MALADAPTATION IN AGRICULTURE

–INSIGHTS AND KEY MESSAGES FROM A NORDIC RESEARCH PROJECT

Adapting Nordic Agriculture to climate change is pertinent, but such actions can also have unintended negative consequences – maladaptive outcomes. The project 'Identifying Thresholds for Maladaptation in Nordic Agriculture' examined how adaptation can result in increased challenges for Nordic agriculture. Although it is obvious that adaptation actions that have negative outcomes should be avoided, adaptation decisions are complex. There is a need for background information to identify and assess potential maladaptation. Raised awareness is crucial to support conscious assessments and sustainable adaptation strategies.

Project background and aim

There is a widely recognized need for adaptation to climate change in society, but also, an implicit recognition that not all adaptation actions are successful. Climate change is projected to result in both challenges and opportunities for Nordic agriculture, and adaptation is important in order to cope with both these aspects. While there is increasing interest and research on agricultural adaptation, the consequences of adaptation actions, and specifically the risk of maladaptation, are rarely studied.

This project focuses on maladaptation and has redefined the concept to make it operational, that is, to support practitioners, analysists and policy-makers in assessing potential consequences of adaptation.

'Maladaptation' is a result of an intentional adaptation policy or measures directly increasing vulnerability and/or eroding preconditions for sustainable development by indirectly increasing society's vulnerability, as presented in the conceptual framework for maladaptation (Fig. 1).

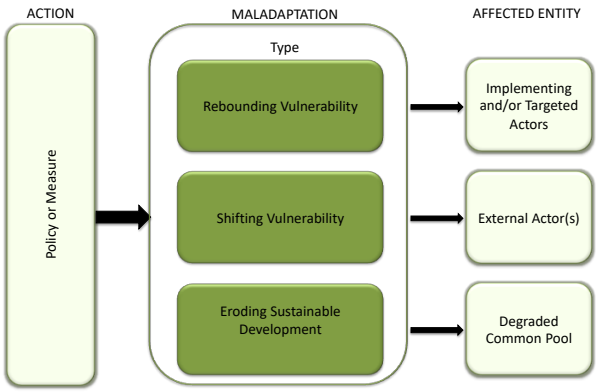

Fig. 1. Feedbacks in maladaptation (From Juhola et al., 2016)

The project aimed to identify and assess when and under which conditions maladaptation can occur in agriculture. Specific objectives have also involved the conceptualization of maladaptation; to understand Nordic famers' perceptions of vulnerability; to identify potential maladaptive outcomes; to study Nordic agricultural stakeholders' understanding of maladaptation; and to develop a serious game to support science-practice dialogues on maladaptation.

This project has included systematic literature reviews, stakeholder interviews in Sweden and Finland, serious gaming and focus group methodology. The mix of methods has been used to address the subject of maladaptation in agriculture from various perspectives and based on various material.

Identifying maladaptive outcomes

A synthesis of current literature and an analysis of interviews with Nordic agricultural stakeholders demonstrated that the adaptation actions suggested in the literature or emphasized by respondents are mostly incremental, that is, adaptation actions that do not change the system but merely some of its elements (Neset et al., 2019). An example of such adaptation actions is the establishment of buffer zones to avoid nutrient leakage as a result from increased precipitation. A majority of the potential maladaptive outcomes are actions that result in unintended negative consequences for the farmer or farm enterprise itself (rebounding vulnerability) (Table 1). The results also demonstrate that adaptation measures with potential environmental impacts (eroding sustainable development) are more frequently discussed and exemplified than measures that could shift vulnerability to others, for example, to neighbors or other stakeholders or sectors.

The project provides a first understanding of what type of unintended consequences various types of agricultural adaptation measures may have and point at the large number of trade-offs that are involved in adaptation decision making in agriculture (Neset et al., 2019). Interviews with famers and agricultural experts however indicated that Nordic farmers do not consider climate vulnerabilities enough to warrant taking timely adaptation action. Transformational changes are happening but incremental changes are more common, and agricultural policy and market conditions are considered more influential stressors than climate change (Juhola et al. 2017).

Table 1. Potential maladaptive outcomes (from Neset et al., 2018). RV – Rebounding Vulnerability; SV – Shifting Vulnerability; E.SD – Eroding Sustainable Development.

Adaptation level	Adaptation practice or strategy	Maladaptation and type
Incremental	New technical equipment (e.g. drying equipment)	Negative impact on farm economy; investment cost and energy cost (RV)
		GHG emissions from increased energy use (E. SD)
	Increased fertilizer use as a result of increased precipitation and production on more marginal land	Negative impact on farm economy (RV)
		Eutrophication (E.SD)
		Increased GHG emissions (E.SD)
	Structural liming	Soil compaction (RV)
	Buffer zones to avoid nutrient leakage	Loss of agricultural area (RV)
	Increased use of pesticides to combat the increased risk of pest and weeds with wetter and warmer climate	Negative impact on farm economy (RV)
		Negative impact on soil quality (RV)
		Negative impact on water quality (E.SD)
		Negative impact on food quality (RV and SV)
		Risk of immunity of pests and weeds to chemical plant protection products (SV)
	Reducing activities on fields to a minimum due to heavy precipitation, to reduce the risk of soil compaction and damaged crops	Negative impact on farm economy (RV)
		Decreased use of labor (SV)
		Creates undisturbed environment for pests and weeds (RV and SV)
	Increased tillage as a measure to combat pests and weeds Subsoil plowing to reduce drought sensitivity	Nutrient leakage, eutrophication (E. SD)
		Soil compaction by tractors (RV)
		Nutrient leakage Soil compaction by tractors (E.SD and RV)
	Reduced tillage to prevent nutrient leakage from increased precipitation	Increasing the risk of pests and weeds (see also *Increased use of pesticides …*) (RV and SV)
		Negative impacts on soil drainage (RV)
Systemic	New drainage system	Negative impact on farm economy (RV)
		Depleting wetlands (SV and E.SD)
		Shift of flooded area (SV)
		Increased nutrient leakage & GHG emissions (E.SD)
	New irrigation system	Negative impact on farm economy (RV)
		Negative impact on groundwater levels – agricultural production (RV and SV)
		Negative impact on groundwater levels – access to drinking water (SV)
	New crop types	See *Increased use of pesticides …*
		See *Increased fertilizer use …*
		Degrading humus content (RV)
		Increased GHG emissions (E.SD)
Transfor-mational	Reform policies and directives for water installations to also target sustainable food production	Negative impacts on wetlands and other valuable water environments (SV)
	Shift from traditional to organic production	Negative impact on farm economy

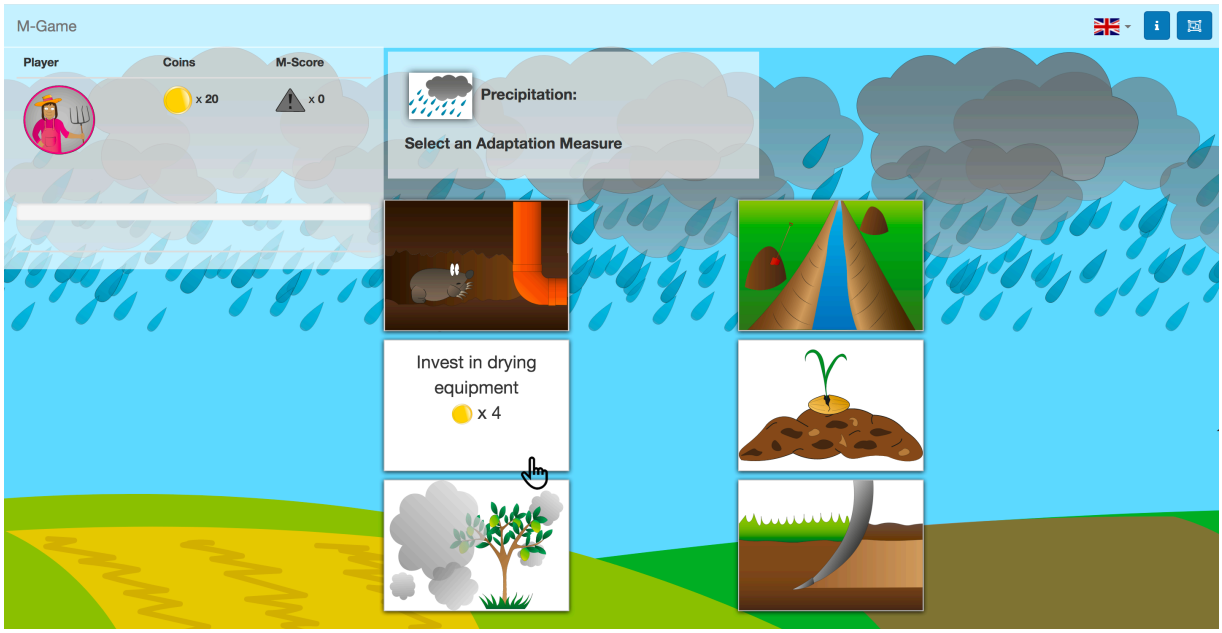

Fig. 2. Screenshot of the Maladaptation game, displaying suggested adaptation measures to the challenge of increased precipitation.

Maladaptation and serious gaming

This project has also developed The Maladaptation game - a serious game, which enables the player to explore, consider and validate unintended negative impacts of climate adaptation measures in agricultural crop production. The game was used within the project to study how agricultural stakeholders and experts understand and negotiate maladaptation in agriculture. Moreover, the game can be used externally, by for example extension officers, in supporting discussions on how to make decisions regarding adaptation while simultaneously dealing with potential maladaptive outcomes.

The Maladaptation game is a single player game with a simple structure. The content is based on the identified potential maladaptive outcomes that are presented in Table 1, but includes significant simplifications and contains no feedback loops that refer back to choices made earlier in the game. A player begins by choosing a character and then the game is built to guide the player through four different challenges which all have to be addressed. In each challenge the player is offered a variety of adaptation measures of which one has to be selected. Each of the measures involve several outcomes but the game randomly displays only one potential outcome for each measure. The measures and outcomes are displayed as virtual cards with an explanation on the backside of the card. As such, the player considers a variety of choices, aiming for best possible outcomes meanwhile accepting potential negative consequences. Although these outcomes may be frustrating, they might resemble the real-life challenges that are related to making good decisions in complex situations without certainty about all factors, such as weather conditions in harvest season or long-term aspects.

The gameplay builds on the simple notion to make adaptation choices that result in low costs (spending as few coins as possible, from the start budget of 20) and low implied harm of adaptation consequences (gain as low M-score as possible).

Facilitated discussions with the players during and/or after the gaming sessions are recommended in order to reflect and exchange perspectives regarding choices made. When ‘The End’ of the game is reached, a summary of choices and scores becomes visible. The scores are not based on exact data but rather represent rough estimations and provide an overall picture of how much harm the measures caused to the environment,

others and the player him/herself (M-score) as well as how much the measures cost the player economically (coins left from the start budget).

The result of this project imply that players tend to make strategies on how to tackle the harmful outcomes they accept when taking a certain measure. This project's study on how agricultural stakeholders make sense of maladaptation (Neset et al., fc.) demonstrates that stakeholders ascribe negative values of maladaptation differently, meaning that there are no static thresholds for when maladaptation occurs but rather negotiations concerning 'the negative'. Thus, based on the game-supported focus group discussions, this project suggests that maladaptive outcomes should be considered dynamic.

This project has been the first to operationalize the concept of maladaptation for a Nordic agricultural context, and has applied novel methodological approaches to do so. The project contributes to increased understanding of the concept, how maladaptation is shaped and how it is perceived by stakeholders. The project identifies both benefits and challenges of serious gaming (Asplund et al., fc). While we conclude that conceptual thinking of game content sometimes clashes with players' everyday experiences and practice, possibly resulting in loss of credibility (Asplund, fc), we also conclude that gaming may function as an eye-opener to new ways of thinking.

Key messages

While some transformative adaptation measures are already being implemented in Nordic agriculture, most changes are incremental. This study identifies multiple trade-offs in adaptation decision-making that need to be addressed to support future adaptation strategies. This project outlines the importance of including maladaptation as an analytical perspective in the assessments of adaptation measures and their outcomes, as well as to address the contextual and multidimensional understanding of the concept. Serious gaming provides a novel approach to science-policy-practice dialogues, but also presents a number of obstacles and opportunities that require further assessment and methodological development.

Sources and Publications

The game is available at: http://maladaptationgame.info

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