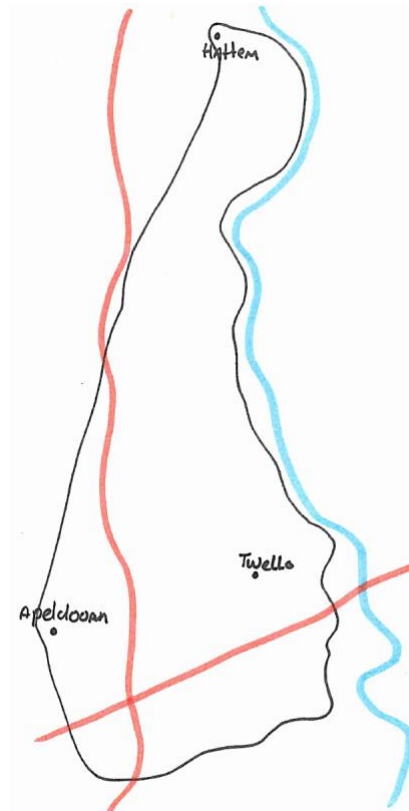


# Local Land-use Scenarios for the Northern IJssel Valley, the Netherlands

*Downscaling higher-level scenarios in collaboration with local stakeholders*



M.Sc. Thesis by Floor van der Meer  
30-04-2021  
Water Systems and Global Change Group



**WAGENINGEN**  
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*Downscaling higher-level scenarios in collaboration with local stakeholders*

Master Thesis Water Systems and Global Change Group in partial fulfillment of the degree of Master of Science in International Land and Water Management at Wageningen University, the Netherlands

**Floor van der Meer**

**30-04-2021**

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## Abstract

Future land-use is uncertain and depends on biophysical and socioeconomic factors. Scenario planning is an approach that allows for uncertainty and possible future analysis. In this research, land-use scenarios for the Northern IJssel Valley (NIV) in the Netherlands are developed. Those scenarios have an explorative nature and focus on “what could happen” in the future. The scenarios are made in cooperation with local stakeholders, so a participatory approach is used. A literature review is done resulting in two combined higher-level scenarios (CHLSs), at the global, national and regional level; relevant for land-use development in the NIV. The two CHLSs “Regional Sustainability” and “Global Economy” are downscaled to local-level scenarios (LLSs) for the NIV by means of semi-structured interviews with local stakeholders. The resulting LLSs contain two levels. The ‘archetype level’ identifies the overarching elements and drivers of “Regional Sustainability” and “Global Economy” from a local-level perspective. The ‘theme level’ identifies the different directions in which “Regional Sustainability” and “Global Economy” can develop by dividing them into three sub-scenarios. An analysis is done on differences and similarities between the CHLSs and LLSs. This comparison shows how the CHLSs and LLSs complement each other. Besides specific characteristics of the CHLSs and LLSs are identified, and the development direction of land-use related themes is evaluated. To conclude, this research shows that using a participatory approach adds valuable information and insights in how CHLSs can be downscaled to LLSs.

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## 1. Introduction

In the Netherlands, the effects of climate change are increasingly visible and tangible. Both droughts and water surpluses are causing problems and more extremes will occur in the future (Attema et al., 2014). Extremely dry periods cause water shortage in the east and south of the Netherlands as extreme rainfall events and run-off cause floods in the delta area of the Netherlands (Stichting Climate Adaptation services, 2020; Wageningen Environmental Research, 2019).

Climate adaptation and mitigation are necessary to cope with climate change while maintaining our living environment, sustaining our food production systems and preserving our ecosystems (Ayers & Dodman, 2010). Choosing adaptation strategies is challenged by the many interests at stake and possible trade-offs with climate mitigation. For example, a high urbanisation rate prioritizes housing, high risk of floods prioritises room to store water surpluses, and a focus on renewable energy transition focuses on building solar parks (Wolters et al., 2018). Even though climate (mitigation) targets are set at international, national and even regional level, high uncertainties remain at the local level on how to implement those climate targets while adapting to and mitigating climate change (Lempert et al., 2004).

Land-use change exemplifies this complexity resulting from uncertainty on socio-economic development and stakes interacting with the biophysical environment (Bukovsky et al., 2021). For example, an economic focus on agricultural production in the future could imply that agricultural lands expand. However, new technologies and alternative agricultural practices could show a different interpretation and direction of land-use with this economic focus. Besides, due to effects of climate change, agricultural practices have to change in order to keep those profitable (Lesschen et al., 2020). Gaining insight into the direction of land-use development is crucial, especially with the urgency of adapting to and mitigating climate change while minimising trade-offs. Scenarios development is a widely used concept to explore possible futures by taking into account uncertainties in future development (Peterson et al., 2003). So, scenario planning can be used to gain insight in uncertainties in land-use development.

The Northern IJssel Valley (NIV) is a diverse region in the Netherlands and sub-catchment of the water authority Vallei & Veluwe. The flank of the Veluwe is an elevated part of the valley where droughts are experienced, causing water shortage in the agricultural and domestic sector. The floodplains and clay soils close to the IJssel are dealing with wet conditions due to seepage of the Veluwe and the IJssel (van den Oever et al., 2020). The NIV consists of different types of land-use: urban areas, agricultural areas with crops, cattle and arboriculture and nature areas. Uncertainties on future land-use in the NIV relate to extremes in climate and current diversity in land-uses (de Ruyter, 2020) and policies, such as the national nitrogen policy, the new environmental policy, the protein transition and the increasing importance of nature in a living environment (Bouwer et al., 2010; Breeman, 2020).

Water authority Vallei & Veluwe developed the Blauwe Omgevingsvisie 2050 (BOVI 2050), a vision aiming for a climate robust future for the water authority, and so for the NIV. So, this vision describes a preferable future state of the region. In order to turn this vision into action, climate adaptation and mitigation measures are required in the NIV. Therefore, the water authority participates in KLIMAP (Klimaatadaptatie in de Praktijk), a research project providing guidelines and practical tools to sustain soil and water systems.

The BOVI 2050 can be seen as goal oriented and focuses on how the future “should look like”. How to reach this goal is uncertain, as the future depends on large biophysical and socioeconomic uncertainties. Explorative scenarios are a tool to systematically explore and analyse possible futures by taking into those uncertainties. (Peterson et al., 2003; Kok et al., 2011). Explorative scenarios for land-use in the NIV are needed, to explore possible future for land-use the NIV. Water authority Vallei & Veluwe and KLIMAP can use those explorative scenarios as basis to build climate adaptation and mitigation measures upon, in order to achieve targets as described in the BOVI 2050.

Research on explorative scenarios is done on socioeconomic trends on the global scale, translated into the Shared Socio-economic Pathways (O'Neill et al., 2017). On the national scale, the Delta scenarios translate both socioeconomic and biophysical trends into scenarios for the Netherlands (Bruggeman & Dammers, 2013). Those explorative scenario studies are not yet downscaled to the local level for the NIV. Downscaling those higher-level scenarios to local-level scenarios has the added value that

important large-scale processes and developments are taken into account while developing local-level scenarios (Kok et al., 2007). Besides, no research is done on developments and trends specifically on land-use for the NIV. A bottom-up approach is needed in order to gain insight in how local stakeholders see the future of the NIV when it comes to land-use development.

This research has the objective to develop and analyse future land-use development scenarios in the NIV. The scenarios are based on existing higher-level scenarios in order to include effects of higher-level developments on the local-level (Pedde et al., 2020). The land-use scenarios integrate stakeholder knowledge on the NIV. Insights and worldviews from stakeholders are included because those are the people who influence or are influenced by those changes. Participatory scenario planning supports this, by identifying and analysing uncertainties about the future land use developments in the NIV with stakeholders (Peterson et al., 2003). In order to place the scenarios into perspective of other explorative scenario studies, the higher-level scenarios are compared with the local-level scenarios. So, this research aims to answer the following research question: *What are plausible local-level land-use scenarios for the Northern IJssel Valley for the coming 30 years and how do they relate to higher-level scenarios?*

## 2. Conceptual framework

Figure 1 shows the conceptual framework used in this research. Scenario planning (box 1) can be explorative and normative. Normative scenario planning answers the question ‘what should happen?’ (box 6). In this research, the focus will be on developing explorative scenarios for the NIV (box 2). Explorative scenario planning answers the question ‘what could happen?’. Multiple levels will be addressed when developing the scenarios for the Northern IJssel Valley by using a set of combined higher-level scenarios (box 3). Relevant stakeholders are addressed by means of archetypes in a participatory approach of scenario development. This leads to an inclusive set of scenarios (box 4). The developed local-level scenarios are explorative, with a combined higher-level scenario input, by using a participatory approach (box 5). In this chapter, all elements of this framework are further explained.

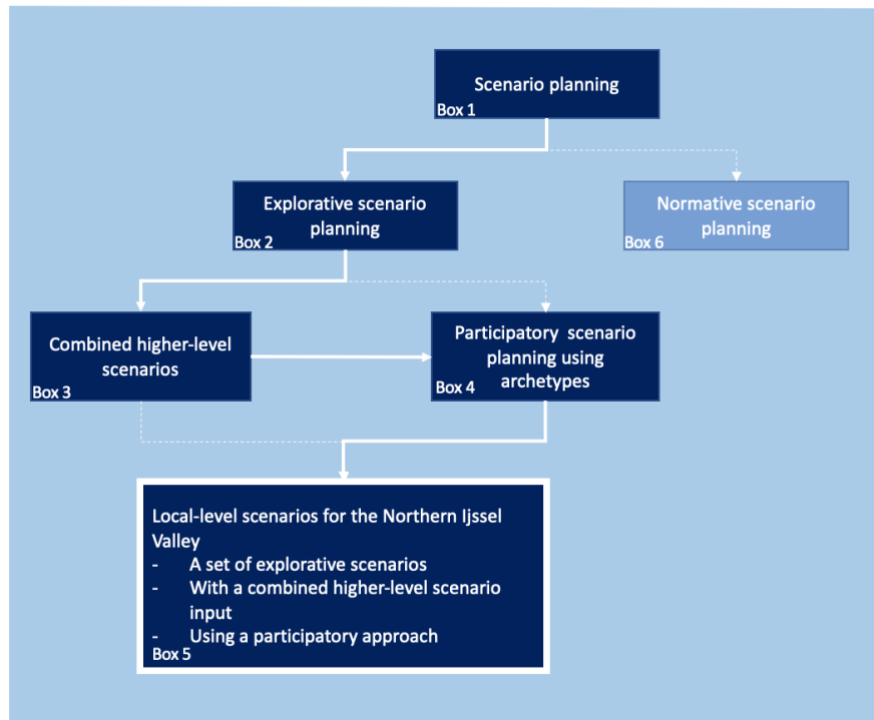


Figure 1 - Conceptual framework

### 2.1. Scenario planning

Scenarios are widely used in science and policy-making processes. In different communities, different terminologies for scenarios are used. One of the definitions is as follows.

*“On a very general level a scenario can be described as a plausible description of how the future may develop based on a coherent and internally consistent set of assumptions. This very broad description includes an extremely wide array of types of scenario and uses of scenarios” (Ansems et al., 2019).*

So, scenario planning (box 1) shows an approach used to explore futures while the circumstances are uncertain. Scenarios structure information on uncertainties and identify relations between those uncertainties. For the future, many factors or variables within the system play a role and therefore, different scenarios represent different combinations of developments in the future. A scenario can be seen as a possible future state of a system. Scenario planning is a relevant tool in relation to climate change because of the uncertainty of the effects of climate change on both global, national and regional level (Pedde et al., 2020). How those elements will separately affect the future is uncertain (Flynn et al., 2018). Scenario planning aims to make it possible to make plans for the long term, which are strategically related to the uncertain circumstances (Amer et al., 2013).

Scenarios can be developed qualitatively, where narratives and other qualitative elements are the outputs, and quantitatively, where models provide quantitative outputs (Shackley & Deanwood,

2003). Quantitative and qualitative scenarios can complement each other. Quantitative models provide data on climate and other quantitatively measurable dynamics. Those can be improved with qualitative data on socio-economic dynamics (M. T. J. Kok et al., 2017). There are three different types of scenarios: probable, possible and preferable scenarios. Probable scenarios predict scenarios for the short time-scale and methods to do so are relatively fixed (Ansems et al., 2019). Definitions and methods for developing possible and preferable scenarios are more variable on orientation, time-scale and spatial scale (van Notten et al., 2003). Possible scenarios answer the question “what can happen?”. For quantitatively model-based scenarios, the term ‘projection’ is mainly used to address the possible future. For qualitatively developed models by using narratives, the term ‘explorative scenario’ is used. Preferable scenarios answer the question “what should happen” and the terms “pathways”, “goal-oriented scenarios” and “normative scenarios” are used (Börjeson et al., 2006). At the local-level, explorative scenarios can be developed to explore the future for that specific region, after which normative scenarios can be built in order to cope with location-specific developments and challenges (Ansems et al., 2019).

## 2.2. Explorative scenarios

In this research, the focus is on developing explorative scenarios (box 2). So, possible or plausible futures for, in this case the NIV, are developed on the time-scale of 30 years. All uncertain factors are considered in a systemic way and span alternative futures rather than focusing on one single prediction of the future. The uncertainty space is defined by the level of influence of the separate elements in the system (Peterson et al., 2003). The aim of this research is to develop a set of scenarios which represents the bandwidth of all possible futures for the NIV. Explorative scenario development takes into account all possible elements influencing the context of, in this case, land-use in the NIV.

## 2.3. Combined higher-level scenarios

Scenarios are developed on multiple levels: global, national, regional and local. Every level on which a scenario is developed, has its own corresponding processes related to this level. In general, global drivers cause global changes and local drivers cause local changes. Examples of global drivers with global effects are climate change and globalisation: world-wide, the results and consequences of both climate change and globalisation are experienced. Examples of local drivers are changes in local regulations and cultural traditions: if those change, results are mainly felt at the local level. Using a multi-level approach, a set of combined higher-level scenarios (CHLSs) (box 3), was developed. This helps to better understand the different processes at those different levels and the interactions across processes and across levels (Kok et al., 2007). When developments happen at the global level, this may influence, in this case, land-use at the local level. Therefore, it is important to take driving forces and developments from all levels into account in order to include their effects at the local level.

The scenarios used as input for the CHLSs are developed with a top-down approach in which the developed knowledge is model and data-driven (Flynn et al., 2018). By using a top-down approach in scenario development, the boundaries of the developed scenarios are broad. For example, the Representative Concentration Pathways (RCPs), which are developed for the global level and in which global drivers are taken into account. This has the advantage that fundamental drivers are not missed when developing scenarios (Falloon et al., 2014).

The scenarios for the NIV build on existing scenarios by including relevant scenarios developed at different levels to ensure that all important processes are taken into account. In addition, using a multi-level approach incentivizes stakeholders to think more broadly when developing narratives for the local level (K. Kok & Van Delden, 2013).

## 2.4. Participatory scenario planning

Scenario development (box 4) can be done with a bottom-up or a top-down approach. A top-down approach is mainly model and data-driven (Flynn et al., 2018). A bottom-up approach is participatory and implies that stakeholders are involved in the generation of knowledge. A bottom-up approach gives the opportunity to include the opinions, perceptions and worldviews of all stakeholders, to

enable them to shape possible futures which are relevant to them (K. Kok et al., 2011). Participatory scenarios stimulate creative thinking and awareness on the challenges and opportunities of the future system, both in the short and long term (Kok et al., 2011). By means of co-production of scenario development, this approach can be seen as an integrated learning process for all stakeholders: academia, policymakers, farmers and inhabitants (Flynn et al., 2018). By using a participatory method, all stakeholders are directly involved and they therefore help to shape possible futures which are relevant and can adapt to changing conditions (Kok et al., 2011). Archetypes are used in order to facilitate future thinking in this participatory approach (Hunt et al., 2012). Archetypes are families of scenarios which represent different worldviews for the future. Those archetypes visualise drivers for future change and the interaction between them. Every archetype focuses on a specific direction in which the world could develop (Hunt et al., 2012).

## 2.5. Combining top-down and bottom-up approaches for downscaling

This research focusses on integrating combined higher-level scenarios (CHLSs) with a participatory approach to develop local-level scenarios (LLSs) for land-use in the NIV. A top-down and a bottom-up approaches are integrated. On the one hand, large-scale drivers and developments regarding land-use development are included. The set of CHLSs is downscaled to the context of the NIV. On the other hand, stakeholder knowledge is used to evaluate the impact of the large-scale driving forces and developments for land-use in the NIV. The integration of those approaches aims to develop a set of explorative scenarios, combining the advantages of CHLSs and co-production with stakeholders (box 5). The approach is described in the methodology.

## 2.6. Glossary

Table 1 shows an overview of all concepts and terms. For every term is defined how it is used in this research.

	Combined higher level scenarios		Local-level scenario					
Level 1: Archetype	Regional sustainability	Global Economy	Regional Sustainability			Global Economy		
Level 2: Theme	Scenario for Regional sustainability	Scenario for Global Economy	Scenario for Regional Sustainability			Scenario for Global Economy		
			Sub-scenario 1	Sub-scenario 2	Sub-scenario 3	Sub-scenario 1	Sub-scenario 2	Sub-scenario 3

Table 1 - Overview of terminology

Term	Definition
<i>A scenario study</i>	A study which aims to explore the future by researching the effects of combined different developments and processes. A scenario study contains at least two single scenarios. Examples of scenario studies are the SSPs and the Delta Scenarios.
<i>A single scenario</i>	One specific scenario in a scenario study. For example, DRUK from the Delta Scenarios or Fossil Fuelled Development from the SSPs.
<i>Level</i>	A position on the spatial scale that describes the rate of abstraction and detail of a scenario. Relevant levels for this research are the global, national, province and local level.
<i>Combined higher-level scenario (CHLS)</i>	A scenario based on a combination of scenarios from the global, national and province level. A CHLS includes processes and developments from different levels which influence land-use in the NIV.
<i>Local-level scenario (LLS)</i>	A scenario that consists of detailed information and location specific elements for land-use in the NIV.
<i>Archetype</i>	A level-independent worldview in which fundamental processes and developments for the biophysical environment and socio-economic society are described.
<i>Sub-scenario</i>	Variants of scenarios, in which the archetype and scenario is the same, but in which the specific development of themes varies.
<i>Theme</i>	A subject that bundles a set of elements, processes and developments influencing land-use in the NIV.
<i>Development Direction</i>	The development direction of a theme describes whether a theme spatially increases, decreases, of remains equal in the future.

### 3. Objective and research questions

#### 3.1. Objective and main research question

The main objective of this research is to develop a set of explorative land-use scenarios for the Northern IJssel Valley for the coming 30 years, in order to analyse plausible future land-use change in the area, by linking scenarios and processes at multiple levels to local stakeholder insights and views on the future of land use in NIV. By doing so, I will elaborate on the added value of large-level scenarios for local land use scenarios for, in this case, the NIV. The corresponding main research question is:

*What are plausible local-level land-use scenarios for the Northern IJssel Valley for the coming 30 years and how do they relate to higher-level scenarios?*

#### 3.2. Sub-questions

In order to address the main research question, three corresponding research question are developed:

RQ 1 – ‘Review and select’

Which combination of existing scenarios on the global, national (and province) scale are, as a set of combined higher-level scenarios, relevant for local-level land use scenarios for the Northern IJssel Valley?

RQ 2 – ‘Develop’

What local-level land-use scenarios for the NIV can be co-developed with stakeholders?

RQ 3 – ‘Analyse’

What are the differences and similarities of the combined higher-level scenarios (RQ1) and the local-level land use scenarios for the Northern IJssel Valley (RQ2)?

## 4. Methodology

In this chapter, the case study area and the used methods are described in order to answer the main research question: *What are plausible local-level land-use scenarios for the Northern IJssel Valley for the coming 30 years and how do they relate to higher-level scenarios?*

### 4.1. Case study area and background

The case study area of this research is the Northern IJssel Valley (NIV). This is the area between Apeldoorn, Deventer and Zwolle, defining a sub-catchment of water authority Vallei & Veluwe as shown in Figure 2. The boundaries of the region are set by the flank of the Veluwe on the west-side and by the river the IJssel on the east-side. The region is characterized with polders and large-scale agriculture in the north of the valley. Towards the south, more variety in the landscape can be identified: agriculture is less large-scale and is alternated with afforestation, estates and nature. Apeldoorn and Twello form the main growth points concerning urbanisation and as this region is located on the edge of the Veluwe, recreation increases and spreads towards the valley. Besides, cultural history of Polder Nijbroek and other polders play an important role in the region (de Ruyter, 2020). Together, this results in a wide range of stakeholders at play.

The west and southwest sides of the valley contain sandy soils and are the more elevated parts of the region. The northern and eastern parts of the valley consist of riverine clay soils, as an effect of deposition of the IJssel. Those parts receive seepage from both the Veluwe and the IJssel. Those areas are therefore characterized with their soggy grounds and called are 'broeklanden'. Water in the region is drained towards the north and partly towards the east by using a drainage system with canals, ditches, sluices and pumping stations (de Ruyter, 2020).

Even though water authority Vallei & Veluwe focuses on 'retention, storing and draining' (vasthouden, bergen, afvoeren), in practice the focus has been mainly on draining a water surplus as quickly as possible during and after extreme rain events (Rijkswaterstaat en Unie van Waterschappen, 2019). Currently, the vision of water management is changing. In 2019, the water authority developed the Blauwe Omgevingsvisie 2050 (BOVI 2050), in which a new way of thinking about water is central. In this vision, water gets a leading role in water management and land use planning. This means that the function of water in the human system becomes less important. How water flows in the natural system is prioritized: 'function follows level', instead of 'level follows function' (van Eijk et al., 2019). The BOVI 2050 serves as a starting point for adaptive water management and climate adaptation in general for the water authority Vallei & Veluwe.

As the water board aims for a climate adaptive water system, they joined the research project KLIMAP (Klimaatadaptatie in de Praktijk). This co-operation of research and engineering institutes, organisations and governmental bodies aims for a climate robust system of the sandy soils in the Netherlands. KLIMAP provides guidelines and practical tools for nature, agriculture and urban areas to sustain soil and water systems on those sandy soils. This research aims to propose land-use scenarios for the NIV in order to implement relevant climate change adaptation measures. KLIMAP is a relevant context for this research. The qualitative nature of this research is a valuable scientific addition to the quantitative methods used by KLIMAP to develop scenarios and can therefore be used as baseline for adaptation measures.



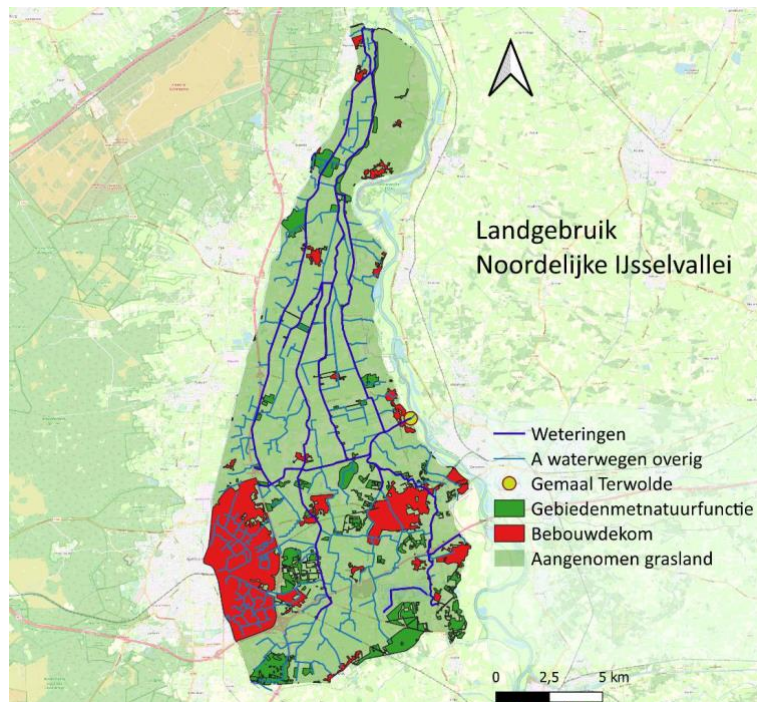


Figure 2 - Land-use in the Northern IJssel Valley (van den Oever et al., 2020)

#### 4.2. Overview of methods

Figure 3 shows an overview of all methods used in steps. Every single research question belongs to its own stage, with in every stage the taken steps. First, a set of combined higher-level scenarios (CHLSs) is created by using existing literature. Then, this set of CHLSs is translated into local-level scenarios (LLSs) by use of stakeholder interviews. Afterwards, the CHLSs and the LLSs are compared. In the final stage, the results are validated and therefore this stage belongs to the discussion.

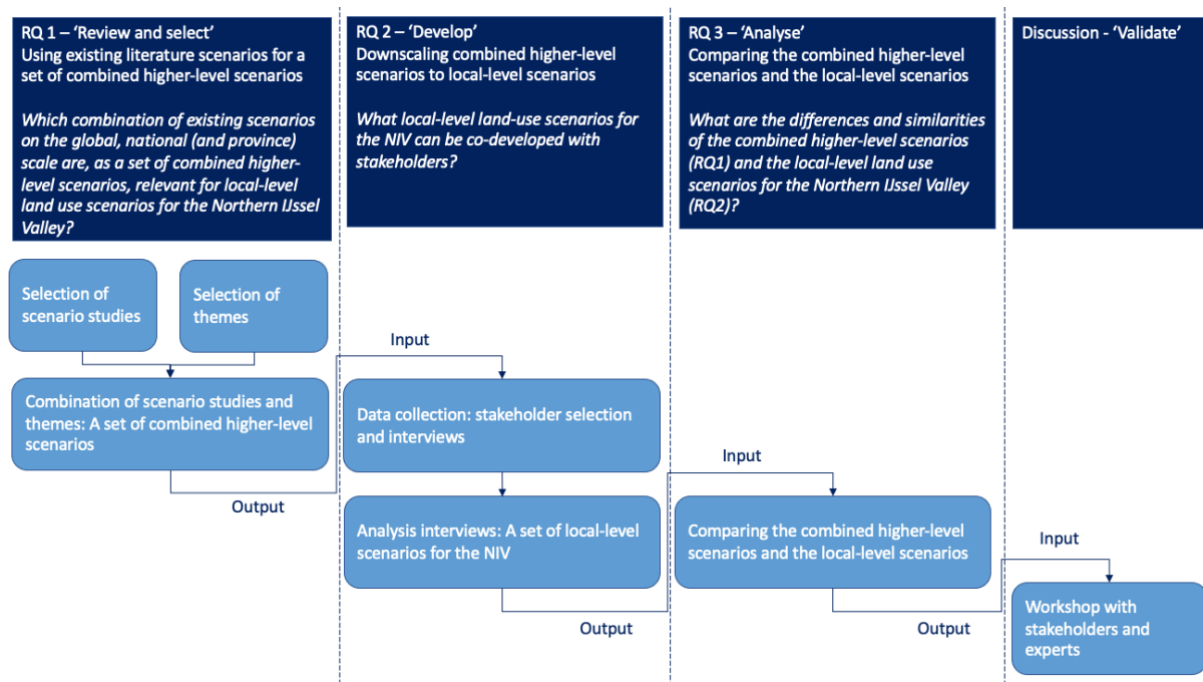


Figure 3 - Overview of methodology

#### 4.3. Review and select: Using existing literature scenarios for a set of combined higher-level scenarios

*RQ1: Which combination of existing scenarios on the global, national (and province) scale are, as a set of combined higher-level scenarios, relevant for local-level land use scenarios for the Northern IJssel Valley?*

##### 4.3.1. Selection of scenario studies

A literature review is done in order to decide which scenario studies from the literature are used as input for the combined higher-level scenarios (CHLSs). In order to comply with this multi-level approach, the aim was to include a scenario study from every level. So, the first condition was that from each level, the global, national and province level, a scenario study was included as input for the CHLSs. Besides that, the chosen scenario studies had to contain socioeconomic elements which were directly or indirectly related to land-use development. With those conditions, a selection of scenario studies could be made that covers all processes and elements from all scales that potentially influences land-use in the NIV.

##### 4.3.2. Selection of themes

The scenario studies were used as input for a set of CHLSs with the focus on future land-use change. In order to mainly focus on land-use, within the selected scenario studies, the focus was on themes that are directly or indirectly relevant for land-use change in the NIV. Later, during the process of downscaling the CHLSs to local-level scenarios (LLSs) for the NIV, those themes are the basis for land-use development in the NIV. The relevance of the themes in the selected scenario studies was assessed by use of literature regarding drivers for land-use change and by use of former studies regarding the NIV as the BOVI 2050 (van Eijk et al., 2019) and Masterplan IJsselvallei (de Ruyter, 2020).

##### 4.3.3. Combination of scenario studies and themes: a set of combined higher-level scenarios

From every scenario study was decided which single scenarios to select and how to combine those with the selected themes. There was decided which single scenarios to combine for one CHLS. The selection of the single scenarios from the different scenario studies was made based on different indicators. There has to be a high level of:

- Diversity between the two CHLSs
- Overlap in the single scenarios that are combined for one CHLS

The foundation of the two CHLSs indicates the archetypes of the two CHLSs and is based on the following aspects:

- The focus of the economy
- The value of sustainability

So, the overall direction of the input of single scenarios from the studies for one CHLS is similar, as the archetype of those single scenarios broadly overlap. A schematic overview is shown in Figure 4.

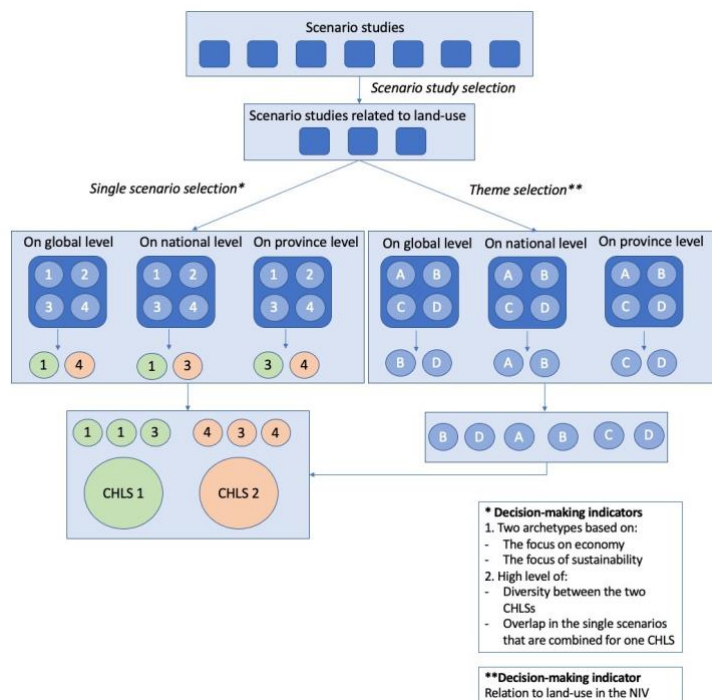


Figure 4 - Schematic overview of methodology for RQ1

In some cases, there are mismatches between the single scenarios for one CHLS. This is the case when the development of a theme in one single scenario does not fit to the development of a theme in another single scenario. When a mismatch appears, the archetype of the CHLS is leading for the decision which development of the themes to include in the final CHLS. The development of themes has to match to the archetype of that corresponding CHLS.

Finally, this has resulted in a scheme in which the set of two CHLSs scenarios was combined with the chosen elements for the themes. This scheme, serving as interview guide, was the input for development of the LLSs of land-use in the NIV.

A test interview was done with Erik van Slobbe. Based on this test interview was decided to include recreation to the list of themes, and to exclude climate change from the list of themes. Recreation was added as it became clear that this was an important theme for the NIV. Climate change was excluded because it became clear that it was too difficult to connect the themes that were directly connected to land-use development to 'moderate climate change' on the one hand, or 'extreme climate change' on the other hand.

#### 4.4. Develop: Downscaling combined higher-level scenarios to local-level scenarios

RQ2: What local-level land-use scenarios for the NIV can be co-developed with stakeholders?

##### 4.4.1. Data collection: Stakeholder selection and interviews

In order to be able to interview stakeholders with a wide variety in background, interest and profession, contacts from Wageningen University and Research, Waterschap Vallei & Veluwe and KLIMAP were used to be able to reach as many different stakeholders as possible. Snowball sampling was used to get in contact with new stakeholders. Stakeholders with the following stakes are included: employers from the different layers of the government, (agricultural) entrepreneurs located in the NIV, inhabitants of the NIV, nature conservers and researchers. In Annex 3: List of interviewees the list of (anonymous) interviewees is included. The interview guide as developed in chapter 5.1.4 was used as input for the semi-structured interviews. The interviews were used to downscale the CHLSs to LLSs in cooperation with the stakeholders. The stakeholders were asked to translate the CHLSs into LLS, by using the themes as basis for development regarding land use.

#### 4.4.2. Analysis interviews: A set of local-level scenarios

The interviews are transcribed. There was chosen to make edited transcriptions, with excluding the irrelevant parts. By use of Atlas TI, the data was coded. Every theme connected to one of the two CHLSs was given an identical colour code, in order to structure the data by theme and scenario. Concrete examples for land use development in the NIV were also coded in order to enrich the LLSs with location specific elements. An overview was made of all data per interviewee per theme, in which the main elements per theme are described. Per interviewee, a summary of main points was made, clarifying the overall direction of the corresponding scenario. Besides, the conditions, consequences and contradictions connected to that corresponding scenario were described, which gives insights into the critical elements connected to the described scenario. Table 2 shows the structural method used.

Scenario	Regional Sustainability			Global Economy		
Interviewee	1	2	...	1	2	...
Theme						
Urbanisation	Code 1a	Code 1b		Code 8a	Code 8b	
Agriculture	Code 2a	Code 2b		Code 9a	Code 9b	
Nature	Code 3a	Code 3b		Code 10a	Code 10b	
Recreation	Code 4a	Code 4b		Code 11a	Code 11b	
Technology and energy	Code 5a	Code 5b		Code 12a	Code 12b	
Policy and politics	Code 6a	Code 6b		Code 13a	Code 13b	
Market	Code 7a	Code 7b		Code 14a	Code 14b	
Summary of main points						
Conditions/consequences/contradictions						

Table 2 - Overview of codes and structured data

There was decided to propose the LLSs of Regional Sustainability and Global Economy on two levels. As perspectives and ideas of a “Regional Sustainability” and “Global Economy” future are diverse, those two levels are made in order to capture the complete diversity of plausible futures. On “archetype level”, the main elements are described that are characteristic for the corresponding scenario, based on the codes. On “theme level”, the archetypes are enriched with location specific elements. In Table 3, the enriched archetypes of Regional Sustainability and Global economy are defined as “Scenario for Regional Sustainability” and “Scenario for Global Economy”. Besides, per scenario three sub-scenarios are developed. All sub-scenarios describe a specific direction of the corresponding scenario. When comparing all data corresponding to one code, different interpretations of the corresponding scenario and themes were discovered. So, per scenario, those interpretations could be categorized into different sub-scenarios.

	Local-level scenario					
Level 1: Archetype	Regional Sustainability			Global Economy		
Level 2: Theme	Scenario for Regional Sustainability			Scenario for Global Economy		
	Sub-scenario 1	Sub-scenario 2	Sub-scenario 3	Sub-scenario 1	Sub-scenario 2	Sub-scenario 3

Table 3 - Levels of data analysis RQ2

#### 4.5. Analyse: Comparing the combined higher-level scenarios and the local-level scenarios

*RQ3: What are the differences and similarities of the combined higher-level scenarios (RQ1) and the local-level land use scenarios for the Northern IJssel Valley (RQ2)?*

In order to place the developed LLSs for the NIV scenarios into a scientific perspective, the CHLSs in RQ1 are compared with the LLSs in RQ2 (see Table 4). Differences between and similarities of the CHLSs and the LLSs are analysed. This is done on two different levels:

- On level 1, the archetypes of the CHLSs and the LLSs are discussed. The comparison was made between CHLSs and LSSs in general. So apart from Regional Sustainability and Global economy: what do CHLSs and LSSs have in common and how do they differ? Besides, there was focussed on Regional Sustainability as a CHLSs, compared to Regional Sustainability as a LLSs. The same was done for Global Economy.
- On level 2, was focussed on the comparison of the CHLSs and LLSs in general on theme level. Besides, the development of themes in each specific sub-scenario of the LLS was compared to the development of themes in the CHLS. This was done for both Regional Sustainability as for Global Economy. The development direction of a theme describes whether the theme spatially increases, decreases, of remains equal.

	RQ1: Combined higher-level scenarios		RQ2: Local-level scenario					
Level 1: Archetype	Regional sustainability	Global Economy	Regional Sustainability			Global Economy		
Level 2: Theme	Scenario for Regional sustainability	Scenario for Global Economy	Scenario for Regional Sustainability			Scenario for Global Economy		
			Sub-scenario 1	Sub-scenario 2	Sub-scenario 3	Sub-scenario 1	Sub-scenario 2	Sub-scenario 3

Table 4 - Overview of methodology for RQ3

#### 4.6. Validate: Workshop with stakeholders and experts

The results from research questions one, two and three were discussed with a selection of interviewed stakeholders and experts from KLIMAP on scenario development in the form of an online workshop. During this interactive workshop, the LSSs for the NIV were presented to the stakeholders and experts. Besides, questions were asked on the results and the methodology and choices were discussed critically. Those questions and discussion points were used for the discussion of the report. The set-up of the workshop can be found in Annex 4: Workshop.

## 5. Results

In this chapter, the results of the research are presented. First, the selection of scenario studies for the combined higher-level scenario (CHLS) input is described (chapter 4.1). Then, the translation of those CHLSs into local-level scenarios (LLS) is presented (chapter 4.2). Finally, CHLSs and the LLSs are compared (chapter 4.3).

### 5.1. Review and select: Using existing literature scenarios for a set of combined higher-level scenarios

In this chapter, research question 1 is answered: *Which combination of existing scenarios on the global, national (and province) scale are, as a set of combined higher-level scenarios, relevant for local-level land-use scenarios for the Northern IJssel Valley?* First, the selected scenario studies are discussed and described. Then, there is elaborated on the selected themes from the selected scenario studies. Afterwards, the selected themes are matched with the selected single scenarios. Finally, the input for participatory scenario development is presented.

#### 5.1.1. Selected scenario studies

As input for participative scenario development by means of interviews, scenario studies on the global, national and province scale are reviewed in order to select relevant scenario studies. Table 5 shows an overview of the reviewed scenario studies, with the selected scenario studies in bold.

The selection of scenario studies covers every level. As described in the conceptual framework, the participatory scenarios have an explorative character. For that reason, the selected scenario studies are also explorative. Three scenario studies are selected.

The single scenarios from both the SSPs and the Delta scenarios are studied in order to select a set of two CHLSs as input for developing the local scenarios for the NIV. The summaries of the single scenarios can be found in annex 1 and annex 2. The final CHLSs contain both global elements from the SSPs and national elements from the Delta scenarios. No specific elements from the Toekomstverkenning Platteland Gelderland 2050 (TPG 2050) are included in the set of CHLSs. However, the philosophy of the three visions developed in the TPG 2050 are taken into account during stakeholder interviews. In this paragraph, all studies are described and there is elaborated on the reason for selection.



Scale	Scenario	Input	Output				source
			Data	Time horizon	Type of output	Scenario type	
Global	Representative Concentration Pathways (RCPs)	land use, atmospheric emissions and concentration data	Four scenarios on climatological changes	Up to 2100	quantitative	Explorative	(van Vuuren et al., 2011)
	<b>Shared Socioeconomic Pathways (SSPs)</b>	<b>Climate policy, socioeconomic conditions, climate models</b>	<b>Narratives for five different scenarios; Trends in both societies and ecosystems</b>	<b>Up to 2100</b>	<b>qualitative</b>	<b>explorative</b>	<b>(O'Neill et al., 2017)</b>
National	KNMI 2014 scenarios (KNMI'14)	Based on RCPs	Four scenarios on climatological changes	Up to 2050/2085	quantitative	explorative	(Attema et al., 2014)
	Welvaart en Leefomgeving scenarios (WLO'15)	Based on SSPs	Two scenarios; regional developments, urbanization, mobility, climate and energy, agriculture	Up to 2030/2050	Qualitative and quantitative	explorative	(Manders & Kool, 2015)
	<b>Delta scenarios</b>	<b>KNMI'14 and WLO'15</b>	<b>Narratives for four different scenarios; river discharge, land use change</b>	<b>Up to 2050/2100</b>	<b>Qualitative and quantitative</b>	<b>explorative</b>	<b>(Wolters et al., 2018)</b>
Regional	Blauwe Omgevingsvisie 2050 (BOVI 2050)	Policy, faced challenges in water board Vallei and Veluwe	Targets and ambitions for the system of water board Vallei and Veluwe	Up to 2050	Qualitative	normative	(van Eijk et al., 2019)
	Actieplan natuurinclusieve landbouw Gelderland	Policy, faced challenges in provincie Gelderland	Targets and ambitions for the agricultural sector in Gelderland	Up to 2030	Quantitative	normative	(Provincie Gelderland, 2019)
	<b>Toekomstverkenning Platteland Gelderland 2050</b>	<b>Workshops and interviews with stakeholders and professionals</b>	<b>Three scenarios; trends in the rural areas of the province of Gelderland</b>	<b>Up to 2050</b>	<b>Qualitative</b>	<b>explorative</b>	<b>(van Duijne et al., 2017)</b>

Table 5 - Overview of reviewed scenario studies

### *The Shared Socioeconomic Pathways*

For the global scale, the Shared Socioeconomic Pathways (SSPs) are chosen to use as input for the participatory scenario development. This study is chosen because it contains socioeconomic trends and developments related to global land-use, which might be indirectly connected to land-use development on the local level. The global trends in the SSPs are described broadly and can therefore be downscaled easily to NIV-related developments. The data in this study is analysed qualitatively and this resulted in a set of five single scenarios. For each scenario, a narrative is developed which describes the socioeconomic developments and the coherence between the developments in the scenario. This is useful input for CHLSs in this research, as the main results of this research are scenarios including narratives. Besides, the SSPs focus on challenges for adaptation and mitigation. How is dealt with climate is one of the main focuses for the archetypes of the CHLSs (see chapter 4.3.3). Therefore, the SSPs fit as input for the CHLSs.

The SSPs consist of a framework developed to analyse possible trends in society up to 2100 on a global level. The five developed SSPs are based on socio-economic challenges for adaptation and mitigation to climate change: low to high challenges for adaptation on the x-axis and low to high challenges for mitigation on the y-axis. The goal of the SSPs is to produce scenarios in which socioeconomic and environmental conditions are taken into account when evaluating both climate change and climate impact. Therefore, the SSPs themselves do not include climate change and climate policy.

The SSPs consist of qualitative and quantitative elements. Qualitative elements are the narratives behind the different scenarios. Quantitative elements are the different assumptions on for example population growth and economic growth (O'Neill et al., 2017).

The different scenarios visualize the range of uncertainties in mitigation and adaptation to climate change. Challenges for mitigating climate change can be seen as the effort that is required to achieve climate outcomes, for example reducing greenhouse gas emissions by emitting less. The SSPs themselves do not include mitigation targets. The SSPs only represent possible future societies in which achieving mitigation targets (without quantifying those), is harder or easier, dependent on the specific SSP. Challenges for adaptation to climate change can be seen as needed actions to prepare ecosystems and societies for and protect them to the effects of climate change, for example shifting to salt tolerant crops. Also, for challenges for adaptation to climate change, the SSPs do not include adaptation goals themselves. The different SSPs represent different societies in which adapting to climate changes is harder or easier for every single SSP (O'Neill et al., 2014).

The SSPs are based on developments in climate change on the one hand, and socioeconomic development and policy assumptions on the other hand. Developments in climate change are represented by the Representative Concentration Pathways (RCPs) (van Vuuren et al., 2011). Policy assumptions are based on the Shared climate Policy Assumptions (SPAs), in which policies are defined for different levels of robust strategies (Kriegler et al., 2014).

Figure 5 shows a summary of the SSPs Framework. An elaborate description of the single scenarios with corresponding elements can be found in Annex 1: Descriptions of the five Shared-Socioeconomic Pathways.



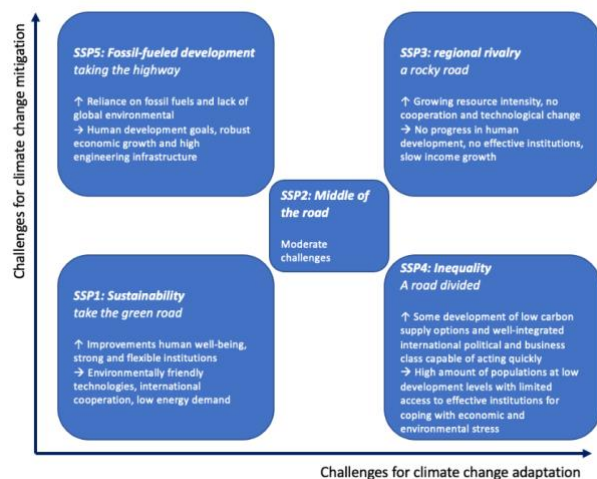


Figure 5 - Schematic overview of the Shared Socioeconomic Pathways

### The Delta Scenarios

For the national scale, the Delta Scenarios are chosen to use as input for the participatory scenario development. This explorative scenario study is selected because this study contains climatic and biophysical elements from the KMNI'14 scenarios and it contains socio-economic elements from the WLO'15 scenarios. In this study, spatial developments related to changes in the landscape of the Netherlands are included and therefore contain relevant themes for landscape developments at the local level (Wolters et al., 2018).

The Delta Scenarios consist of a framework of four scenarios for the Dutch context. In this framework, developments in climate change and socioeconomic growth are combined and provide four scenarios in which developments up to 2050 are described. On the x-axis moderate to extreme climate change is visualized and, on the y-axis, socioeconomic shrink to socioeconomic growth is visualized. The goal of the Delta Scenarios is to provide as a base when testing, evaluating and selecting strategies for climate change under different circumstances. Therefore, also the Delta Scenarios do not include climate policy.

The Delta Scenarios consists of a combination of qualitative and quantitative elements. In general, the climatological developments are expressed quantitatively and are based on the KMNI'14 scenarios. The socio-economic developments are expressed both quantitatively and qualitatively. Those developments are based on the WLO'15 scenarios.

With the Delta Scenarios, both moderate and rapid climate change can be combined with both economic growth and economic shrink. This results in four scenarios: 'DRUK', 'STOOM', 'RUST' and 'WARM'. Every scenario has a story line which contains the main challenges and opportunities corresponding to the circumstances of that specific scenario.

Figure 6 shows a summary of the Delta Scenarios. An elaborate description of the single scenarios with corresponding elements can be found in Annex 2: Descriptions of the four Delta Scenarios.

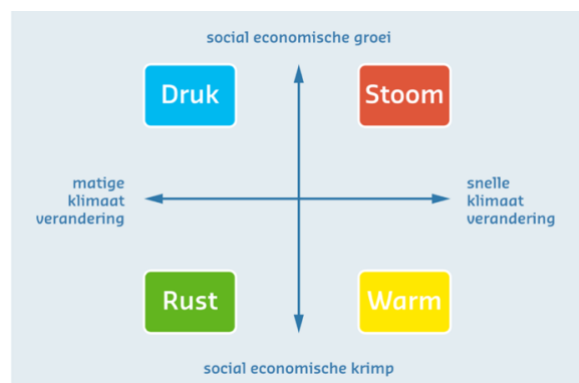


Figure 6 - Schematic overview of the Delta Scenarios

### *Toekomstverkenning Platteland Gelderland 2050*

For the regional scale, in this case province scale, the Toekomstverkenning Platteland Gelderland 2050 (TPG 2050) are chosen to use as input for the participatory scenario development. This explorative scenario study is selected because this study contains specific insights of possible developments in the rural and urban area specifically for the province of Gelderland and is based on the research of Lesschen et al. (2020) about the direction of development of the countryside of the Netherlands. Besides, within this vision development is not made use of a matrix with socioeconomic and/or climatic development but is only dived into the relation between the urban and rural area by having more specific knowledge about the area as a whole. The framework differs from the frameworks of the SSPs and the Delta Scenarios and give therefore a new perspective on relationships between developments regarding land-use.

The TPG 2050 provide three visions focussing on the relation between urban areas and rural areas in the Province of Gelderland. Those visions are developed in order to place societal into perspective focusing on the future (van Duijne et al., 2017). Those visions are shown in Table 6. Questions about how the urban and the rural area will develop depends on societal focus for the future. The visions are created in cooperation with stakeholders and experts of the Province of Gelderland. The TPG 2050 is used as baseline for future spatial planning policies.

Vision	Main direction	Sub-elements
1	The countryside serves urban and national interest	Rural areas are purely functional: economic, recreational and nature Relations with foreign countries also play a role in this
2	Equal relationship countryside and city	No dividing lines between city and countryside
3	The countryside has an autonomous position	Natural values and community values are paramount Small-scale agriculture and recreation Both economic value and nature / high-quality environment are the starting point: balance

Table 6 - Overview of Toekomstverkenning Platteland Gelderland 2050 (van Duijne et al., 2017)

#### 5.1.2. Selected themes per scenario study

For every selected scenario study, relevant themes for land-use development are described.

#### *The Shared Socio-economic Pathways*

Within the SSPs, different themes are taken into account while developing the scenarios. The included themes in the SSPs are: 1) demographics, 2) economic development, 3) welfare, 3) environmental and ecological factors, 4) resources, 5) institutions and governance, 6) technological development, 7) broader societal factors, 8) policies (excluding climate policy)

Not all themes are relevant for land use developments for the NIV specific. Only those that potentially influence land use development in the NIV in a direct or indirect way are used from those global scenarios. In the end, the CHLSs must include themes which are connected to land use development in the NIV. Stakeholders that were interviewed needed to be faced with themes and processes from which they can image how those processes may influence the NIV in terms of land-use developments. The following global themes from the SSPs are relevant for potential land use developments in the NIV. For every theme will be explained which elements may play a role in land use development for the NIV and how.

### 1. Economy and lifestyle

The global economy influences the economy on the national and regional scale. Developments at the global market stimulate developments at markets on national and even regional scale. When there is a high global economic growth and the main focus is on globalisation, this influences the global market. The main focus is on developing a global market system with an intensive character and these developments will be felt at the regional scale (Holling, 2001). The global market system will stimulate exportation and importation of products between countries. In the agricultural and industrial sectors, production systems will be focused on large-scale and intensive production. When global economic growth stagnates and the focus on economy and production will shift to small-scale markets, production chains will be shorter (O'Neill et al., 2017). Besides, the state of the global economy influences prices on the global market. Prices of goods and resources may flow with the state of the global economy. These developments may influence land-use and spatial planning in terms of types of production in the industrial and agricultural sector and also how these productions are set up: intensive versus extensive, large-scale versus small-scale, for long versus short production chains. Next to the effects on the global market, the global economy also influences the standards in human well-being and education. As an effect of global economic growth, more jobs come available, and wages rise. This results in higher standards in human well-being. On the one hand, this may result in a more 'intense' lifestyle combined with more CO<sub>2</sub> emission and pollution (Kriegler et al., 2017). On the other hand, this may result in an increased perceived value of nature and climate change awareness and so a shift to a sustainable lifestyle (Stolwijk, 2011).

### 2. Technology

Together, the global market, human well-being and education influence the level of technological development. The state of the global economy indicates to what extent technological development is possible. Besides, those elements influence the 'direction' of this technological development: into the direction of large-scale production and natural resource extraction, or into the direction of sustainable technologies and renewable energy production. Those trends in technological development affect land-use at the regional scale, namely in terms of use of technology in the agricultural and industrial sector, but also in the human living environment (Verburg et al., 2008).

Besides, technological development on itself may influence land-use on the regional scale. First, whether there is technological development or not, has to be questioned and in that sense influences future land-use development. Then, when assumed that there will be technological development, the type of technological development on the global scale is important. Whether technological development is sustainable or not, gives to some extent direction of land-use and spatial planning (O'Neill et al., 2017). New sustainable technologies may result in a different type of land-use than new non-sustainable technologies.

### 3. Environment and natural resources

In general, there can be assumed that sustainable technologies are more focused on a reduced energy use or on more renewable energy. In contrast, new non-sustainable technologies are less focused on energy reduction or renewable energy and are more based on fossil energy use. This also influences land-use at the regional scale in terms of focus on renewable energy production and using (non-) sustainable technologies in different sectors (Kriegler et al., 2017).

To some extent focus on and the perceived importance of the environment, in terms of natural value and biodiversity on the global scale, will influence land-use development on the regional scale. This is related to education and human well-being. When there is an increased well-being, there might be more production and emission resulting in environmental degradation on the one hand, or more room for environmental development and an increased value of nature and environment on the other hand. This influences land-use developments on the regional scale in terms of to what extent there will be focused on sustainable land-use and room for natural areas and ecosystem functioning (O'Neill et al., 2014).

#### 4. Policies and institutions

In the SSPs, policies related to climate and environment are not included. However, policies on development, technology, infrastructure, energy security and protection of air, soil and water quality are included and those, to some extent, overlap with climate and environmental policy. Besides, the level of cooperation between countries is analysed and the existence, type and effectiveness of institutions on all levels are taken into account (O'Neill et al., 2014).

The analysed policies on the global scale on the above-mentioned themes, influence land-use developments on the regional scale. To what extent those policies influence land-use developments, depend on the degree of cooperation between different countries. When countries cooperate closely, and so policies on those different themes are implemented and adhered, these policies will have a large impact on the land-use development and planning on the regional scale. When there is no cooperation between countries and policies and institutions are fragmented, land-use development will be less influenced by global policies and institutions and more by national and regional policies and institutions (Geerlings & Stead, 2003).

#### *The Delta Scenarios*

Within the Delta Scenarios, both socioeconomic and climatological themes are taken into account. For the socioeconomic used to develop the scenarios are 1) economic growth, 2) demographic development, 3) urbanisation, 4) agriculture, 5) nature and recreation, 6) shipping, 7) energy supply and 8) drink and process water. The climatological themes in the Delta Scenarios are 1) sea level rise, 2) temperature rise, 3) precipitation (deficit) and 4) discharge of the Maas and the Rijn.

Also, for the Delta scenarios will be analysed which themes are relevant for land use developments in the NIV specific. As the Delta scenarios are developed for the national scale, a lot of the developments and processes within those themes will, directly or indirectly, influence possible future land use developments in the NIV. For every theme will be elaborated on the importance of that specific theme related to the other theme. Besides, there will be explained which elements may play a role in land use development for the NIV and how. The following themes may directly influence land use developments in the NIV:

##### 1. Urban areas and regional developments

It is uncertain whether urbanisation will rise or stagnate. Besides, it is important to get insight on the locations where urbanisation will be focussed. When urbanisation will rise significant, but this happens mainly in the Randstad, this will have other consequences compared to urbanisation spread over the whole country, including the less urbanised regions in the middle and the east of the Netherlands (Ritsema Van Eck & Koomen, 2008). How regions will develop in terms of urbanisation will result in more or less regional differences. For the NIV, the ratio of urbanisation combined with the regional spread, will influence to what extent the urban areas, for example Apeldoorn, will develop and whether the nature areas in the valley will increase or decrease (de Ruyter, 2020).

##### 2. Agricultural areas

The main challenge in future agricultural developments is how life-stock production will develop next decennia. Whether extensive or intensive agriculture will increase, depends on the (international) market, consumers and farmers. When the market and the consumer's focus shift to more sustainable, organic, and even meatless products, the agricultural sector will change. The amount of life-stock production may decrease, and this may also happen in the NIV (Lesschen et al., 2020). Besides, the focus on climate adaptation and mitigation influences the agricultural sector. When climate adaptation and mitigation will become a priority, the agricultural sector will be designed differently. Different crops will be cultivated and systems as agroforestry and water inclusive agriculture become more prominent. When the agricultural sector will mainly focus on large-scale production for the (global) market, this will also affect the landscape. As a large amount of land use in the NIV is agricultural, the land use will be influenced by those trends (Wolters et al., 2018).

### 3. Climate, energy and technology

The Delta scenarios do not include climate policy. However, how in general will be dealt with climate change may influence land use developments for the NIV. Climate change is highly related to energy use and technology. More sectors will be affected with possible land use changes depending on the direction of energy and technological development (Manders & Kool, 2015). With a focus on renewable energy, the focus in land-use might shift to technologies related to renewable energy, for example solar panels. Such technologies can for example be located on former arable land. Besides, a focus on renewable energy can result in more production of, for example, biofuels. This may result to a shift in types of cultivation. Also, new sustainable technologies might influence be infiltrating in the city. Urban areas might be differently designed and planned, depending on those technologies. On the other hand, when the focus will be more on fossil fuels, land-use in the NIV will not be directly affected, but the indirect effects will be explained in theme 'economic growth' (Verburg et al., 2004).

### 4. Mobility

The IJssel is an important river for shipping transport and the A1 and the A50 cross the area. Besides possible expansion of the high-way and train network, developments in mobility do not have direct influence on land use in the NIV (Manders & Kool, 2015).

The above themes are all indirectly related to each other and to the rest of the themes playing a role in the Delta scenarios. The following themes can be seen as the underlying themes for all socio-economic developments and indirectly influence land use developments in the NIV:

### 5. Population and households

The direction the national population is developing influences all themes in the Delta scenarios, so this theme serves as an underlying theme for all developments. Population growth means more people to be settled and population decline may result in an economic stagnation. Also, these demographic developments influence urbanisation and regional development. Depending on the circumstances, a growing population might result in an increase in urbanisation and with a stable population urbanisation will stagnate. Besides, a growing population might result in less nature areas (Wolters et al., 2018). But in combination with other developments, for example economic growth and an increased welfare, priorities might shift. Nature may become more important, and urbanisation may be focused on the Randstad specifically. On the one hand, population growth may result more energy use and so more CO2 emission. But together with an increase in renewables, this increase in energy use might be compensated with renewables (Manders & Kool, 2015).

### 6. Economic growth

Economic growth can as well be seen as an underlying theme for developments in all sectors and themes. An increasing economic growth stimulates many other developments that indirectly have influence on land use developments in the NIV. Economic growth stimulates population growth. Economic growth together with investing in (sustainable) energy results in more renewables or more fossil fuels, depending on the sustainability. More economic growth means an increase in welfare and so more priority for nature areas. Economic growth can also result in more sustainable technology and land management, which results in more extensive agriculture.

#### *Toekomstverkenning Platteland Gelderland 2050*

Themes included in TPG 2050 are 1) demography, 2) digitalisation, 3) changing ownership relations, 4) climate change, 5) energy transition and 6) nature quality. Those themes do overlap with the themes in the Delta scenarios and therefore are similarly related to possible developments for the NIV. However, the three visions show interesting unique insights that can be combined with themes on global and national scale (van Duijne et al., 2017). The main elements from the three visions are described in relation to land use developments for the NIV:

**a) Rural areas for practical use**

For Gelderland, this would mean that the countryside is secondary to the city. This will also be the case in the NIV. The countryside has a functional role in economy: agricultural areas are used for food production. Besides, the countryside has a functional role as nature: it will be used for recreation.

**b) Rural areas equal to urban areas**

In Gelderland, there is no dividing line between the city and the countryside. For the NIV, this means that the value of the countryside is the same as the value of the city. Urban and rural areas have the same possibilities

**c) Rural areas are autonomous**

In Gelderland, natural values and community values of the countryside are unique and not comparable with urban areas. For the NIV, this would mean a high-quality environment which is a balanced ecosystem. Small-scale agriculture and recreation are important and unique in the rural areas.

5.1.3. Combined scenarios

*Selection and combination of single scenarios*

Table 7 shows which Delta Scenarios and which SSPs are combined and what the set of combined higher-level scenarios looks like. No specific elements from the TPG 2050 are included in the set of CHLSs, because the origin and set-up were not comparable to the Delta Scenarios and the SSPs and could therefore not be combined. However, the philosophy of the three visions developed in the TPG 2050 are taken into account during stakeholder interviews.

Scenario study (input)		
Name of the single scenarios		
SSPs	SSP5: 'fossil fuelled development'	SSP1: 'Sustainability'
Delta scenarios	STOOM	DRUK and RUST
TPG 2050	n/a	n/a
Combined higher-level scenario (output)		
	<i>Global Economy</i>	<i>Regional Sustainability</i>

Table 7 - Combinations of input scenarios and corresponding combined higher-level scenarios (output)

In both SSP5 and STOOM mitigation is not to climate change is not a priority in policy and society. In both scenarios, the future relies on fossil energy as this supports economic growth on both national and international level. Both SSP5 and STOOM focus on production for the global market, in agricultural products, knowledge and technology. For those reasons, are SSP5 and STOOM the foundation for the CHLS 'Global Economy'.

In SSP1, DRUK and RUST a sustainable environment is key, both on national and international level. Mitigating and adapting to climate change is high on the social and political agenda. In both SSP1, DRUK and RUST is the economy used to create a healthy and sustainable (living) environment, so economy is not only seen as a way to grow in financial capital, but also in human and natural capital. For those reasons, are SSP1, DRUK and RUST the foundation for the CHLS 'Regional Economy'.

Not all developments and processes in every theme do match as input for the CHLSs. The matches and mismatches per theme will be discussed in the next paragraph.

Table 8 and Table 9 show the main elements of every input scenario for the chosen themes. The elements from the input scenarios (the SSPs and the Delta Scenarios) are compared. Most of the elements per theme overlap. This shows, in general, that the input scenarios are in line with each other. Most of the elements match when comparing the themes for the different scenarios. However, there are some mismatches when comparing the elements per themes of the different scenarios. The mismatches are marked (in bold) as those elements within a specific theme are not the same in every input scenario study.

Table 10 shows the chosen elements. By colour codes is visualised what the source (which scenario) of the chosen elements is. In order to help the stakeholders to make those LLSs as out-of-the box as possible, the input for the stakeholders need to include two scenarios with a range as wide as possible. Besides, the elements for the final CHLSs need to be relevant for the context of this study: land-use in the NIV. Elements of themes which do not fit within the context of land-use are not included in the final scenarios. In sum, the elements of the themes of the final scenarios are:

- As wide-ranged as possible;
- Relevant for the case study area;
- Relevant for land-use development.

#### 5.1.4. Presentation of scenarios as input for the interviews

Table 10 is transformed into a table used as input for the interviews. The themes are ordered on relevance and tangibility. The themes which directly influence land-use are located in the beginning of the table, and the themes which influence land-use indirectly are located more at the bottom of the table. The theme 'recreation' is added to the table as this is seen as an important theme, and 'population and lifestyle' is in practice integrated with the other themes, so this theme is not directly been questioned. Every theme contains some examples added to make the themes more tangible in

case the themes are not clear themselves when talking with the stakeholders about them. This overview is shown in Table 11 (in Dutch).



Scenario	Combined higher-level scenarios (output)	Global Economy	
	Single scenario study (input)	STOOM	SSP5
Theme	Climate change	Extreme	n/a
	Institutionalization and politics	Climate change not on political agenda <b>Decentralisation government</b>	<b>Global institutions</b> Lower level of corruption Participatory politics Removing institutional barriers Lack of regional convergence Individualisation
	Economy and market	Fossil fuel markets remains profitable Agricultural production for global market → more competition and intensification Trade liberalisation More jobs	Economic success International trade Foster competitive markets Removing market barriers for everyone: opening labour market
	Technology and natural resources	Increase infrastructure Increase ICT	International mobility increases High engineering infrastructure Digital revolution
	Environment and natural resources	Exploitation fossil fuels <b>Renewables electricity use</b>	Exploitation of fossil fuels and energy intensive lifestyles Less effort to compensate for emissions: no policies <b>Sustainability/renewable developments: only if necessary for economy or well-being</b> Lack of environmental concern
	Population, lifestyle and households	<b>Population growth, decline after 2050</b> Increase in well-being <b>Need for a green living environment</b>	<b>Population growth (to 2100)</b> Participatory societies Development in human capital: education and health Development of developing countries → fossil fueled Income increase: consuming society Individualism
	Land use: urbanisation, regional developments, agriculture, nature	Migration: urbanisation in both Randstand as east-NL <b>Decrease of agricultural area, more export of knowledge and services</b> , more intensive production 'artificial green'	High levels of urbanisation Migration: mega-cities <b>Resource intensive/large-scale management in agriculture</b> Deforestation Highly managed land and water systems for human needs

Table 8 - Input for combined higher-level scenario: "Global Economy"

Scenario	Combined higher-level scenarios (output)	Regional Sustainability		
	Single scenario study (input)	DRUK	RUST	SSP1
Theme	Climate change	Moderate		N/a
	Institutionalization and politics	<b>International cooperation</b>	Regional oriented No international trust Policy/decisions regional oriented Focus on regreening	Cooperation of local, national and international organizations and institutions Policy to reduce fossil resource use Collaboration across scales (bottom-up) Corruption decrease and transparency
	Economy and market	<b>High economic growth: focus for nature development</b>	Moderate economic growth: NL stays behind on global market No trade liberalism	Focus on well-being: slower economic growth Reduce inequality Focus on regional production
	Technology and natural resources	Energy transition renewables Technology effectively	Less emission due to less innovation <b>Increase renewables BUT fossil remains dominant</b> No innovation infrastructure	Investment in environmental technology Technologies for challenges food security
	Environment and natural resources	Focus on nature development and robust environments	Focus on ecosystem services and circular economy <b>Less means to invest in nature</b>	Focus on SDGs Protect vulnerable ecosystems Challenges with trade-offs (bio-energy) Investment in research and development
	Population, lifestyle and households	Focus on living in a green environment: increase in well-being <b>Population growth</b> More luxurious products/regional products	Stable, decline after 2030 Less jobs, regional spread population	Education and health investments → low population growth Reduced inequality Sustainable consumption and investment patterns Social cohesion
	Land use: urbanisation, regional developments, agriculture, nature	Water inclusive agriculture Urbanisation in Randstad More nature, less agriculture Effectivity agriculture increases intensification on a sustainable way <b>Clearer division between agriculture and nature</b> More focus on recreation	Short food chains: sustainable and flexible <b>Less nature investment</b>	Agricultural productivity increase sustainably Urban population deconcentration Improved regional livelihoods

Table 9 - Input combined higher-level scenario: "Regional Sustainability"

Scenario	Combined higher-level scenarios (output)	Regional sustainability	Global economy
	Single scenario study (input)	SSP1 – DRUK – RUST – DRUK/RUST – SSP1/ RUST – SSP1/DRUK Corresponding	SSP5 – STOOM Corresponding
Theme	Climate change	Moderate	Extreme
	Institutionalization and politics	Regional oriented – bottom-up – collaborations across scales – policy on sustainability	Global institutions – individualism
	Economy and market	Moderate economy - focus on regional production and markets	Economic growth – international trade – more jobs
	Technology and natural resources	Sustainable technology – transition to renewables – less focus on innovating infrastructure – technology for food security	High engineering – ICT – infrastructure – fossil fueled focus
	Environment and natural resources	Nature development – protect ecosystems – circular economy	Renewable development for economy and well-being – no environmental concern
	Population, lifestyle and households	Low population growth – regional spread population – investment in research and development – focus on a sustainable lifestyle	Population growth up to 2100 – increased well-being: development in education and health – consuming society – individualism
	Land use: - Urbanization  - Agriculture  - Nature	Urbanisation in Randstad, population ‘deconcentrates’: regional livelihoods Extensive/sustainable agriculture – short food-chains – sustainably increased productivity Integration nature and agriculture – nature development	Urbanisation in Randstad and East-NL  Area stays equal – large-scale agriculture – intensification – production for world market Artificial green in function for economy and well-being

Table 10 - Chosen elements from input combined higher-level scenario

	Combined higher-level scenario	Regionale Duurzaamheid	Mondiale Economie
Thema	Klimaat-verandering	Gematigd	Extreem
		<i>‘maar’ 1 graden temperatuurstijging voor 2100</i>	<i>Elke zomer zoals in 2018 - watersnoodramp 1953</i>
	Urbanisatie	Randstad groeit maar de populatie wordt stabiel en verspreidt zich meer over het regionale gebied	Urbanisatie in heel Nederland
		<i>Mensen werken in eigen regio – Behoeftte aan groene leefomgeving</i>	<i>Steden als Apeldoorn ontwikkelen naar vergelijkbare grootte als steden in de randstad</i>
	Landbouw	Duurzame en extensieve landbouw – korte voedselketens – duurzame productievare landbouw	Intensieve en grootschalige landbouw – toenemende productiviteit – productie voor wereldmarkt
		<i>50% van de landbouw is agroforestry/water-inclusieve landbouw, regionale ketens → druk op de landbouwsector</i>	<i>Monocultuur zoals in Amerika/Australië met producten van hoge opbrengst</i>
	Natuur	Integratie van natuur en landbouw – natuurontwikkeling en ecosysteembescherming	De natuur is functioneel voor het welzijn en de landbouw
		<i>Gemalen verdwijnen uit het watersysteem</i>	<i>Enkel parken als ‘aangelegde’ natuur</i>
	Recreatie		
	Technologie, natuurlijke hulpbronnen en milieu	Duurzame technologie – transitie naar hernieuwbare energie – circulaire economie – natuurontwikkeling en ecosysteembescherming	High-tech – ICT – infrastructuur – fossiele brandstoffen – geen milieu overwegingen – hernieuwbare ontwikkeling voor de economie en het welzijn
		<i>Elk huis produceert zijn eigen energie - Veen: water level op maaiveld - Geen gaswinning meer in Groningen</i>	<i>Lage prijs fossiele brandstof - Toename transport (internationale/lucht)</i>
	Economie en markt	Gematigde economische groei – focus op regionale markten	Economische groei – internationale handel – toename van banen
		<i>Circulaire economie - Markt gefocust op seizoensproducten en regionale verkoop in landwinkels → haalbaarheid?</i>	<i>Wereldwijde armoede neemt af - Industrialisatie van arme gebieden wereldwijd, focus op fossiele ontwikkeling</i>
	Bevolking en levensstijl	Gematigde bevolkingsgroei – verspreide bevolking (landelijk) – investering in onderzoek en ontwikkeling – duurzame/‘groene’ levensstijl	Bevolkingsgroei – stijgende welvaart – ontwikkeling in educatie en gezondheid – consumerende samenleving
		<i>Burger initiatieven rondom klimaatmitigatie: groene tuinen, voedselbossen in de stad, dakgoot afkoppelen - Boodschappen doen bij de lokale boer</i>	<i>Gedigitaliseerde banen - Vleesrijk dieet - Verdeeldheid bevolking: conflicten</i>
	Instituten en politiek	Regionaal georiënteerd – bottom-up – samenwerkingen tussen schalen – beleid gefocust op duurzaamheid	Mondiale instituten – top-down - individualisme
		<i>Elke regio/provincie heeft zijn eigen klimaatdoelen</i>	<i>Digitale handhaving overheid (zoals in China) - Geen klimaatoppen meer: is geen prioriteit</i>

Table 11 - input for interviews generated from combined higher-level scenario (in Dutch)

## 5.2. Develop: Downscaling combined higher-level scenarios to local-level scenarios

In this chapter, research question 2 is answered: *What local-level land-use scenarios for the NIV can be co-developed with stakeholders?* By means stakeholder interviews, CHLSs are downscaled to LLSs specific for land-use in the Northern IJssel Valley (NIV). Results are analysed in this chapter. As shown in Figure 7, the LSSs of Regional Sustainability and Global Economy consist of two different levels: Level 1 describes the archetypes. Level 2 shows the scenarios and sub-scenarios based on the themes. The scenarios show how the archetypes are translated to a NIV-specific context. The sub-scenarios show different interpretations of the corresponding scenario. Every sub-scenario is supported with a visual representation. Those are self-made and detailed observations of the sketches can be done in Annex 5.

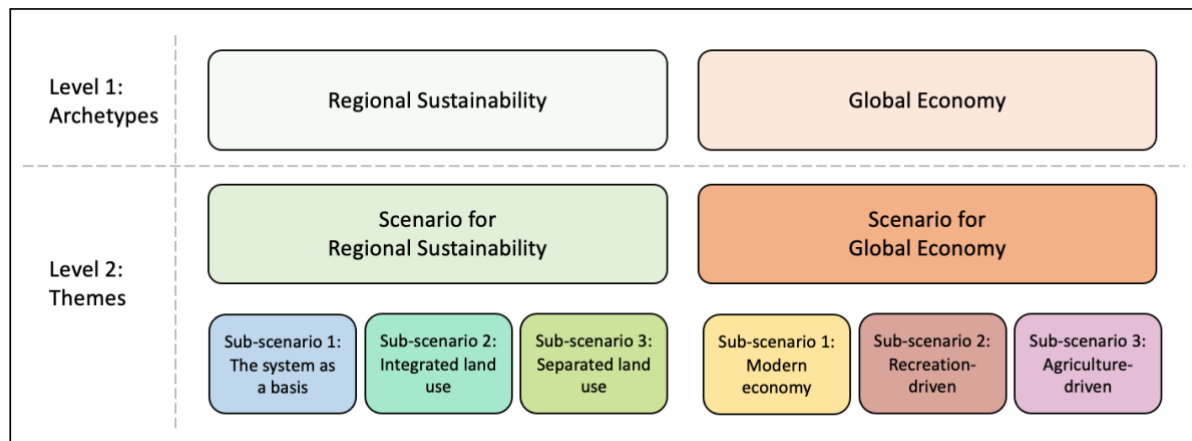


Figure 7 - Overview of archetypes and sub-scenarios of the local-level scenarios

### 5.2.1. Regional Sustainability

#### Scenario for Regional Sustainability

In general, the scenario for Regional Sustainability is focused on a sustainable future for the NIV. How sustainability is achieved differs per sub-scenario, but in every sub-scenario compromises in (decisions in) land-use are made on what is best for the future of the region. Investing in and focusing on biodiversity and soil quality are the main elements of the Regional Sustainability scenario. The perceived sponge effect (Stakeholder 9, p.c., January 11, 2021) is important for water storage, carbon storage and a healthy ecosystem for both humans and animals. Therefore, changes in the agricultural sector are required. A large number of farmers quit, and intensive agriculture makes room for nature-inclusive agriculture. People are more aware of their consumer behaviour, so there is a shift to short food chains and regional markets. Fossil energy use stops, and the society completely shifts to renewable energy. Solar energy becomes the main renewable resource, but it is important to first focus on solar panels on roofs and other urban areas before considering solar parks on valuable arable land. Urbanisation continues, but it is filled in sustainably. Climate-neutral building can be part of this (Stakeholder 14, p.c., January 29, 2021). Windmills are considered in the NIV, on the Veluwe or in the North Sea.

## Sub-scenarios

### The system as a basis

The natural system of the NIV is the basis for spatial planning of the NIV. This means that the water level in the area is not regulated by ditches and sluices, but that water in the area flows naturally as a natural delta (Stakeholder 1, p.c., December 9, 2020). The NIV becomes a large flood plain of the IJssel. Gemaal Terwolde, the main water inlet and outlet in the NIV, is no longer used (Stakeholder 3, p.c., December 14, 2020). As a result, the NIV becomes a natural ecosystem again. Land-use is based on what this ecosystem allows. Urbanisation moves to the poor sandy soils at the Veluwe (Stakeholder 16, p.c., February 2, 2021) and only water-inclusive agriculture is possible in the Broeklanden/lowest area of the valley due to seepage, the Hoenwaard and the Hattemerpoord will be used for water shortage (Stakeholder 7, p.c., December 21, 2020). Farmers stop with conventional agriculture and focus on maintaining nature areas. Areas as Hoogwatergeul Veessen-Wapenveld are completely transformed into nature area (Stakeholder 8, p.c., January 7, 2021). Cows hibernate at the Veluwe instead of in stables (Stakeholder 9, p.c., January 11, 2021). Recreation will be possible in areas where the system allows. New technologies give new opportunities for urbanisation, agriculture and the energy sector. Both windmills and solar panels are considered at the Veluwe, as this nature area contains relatively poor soils (Stakeholder 10, p.c., January 13, 2021, Stakeholder 12, p.c., January 20, 2021). Besides, small-scale solar energy production is considered on roofs of houses and farms (Stakeholder 1, p.c., December 9, 2020).

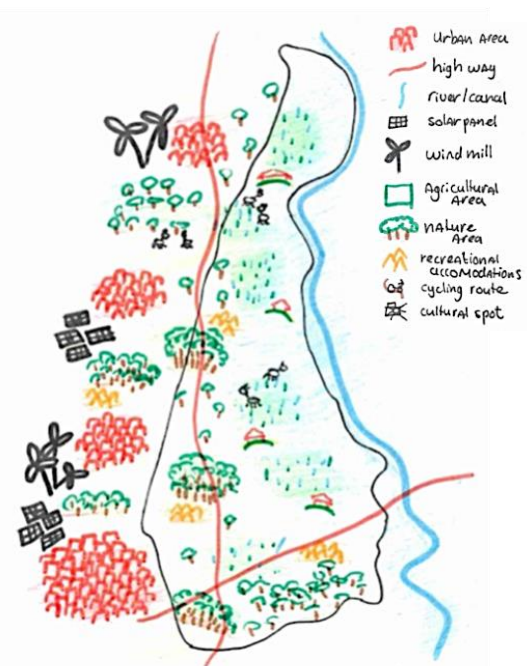


Figure 8 - Visual representation 'The system as a basis'

### Integrated land-use

All types of land-use are integrated with each other and therefore the conventional types of land-use are shaped differently. Climate buffer zones (klimaatmantels) are created and the region is part of the Cleantech region (Stakeholder 2, p.c., December 10, 2020). Urban and rural areas are interwoven, brooks in the cities become more visible (Stakeholder 3, p.c., December 14, 2020). The 'rood-voor-rood' regulation are used and as an effect people living in/close by rural areas, they feel connected with the rural area. Hedgerows, brooks and watercourses are restored in order to create an inclusive landscape (Stakeholder 12, p.c., January 20, 2021). People become more aware of topics as climate change and shortening the foodchain. Short food chains are created, for example a goat farmer delivers directly to a restaurant (Stakeholder 6, p.c., December 18, 2020). Sustainable districts are developed both in urban and in rural areas, for example on the not-used airport Teuge (Stakeholder 7, p.c., December 21, 2020). Conventional

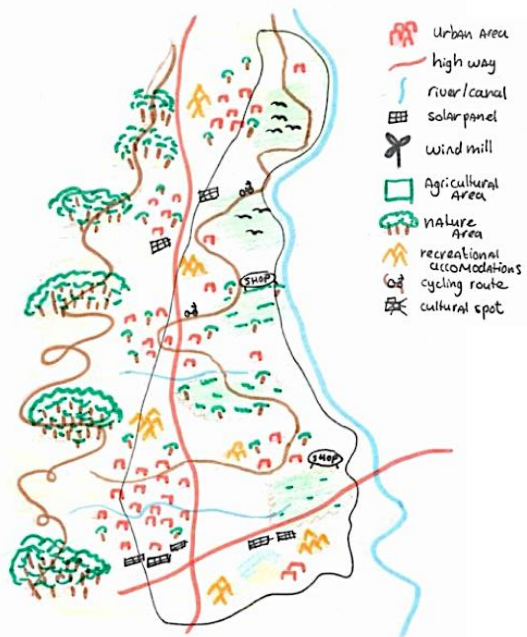


Figure 9 - Visual representation 'Integrated land-use'



agriculture makes room for alternative agriculture, for example insect farming (Stakeholder 12, p.c., January 20, 2021), Herenboeren and food forests (Stakeholder 4, p.c., December 15, 2020), in combination with nature conservation. Nature areas are maintained by farmers, instead of completely naturalised, for example in the Wapenveldse Broek. This area is used for nature conservation and maintained by farmers (Stakeholder 9, p.c., January 11, 2021, Stakeholder 7, p.c., December 21, 2020). Many farmers quit and those remaining take over agricultural enterprises for extensive farming due to land consolidation. Also in the rest of the northern part of the NIV, meadow bird management is done in combination with extensive livestock farming and plant-based farming (Stakeholder 8, p.c., January 7, 2021). In the south of the NIV, extensive farming will be done, for examples the use of herb-rich grasslands and hedges. This is combined with alternative revenue models as campsides, shops on the farms and insects. Recreation is combined with the different types of land-use: urban areas, nature areas and agricultural areas. There is a focus on new technologies, both in agriculture, for example remote sensing (Stakeholder 3, p.c., December 14, 2020), as in the industrial sector, for example reusing residues of the paper factory in Eerbeek (Stakeholder 2, p.c., December 10, 2020). Investing in technologies as 'solar energy sunflowers' becomes the norm (Stakeholder 4, p.c., December 15, 2020). Besides, solar energy production on roofs of houses and farms increases (Stakeholder 1, p.c., December 9, 2020). Solar panels on nature and agricultural areas are not desirable, but there is no other option, since solar panels on roofs are not sufficient. Solar parks along the highway might be an option (Stakeholder 4, p.c., December 15, 2020). Windmills are also not desirable, but rather in the North Sea than in the valley.

#### Separated land-use

There is a hard line between urban areas and rural areas. Urbanisation is focused on the large cities: Apeldoorn, Zutphen, Twello and Deventer. The 'rood-voor-rood' regions in the rural areas stop (Stakeholder 10, p.c., January 13, 2021) and urban areas expand 'into the sky' (Stakeholder 5, p.c., December 16, 2020). It is important to keep the cultural-history of the agricultural areas as Polder Nijbroek intact. For example, historical plots and hedges and other unique elements as the location of Terwolde (Stakeholder 14, p.c., January 29, 2021), the IJssellinie, the tumulus and brooks on the edge of the Veluwe (Stakeholder 4, p.c., December 15, 2020). Sustaining those cultural elements are conflicting with nature conservation (Stakeholder 4, p.c., December 15, 2020), as can be seen in hoogwatergeul Veessen-Wapenveld: which is planned to serve as nature area, but in which the cultural elements have disappeared (Stakeholder 8, p.c., January 7, 2021). Farmers quit and the remaining farmers grow and therefore get the opportunity to include nature-inclusive activities in their business. High-quality soils are for conventional production, low-quality soils are used for extensive activities. Complete nature-inclusive agriculture is not feasible as that is too expensive (Stakeholder 8, p.c., January 7, 2021). Natura2000 areas, as the Veluwe, are highly protected so there is also a hard division between nature and non-nature areas. With expansion of those areas, there is less room for agriculture, as there is a buffer zone around nature areas (Stakeholder 11, p.c., January 18, 2021). In this sub-scenario has a large NIMBY ("Not in my backyard") effect: renewable energy is needed, but rather not in the NIV, nor at the Veluwe.

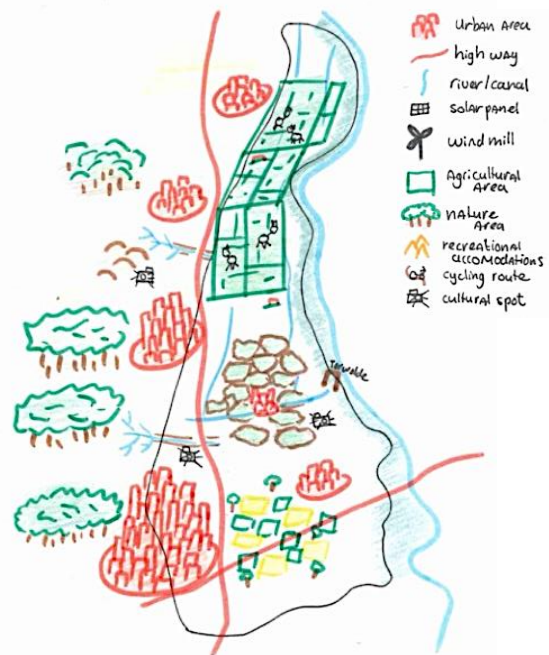


Figure 10 - Visual representation 'Separated land-use'

### 5.2.2. Global Economy

#### Scenario for Global Economy

In the scenario for Global Economy, the landscape is seen as profitable area. How the region is used for economic activities differs per sub-scenario. Even though sustainability is not the base of the scenario, the Global Economy scenario strives for achieving the Paris Agreement. The decisions made for achieving the agreement have large impacts on the landscape, as the climate targets are imposed by the national government and do not take regional variability into account. The Global Economy scenario is based on the manufacturability of the area. A lot of farmers quit and (foreign) investors buy those agricultural soils to build large-scale solar parks and windmills. Subsidised solar parks are projects for 15 years, but the expectation is that those parks will remain longer. Investing in windmills in the area is also part of the plan to achieve the Paris Agreement. As a result of economic growth, urbanisation increases as a result of pressure from the Randstad. The large cities Apeldoorn, Zutphen, Deventer grow. There is no room for green areas at the borders of Apeldoorn, as this is saved for urbanisation (Stakeholder 11 p.c., January 18, 2021). The city is expected to grow with over 20.000 inhabitants the coming 30 years (Stakeholder 16, p.c., February 2, 2021). Airport Teugen will be used for efficient urbanisation (Stakeholder 7, p.c., December 21, 2020). Also, local centres grow: Vaassen, Epe, Wapenveld and Heerde get 'a new round of vinex-areas' (Stakeholder 3, p.c., December 14, 2020). Business areas and distribution centra settle in Apeldoorn (Stakeholder 4, p.c., December 15, 2020) and therefore infrastructure increases (Stakeholder 1, p.c., December 9, 2020). Urbanisation expands to the rural areas and 'rood-voor-rood' regulations ease.

#### Sub-scenarios

##### Modern Economy

There are two developments in agriculture: Large-scale agriculture and broadening agriculture (Stakeholder 8, p.c., January 7, 2021). Nature-inclusive and alternative agricultural activities, for example insect farming (Stakeholder 12, p.c., January 20, 2021), are required in order to make agriculture profitable in the future, but a complete nature-inclusive agricultural system is not feasible (Stakeholder 10, p.c., January 13, 2021). Grasslands for cattle, is also used for livestock farming in the future. On other arable lands is room for the protein transition (Stakeholder 8, p.c., January 7, 2021). With the help of subsidies for organic, nature-inclusive and other alternative agricultural practices, farmers are supported to invest in sustainable agriculture. Regional products are the focus of the economy and are subsidized. The mindset of the society and regional and organic products get a social value. This sub-scenario gives opportunities for recreation and a lowering quality of nature in the area is the risk of the upcoming recreation sector. Investing in holiday accommodations (Stakeholder 12, p.c., January 20, 2021) is a new source of income. Business parks and industry settle in the area, but the 'settling climate' is prioritized by companies. A green environment becomes important, also for the economy (Stakeholder 4, p.c., December 15, 2020). Deventer and Zwolle might make de IJsselsprong in order to give room for those economical activities (Stakeholder 4, p.c., December 15, 2020).



Figure 11 - Visual representation 'Modern Economy': a combination of 'Integrated land-use' and 'Agriculture-driven'



### Recreation-driven

The tourism sector becomes a large income source. Nature areas are conserved in order to serve for recreation purposes. The landscape is focused on large scale (international) tourism and agriculture in the area makes room for nature and recreation. The Veluwe are highly 'consumed' and possibilities for overnight stays increase (Stakeholder 8, p.c., January 7, 2021). Also the floodplains and the "Apeldoorns kanaal" are used for recreation, for example canoeing (Stakeholder 15, p.c., January 29, 2021). More campsites pop up in the floodplains (Stakeholder 5, p.c., December 16, 2020). Resorts and parks settle on the edges of the veluwe (Stakeholder 11, p.c., January 18, 2021) and Thermen Bussloo expands. Nature areas might get overburdened. As an effect of the area intensively used, expansion of the high ways the A1 and A50 is needed.



Figure 12 - Visual Representation 'Recreation-driven'

### Agriculture-driven

The agricultural sector remains focussing on production for the world food market. Farmers focus on expanding their enterprise as the banks mainly fund large-scale businesses. Especially agriculture in the northern part of the NIV expands (Stakeholder 3, p.c., December 14, 2020). Quited businesses are taken over by other farmers so the agricultural plots become larger. As a result, two mega businesses with each 800 cows are located in the Wapenveldse Broek (Stakeholder 7, p.c., December 21, 2020). In the southern part the focus will be on intensifying the agricultural activities as the agricultural plots are (too) small (Stakeholder 11, p.c., January 18, 2021). Nature on agricultural areas limits to the edges of the plots. New technologies will be developed in order to make agriculture more efficient and profitable. This has positive effects on the sustainability of the agricultural activities. Nature areas (Natura2000), as the Veluwe, will be conserved and protected. However, the quality of those areas decreases as an effect of the intensively used surrounding agricultural and urban areas. Due to urbanisation in the rural areas the landscape is considered as fragmented.



Figure 13 - Visual representation 'Agriculture-driven'

### 5.2.3. Additional findings in force for all (sub-)scenarios

During the interviews, some additional interesting findings came to light. Those findings are not part of the scenarios or sub-scenarios but are important to take into account as addition to the scenarios. Those findings are in force for every (sub-)scenario:

#### 1. Insufficient energy supply for the current demand

The focus on renewable energy is a major development in future land-use. In both “Regional Sustainability” as “Global Economy” and the corresponding sub-scenarios, has become clear that the renewable energy sector becoming part of future land-use is inevitable. What has not become part of this conversation, is to what extent the current trends in renewable energy will reach the current energy demand. In the NIV, the focus in renewable energy is on solar parks. The calculation of the current energy demand and the energy revenue of solar panels shows that solar energy is not able to meet the energy demand, not even when the complete valley will be filled fully with solar panels (Stakeholder 10, p.c., January 13, 2021).

#### 2. The interpretation of ‘nature’

The interpretation of the theme “nature” has been very broad. For one is nature defined as preserved nature areas, as Natura2000 areas and areas managed by organisations as Staatsbosbeheer and Natuurmonumenten. For example, Veluwe and the flood plains along the IJssel. For one other, nature in combination with agriculture is seen as nature, or even agricultural lands themselves can be perceived as nature. The definition of nature is not fixed, and the interpretation of nature influences the interpretation of the proposed scenarios. For one, only the sub-scenario “The system as a basis” contains nature, while for one other also “Agriculture-driven” is considered as a sub-scenario containing nature.

#### 3. Drivers for decision-making for agriculture

In the proposed scenarios, a lot of changes in land-use are related to the agricultural sector. Apart from those changes in the agricultural sector as described in the scenarios, there are some factors at play that impact decisions and practices in the agricultural sector. First, the direction of farming depends on long-term investments. The direction of the farmer depends on the chosen direction of the business which is set for at least 30 years. This direction cannot be changed on the short term so a change in agricultural practice is not easily done. For example, when a farmer invests in a large-scale stable, the farmer cannot change those practices easily to extensive agriculture. This direction partly depends on the availability of a successor. When there is none, it does not have to be a goal to grow as a business, and when there is a successor, differently will be looked at the future and other decisions will be made (Stakeholder 8, p.c., January 7, 2021; Stakeholder 9, p.c., January 11, 2021; Stakeholder 11, p.c., January 18, 2021). The second important factor at play is the financial dependency of farmers. When farmers want to shift into a different direction with their business, they are dependent on if this will be financed by the bank. As the bank is mainly focussed on whether their investments will be earned back, it is difficult for farmers to switch to a more extensive, and sometimes less profitable practice. Due to this large influence of the bank, it becomes hard for farmers to switch and focus more on alternative practices.

### 5.3. Analyse: Comparing the combined higher-level scenarios and the local-level scenarios

In this chapter, research question 3 is answered: *What are the differences and similarities of the combined higher-level scenarios (RQ1) and the local-level land use scenarios for the Northern IJssel Valley (RQ2)?* The differences and similarities of the combined higher-level scenarios (CHLSs) as developed in RQ1 and the local-level scenarios (LLSs) as developed in RQ2 are analysed. This is done by means of the two different levels: archetype level and theme level.

#### 5.3.1. Level 1: Archetypes

*Regional Sustainability: Comparing the CHLS and the LLS*

Table 12 shows the comparison in this section (in bold).

	Combined higher level scenarios (RQ1)		Local-level scenario (RQ2)					
Level 1: Archetype	<b>Regional sustainability</b>	Global Economy	<b>Regional Sustainability</b>			Global Economy		
Level 2: Theme	Scenario for Regional sustainability	Scenario for Global Economy	Scenario for Regional Sustainability			Scenario for Global Economy		
			The System as a Basis	Integrated Land-uses	Separated Land-uses	Modern Economy	Tourism-driven	Agriculture-driven

Table 12 - Comparing the archetypes of Regional Sustainability

Table 13 shows the archetypes of Regional Sustainability for both the CHLS as the LLS. There is elaborated on the differences between and similarities in the archetype of the CHLS and the LLS.

Archetypes for 'Regional Sustainability'	
Combined higher-level scenario	Local-level scenario
<i>A world focussed on regional production and consumption. Adapting to and mitigating climate change together with a sustainable living style are driving forces. Therefore, investments in sustainable technologies are made in order to protect ecosystems and stimulate circular economy.</i>	<i>A world in which biodiversity and soil quality are important, in order to adapt to and mitigate climate change. Local system elements (natural, agriculture and/or culture-historical) are sustained, as those are important for the area. Therefore, future developments in land-use need to fit to those local system elements.</i>

Table 13 - Archetypes CHLS and LSS 'Regional Sustainability'

The Regional Sustainability scenario created from SSP1, DRUK and RUST, is as a CHLS focused on a sustainable future. This focus is similar for the LLS, as decisions and developments regarding land-use are aiming for a future as environmentally sustainable as possible, so the core of both archetypes overlaps. So in general, the LLS and the CHLS of Regional Sustainability belong to the same archetype. How sustainability exactly is defined and how sustainability exactly influences land-use development differs for the CHLS and the LLS. In the LLS, it even differs per sub-scenario, as shown in chapter 5.2. However, the overarching elements of sustainability in the local Regional Sustainability scenario are in line with those of the CHLS Regional Sustainability. The international market as driving force is limited and room is made for regional markets and economies. In both archetypes, investments are made in good quality of soils and ecosystems.

The combined higher-level and local-level Regional Sustainability scenarios vary in orientation. SSP1 (sustainability) is a predominantly top-down oriented scenario. Literature on SSP1 shows that a strong government is needed to force a sustainable direction in both economy and society. Ambitious goals regarding climate mitigation and adaptation need to be defined and regulated by governmental bodies. By doing so, sustainable developments in technology, research and education can be facilitated by the government (Pedde et al., 2019). In the LLS Regional Sustainability is highly focused on a bottom-up orientation. In fact, civic participation and initiatives are seen as the core of a sustainable scenario

for the NIV. This bottom-up orientation of the LLS Regional Sustainability facilitates land-use development that fits to the local natural and societal system of the NIV.

#### *Global Economy: Comparing the CHLS and the LLS*

Table 14 shows the comparison in this section (in bold).

	Combined higher level scenarios (RQ1)		Local-level scenario (RQ2)					
Level 1: Archetype	Regional sustainability	<b>Global Economy</b>	Regional Sustainability			<b>Global Economy</b>		
Level 2: Theme	Scenario for Regional sustainability	Scenario for Global Economy	Scenario for Regional Sustainability			Scenario for Global Economy		
			The System as a Basis	Integrated Land-uses	Separated Land-uses	Modern Economy	Tourism-driven	Agriculture-driven

Table 14 - Comparing the archetypes of Global Economy

Table 15 shows the archetypes of Global Economy for both the CHLS as the LSS. There is elaborated on the differences between and similarities in the archetype of the CHLS and the LSS.

Archetypes for 'Global Economy'	
Combined higher-level scenario	Local-scale scenario
<i>A world in which the focus is on economic growth. Capitalism and the international market are the driving forces in this world. Developments are mainly fossil fuel driven and land use is in service of economic development.</i>	<i>A manufactured world in which the landscape is made as profitable as possible. Economic growth and achieving climate goals are the main goals, achieved through large-scale interventions by governmental bodies.</i>

Table 15 - Archetypes CHLS and LSS 'Global Economy'

The core of the archetypes overlaps so the archetypes of the CHLS and the LLS of Global Economy are very similar. Both archetypes are focused on maximized economic growth. In both archetypes, the international market is the main driver for future land-use and development regarding future land-use. Decisions in land-use are made on the basis of improving the economic value, as efficient as possible.

Another similarity in archetype of the CHLS and the LSS can be found in the top-down approach. In both scenarios strong governments take the lead and this leading force is used to implement large-scale interventions in order to achieve goals, even though these goals differ per archetype. Profitable production for the international market is key, in either the agricultural, fossil energy sector or the renewable energy sector.

The Global Economy scenario created from SSP5 and STOOM is, as a combined higher-level scenario, focused on a 'fossil fuelled society'. The LSS of Global Economy scenario is, in contrary, not fossil fuelled at all, because this development is seen as unrealistic to happen for the local level. In SSP5 (fossil fuelled development) is large economic growth combined with a high fossil fuel demand. SSP5 represents a world with high mitigation challenges and high economic growth combined. Even though this assumption is made for SSP5, this does not mean that that high economic growth always has to go hand in hand with high fossil fuel demand (Kriegler et al., 2017). Especially for the local level can this combinations of drivers in SSP5 result in an unrealistic scenario (Bukovsky et al., 2021).

Table 16 shows the comparison in this section (in bold).

	Combined higher level scenarios (RQ1)		Local-level scenario (RQ2)					
Level 1: Archetype	<b>Regional sustainability</b>	<b>Global Economy</b>	<b>Regional Sustainability</b>			<b>Global Economy</b>		
Level 2: Theme	Scenario for Regional sustainability	Scenario for Global Economy	Scenario for Regional Sustainability			Scenario for Global Economy		
			The System as a Basis	Integrated Land-uses	Separated Land-uses	Modern Economy	Tourism-driven	Agriculture-driven

*Table 16 - Comparing the archetypes of Regional Sustainability and Global Economy*

In comparing both the CHLSs and LLSs of Regional Sustainability and Global Economy, a dependency between the spatial and temporal scale can be discovered. The CHLSs, contain elements and drivers that are relatively long-term. The LLSs contain, in contrast to the CHLSs, elements and drivers for a shorter time frame. This may be an effect of the different levels of abstraction in the CHLSs and the LLSs. There is a correlation between spatial and temporal scale. For the small-scale, there are mentioned several examples of sustainable initiatives in the region: the initiative of “Herenboeren” or reuse of residuals in the paper factory of Eerbeek. The development of those initiatives belongs to a timescale no longer than a few years. Such specific examples have hardly been mentioned for a timescale of three decades.

Related to this correlation between the spatial and temporal scale as mentioned above, another correlation can be found in the width of scenarios. The CHLSs are broader in how developments and processes affect the future in the scenarios. The LLSs are nuanced versions of the CHLSs. The LLSs are relatively realistic versions of the CHLSs and stay close to the ‘business as usual’ scenario. Therefore, the LLSs/sub-scenarios do not contain a lot of radical system changes. The system changes in the CHLSs are hard to down-scale to the lower level. For example, a world in which sustainability is not important at all, and in which fossil resources are solely used for energy production. As the local governments (province/water authority/municipalities) are keen to lower emissions, a scenario in which that completely stops is not realistic.

The CHLSs are able to place the scenarios in a broader perspective than only the scope of one single location. The local scale scenarios are purely focused on developments within the NIV, and therefore do not take consequences of those developments for outside the NIV into account. For example: in some sub-scenarios a more extensive agricultural sector a plausible development. However, the meaning of this extensification for the national and even global food production is not taken into account. In CHLSs, choices are made and the consequences of particular developments are clearly balanced. This is an example of the top-down approach used in developing the CHLSs. In the LLSs, which are developed by using a bottom-up approach, the consequences of particular effected of development or trend on another aspect are not taken into account. Themes are considered more individually instead of as a set of themes and therefore, LSSs are less suitable for upscaling and there is less ability to place scenarios into the broader perspective.

### 5.3.2. Level 2: Themes

The development and direction of themes in the CHLSs are compared with those in the LLSs. This analysis gives insight to what extent the CHLSs and the LLSs overlap on theme level. For every sub-scenario, differences, similarities and gaps are elaborated for each theme. For both the CHLSs and the LLSs the development of each theme is analysed. When one of the themes is not described, a substantial process or development misses in the context of land-use in the NIV. Such an absent theme is defined as a gap.

## Regional Sustainability: Comparing the CHLS and the LLS

Table 17 shows the comparison in this section (in bold).

	Combined higher level scenarios (RQ1)		Local-level scenario (RQ2)					
Level 1: Archetype	Regional sustainability	Global Economy	Regional Sustainability			Global Economy		
Level 2: Theme	<b>Scenario for Regional sustainability</b>	Scenario for Global Economy	<b>The System as a Basis</b>	<b>Integrated Land-uses</b>	<b>Separated Land-uses</b>	Modern Economy	Tourism-driven	Agriculture-driven

Table 17 – Comparing the themes of Regional Sustainability

Table 18 gives an overview of the direction of developments of every theme for both the CHLSs and the LLS sub-scenarios of Regional Sustainability. Per theme is for both the CHLS as the LLS sub-scenarios indicated in what direction each theme develops. The different symbols indicate an increase (+), a decrease (-), an equality (0) or an absence (x) of the spatial development of the theme. The colour codes show to what extent the development direction per theme in the LLS sub-scenarios correspond to each other: the darker the green colour, the more the developments go into the same direction and the darker the red colour, the more the developments go into the opposite direction.

	(Sub-)scenario	CHLS	LSS sub-scenario		
		Regional Sustainability	System as a basis	Integrated land-uses	Separate land-uses
Theme	Urbanisation	0	+	+	+
	Agriculture	-	--	+	++
	Nature	+++	+++	++	+
	Recreation	nvt	+	++	x
	Energy and technology	+++	+	+	x
	Market	Regionally focused	x	Regionally focused	Partly regionally, partly internationally focused

Table 18 - Direction of development of themes 'Regional Sustainability'

### System as a basis

This sub-scenario is focussed on the natural system of the NIV. The gap in this sub-scenario is the absence of the market. In the CHLS of Regional Sustainability, a regionally oriented market is included as this fit to a regional consuming society. In this sub-scenario, there is not spoken about whether nor how the market is included.

In the CHLS, urbanisation is decreasing as an effect of limited economic growth. In the LLS, however, urbanisation is slightly increasing. The decrease of the agricultural sector in the LLS is larger because of a more extreme focus on the natural system. As the natural system causes a relatively high water-level in the brook areas and low water levels on the high sandy soils, conventional agriculture is not suitable. This means that only nature- and water-inclusive types of agriculture are possible, and a relatively large decrease of agriculture takes place. In the CHLS, renewable energy production by means of solar parks and windmills increases heavily. In this sub-scenario, only a small increase in renewable energy production takes place as large-scale renewable energy production does not fit in the natural system.

### Integrated land-uses

In this sub-scenario, all land-use types are integrated. As all themes are represented, this sub-scenario does not contain any gaps. However, there are differences in how the themes develop. Similar to the



‘System as a Basis’ sub-scenario, urbanisation is slightly increasing in contrary to the CHLS Regional Sustainability. The agricultural sector increases as an effect of the increased organic and nature-based agricultural activities in combination with other land-use types. Nature areas increase, but as an effect of the integration of all land-uses (agriculture, urbanisation and tourism) this increase is less extreme compared to the CHLS. This counts also for renewable energy production: only a small increase of renewable energy production takes place. Due to the integration of all different land-uses, there is no space for large-scale renewable energy production. Besides, there is also a large NIMBY effect regarding windmills and solar panels in the area.

#### Separated land-uses

In this sub-scenario of Regional Sustainability are the different land-use types, in contrary to the ‘integrated land-uses’ sub-scenario, separated. The gap in this sub-scenario is the absence of the energy and technology theme. As an effect of a large NIMBY effect, there is not spoken of production of renewable energy in this sb-scenario. There is accepted that windmills and solar panels are required in the future, but no option is seen in the NIV itself.

Similar to the two former sub-scenarios, urbanisation is slightly increasing compared to the CHLS Regional Sustainability. The agricultural sector is increasing, as the agricultural sector remains important in this scenario: both for food production as for the culture-historical background. It is desired to sustain the agricultural sector. Nature areas will slightly increase, but not as much as in the CHLS Regional Sustainability, as room is need for the agricultural area. In this sub-scenario, both the regional as the international market will be served as this is seen as inevitable for a profitable system.

#### Global Economy: Comparing the CHLS and the LLS

Table 19 shows the comparison made in this section (in bold).

	Combined higher level scenarios (RQ1)		Local-level scenario (RQ2)					
Level 1: Archetype	Regional sustainability	Global Economy	Regional Sustainability			Global Economy		
Level 2: Theme	Scenario for Regional sustainability	<b>Scenario for Global Economy</b>	Scenario for Regional Sustainability			Scenario for Global Economy		
			The System as a Basis	Integrated Land-uses	Separated Land-uses	<b>Modern Economy</b>	<b>Tourism-driven</b>	<b>Agriculture-driven</b>

Table 19 - Comparing the themes of Global Economy

Table 20 gives an overview of the direction of developments of every theme for both the CHLS and the LLS sub-scenarios of Global Economy. Per LLS sub-scenarios will be elaborated on those differences, similarities and gaps. Per theme is for the CHLS as the LLS sub-scenarios indicated in what direction each theme develops. The different symbols indicate an increase (+), a decrease (-), an equality (0) or an absence (x) of the development of the theme. The colour codes show to what extent the direction of development per theme in the LLS sub-scenarios correspond to each other: the darker the green colour, the more the developments go into the same direction and the darker the red colour, the more the developments go into the opposite direction.

	(Sub-)scenario)	CHLS	LSS sub-scenario		
		Global Economy	Modern economy	Recreation-driven	Agriculture-driven
Theme	Urbanisation	+++	+++	+++	+++
	Agriculture	+	+	x	+++
	Nature	-	0	+	-
	Recreation	NA	+	+++	x
	Energy and Technology	-	+++	+++	+++
	Market	Internationally focused	Partly regionally, partly internationally focused	Focused on tourism and not on agriculture	Internationally focused

Table 20 - Direction of development of themes 'Global Economy'

#### Modern economy

For this sub-scenario, there is focused on both large-scale and more extensive agriculture combined with investing in renewable energy. Due to the combination of conventional and extensive agriculture, the nature areas remain equal as those are part of the economic value of the area. However, the quality of the nature areas decreases as an effect of intensive use for agriculture and renewable energy production. Development regarding energy production differs highly compared to the CHLS Global Economy. There will be highly invested in windmills and solar panels as those have high economic value. Besides, meeting international climate goals is an important driver investing in large-scale renewable energy production. Even though this sub-scenario is based on economic growth, regional production and consumption is seen as an inevitable in the future. Therefore, the market is also partly regionally focused.

#### Recreation driven

This sub-scenario is mainly focused on the economic potential of the recreation sector. As an effect of this focus, there is no room for the agricultural sector, and in this scenario, alternatives are not considered. So, a missing agriculture sector is a gap.

As an effect of an increasing recreational sector, nature areas increase in contrary to the decreased nature areas in the CHLS. The quality of the nature area, however, decreases as an effect of the intensive use. Similar to "Modern Economy", renewable energy production gets a large impulse for economic value and for meeting international climate goals. Due to the absence of the agricultural sector and the increase of the recreational sector, the focus of the market shift towards a tourism-driven market. This does not match with the focus of the market in the CHLS, which is on production for export and the international market.

#### Agriculture driven

This sub-scenario is focused on the economic potential of the agricultural sector. So, in contrary to CHLS Global Economy, agricultural areas increase for high agricultural production. Similar to the Modern Economy and the Recreation-driven sub-scenarios, renewable energy production increases highly for economic value and for meeting international climate goals.



Table 21 shows the comparison made in this section (in bold).

	Combined higher level scenarios (RQ1)		Local-level scenario (RQ2)					
Level 1: Archetype	Regional sustainability	Global Economy	Regional Sustainability			Global Economy		
Level 2: Theme	<b>Scenario for Regional sustainability</b>	<b>Scenario for Global Economy</b>	Scenario for Regional Sustainability			Scenario for Global Economy		
			The System as a Basis	Integrated Land-uses	Separated Land-uses	Modern Economy	Tourism-driven	Agriculture-driven

Table 21 – Comparing the themes of Regional Sustainability and Global Economy

Overall, the drivers for developments in land-use in the CHLSs and LLSs overlap. In both the Global Economy and the Regional Sustainability scenario are drivers the same. Economic growth, population and lifestyle, urban and rural development and technological development are all drivers that, directly or indirectly, influence land-use, in both the multi-level and the local context. So, these overlapping drivers for changes in land-use change in the multi-level context and the local scale context, for both Global Economy and Regional Sustainability show a similarity on ‘theme level’ in what drives land-use change.

A fundamental difference on theme level between the CHLSs and the LLSs is the presence of (climate) policy in the scenarios. In both the SSPs and the Delta Scenarios is deliberately chosen to develop scenarios in the absence of climate policy, in order to have clear baseline for every single scenario. Moreover, the SSPs and the Delta Scenario are used to evaluate climate policy (O’Neill et al., 2014; Wolters et al., 2018). As those scenario studies are the underlying scenarios for the CHLSs, the CHLSs do also not include (climate) policy. The LLSs, however, do include policy. The Paris Agreement on the global level and also the RES (regionale energie strategie) on the regional level are taken into account in the LLSs. Also, other policies regarding spatial planning, as the ‘rood-for-rood’ rule are taken into account during development of the LLSs. As a result of taking into account those policies, the LLSs are limited and have a less broad perspective compared to the CHLSs.

Another fundamental difference on theme level between the CHLSs and the LLSs lays in assumptions on climate change. In the CHLSs, a difference is made in how climate change affects the world. The Regional Sustainability scenario is matched with ‘moderate climate change’ and the Global Economy scenario is matched with ‘extreme climate change’. In the LLSs is assumed that climate change is a fact, and climate change is not seen as a variable. The difference lays in how is dealt with climate change in the different LLSs.

Overall, the level of detail in the CHLSs and the LLSs is highly different. The LLSs, both Global Economy as Regional Sustainability, include location specific elements and developments as a result of focusing on the case-study of the NIV. For example, possible developments regarding the Apeldoorns Kanaal, the spatial interpretation of Polder Nijbroek and Hoogwatergeul Veessen-Wapenveld. For the CHLSs, also both for Global Economy and Regional Sustainability, the level of detail is mainly at national and partly province level. This means that the LLSs contain a higher richness of location specific details, which directly shows the main added value of using LLSs. On the other hand, the CHLSs, capture more general processes and keep eye for more large-scale developments and drivers.

## 6. Discussion

In the discussion will be reflected on the research. First, will be reflected on the conceptual framework, methodology and results. Then, this research is placed into the perspective of other research done regarding this topic.

### 6.1. Reflection on the conceptual framework

#### 6.1.1. Downscaling by using a participative approach

The CHLSs are downscaled to LLSs for the NIV by using a participatory approach. The process of downscaling is done in cooperation with stakeholders in the NIV. This approach is used in order to integrate local knowledge on the biophysical and socioeconomic context of the region. This gave the opportunity to give value to the different themes of the scenarios. By using knowledge of stakeholders with different perspectives, it was possible to research how the stakeholders perceived the proposed themes in a context of future land-use in the NIV. This resulted in a possibility to place certain processes and developments into perspective. Besides, the different stakeholders give their own vision on challenges, opportunities and weaknesses for the future of the NIV. From their own point of view, they reflected on the spatial, economic and social feasibility of the NIV.

Another, widely used, approach for downscaling scenarios is the use of models. Spatial and statistical models are valuable to translate global and other large-scale scenarios to the local level (Sherba et al., 2005). This approach provides detailed quantitative scenarios. Besides, when land-use development is measured quantitatively, it can be used as a base for technical improvements and climate adaptation and mitigation measures on the local level. Also, larger-scale models for scenarios include assumptions which may not be related to the smaller-scale land-use context. A risk of downscaling scenarios by use of models with those assumptions, is that the outcomes are not applicable at the local level. Another risk of using quantitative downscaled models is that those tend to be false accurate, as provided detailed output of the models are based on higher-level and less specific data (Rounsevell et al., 2006). So, using quantitative models for downscaling is a top-down approach and the participatory approach used in this research has a bottom-up character. This has the advantage that local stakeholder knowledge is integrated during development. The disadvantage is that quantitative data is missing so the scenarios cannot directly be used for implementing measures in the region for which quantitative data is required.

In other downscaling approaches for land-use scenarios, local expert knowledge is used in order to validate quantitative land-use scenarios. Experts do have specific and detailed knowledge on their own profession and using this knowledge is a valuable addition to quantitative land-used scenarios. Besides, when those experts have knowledge on location-specific land-use development, they are able to place the scenarios in the location-specific context. However, experts may be biased by focussing on his or her own profession, which is a drawback of this approach (Muskat et al., 2013). By using this approach, the character is less top-down and more bottom-up which has the advantage that it is both quantitative and validated with location-specific knowledge. Still, integrating knowledge of others than experts is excluded in this approach. This proves that using a participatory approach by using stakeholder knowledge is a valuable approach for downscaling scenarios for land-use.

#### 6.1.2. Co-production: using stakeholder knowledge

During the workshop, the results of this research were validated. Stakeholders discussed whether the proposed local-level scenarios (LLSs) for the NIV and their corresponding sub-scenarios contain possible futures for the NIV or not. By doing so, the value of both the participatory approach and the explorative character of this research could be discussed. In general, the stakeholders did recognize the scenarios and sub-scenarios. They agreed upon the developed scenarios and sub-scenarios based on the data collected during the interviews. However, a number of stakeholders indicated that the complexity of the scenarios has given the scenarios a high level of abstraction. The set of CHLSs in combination with the themes as input have given the research an integrated character. For stakeholders, this has made it more difficult to understand those scenarios. So, the multi-level and

integrated framework has led to a certain level of complexity, and this might have been too abstract in combination with the participative approach with stakeholders. Therefore, it was difficult for the stakeholders to really validate the scenarios as more time was needed to have an elaborate discussion on the scenarios.

Related to this is the lack of ability to place developments and processes related to land-use in the NIV into a perspective broader than the boundaries of the NIV. Stakeholders find it hard to take consequences of certain development regarding land-use into account that take place outside the boundaries of the NIV. For example, in the 'system as a base' sub-scenario, agricultural activities are placed at locations where the natural (water)system offers favourable conditions. This means that agricultural land-use is reduced to a very small scale. However, when the principle of this sub-scenario is upscaled to the national level, this means that there is very little space left for agricultural activity and that food production in the Netherlands drops enormously. This consequence is not taken into account while proposing the 'system as a base' sub-scenario. Consequences for developments regarding land-use on the national and even international level turn out to not be taken into account while focussing on land-use developments for the local-level.

#### 6.1.3. Explorative scenarios

This research has an explorative approach. The focus was on 'what could happen' and not on 'what should happen'. However, stakeholders tended to elaborate on how they want the future to look like and on how they do not want the future to look like, which is both a normative approach. Sustainable development on the one hand and economic development on the other hand, are strongly connected to personal priority and perception of stakeholders. Depending on personal interest, background, knowledge and profession was decided which themes are of importance and are given more spatial priority. So, perceptions of a 'wrong' or 'right' have partly resulted in the different scenarios and sub-scenarios. This tendency to focus on a 'best-case scenario' and a 'worst-case scenario' for land-use development in the NIV indicates the difficulty to do explorative future, especially combined with a participatory approach. During the workshop was discussed which of the developed sub-scenarios could be considered as 'most extreme' possible futures. This discussion illustrates how the overall focus is on the extremes on both sides of the spectrum: the 'best-case side' and the 'worst-case side'. However, the focus of this research was not on identifying those extremes, but on identifying the complete spectrum of scenarios.

#### 6.1.4. Time frame

This research was focused on land-use scenario for the coming 30 years. In practice, it is questionable to what extent the results are really connected to this timeframe. In Holling (2001) is elaborated on the correlation between spatial and temporal scale. Hierarchy shows that processes and developments on the long term are related to large scales and that short term processes are related to small scales. As shown in chapter 5.3.1, the dependency between the spatial and temporal scale can be discovered when comparing the CHLSs and LLSs, and this dependency can be explained by Hollings theory.

For stakeholders, it was considered difficult to link large processes and real system changes to the NIV. It was hard to imagine what effects a trend as "a globally increased fossil fuel use" would have on land-use in the NIV specifically. As the NIV is a relatively small-scale area, Hollings theory explains that stakeholders were mainly focussed on small and short-term processes: small scales are related to short term processes. This means that a time frame of 30 years has been too long to come up with developments that on the one hand are location-specific and detailed, and on the other hand long-term.

### 6.2. Reflection on the methods used

#### 6.2.1. Interviews

Data was collected by means of interviews, what has led to several reflection points. A snowball method was used to reach local stakeholders, which may have resulted in a biased data collection. The

interviewed stakeholders were very willing to cooperate and discuss about future land-use development, what in practice meant that those stakeholders were relatively progressive and open-minded. This means that future world views of less open-minded stakeholders were not taken into account as those stakeholders have not been reached or willing to cooperate with this research. Another reflection point on the decision of data collection by means of interviews is that it was difficult for stakeholders to step out of their comfort zone. The stakeholders have been stimulated to think as broad as possible about land-use development and use their imagination. However, in practice the stakeholders tended to visualize the future within their own profession and framework. With those individual interviews, there was assured that the stakeholders were not influenced by others, but this may also have led to less creative and open-minded data as there was no room for group brainstorm and discussions.

#### 6.2.2. Data analysis

The interview questions were structured per theme. Those themes were presented with as less context as possible, in order to give the stakeholders room to interpret the themes their own way. Even though the stakeholders live and/or work in the NIV, it was difficult for stakeholders to come up with location specific elements. How the different themes affect land-use specifically in the NIV, remains in some cases relatively vague. For example, in the CHLS Regional Sustainability, a main development is the focus on short food-chain. In the LLS Regional Sustainability, this is also mentioned as an important development. Farm shops are mentioned as examples, but in most cases is not made tangible how short food-chains will influence land use in the NIV.

Another drawback of structuring the interviews per theme, instead all themes in one scenario as a whole, is that the final representation of one scenario may have resulted in a fragmented one. How the individual themes are interrelated is not always taken into account which leads to conflicting developments between different themes in one scenario. For example, one stakeholder has given the natural system the main focus in the 'Regional Sustainability' scenario and in the first place the theme 'recreation' did not fit into that scenario at all. However, when he was asked about how recreation could develop in that scenario, he also could imagine how recreation could fit in 'a' Regional Sustainability scenario, even though it did not particularly fit into 'his' created 'Regional Sustainability' scenario. Those nuances may have faded into the background as a consequence of structuring the data per theme. All stakeholders were asked to address every theme in both scenarios, even though particular themes did not fit to the stakeholder's interpretation of one of those scenarios. The overall message or the interpretation of that particular scenario may have been scattered during the whole analysis. This might explain why some of the stakeholders found the final scenarios and sub-scenarios include a high level of complexity as all themes are tried to put into both scenarios.

### 6.3. Reflection on results

#### 6.3.1. Spatial feasibility

Land-use development is all about decisions and trade-offs. The scenarios and particularly the sub-scenarios show the range of directions in which land-use could develop. However, the sub-scenarios do not show all trade-offs and consequences of certain developments and are therefore simplified representations of reality. For example in the 'Agriculture-driven' variant, large-scale and intensive agriculture is combined with large-scale renewable energy production. Another example is the combination of a large-scale tourism industry combined with large-scale renewable energy production in the 'Recreation-driven' sub-scenario. Quantitative research needs to be done in order to evaluate the spatial feasibility of the sub-scenarios.

#### 6.3.2. Feasibility of organic, extensive and nature-inclusive agriculture

Especially in the 'Regional Sustainability' scenario, the main developments are related to sustainable agriculture. Alternative types as organic and nature-inclusive agriculture are proposed. Those are combined with a focus on local consumption and short food chains. More research needs to be done

on the feasibility of alternative types of agriculture. Without subsidies, nature-inclusive and organic agriculture are not profitable for a lot of farmers, as those extensive types of agriculture require more agricultural land to reach the same productivity as conventional agriculture. This is strengthened by the increasing competition for land. Subsidies for nature-inclusive and organic agriculture partly counter this problem of making those alternative agricultural practices profitable. However, on the long term an economy based on subsidies is not sustainable. The food prices should increase in order to keep the agricultural sector economically and environmentally sustainable. A governmental regulated market or shift in consumer behaviour and responsibility is needed in order to change the power of the international market on local food production (Stakeholder 11, p.c., January 18, 2021). More research needs to be done on the potential of those developments.

#### 6.3.3. Climate change and policy as given factors

In the development of local land-use scenarios for the NIV with stakeholders, two important aspects were seen as givens: climate change and policy regarding climate and environment. Both of those given aspects have had influence on the final LLSs for the NIV.

Climate change is an important variable for land-use development. Extreme climate change in the future may result in more floods in the low regions close to the rivers. This may include urban areas that are not be suitable for housing anymore in the future. Also, an increase of droughts as an effect of climate change may negatively influence the agricultural production which means that agricultural practices have to stop or adapt to climate change in that specific area. As this variable is not taken into account, the final LLSs for the NIV are highly influenced by taking climate change as fixed value. With taking climate change into account as variable, the different climate conditions could have given the scenarios and variants a wider bandwidth.

Also, policy regarding climate change and environment are considered as taken values. As many policies are set and will not change the coming years, it was difficult for stakeholders to imagine the absence of those policies in the future. A future without those policies is considered as irrational. Policy regarding urbanisation ('rood-voor-rood') and nature development (Natura2000) have already set boundaries for development. Similar to climate change considered as taken value, climate and environmental policy considered as taken influence the bandwidth in which the scenarios and variants are proposed. Without policy taken as fixed, the bandwidth of the scenarios and variants could have been much wider. However, the proposed scenarios and variants can be considered as more realistic, as those stay close to reality.

#### 6.4. For further research: including normative elements in scenario development

The research of Pedde et al. (2020) focussed on developing a climate scenario toolkit to make scenarios more relevant and accessible to international decision-makers and stakeholders. Similarly in this research, the combination of a multi-scale approach and a participative approach was used in order to develop scenarios. A fundamental difference between this research and the research of Pedde et al. (2020), is the way in which explorative scenarios are used. In the research of Pedde et al. (2020), there has been made use of an integration of pathways in the scenarios. The scenarios are defined as explorative, and therefore describe what could happen in the future. Pathways describe ways how to achieve the vision, and the vision describes the desired future. By integrating pathways in the scenarios, the scenarios will be more robust in time. In fact, the research of Pedde et al. (2020) an extra step was taken in order to develop robust scenarios, as shown in Figure 14. The comparison with the research of Pedde et al. (2020) shows that for future research it would be valuable to include this extra step in order to make the developed scenarios more robust.

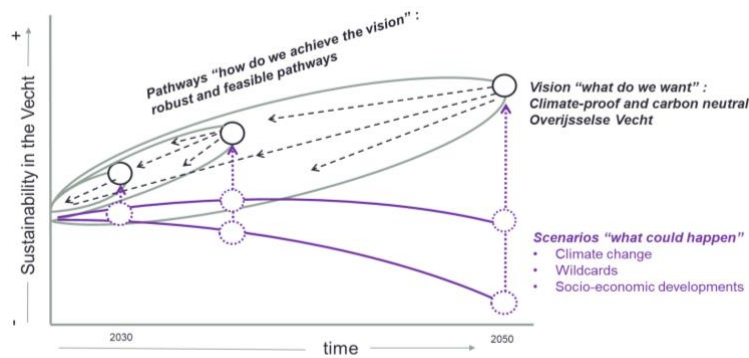


Figure 14 - Framework of combining scenarios, pathways and visions (Pedde et al., 2020)

In a case study of KLIMAP in the Dutch province of Limburg, scenario development is used in order to implement climate robust measurements. Within this study, the choice was made to not focus on developing explorative scenarios for the region, but to focus on “development plans” (inrichtingsplannen) for the future (Bakema & Ellen, 2021). This decision of focusing on development plans instead of on explorative scenarios was made because scenarios are often extreme representations of reality that create resistance when using them in practice. Similar to the research of Pedde et al. (2020), this framework includes normative elements. Figure 15 shows the “leading principles” (leidende principes) and “visions” (wensbeelden) are used as input to develop the “development plans”.

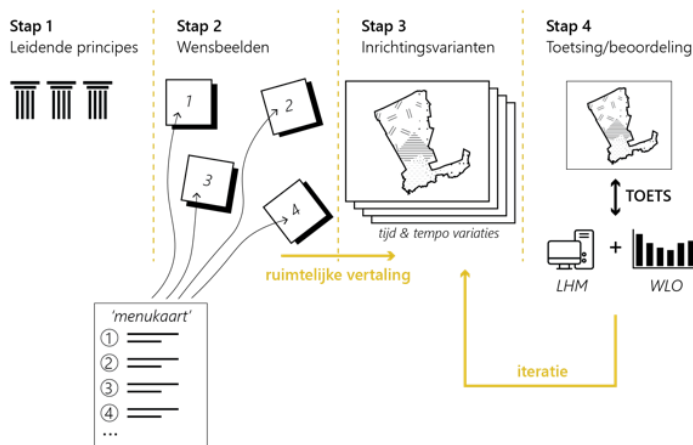


Figure 15 - Conceptual framework for development plans in the province of Limburg (Bakema & Ellen, 2021)

Intentionally, this research has been fully focussed on creating explorative scenarios without integrating pathways or visions with a more normative character. This choice was made to develop scenarios representing the full bandwidth of how the future for the NIV could look like. However, as elaborated upon in the reflection on the conceptual framework, stakeholders tended to talk about normative scenarios. In their sketches of “Regional sustainability” and “Global Economy” elements of visions and pathways were present. This, in combination with the research of Pedde et al. (2020) and Bakema & Ellen (2021) shows that adding normative elements to the scenarios, can be a useful next step after the development of explorative scenarios for the NIV, in order to place the explorative scenarios into a perspective of the challenges for a climate robust future.



## 7. Conclusion

The main objective of this research was to develop a set of explorative land-use scenarios for the Northern IJssel Valley (NIV) for the coming 30 years, to analyse plausible future land-use change in the area. In this research, different conceptual and methodological concepts are combined in order to answer the following main research question: *What are plausible local-level land-use scenarios for the Northern IJssel Valley for the coming 30 years and how do they relate to higher-level scenarios?*

In cooperation with stakeholders, a set of local-level scenarios (LLSs) was developed by using a set of combined higher-level scenarios (CHLSs) as context. The results show that this conceptual approach is useful to develop land-use scenarios that are location-specific and inclusive for the NIV.

In order to cover the complete range of visions and opinions given by the stakeholders, two different levels are used to develop the LLSs for the NIV. The archetype-level describes the overall worldviews. The theme-level describes, per archetype, the corresponding scenario and three sub-scenarios. Each sub-scenario describes a specific direction in which land-use in the corresponding scenario develops. Those two LLSs for the NIV and their corresponding sub-scenarios cover the complete range of directions in which stakeholders expect land-use to develop potentially. Figure 16 shows the overview of developed scenarios and sub-scenarios. The complete descriptions can be found in chapter 5.2. Those scenarios and sub-scenarios must be interpreted as directions in which land-use in the NIV can develop. The sub-scenarios sketch the bandwidth of all potential land-use developments in the NIV.

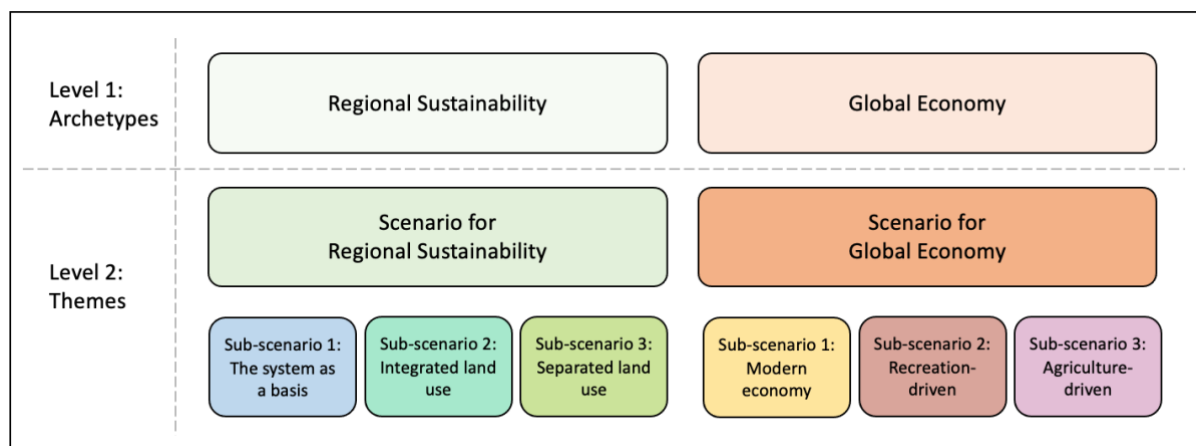


Figure 16 - Overview of developed scenarios and sub-scenarios

When comparing the CHLSs developed in chapter 5.1, and the downscaled LLSs in chapter 5.2, differences and similarities can be found. This comparison has given an indication how the LLSs can be placed in a broader perspective. This leads to two main insights:

- The starting point of, on the one hand Global Economy, and on the other hand Regional Sustainability, do overlap in the CHLS and the LLS: their archetype on the most abstract level was similar. In both the CHLS and the LLS of Global Economy, the main direction of the archetype is to maximize economic growth. In both the CHLS and the LLS of Regional Sustainability, the main driver for land-use change is sustainable development.
- Complete divergent interpretations of those starting points can be found when comparing the developments of themes of the scenarios. In the CHLS of Global Economy, economic development is based on maximizing fossil energy, while in the LLS, economic development is based on investing in large-scale renewable energy production. In the CHLS of Regional Sustainability, sustainable development is focussing on investing in renewable energy production, while in the LLS sustainable development is based on sustaining the region-specific elements.

A complete overview of differences and similarities of the local-scale scenarios and the multi-scale scenarios can be found in chapter 5.3.

In this research, a participatory approach was used. Besides, the LSSs on land-use for the NIV are developed by using the set of CHLSs as context. The two main insights on this conceptual approach are as follows:

- The participatory approach made it possible to develop local-level scenarios specific for the NIV. The LLSs, developed based on the CHLSs, are rich of location specific and detailed elements for the NIV. Due to the participatory approach, the LLSs include personal perceptions and stakes of local stakeholders from the NIV. Therefore, the LLSs give valuable insights on plausible land-use development at the local-level. Stakeholders place higher-level developments from the CHLSs into perspective of the NIV, as stakeholders are able to foresee consequences for the NIV as effects of higher-level developments. Adding those different stakes and consequences for the local-scale scenarios has resulted in an integrated approach for the local land-use scenarios.
- The decision of developing explorative scenarios in co-production with stakeholders has resulted in a set of scenarios that is very diverse at the local level. The CHLSs are used as context for developing the LLSs. The results show that the LLSs diverse strongly from the CHLSs. The explorative nature of this research has stimulated the stakeholders to explore the future for the NIV that are as wide ranged as possible.

To conclude, existing scenarios on multiple scales can be downscaled to land-use scenarios for the NIV by using a set CHLSs as input and using a participative approach. The developed 'Regional Sustainability' and 'Global Economy' scenarios and their corresponding sub-scenarios are location specific, and they include different perceptions and themes that are important in order to come up with integrated land-use scenario for the NIV. Therefore, this research shows that CHLSs and LLSs complement each other due to their distinct perspectives and focus.



## 8. Recommendations

For further research, some recommendations can be defined on both the conceptual approach as the methodology.

The correlation between spatial and temporal scale explains the lack of detailed information in the scenarios on the one hand, and a disability for stakeholders to think out-of-the-box on the other hand. There is recommended to choose a focus for desired results: or a focus on details or a focus on a broad bandwidth of scenarios, as the combination of both is perceived as not feasible. For developing scenarios as detailed as possible, focussing on a smaller research area would result in more detailed data to build scenarios upon. For developing scenarios with a bandwidth as broad as possible, the use of more extreme and abstract archetypes as input for the scenarios would result in more out-of-the-box data to build scenarios upon.

The use of individual interviews has influenced the bandwidth in which stakeholders were able to sketch future land-use development. Making use of interviews has led to data which can individually be assigned to the stakeholders, which has given interesting insights corresponding to the individual stakeholders. However, for further research is recommended to include group discussions in the research. Including group discussions based on the interviews can give a new level of in-depth information. By combining those two methods of participation, individual visions of stakeholders can be gathered and interactive and outside the box insights can be combined. This may lead to a broader bandwidth of scenarios. Besides, including those group discussions give the opportunity to develop the scenarios by using another iteration. Feedback on the designed scenarios leads to discussions and this information can be used to improve the scenarios iteratively.

As described in chapter 6.4, follow-up research on land-use scenarios for the NIV can include visions for the specific region. Adding visions to the explorative scenarios make the scenarios more robust and place the scenario into perspective of plans and targets that are already at play in the region. Besides, follow-up research could be done on quantification of the current qualitative land-use scenarios for the NIV. Models can be used to evaluate the feasibility of the scenarios of this research, as described in chapter 6.3.

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## Annex 1: Descriptions of the five Shared-Socioeconomic Pathways

The descriptions of the single SSPs are generated from (O'Neill et al., 2017).

### **SSP1: Sustainability – Taking the green road**

- Development towards sustainable development and environmental awareness
- Cooperation of local, national and international organisations and institutions, private sector and civil society
- High-income countries take the lead in achieving development goals and developing countries follow
- Education and health investments lead to relatively low population
- Economic growth shifts to emphasis on human well-being
- Achieving development goals leads to reduced inequality
- Investment in (environmental) technology and changed tax structures lead to reduced energy use
- Changes in consumer behaviour leads to lower resource use
  - environmentally friendly technologies, international cooperation, low energy demand → low challenge in adaptation
  - Improvements human well-being, strong and flexible institutions → low challenge in mitigation

### **SSP2: Middle of the road**

- Social, economic and technological trends same as historical
- Politically stable situation
- Institutions work towards slow achieving development goals
- Environmental degradation on the one hand and development towards fossil fuel independency on the other hand
- Moderate population growth in high-income countries, due to moderate educational and health investments, to high population growth in developing countries
- Limited social cohesion
  - moderate challenges to mitigation and adaptation

### **SSP3: regional rivalry – a rocky road**

- Nationalism, competitiveness and conflicts lead to focus on domestic and regional issues
- There is no cooperation between countries, so policies are nationally oriented and highly authoritarian
- Barriers in trade lead to focus solely on regional markets
- Decline in investments of in education and technology lead to issues regarding maintaining living standards, especially in developing countries
- Low population growth in industrialized countries and high population growth in developing countries
- Environmental degradation due to a lack of priority leads to poor sustainability
  - Growing resource intensity, no cooperation and technological change → high challenges to mitigation
  - No progress in human development, no effective institutions, slow income growth
  - high challenges to adaptation

**SSP4: Inequality – A road divided**

- Highly unequal investment in human capital leads to unequal economies and political situations
- Fragmentation in education leads to a knowledge and capital gap and fragmented technological development
- Due to unequal political and financial power do inequalities in income grow
- Conflict and social cohesion degradation
- There is an underinvestment in renewables and investors use price fluctuations in the renewable energy market
- Environmental policies do only focus on local issues in middle- and high-income areas
  - some development of low carbon supply options and expertise and well-integrated international political and business class capable of acting quickly and decisively → low challenges to mitigation
  - high amount of populations at low development levels with limited access to effective institutions for coping with economic and environmental stress → high challenge to adaptation

**SSP5: Fossil-fueled development – taking the highway**

- Economic success as an effect of emerging economies and competitive markets
- Participatory societies and development in human capital leads to a lower gap between high-income and developing countries
- Strong investments in health, education and institutions due to social development
- Exploitation of fossil fuels and energy as a result of intensive lifestyles and population growth
- Less effort to compensate for emissions as economic and social development have the highest priority
- International mobility increases due to international labor markets
  - reliance on fossil fuels and lack of global environmental concern → high challenges to mitigation
  - human development goals, robust economic growth and high engineering infrastructure → low challenge to adaptation

## Annex 2: Descriptions of the four Delta Scenarios

The descriptions of the single Delta Scenarios are generated from (Wolters et al., 2018).

### DRUK

- Moderate climate change combined with high economic growth
- A lot of international cooperation, also in climate policy
- Population grows as an effect of economic growth leads to urbanisation focussed on the Randstad
- Due to welfare increase, there is more demand for luxury and organic products
- Nature areas are important, both for the natural environment as for a green and healthy living environment
- As an effect of economic growth, there is room for more nature development (Natura 2000) and making the environment more climate robust. Nature areas increase with 17%
- Focus on technological development and an energy transition as an effect of scarcity of fossil fuels
- Agricultural areas decrease with 9%, because there is made more area in use by nature and urban areas. However, the productivity remains the same due to efficiency increase.
- There is more room for both nature-inclusive and circular agriculture and divided nature and agriculture areas.
- Regional areas are more focus on small-scale recreation

### STOOM

- Intense climate change combined with high economic growth
- No international cooperation and the Dutch government decentralise
- Population grows until 2050 and stabilises due to welfare increase. This leads to strong urbanisation in both the Randstad as the east of the Netherlands.
- Even though renewable energy for electricity production is upcoming, remains fossil energy dominant.
- There is need for more infrastructure as the mobility increases
- Nature areas increase with 17% and become more artificial and they are divided from the agricultural sector
- Agricultural area decreases with 9% and large-scale and intensive agricultural production for the international market becomes the norm

### RUST

- Moderate climate change combined with moderate economic growth
- International cooperation is limited due to lack of trust, the government is regional oriented. Those regional governments focus on circular and biobased economy and greening the environment.
- Population stabilises and shrinks after 2030 due to little economic growth.
- Companies 'leave' the Netherlands due to a lack of innovation and the Netherlands become less important on the world market.
- Due to low economic activities remains climate change moderate, but fossil energy remains dominant.
- Due to a lack of capital, there will not be invested in nature conservation. Nature areas increase with 8%, but this is mainly for ecosystem services and biobased economy.
- Agricultural activities are mainly for regional use and are focused on short food-chains

## WARM

- Intense climate change combined with moderate economic growth
- No international cooperation due to a lack of trust. Institutionalisation nationalises but this ends up in inefficiency and no cooperation.
- No cooperation regarding climate policy due to a lack of support.
- Economic growth is only moderate due to no technological or knowledge development
- Population stabilises and shrinks after 2030. Urbanisation centres in the Randstad and the regional areas run down
- In the agricultural sector is little innovation so the production decreases and the agricultural area decreases with 3%
- As the agricultural sector decreases, increase nature areas with 8%. There is no focus on nature-inclusive agriculture



### Annex 3: List of interviewees

No.	Stake	Date
1	researcher and project manager	09-12-2020
2	Policy advisor planning	10-12-2020
3	Accountmanager	14-12-2020
4	Advisor spatial quality	15-12-2020
5	Alderman municipality	16-12-2020
6	Representative local interest group	18-12-2020
7	Ecologist in transition agricultural soils to nature soils	21-12-2020
8	Dairy farmer	07-01-2021
9	Dairy farmer	11-01-2021
10	Advisor nature inclusive agriculture	13-01-2021
11	lifestock farmer and LTO-Noord representative	18-01-2021
12	Advisor urban climate adaptation	20-01-2021
13	Inhabitan Twello	20-01-2021
14	Inhabitan Terwolde	29-01-2021
15	Dairy and lifestock farmer, camping owner	29-01-2021
16	Accountmanager	02-02-2021

## Annex 4: Workshop Landgebruikscenario's voor de NIV

25-03-2021

17 aanwezigen

Het programma van de workshop is als volgt:

- 11.00 – 11.05 Welkom door Erik van Slobbe
- 11.05 – 11.10 Exploratieve scenario's, input uit de literatuur, keuzes
- 11.10 – 11.15 Vragen & discussie
- 11.15 – 11.25 De twee hoofdlijnen: 'Regionale Duurzaamheid en Mondiale Economie'
- 11.25 – 11.35 Vragen & discussie
- 11.35 – 12.45 De zes varianten
- 11.45 – 11.55 Vragen & discussie
- 11.55 – 12.00 Afsluiting

### DEEL 1

Hoe zijn de regionale plannen betrokken bij het tot stand komen van de multi-scale scenarios?

Al deze regionale plannen zijn normatieve plannen, en zijn daarom niet direct toegevoegd aan de multi-scale scenario's. Wel heb ik gekeken naar de belangrijke thema's die in deze plannen beschreven staan en die thema's heb ik geïntegreerd in de uiteindelijke lokale scenario's.

Zijn er nog andere thema's die je bewust niet hebt opgenomen in de interviews?

Klimaatverandering is natuurlijk een grote variabele. Ik heb ervoor gekozen dat niet als variabele te nemen tijdens de scenario ontwikkeling, omdat de omstandigheden dan te verschillend zouden worden om de twee scenario's goed naast elkaar te kunnen leggen.

### DEEL 2

Wat is de 'top' in top-down?

Dat kan zowel de nationale al de regionale overheid zijn, maar in elk geval wordt er met top-down bedoeld 'regionaal gestuurd'.

En wat was de reden van stakeholders om een voorkeur te hebben om meer een bottom-up systeem te hebben?

Dat is vooral om het zelf in de hand houden hoe het gebied eruit moet komen te zien. Een voorbeeld is het aanleggen van grootschalige zonneparken: dat lijkt een goed idee, maar hoe verder je inzoomt, hoe meer blijkt dat individuen daar helemaal niet blij mee zijn. Ze houden liever zelf in de hand hoe het gebied dan wordt ingericht.

Wat zijn lokale elementen?

Dat gaat vooral om de structuur van het landschap. Maar ook de wat bredere betekenis ervan, dus het behouden van de cultuur-historische waarde van het gebied (de sprengen en polder Nijbroek).

Bedoel je met effectiviteit misschien efficiëntie? En staat dat ook in verband met die top-down benadering

Ja, dat staat wel met elkaar in verband. Van bovenaf lijkt een efficient zonnepark ideaal, maar dat is niet meteen super wenselijk, omdat er andere belangen spelen.

Valt het energie aspect ook onder duurzaamheid bij Regional Sustainability?

Ja, maar wel op een andere, kleinschalige manier. De focus in het regional sustainability scenario is meer de duurzaamheid van de bodem en de biodiversiteit.

Kan het zo zijn dat het landschap ook economische waarde kan hebben in een duurzaam scenario?

Ja, dat is anders ingestoken, daar dat is zeker waar.

Grootschalige zonneparken leidt tot veel verlies aan grond, is er ook gedacht aan alternatieve mogelijkheden? Op daken van schuren, in de stad? Waarom die daken niet volleggen? En daar een verdienmodel van maken.

Dat past volgens de interviews meer bij regionale duurzaamheid, omdat dit minder efficiënt en kostbaarder is, en op grote schaal minder oplevert.

### DEEL 3

Als we het hebben over de verdeling van landgebruik, dan is het een trade-off: hoe meer zonnepanelen, hoe meer schade ook aan recreatie, wat is daarover gezegd in de interviews?

Dat is denk ik het grootste discussiepunt. De afweging in welke keuzes er gemaakt moeten worden is de grootste vraag. In de interviews merkte ik wel dat het lastig is gebleken om de stakeholders de afwegingen te laten maken. Ook omdat ik iedereen heb gevraagd zo extreem mogelijk te denken. Hoe extremer je denkt, hoe minder je rekening gaat houden met deze afwegingen.

Welke twee scenario's zouden het beste de bandbreedte van de scenario's in beeld brengen?

Deze vraag hoopte ik in deze workshop ook beantwoord te hebben, dus ik wil deze vraag graag aan iedereen hier stellen.

→ voornamelijk 'integrated land-use' en 'agriculture-driven'

→ 'system as a basis' geldt ook wel aan de duurzame kant

Ik ben benieuwd: hoe nu verder? Het echt concreet maken is een grote uitdaging.

→ En uit deze scenario's/varianten komt nog niet 'echt' een concreet beeld (is wat hij op een vriendelijke manier zei 😊)

Zien de geïnterviewden hun gesprekken met Floor hierin terug?

→ Ik vind het moeilijk het gesprek te vertalen naar de kaartjes

→ Ik zie wel een deel terug, verder vind ik het een hoog over gehalte

→ Ik herken wel veel terug

→ Ik zie wel wat terug, maar is wel een zeer complex gebeuren.

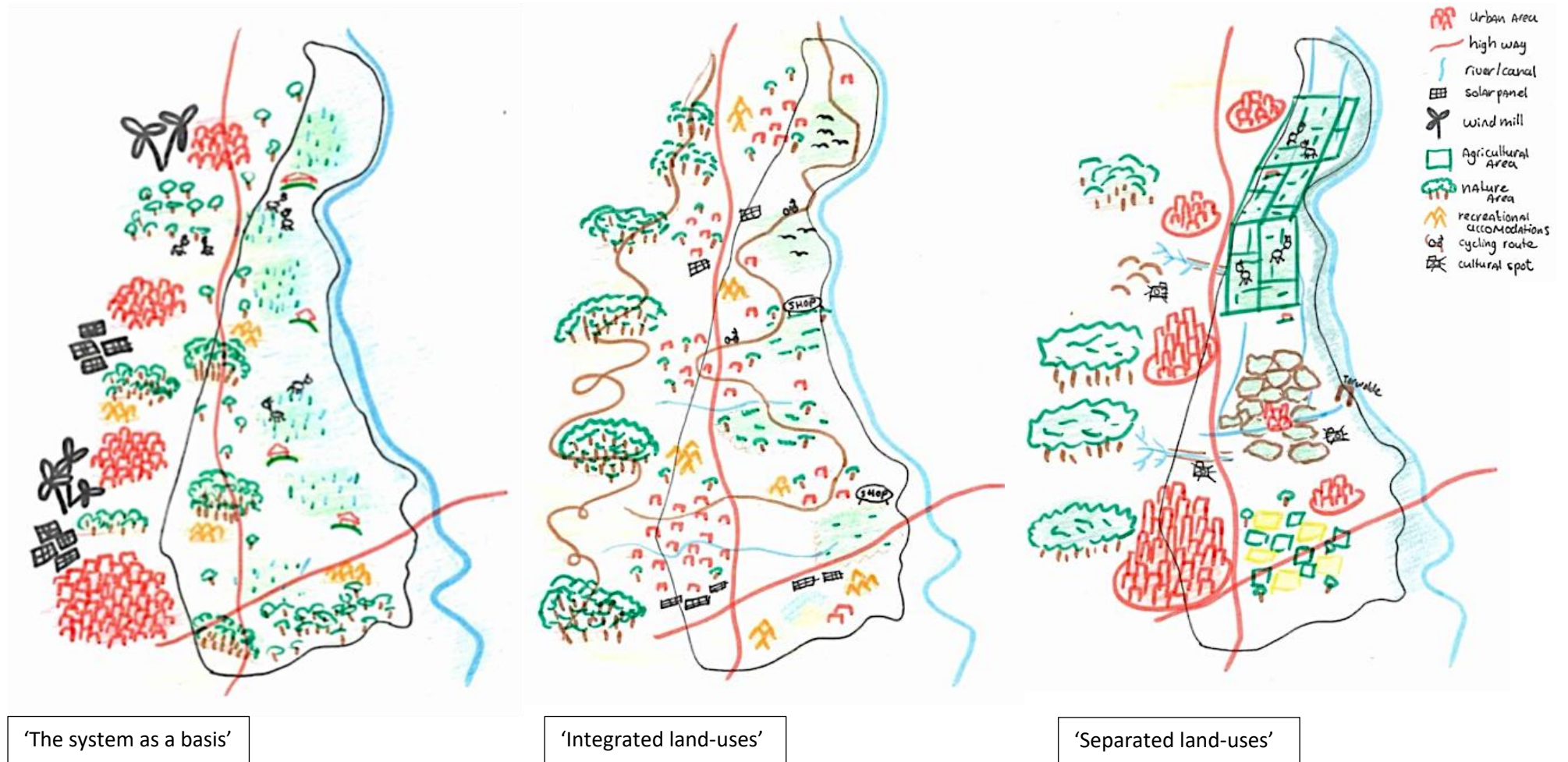
Scenario's worden vaak als extremen weggezet. Je hebt hele verschillende richtingen, en als je die tegenover elkaar zet krijg je wel meteen een erge weerstand. Wij proberen verschillende wensbeelden naast elkaar te zetten, waarbij je ook echt reële scenario's krijgt. Op deze manier krijg je niet iedereen meteen tegen je. Een uitdaging is, hoe voorkom je dat die extremen direct heel veel weerstand vormen?

Het scheiden van die exploratieve scenario's en normatieve scenario's is heel moeilijk. Dat zie je ook in de scenario's van Floor terug.

Specifieke punten over de varianten uit de chat:

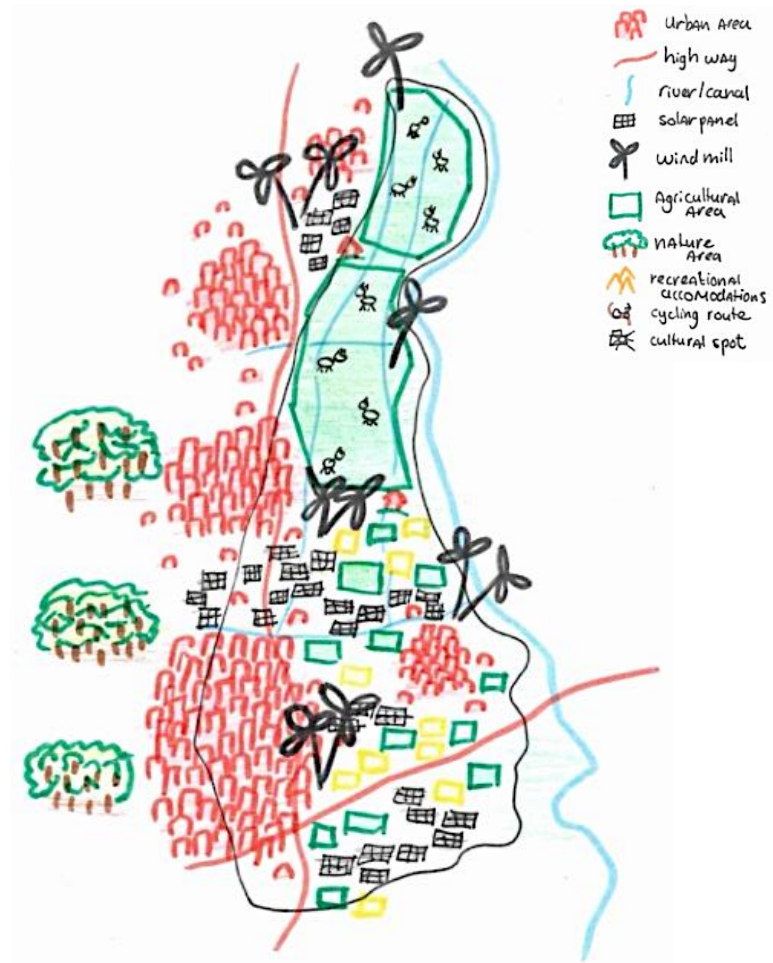
- Bij het leggen van zonnepanelen op daken ligt het er ook aan of deze daken dit kunnen dragen. Want dat kan dan ook leiden tot extra investeringen om dit mogelijk te maken.
- Er zijn veel zonnepanelen aan de veluwe kant
- Zonnepanelen verminken het landschap, en zo ook de mogelijkheid voor recreatie.

## Annex 5: Visual representations of the local-level scenarios for the NIV





'Tourism-driven'



'Agriculture-driven'

'Modern economy' is a combination of  
'Integrated land-uses' and 'Agriculture-driven'