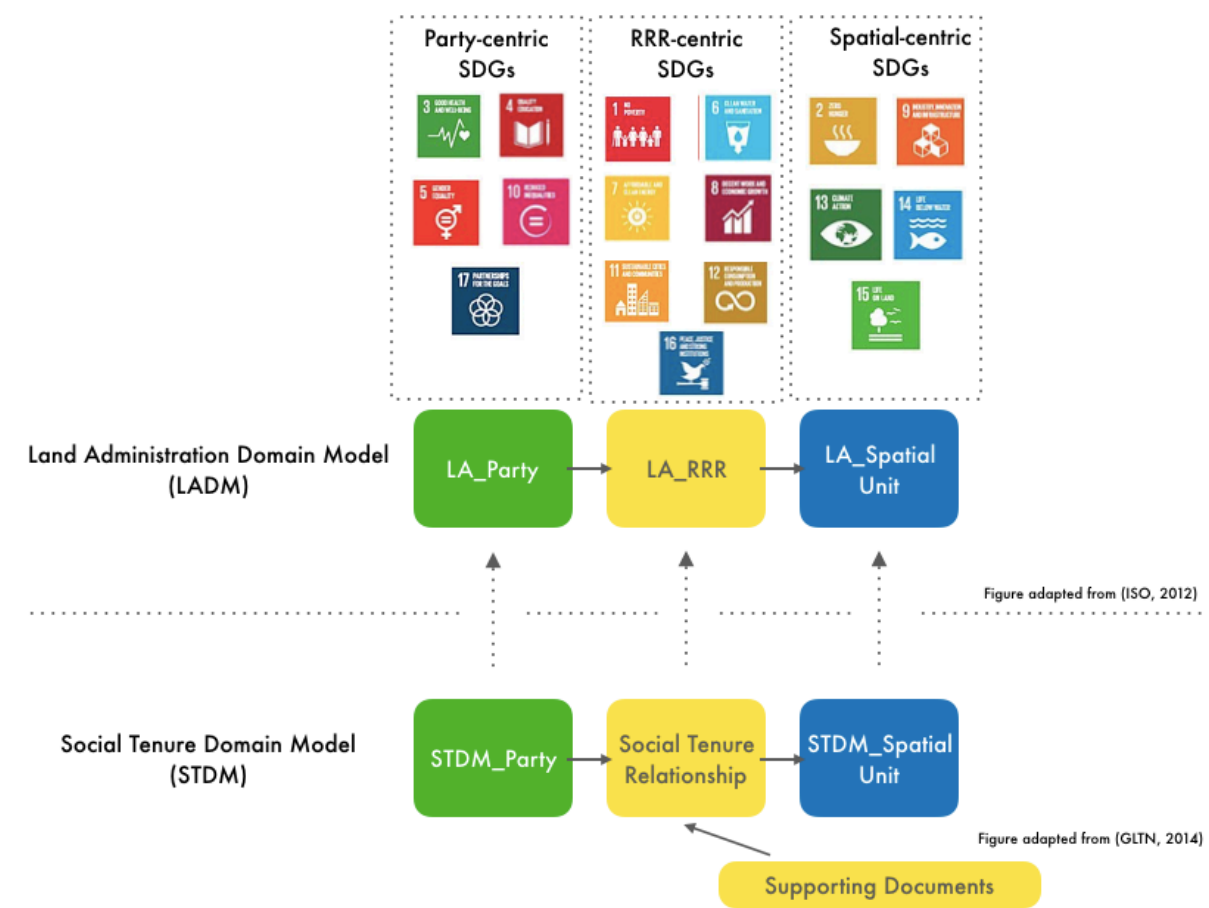


Figure 5: LADM as a base to support the SDGs

As presented in Figure 4 and Figure 5 the approach can be explained in more detail based on the SDG 5 Gender Equality. SDG 5 ‘Gender Equality’ is closely linked to the Human Rights Declaration (HRD) and other policies such as for example the Convention on the Elimination of all forms of discrimination against women and the United Nations Declaration on the rights of indigenous peoples and many more. Through an investigation of global policies, rules and regulations, requirements for LADM can be defined which ensures that LADM and the linked LA processes are gender sensitive and inclusive. The generated or adapted LADM model, as named here for example LA-Gender Model, can then be used to deliver the requested SDG targets and indicators. The result of the investigation could also be that no changes in the LADM model are needed. Nevertheless, the requirements assessment but also the assessment whether or not the model is aligned with those global policies can be done using policy transfer processes. Hence, an integrated approach for SDG 5 and LADM can be conceptually shown in Figure 6.

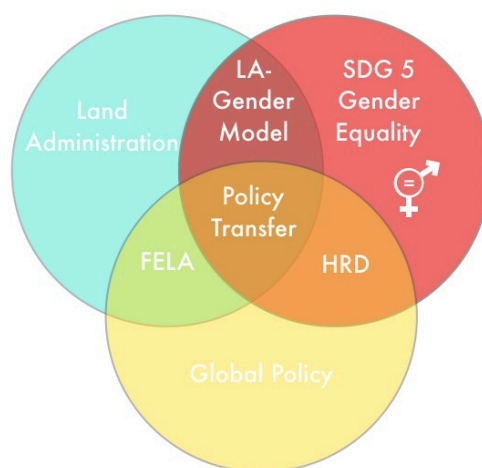


Figure 6: LADM as a base to support SDG 5 ‘Gender Equality’

Based on Figure 5 Gender Equality (SDG 5) is seen as a party-centric SDG since most of the changes required in LADM are suspected by the researchers to be in the LA_Party class. One of the changes could be the introduction of a gender attribute or an additional distinction of the LA_GroupPartyType.

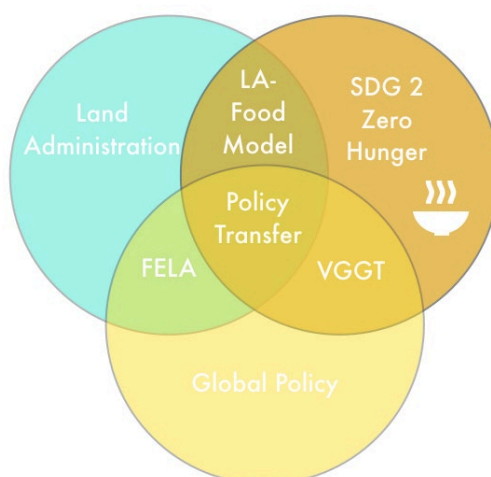


Figure 6: LADM as a base to support SDG 2 ‘Zero Hunger’

Another example can be generated based on SDG 2 – Zero Hunger. As a global policy guideline, the VGGT can be investigated. Within the VGGTs and other literature land readjustment, for example is one of the measures to address food security. Hence, LADM must be supportive towards the processes of land readjustment in order to support SDG 2 and deliver for its indicators and targets. SDG 2 – Zero Hunger was categorised as spatial centric

SDG, though the researchers are aware that especially when it comes to food security clearly defined rights, restriction and responsibilities (RRR) are imperative.

This paper should not get into the level of detail to describe the changes and conduct the assessments but should show the potential of an integrated holistic approach of LADM in regard to the SDGs and as it was done with the LA-DRM model.

5. CONCLUSION AND KEY LESSONS

This paper showed the potential and added value of an integrated approach of responsible LA and DRM and the impact of LADM based data models to support the SDGs. Future research should focus on applying a similar holistic approach on other domains/global challenges.

In addition, future works should focus on applying, testing and hence further developing the conceptual framework as well as the conceptual data model, LA-DRM. For example, each of the global change forces as well as the disaster risk drivers, as introduced in (Unger, et al., 2017), have different aspects to focus on and therefore more research could be undertaken to refine and tailor the concepts and tools towards these focuses. Further, the approach used in Dolakha, Nepal, was used for a specific context but may not be fully replicable in other regions. Also, especially in regard to natural disasters, scaling up mechanisms need to be further investigated. This scaling up can be achieved through integration of other domains and disciplines but may also be achieved through technologies, which are outside the ‘normal’ FFP LA or DRM toolboxes.

Standardisation, through the conceptual data model, which is based on an internationally agreed standard, LADM, creates opportunities but can also create dangers, especially in case of a natural disaster. As reported in media, the Federal Emergency Management Agency (FEMA) in the US shared the data of 2.3 million disaster (hurricane and wildfire) survivors with a federal contractor (Georgiadou, 2019). Standards support interoperability and hence can be used by machine learning mechanism. Therefore, future research could address these dangers, where personal data collected may be manipulated and linked to other data, and hence used for less benevolent purposes than the immediate disaster response.

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BIOGRAPHICAL NOTES

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Jaap Zevenbergen is full Professor Land Administration and Management at the Faculty of GeoInformation Science and Earth Observation of the University of Twente in the Netherlands. He has served four years on the International Advisory Board of GLTN and as co-chair of the working group on land administration and disasters of FIG. Currently he is among others Editor-in-Chief of the journal Land Use Policy.

Paula Dijkstra works as regional manager for the international department of the Netherlands' Land Cadastre, Registry and Mapping Agency (Kadaster). She obtained a Master degree in Social Geography. Within her job she is responsible for the international projects in the Central and Eastern European region and the joint projects of Kadaster and the Global Land Tool Network (GLTN). She is chair of the FIG Task Force on Surveyors and the Climate Change. She Congress Director of the FIG Working Week in Amsterdam, The Netherlands in 2020.

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