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SYMBIOSIS BETWEEN SAFETY AND NATURE

Putting the cyclic rejuvenation strategy into practice

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Abstract

Unbridled growth of shrubs and forests in the nature restoration projects of the regulated Meuse River and Rhine River floodplains, reduce the water discharge capacity beyond acceptable levels. To meet both hydraulic and ecological conditions a new floodplain management strategy will be further elaborated and applied to the Beuningen floodplain (300 ha; Waal River). This management strategy is referred to as Cyclic Floodplain Rejuvenation (CFR) and comprises new institutional arrangements, periodic (cyclic) interventions in the morphology and vegetation of the floodplains and the application of innovative management techniques. The research project is mainly funded by EU INTERREG IIIB and the Dutch research programme "Living with Water".

1. Introduction

Since the publication of Plan Stork (1987) the land use of many floodplains along the Meuse River and Rhine branches in The Netherlands has been transformed from agriculture to nature management. Although the implementation of this policy can be considered as a success, the vegetation development in some floodplains causes a dangerous decrease of the water discharge capacity (RIZA, 2004).

This project is defined to develop and apply a management strategy that combines both nature and safety objectives. The research project is part of the more comprehensive INTERREG IIIB project named "*Freude am Fluss*". The *Freude am Fluss* project focuses on changes in land use via local initiatives, new market mechanisms and technical innovations. These changes in land use will generate more space for the river and the riparian vegetation but also requires a new view on management. The *Freude am Fluss* project is carried out by French, German and Dutch governmental organisations, academic institutions and consultants.

2. Case-study Beuningen floodplain, Waal River

Since 1991 the shift from agriculture to nature restoration has been carried out successfully in the Beuningen floodplain (300 ha; Waal River). However, since this transformation the growth of shrubs and trees gradually exceeded the standard value of hydraulic roughness. Figure 1 shows the increase in hydraulic roughness due to vegetation development between 1985 and 2003. As a consequence, the maximum water level linked to the standard maximum water discharge in this river section raised with 5.5 cm (Rijkswaterstaat, 2003). This causes an unacceptable situation. In cooperation with the river and nature managers, it was decided to further elaborate and apply a new management strategy

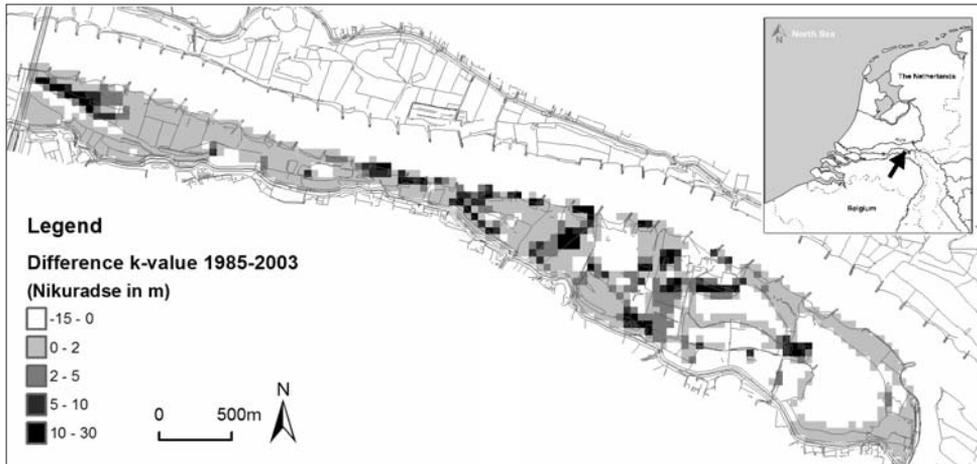


Figure 1. Increase hydraulic roughness in floodplains Beuningen 1985-2003.

to the Beuningen floodplain to compensate for the increased hydraulic roughness without affecting the ecological values. This new management strategy is named Cyclic Floodplain Rejuvenation.

2.1 The new management strategy; Cyclic Floodplain Rejuvenation

In this research 'Cyclic Floodplain Rejuvenation' (CFR) is considered as the system of natural processes in non-regulated rivers that is responsible for building up and breaking down morphology and vegetation. The main processes are erosion, sedimentation and vegetation succession. In natural rivers the combined action of these processes result in cyclic rejuvenation of morphology and vegetation, and therefore in a natural regulation of the discharge capacity (Smits *et al.* 2000).

In regulated rivers like the Rhine branches these natural processes can't act freely because of the presence of for instance dams, weirs, dikes and groynes. As a consequence the natural rejuvenation cycle is broken, and vegetation tends to develop to the climax-stage (forest). The result of this development is an increase of hydraulic roughness, and subsequently an increase of the risk of flooding. (Duel *et al.* 2001; Baptist *et al.* 2004).

The basic idea of the CFR-strategy is to 'repair' the broken rejuvenation cycle by human interventions. Therefore we have to understand the natural rejuvenation processes and if possible, imitate them. In practice, this means setting back succession stages to a pioneer situation (e.g. removal vegetation, lowering floodplains or digging side channels).

The CFR-strategy can contribute to re-establish the discharge capacity, because normally pioneer stages have a lower hydraulic roughness (RIZA, 2003). The CFR-strategy will also result in more variation of succession stages, and therefore in a higher biodiversity. These are the two main reasons that the CFR-strategy is a promising solution for the realisation of a symbiosis between safety and nature. Besides, the CFR-strategy provides also opportunities for sand or gravel excavations which can reduce the management costs.

In summary, applying the CFR strategy to nature restoration projects in floodplains may realise a symbiosis between safety and nature. However, many knowledge gaps still need to be filled before

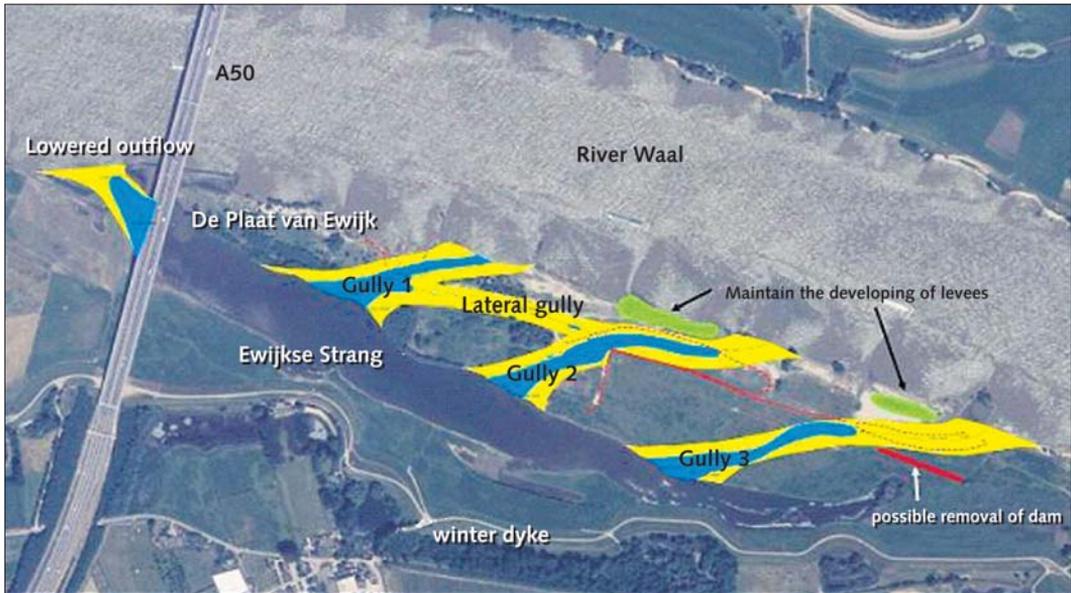


Figure 2. Layout design cyclic rejuvenation measure Ewijkse plaat.

this new management strategy can be applied and up scaled to entire river sections. The most important knowledge gaps have been identified and incorporated into this research project named “Symbiosis between Safety and Nature”.

2.2 Design Cyclic rejuvenation measures Ewijkse plaat and Beuningen

In 2005 a cyclic rejuvenation measure was designed for the western part of the floodplains of Beuningen, namely the Ewijkse plaat. The measure comprises the excavation of three diagonal side channels across the sandbar. In Figure 2 the layout of the diagonal channel is projected on the aerial photograph of the floodplain.

Before excavating the channels a part of the softwood forest will be removed, and in combination with the excavation the discharge capacity will be restored. The measure is inspired by existing erosion spots along the sandbar. Along the excavated channels pioneer stages of riparian vegetation will develop, and will enrich the ecological diversity.

This design is discussed and approved by German and French ecologists and morphologists during an inter-vision team meeting in The Netherlands.

3. Transnational Co-operation

In the *Freude am Fluss* project transnational co-operation is focused on France, Germany and The Netherlands. This paper focuses on the Dutch aspects of vegetation development and flood risk management. During several international meetings the contents of related projects along the Loire (France) and the Lower Rhine (Germany) are discussed.

Co-operation between different INTERREG IIIB project is elaborated by attending meetings and thematic groups of related projects (SDF, Floodscape).

The Loire River is considered as one of the last rivers in the North West of Europe that is hardly regulated. Nevertheless, the naturalness is threatened by human activities. Gravel extraction between 1950-1991 lead to an incision of 1.5-2 m. Due to this incision, the floodplains of the Loire River are flooded less frequently. This causes an increase of the growth of hydraulic rough vegetation types (shrubs and forest). To maintain the discharge capacity during floods (flood risk management) the vegetation development is managed. In the '*Plan Grandeur Nature Loire*' (1994) a strategy is proposed to serve both nature restoration and flood risk management objectives in the Loire River. In October 2004 *L' Etablissement public Loire* hosted an inter-vision team meeting along the Loire. The strategy of the French floodplain manager was discussed as a possible reference for the Dutch and German projects. German and Dutch experts, river and nature managers attended this meeting (Kater & Vreugdenhil, 2005).

The German study area (Rest Rhein) is located upstream the Rhine River. In the Rest Rhein 25 million m³ of retention area will be created in combination with nature restoration as a part of the Integrated Rhine Programme. The retention capacity is obtained by excavation of gravel and development of vegetation. The excavation of gravel provides more room for the river. The retention capacity of this extra room will be optimised by vegetation development. Hydraulic rough types of vegetation decrease the discharge capacity, and will increase the retention volume.

The objective of the Rest Rhein project in the framework of the Integrated Rhine Programme is to increase the water retention volume without decreasing the quality of nature values. Within the *Freude am Fluss* project it should be analysed whether a braided river could be achieved by extra measures (controlled erosion, increased discharge, ...)

The difficulty in this project is to find a balance between a maximized hydraulic roughness (forest and shrubs) and biodiversity (also less rough vegetation types in natural braided rivers). In 2006/7 an inter-vision team meeting on floodplain management along the Lower Rhine will be organised.

In May 2005 an inter-vision team meeting was organised to discuss the design of the cyclic rejuvenation measures in the floodplains of Beuningen and the Ewijkse plaat. German, Dutch and French experts, river and nature managers participated in this meeting.

4. Scope for further research and cooperation

The planned research activities (2004-2008) address the following issues:

- Institutional arrangements of floodplain and river management;
- Spatial and temporal application of the CFR strategy;
- Cost-effective, innovative management techniques.

5. Institutional arrangements

During the last two centuries the responsibilities and management tasks of the floodplains in The Netherlands has hardly been changed. However, because of large scale transformation of agricultural use of floodplains to nature management and the upcoming measures within the context of the national flood defence project "Room for Rivers", a new and dynamic situation has evolved. This requires a thorough analysis and possible adjustments of the existing institutional arrangements between involved stakeholders.

6. Spatial and temporal application of the CFR-strategy

Because the strategy implies periodic (cyclic) interventions at different locations, the spatial and temporal application of CFR-measures is important. The preliminary study activities focused on the Beuningen floodplain demonstrate that various scale levels need to be addressed:

- Studying the ecological aspects requires the river section on both sides of the river between Nijmegen and Tiel (ca. 40 km);
- Considering the hydraulic effects of CFR interventions, solutions for solving the problems in the Beuningen floodplain can be searched up to ca. 15 km downstream;
- An analysis of the institutional arrangements has to be carried out on the local, regional and national scale.

7. Cost-effective, innovative techniques

As stated, within the CFR-strategy interventions are necessary on a regular basis. Therefore the development of cost-effective techniques is crucial for a successful implementation of this strategy. The case-study of the Floodplains Beuningen focuses on CFR-interventions realised by applying cost-effective, innovative techniques. For example a combination between sub-surface sand excavation techniques and removal of floodplain vegetation will be investigated. Another promising technique is the use of a transformed agricultural machine to remove young trees effectively.

8. Deliverables of the project

The activities will lead to the following deliverables in 2008:

- Handbook CFR-strategy for river and floodplain managers, focusing on concrete interventions measures, planning in space and time and organisational and logistic recommendations;
- Design and realisation of CFR-interventions in the Beuningen floodplain which will result in a river management permit delivered by the river manager;
- A series of scientific reports and articles in peer reviewed scientific journals dealing with nature management, institutional arrangements and technical innovations in floodplain management.

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