Newsletter

Plants and Pollution

ENVIS-NBRI

Flood Management by plants

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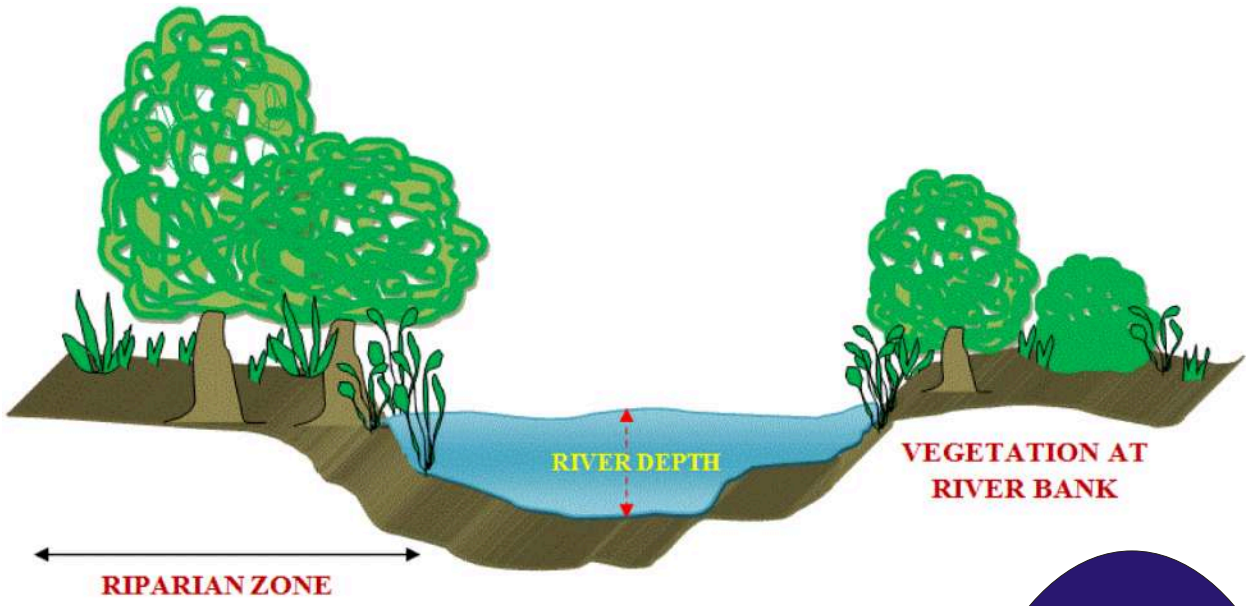
CSIR - National Botanical Research Institute, Lucknow



Amenity and recreation

Riparian vegetation can have significant benefits for people too. It can add better aesthetic value increasing people's enjoyment of the environment and provide green recreation at place.

Diffuse pollution mitigation

A buffer strip of riparian vegetation can protect water quality by reducing the impacts of diffuse pollution

Strengthens river banks

The roots of plants can bind river banks together, preventing erosion and protecting important nearby farmland and housing. Without vegetation, river banks are prone to a far greater chance that the bank will be excessively eroded by the river; it can also be susceptible to erosion by heavy rain.

Reduces the risk of flooding

Rivers in high flow can be slowed down by riparian vegetation to reduce the impact of flood. Riparian vegetation can slow down surface runoff during heavy rain, further alleviating problems related to flood.

Contents

NBRI ENVIS node: http://www.nbrienvis.nic.in
NBRI Website: http://ww.nbri.res.in
ENVIS cell: http://envis.nic.in
Ministry of Environment & Forest: http://envfor.nic.in

Flood management by plants

The natural calamity that actually affects the environment and people worldwide tend to become more powerful as the years go on. Man has spent years trying to find ways to predict weather patterns, but it seems that there's still a long way to go because windstorms, earthquakes, floods, diseases, and other types of natural calamities are still striking the earth with death tolls in the millions. Some natural calamities like earthquakes and cyclones strike unexpectedly with no warning indication. Among these, flooding is the most common natural hazard worldwide. In some very recent years flood occurred one after another in many countries of the world including India. Flood causes eruption, difficulty and high destructiveness (Ji et al. 2006). For reducing the tragedy risk of flood, requires an immediate mitigation with understanding of the natural systems of our environment, including floodplains and the frequency of flooding events.

A flood is an overflow of water that submerges land which is usually dry. Floods occur in all types of river and stream channels. Heavy rainfall, topography of the region, soil conditions, as well as ground cover plays a significant role in flood of any region. Within a few minutes speedily rising water can reach heights of 30 feet or more, and causes worst situation. In India mainly, North region faces threat of flood devastation. In the past India is a witness of nine deadliest floods (Table 1).

Table 1: Year wise worst flood events in different Indian state.

S. No	State	Year
1	Bihar	1987
2	Assam	1998
3	Bihar	2004
4	Maharashtra	2005
5	Bihar	2008
6	Ladakh	2010
7	Assam	2012
8	Uttarakhand	2013
9	Jammu & Kashmir	2014
10	Chennai	2015

Flood Mitigation

Floodplains are areas of low-lying land (at low altitude above sea level) next to a sluice which are subject to flooding. Floodplains with nicely located vegetation/flora help to spread and deliberate the flow of floodwater and allow water and soil to soak into the ground. Following Fig. 2 indicates the methods of management of flooding:

In present situation, natural methods have been broadly understood to reduce the flood intensity remarkably. At the place of heavy rainfall, riverbank plants hold the soil and preventing erosion. Plantation creates a rough surface, which helps to slow the flow of water, giving it time to immerse into the soil. This reduces flooding downstream and reduces erosion associated with fast flowing water. Additionally, slower moving water permit

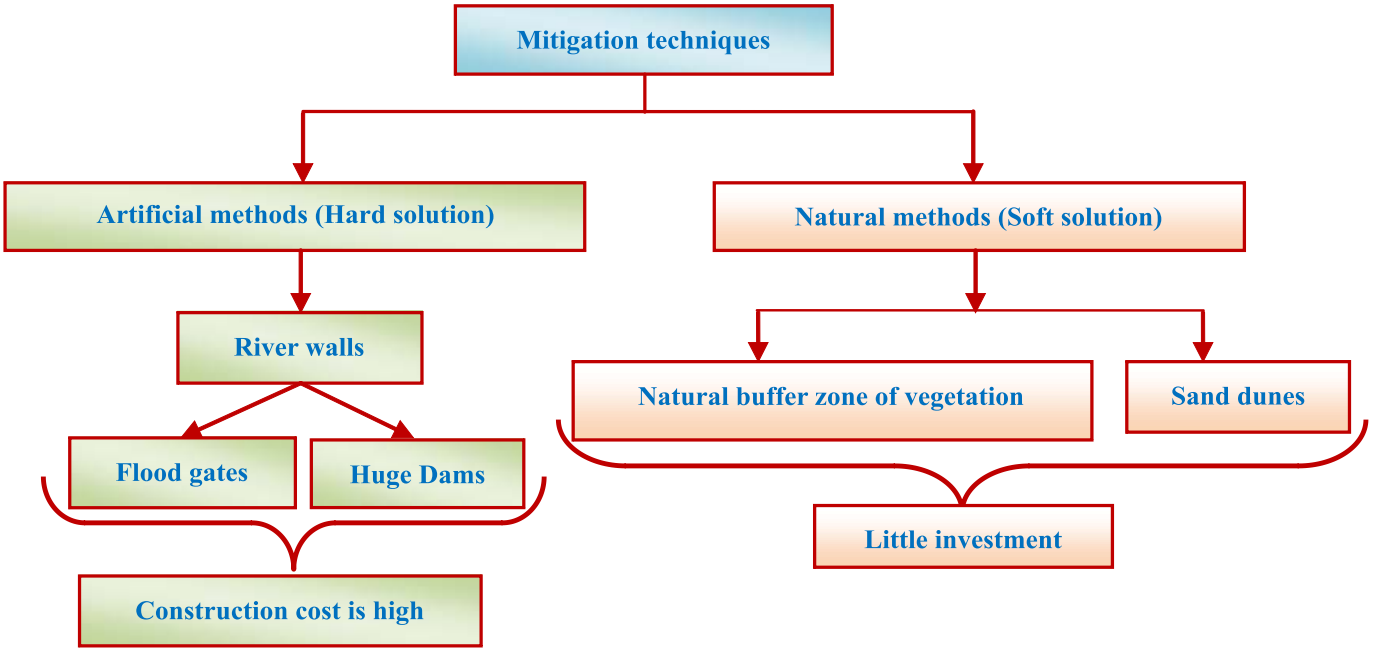
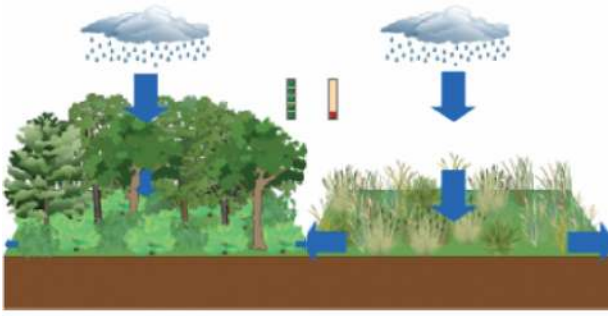
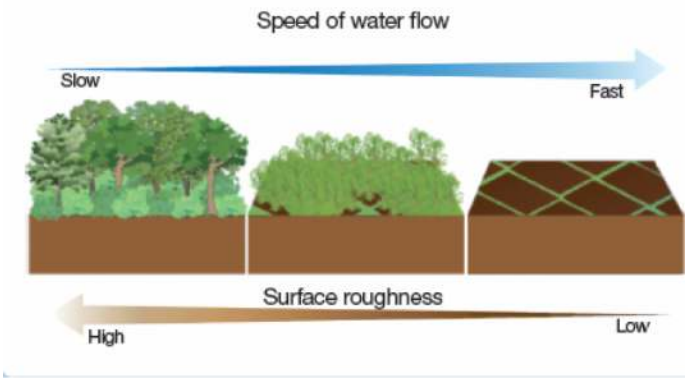


Fig.2 Diagram showing flood mitigation techniques.



Rain water is intercepted and absorbed by well established vegetation, reducing the amount of runoff.

Avoid developing areas of the floodplain which are restricted by surrounding hills, as these are commonly flash flood areas.



Well established vegetation significantly reduces the speed of water moving across the landscape.

Fig. 3 Flood mitigation using vegetation.
Source: www.healthywaterways.org

the mud to settle on the land before it reaches our waterways.

How trees help in preventing floods?

During heavy rains, trees reduce the risk of flooding because trees allow water to be drained into the ground. The mechanism behind is when plants grow in an area, the roots of plants dig deep in to the soil and create space between soil particles. When it rains in hilly areas, rain water flows downhill gets drained into the space created by the root system of plants. Due to this, chance of flooding is greatly reduced. Land covered with trees acts as a barrier to floodwater; prevent soil erosion; as well as reducing sediment going into rivers. This procedure of trees slows rainwater running off into swollen streams and helps lower peak flood levels.

In the absence of trees, especially in rocky areas there is no area for water to soak. Same incidence is also observed in cemented roads of cities. This type of situation causes flooding in nearby water bodies. When continuously moving water runs off a rocky surface, it reduces friction and will run more freely. When this running water with reduced friction is comes into rivers and lakes then, these water bodies tend to overflow and the banks burst and cause flooding. If there are more trees in an area that is prone to water runoffs, the root system of trees can create space between these rocks and hence reduces the amount of water being dumped into lakes and rivers.

In a joint study undertaken by the Bristol City Council, England and local Biomass Company Crops for Energy, the Swales were used to manage flood water by creating ditch system has a step down slope (Figure 4). Flood water is stored in the exhume ditches supporting slow percolation of water down to the slope.

Floodplain plantation is not only the best flood protection system but create a highly valuable natural area also. These areas can even be used for recreation and tourism, if a good flood alert system is in place. There are some following essential clues to be considered in order to use plantation to control floods:

- Suitable species of plants should to be planted, which can absorb more water from the soil.
- Dead trees should be cleared from the area and tree stability should be monitored especially on the river front.
- For appropriate plantation of the area, good knowledge of the local ecosystem and vegetation association is essential.
- A good variety of species should be used in order to ensure the regeneration of the plants and the ecological quality of the area.

A healthy environment is the first defence against any natural hazard such as flood, and especially in river basins. Some of the following tree species are being used to control floods, both in ponds and on the levees.

- ***Poplars* sp. (Cottonwood),** Amlin.1999
- ***Fraxinus profunda* (pumpkin ash),** Hook 1983
- ***Salix tetrasperma* (Indian Willows),** Shafroth et al. 1998
- ***Salix nigra* (black willow),** Hook 1983
- ***Taxodium distichum* (bald cypress),** Hook 1983

These trees have fantastic root system and can live with their roots underwater for months with high survival rates and ecologically important also.

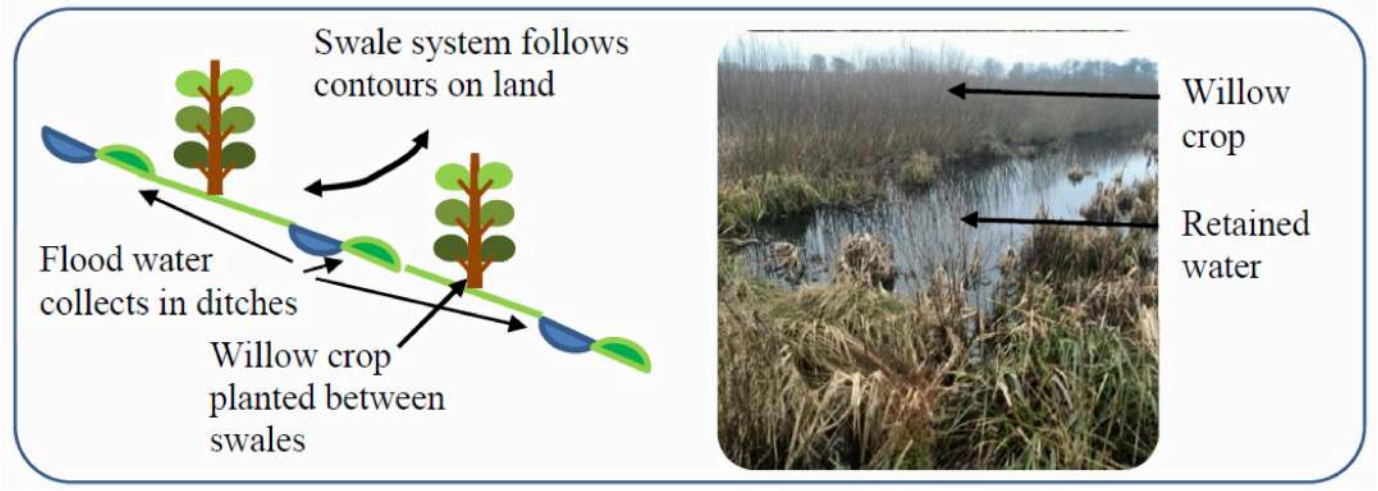


Fig. 4 A simplified arrangement of swales along the field (left), a willow site with swales
Source: Kuzovkina et al 2004

By planting vegetation along riverbanks it is possible to keep soil on the land and can keep valuable top soil on the earth to grow crops. There is a need to strategically increase native vegetation along riverbanks and in the floodplain especially in those areas where chances of flooding is very common. Each plant species has its own adaptation according to climate and physiographic conditions. If we consider all the above mentioned facts then there are better chances of flood mitigation in a particular area.

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2. Hook, D.D. 1983. "Forest Ecology". In: K.E. Wenger (Ed.). Forestry Handbook. Second Edition. Wiley, New York City, New York, U.S. 1335 pp.
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5. Shafroth, P.B., G.T. Auble, J.C. Stromberg, and D.T. Patten. 1998. "Establishment of woody riparian vegetation in relation to annual patterns of stream flow, Bill Williams River, Arizona". Wetlands 18: 577-590.

ABSTRACTS

Impacts of floods on forest trees and their coping strategies in Bangladesh

Shukla Rani Basaka, Anil Chandra Basakb, Mohammed Ataur Rahmanc

Weather and Climate Extremes, Vol 7: 43–48 (2015)

During recent years, the Government of Bangladesh, Non-Government Organizations (NGOs), semi-government organizations, private organizations and individuals have established a large number of plantations under different programs *viz*. social forestry, agro-forestry and avenue plantations with indigenous and exotic tree species without considering their habit and habitats. Along with the indigenous species like *Albizia procera*, *Albizia lebbeck, Mangifera indica, Azadirachta indica, Gmelina arborea*, *Trewia nudiflora* and *Artocapus heterophyllus* and many exotic species e.g. *Swietenia macrophylla*, *Albizia saman, Dalbergia sissoo, Eucalyptus camaldulensis, Acacia auriculiformis*, *Melia sempervirens, Acacia mangium* etc. have been planted randomly. With increasing trend of climate-induced floods, millions of trees have been dying due to floods and water-logging. The most affected species are *Dalbergia sissoo, Albizia saman, Acacia auriculiformis, Acacia mangium* and *Artocarpus heterophyllus* etc. This situation has caused severe impacts on socio-economic conditions of Bangladesh. The impacts involved a significant loss in terms of investment, biodiversity and afforestation program. Little investigations have been conducted to find out the causes of the deaths and also to find out the suitable adaptation practices to reduce impacts of floods on trees. This synthesis focused on the impacts of floods on plantations and also assessed the potential role of traditional forest management practices in addressing the effects flooding on forests in Bangladesh. The study added important information and revealed knowledge gaps on the causes of large forest deaths. It also provided recommendations for policy on the establishment of frequent floods resilient tree crop plantations.

Reponses of mamey sapote (*Pouteria sapota*) trees to continuous and cyclical flooding in calcareous soil

Mark T. Nickum, Jonathan H. Crane, Bruce Schaffer, Frederick S. Davies

Scientia Horticulturae, Vol 123: 402–411 (2010)

Physiological and growth responses of 'Pantin' and 'Magana' mamey sapote (*Pouteria sapota*) trees to continuous and cyclical flooding were studied in a series of experiments. Trees were grown in containers in a very gravelly loam soil and were subjected to continuous flooding of the root zone for 30–66 days (Experiments 1 and 2) or alternating flooding–un flooding cycles for 50 days (Experiments 3–5). For all experiments, the control treatment consisted of non flooded trees. Net CO_2 assimilation (A) and stomatal conductance (gs) decreased within 3 days of continuous flooding and internal CO_2 concentration was significantly higher in leaves of flooded than non flooded plants. In the cyclic flooding experiments, trees were flooded in 3- to 6-day cycles and then un flooded for the same time periods. Stomatal conductance and A decreased within 3 days of flooding, leaf epinasty occurred between days 5 and 10, leaf senescence and abscission occurred between days 15 and 30, and branch dieback and tree death occurred between days 30 and 60. Three cycles of 3-day flooding and 3-day recovery of trees had little effect on leaf gas exchange of 'Magaña' trees. Similarly, 'Pantin' trees survived 3 cycles of 6 days of flooding interspersed with 3–6 days of recovery despite consistent decreases in gs and A during flooding. Stomatal conductance and A of both mamey sapote cultivars decreased within a few days of flooding and this species appears to have intermediate flooding tolerance compared with other tropical fruit crops based on tree survival.

NEWS

North East needs 'millions' more trees to protect against flooding, says Durham scientist.

Nick Odoni, of Durham University, said the landscape of Britain will need to change to adapt to increasingly extreme weather. A scientist has called for “millions” of trees to be planted across the North as part of a long-term strategy to protect against flooding. Dr. Nick Odoni said a significant alteration in Britain's landscape is needed to adapt to increasingly extreme weather caused by climate change. The comments came after flooding caused by Storm Desmond devastated parts of Cumbria and Northumberland last weekend.

He said although flood defences and dredging were needed, these changes alone would not be enough, nor would big schemes be affordable. The honorary research fellow at Durham University's department of geography said the UK needs to plan “20 or 30 years ahead” to manage flood risk. And he believes trees numbering in the “low millions” should be planted across the region in carefully selected areas, especially in the uplands. He stressed tree planting must always involve the cooperation and consent of farmers and rural people. He added that flood prevention schemes should be well-planned, as interventions in the wrong place can make problems worse in other areas. Dr Odoni said: “Tree planting needs to begin soon so that the landscape is ready to offer these benefits by the time greater climate changes kick in over the next 20 to 30 years. “But whatever we do, we have to plan and target very carefully where we place our flood management interventions, as if we get it wrong this can cause problems downstream.” Trees and other vegetation in the uplands help create well-drained soil that soaks up excess water. This reduces the rate that rainwater enters streams and rivers, easing floods. More vegetation downstream can also create a buffer that slows the rate that water leaves the river during floods. Dr. Odoni said tree planting should take place alongside other measures to make the landscape suited to increasingly extreme weather. He stressed that although the changes would require large amounts of resources it could present a “tremendous” opportunity for the North. He added: “Flood control will continue to include dredging and hard engineered defences where appropriate, but these will not by themselves be enough. “Other interventions will include replanting hedges and riverside woodland, building debris dams in streams, and erecting timber 'minibunds' near source areas in catchments. “If this is done in the right way, and includes things like rewilding, it could be the most tremendous economic opportunity for the North rather than a burden.

Source: www.chroniclelive.co.uk

Planting 200 million trees in England by 2020 could help prevent future flooding.

Anne-Marie Trevelyan, Conservative MP for Berwick-upon-Tweed, suggested the existing 11 million targets by 2020 should be increased almost 20-fold to 200 million trees. The vice-chair of the All Party Parliamentary Group on Forestry made her call against the backdrop of the devastating floods which caused major damage and disruption in the north of England and Scotland. In a move welcomed by the forestry sector, Ms Trevelyan said that increased planting could help reduce flood risk in the long term. Chief executive of Confor: forestry and wood - the sector's trade body - Stuart Goodall said: “The terrible floods, especially in Cumbria, demonstrate that Government has to look at more than just flood defences. He also said that there is a need to hold rainwater in the hills so that the peaks flow of water is reduced, helping flood defences to do their job. “Planting productive forests manages water flow, while also helping wildlife, providing alternative income for farmers and locking up carbon - another very relevant current issue given the climate talks in Paris.” In March Confor and Forest Research published “The Role of Productive Woodlands in Water Management”, a report which demonstrates how productive woodlands can reduce flood risk and protect British waterways.

Mr. Goodall added: "Anne-Marie Trevelyan MP has made a sensible suggestion which is backed up by scientific evidence produced by the government's

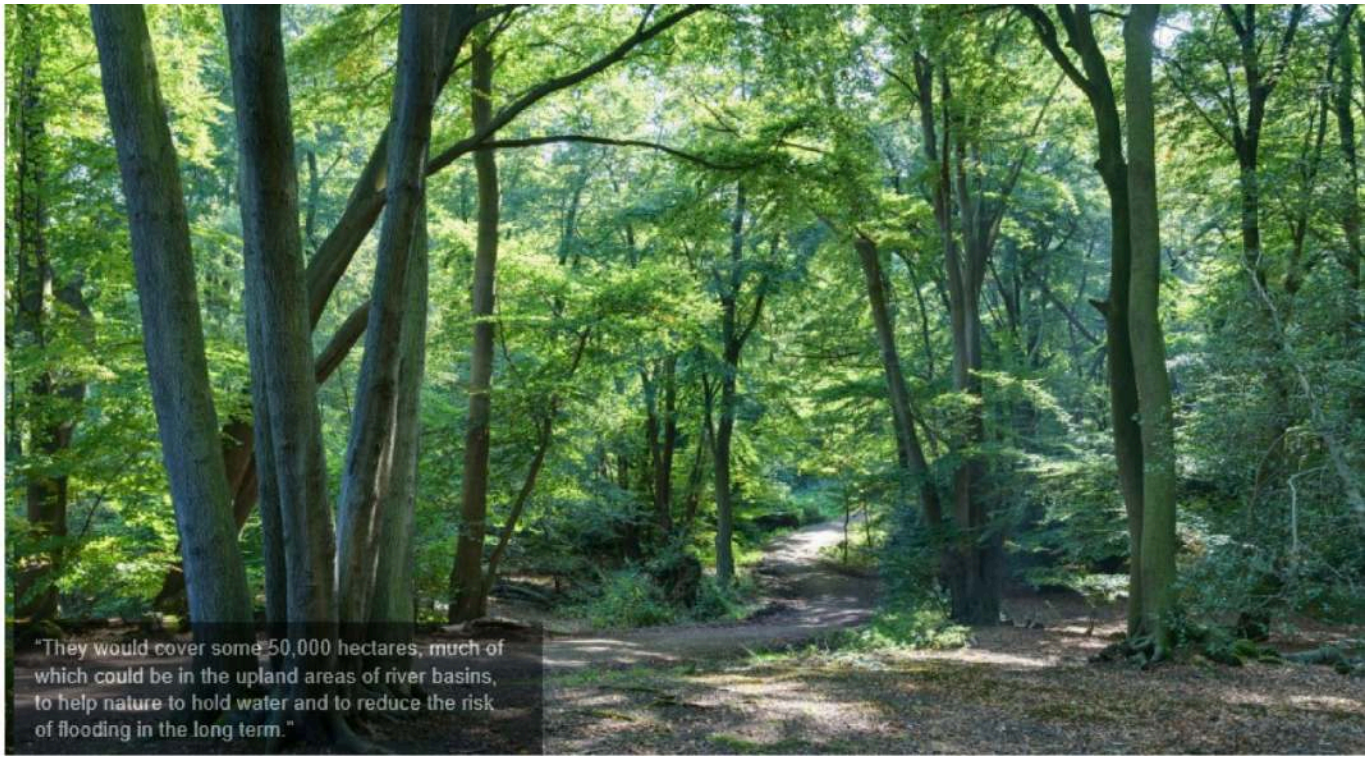
Forest Research agency. He added that they would cover some 50,000 hectares, much of which could be in the upland areas of river basins, to help nature to hold water and to reduce the risk of flooding in the long term." Environment Secretary Truss said she agreed about 'looking at the environment on a catchment level and making sure that we put in place tree-planting programmes that can both reduce flood risk and improve the environment at the same time'. Together with the Woodland Trust, Confor has been lobbying the Government on its tree planting targets.

Source: www.fginsight.com

MP calls for 200 million new trees by 2020 to stop floods

Anne-Marie Trevelyan, Conservative MP for Berwick-upon-Tweed, suggested the existing 11 million target by 2020 should be increased almost 20-fold to 200 million trees. The vice-chair of the All Party Parliamentary Group on Forestry made her call against the backdrop of the devastating floods in North-west England and said hugely increased planting could help reduce flood risk in the long term. Stuart Goodall, Chief Executive of Confor: forestry and wood - the sector's trade body, said: "The terrible floods, especially in Cumbria, demonstrate that Government has to look at more than just flood defences. It is necessary to hold rain water in the hills to reduce the peaks flow of water. "Planting productive forests manages water flow, while also helping wildlife, providing alternative income for farmers and locking up carbon - another very relevant current issue given the climate talks in Paris". In March Confor and Forest Research published -The Role of Productive Woodlands in Water Management, a detailed report which demonstrates how productive woodlands can reduce flood risk and protect British waterways. During the House of Commons debate on flooding, Anne Marie Trevelyan MP said that "In the light of the floods in Cumbria and elsewhere, she is pleased to say that flood defences provided security and protection, as they were supposed to, in north Northumberland. Will the Secretary of State consider, as a matter of urgency, increasing the number of trees she plan to plant during this Parliament from 11 million, which equates to only one tree for every five people, to some 200 million, which equates to five trees for every person. "They would cover some 50,000 hectares, much of which could be in the upland areas of river basins, to help nature to hold water and to reduce the risk of flooding in the long term." In her response, Secretary of State Liz Truss MP said that she is completely agreed with Anne-Marie about looking at the environment on a catchment level and making sure that we put in place tree-planting programmes that can both reduce flood risk and improve the environment at the same time." Confor has already highlighted the need for the UK Government to be far more ambitious in its tree planting targets. The Woodland Trust to call on the government to commit to planting planting 7000 hectares (ha) of woodland every year until 2020 (around 15 million trees per year) and then to increase that to 10,000 ha per year when the next Government is elected in 2020.

Source: www.farminguk.com



BOOKS

Flood Control Management for the City and Surroundings of Jeddah, Saudi Arabia
ISBN: 9401796610, 9789401796613
Publisher: Springer
Author: Mashael Al Saud

Strategic Flood Risk Management
ISBN: 0215084489, 9780215084484
Publisher: The Stationery Office, 2015
Author: Great Britain: Parliament: House of Commons: Committee of Public Accounts

Geomorphic Approaches to Integrated Floodplain Management of Lowland Fluvial Systems in North America and Europe
ISBN: 1493923803, 9781493923809
Publisher: Springer
Author: Paul Hudson, Hans Middelkoop

Flood Risk: The Holistic Perspective: From Integrated to Interactive Planning for Flood Resilience
ISBN: 1780405324, 9781780405322
Publisher: IWA Publishing
Author: Zoran Vojinović

Flood Management Strategy - Port Phillip and Westernport
ISBN: 1921911913, 9781921911910
Publisher: Melbourne Water
Author: Melbourne Water

UPCOMING CONFERENCES

56th Floodplain Management Australia Conference
Venue: Shoal haven Entertainment Centre, Nowra
Date: 17th -20th May 2016
Website: http://www.floodplainconference.com/

FRIAR 2016: 5th International Conference on Flood Risk Management and Response
Venue: San Servolo, Venice, Italy
Date: Jun 29th - Jul 1st, 2016
Website: http://www.wikicfp.com/cfp/servlet/event.showcfp?eventid=45833

2nd International Conference on flood resources and Security (O21CFRS 2016)
Venue: Gall Face Hotel, Colombo, Sri Lanka
Date: 1st July 2016
Website: http://foodscienceandnutrition.screndivusconferences.com/index.php/main/secondinternationalconferenceonfoodresourcesandsecurity

3rd European Conference on Flood Risk Management
Venue: Lyon, France
Date: 17th - 21st October 2016
Website: http://floodrisk2016.net/

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