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# Integration of water management and land consolidation in rural areas to adapt to climate change: Experiences from Poland and the Netherlands

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ABSTRACT

Rural areas face major challenges in adapting to the impacts of climate change, in particular to floods and droughts. This calls for both adaptation of rural functions and climate-proof and water-resilient design of the rural area, often implying improvement of water retention and flood protection. Implementation of such climate change-related goals in spatial planning often involves adaptations in water management, perhaps even leading to land consolidation. Water management and land consolidation thus form important tools for spatial adaptation. Land consolidation is also a tool to support the integration of other claims that need room, such as agriculture, nature, landscape and tourism functions. This paper investigates the history of and approaches to land consolidation and water management in Poland and the Netherlands, and illustrates the integration of land consolidation and water management to realize a multifunctional climate resilient rural area by two examples in each country. We qualitatively compared the extent to which the planned activities in water retention and flood protection were realized and planned results were achieved for other functions. We found that the two adaptation measures, water retention and flood protection, were more effective in the Netherlands, stemming from ample attention for the impact of climate change and the incorporation of climate change adaptation goals in water policy. Furthermore, the water retention and flood protection measures in the Netherlands better serve multiple functions: agriculture, nature, recreation, landscape and infrastructure. Reasons for this are the multidisciplinary and participatory approach, attention to public awareness and communication and promotion of the process. On the other hand, the Dutch have much to learn from Poland's vast, undisturbed natural areas, which contribute to a climate resilient landscape. Both Poland and the Netherlands could therefore benefit from bringing together ideas and experiences regarding climate proofing the rural area.

## 1. Introduction

Water-related hazards like floods and droughts account for the majority of natural disasters worldwide (IFRC (International Federation of Red Cross and Red Crescent Societies), 2016), and it is foreseen that climate change will increase both impact and frequency of these water crises (e.g., IPCC, 2007, 2014; EEA (European Environmental Agency), 2017). Therefore, failing to adapt to climate change is among the greatest risks that the world is facing, according to the World Economic Forum (2017). These insights have resulted in greater priority for adaptation to climate change on international as well as national agendas, and in the formulation of international agreements and numerous international and national programmes to stimulate climate adaptation. For instance, the European Commission adopted in 2013 an EU strategy on adaptation to climate change with the aim of making Europe more climate resilient. The EU adaptation strategy focuses on promoting the development of adaptation strategies by member states, and helps them build their adaptation capacities and take action to promote adaptation in key vulnerable sectors, such as agriculture, fisheries and transport, and to provide adaptation information via the Climate-ADAPT platform. Furthermore, the European Commission agreed to spend at least 20% of its 2014–2020 budget to respond to the challenges and realize investments related to climate change.

This public and policy interest and the associated funding

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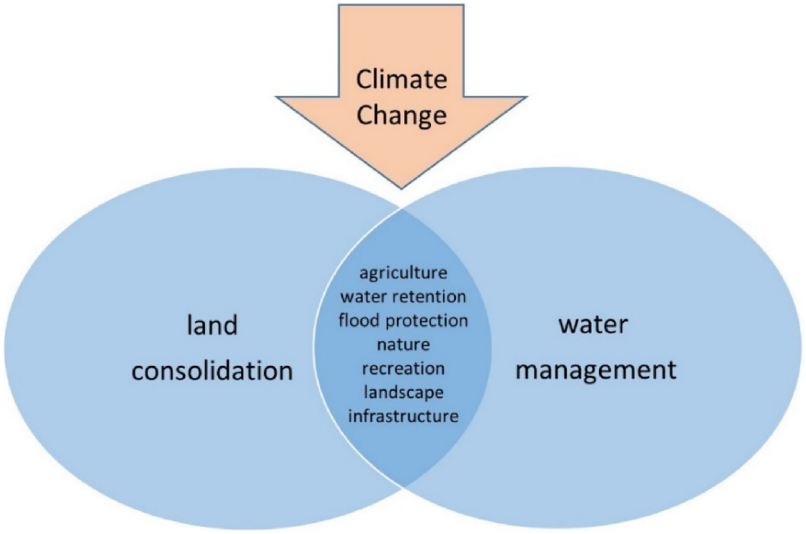


**Fig. 1.** Water retention and flood protection as measures to adapt to climate change for the realization of a multifunctional climate resilient landscape by integration of land consolidation and water management (Source: own elaboration).

opportunities for climate adaptation have stimulated regional and local governments as well as the private sector to start or to join initiatives on climate adaptation. The City Leaders Forum programme (AIWW (Amsterdam International Water Week), 2017) is an example of such an initiative. Here, cities, industries and utilities share experiences and collaborate in adapting urban areas to climate change. Several Dutch and Polish cities joined this programme. Both countries actively stimulate adaptation action on the local scale, and several cities in both the Netherlands and Poland have taken the initiative to develop local adaptation strategies and implement adaptation measures, and to strengthen Dutch-Polish collaboration.

In the Netherlands the Delta Programme stimulated major cities like Rotterdam and Amsterdam and regional capitals like Leeuwarden and Zwolle to adapt, and in Poland, for instance, the project "Development of Urban Adaptation Plans for Cities with More Than 100,000 Inhabitants in Poland" has been joined by 44 Polish cities, including Warsaw, Gdynia, Poznan and Wroclaw.

The rural area, however, also faces major challenges in adapting to climate change. Foreseen changes in temperatures, amounts and seasonal patterns of rainfall, and salt intrusion along the coast will have huge impacts on rural functions like agriculture and forestry and on nature (EEA (European Environmental Agency), 2017). These call for adaptation of agricultural and forestry practices as well as for a climate-proof and water-resilient design of the rural area. However, beyond the major challenge to adapt, rural areas also have considerable potential to play a role in climate adaptation, e.g., by providing space to store water during extreme rainfalls for release in dry periods (e.g., Ellen et al., 2011; Ritzema et al., 2016). These kinds of spatial adaptations may complement or even enhance spatial functions like nature conservation and restoration, recreation and tourism, or improve spatial quality. On the other hand, they may compete with other claims that need room, such as agricultural production. Furthermore, demographic and economic developments in rural areas, such as depopulation and the disappearance of facilities, pose additional challenges and opportunities to spatial adaptation. In this complex context, it is of utmost importance to balance all ambitions and tasks and involve important stakeholders in the search for climate-proof and water-resilient measures and designs for the rural area.

Spatial planning is a process whereby combinations of land uses can be fashioned to facilitate climate change adaptation (Hurlimann and March, 2012). Implementation of climate change-related goals in spatial planning often involves adaptations in water management, and may even result in land consolidation to realize climate-proof and water-resilient rural areas. Water management and land consolidation thus form important tools for spatial adaptation (Olesen and Bindi, 2002; Huq et al., 2015; Zeleňáková et al., 2015). Additionally, land consolidation forms a tool to support the multifunctional and sustainable development of rural areas (Janus and Markuszewska, 2017; Haldrup, 2015; Kupidura et al., 2014; Lisec et al., 2014; Pašakarnis and Maliene, 2010; Sklenicka, 2006; van Dijk, 2003).

Because of their mutual interest in climate adaptation and governmental support for collaboration and exchange of experiences between the Netherlands and Poland, we compare land consolidation and water management approaches in Poland and the Netherlands. Furthermore, we illustrate how land consolidation and water management can be integrated to realize a multifunctional climate resilient rural area. We present two examples in each country seeking insight into the effectiveness of measures and to distil lessons learned on adapting rural areas to climate change.

## 2. Materials and methods

### *2.1. Overview of main directions and changes in land consolidation and water management approaches in Poland and the Netherlands*

We started with a review of scientific and grey literature related to rural water management and land consolidation practices in Poland and in the Netherlands, and presented an overview of the main directions and changes in land consolidation and water management in Poland and the Netherlands.

### *2.2. Ex-post assessment of the realization of multifunctional rural areas*

Water retention and flood protection are the two most common measures for addressing the rising challenges of water management, namely, increasingly frequent and widespread flooding and drought. We looked at the effectiveness of integrating land consolidation and water management processes for realizing multiple functions in Poland and in the Netherlands. Two case studies in each country were examined, whereby 'effectiveness' was used to characterize a project or process's achievement of its intended effect (Clark, 2000; Helms, 2006; Kowal, 2013).We qualitatively compared the extent to which the planned activities in water retention and flood protection were realized and planned results were achieved for the multiple functions: agriculture, nature, recreation, landscape and infrastructure (ISO, 2005) (Fig. 1).