Environment

Water Community

Solution Exchange for the Water Community
Consolidated Reply

Query: Eco-Restoration of Streams/Rivers - Experiences

Compiled by Nitya Jacob, Resource Person and Ramya Gopalan, Research Associate

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From Mrinalinee Vanarase, Ecological Society, Pune

Posted 19 April 2008

Ecological Society, Pune, is working on the ecological restoration of streams in three districts of Maharashtra with community help. The result would be demonstration units of stream restorations in three different bio-geographic zones. The restoration depends on the biogeography and ecological status of the stream but there are common points. The restoration will ensure the streams have a continuous flow of water and percolation takes place to recharge aquifers

During our survey, we found nearly all these streams have undergone major changes because their water has been diverted for crops and road building. Urbanization has increased the diversions and open spaces have shrunk.

As part of the restoration, we plan to regenerate, protect and nurture local vegetation and wildlife, including fishes. We will set up vegetation-based wastewater treatment areas, and solid waste management systems. We are also stabilizing the banks and slopes that are the catchments for the streams.

The response of the local people to the initiative has been overwhelming. They are helping to collect the ecological history of the streams and restore areas that are free of encroachment and diversions.

The challenges include a long gestation period for the measures of up to 10 years, for the measure to have an effect, depending on the extent of damage. Local communities have to assume responsibility to wait out this period and allow the stream eco-system to regenerate. The restoration sometimes clashes with work being done under government schemes such as NREGS. It is important to ensure the maximum number, including women, small farmers and the poor, participate in the restoration. Uniform processes cannot be applied because the watershed of each stream is different, so we have to learn anew for each stream.

I request members of the community to share:

- Experiences and outcomes of activities where communities have been involved in eco-restoration of small streams and rivers, across India
- Factors that have determined success or failure of such initiatives
- Ways of motivating communities to participate in this type of initiative

We will compile these experiences into a guidebook and evaluate what principles can be applied in different contexts unique to India. This could become a guide for others working on similar projects.

Responses were received, with thanks, from

1. **Shrikant D. Limaye, UNESCO-IUGS-IGCP Project GROWNET and Ground Water Institute, Pune**
2. **N. K. Agarwal, Geological Survey of India (G.S.I.), Dehradun**
3. **Parineeta Dandekar, Gomukh Environmental Trust for Sustainable Development, Pune**
4. **Ajit Seshadri, The Vigyan Vijay Foundation, New Delhi**
5. **Arunabha Majumder, Jadavpur University, Kolkata**
6. **Ramesh Sakthivel, WES-Net India, New Delhi**
7. **P. S. Yadav, Haryana Institute of Rural Development and Department of Development and Panchayats, Haryana**
8. **Ramakrishna Nallathiga, Centre for Good Governance, Hyderabad**
9. **Avudai Nayakam S., Water Partners International (WPI) India Office, Tiruchirappalli**
10. **Uday Bhawalkar, Bhawalkar Vermitech Private Limited, Pune**
11. **Jeevanandhan Duraisamy, Food and Agriculture Organization of the United Nations (FAO), Rome**
12. **Shailja Kishore, Aga Khan Rural Support Programme India (AKRSPI), Ahmedabad**
13. **Yusuf Kabir, UNICEF Consultant, Kolkata**

Further contributions are welcome!

Summary of Responses

Responding to a query on eco-restoration of streams, members discussed the role of communities at all stages, from planning to implementation. They also shared a number of experiences with community eco-restoration efforts and listed reasons underlying the need for eco-restoration and factors affecting the success of such initiates.

Respondents noted the issue of reconciling conflicting interests of the water users as a major reason for the degradation of streams and rivers, and also highlighted that many streams and rivers which used to have a perennial flow have become dry, only flowing when there is a heavy downpour, which affects the natural processes of water purification. **Degradation of river systems** is a common problem for many perennial as well as seasonal rivers, discussants explained. Encroachment has shrunk and congested rivers, and the discharge of untreated or partially treated waste water from cities, towns and industries, surface runoff carrying silts, pesticides, insecticides and agricultural waste, dumping of solid wastes or mixing of leachates, animals bathing and discharging, and dumping of dead bodies have polluted them.

Citing several **examples of community-led eco-restoration initiatives**, members pointed out they have long gestation periods, usually a decade or more and that while water treatment plants can reduce this lead-time for projects to show results, they are not the best option in the long run owing to their high capital and running costs. Using a mix of local vegetation can eco-restore streams, rivers or

watersheds and provide biomass for local communities' needs, help in carbon fixation and can even become a livelihood source, for example bamboo. Results are particularly strong in the case of small watersheds spread over a single habitation, or a few contiguous and homogenous ones.

Discussants identified two critical factors in the **success of eco-restoration schemes-** strong local leadership to galvanize local communities into action and the involvement of non-governmental organizations and local government authorities acting in a catalytic role. For example, in **Punjab**, Baba Balbir Singh Seechewal encouraged his followers to clean the Kaliben River, changing the river from a virtual sewer to a fresh water stream. Strong leaders can also motivate communities to work alongside local NGOs or authorities; however, members stressed it is the **commitment of communities**, which really makes these schemes fruitful.

Discussing effective community involvement, respondents highlighted several experiences. In **Gujarat**, the Aga Khan Rural Support Programme (AKRSP) worked to restore the Meghal River. It raised awareness (through street plays and folk songs), strengthened village institutions, built on the community's attachment to the river to ensure participation, constructed water-harvesting structures and introduced more efficient irrigation systems and crops; resulting in higher groundwater levels, which benefit both farmers and the local community. In **Tamil Nadu** and **Karnataka** a Community-Based Natural Resource Management programme, led by the government and implemented by NGOs is working to make villages water self-sufficient by mobilizing communities and in **Andhra Pradesh**, a consortium of voluntary organizations worked to systemically rejuvenate the Swarnamukhi River. Another experience came from **Rajasthan,** where the Arvari River was saved after an NGO organized non-violent protests by communities to fight a policy that could have negatively affected the river.

Community participation has been keys to success in projects in urban areas as well. In **Tamil Nadu** the Coimbatore City Corporation, along with an NGO called Siruthuli (promoted by companies in the city) and local communities, restored a system of tanks in the city. It was implemented under the Jawaharlal Nehru Urban Renewal Mission, but it owed much of its success to the involvement of the communities living near the tanks. Additionally, in **Maharashtra** a group of stakeholders, consisting of NGOs, planners, environmentalists, academics, ecologists, scientists, students, architects, developers, Muhalla committees, and personnel from the Municipal Corporation worked together to create a plan for eco-restoration of the Ambil and Ram Nadi Catchments areas. In 2006, the **West Bengal** state government passed the East Kolkata Wetlands (Conservation and Management) Act to preserve them. Under this, the East Kolkata Wetland Management Authority and Committee were set up. The Committee's terms of reference includes consultations with landowners, promoting research and other findings among stakeholders and the local public to raise awareness about the importance of the wetlands.

Members also shared successful examples of eco-restoration project which did not involve communities, such as the Hyderabad Urban Development Authority's (HUDA) four-year Green Hyderabad Environment Programme, which cost Rs 206 crore, which is working to restore the Hussain Sagar and other lakes. Due to active government leadership the programme is scheduled to be completed on time.

Along with sharing successful experiences with community-led eco-restoration programmes, respondents stressed the importance of **costs and appropriate technology** when planning and implementing such programmes. Most eco-restoration programmes have used eco-technology to process wastewater, like an initiative in **Delhi** using natural methods and bio-remediation. This strategy involves cultivating beds of selected plants and allowing wastewater to percolate through them, breaking down toxic organic molecules that conventional sewage treatment cannot and allows for groundwater recharge. The treated water then either flows back into streams or is used for farming and/or gardening.

River bank plantations comprising coconuts, bamboo and other trees are also appropriate for technologies. Bamboo has a great role in purification of sewage water; it has the added benefit of being a raw material for cottage industries, water hyacinth has good water purification properties as well. A

combination of anaerobic and aerobic purification followed by polishing with plants and fishes can also be used for wastewater treatment, members noted as was done in a project near Pune to treat sewage flowing into the Mula Mutha River and its feeder streams.

Using eco-technologies has other advantages, respondents pointed out, because it does not need energy or chemicals it is cheaper than modern methods. Sewage treatment costs Rs 50,000 per household to establish and up to Rs 18,000 a year per household. Moreover, most sewage treatment stops at the second level, making wastewater more hazardous and favorable for mosquitoes and legionella bacteria. Additionally, eco-technology absorbs CO_2 and heat, and reduces global warming.

Discussants also outlined eco-restoration challenges, including the removal of encroachments on riverbanks and beds. This reduces the recharge area for groundwater while increasing the seepage of pollutants into aquifers. Streams polluted by urban encroachments in turn pollute rivers. Eco-restoration has to reduce the biological oxygen demand to less than 3 mg/litre, faecal coliforms to less than 500/100 ml and dissolve oxygen levels to above 6 mg/litre; these parameters must be tested regularly to monitor effectiveness. For large river systems, eco-restoration efforts have to be supplemented with deep dredging, extended plantation in flood plains and upgradation of recharge zones.

Finally, respondents felt **active and effective leadership can motivate communities** to lead eco-restoration of their local streams. Communities need to see immediate, long-term benefits, be included as active participants through NGO-led awareness building, and involved in planning and implementation.

Summing up, members argued holistic, location specific approaches are needed, because each stream, and river has its own set of challenges and opportunities; and that low-cost and appropriate technology, such as eco-technology, is usually best suited for such initiatives, even though the lead time is longer.

Comparative Experiences

Maharashtra

Urban Watershed Restoration Program Uses IRBM Approach, Pune *(from Parineeta Dandekar, Gomukh Environmental Trust for Sustainable Development, Pune)*
The Pune Water Group worked on a plan for eco-restoration of the Ambil and Ram Nadi Catchments. Using the principles of Integrated River Basin Management (IRBM), the program started from the source, covering the watershed of first order streams and studied the impact of urbanisation and possible solutions. The Group also integrated stakeholders into the process and each stakeholder contributed to the proposal and brainstorming sessions. Read more

Delhi

Natural Treatment of Wetlands, New Delhi *(from Ajit Seshadri, The Vigyan Vijay Foundation, New Delhi)*
The Vigyan Vijay Foundation implemented wastewater treatment projects using natural methods and bio-remediation. The recycled water is drawn from urban drain channel-*nallahs* and used in irrigating urban landscapes. This worked as an ideal solution with the possibility of scaling up using native and traditional plants and foliage at banks of streams. Read more

Andhra Pradesh

Ecological Restoration in Urban Development Processes, Hyderabad *(from Ramakrishna Nallathiga, Centre for Good Governance, Hyderabad)*

HUDA proposed to restore the water quality of Hussain Sagar Lake and other lakes with support from the Netherlands Government. This included industrial wastewater treatment of toxic chemicals at CETP of industrial areas, diverting sewage with high organic loads to sewage treatment plant, managing sewage water flow into the Lake through oxidation ponds, firming the lake's boundary with bunds and promoting tourism activities around lake. As a result the lake has transformed. Read more

From Jeevanandhan Duraisamy, Food and Agriculture Organization of the United Nations (FAO), Rome

Consortium for River Rejuvenation, Chittoor and Nellore Districts
Swarnamukhi River played an important role in the control of the local groundwater table, facilitates rain water flow and contributes significantly to agriculture production due to the lack of rains in the area. The river flow extends 155 km, covers 9 mandals in Chittoor and 822.372 sq miles. However, the river dried up a long time. To address this problem, nine voluntary organisations formed a consortium to rejuvenate the river in a phased in manner. This effort is being financed by Capart. Read more

Rajasthan

Community Motivation towards Eco-Restoration of Rivers
Arvari, a seasonal river in the northeastern area of the state, nearly dried up and after working to regenerate the river, the state government issued fishing contracts for some stretches. A three month long Satyagraha was held by Tarun Bharat Sangh (TBS) opposing this policy in order to protect fish and other riverine life forms. The policy was ultimately reversed, the river is now perennial and a decentralized power model was created in 70 villages along the river to ensure sustainability.

Gujarat

Meghal River Basin Project Rejuvenates Local Communities, Junagadh District *(from Shailja Kishore, Aga Khan Rural Support Programme India (AKRSPI), Ahmedabad)*
The Meghal River extends 70 km and is hugely important to the Maliya, Mendarda, Keshod and Mangrol talukas. AKRSP used a 3-pronged approach to rejuvenate the river 1) ensuring massive community participation, 2) constructing more than 140 check dams and percolation tanks, and 3) employing side-by-side traditional rainwater harvesting measures. As a result, this small seasonal, rain-fed river is now an all-season and increased farm produce/prosperity and provided quality drinking water. Read more

West Bengal

East Kolkata Wetlands Model Implemented by the Community *(from Yusuf Kabir, UNICEF Consultant, Kolkata)*
The East Kolkata Wetlands are renowned as model of multiple use wetlands with resource recovery system developed and maintained by the local community. It now faces being deleted from the Ramsar Wetland list due to urban encroachment and pollutant loading. To save it, the state Government passed an Ordinance to define land-use pattern. Additionally, SAFE engaged in restoration efforts-GIS mapping, habitat evaluation, EIA and awareness campaigns, etc. to protect the area. Read more

Tamil Nadu

Joint Programme towards Eco-Restoration of River Basin, Coimbatore *(from Avudai Nayakam S, Water Partners International (WPI) India Office, Tiruchirappalli and Ramesh Sakthivel, WES-Net India, New Delhi)*
A study on the Noyyil River Basin, which flows through a system of eight tanks connected in a cascade, conducted by hydrologists and hydro geologists from AFPRO, showed contributes 229.5 million cubic feet (MCF) of water to the city. The Corporation thus initiated bio-remediation and fish rearing to generate

money for maintenance and the NGO Sirithuli with community participation undertook restoration of water bodies, including maintenance of tanks. Read more

Conservation of Vegetation Diversity for Sustainable Livelihoods *(from Ramya Gopalan, Research Associate)*
A conservation project aimed at problems of deforestation, land degradation and non-eco-friendly agricultural practices worked to regenerate forest cover through indigenous practices and the promotion of sustainable farming techniques. The project's target groups were small and marginal farmers and farm women. The project incorporated technological changes in input use, planning and programming of farming system, etc. all designed to restore the areas ecological balance. Read more

Tamil Nadu and Karnataka

Community Based Natural Resource Management *(from Avudai Nayakam S, Water Partners International (WPI) India Office, Tiruchirappalli)*
This project implemented by government and several NGOs is helping to rejuvenate several water bodies, develop self-sufficient villages to meet water requirements and improve livelihood options. Through activities like nallah training works, revival of irrigation tanks and appropriate soil and water conservation measures the water table, vegetative cover, land productivity, soil moisture retention capacity, income levels and land values have improved and soil erosion reduced.

International

United States

Restoration of Wetlands in the Mississippi–Ohio–Missouri (MOM) River Basin *(from Ramya Gopalan, Research Associate)*
High nitrate–nitrogen levels in the Mississippi, Ohio and Missouri Rivers due to increased fertilizer use in caused eutrophication and recurring hypoxic conditions in the Gulf of Mexico. The land along the rivers was also artificially drained, resulting in a loss of 80–90% of the original wetlands. Efforts to address the problem, involve strategic creation and restoration of 2.2 million ha of wetlands in the basin through the interception of agricultural runoff, solving the Gulf hypoxia and improving water quality. Read more

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Related Resources

Recommended Documentation

Draft Proposal for Ecological Restoration of the Ambil Odha Watershed through Negotiated IWRM Approach *(from Parineeta Dandekar, Gomukh Environmental Trust for Sustainable Development, Pune)*
Project Proposal; Asia Urbs INUWASAPI Project; DEMATEDEE Network (2003-2004); September 2006
Available at http://www.cerna.ensmp.fr/Progeuropeens/INUWASAPI/PuneDraftProposal.pdf (PDF, Size: 417 KB)

> *Proposes eco-restoration of Mula Mutha and feeder streams like Ambil, Nagzari by treating sewage ecologically through root zone treatment, parallel channels and aeration*

From Ramakrishna Nallathiga, Centre for Good Governance, Hyderabad

Note on Green Hyderabad Environment Programme (2002-2006)
Programme Brief; Royal Netherlands Embassy (RNE) and Hyderabad Urban Development Authority (HUDA); September 2005
Available at http://www.hudahyd.org/inside/document/ghep.doc (Document, Size: 54 KB)

Notes the project's objectives and achievements aimed to increase the green cover in Hyderabad Development Area and to conserve, treat and manage 87 lakes in the area

International Workshop on Urban Lakes: Conservation and Management
Report; Hyderabad; June 2003
Available at http://www.worldwaterinstitute.org/docs/huda.doc (Document, Size: 102 KB)
Discusses strategies for the management of urban lake ecosystems and presents interesting case studies, policies, technologies and legal issues relating to lakes

Management of Lakes in India
Paper; by M. S. Reddy and N. V. V. Char; LakeNet; March 2004
Available at http://www.worldlakes.org/uploads/Management_of_lakes_in_India_10Mar04.pdf (PDF, Size: 405 KB)
Presents the typical problems experienced in the well known Indian lakes, including their present environmental status and efforts being made to make them environmentally sustainable

Consultancy Services for Preparation of Detailed Project Report on Basic Services for Urban Poor - Detailed Project Report for 18 Slums *(from Avudai Nayakam S, Water Partners International (WPI) India Office, Tiruchirappalli)*
Report; Coimbatore Municipal Corporation; Infrastructure Professionals Enterprise (P) Ltd; January 2007
Available at http://www.coimbatore-corporation.com/dwnldforms/BSUP-PHASE1.pdf (PDF, Size: 6 MB)
Available at http://www.coimbatore-corporation.com/dwnldforms/BSUP-PHASE2.pdf (PDF, Size: 2 MB)
Available at http://www.coimbatore-corporation.com/dwnldforms/SWM-DRP.pdf (PDF, Size: 12 MB)
Available at http://www.coimbatore-corporation.com/dwnldforms/UGD_CBE.pdf (PDF, Size: 6 MB)
Details the implementation and sustainability of the Noyyil River Basin project undertaken jointly by the community, NGO and the Corporation of Coimbatore

From Yusuf Kabir, UNICEF Consultant, Kolkata

The East Kolkata Wetlands (Conservation and Management Act), 2006
Act; Government of West Bengal; 2006
Available at http://www.enviswb.gov.in/ENV/downloads/EKW_Notification_dated_11-10-2006.pdf (PDF, Size: 2 MB)
Provides information on the conservation/management of the wetlands and matters connected, also calls the formation of Management Authority and Committee to manage with the wetlands

Restoration and Sustainable Development of East Kolkata Wetlands (EKW): A Threatened Ramsar Site
Project Brief; South Asian Forum for Environment Indian Chapter (SAFEINCH)
Available at http://www.safeinch.org/projects.htm
Reviews the ecological status of EKW; SAFE's efforts and identifies ecological fronts for habitat restoration possible through community participation and partnership.

Consortium to Rejuvenate Swarnamukhi River Formed *(from Jeevanandhan Duraisamy, FAO, Rome)*
Article; The Times of India; August 2001
Available at http://timesofindia.indiatimes.com/articleshow/1039837637.cms
Recounts the establishment of a consortium of nine voluntary organizations to facilitate and ensure rejuvenation efforts of the Swarnamukhi River

Aga Khan Rural Support Programme (AKRSP) Project Brings Prosperity to 54 Villages *(from Shailja Kishore, Aga Khan Rural Support Programme India (AKRSPI), Ahmedabad)*
Article; by Saurav Kumar; Ismaili Mail; August 2007

Available at http://ismailimail.wordpress.com/2007/08/18/akrsp-project-brings-prosperity-to-54-villages/

Describes the efforts of AKRSPI towards the revival of the Meghal River in Junagadh district, bringing about an increase in farm produce and prosperity

Clean Your Act + A Wastewater Recycling Manual *(from Uday Bhawalkar, Bhawalkar Vermitech Private Limited, Pune)*

Manual and Film; Centre for Science and Environment; Permission Required: Yes, paid product Ordering details available at http://csestore.cse.org.in/store1.asp?sec_id=4&subsec_id=14

Evaluates traditional/modern wastewater treatment methods showcasing low cost effective treatment technologies for communities, households and institutions towards restoring water

From Ramya Gopalan, Research Associate

Standards for Ecologically Successful River Restoration

Journal Article; by M.A. Palmer *et al*; Journal of Applied Ecology; 2005

Available at http://restoringrivers.org/PDF/standards/Palmer_et_al_2005_JAE.pdf (PDF, Size: 128 KB)

Proposes five criteria for measuring success of river restoration projects aimed at maintaining or increasing ecosystem goods and services while protecting them

Restoration of Wetlands in the Mississippi–Ohio–Missouri (MOM) River Basin: Experience and Needed Research

Journal Article; by William J. Mitsch and John W. Day Jr.; Ecological Engineering; Elsevier; 2006

Available at http://swamp.osu.edu/Research/LSU-OSU/PDFs/MitschDayMOM.pdf (PDF, Size: 865 KB)

Details the proposed strategy and experience of the ecological and hydrologic restoration of the Mississippi–Ohio–Missouri (MOM) Basin in the United States

Recommended Organizations and Programmes

Tarun Bharat Sangh (TBS), Rajasthan *(from Jeevanandhan Duraisamy, Food and Agriculture Organization of the United Nations (FAO), Rome)*

Tarun Ashram, Bhikampura Kishoree Via Thangazi, District Alwar Rajasthan 301022; Tel.: +91-1465-225043; rajendrasingh@tarunbharatsangh.org; http://www.tarunbharatsangh.org/about/rs.htm

Undertook eco-restoration efforts in Alwar for a local river called Arvari and motivated community involvement towards sustaining the same

Siruthuli, Tamil Nadu *(from Avudai Nayakam S, Water Partners International (WPI) India Office, Tiruchirappalli and Ramesh Sakthivel, WES-Net India, New Delhi)*

308, III Floor 1074, Raheja Center, Avanashi Road, Coimbatore 641018 Tamil Nadu; Tel.: +91-422-4333301; Fax: +91-422- 4333302; siruthulicomn@pricol.co.in; http://www.siruthuli.org/

Engaged in efforts to restore the Noyyil River Basin, working along with the Coimbatore Corporation, AFPRO and the local community

From Ajit Seshadri, The Vigyan Vijay Foundation, New Delhi

National River Conservation Directorate, Ministry of Environment and Forests, New Delhi

B-Block, Paryavaran Bhavan; CGO Complex, Lodi Road; New Delhi 110003; Tel.: +91-11-4362281; Fax: +91-11-4360009; nrcd@envfor.delhi.nic.in; http://envfor.nic.in/nrcd/

Coordinates the implementation of Ganga and other action plans and also handles other items of work such as river classification, pollution, monitoring mechanisms, issues etc.

The Vigyan Vijay Foundation, New Delhi

C-3 A/126 C, Janakpuri, New Delhi 110058; http://www.vigyanvijay.org/prakrit.htm

Implements various wastewater treatment projects using natural technologies to restore and rejuvenate water sources

The River Restoration Centre (RRC), England and Wales *(from Ramya Gopalan, Research Associate)*
Cranfield University, Building 53, Cranfield Bedfordshire, MK43 0AL United Kingdom; Tel/Fax: +44-1234-752979; admin@therrc.co.uk; http://www.therrc.co.uk/rrc_overview.php

Disseminates information on river restoration and enhancement and provides advice on site-specific technical issues through a network of river restoration practitioners

Recommended Communities and Networks

World Lakes Network (LakeNet), USA *(from Sarah Figge, UNDP, New Delhi)**
http://www.worldlakes.org/; info@worldlakes.org; +1-410-268-5155

A global network of more than 1000 people and organizations in 100+ countries working for the conservation and sustainable management of lakes

**Offline Contribution*

Recommended Portals and Information Bases

Waste to Health, Bhawalkar Vermitech Pvt. Ltd., Pune *(from Uday Bhawalkar, Bhawalkar Vermitech Private Limited, Pune)*
http://www.wastetohealth.com/; bvpl@vsnl.com

Provides details on new eco-technological methods suitable for decentralised sewage and wastewater treatment which facilitates their reuse and key role in eco restoration

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Responses in Full

Shrikant D. Limaye, UNESCO-IUGS-IGCP Project GROWNET and Ground Water Institute, Pune

The initiative of Ecological Society, Pune, is certainly commendable. Can you please tell us which the three selected districts are and whether the restoration will start from small streams and progress towards the main river or the other way around.

Regarding diversion of water for road building does this mean construction of a dam or bund with a road running over the crest.

The Office of the Ecological Society is in Pune, which has two highly polluted rivers, Mutha and Mula, flowing through its ever-expanding urban area. It would be good to start with these rivers which have been degraded to the state of "open sewers". The problem is "how to make the industrial or institutional polluters pay? Or motivate them to clean and treat their effluents before letting them into the river"? This is difficult when the Municipal Corporation, with its limited capacity for wastewater treatment, is one of the largest polluters.

The biggest problem is reconciling the conflicting interests of the water users. Some use water for irrigation, in which 70% is lost in evapo-transpiration. Some want to use for industrial purpose and save money by not treating the effluents.

The common person in Pune or any other city wants a clean, flowing river in the city with greenery on the banks. How do we come to a common agreement and who pays for the cleanup?

N. K. Agarwal, Geological Survey of India (G.S.I.), Dehradun

Degradation of river systems is a common problem of most of the perennial as well as seasonal rivers. “Planned” and “un-planned” encroachment has shrunk/congested the rivers and turned them into filth and waste carriers.

This has happened in the large river basins such as the Ganga and Yamuna basins, as well as smaller rivers that have been robbed of their flood plains.

The result is:

1. The mushrooming settlements in the river space are vulnerable to floods and bank line erosion
2. The natural re-chargeable area for groundwater has shrunk
3. The groundwater is getting contaminated due to seepage of pollutants from surface water sources
4. Polluted feeder streams have also become a source of downstream pollution of the main rivers like Ganga and Yamuna

The solution is to remove encroachments and de-congested rivers so they get their space back, laying suitable drainage systems to channelize the sewage and other filth into treatment plants for productive utilization and recycling.

Parineeta Dandekar, Gomukh Environmental Trust for Sustainable Development, Pune

At the outset, thanks for initiating discussion on a crucial and much-neglected topic of eco-restoration. Though we do talk about effluent treatment and waste management, we seldom talk about restoration of aquatic systems.

Well, in Pune again, River Action Group was working on eco-restoration of the Mula Mutha and its feeder streams like Ambil, Nagzari, etc. The approach was treating sewage (as you know, huge quantities!!) through ecological methods like root zone treatment, parallel channels, aeration, etc. Bank stabilisation through vegetative cover was an option to conventional channelisation. The effort was marginally successful in cases of Nagzari and Ambil.

But again, as you said, there can hardly be a universal blue print of these efforts as each stream, river or nallah has its own set of problems and opportunities.

The Pune Water Group has also worked on a plan for eco-restoration of the Ambil and Ram Nadi Catchments. This is an 'urban' watershed restoration program and we tried putting principles of Integrated River Basin Management (IRBM) in practise. We stated from the source, that this is the first order streams and studied the impact of urbanisation and possible solutions. We covered the entire watershed of these streams.

The main feature was integration of stakeholders. Pune Water Group, as you know, consists of NGOs (like Ecological Society), planners, environmentalists, academics, ecologists, scientists, students, architects, developers, Muhalla committees, and of course, personnel from the Municipal Corporation like the Chief of Water Supply and Sanitation, Garden Department and the Honourable Commissioner. Each stakeholder contributed to the proposal and brainstorming sessions.

After a process that lasted nearly a year, we now have the proposals for eco-restoration of Ambil and Ram Nadi ready. These are more like research documents than proposals (equally lengthy but not-so-boring!)

Though this is just the first step, it is crucial to have a sustainable, participatory plan in place so that we can proceed on those lines. You may view the proposal for Ambil at:
http://www.cerna.ensmp.fr/Progeuropeens/INUWASAPI/PuneDraftProposal.pdf (Size: 417 KB)

Hope this helps and thanks again for the fantastic effort Ecological Society is making...

Ajit Seshadri, The Vigyan Vijay Foundation, New Delhi

We are appreciative of the task being taken up by Ecological Society, Pune which is a direct activity which NRCD-National River Conservation Directorate under MoEF is doing for years.

Our NGO has implemented a few projects on waste water treatment using natural methods and bio-remediation. The recycled water drawn from urban drain channel-*nallahs* is used in irrigating urban landscapes. This comes as an ideal solution and the micro-level experience drawn from say in remedying 100 kl per day flow may be upscaled using native and traditional plants and foliage at banks of streams etc.

These engineered natural wetlands when sustained would do the service of natural cleanup using mechanisms of nature happening all the time. The technique of following anaerobic, then aerobic and lastly polishing process with plants/ fishes could be employed. In all these the use of recycled water if taken up for commercial uses say floriculture to start with and once the water is ensured septic-free etc. maybe used for vegetables, fruits and for fish-culture which will assist in sustaining the project.

STF-Sewage Treated Fisheries is an old practice going on at Kolkata-wetlands. There is an example of sustainable sewage water management described by Dr. Amar K.J.R. Nayak, Associate Professor, Xavier Institute of Management, Bhubaneshwar as experienced in three of his projects. The book bears an ISBN-10:1403-93016-3, ISBN-13:978-1403-93016-3, published by Rajiv Beri for Macmillan India Ltd. The vivid description of the project elements may be used by the project implementation team for eco-restoration of rivers.

We have also been associated with study work and assessment on the extent of pollution in river Yamuna at Delhi. The extent of pollution is alarming, these small micro-decentralised level initiatives are all fine for small river-estuarine canal stretches but to address and provide solutions at main flood planes of rivers, bold and innovative mega plans viz. mechanised deep dredging, clearance of bio-sludges for wasteland development, rejuvenation of flood planes by extended plantation and upgrade recharge zones by catch basins are to be considered if effective eco-restoration is to be attempted.

In some areas having ponds and lakes the situation is different and here the water-bodies have to be studied more carefully and applied for gainful uses. A holistic approach is to be evolved for practical and sustainable solution.

All cities, towns have to put in place safe sewage and solid waste management system. The best way is to find and adapt sustainable commercial ventures which are already thriving at local levels, to be encouraged using mechanisms of SHGs and NGOs initiatives applying local factors etc. Communities have to be associated and partake in all these activities.

Arunabha Majumder, Jadavpur University, Kolkata

The followings are the major sources of river pollution in India:

- Discharges of untreated or partially treated waste water from cities and towns
- Discharges of untreated or partially treated waste water from Industries
- Surface runoff carrying silts, pesticides, insecticides and agricultural waste

- Dumping of solid wastes or mixing of leachates from solid waste dumps
- Wallowing and bathing of cattle and discharges of cattle -shed wastes
- Dumping of dead bodies

The above results in deterioration of water quality and threat to aquatic flora and fauna. The siltation is another problem which minimizes carrying capacity of river. Restoration of greenery with water-shed development may help to have more flow in the river. Waste stabilisation pond practices may help to treat municipal waste water effectively. It is a low cost approach and does not require equipment and electricity to run the plant. The solid waste management system for both urban and rural areas needs to be improved. The dissolved oxygen in the stream should preferably be above 6mg/l. It must not be less than 4mg/l. The BOD in stream must be less than 3mg/l.

The other parameters in stream must conform to standards. Faecal coliform needs to be less than 500/100ml. For stream restoration work community participation is essential. Panchayats must be involved with the program. There should be inter-sector co-ordination. I congratulate Ecological Society, Pune for the ecological restoration work of streams.

Ramesh Sakthivel, WES-Net India, New Delhi

There are few examples of restoration of streams and the chain of tanks located on them in Tamil Nadu. The programmes have demonstrated that local community can be effectively mobilized through such initiatives as the benefits are clearly visible. Recently, the Tamil Nadu Government also started similar initiatives of clearing the encroachments on the waterways to facilitate proper stream flow.

In particular, the experience of revival of water bodies in the Coimbatore city by Siruthuli, an NGO promoted by Corporates in the Coimbatore city, in collaboration with the Corporation and the technical assistance of AFPRO is worth mentioning here. As a result of the works such as clearing encroachments in the tank areas, desilting the tank areas, removal of weeds/water hyacinth, improving stream flow, etc., some of the tanks around the city have been brought back to life.

Other city corporations can learn from this experience and make use of the JNURM programme to replicate such initiatives in many cities across the country.

P. S. Yadav, Haryana Institute of Rural Development and Department of Development and Panchayats, Haryana

One of the best examples of community participation for cleaning of rivers is 'Kaliben' in Punjab under the leadership of Baba Balbir Singh Sicchewal. The virtual drain has been made into a fresh water stream with active community participation.

Success and failure of such initiatives depends upon the leadership. If the leader of such initiative is selfless, motivated and dedicated, the community follows. If the leaders lack these qualities, people come to know and they stop participating. That is how the government machinery has failed to clean rivers like Yamuna and Ganga despite having spent crores.

Therefore, it is the leadership alone that counts. Generally, the biggest culprits of pollution are industrialists. There should be severe punishment for such polluters. The communities can be motivated by if they present system of spending money on such initiatives is transparent whether it is done by NGOs or the Government.

Instead of spending huge money, biologically sustainable methods are taught to the people to clean the

rivers. The treatment should be done only at source. There should be some public recognition for such efforts.

Ramakrishna Nallathiga, Centre for Good Governance, Hyderabad

Hyderabad is one of the first few cities which undertook studies/ projects for restoration of lake water quality (and eco-restoration). The Hyderabad Urban Development Authority (HUDA) has proposed to restore the water quality of Hussain Sagar Lake located in the centre of the city with the help of the Netherlands Government support which had several components, such as:

- Treatment of industrial waste water comprising toxic chemicals at CETP of industrial areas
- Diversion of domestic and industrial sewage with high organic loads to the sewage treatment plan rather than allowing discharge into the lake
- Firming up of the lake boundary with a bund around the lake and constructing a necklace road so that encroachments of its area would be constrained
- Management of sewage water flowing into lake through oxidation ponds before entering the lake and weeding out of the plants
- Development of tourism and its promotional activities in and around the lake

Apart from that lake, HUDA drew drawn up plans to restore about 16 other lakes in Hyderabad so that they are not lost in the process of urban development at first instance and their ecological/community services are not lost in the second instance and finally they do not become a problem/ nuisance by becoming the places of waste water stagnation.

Some details of the same are kept at: http://www.hudahyd.org/inside/document/ghep.doc (Size: 54 KB). But more details can be had from HUDA. An earlier VCP of HUDA – Ms. Lakshmi Parthasarathy was very active on getting all these plans prepared and implementation is done to the extent possible. As a result, lot of lakes found a new shape and this has boosted the value of properties around them significantly.

A description of the experiences is also provided at http://www.worldwaterinstitute.org/docs/huda.doc (Size: 102 KB) which also gives detailed coverage of the movement in India. There is also a good but technical sum up of experiences in India available at http://www.worldlakes.org/uploads/Management_of_lakes_in_India_10Mar04.pdf (Size: 405 KB).

Avudai Nayakam S, Water Partners International (WPI) India Office, Tiruchirappalli

To supplement Ramesh Sakthivel's view, there is a wonderful experience from a project on restoration of the streams and tanks that are linked in a cascade in Kancheepuram district, Tamil Nadu. Kancheepuram is the Lake District of Tamil Nadu, and traditional tank systems follow the fill up and spill over formula. Another unique feature of these tanks is that the upper tank's command area ends with lower tank's water spread area.

The Community based Natural Resource Management project implemented by partner organizations in Tamil Nadu and Karnataka helped to rejuvenate several water bodies. This improved the water table, vegetative cover, land productivity and soil moisture retention capacity. It reduced soil erosion. The income levels of people from remote, neglected and drought prone villages increased many times over as did land values. Neighboring communities/villages are now tying out similar models.

The overall objective of the project villages was to develop self-sufficient villages to meet water requirements for drinking, domestic and agriculture through the year. This improves the livelihoods of the people. Activities such as nallah training works, revival of irrigation tanks and appropriate soil and water conservation measures were carried out.

The common features noticed in the tank system which impair irrigation efficiency are:

- Large-scale infestation of weed in the feeder channels and tank water spreads
- Encroachments by farmers and others in the feeder channels/tank beds and other tank Porombokes
- Siltation in feeder channels and tank water spreads (which resulted not only in reduced storage capacity of tanks but also diversion of water towards fields
- Choked or leaky sluice and damaged surplus weirs
- Outlets with missing water regulating mechanisms resulting in wastage of water
- Deforestation and denudation in the catchment area
- Dilapidated weak or cut down tank bunds

Tank cascades exist in urban areas also. In Coimbatore City, the Corporation initiated bio-remediation and fish rearing in the lakes to generate money to maintain the tanks, canals, sewage treatment plants. The Noyyal River flows through Coimbatore City, through a system of 8 tanks connected in a cascade. Hydrologists and hydro geologists of AFPRO conducted the Noyyil River Basin study in the 1970s. They contribute 229.5 million cubic feet (MCF) of water to the city.

The restoration and development of these tanks is essential not only to bring back past glory but also recharge the aquifers to augment water for the city. More emphasis was given in an integrated and holistic manner to control pollution entering these tanks. The restoration of water bodies included cleaning, widening and desilting of the tanks by Siruthuli (http://www.siruthuli.org/) with active participation of village communities in collaboration with the Coimbatore City Corporation. The activities were carried out under JNNURM:

- Desilting and dredging to increase the water storage capacity
- Periphery formation and Bunds strengthening work
- Revetment and construction of retaining walls
- Creation of Sewage Treatment Plants, maintenance rooms and Toilets
- Provision of complete fencing on the outer side and rails in the inner side
- Provision of bioremediation and beautification of tanks
- Pisci-culture for upkeep and maintenance of tanks
- Solar display boards for awareness to Public.

People were involved to ensure successful implementation and sustainability of the project and all activities were undertaken jointly by the community, the NGO and the Corporation of Coimbatore as lead promoters and project managers. For some more details on Detailed Project Report (DPR) of Coimbatore City Corporation under JNNURM, log on to
http://www.coimbatore-corporation.com/dwnldforms/BSUP-PHASE1.pdf (Size: 6 MB)
http://www.coimbatore-corporation.com/dwnldforms/BSUP-PHASE2.pdf (Size: 2 MB)
http://www.coimbatore-corporation.com/dwnldforms/SWM-DRP.pdf (Size: 12 MB)
http://www.coimbatore-corporation.com/dwnldforms/UGD_CBE.pdf (Size: 6 MB)

Uday Bhawalkar, Bhawalkar Vermitech Private Limited, Pune

I have noticed streams and rivers that used to have a perennial flow up to 1965 have now become dry throughout the country. They have fresh water only when there is a heavy downpour, say 30 days a year. The rest of the time, they are merely channels to carry sewage. This has affected the natural processes of water purification.

Every river used to rejuvenate naturally every 3-5 km, and hence villages used to be separated by this distance. This meant the pollutants and effluents from one village were naturally purified before the river reached the next settlement. The downstream of one community becomes an upstream of the next and hence one cannot pollute more than what can be assimilated by nature.

However, in modern times, high density townships have come up along the rivers that produce large volumes of sewage that cannot be let into these natural streams without treatment. Their treatment methods lag behind the speed of township development, causing pollution in rivers and streams.

Conventional modern treatment technologies cost typically Rs 50,000/- per house, need about 2-5 m^2 of space (very scarce in urban area), and Rs 12,000 – Rs 18,000 per year to operate and maintain. They also produce toxic sludge and greenhouse gases. The sludge needs extra resources to dispose off and the treated water is actually more hazardous than the raw sewage that was treated at such a high cost.

While the raw sewage may breed ordinary mosquitoes, the treated sewage breeds mosquitoes that spread malaria and promote the spread of water hyacinth. Both water hyacinth and mosquitoes need high concentrations of nitrates and phosphates to spread, and treated sewage abounds in these because tertiary treatment for N and P removal is rarely practiced in India. Most sewage treatment plants stop at the secondary treatment level (reduction of suspended solids, oil, reduction of BOD and COD).

This secondary treatment is actually a microbiological input for tertiary treatment and hence stopping after the secondary treatment actually amounts to making the sewage more hazardous. The sewage looks clean and does not smell because the food that is required to sound these natural alarms has been removed. However, this treated sewage is actually a better food for pathogens, malaria mosquitoes and water hyacinth.

This analysis will explain why our rivers have remained polluted in spite of crores of rupees spend on treating sewage up to the secondary level of treatment. In fact, the river gets more hazardous, as has happened with the River Ganga. Such treated sewage can both breed disease-causing mosquitoes and encourage water hyacinth in water bodies where it is disposed, especially into rivers.

In the light of this, ecological methods are better than these highly energy intensive methods. They also convert N and P into plant biomass, a resource for man or his domesticated animals. Toxic organics such as recalcitrant molecules get cracked on priority by these eco-technological methods, while conventional treatment cannot crack them. These molecules are left behind in the sewage sludge or even remain in the treated sewage that has a permitted COD (chemical oxygen demand) of 250 mg/L, all of which can be toxic.

Therefore, even assuming that Delhi treats its all of its 3,000 million litres a day of sewage, 250 mg/L toxic matter means the city is discharging 750 tonnes of this into the River Yamuna. This becomes the drinking water source for Mathura, Agra and other cities. However, not all sewage is treated and that is why these cities manage to survive.

The Centre of Science and Environment has carried out evaluation of all the old and modern eco-technological methods and published a 'Design Manual for Wastewater Treatment', and also a wonderful video. Please see http://www.indiawaterportal.org/blog/index.php/2008/02/25/clean-your-act-book-from-cse/ and http://csestore.cse.org.in/store1.asp?sec_id=4&subsec_id=14 .

These new eco-technological methods are very suitable for decentralized sewage treatment and thus, facilitate their reuse for the garden or for flushing. This method allows groundwater recharge that can enable rivers to flow round the year. These methods can be maintained even by gardeners because they integrate gardening even when sewage is being treated. The BIOSANITIZER Eco-technology is the most evolved method and can play a key role in eco-restoration of streams and rivers. I will post specific case studies soon, but meanwhile please go through http://www.ecoguru.org/.

Jeevanandhan Duraisamy, Food and Agriculture Organization of the United Nations (FAO), Rome

Upstream watershed treatment and downstream semi-permeable gabions structures which can delay run off and also low lying dyke's across rivers can play a great role. Also upstream watershed treatment with soil stabilising bio engineered plants play a crucial role in delayed run off and vertical slow flow of water to recharge aquifers. I think river bank plantations are one of way that some of the organic pollutants can be naturally purified. Some of the southern river banks are so well protected from the erosion as well as river migration due large coconut palms, bamboo and other trees along the rivers.

One should also look at bamboo a potential crop for bio engineering which will help in eco-restoration both in upstream and also along the downstream providing additional income as well as in good protection. Bamboos should be reinforced with other deep root timber trees such as teak, sal, etc. which can further add value. This lick http://www.alcanprizeforsustainability.com/tiki-read_article.php?articleId=48 – is on the IDRC, INBAR funded project and is one example of eco restoration in down stream of a degraded land in Ganges flood plains.

Bamboo can also play a great role in purification of sewage water directly or from the treatment plants, instead of cultivating food crops, bamboo can be watered using these and than bamboo can used as charcoal/ to make boards which can add to sequestration of Carbon.

Also watershed with bioengineering with fast growing bamboo, fast growing native should be looked as way forward to sequester carbon.

Always one should remember that there is no one single solution to these kinds of multiple problem scenarios. A combined and integrated effort is essential (engineering, biological and social - from water users etc) is essential when looking at complex easy. A good saying is that it is easy to destroy something and it is very cumbersome to restore something back to its past.

I think it would also be worth looking at the some of the NGO-driven projects which were heavily funded by CAPART. When I was working there in 2000-2001, there were several projects on river rejuvenation.

1. Tarun Bharat Sangh in Alwar where a local river called Arvari was brought back to life in Alwar
2. There was also a project called the Swarnamuki river rejuvenation project in the Chitoor district of AP, which was proposed to be undertaken though a consortium of NGOs.
3. Many of the NGO projects on mini and micro-watershed have been were real successes and if someone can study them, it would be really worthwhile.

Hope there will be more responses.

Shailja Kishore, Aga Khan Rural Support Programme India (AKRSPI), Ahmedabad

AKRSPI adopted the river basin approach in one of the environmentally challenged regions of Junagadh to address the critical issues of water salinity due to sea water ingress and over withdrawal of ground water and dependence on forest. Meghal river basin in Maliya Taluka was selected for the same. The river basin is formed by four streams, the Lathodariya, the Meghal, the Brajmi and the Kalindri. With a length of 45 kms and catchments area of 58 sq kms, Meghal river originates in the Kanada Dungur of Mendarda taluka in Junagadh district and flows into the Arabian Sea at Chorwad of the same district. The basin supports the people of Maliya, Mendarda, Keshod and Mangrol talukas through which it flows. The ground water system in entire Meghal basin is very fragile.

Three-pronged approach was adopted for the Meghal River Basin Project:

- Spreading awareness and knowledge through basin-wide teams of villagers regarding the revival of a system of rivers and streams. Strengthening of the village institutions at the sub village, village and supra village level for the implementation of the strategies with a pro poor focus. Emotional attachment for the rivers was used to ensure massive community participation across

communities in the region. Street plays based on traditional characters and folk songs on the issue were widely used.

- Construction of various types of water harvesting structures along with traditional SWC measures. More than 140 big /small structures like check dams, percolation tanks, river deepening and widening undertaken.
- Minimizing the use/withdrawal/effective use of ground water by adopting improved irrigation devices and change of crops, drips, sprinklers etc. Promoting economically sustainable safe drinking water sources and schemes.

The interventions have been taken on a comparatively small scale but the results it has given is in terms of revival of the stream, increase in the ground water level, increased productivity and income of the farmers in the region and availability of quality drinking water in the village sources. (A study on the mid term impact of the programme is under progress, we will share the findings once it is complete.)

The impact of the interventions has been great. According to Jivanbhai Waljibhai Bhanwadiya, member core group, Maliya, "I have 30 bigha's of farm. I used to cultivate groundnut in my fields. Towards the end of the season, the water used to dry up and I fell short of 2 irrigations. My production was 45 khandi (1khandi = 400 kgs.). The quality of the product also suffered and the selling price was also affected. After the construction of bori bund, I am able to save the water that used to flow away. With this water I am able to provide the last two irrigations to my crop. The production was 60 khandi and the quality of product was also good. The last 2 irrigations gave me an extra profit of Rs 45,000.00 which could be possible just because of this bori band. Hence now I devote most of my time motivating others for the construction of Bori band. If you look into the cost analysis, for every Rs. 1.00 spent you save 7,000 liters of water. You can't get a cheaper option than this."

The impact of the bori bunds has been tremendous; the people in the area have seen that the flow of water in river Brajmi has been extended by 4 months due to the construction of these bori bunds.

Yusuf Kabir, UNICEF Consultant, Kolkata

I should congratulate you first for raising such an important issue in front of us.

As you know, Kolkata has a unique natural treasure like Wetlands, known as East Kolkata Wetlands and those are conserved under Ramsar-site convention. Beside having rich bio-diversity and giving livelihood opportunities to many, these wetlands are the only natural drainage system of Kolkata city. Because of topography and natural drainage path, waste water of Kolkata city largely goes to these wetlands, and these wetlands act as a basin and lagoon.

However, Government and Authority have been finding it difficult to protect and conserve this natural heritage from encroachment. In 2006, GOWB (Government of West Bengal) created a special Act, The East Kolkata Wetlands (Conservation and Management Act), 2006 http://www.enviswb.gov.in/ENV/downloads/EKW_Notification_dated_11-10-2006.pdf (Size: 2 MB). The Act intends to provide for conservation and management of the East Kolkata Wetlands and for matters connected therewith and incidental thereto. Under this act East Kolkata Wetland Management Authority and Committee has been formed.

The committee develops a coordinated and consensual action plan for the conservation and management of the wetlands system in consultation with the various stakeholders, Government Departments and organizations, research bodies and NGOs.

The Department of Environment is the nodal department for the management of the East Kolkata Wetlands and service this Committee. The Terms of Reference of the Committee is as follows:

- Making a precise demarcation of the limits of the East Kolkata Wetlands, preparing and maintaining a map and a land schedule showing the boundaries of the area, the plot numbers of the land comprised in the wetlands, the actual land use of each plot
- Reviewing the existing policy and legislation as applicable to the wetlands in general and specially to the East Kolkata Wetlands area and the formulation of a policy and legislation as deemed necessary for promoting their wise use.
- Preparing a management action plan for the East Kolkata Wetlands area, consistent with the stipulations of the Ramsar Convention, the legislation and the policy for the use of wetlands.
- Examining and formulating recommendations on the applications made by land owners and others for the use of the East Kolkata Wetlands area, consistent with the management action plan.
- Promoting research and dissemination of research findings and other relevant data among the stake holders and the public.
- Promoting training of personnel of the Government and NGOs in the field of wetlands research and management.
- Raising awareness among the public about the utility of wetlands in general and the East Kolkata Wetlands in particular.

This committee has been slowly turning to be useful in protecting East Kolkata Wetlands. You can explore something in this line.

Many thanks to all who contributed to this query!

If you have further information to share on this topic, please send it to Solution Exchange for the Water Community in India at se-wes@solutionexchange-un.net.in with the subject heading "Re: [se-watr] Query: Eco-Restoration of Streams/Rivers - Experiences. Additional Reply."
