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Adaptive Land use for Flood Alleviation

Water Friendly Land Management

Best practices on combining farming and forestry with flood protection from the ALFA project

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Content

Investing in Opportunities
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1 Introduction

ALFA stands for Adaptive Land Use for Flood Alleviation. In the ALFA project, six partners worked together to decrease the risk of flooding in their river catchments, by creating new capacity for water storage or for the discharge of peak floods. All the partners involved, had projects which changed the course of the river, encouraged storage of water within the landscape or otherwise allowed water to flow in areas that hitherto had been protected from flooding. The areas in which this has been done are predominantly rural. However, this does not mean that they are unused or empty areas. In practice it involved areas with a certain ecological or natural value and also different stakeholder interests such as farming, forestry, sand mining, fisheries and recreation. For the flood management projects to be successful, these stakeholder interests needed to be taken into account. That is the reason for water friendly land management.

In this report the ALFA partners want to collect and share their experience and best practices on water friendly land management. These findings range from technical solutions, to public involvement and social economic and ecological benefits. The technical solutions very much depend on the location in the catchment of the projects. The way public involvement is organized depends on the socio-cultural and institutional context. However, all the projects have in common that they need to find strategies so that people can continue living and working in areas that, from time to time, will be flooded.

In this report three case studies of water friendly land management will be presented; one upstream, one mid-stream and one in the downstream part of the catchment. The cases show successful combinations of flood risk management with farming and forestry. In the next section the different flood management measures will be explained, according to the different locations in the river basin. Then the three examples from the ALFA project will be presented, giving some attention to the institutional background and the role of the organisation in flood management. The report will end with a summary of general best practices common to all three cases.

The six ALFA partners are the Eden Rivers Trust (U.K), Vlaamse Milieu Maatschappij (Belgium), EPTB Seine Grands Lacs (France), Emscher Genossenschaft (Germany), Struktur- und Genehmigungsdirektion Süd (Germany) and Rijkswaterstaat (The Netherlands). The ALFA project has been funded by INTERREG IVB NWE programme. The INTERREG IVB NWE programme is a financial instrument of the European Union's Cohesion Policy. It funds projects which support transnational cooperation. The aim is to find innovative ways to make the most of territorial assets and tackle shared problems of Member States, regions and other authorities.

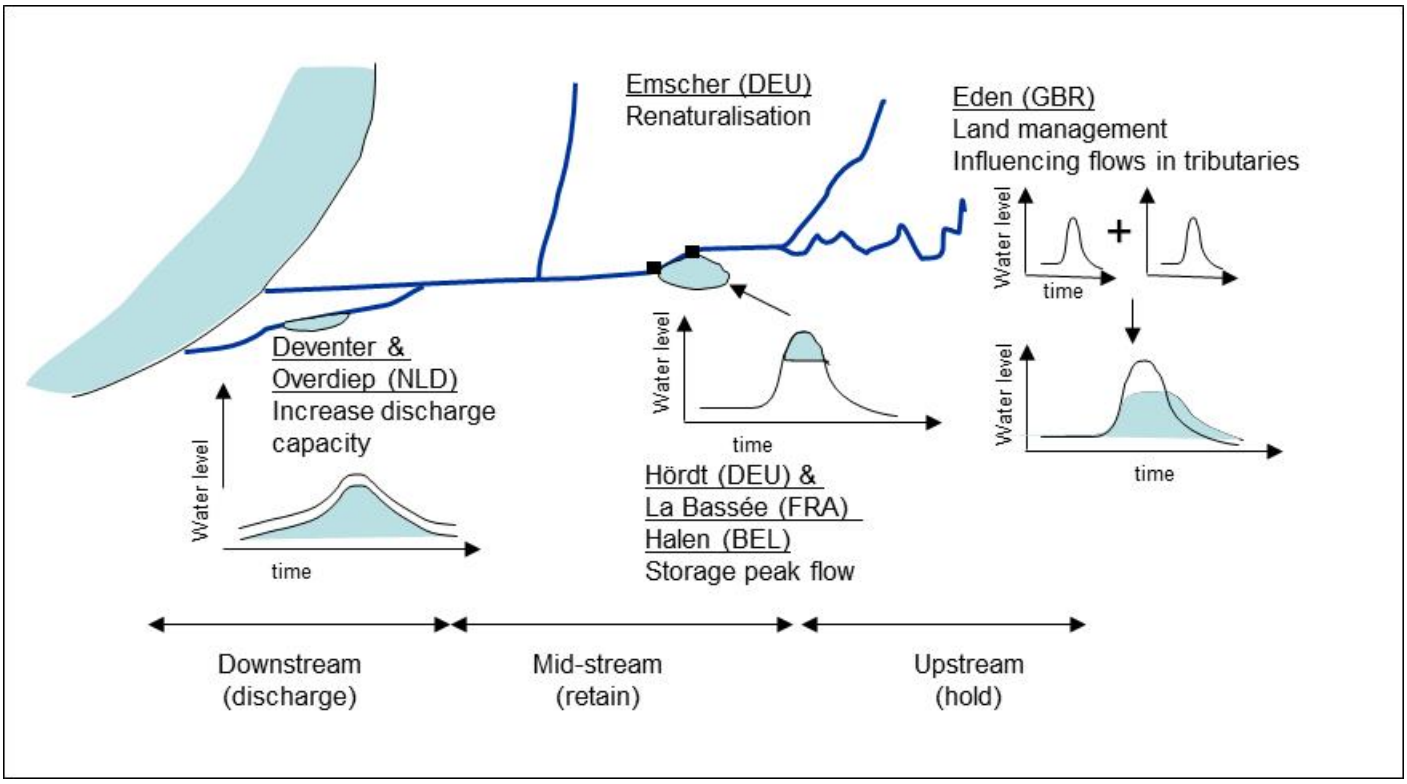
2 Flood risk management in the upper, middle and lower part of the catchment

Since 2011, in the Netherlands the concept of hold – retain – discharge has been officially used to describe the strategy for water management (combining both floods and droughts)[1]. This concept entails a three-step approach for flood management. First hold water where rainfall occurs. If this is not possible, store water temporarily. The

[1] Hold-retain-discharge (*vasthouden-bergen-afvoeren*) is the basic approach in Dutch Water Management recommended by Nationaal Bestuursakkoord Water [NBW] (2011), p. 19.

third and final option is to discharge water downstream as quickly as possible.[2] In Dutch policy this trio is also a preferential sequence; meaning that the use of green spaces and gardens is stimulated to allow as much infiltration as possible, that ponds and meadows are made to store water and finally that drainage, pumping and river discharge capacity are increased to discharge the surplus of water.

This sequence is also a useful concept to apply across a whole river basin (though without a preferential sequence). It implies that in the upper areas of the catchment we try to hold as much water as possible by improving infiltration of rainwater into the ground and by influencing the timing of peak flows from the tributary streams (e.g. slowing the flow). Mid-stream flood reservoirs or retention areas are often constructed to store water during peak flows (peak-shaving). At the upstream part of the flood storage reservoir, a gate or a sluice will let the water in the retention area thus diminishing the height of the peak flow and protecting the areas downstream. When the maximum flood peaks have passed, the stored water will be let out of the reservoir again. In the downstream area the topography is usually much flatter whilst the water volumes are the largest. Water retention to lower the peak flow is hardly possible; the most effective flood protection measure is to provide more discharge capacity to allow water to flow away as quickly and safely as possible. Major obstacles such as bridges, groins or narrow stretches of the river will cause a back-up of water behind the obstacle. Therefore a solution is to remove these obstacles and so protect areas upstream of these points from flooding.



ALFA projects placed along an imaginary river

[2] Similar strategies involving the combination of measures are used in the other European countries, e.g. in Germany the flood management concept is summarised in the terms “natural retention” – “technical protection” – “damage prevention” see Hochwasserschutz in Rheinland-Pfalz. Ministerium für Umwelt, Forsten und Verbraucherschutz Rheinland-Pfalz (Mainz, 2011).

The ALFA experience includes projects throughout the whole river basin, as shown schematically in the above figure. Four of these projects also have innovative ways to combine land use (farming and forestry) with flood management. These are projects on the River Eden (UK) in the upstream area, waterfriendly forestry projects on the River Rhine (Germany) for the mid-stream area and farming projects on the IJssel and the Kleine Maasje (Netherlands) for the downstream area. Best practices for farming pertain to water quality as well as to water quantity. Best practices on water quality are similar in different parts of the river catchment (upstream, midstream and downstream). Measures for managing water quantity, however, vary depending on the course of the river. Therefore this report will concentrate on these last ones.

3 Flood management upstream: Combining farming and small scale measures in the Eden catchment (U.K.)

3.1 How flood management is organized in England

Flood management in England is divided between the national authorities and the local authorities. At the national level the lead entity to develop flood risk management policy is the Department for Environment, Food and Rural Affairs (DEFRA). The Environment Agency (EA) has operational responsibility for managing the risk of flooding from main rivers, reservoirs, estuaries and the sea, as well as being a coastal erosion risk management authority.From their overview of flood risk in England, the EA also provide support for local authorities in the form of best practices and guidelines. Lead Local Flood Authorities-LLFA (usually county councils) are responsible for maintaining and applying local flood management strategy in their areas. They have lead responsibility for managing the risk of flooding from surface water, groundwater and ordinary watercourses. Besides the above, Water and Sewerage companies, the Highways Authorities and Internal Drainage Boards all have an important role in managing the risk of flooding from the sewer network, highways and low lying areas respectively. Next to these public and private bodies, there are the River Trusts. These are Non-Governmental Organisations (NGOs), charities working for the benefit of a specific river catchment. The Eden Rivers Trust (ERT) is the trust dedicated to the conservation and protection of the River Eden catchment. ERT works closely with local people, farmers and landowners to influence positive changes for the river, its wildlife and the people who live, work and play in the catchment. A lot of their daily work revolves around education and explaining the importance of the river to people.

3.2 The River Eden Catchment

The Eden catchment is located in North West England. The river flows through some of England's most beautiful landscapes including the Lake District, Northumberland and Yorkshire Dales National Parks, the North Pennines and Solway Coast Areas of Outstanding Natural Beauty (AONB's), and the Hadrian's Wall World Heritage Site. The catchment is formed by limestone, sandstone and volcanic geologies which give it a broad range of ecological conditions. It has Special Area of Conservation (SAC) status, for Atlantic salmon, white-clawed crayfish, bullheads, three species of lamprey, water crowfoots and otter. The Eden catchment is also important as a water resource for domestic and industrial use, as an area of agricultural production and as an attraction for tourism. In 2005, severe floods occurred in the Eden catchment causing estimated damages of £250 million in the city of Carlisle alone. Conversely, in 2010 the county had the driest start to the year since 1929.

Eden catchment.

Facts

- Length: 130 km
- Area: 2,300 km^2
- Inhabitants: 150,000

Other interesting facts:

- 97% of the catchment is used by agriculture which employs more than 5,000 people.
- There are more than 200,000 cattle in the catchment, nearly 900,000 sheep, more than 30,000 pigs and approximately 2million poultry.
- Farm businesses make up over 30% of the Eden Valley's VAT registered businesses.
- There are more than 2,000 farm holdings in the Eden catchment.

3.3 The Eden Rivers Trust and flood risk management

The overall approach of the ERT case is to implement catchment scale planning and land management to help manage river flows - both floods and droughts - in an ecologically sustainable way. Sustainable land management means that the solutions contribute to protecting the future ecological value of the river and that they are self-managing and do not require costly ongoing investments or long-term maintenance.

For this approach two steps have been taken. First, with the help of hydraulic models and statistical approaches, the interaction between peak flood waves from different tributaries of the River Eden and their effect on water levels at Carlisle has been investigated by researchers at Durham University. Slowing down the peak flow in a tributary, for example, avoids peaks from different tributaries coinciding and creating a high water level downstream. This helped identify those tributaries or sub-catchments where adapting land use to slow down or store more water was most likely to help reduce flood risk downstream. The impact of land use and land management changes (e.g. reducing soil compaction, creating flood plain woodland), on high and low river flows within these target sub-catchments was then analysed.[3]

[3] Pattison, I (2010) *Rural land management impacts on catchment scale flood risk*, Unpublished PhD Thesis, Durham University

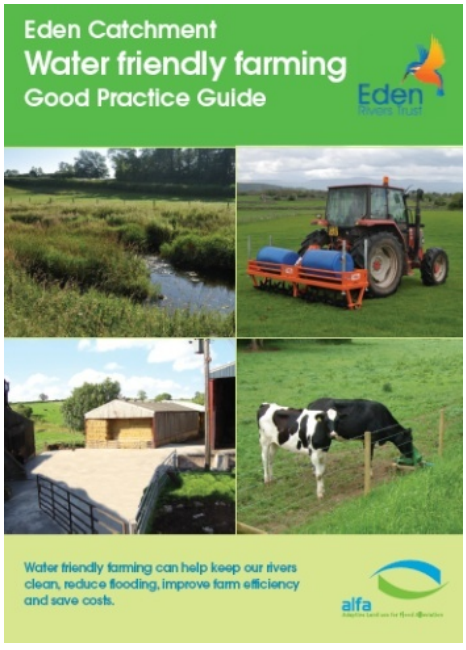
Second, once the catchment has been modelled and in theory has shown where and what type of land management changes could be most effective, the task of implementing these changes comes. Land in the Eden catchment is composed of farms and estates in private property who have to be shown and convinced that there are benefits for them for adapting their land management to reduce flood risk downstream. Successful delivery of water friendly land management depends on involving the local farming community. This requires actions to raise awareness, to enhance skills, knowledge and education, to enhance solidarity within the catchment, to influence behaviour, and to develop win:win solutions.

An independent organisation such as ERT is ideally placed to do this as they are trusted by the farming community and seen as an honest broker between farmers and the government agencies. Through the ALFA Project ERT has worked with farmers in a small sub-catchment of the Eden to create a network of projects that help to reduce surface water runoff, to store water temporarily in the landscape and to slow the rate at which rainwater flows from farmland into the rivers. These local retention measures in the upstream catchments can also be very well combined with improving the river's water quality and restoring wildlife habitats, as well as offering benefits for the farmers themselves.

In addressing flood risk management, the ERT underlines that sustainable river management is about much more than regular dredging. It is a combination of land and water management. It's about spatial planning and opportunities, and it is important to consider the Eden river catchment as a whole.

3.4 Best practices for upstream land management

ERT has developed its recommendations for water-friendly farming in a Good Practice Guide[4]. The short, colourful leaflet provides easy to read guidelines and suggests simple steps that can help famers reduce soil and nutrient losses from their land, help manage river banks in an environmentally friendly way and help slow the flow of water from farmland during heavy rainfall. The aim of the guide is to show how small changes around the farm can make a big difference, helping to keep rivers clean and reduce flooding whilst at the same time being good for the farm business by improving efficiency and saving costs. It is aimed at crop and livestock farmers, farm advisors and landowners within the Eden catchment.



The guide has the form of a folder, and can be downloaded, but is also available as a hard copy. The advantage of hard copies is that in personal contact with the target group (essentially farmers), it can be left as a physical reminder of the recommendations. A hard copy will be looked at more often than a folder which needs to be downloaded first. The layout is attractive with illustrations in which the local landscape is well recognisable.

Examples of recommendations from the guidelines include:

[4] Water Friendly Farming Good Practices Guide; Eden Rivers Trust; http://trust.edenriverstrust.org.uk/downloads.html

Controlling runoff at source and managing soils

- Utilise a cropping sequence that ensures ground coverage throughout the year
- Identify areas of soil erosion and runoff risk to safeguard the most valuable resource of a farm (land)
- Avoid vehicle movements and wheel ruts on wet soil
- Check soils regularly for capping and compaction. Machines such as a soil aerator or sub-soiler can help to improve compacted soil. Breaking up compaction can help more rainfall to enter the soil, reducing rapid surface runoff and erosion. Improvements in soil structure can also help plant growth.
- At field corners consider creating small ponds or filter-beds to encourage settlement of silt.
- Consider permanent vegetation (e.g. hedgerows, woodland, grass buffers) on steep slopes, natural drainage pathways at risk of erosion, field boundaries and wet soils at difficult corners. This helps to trap soil and nutrients and slows the flow of rainfall to the river.

Managing livestock and river banks

- Chose winter grazing sites carefully to avoid erosion on high risk locations
- Reduce stocking densities to avoid overgrazing, compaction and soil erosion, particularly during winter and spring months and in the vicinity of the watercourse.
- Use temporary or permanent fencing to exclude livestock from river banks. Fencing allows riverbank vegetation to re-establish, helping to stabilise eroding riverbanks. It also allows the river to narrow and deepen, to encourage ‘scouring’ of the riverbed.
- Set fencing at an appropriate distance from the river. Align fencing parallel to flow and build in break points to minimise potential flood damage. Temporary electric fencing or three lines of wire may be more appropriate than stock netting in areas of high flood risk. Make provision for gated access, to allow control of invasive vegetation by topping or occasional grazing by livestock.
- Use large woody debris (e.g. branches and trunks) which can help stabilize eroding river banks and slow river flows during a flood reducing flood risk downstream. Moreover woody debris provides shelter and food for wildlife and spawning and rearing habitat for fish. Woody debris creates divers flow conditions and a larger range of stream temperatures creating more niche habitats.
- Identify erosion and pollution hot spots such as tracks, yards and gateways. Move, drain or resurface these hot spots to reduce soil and animal wastes entering rivers. Stable, firm surfaces will also help reduce lameness in cows.

An example: Dacre Beck

The Dacre Beck is a small sub-catchment of the River Eden. Computer modelling showed that Dacre Beck is an area where reducing rapid surface water runoff from agricultural land could help reduce the risk of flooding downstream. Dacre Beck is also part of the River Eden Special Area of Conservation designated under the EU Habitats Directive but it is currently in Unfavourable Status. One of the reasons is poor water quality. These factors made Dacre Beck a good case for the ERT to develop as a demonstration site that could show how changing land management has benefits for flood protection, for the rehabilitation of river and wildlife habitats and for improving agriculture. Over a period of several years, a total of 12 land-owners agreed to implement 19 different land management schemes on their properties. Schemes were tailor made for each property and with each land-owner a 10-year agreement to maintain the projects was signed. Measures included the creation of grassland buffer strips, hedgerow planting, woodland creation, rainwater harvesting, improving farm tracks, and flood storage pond creation.

For example, on one of the properties, a hill sheep farm, a whole farm water management and runoff scheme was designed. This removed grazing pressure from wet floodplain fields over the winter by building winter housing for sheep and created a network of natural features (hedgerows, riverside buffers, and woodlands) throughout the farm to intercept runoff, trap sediment, increase infiltration, increase channel and riverbank roughness and improve river and wildlife habitats. The features also offered benefits for the farm including improved field boundaries for better grazing management and livestock shelter.

Newly planted streamside woodland fenced off for protection against grazing.

Ditch buffer of rougher vegetation at the base of a hillslope

Newly planted hedgerows fenced off for protection from grazing.

Green farm infrastructure: a cow track made with permeable woodchip materials.

At another property, a dairy farm, the water management scheme included the resurfacing of the farm's cow track. Instead of using impermeable materials such as concrete, the main part of the track was resurfaced using permeable woodchip to reduce runoff and allow infiltration. A short section of track closest to the yard was resurfaced with concrete to allow cleaning of faecal material in the area most prone to waste. The track runs alongside a small stream in which the cows previously trampled. This was fenced and planted with trees to create a buffer of rougher vegetation to further intercept runoff, improve habitat and prevent cows trampling in the stream. The track helps improve cattle movements throughout the farm.

4 Flood management mid-stream: combining forestry and flood storage reservoirs in the Hördt (Germany)

4.1 How flood management is organized in Germany

Germany is a state with a federal structure consisting of 16 separate Federal Constituent States (Länder) under a Federal Government (Bund). The federal level transposes EU Law into National Law and has emitted the Federal Water Act which provides water management planning based on river basins. The federal states are responsible for the implementation of flood risk management on national waterways in their area of responsibility i.e. the federal state. The administrative regions, districts, municipalities, communities or boroughs are responsible for the implementation of flood risk management at local level.

4.2 The River Rhine in the region of the Rhineland Palatinate

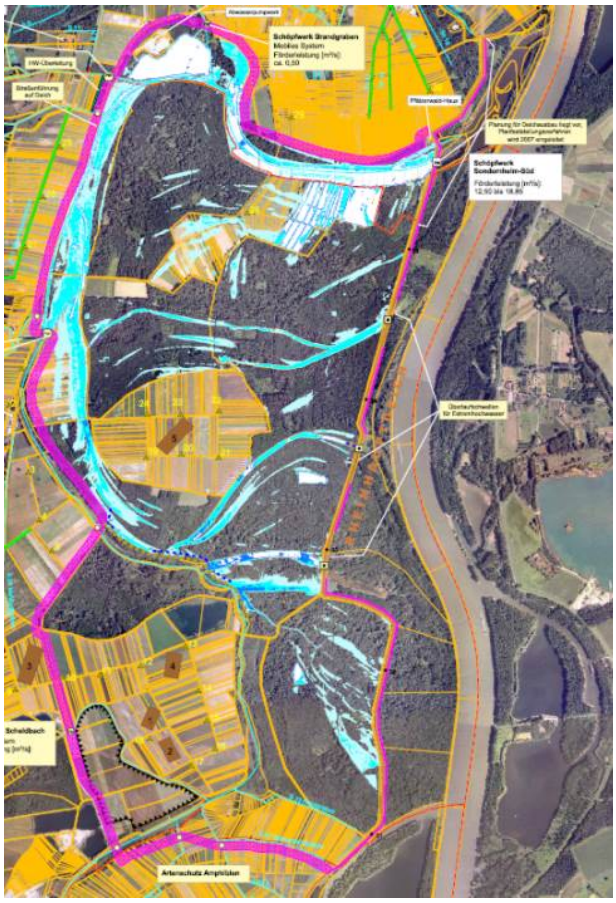
The Rhine in the state of the Rhineland-Palatinate is part of the so-called “Upper Rhine“; the Rhine section between Basel and Bingen. Part of this section forms the border between Germany and the Alsatian region in France. In the 19th and 20th century, alterations to the course of the river under the direction of Johann Gottfried Tulla, heavily modified the landscape of the Upper Rhine. Meanders were cut-off and the river was straightened for navigation. In the 20th century, the French part of the Upper Rhine has had many barages built for hydroelectricity. As a consequence much of the natural floodplain was lost. Agreements between Germany and France resulted in nearly thirty areas in the states of Rhineland-Palatinate and Baden-Württemberg being designated as retention areas (polders). In addition, two emergency polders were designed in order to cope with the challenges of climate change, i. e. exceptional extreme flood events that occur with a probability of more than 1:200 years. The retention area near Hördt is one of them.

4.3 The Struktur- und Genehmigungsdirektion Süd and flood risk management

The SGD is the authority responsible for planning and implementing of the Hördter Rheinaue retention area. SGD Süd is an agency of the German federal state of Rhineland-Palatinate. Based in Neustadt an der Weinstrasse it is an approving body for environmental protection, emission control, water management, nature conservation and wine growing in the southern part of the state. As water management authority SGD Süd is also in charge of dike maintenance in their area of responsibility including parts of the Upper Rhine.

In 2005 the state of Rhineland-Palatinate decided to construct two extra retention areas along the river Rhine in addition to its ten already under construction. The retention area for extreme flood events in the Hördter Rheinaue, 20 km south of the city of Speyer. The plan covers an area of 870 hectares with capacity to store more than 30 million cubic meters of flood water. The costs are estimated at 75 million euro. The retention area near the village of Hördt is located in the former natural floodplain of the Rhine that has been cut off from the main river for over a century.
Round table sessions were an important element in the project. SGD met stakeholders to negotiate the course of the dike. For example, for the farmers it was important to keep the retention area small in order to lose as little farmland as possible. Another important task is the coordination and initiation of cooperation between local communities. SDG Süd is in charge of preparing the plan approval for the development of the retention area. The

plan approval process involves on-going meetings with all local stakeholders including the municipalities, farmers, land owners, nature preservations groups and local state departments. After the meetings SDG Süd is in charge of drawing up the agreed general plan.



4.4 Best practices for stakeholders – forestry

Besides creating additional capacity for extreme floods it is an objective of the retention area near Hördt to guarantee traditional land use concepts. Two thirds of the emergency polder is covered with commercial forest which at the moment is safe from floods as it is protected by the main dike. In addition the forest area is part of the Natura 2000 network designated by the EU Habitat Directive and serves as an attractive local recreational area for hikers and cyclists. Due to the protection against floods a terrestrial forest has developed thus allowing the cultivation of high-yield hardwood tree species like beech and maple. These species are sensitive to high water levels and a retention event would cause huge damage due to drowning of trees. To minimise the damage of a potential flood event on nature and forestry the concept of ecological floods was designed. Once the retention area is established it will be connected to the river Rhine by three sluices through the main dike to let in water regularly up to a defined level. This will increase the dynamics of ground- and surface water facilitating long-tern adaptations towards higher flood tolerance as well as the development towards flood tolerant species community (biocoenosis).

In order to cope with the future situation silvicultural measures were designed in order to establish cost-effective forestry under flood conditions (water friendly forestry). Three major issues were taken into account:

- **Forest conversion**: conversion of predominant terrestrial communities includes substitution of flood sensitive species with flood tolerant species. Hard wood trees like Common Beech (*Fagus sylvatica*), Norway Maple (*Acer pseudoplatanus*) and Sycomore Maple (*Acer platanoides*) do not tolerate long lasting flood events or high water levels. Furthermore a typical floodplain tree like the Common Ash (*Fraxinus excelsior*) is sensitive and in danger of disappearing due to ash dieback, a fungal disease from which ashes all over Europe are suffering. Therefore sensitive hardwood including ash is harvested and substituted by more flood tolerant species like **Common Oak** (*Quercus robur*). In addition rare species are planted like the **European White Elm** (*Ulmus laevis*) and the **Turkish Hazel** (*Corylus colurna*). Like the **Yew Tree** (*Taxus baccata*), a species formally widely but scarcely spread in natural floodplain forests, these trees are able to withstand floods for up to three months. These species can help to guarantee a sustainable and cost efficient forestry for the future within an emergency polder.
- **Improvement of forest areas according to the location:** depending on the local altitude of the area tree species suitable for the future dynamics in water level will be replanted e.g. poplars and willows in periodically flooded areas, oaks and elms in higher areas. This helps to guarantee profitable forestry in the long term.
- **Self-dynamic growth**: forest management will be given up in low lying areas in particular along creeks and ditches to facilitate nature conservation according to the Habitats Directive. These areas will be left to self-dynamic development featuring the development of typical flood plain habitats (Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae,* EU-code 91E0*) thus improving biodiversity.

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Best practice guidelines apply to the future conditions in the area i.e. the ecological floods and include measures for nature conservation, forestry and education / recreation:

For nature conservation

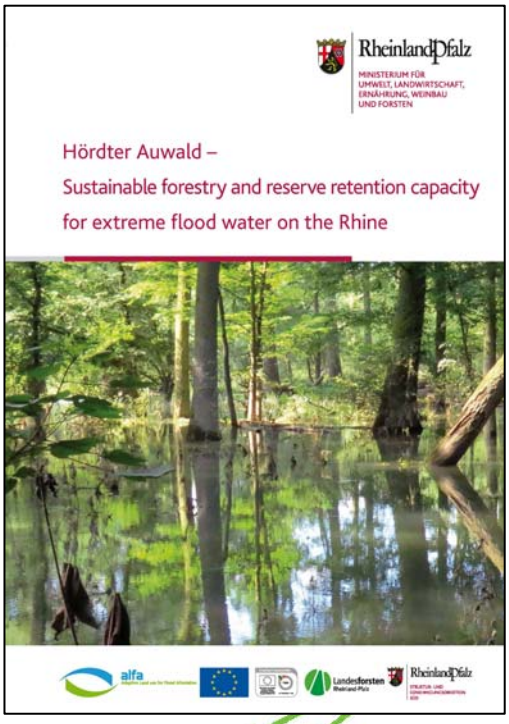
- Allow areas with self-dynamic growth and natural succession
- Promote species / habitat types annexed according EU directives.

For forestry

- Flood tolerance of trees depends on the water level and flooding time.. The adaption of the species community towards higher water levels and extension of individual tolerance is possible by means of ecological floods.
- Flood sensitive species are Common Beech, Sycamore Maple, Wild Cherry and Common Ash. They should be substituted by flood tolerant species as Common Oak, Wild Pear/Apple, European White Elm, Turkish Hazel, Yew Tree, Black Poplar and Black Walnut

For education / recreation

- Educational hiking / cycling trails can be implemented focussing on forestry in the flood plain, floodplain ecology, ecological floods and flood retention



- Regulated recreation i.e. concentration of activities on major paths leaving quiet areas for nature conservation
- Silent recreation due to Natura 2000 areas, no priority areas for leisure activities,
- Guided tours by specially educated staff.

5 Flood management down-stream: combining farming and flood discharge in Room for the River (the Netherlands)

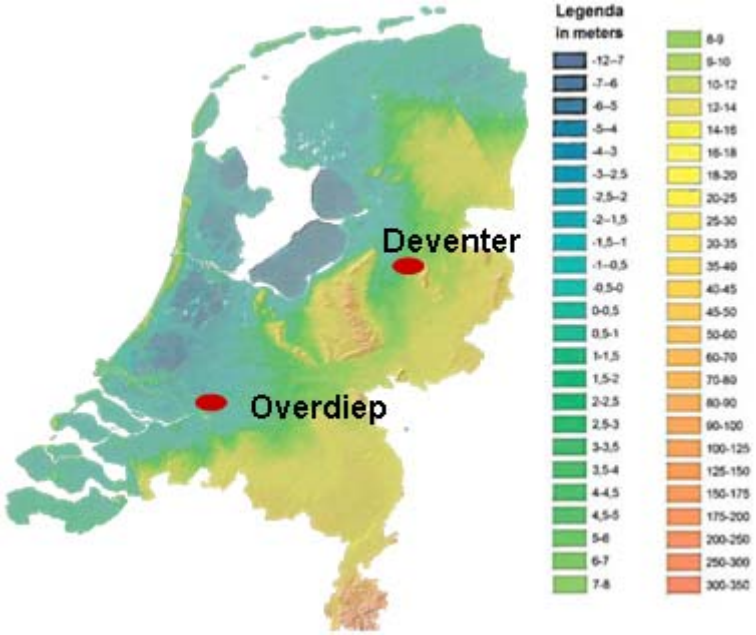
5.1 How flood management is organized in The Netherlands

Much of the Netherlands has been formed since Roman times by successively draining lands and raising dykes and levees to protect it from floods. Through drainage the peat and clay soils compacted making higher dykes necessary. At present, without dykes and barriers, more than 50% of the Netherlands is at risk of flooding. Approximately 30% lies under mean sea level. Consequently, flood protection has always been a major task and since the Early Middle Ages official organisations were created for that task.

Water management is now hierarchically organized in three government levels. At national level the Ministry of Environment is responsible for water policy, and Rijkswaterstaat, the executive agency is responsible for execution of that water policy at national level. At a regional level, water boards take care of water management and levee their own taxes for this purpose. The local authorities are responsible for water management in cities and towns but do so under guidance from the water boards.

5.2 The Delta of the Rhine, Meuse and Scheldt

The Netherlands are located in a delta formed by the confluence of three rivers: the Rhine, the Scheldt and the Meuse. The landscape is dominated by a multitude of bifurcations, braches and islands. The surrounding land is relatively low, between 1,5 m above and 1,5 m below national ordinance level (approximately mean sea level). The rivers have a clear summer bed and a flood plain (also called winter bed) surrounded by dykes to protect the towns and cities behind. River floods occurred regularly until the mid nineteenth century when a national project was set up to train and regulate the rivers for navigation and flood protection. The last two major flood events occurred in December 1993 and January 1995. The water levels were extremely high and the dikes just managed to hold; but a quarter of a million people had to be evacuated. As a result a major programme was initiated called Room for the River.



5.3 The Room for the River programme and flood management

The Room for the River programme is implemented by Rijkswaterstaat in partnership with regional and local authorities (municipalities, provinces and water boards). The programme consists of 30 measures which increase the discharge capacity of the large rives in the Netherlands to 16.000 m^3/s. This is done by widening the river where necessary, creating by-pass channels, lowering the floodplain, taking away obstacles like bridges, lowering groins etc. The programme has an overall budget of 2,3 billion euros and all measures should be ready by 2015. Two measures from Room for the River are relevant as examples of water friendly land management; the Overdiepse polder and the river widening in Deventer.

The Overdiepse Polder is being adjusted to become an overspill area for the River Meuse. The inhabitants, farmers with their houses and farming business, have been relocated on to mounds or *terpen* that will remain dry when the area is under water. This solution was provided by the farmers who got themselves involved at a very early stage of the planning process. It is a sustainable solution for safety and for the agricultural use of the polder. The water from the river will flow through the polder on average once every 25 years. This will cause the high water level of the river to drop by approximately 27 cm where the Overdiepse Polder is located and approximately 10 cm upstream at the city of ‘s Hertogenbosch. An inlet construction is not necessary, only a new pumping station is built to drain the polder again after a flood.

In the River Ijssel (a distributary of the Rhine) downstream of the city of Deventer along a stretch of 10 km, part of the floodplain is being deepened to improve river discharge during flood peaks. In the floodplain an extra by-pass channel is being excavated, approximately 10 km in length and 100 m width. This measure will lower the peak flows by 10 cm. In 1986 this area (called the Keizers- en Stobbewaarden) was designated a Natura 2000 area, amongst other reasons because of natural river dynamics. The farm maintenance is directed to maintaining the Natura 2000 goals.

Upstream from Deventer, part of the floodplain belongs to Stichting IJssellandschap (Ijssel Landscape Trust) and is rented to an organic dairy farm. The farm is located on a small hill , which will remain dry during floods. The farm is a closed system regarding energy and nutrients and must also be run profitably taking into account that the floodplain will be flooded regularly in the winter . The farmer has a contract with RWS to maintain the floodplain free of high vegetation during the flood prone winter months. The farmer does this partly by allowing the livestock to graze in the floodplain[5].

The farm and the residence have been architecturally designed. The residence includes an educational centre with a visitors centre. All the activities of the educational centre have been grouped under a trust (Keizersrande Trust) and kept separate from the actual farming business. The goal of Keizersrande Trust is to combine information, education and art related to the farm and the location. In this way the Trust seeks to raise and maintain the awareness about the local Room for the

[5] Grazing is a used method in the Netherlands to keep the dykes and floodplains free of vegetation; but usually non-consumable species such as the highland cows are used instead of farm livestock.

River measure, to inform visitors about visitors about the landscape, the Room for the River measure and on the farm and its operation. This has been carried out in cooperation with artists. AS a example, the visitor's centre which includes a meeting room has been furbished and decorated by young artist, and the observatories, placed on the property, are works of art that at the same time allow visitors to focus on particular traits of the landscape.

Artwork in the landscape. The children can climb in it. At the same time it by constraining the view, it focusses Attention to certain points in the landscape.

Visitors centre, designed and furnished by young artists. The cabinet is a modern Interpretation of an antique rarity-cabinet.

5.4 Best practices for farming in the flood plain

The Room for the River program is a national program, approved in parliament and carried out with national budget, but the measures are implemented locally. Within the Dutch context, one of the innovative aspects of Room for the River, was that at a very early stage the implementation was carried out with local authorities, taking very much into account the local needs and wishes for spatial quality. In some cases, as in the Overdiepse polder this went so far as to follow the initiative of the local farmers, getting them involved in the whole process. In Deventer this meant involving the owner of the floodplain area: Stichting IJssellandschap. This organisation sought possibilities to combine ecological farming and the maintenance of the ecologically valuable floodplain. The result was the development of a water friendly dairy farm in the floodplain. The farm itself is built on a mound above flood level and was designed and built in cooperation with the tenant. It also houses an educational centre devoted to the reason for the measure, and to water friendly farming.

Some of the best practices include:

- The combination of maintaining an organic dairy farm in the floodplain seems feasible. The organic character of the business (closed circle energy and food) blends in well with the proximity to the river and the task of maintaining the floodplain free of heavy vegetation. What is left over by the cattle is mowed and stored as winter fodder. However an evaluation over a long term (e.g. 10 years, including seasons with good harvests, bad harvests ad floods) is needed to assss and gain experience on how and under what conditions the water friendly farm can run as a profitable business.
- In the case of tenanted land, with the possibility of building a complete new farm it is highly recommended to do this in close cooperation with the future (long-term) tenant. This results in a construction that fits the needs of the end user, has the required flexibility and is probably sometimes more economical.

- It is important to find a good balance between running a farming business and creating nature according to the Natura2000 directives. For example not all the areas are fertilized, mowed or used as pasture in equal measure. This provides the conditions for a greater variation in plants, insects and birds and so a larger degree of biodiversity. Also, characteristic elements in the landscape are maintained, such as pools, hawthorn hedges, river crevasses, hedgerows and groves. The maintenance is geared towards the development of the flora and fauna that are typical for this unique area: traditional croplands , meadows with varied species of grass and grassland birds.
- It is feasible to use dairy cattle to keep the floodplain free of major vegetation instead of semi-wild livestock (e.g. highland cows).
- The combination of a water-friendly organic farm with an educational centre raises local awareness for flood management and regional/national awareness amongst professionals for the possibilities of combining farming-nature and flood management.
- Separating the actual farming business from extra tasks like education and information helps to separate the purely business side which needs to be run profitably, from other functions of this pilot farm. Including art as an important factor on the property and in the visitors centre is a distinguishing trait, that offers opportunities and has helped to create considerable publicity for the whole project.

6 General conclusions

In this report we have considered three cases where farming and forestry have successfully been combined with flood management; one case in the upstream part of the catchment, one in the mid-stream part and one example in the down-stream part. Up-stream the measures involve improving infiltration and slowing down water flow over the land. Mid-stream the measures involve building a water retention area to store water during floods. Down-stream the measures involved making more room available for discharging water during peak flows.

What is in it for them?
The measures are taken in one area mainly to protect other areas upstream or downstream, therefore they require an act of solidarity. Landowners, farmers and people have to adapt to changing surroundings to protect other areas from flooding. Therefore it is essential to include benefits for the local people. This can be achieved by developing the multi-benefit aspects of the measures, as in the Eden catchment , by including compensation measures as in the Hörder-Rheinaue or by developing measures that improve the spatial quality of the environment as in Overdiep and Deventer. The bottom line is there must be something in it for them.

Design together
A second common issue is that water-friendly land management solutions against flooding need to be tailor-made up to the level of the end-user. Often the end user is the property owner or a long-term tenant who will develop a business there. Therefore it must be designed together with them to suit their needs. In Eden water management schemes are developed with the farmer. In Deventer and Overdiep the farm design has been made taking account of the explicit wishes of the farmers.

Nature does not require much
In all cases, improved nature quality (biodiversity) is an extra benefit. And this often does not require huge investments in terms of money or land-surface. For example the areas of land least suited for farming such as pools or wet corners, or the low lying areas in forestry are often the best areas for nature and biodiversity. Buffer strips next to rivers or tracks also improve nature. These are small investments in terms of land or money but give

large benefits. They very often meet the standards of supplementing EC regulations like Habitat Directive (Council Directive 92/43/EC) and Birds Directive (Council Directive 2009/147/EC).

Translate and visualise in accordance to the local situation
Working closely with local stakeholders requires communication and communication material. Even in an age of social-media, physical brochures that can be left on the table remain handy because they leave tangible evidence that tends to be perused in spare moments. It is important that brochures and paper information be as specific as possible, recognisable to the local situation and include visual material.

7 References

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