Report of the three-day workshop on

Regeneration of the Banas-Bisalpur Socio-ecological Complex

in association with

University of the West of England (UWE Bristol, UK)

JK Lakshmipat University, Jaipur (Rajasthan, India)

WaterHarvest – India Liaison Office, Udaipur (Rajasthan, India)

Kindly sponsored by Wetlands International – South Asia Office (India)

Monday 4th to Wednesday 6th December 2017

Venue: JK Lakshmipat University Campus, Jaipur

Kindly sponsored by – South Asia Office (India)

Acknowledgements

The organisers of this workshop would like to thank all participants on what is acknowledged as "…a journey, not a destination" as we work to address the shared goal of 'Regeneration of the Banas-Bisalpur Socio-ecological Complex'.

Our thanks to JK Lakshmipat University for hosting the workshop, and particularly to Wetlands International – South Asia Office for sponsoring the event.

Many thanks to for the support of the Government of Rajasthan, recognising that this workshop is a building block in the broader vision set out in the *Mukya Mantri Jal Swavlamban Abhiyan* and other high-level government programmes.

Suggested citation

Everard, M., Sharma, O.P., Singh, A.K., Vishwakarma, V.K. and Pinder, A.C. (2018). *Regeneration of the Banas-Bisalpur socio-ecological complex: workshop report, JKLU, Jaipur (4-6th December 2017)*. University of the West of England, Bristol.

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Executive summary

The 'Regeneration of the Banas-Bisalpur Socio-ecological Complex' workshop (JK Lakshmipat University, Jaipur, December 2017) brought together approximately 70 participants from government, NGOs, academia, village governance institutions and Corporate Social Responsibility (CSR) programmes sharing an interest in reversal of the currently degrading cycle of linked ecological and socioeconomic degradation across the Banas River catchment in Rajasthan. The workshop was run in association with the University of the West of England (UWE Bristol, UK), JK Lakshmipat University (Jaipur, India), and WaterHarvest – India Liaison Office (Udaipur, India), and was kindly sponsored by Wetlands International – South Asia Office (Delhi, India).

Like many catchments globally, the Banas has not been treated in modern times as a living resource. Rather, it has been subject to high levels of abstraction without proportional rebalancing resource renewal, putting the socio-ecological system into degrading cycle. Yet, for four-and-a-half thousand years of pre-industrial history, the people of Rajasthan had subsisted and thrived on scarce water by innovation and operation of a diversity of 'water wise' recharge, storage and efficient use solutions attuned to local geography and culture. A key challenge for reversal of the currently rapidly degrading cycle in the Banas catchment, with its associated vulnerabilities for all inherently interconnected urban and rural people co-dependent on its water, is to recognise the central role played by the primary resource of ecosystem processes.

Workshop participants welcomed the opportunity to work together to explore problems, emerging needs and potential solutions, and to do so as part of an ongoing strategy of 'action learning' towards a vision of a regenerative socio-ecological system. Future progress entails working together to co-develop solutions that work with natural processes, hybridising traditional knowledge and modern techniques to achieve a regenerative socio-ecological cycle better connected across the catchment in a modern world of significant population growth, urbanisation and climate change. Cross-catchment connections include closer integration and equitable balance between needs and appropriate solutions that work for all people, with the current fracture of perspectives between urban and rural regions highlighted as a particular priority for action. Economic and regulatory reforms attuned to supporting environmental processes are essential, backed up by research in environmental and social systems, engineering, economics and governance mechanisms. Shared awareness and responsibility by all people across the catchment is necessary to achieve a more integrated approach to catchment sustainability, including reducing current fragmentation of institutions and knowledge. NGOs, village governance institutions and faith leaders have significant roles to play in integrating effort and knowledge, along with government, CSR and academic programmes.

All technologies, both ecosystem-based and 'hard' engineering techniques, have roles to play, but the ramifications of their deployment need to be understood. An agreed foundational goal within the Banas vision is sustainable hybridisation of water management technologies –natural infrastructure, traditional management, 'green' technologies and 'hard' engineering – in ways that are beneficial to local people and catchment processes. This is vital to reverse current and cumulative cumulate pressures arising from proliferation of unlicenced tube wells and large dam-and-transfer schemes that are not today balanced with recharge, constituting primary drivers of catchment decline. Water efficiency in urban area, responsible for a high density of demand, is substantially underinvested today. Novel urban self-sufficiency, benefit sharing and investment mechanisms to regenerate the resource are required, overcoming former narrow exploitation-based approaches founded on limited knowledge and power asymmetries. Novel ideas include limiting water diversions from the Bisalpur to the city of Jaipur, quantitatively or on a time-limited basis, as a means to force greater awareness and self-reliance on local urban sources (such as investment in infiltration pits and local storage) and 'green infrastructure' solutions (rooftop water harvesting, greywater reuse, etc.) to redress power asymmetries and assumptions, and to promote urban self-sufficiency.

Some knowledge gaps and incorrect assumptions need to be addressed. This includes in particular divergent opinions about the impact of small anicuts in upper sub-catchments, seen by some a stopping water reaching the Bisapur Dam but by others as sustaining local livelihoods whilst also regenerating groundwater systems that store and buffer flows downstream. There is also a need to better understand underground and surface flows of water in the catchment as a robust basis for more sustainable management, and to improve the protection of this vital natural capital to combat poverty and better support human needs.

Novel livelihood practices could be innovated to make better beneficial use of water within the catchment, rather than depending on abstraction from the ecosystem to drive short-term consumptive economic uses. The economics of water include thinking in a cyclic way consistent with the water cycle, for example directing investment in upstream practices that recharge the catchment system rather than simply using it to increase the technical efficiency of extractive technologies that the current declines in water quantity and quality will render unsustainable. Reformed economic instruments are part of a wider transition to cyclic thinking and behaviour, also addressing equity issues, creating a regulatory environment across the catchment that works in synergy with its natural supportive and regenerative processes.

Reaching for a regenerative vision necessarily includes innovating effective, nested governance systems. A 'top down' catchment-scale vision and enabling policy environment is necessary to inform and facilitate progress towards the catchment-wide vision, also helping enforce practices such as driving roof water harvesting, water efficiency and reuse, and other necessary efficiency measures in urban areas. However, practical delivery requires a high level of delegation to identify and deploy solutions closely tuned to specific geographical and cultural situations, that are best innovated and governed on a highly localised basis. Enabling, nested and co-creative governance arrangement are required. This includes far closer integration of the disparate CSR, NGO, local, faith leader and government programmes (MGNREGA, Smart Cities, Rajasthan's MJSA programme, and many more departmental initiatives and associated budgets that are currently narrowly deployed). This can be implemented with far greater synergy and cross-departmental co-benefits leading towards the ultimate vision of a regenerative socio-ecological system.

'Business as usual' – today's overemphasis on technically efficient extraction, overlooking ecosystem processes underpinning resource recharge and availability – is not a sustainable option, and can only perpetuate ecological depletion and associated human vulnerabilities. There is now no viable, equitable or sustainable alternative than acting upon what we now know about the systemic nature of catchments, and refocusing energies, investment and innovation on an ecosystem- and community-based regeneration programme for the Banas socio-ecological system. There is a pressing need to change paradigm from narrowly short-term exploitation, leading to the depletion of water and associated ecological and human wellbeing, towards more informed and strategic stewardship with efficient uses balanced with resource protection and regeneration.

Workshop participants saw substantial value in bringing people together from a diversity of societal sectors associated with the catchment, welcoming future opportunities to share perspectives and make strides towards co-created sustainable solutions. Ecosystems and their processes were acknowledged as the fundamental resource underpinning continuing human security and opportunity, and need to be valued on that basis in all management and use decisions within a bold vision of a regenerative socio-ecological Banas system. Though the challenges of attaining it are daunting, confronting many assumed norms and vested interests, this vision can be focal for progressive innovation, evolution and integration of initiatives, to get as close as possible to a baseline of natural catchment functioning and sustainable human interactions with it.

Above all, the tight interlinkage between all people co-dependent on the catchment system needs to be recognised within a collaborative approach to balance water use with recharge, regenerating the entire socio-ecological system. This is "a journey, not a destination" that all participants are happy to progress.

1. About the Banas regeneration workshop

The three-day 'Regeneration of the Banas-Bisalpur Socio-ecological Complex' workshop took place at JK Lakshmipat University Campus, Jaipur[1], from 4th to 6th December 2017. The purpose of the workshop was to bring common-cross-sectoral interest together to promote the reversal of the currently degrading cycle of linked ecological and socio-economic degradation across the Banas River system. The workshop was run in association with the University of the West of England (UWE Bristol, UK), JK Lakshmipat University (Jaipur, India), and WaterHarvest – India Liaison Office (Udaipur, India). It was kindly sponsored by Wetlands International – South Asia Office (Delhi, India).

Workshop Coordinators were:

1. Dr Mark Everard
   Associate Professor of Ecosystem Services, University of the West of England (UWE Bristol), UK
2. Prof. Dr.-Ing. Anupam Kumar Singh
   Professor in Civil Engineering (Water and Environment), JK Lakshmipat University, Jaipur, India
3. Dr Vinod Kumar Vishwakarma
   Assistant Professor in Civil Engineering, JK Lakshmipat University, Jaipur, India
4. Mr Om Prakash Sharma
   Country Director, WaterHarvest - India Liaison Office, Udaipur, India

The workshop brought together participants from government, NGOs, academia, village governance institutions and Corporate Social Responsibility (CSR) programmes sharing a common interest in reanimation of the Banas catchment (Figure below) and the multiple linked livelihoods that it supports. A list of attendees and also corresponding members unable to attend is appended at Annex 1.

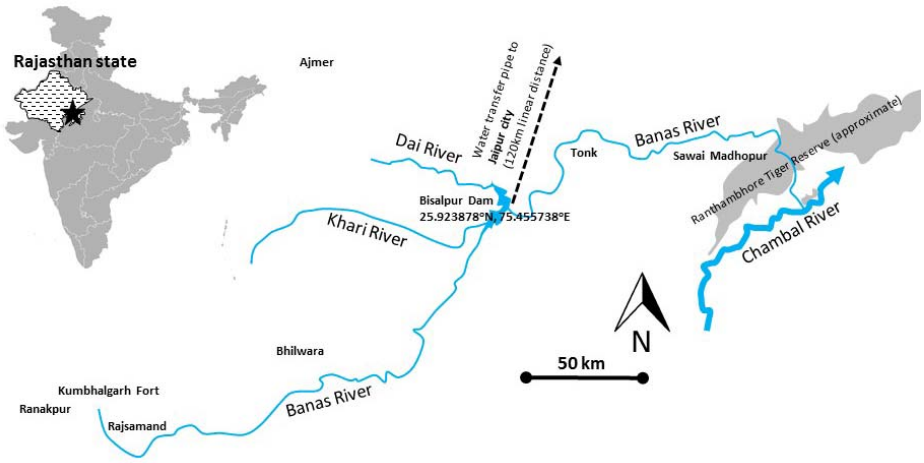


Image © Dr Mark Everard

The structure of this report is represented in the Table of Contents.

[1] JK Lakshmipat University (JKLU), is located off the main Ajmer Road (NH 8) Nr. Mahindra SEZ, reached via Mahapura, opposite Kanchan Kesari Resort on Ajmer Road (NH8). The University is approximately 11 km from Jaipur City centre, 18 km from the Jaipur Railway Station and 25 km from Sanganer Airport.

2. Background

India is home to 16% of the world's population, with much of the land mass subject to episodic monsoon rains and water scarce. This situation is exacerbated by a changing climate, rapid population growth and urbanisation. Water security is a pressing and cross-cutting issue, the challenges enormous and immediate. Wise management of water – its interception and safe storage, efficient and equitable use, and sustainable allocation for economic and ecological needs – is of high and growing importance for supporting a good quality of life. This is true across India, but the underlying challenges and potential solutions are common across much of the water-insecure world.

Recently published reports highlight water scarcity as limiting for the wellbeing for both urban and rural people, Government of India data revealing that residents in 22 out of 32 major cities have to deal with daily water shortages. In reality, conceptual divisions between urban and rural areas overlook the reality that these are highly interconnected via the catchment ecosystems from which both derive water and a wider range of water-dependent ecosystem services.

Current rates of surface and groundwater depletion raise concerns not merely about environmental impacts, but also outcomes for all those dependent on common water resources including rural residents, urban dwellers and economies dependent on diverted water, irrigation schemes, and also wildlife of conservation, subsistence and tourism importance. Depleting and increasingly contaminated water resources ultimately affect all stakeholders linked within a wholly integrated socio-ecological cycle.

The workshop focused on the Banas catchment, running 512km eastwards through Rajasthan from the Khamnor Hills to join the Chambal River. The Banas supports the needs of disparate rural and urban people and ecosystems, impounded in its mid-course by the Bisalpur Dam which now constitutes the principal supply to the city of Jaipur 120km to the north east. Declining quality and quantity of water in the Banas system creates vulnerabilities for all its linked co-dependents. Recent techno-centric approaches to ever deeper and more remote exploitation of water resources, overlooking resource replenishment, are unlikely to be sustainable.

A recent scientific paper[2] published by a number of the workshop promoters suggests a visionary solution based on reinstatement of water resource replenishment at source by interception of episodic monsoon, founded on reinstatement and innovations based on the traditional 'water wisdom' that has underpinned sustainable communities in the drylands of Rajasthan over centuries, as well as modern water-efficient techniques and their integration with engineering schemes.

Realising this vision will require far-sighted policies (we are already seeing this emerging for example under the Government of Rajasthan's *Mukya Mantri Jal Swavlamban Abhiyan* [MJSA] programme), novel economic instruments, effective community-based outreach recognising self-beneficial solutions that also rebuild catchment hydrology, and research to address knowledge gaps.

This workshop seeks to progress those goals, bringing together key actors, influencers and knowledge providers with the aim of reversing current degenerative cycles, building together the stepping stones towards a regenerative socio-ecological cycle beneficial to the diversity of catchment co-beneficiaries.

[2]Everard, M., Sharma, O.P., Vishwakarma, V.K., Khandal, D., Sahu, Y.K., Bhatnagar, R., Singh, J., Kumar, R., Nawab, A., Kumar, A., Kumar, V., Kashyap, A., Pandey, D.N. and Pinder, A. (2018). Assessing the feasibility of integrating ecosystem-based with engineered water resource governance and management for water security in semi-arid landscapes: a case study in the Banas Catchment, Rajasthan, India. *Science of the Total Environment*, 612, pp.1249-1265.

3. Workshop purpose and objectives

3.1 Purpose of the workshop

The Purpose of the workshop was:

- *Development of a shared vision across multiple stakeholders of the challenges, knowledge base and policy gaps, and steps towards development of a regeneration programme of the socio-ecological system of the Banas catchment, Rajasthan, for linked rural, urban, irrigation and ecological and ecosystem services benefits*.

3.2 Objectives

The Objectives of the workshop were to:

- Develop common understanding of current status and trends in the Banas catchment, including vulnerabilities of all linked rural, urban, irrigation and wildlife co-beneficiaries.
- Understand and support for further development of the aims of Government of Rajasthan, particularly of the *Mukhya Mantri Jal Swavlamban Abhiyan* (MJSA) and related programmes.
- Co-create potential multi-sectoral solutions relating to progressing reanimation of the Banas socio-ecological system.
- Familiarisation with practical realities on the ground in a target area of the catchment.
- Agreement of priorities for:
    - (1) an action plan;
    - (2) research needs;
    - (3) catchment vision and catchment management; and
    - (4) targeting and synergies between existing initiatives and funding streams.
- Consideration of out-scaling learning across the Banas, state, India and beyond.

4. Workshop agenda

The agenda for this workshop was inevitably fluid around an initial framework, responding to the availability of people on the day and reacting to learning outcomes as the workshop unfolded.

Dr Deep N Pandey, Additional Principal Chief Conservator of Forests (Soil conservation), Jaipur, intended to attend, offering a keynote presentation of Government of Rajasthan aims for water security and catchment management and also summing up at the conclusion of the workshop. However, Dr Pandey was unable to attend due to other obligations arising at short notice within his department. Dr Pandey – a co-author of the background scientific paper and also the WaterHarvest/UWE *Wise Water Solutions in Rajasthan* guide – nonetheless conveyed his support for the event and intent to be involved in arising initiatives.

Dr Shriram Vedire, Chairperson of the Rajasthan River Basin and Water Resources Planning Authority, Jaipur, had also planned to offer a keynote address, but was also unable to attend due to similar obligations. Dr Vedire nonetheless offered his support for a successful workshop.

The workshop was conducted in both Hindi and English, whichever language best suited the purpose of the session (mainly Hindi) with translation where helpful to keep everyone engaged. The workshop programme with adjustments comprised:

Day 1: Monday 4th December 2017 (at JKLU)

Inauguration and welcome from the workshop leads:

- Welcome to the workshop and JKLU: Professor Anupam Kumar Singh, JKLU

- Welcome and outline of the purpose of the workshop: Dr Mark Everard, UWE
- Welcome and confirmation of purpose: Shree Om Prakash Sharma, WaterHarvest
- Introductions from all present delegates

Morning tea

Session I: Presentations with discussion:

- Key findings of the Everard *et al*. (2018) Banas catchment study: Dr. Mark Everard
- Reliance Foundation initiatives, particularly in Rajasthan: Sunil Shrivastava
- Masi-Bandi River Parliament initiative: Dr M.S. Rathore
- Ambuja Cement Foundation initiatives including the 'Ripple Effect' video: Mr Manoj Agarwal
- Jaipur Bloc: Mr Sarvendra Kumar

These presentations were offered as stimuli for further workshopping and discussion leading to potential solutions and further research and other needs.

Lunch

Summary of key points from the morning session (Dr Mark Everard)

Session II: Parallel breakout working groups addressing the topics of:

A. Institutional mapping (organisations, strategies, laws and budgets)
   - Potential synergies (not parallel and potentially conflicting efforts)
B. Local un-sustainability issues: what are the 'top three'?
   - And what are their solutions (thinking about catchment processes)?
C. How best to connect equitable benefit-sharing between upstream and downstream (including dam beneficiaries)?
   - Thinking of cyclic systems of ecosystems, benefits and financing

Session III: Report back – Plenary presentations and discussion

Dinner

Day 2: 5th December 2017 (Field visit)

Field visit to the Bisalpur Dam complex

- Visit to the dam site and its operation
- Discussion of learning points and questions to focus our discussions on Day 3

Day 3: 6th December 2017 (at JKLU)

Welcome:

- Welcome to those joining the workshop today
- Restatement of the Purpose and Objectives
- Discussion of key points learned from the workshop and site visit to date

Session VI: Breakout groups to discuss key emerging questions arising (also linked to Objectives)

- Avoiding the collision of needs and availability
- Catchment vision and catchment management
- Looking for sustainable uses and livelihoods
- Targeting and synergies between existing initiatives and funding streams

Session VII: Feedback from groups and discussion of emerging learning points

Session VIII: Closing session

- Summing up (Dr Mark Everard) with discussion
- Thoughts from the Vice-Chancellor
- Thoughts from the Director

5. Key points from workshop sessions

This is not a detailed account of every presentation and discussion throughout the workshop, as that would detract from key points. Key points related to each session are recorded here, with 'thumbnail' presentations included where relevant in Annex 2.

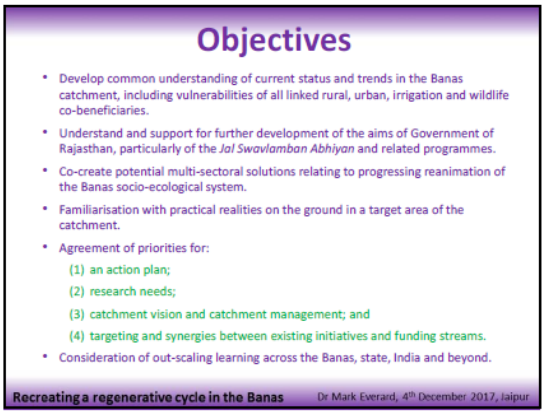
5.1 Welcome, purpose and objectives of the workshop

Prof. Anupam Singh (JKLU), Om Prakash Sharma (WaterHarvest) and Dr Mark Everard (University of the West of England) welcomed delegates to this important workshop on behalf of the three organising institutions. This opening address included messages from dignitaries who had hoped to attend but were called away at short notice by higher priorities

- Dr Deep N Pandey, Additional Principal Chief Conservator of Forests (Soil conservation), Jaipur; and
- Dr Shriram Vedire, Chairperson of the Rajasthan River Basin and Water Resources Planning Authority.

Delegates introduced themselves with a note of their affiliation, and their interest in and expectations of the workshop.

Mark Everard reiterated the purpose and objectives as laid out in the invitation paperwork, as summarised in the brief 'thumbnail' presentation below.



5.1 Session I: Presentations with discussion

These presentations were offered as stimuli for further workshopping and discussion leading to potential solutions and further research and other needs.

5.1.1 Key findings of the published Everard *et al*. (2018) Banas catchment study: Dr Mark Everard

This presentation drew out key points from the published scientific paper looking at the Banas system as an interconnected socio-ecological system, exposing causes of and linked vulnerabilities to declining water quantity and quality as well as potential solutions requiring a cross-sectoral 'joined up' approach. See Annex 2 for 'thumbnail' images of presentation.

5.1.2 Reliance Foundation initiatives, particularly in Rajasthan: Sunil Shrivastava

Sunil Shrivastava presented on initiation of the Reliance Foundation work on water security, starting in 2010 and with a number of integrated goals, addressing in particular holistic solutions undertaken by Reliance Foundation in Rajasthan. See Annex 2 for 'thumbnail' images of presentation.

5.1.3 Masi-Bandi River Parliament initiative: Dr M.S. Rathore

Dr M S Rathore outlined the multi-dimensional challenges in water resources management, its history in India, and novel approaches in the Masi-Bandi sub-catchment leading to formation of a River Parliament initiative. See Annex 2 for 'thumbnail' images of presentation.

5.1.4 Ambuja Foundation initiatives including the 'Ripple Effect' video: Manoj Agarwal

Mr Manoj Agarwal played a video titled *The Ripple Effect* of the Ambuja Cement Foundation's work contributing to water security in rural Rajasthan. It is not possible to upload the video into this report, but the following YouTube clip encompasses many of its key points: https://www.youtube.com/watch?v=W_3fUcavhd8.

5.1.5 Jaipur Bloc: Mr Sarvendra Kumar

Sarvendra Kumar outlined the work of the Jaipur Bloc, a groups of textile companies committed to sustainable production. The *Sustainable textiles made in Jaipur* video is available on YouTube at: https://www.youtube.com/watch?v=mB-7U2586Yk.

5.1.6 Summary of key points

Dr Mark Everard summarised some of the key points arising from free-ranging discussions following these stimuli presentations:

- Ecosystem services – the benefits we derive from natural systems – underpin our needs now and into the future, yet we have often overlooked them in an exploitative, techno-centric approach to development
- India's long history water wisdom needs integration with novel technologies in a modern world of higher, urbanising population and a changing climate
- We need multi-beneficial solutions that have the regeneration of supporting ecosystems at their heart, progressively superseding the fragmented issue-by-issue uses and fixes that are common today
- Solutions need to work for local people but also contribute to benefits at broader catchments scale.

5.2 Sessions II and III: Parallel breakout working groups and plenary feedback

The following topics were identified for discussion by parallel working groups, based on learning during the workshop to date:

A. Institutional mapping (organisations, strategies, laws and budgets)
- Potential synergies (not parallel and potentially conflicting efforts)

B. Local un-sustainability issues: what are the 'top three'?
- And what are their solutions (thinking about catchment processes)?

C. How best to connect equitable benefit-sharing between upstream and downstream (including dam beneficiaries)?
- Thinking of cyclic systems of ecosystems, benefits and financing

Feedback into the plenary session from discussion groups in listed below.

5.2.1 Working group A: Institutional mapping (organisations, strategies, laws and budgets) – potential synergies (not parallel and potentially conflicting efforts)

- Organisations may be:
  - Social
  - Political
  - Government
  - Regulatory

- Different institutions involved in the Banas are:
  1. Panchayat (Gram Panchayat)
  2. Municipalities (Nagar Nigam)
  3. Irrigation Department (Water Resources Department)
  4. Watershed Department (Water Resources Department)
  5. Pollution Control Department
  6. Irrigation Department
  7. Environment Department (Pollution Control Board)
  8. Forest Department
  9. Revenue Department
  10. Mining and Quarrying Department
  11. Electricity Board Department
  12. Highway Authority Department
  13. Town Planning Department
  14. Religious Groups (Sacred Groves)
  15. Groundwater Department
  16. Rural Development Department
  17. NGOs

In relation to any activity, synchronisation is essential between all relevant departments and authorities.

- Laws and Regulation: There are numerous laws regarding the issues for the above listed institutions. But there is currently no synchronisation between them.

- Water Regulatory Authority Act (2013) has been passed. Rajasthan has adopted state water policy 2010.

- Budget: District-wise and sector-wise. The budget is allocated according to the priorities:
    1. Human drinking water
    2. Livestock drinking water
    3. Domestic, commercial, municipality
    4. Agriculture
    5. Power generation
    6. Industrial
    7. Cultural
    8. Others

- Ownership of the water resource is the main issue:

    1. Awareness should be developed between the people by organising different camps.

    2. Community participation must be encouraged. Decision-making power should be decentralisation, giving individuals power and authority relevant to their own local situation level though informed by the oversight on catchment dynamics provided by higher-level authorities.

5.2.2 Working group B: Local un-sustainability issues: what are the 'top three'? And what are their solutions (thinking about catchment processes)?

Far more than three priority issues were identified by the working group, with additional consideration (in sub-bullets) of potential solutions:

1. Mining – A. Stone mining, B. Sand Mining
    I. Collection of waste dust material in a suitable landfill site would enable the conversion of collected material throughout the year to form useful stones, avoiding effect on runoff contamination protecting river health
    II. This approach may also be applicable to production of sand from crushed stone

2. Deforestation, ecological imbalance
    I. Biodiversity conservation is a priority as the adverse effects of deforestation include damage to the entire ecological cycle, increasing vulnerability to drought and flood conditions

3. Encroachment on the common properties (especially water reservoir, river bed)
    I. Local organisations could strengthen the capacity of villagers to oppose both those undertaking encroachment and the political leaders promoting it

4. Encroachment by people on government/community lands appears to be encouraged by local politicians
    I. Local organizations should strengthen the villagers so they can fight against the encroacher and the political leaders who promotes the encroachment

5. Unplanned works done under the MGNREGA programme

   I. MGNREGA activities should be planned and a DPR (Detailed Project Report) should be prepared before construction of structures or other interventions

6. The education system does not currently address the causes and effects of river degeneration
   I. The causes and effects of river degeneration should be included in the curriculum at school-level education, so that students are aware of these problems and can better contribute to catchment regeneration

7. Various government departments are not seriously doing their jobs like agriculture department, forest department, etc.

8. Population growth increases pressure on the available resources

9. Waste management is not currently being done in a proper way, such as people burning tree leaves:
   I. Tree leaves can be used beneficially, such as fertilisers and pesticides if suitably processed

10. Use of chemical fertilisers depleting the soil fertility and quality:
   I. People need to understand the potential negative impacts of chemical fertilisers, and the need to reduce or halt use of excess chemical fertilisers

5.2.3 Working group C: How best to connect equitable benefit-sharing between upstream and downstream (including dam beneficiaries)? Thinking of cyclic systems of ecosystems, benefits and financing

Before coming to "how", let us focus on "why": the reasons which are not letting equitable benefits-sharing between upstream and downstream. This is mainly due to three reasons:

- Loopholes in institutional mapping;
- Sudden encounters with the local un-sustainability issues (not having the foresightedness to predict future issues which we may encounter as we move along with our plans); and
- Differing assumptions between workers on the ground and technical/policy-making communities, the latter often based on theories, old data which may be inaccurate or outdated. We are living in an uneven and recently drastically changing world, so generalization on which assumptions are based can be the considered as the guide lines but cannot be and should not be considered the ultimate truth.

Discussion of solutions covered a range of linked areas:

- The regeneration of degraded aquatic ecosystems, which formerly met many more human and ecological needs. Relevant factors for research and follow-on policy include:

  a) To understand a baseline of how the system would have functioned naturally without the dam. Was the river ephemeral pre-intervention? Were there interconnected pools?

  b) How can we get as close to this as we can?

  c) There are lots of check dams throughout the catchment, which could, for example, be fitted with slots at a lower level than the tier enabling fish are able to migrate when the dams overtop.

  d) It is not just about connecting water and wildlife, there is also an issue of connecting people with the river and the resource requiring an education programme of some sort (where the water comes from, goes to, cycles)

e) Livelihoods: are there any savings to be made in terms of water utilisation? Around the dam where water is perceived to be plentiful, there is greater irrigation and water-intensive crops such as sugar cane.

f) There may be alternative livelihoods (ecotourism, recreation, angling, etc.), also using water within the dam (e.g. caged aquaculture), that make beneficial uses of water in situ rather than abstracting it to support e.g. cropping for cash crop sales. This is a more efficient, multi-beneficial use of water and of the water cycle.

- Whilst retaining a focus on letting the river flow as close as possible to its natural course, this does not preclude engineering approaches. Rather, it calls for a symbiotic approach between ecosystem-based and engineered solutions when planning and building new structures, such that maximum benefits ensue and we avoid the historic tendency to create many unforeseen problems when imposing narrowly conceived solutions (as seen by the 'broken' model of Jaipur City's annexation and subsequent depletion of increasingly remote water resources). Working synergistically with ecosystem processes will not only support and restore aquatic life, but potentially create alternative job opportunities (fishing, recreational angling, ecotourism around regenerating bird populations, etc.) in the spirit of the workshop theme of "Regeneration of the socio-ecological complex".
- Additional major issues include climate change (uneven rainfall, high rate of evaporation, etc.) Though daunting, they should not prevent development of bold and proactive solutions, which can serve to increase socio-ecological system resilience. We have the knowledge to undertake this systemic change, so should challenge established paradigms that might present themselves as obstacles.
- It is important to reflect the geographical realities of Rajasthan in development and land use aspirations. For example, Rajasthan's significantly different soil, topography and water resources mean that it cannot be, and should not be planned to emulate, the 'bread basket' of the Punjab. A sustainable vision works with geographical realities, including constraints and opportunities, which should shape plans so that development does not work in opposition to natural processes.
- The above situation is exemplified, for example, by homogeneous policies upstream and downstream of the Bisalpur Dam, geographical differences between which might require a different approach. (The analogy discussed was that chemotherapy-based cancer treatment would not be suitable for a TB patient.) Government policies need to become far more adaptable and consequently nuanced to the geology and other natural features of local areas, including processes potentially recharging groundwater, also addressing the cyclic nature of water systems in fiscal and other measures to create sustainable linkages between those recharging water upstream and the downstream beneficiaries of more secure water.

5.3 Visit to Bisalpur Dam

Day 2, Tuesday 5th December 2017, was a visit to the Bisalpur Dam. The group explored the engineering, ecology and other facets of the dam site and its environs.

This trip as a whole provided opportunities for free discussion and consideration of current and future challenges. Potentially sustainable options informed discussions on Day 3 as well as the ongoing journey of co-created solutions beyond it.

5.4 Summary of outcomes of Days 1 and 2

Welcoming new attendees on Day 3, Wednesday 6th December 2017, Dr Mark Everard also drew together some key points emerging from the first two days of the workshop. These in turn fed into the framing questions (linked to workshop outcomes) for discussion in the morning sessions.

5.5 Sessions VI and VII: Key discussion points arising from the workshop to date

Sessions VI (Breakout groups to discuss key emerging questions arising linked to Objectives) and Session VII (Feedback from groups and discussion of emerging learning points) were shaped by four generic sets of issues emerging from presentation, working groups, discussions and the Bisalpur Dam site visit. Four generic areas emerged as prompts for breakout group discussion:

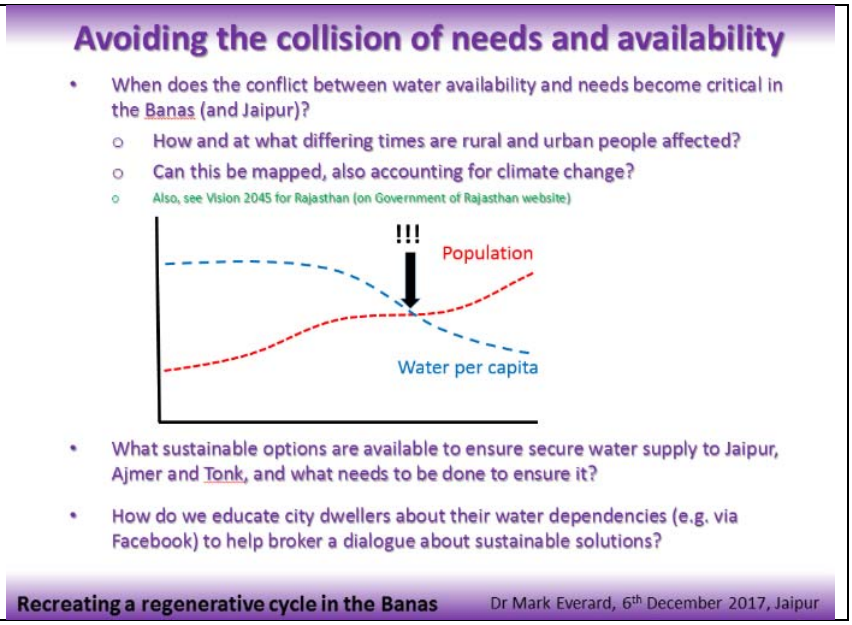
- Avoiding the collision of needs and availability;
- Catchment vision and catchment management;
- Looking for sustainable uses and livelihoods; and
- Targeting and synergies between existing initiatives and funding streams.

These were influenced both by learning to date and the notes in the Objectives about turning vision into deliverable reality:

(1) Action plan;
(2) Research needs;
(3) Catchment vision and catchment management;
(4) Targeting of *Mukya Mantri Jal Swavlamban Abhiyan* and other resource regeneration initiatives

Prompting slides for each of the working groups are reproduced below, followed by plenary feedback from discussion groups.

5.5.1 Avoiding the collision of needs and availability

The framing PowerPoint slide to promote discussion is reproduced here, followed by a note of ensuring discussions.	

Notes from ensuing working group discussion:

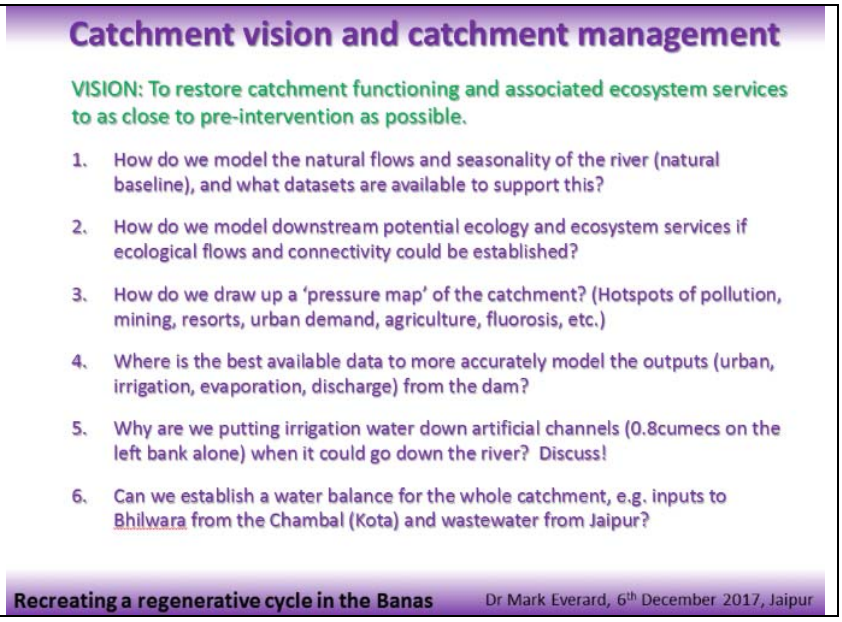
- Different types of conflict
  - The 'giver' side: There is a general lack of consideration of where water is coming. Villages are given the highest priority for sensitising people about water management, but there is asymmetric sensitisation of often unaware and/or profligate urban users. More integrated management support is required.
  - Upper catchment solutions are needed as without solutions that work for the catchment they will devise their own solutions. There is a general lack of guidance about this.
  - Inflows to the Bisalpur Reservoir will increasingly decline if this situation persists, creating conflicts between all of the users of its water.
  - If water is limited, people will try to stop water leaving their villages, which can compound problems in the light of declining rainfall.
  - There will also be increased costs associated with water availability and distribution.
  - Social changes are leading younger people to want different lifestyles than those associated with traditional agriculture, which is likely to increase the costs of produce and therefore create further potential for conflict.
  - The marble industry is also causing problems, through slurry production and extraction activities.

- Possible solutions:
  - Policy change reflecting concrete policy focus on demand in urban areas, particularly Jaipur.
  - We are not currently sensitising urban people about water use.
  - This is more difficult that sensitising rural people, so we need new methods (e.g. social media, but mainstream media has a major role here).
  - Must start with younger people: water wisdom should be an integral part of their education.
  - There is a need for different types of policies, so that urban people can provide water from their own resources (e.g. mandatory roof water harvesting, wastewater generated in houses, etc.) that has to be cemented into law.

- On the giver side:
  - Utilisation of traditional cropping practices is currently declining, with people moving to cash crop production with limited water but increased input of agrochemicals which affects soil quality and water infiltration. There is a need to promote traditional practices.
  - We need to sensitise and motivate people about clearing waterways to improve conveyance and infiltration of water.

- Potential solutions are emerging:
  - There are social movements, such as Rally for Rivers led by faith leaders.
  - Afforestation could also be implemented along the banks of rivers, which can act as a sponge that evens out flows over the year.
  - There are some pending laws on mandatory roof water harvesting.
  - Water needs for the city of Jaipur could be time-limited from the Bisalpur Dam source, requiring urban users to get water from elsewhere the rest of the time. This would drive thinking about resource conservation and sustainability

5.5.2 Catchment vision and catchment management

The framing PowerPoint slide to promote discussion is reproduced here, followed by a note of ensuring discussions.	

The following conclusions were reached by the discussion group on the topic "Catchment vision and catchment management"

1. Addressing the question about the use of artificial structures for irrigation purposes, the group concluded that these artificial channels are very efficient, reduce the losses of the water, so that the water can be delivered to the end users effectively. Another reason why the natural course of the river is not used for the supply of the water is because the state of the land is no longer supportive of the natural course of the river, with significant seepage and evaporation likely that will reduce delivery to end-users. The idea of re-establishing the natural river's course is novel, and would require significant effort and a foresighted plan.

2. In addressing pressure mapping, the following factors should be considered
   a. We should divide the catchment according to its uses, akin to the way that most cities are planned with dedicated areas for different facilities (educational area, industrial area, etc.)
   b. Following this approach, further details are required about the pressure points: water consumption, efficiency, recycling and natural impact. Appropriate data on these factors would support solutions better informing the success of policies and projects, informing necessary plans better to manage these pressure points.
   c. Rajasthan has a large land area. This provides opportunities for 'reverse thinking' in villages, in which local people could make use of more water-sensitive land use solutions to reduce their insecurities averting the out-migration of people to cities such as Jaipur, which become an increasingly major pressure point. Policies linking rural and urban interests, such as government incentives for buying an amount of the production by the farmers corresponding to the land area, would better close this currently poorly linked rural-urban interdependency.

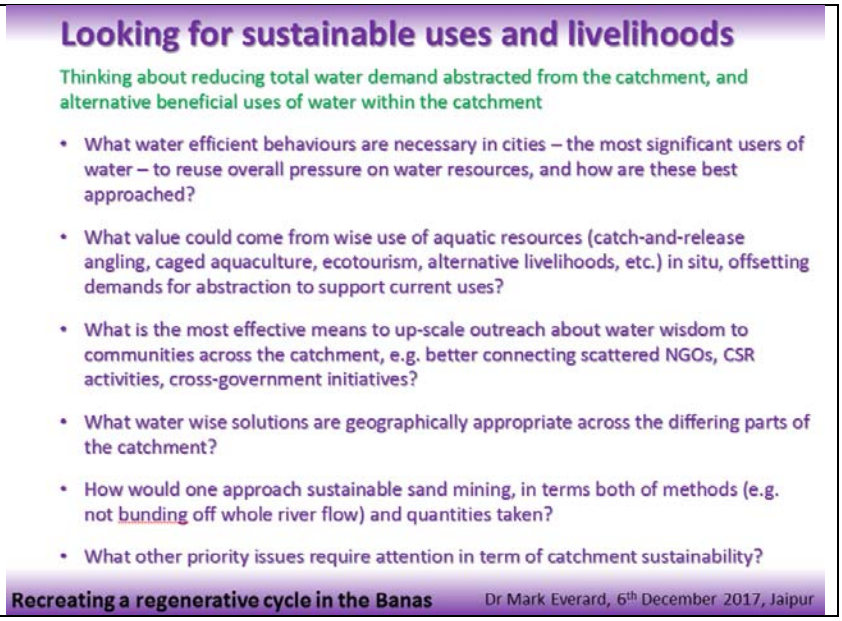
3. The 'dependency syndrome' which has developed among the people towards their government about security, supply and protection of the water also presents an obstacle. It is time to address water supply like electricity, with subsidies reduced to only needs per person with additional supplies charged on a rising tariff over a 24-hour supply model. Whilst this may be opposed by richer sectors of society, ultimately such solutions will be necessary whether electively and planned, or else later by enforced necessity. Another option is the institution of two types of supply – potable water (drinking water) and less highly treated water – and to charge for them separately. The present scenario is not perfect, as it has many loopholes (for example with villages with only intermittent water supply that seek to store as much water as possible which can result in 60-40% of the water stored for contingency being wasted). The Rajasthan government is already encouraging novel ways of saving water, such as rainwater harvesting, through subsidies, which could be broadened to a wider suite of water-wise solutions.

4. Data useful to support such a transition may already be retrievable from the Ground Water Survey Department and organisations like IMD, so could be better used.

5. The last but the most important conclusion is that plans, processes, analyses, etc., are limited in vision by two problems: (1) lack of awareness in the people; and (2) data availability, accuracy and affordability issues. Data sharing at no or low costs by the holding institution could make a major contribution to more integrated solutions, though it is acknowledged that this is in conflict with organisations motivated by profit.

One cross-cutting solution across all of these problems is to use the youth of the nation. There is a large number of engineering colleges across Rajasthan and India. These could be mobilised towards data collection, analysis, awareness generation and integrated solutions, particularly if these efforts could be pooled and directed better to inform projects and policies. As profit from data and solutions is not a primary driver of the academic sector, this may be a suitable vehicle, with processes that can be readily interrupted and later resumed pending funding, student availability, etc. In this way, every institute is empowered to turn their laboratory facilities to address not only water issues but also many other issues. As education boards have mandatory requirements for engineering students to do internships, this provides another stimulus for the massed student body to invest some of their internship time into the wellbeing of Indian society.

5.5.3 Looking for sustainable uses and livelihoods

The framing PowerPoint slide to promote discussion is reproduced here, followed by a note of ensuring discussions.	

Notes from ensuing working group discussion:

What water efficient behaviours are necessary in cities and how should these be approached?

- Ideally, water would be prioritised according to needs rather than being indiscriminately made available to those connected to piped supply. The feasibility of achieving this presents significant challenges. One suggestion was mapping the city to identify different zones (residential, industrial, hotels, other institutions, etc.) enabling water to be supplied according to needs when in short supply, though in reality cities generally comprise mixed development making this unworkable. Other forms of prioritisation during periods of scarcity may need to be identified to avoid default situations of 'first come first served', or those with the greatest wealth and influence favouring their own needs, though no clear suggest was identified in this working group.
- Addressing distributional losses, including leakage (pumping and transportation), as well as breakages of pipeline which require improved inspection and maintenance regimes.
- Managing unauthorised irrigation or other uses of water. Governance systems need to be robust and transparent to avoid illegal or other unauthorized supplies to farmed land or other intensive uses of water.
- Greater emphasis on the quality of water made available for public supply, to counter situations such as those revealed by a study at Dudu (a town to the south of Jaipur) which found that fresh water was blended with saline water at levels that put the health of 50,000 people at risk.
- The group recognised that many industrial sites did not operate their wastewater treatment plants, where installed, for much of the time, often only doing so when an inspection by any regulatory authority was being undertaken. This calls for a more effective compliance regime to back up the intention of the regulatory regime.

What value could come from alternative uses of aquatic resources in situ, rather than depending on water abstracted from the catchment system?

- In order to maximize the potential benefits from sustainable use of aquatic resources, such as ecotourism or fisheries, government, CSR and NGO organisations active in the catchment could usefully map the many water bodies and water sources throughout the catchment.
- The raising of awareness in people across the catchment is a priority so that they better understand the consequences of their and other people's actions and can become active in better catchment management. This may be though a range of routes, such as formal education, religious groups, media or other routes. For example, a case study in Dudu identified a slaughterhouse from which contaminated water was draining directly to the Chapparwada Dam, significantly impacting on the quality of water used as a source of irrigation and supply for the region. Awareness of this impact led to civil opposition, culminating the closure of the slaughterhouse.
- As one example, aquaculture could not only provide an economic basis and alternative livelihoods for use of the water of the Banas in situ, but its sustainability could be further improved though implementation of novel systems such as closed loop tanks for fish production and the selection of fish species native to the ecosystem that avoid problems commonly associated with potentially invasive species.

What is the most effective means to up-scale outreach of water wisdom across the catchment?

- There is already a wide network of institutions active across the catchment. However, these institutions currently are not well connected and coordinated. A shared vision of the regenerated Banas socio-ecological systems could form the basis for far more strategically coordinated activities across these diverse NGO, CSR, government and other bodies.
- A regulatory, River Basin Authority or other umbrella body could serve a valuable role in brokering this coordination, recognising and integrating the best intentions and potential contributions of all bodies towards the catchment regeneration vision.

What water wise solutions are geographically appropriate across the differing parts of the catchment?

- A great deal of traditional wisdom generated over five millennia is inherent in the many and diverse water management solutions found in Rajasthan (talabs, taanka, johaidi, beris, naadi, etc.), each adapted to particular localized geological and other geographic and cultural contexts.
- It is important to recognize the value of this traditional wisdom in devising solutions, and to institute governance systems that promote their continuation and restoration rather than imposing uniform 'top down' solutions.
- It is essential to reimagine how this traditional wisdom can be integrated with modern approaches in contemporary landscapes.

How might one approach sustainable sand mining, as one example of a modern intensive catchment use that is currently largely uncontrolled?

- Excessive sand mining was recognised by the groups as a major problem in the Banas catchment. Commercialisation and individual interests are the primary drivers of unauthorised sand mining.

- There is a need for a clear and transparent regulatory regime, entailing community participation and public interest, to prevent sand mining activities from causing damage to water resources and other community assets.
- Education of sand extraction industries is required to highlight potential harm to public interest from individualised over-extraction, for example in the exposure of bedrock and consequences for water flows to the Bisalpur Dam and downstream. This should ideally lead to a co-created approach to sustainable sand mining.

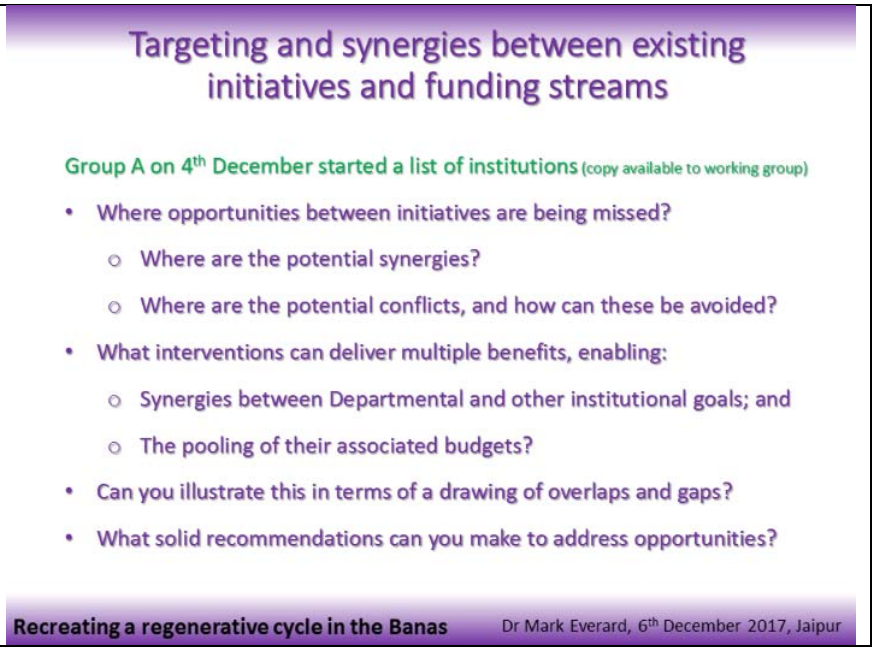
What other priority points need attention

- Better integration between rural and urban areas is a high priority. For example, in rural community areas in Bhilwara District, there is substantial water recharge activity, but wasteful uses of water in Bhilwara City largely undermine the benefits of these activities at catchment scale. Water inefficiency in Jaipur is also an example of wastage of water recharge and conservation activities across the Banas system.

Conclusion of the working group discussion

- Recognising the catchment ecosystem as the essential resource underpinning the resilience and water security of diverse human interests is crucial. This needs to be reflected not merely in theory but in practical uses of the catchment and its water in ways that sustain the supporting ecosystem.
- This ecosystem-centred vision of a sustainable Banas system needs then to inform better coordination and a common vision for communication that improves coordination between the many NGO, CSR and government initiatives operating across the Banas catchment.
- Subsidies are a significant part of the fiscal and policy environment influencing the behaviours of water users. These influencing tools should be aligned to promote sustainable use of technologies by rural, urban, irrigation and industrial beneficiaries of water in ways that balance regeneration with exploitation of the water system.

5.5.4 Targeting and synergies between existing initiatives and funding streams

The framing PowerPoint slide to promote discussion is reproduced here, followed by a note of ensuring discussions.	

Notes from ensuing working group discussion:

At present the Government of Rajasthan is implementing many schemes like the *Mahatma Gandhi National Rural Employment Guarantee Act* (MGNREGA) and *Mukya Mantri Jal Swavlamban Abhiyan* (MJSA), which are associated with augmenting water resources at rural level. Apart from this, NGOs are already engaged in such activities in the same areas for many years. In some villages, water resources development works led the local NGOs are recognized as consistent with emerging government aims.

However, there is at present a need for improved coordination between the government schemes and the often fragmented approach taken up by the various NGOs working across the catchment. As one example, during the planning and design phase of the Bisalpur Dam there were 5,000 impoundments in the upstream catchment, but today there are now an estimated 32,000 constructed by various watershed development programmes and under the MNREGA scheme. Some perceive these as reducing water inflow to the reservoir, whereas experience elsewhere in Rajasthan suggests that retaining run-off during the monsoon promotes groundwater recharge increasing overall catchment storage and reliability of flows.

Another lever for action is the Smart Cities programme project being implemented in major cities. At present, fund to support Smart Cities are not being implemented in a coordinated way, for example funding the often *ad hoc* installation of Wi-Fi services, parking spaces, etc. For example, in Udaipur, major funding is directed towards Wi-Fi systems, parking spaces and related infrastructure, but the water system is not being addressed as a priority. For example, separation of foul and storm water sewers could substantially reduce loads of pollutants and litter draining into local seasonal rivers as well as the city's characteristic lakes.

Another major Indian initiative is the *Swachh Bharat Abhiyan* (Clean India Mission), including the construction of toilets in rural areas. However, laudable though this initiative is, experts are predicting, based on the design of the compost pits, that this programme will result in severe contamination of groundwater within two or three decades.

These are higher-profile examples of the many potentially interconnecting programmes spanning different government departments as well as civil society initiatives that in some way or another have an impact on

water resources. An absolute priority is to harness the good intentions and fragmented funding of all of these schemes to contribute to a clear vision of catchment regeneration, from which multiple sectors of society will obtain benefits. In order to achieve this, there is need for some form of 'supervisory and regulatory' authority, be that a formal body such as a River Basin Authority or an informal institution such as various village governance organisations, to coordinate between different decision-making bodies as well as to reflect localised geographical and cultural conditions. This body may also be a broker for pooling, overseeing and distributing funds to initiatives that deliver the greatest benefits across the interests of different departments.

Existing initiatives in the Banas catchment to coordinate management

Two initiatives were highlighted by workshop participants where coordinated action was taking place in sub-catchments within the Banas system:

- Dr M.S. Rathore made a presentation on development of the Mashi River Basin Water Parliament, as noted in Section 5.1.3 (slides reproduced in Annex 2, Section A2.3).

- Shree Bhanwar Lal Tailor (Jan Vikas Sansthan Tilonia: JVST) subsequently highlighted development of the 'Macro socio-ecological Complex' initiative, running for a year to regenerate Masi river in the vicinity of Tilonia village (Kishangarh Tehsil, Ajmer District, Rajasthan). The Masi river supports flows in the Banas system through its overflow from Jodhpuriya Dam. This inititiave is therefore contributor to the wider mission to regenerate the Banas- Bisalpur Socio-ecological Complex', also directly beneficial for the rural populations of two additional districts. An overview of the 'Macro socio-ecological Complex' initiative in the Masi river catchment area, as supplied by JVST, is included in Annex 3.

6. Summing up workshop outcomes to date, and workshop conclusion

Dr R.L. Raina, President/Vice Chancellor of JK Lakshmipat University, joined the workshop for this concluding session.

6.1 Summing up the workshop

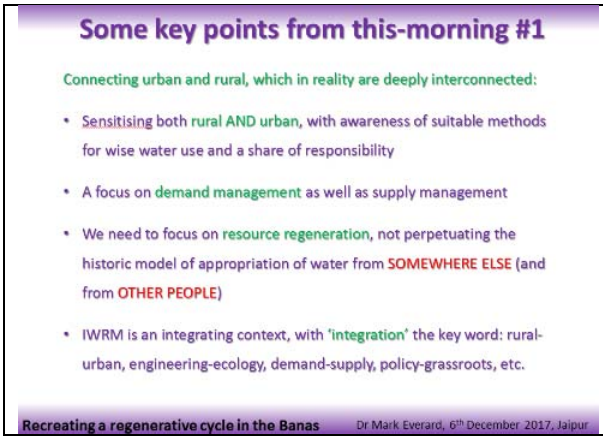
Mark Everard sought to sum up key points emerging from the workshop to date, noting that the experience of trying to succinctly capture key points from such a wide-ranging and engaged set of discussions (mainly in Hindi) felt a bit like the image to the right!

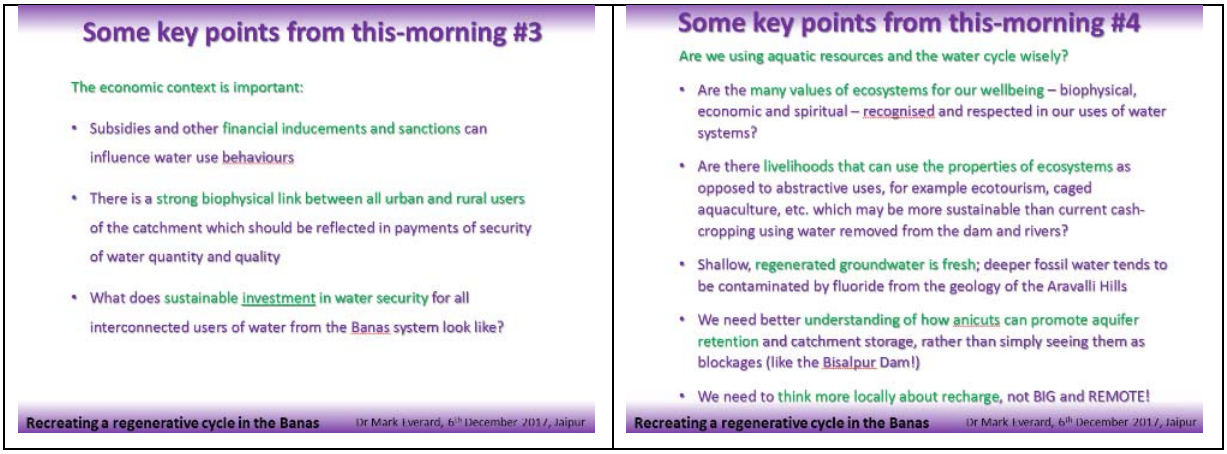
This workshop and its summary outcomes to date are a journey, not a destination, leaving us all with much work to do and a joint set of responsibilities to work together to achieve bold and visionary outcomes.

Engagement and collaboration across sectors in this work is necessary for all those interconnected by the Banas, inevitably sharing in its continuing degeneration or alternatively regeneration, but also as a 'global laboratory' finding solutions needed by the wider world.

The following slides address four generic headers of points summarised to date:

- Connecting urban and rural, which in reality are deeply interconnected;
- There are multiple influential players (NGOs, government, faith leaders, etc.) and initiatives across the catchment that could be better connected;
- The economic context is important; and
- Are we using aquatic resources and the water cycle wisely?





6.2 Key points from the Vice Chancellor, JKLU

Dr R.L. Raina, President/Vice Chancellor of JK Lakshmipat University, responded to these points, noting that we should set our findings under the broader context of:

- Communication (create awareness);
- Convergence (with other schemes of Government of India); and
- Capacity-building.

Thanking delegates for attending and contributing, Dr Raina said that the university would support this initiative in any way it could.

6.3 Concluding points from the Director, JKLU

Prof. Dr-Ing Anupam Kumar Singh, Director of JK Lakshmipat University, endorsed the sentiments of the Vice Chancellor, thanking all organisers and delegates and reiterating the support of JKLU for progressing this important initiative.

7. Synthesis of workshop findings

The four 'Dublin Principles', agreed within the Dublin Statement on Water and Sustainable Development at the International Conference on Water and the Environment (ICWE) in 1992, state that "Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment" (Principle 1). The 'Dublin Principles' also recognise the importance of the participatory approach (also Principle 2), the central role of women (Principle 3) and the economic value of water (Principle 4). Like many land-water systems, the Banas catchment has not been treated in modern times as a living resource, but rather the focus has been on abstraction of water for various uses that are putting the whole interconnected socio-ecological system into a cycle of degradation. Yet the people of Rajasthan have subsisted and thrived on scarce water for some four-and-a-half thousand years throughout pre-industrial times, innovating a diversity of recharge, storage and efficient use solutions attuned to local geography and culture. A key challenge for reversal of the currently rapidly degrading cycle in the Banas catchment, with its associated vulnerabilities for all people co-dependent on its water, is to recognise the central role played by ecosystem processes, which constitute the primary resource underpinning future human security and opportunity. Above all, the tight interlinkage between all people co-dependent on the catchment system needs to be recognised within a collaborative approach to balance water use with recharge, regenerating the entire socio-ecological system.

Beyond this general, high-level message from the Jaipur workshop, further key points are stratified below using the STEEP (social, technological, environmental, economic, political) framework, which has proven valuable for systemic analysis of issues and potential solutions in the Banas system.

7.1 Social considerations

At low, pre-urbanised population densities and distribution, the fragmentation of communities across the Banas catchment was not problematic. However, significant population growth and interactions between the users of land and water in the catchment creates greater pressures and potential conflicts. This resource conflict is intensified by the clustering of people in cities, particularly given power asymmetries between urban and rural economies that has seen water appropriated to Jaipur City and other urban centres from across the catchment and beyond, to the detriment of the rights of local people and catchment ecosystems.

Other major social changes are seen in the abandonment of community collaboration, as important a constituent as physical structures in traditional 'water wise' solutions, in favour of individualised and often competitive extraction of water. The progressive erosion of traditional knowledge, particularly as younger people migrate out of villages to pursue urban lifestyles, also breaks the historic awareness of the need to balance water system recharge from monsoon rainfall with exploitation. A skewed contemporary focus on technically efficient water extraction without balancing recharge erodes the overall water system, which constitutes the fundamental natural resource underpinning the security and prospects of all co-beneficiaries (or victims if depleted) of the catchment system.

Mohandas K Gandhi advised that, in all decisions, one should always consider "…the man at the end of the queue". Social equity in access to water is also a priority in considering regeneration of the socio-ecological Banas system. This must be tackled sensitively, to avoid reinforcing or creating a 'dependency' culture.

Urban-rural power asymmetries that have manifested in previous water appropriation need serious review. The renewed focus on regeneration of the natural capital of catchment ecosystem services underpinning the needs of all constituencies needs to inform serious enquiry about its more equitable sharing.

Redressing this asymmetry also relates to education, both formal and informal. Workshop delegates agreed that urban dwellers generally lacked awareness of where their water comes from, and so were disconnected from a sense of natural limits and accountability for use and overuse of piped supplies. Whilst significant focus was given to support, education and water efficiency advice to rural people, who are already generally more aware of the water systems on which they depend, far less effort is expended on promoting water efficiency in urban areas despite the fact that urban residents and economies are the most intensive users of water. Better influence of water efficient behaviours and more water-efficient infrastructure in urban centres is therefore seen as a priority, reflecting their disproportional impact on overall catchment water demand.

Shared awareness and responsibility by all people across the catchment is essential if a more integrated approach to catchment sustainability is to be achieved. Current fragmentation of institutions (of all types) means that data and knowledge (also of all types) is also not coordinated, yet there is a wealth of information that could be better integrated to inform sustainable decision-making. NGOs and village governance institutions were seen as key agents in social mobilisation for change, with faith leaders also influential and possibly demanding greater focus of attention to broker sustainable change. Ultimately, all constituencies – rural, urban, irrigation, ecological and wildlife-dependent – run common risks from declining water availability and rising pollutant levels, particularly rising fluoride and other geological contaminants. A common focus on water use efficiency between rural and urban constituencies is one of many areas of shared responsibility for the increasingly sustainable co-management of the Banas system, responding to changed and still-changing lifestyles and needs. Novel ideas include limiting water diversions from the Bisalpur to the city of Jaipur, quantitatively or on a time-limited basis, as a means to force greater awareness and self-reliance on local urban sources (such as investment in infiltration pits and local storage) and 'green infrastructure solutions (rooftop water harvesting, greywater reuse, etc.) to redress power asymmetries and assumptions, and to promote urban self-sufficiency. Part of this refocusing includes awareness of the benefits of investment in natural and traditional water capture and storage processes in the catchment upstream of the dam as a contribution to sustainable water supplies both for the city and the region from which it draws its water.

7.2 Technological considerations

Technology itself is value-neutral, be that ecosystem-based or 'hard' engineering. However, technology deployment has far wider, often unrecognised equitable, environmental and economic consequences. Traditional water management was attuned to often highly localised geographical and cultural conditions, adapted for example to slope, soil permeability, bedrock depth, underlying groundwater condition, local needs, cultural preferences and other parameters. These solutions worked with natural processes to augment the pre-existing 'natural infrastructure', for example though accelerated recharge of shallow groundwater and soil moisture.

By contrast, the proliferation of unlicensed tube wells and mechanised pumps has played a key role in depressing groundwater levels as well as accessing deep groundwater that may be replenished at rates far more slowly than exploitation rates and which is commonly geologically contaminated. Dam-and-transfer

schemes, ranging from the large Bisalpur Dam to impoundments of varying sizes across the Banas catchment, also often skew the focus from a balance between recharge and use of water, towards a narrower focus on water exploitation alone that tends to result in resource depletion. Above all, a water resource model narrowly based on mechanically efficient exploitation, depletion and eventual abandonment in pursuit of more remote sources (as for example Jaipur City rendering unusable its local sources, then those of the Ramgarh Dam to the north east and now progressively the Bisalpur Dam 120km to the south west) is clearly unsustainable and needs to change to address the regeneration of the source system to balance demand.

This is not an outcome that can be achieved by mechanised technologies alone, but rather can only be achieved by a sustainable hybridisation of both engineered and ecosystem-based technologies. In essence, how should traditional water wisdom be reinterpreted in the modern world? How can recharge using infiltration enhancement techniques that work with natural processes rebuild catchment water balance, thinking of the catchment as a whole, integrated system? Also, at a more local scale, how may recharge solutions be integrated self-beneficially at village scale whilst delivering benefits at scales that are both localised (greater local water security) and wider catchment (overall contribution to basin-scale quality and quantity)? These measures could reduce demands on, but also increase the capacity of exploitable resources in, the water system. Cumulatively, this would reduce pressures currently contributing to receding, contaminated groundwater and depleted surface water flows and soil moisture.

There is a need to promote water efficiency amongst all users of the Banas system, rural and urban alike. Water-efficient technologies are commonly advised in rural areas, for example trickle or spray irrigation in place of flood irrigation and the use of water-efficient crops. These technical measures can make significant savings on water. However, roof water harvesting, automated pump control technologies, low-flow taps and domestic water systems are also required in urban areas, which consume the greatest amount of water. Techniques for wastewater reuse and adequate treatment can also make significant contributions to reducing overall urban demands on catchment resources.

One issue that needs research is the impact of the many small anicuts across the diverse sub-catchments of the Banas system. Some documentation assumes that water retained in anicuts reduces flows filling the Bisalpur Dam. However, workshop delegates were of the opinion that these and related structures encourage infiltration and consequently the recharge of groundwater, resulting in improved buffering of surface/groundwater flows and quality in the river system at broader scale. ‘Blue’ (surface), ‘green’ (within landscapes) and groundwater are highly interactive, all contributing to the quantity and quality of water flows and availability, and so should be considered in an integrated way in technology deployment.

7.3 Environmental considerations

Surface, shallow groundwater that tends to be fresh and can be readily replenished, and deeper, potentially non-renewable and often geologically contaminated water resources, may be interlinked but behave differently and need to be addressed in different terms. However, they collectively constitute the primary natural capital supporting ecological quality, now fragmented, and human wellbeing including poverty alleviation. Surface and shallow groundwater in the Banas system are currently degraded both in quantity and quality, reducing the capacity of the catchment to continue supporting human livelihoods and progress.

Ecological processes performed by this natural capital and their contributions to human security and wellbeing are poorly appreciated, with an emphasis on extractive uses of water rather than valuation of the ecosystem services provided by the water system itself. Reversing the current declining cycle in the Banas is an absolute priority, achieving in its place a regenerative socio-ecological cycle to underpin future sustainability. Rebuilding ecosystem vitality rather than merely slowing or halting its decline is essential, reflecting both the need to restore damage already inflicted but also to provide increasing resilience to cope with the changing climate and increasing population.

Valuing, protecting and restoring catchment ecosystem services also increases their capacities to support wellbeing into the future, rather than perpetuating the recent destructive, broken model of depleting, abandoning and then appropriating alternative, generally increasingly remote water resources. Natural capital important for recharge of water resources, for example wetlands and forests but also other important natural assets not currently recognised as such, needs to be valued for its functional services and not merely extractive and inherent values, and to be better understood, safeguarded or restored as the core resource recharging the water system.

It is important to recognise that replenished ecosystems provide many ecosystem services beneficial to a wider range of ecological and human needs, whereas abstracted water, depriving aquatic systems, tends to serve single or narrow uses with many negative externalities for depleted ecosystems.

7.4 Economic considerations

Current water-related markets in the Banas catchment tend to be based on activities relating to abstraction of water from the system, such as diversion for urban economies and irrigation using manufactured channels as well as the 'virtual water' exported with cash crops and market commodities, rather than valuing water in situ. Novel economic uses providing alternative livelihoods that make use of water in the system might include potentially profitable recreational angling, aquaculture both caged within the Bisalpur Reservoir and in adjacent pumped systems ideally using native species to prevent issues stemming from invasive organisms. Other economic uses of water in the system could include using the river for conveyance to regions where irrigated agriculture is carried out, such that vitality of the river and economic activities (e.g. fisheries) can be carried out as the water flows to the area where it is abstracted for irrigation.

Water naturally cycles, and catchment processes are part of this cyclic behaviour. However, water today is abstracted from the catchment for urban use without a cyclic flow of payments to support management sustaining flows of water. Substantial investment is made by Jaipur and other cities in the increase of dam height, abstraction and transport of water from the Bisalpur Dam, but this will in future be a poor investment if the reservoir continues to fail to fill and to increase in contaminant concentration. A more sustainable, longer-term basis for investment in urban water security is promotion of source recharge, for example though subsidies and other 'payments for ecosystem services' (PES) approaches that connect downstream urban users with upstream rural 'providers' in a cyclic economic manner reflective of cyclic ecosystem processes. A great deal more research is required, involving academic, policy and stakeholder groups, to develop a practical, operable and acceptable financial model. However, with options limited geographically and by distributional equity issues increasing in profile, perpetuating the historic, manifestly unsustainable 'appropriate-exploit-deplete-abandon and move on' model is subject to increasing scrutiny. The most economically sustainable approach would appear to be learning from traditional wisdoms and

practices, balancing the regeneration of resources with exploitation for sustainable supply rather than sinking investment in extraction of declining resources.

The economics of water use therefore require review, removing perverse incentives and bringing economic flows closer to the natural flows of water including interactions between upstream and downstream. Some users pay nothing, or else a flat tariff for unlimited access, providing no incentive for water efficiency. Rising tariffs that make basic water needs affordable whilst charging more for luxury uses provide one mechanism to control demand, and could usefully be investigated and developed across the Banas catchment particularly in urban and other high demand areas. State water policies also refer to prioritisation of water allocation to address a range of needs (human drinking water, livestock drinking water, domestic-commercial-municipality, agriculture, power generation, industrial, cultural and others). These remain to be implemented in practice, but could lead to more economically efficient uses of water, also attracting different tariffs. The economic and wider ecological ramifications of activities such as sand and marble mining also need to be explored better to balance private profit-taking with public costs arising from water depletion and contamination.

Substantial investment is already made in the catchment. In addition to CSR, NGO and other local initiatives, government programmes span support for rural economic development, water resources, fisheries, biodiversity, agriculture and other policy priorities. Often, this funding is fragmented, both geographically and in addressing issues in isolation. If there is a consensual vision of regeneration of the Banas as an integrated socio-ecological system, rooted in restoring the currently depleted water system, this may form a basis for cost-effectively pooling currently disparate budgets into measures that can contribute to multiple, interconnected outcomes. For example, recharged shallow groundwater can, and has been observed to (for example in catchments restored under the promotion of the NGO Tarun Bharat Sangh in Alwar District), regenerate water systems including access to water closer to people's homes, improve agricultural production and hence food and economic security, empower women freed from the drudgery of collecting water from remote sources, and restore sources of natural medicines amongst other benefits. A systemic, connected approach to investment focused on restoration of the primary natural resource underpinning multiple economic outcomes can offer optimal value for money.

7.5 Political (governance systems) considerations

On the one hand, catchment-wide vision and coordination of activities is required if diverse stakeholders are to be brought together and the dynamics of the catchment as a whole are to be reflected in coordinated action. On the other hand, successes with catchment regeneration, as well as the long-term sustainability of Rajasthani communities over four-and-a-half thousand years of pre-industrial history, has be founded on collaboration around often highly localised geographically and culturally adapted solutions. Furthermore, localised solutions across the catchment have to be self-beneficial for the local people who are key actors in implementing and maintaining them. This calls for nested, multi-scalar governance arrangements. Top-down enforcement of monolithic policies, however well-intentioned, tend to drive uniform technical solutions that may be neither effective nor accepted.

The role of the state, or other higher-level coordination reflective of catchment-scale processes, therefore needs to be enabling and informing rather than enforcing. This provides an 'umbrella' to hold a consensual vision of a regenerated Banas socio-ecological system, within which the disparate CSR, NGO, local, faith leader and government programmes (MGNREGA, Smart Cities, *Swatchh Bharat Abhiyan*, MJSA, and many

more departmental initiatives) can be better coordinated. 'Top down' and 'bottom up' approaches both have a role to play but, much like the potential roles of both ecosystem-based and 'hard' engineering solutions, needing to be developed on a synergistic basis to contribute optimally to catchment sustainability. For example, 'top down' regulation to drive uptake of roof water harvesting in urban areas, to address leakage of water on conveyance and to prevent encroachment on functionally important habitat may be essential, but village-scale water recharge and water-efficient crop solutions are best innovated using local knowledge and under local governance. This coordination of initiatives includes breaking down 'silos' within government, such that programmes and associated budgets can be pooled to address multi-beneficial solutions, rather than narrow interventions focused only on specific outcomes. This type of approach is implicit in Rajasthan's *Mukhya Mantri Jal Swavlamban Abhiyan* (MJSA) programme.

Reiterating the sentiment of Gandhi to always consider "…the man at the end of the queue", governance systems have to make space for the least powerful in society, particularly landless people who may not have any direct control of water resources, and to balance out historic power asymmetries. This more equitable approach may challenge vested interests, but in a depleting catchment it should be made clear that all catchment co-beneficiaries will ultimately only lose if the supporting ecosystem continues to decline.

7.6 Systemic outcomes

The above synthesis, stratified from workshop learning around the STEEP framework, above all highlights the need to bring people together across the catchment and to found actions on the dynamics of the supporting catchment ecosystem. This includes finding appropriate means for deploying ecosystem-based and 'hard engineering' technologies, obtaining enduing economic value, and developing governance systems enabling a collaborate approach with catchment regeneration.

It is clear that' business as usual' is not an option, and can only lead to continuing ecological decline and associated human hardship. Plans are, apparently, afoot to draw in water from even further afield, through the ecological, ethical and economic sustainability of this narrowly exploitative and technocentric approach are now highly questionable. It could be that there is now no viable nor sustainable alternative than acting upon what we now know about the systemic nature of catchments, and refocusing energies, investment and innovation on an ecosystem- and community-based regeneration programme for the Banas socio-ecological system.

7.7 Consensus and next steps

The following points emerge from workshop sessions as issues of consensus and/or for further development:

- Delegates saw substantial value in bringing people together from a diversity of societal sectors associated with the catchment, welcoming this and future opportunities to share perspectives and co-create sustainable solutions.
- There is a pressing need to change paradigm from narrowly short-term exploitation leading to the depletion of water and associated ecological and human wellbeing, towards more informed and strategic stewardship with efficient uses balanced with resource protection and regeneration.

- Ecosystems and their processes are the fundamental resource underpinning human wellbeing, and need to be regarded and valued on that basis.
- A vision of a regenerative socio-ecological Banas system may present daunting challenges, but is focal for progressive innovation, evolution and integration of initiatives, founded on getting as close as possible to the baseline of natural catchment functioning and sustainable human interactions with it.
- Wise water management needs to integrated, addressing: (1) the fundamental value of natural processes at catchment scale; (2) traditional wisdom in water management reinterpreted for modern conditions; (3) 'green' engineering; all hybridised with important (4) 'hard' engineered infrastructure necessary for supporting urban and other centres of high demand.
- Integration is also necessary between social (different communities), technological (appropriate for the sustainable support of needs), environmental (working with and ensuring maintenance of natural resources and processes), economic (appropriate economic instruments) and political (effective nested governance) facets of the socio-ecological system.
- Far better connections between urban and rural regions are required, including better education of urban people about water dependencies and efficiency and the recirculation of investment in water services to those active in regenerating groundwater upstream in the river.
- Reconnection of urban users with wise stewardship, equitable sharing and investment in catchment water resources is essential. This can form a significant element of a Smart Cities vision securing sustainable water supplies through greater urban self-sufficiency (e.g. roof water harvesting, water efficient applications, greywater reuse, etc.) reducing demands from elsewhere in the catchment, as well as investment in replenishment of catchment-scale resources as an economically efficient approach to water security.
- A great deal of learning and innovation (recognition of broad-scale linkages between stakeholders, reinterpretation of traditional wisdoms in modern village settings, better understanding of groundwater processes, novel economic instruments, etc.) is necessary to work towards a vision of a regenerative socio-ecological system in the Banas catchment. This is most usefully progressed through 'action research', drawing on knowledge from multiple stakeholder groups involved in the research and with a focus on delivery of integrated and consensual solutions. Diverse areas for priority research include biophysical studies where knowledge is missing (better understanding of natural and anthropogenic flows of water across the catchment above and below ground and through society, how small upstream anicuts interact with flows to large dams and downstream users, etc.) as well as linked social, economic, technological and policy-informing research.
- There is broad consensus about the need to work towards a vision of a Banas catchment with regenerated natural processes, including water. This vision needs to be given further substance as a basis for developing practical steps towards its longer-term attainment.
- Many excellent strategies (Smart Cities, MGNREGA, MJSA, Swachh Bharat Abhiyan, etc.) are already in place, backed up by programmes at sub-catchment scale (such as the Masi-Bandi River Parliament initiative, the 'Macro Socio-ecological Complex' initiative in the Masi River catchment area) and a variety of local CSR and NGO-led initiatives. Greater synergies and co-learning could be brokered to maximise the impacts and outreach of these initiatives.

- This Banas programme of working towards a regenerative socio-ecological vision is important for all its co-dependents, now and into the future, but is also genuinely a 'global laboratory'. Learning here will be valuable for all global regions facing challenges related to water stress today, and also represents a paradigm change necessary to underpin sustainable development for all of global society in an increasingly populated, climate-changing and resource-depleting world.

In effect, seeking security at whole-catchment scale does not differ from successes already achieve (by Tarun Bharat Sangh, Reliance Foundation and others) in achieving village and small sub-catchment scale security, other than matters of spatial scale and societal complexity. The same principles of a common awareness and vision of co-dependence on a common resource, collaborative governance to balance resource regeneration with exploitation, involvement of all stakeholders, and a governance system to secure differential responsibility for overall system sustainability apply equally, albeit within a more complex socio-political context. The tools for building such a functioning socio-ecologically sustainable vision are therefore already available. The next steps, that we will take together, are to develop them into a working model for the long-term security and opportunity of all.

Annex 1: Attending and corresponding members

A1.1 Attending the workshop

- Dr Mark Everard, University of the West of England (UWE Bristol), UK (mark.everard@uwe.ac.uk)
- Prof. Dr-Ing Anupam Kumar Singh, JKLU Jaipur, India (prof.anupamsingh@gmail.com)
- Mr Om Prakash Sharma, WaterHarvest – India Office Udaipur, India (om.waterharvest@gmail.com)
- Dr Jitendra Kumar Singh, JKLU Jaipur, India (jitendrakumarsingh@jklu.edu.in)
- Prof. Vinod Kumar Vishwakarma, JKLU Jaipur, India (vinodvishwakarma@jklu.edu.in)
- Prof. Amit Kumar, JKLU Jaipur, India (amitkumar@jklu.edu.in)
- Mr Sunil Shrivastava, Reliance Foundation, Mumbai, India (Sunil.Shrivastava@reliancefoundation.org)
- Mr Nitin Sharma, Reliance Foundation, Rajasthan (Nitin.Sharma@reliancefoundation.org)
- Dr Deepti Sharma, University College of Law, MLSU, Udaipur (envirolegal@gmail.com)
- Mr Adrian Pinder, Bournemouth University in association with the Mahseer Trust, UK (apinder@bournemouth.ac.uk)
- Prof. M S Rathore, Director, Centre for Environment and Development Studies (CEDSJ), Jaipur (msr@cedsj.org; T: 09414061241).
- Mr Bhanwar Lal Tailor, Jan Vikas Santhan, Tilonia, distt. Ajmer (jvstilonia04@gmail.com)
- Mr Somendra Sharma, WaterHarvest – India Liaison Office, Udaipur (somendra.waterharvest@gmail.com)
- Sh. Kedar Prasad Shrimal, Gramodya Sanathan (gramodaya_sansthan@rediffmail.com)
- Sh. Satynarayan Gupta, Sawsahyog Snathan (swasahyogsanstha@gmail.com)
- Mr Rajendra Singh, KGVS (kagvs@rediffmail.com)
- Mr Bansi Bairwa, Prayas Kendra Santhan (prayas.ks@gmail.com)
- Mr Manoj Agarwal, Ambuja Cement Foundation (manoj.agarwal@ambujacement.com)
- Mr Maulik Sisodia, Tarun Bharat Sangh (mauliksisodia@gmail.com)
- Mr Kanhaiya Puri, Grameen Vikas Shodh Avam Takniki Kendra (gvstk.malpura@yahoo.com)
- Mr Sarvendra Kumar, Jaipur Bloc (see the website http://jaipurbloc.com/)
- Dr Suraj Kumar Singh, Suresh Gyan Vihar University, Jaipur (suraj_rsgis@yahoo.co.in)
- Mr Vikrant Singh Bhandari, JK Lakshmipat University, Jaipur (vikrant02nov@gmail.com)
- Mr Aayush Bansal, JK Lakshmipat University, Jaipur (aayushbansal101@gmail.com)
- Mr Jaspal, JK Lakshmipat University, Jaipur (jaspaldhanjal1993@gmail.com)
- Mr Keshav Mundra, JK Lakshmipat University, Jaipur (keshavmundra04@gmail.com)
- Mr Neeraj Lunawat, JK Lakshmipat University, Jaipur (nandit.jain2010@gmail.com)
- Mr Nikhil Jhanwar, JK Lakshmipat University, Jaipur (nikhinjhanwar@jklu.edu.innikhiljhanwar@jklu.edu.in)
- Mr Sagar Mewara, JK Lakshmipat University, Jaipur (sagarmewara@gmail.com)
- Mr Arum Kumawat, Navachar Sansthan, Chittorgarh (navacharngo@gmail.com)
- Mr Jagveer Singh, Gram Vikas Navyuvak Mandal Laporiya, (jagveer@gvnml.org)
- Mr Ramratan Jangid, Gramodya Sanathan (gramodaya_sansthan@rediffmail.com)
- Mr Satya Narayan Gautam, Swa- Sahyog Sanstha (swasahyogsanstha@gmail.com)

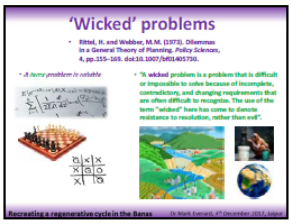
A1.2 Unable to attend by corresponding

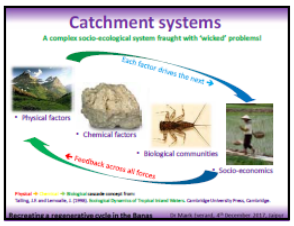
- Dr Deep N Pandey, Additional Principal Chief Conservator of Forests (Soil Conservation), Jaipur, India (dnpandey@gmail.com)
- Mr Rahul Bhatnagar, Chief Conservator of Forests, Udaipur, India (rahulbudr@yahoo.co.in)
- Dr Ritesh Kumar, Wetlands International, Delhi, India (ritesh.kumar@wi-sa.org)
- Prof. Chad Staddon, UWE, UK (Chad.Staddon@uwe.ac.uk)
- Dr Pradeep K Singh, College of Technology and Agriculture Engineering (CTAE), Udaipur, India (pksingh35@gmail.com)
- Prof. A B Gupta, MNIT, Jaipur (akhilendra_gupta@yahoo.com)
- Dr S P Chaurasia, MNIT, Jaipur (spchaurasia.chem@mnit.ac.in)
- Mr Brajesh Tomar, Ambuja Cement Foundation (brajeshsingh.tomar.ext@ambujacement.com)
- Ms Laura Turley, University of Geneva, Switzerland (Laura.Turley@unige.ch; laura.e.turley@gmail.com)
- Dr Anil Kashyap, University of Western England Bristol, UK (Anil.Kashyap@uwe.ac.uk)
- Dr V Joshi, Jaipur Integrated TexCraft Park Pvt Ltd (md@jaipurbloc.com)
- Prof. Eldho T.I., Dr TI Eldho, IIT Bombay, Mumbai, India (eldho@civil.iitb.ac.in)
- Prof. Chris A Scott, University of Arizona, USA (cascott@email.arizona.edu)
- Mr Neil Mehta, WaterHarvest, UK (nmehta@water-harvest.org)
- Mr Ravindranath Rangoori, Reliance Foundation, Mumbai, India (Ravindranath.Rangoori@reliancefoundation.org)
- Dr Anjan K Prusty, Gujarat Institute of Desert Ecology (GUIDE), Bhuj, India (anjanguide@gmail.com)
- Mr Yogesh K Sahu, Field Director, Ranthambhore Tiger Reserve, Sawai Madhopur, Rajasthan, India (yksahu@yahoo.com)
- Dr Dharmendra Khandal, Tiger Watch, Sawai Madhopur, India (dharmkhandal@gmail.com)
- Dr Ashgar Nawab, WWF-India, New Delhi, India (anawab@wwfindia.net)
- Dr Vivek Kumar, IIT Delhi, India (vivekk@iitd.ac.in)
- Ms. Pratiti Pridarshni, Foundation for Ecological Security (fes.udaipur@gmail.com)

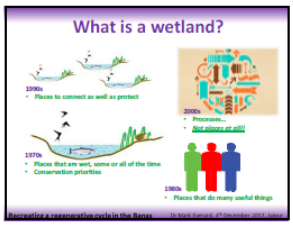
End of Annex 1

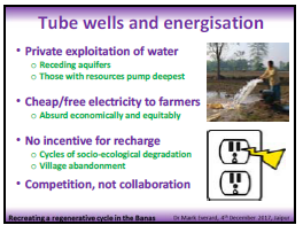
Annex 2: Thumbnail' presentations from Session 1

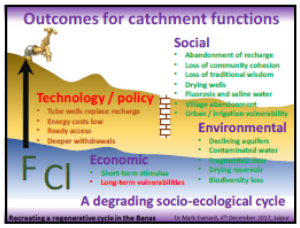
A2.1 Key findings of the Everard *et al*. (2018) Banas catchment study: Dr Mark Everard

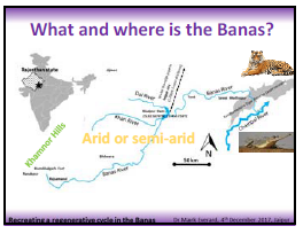


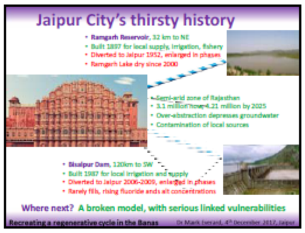


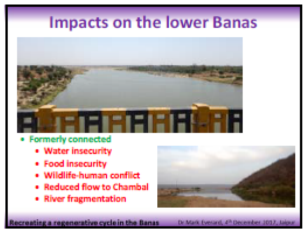


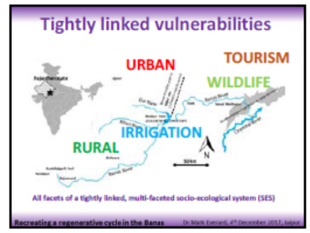


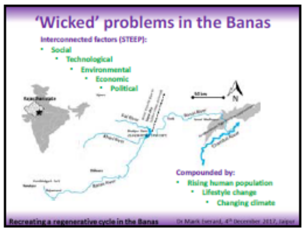




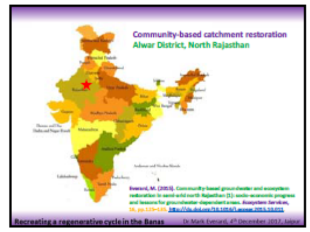

Jaipur City's thirsty history
Ramgarh Reservoir, 32 km to NE
Built 1897 for local supply, irrigation, fishery
Diverted to Jaipur 1952, enlarged in phases
Ramgarh Lake dry since 2000
Semi-arid zone of Rajasthan
3.1 million now, 4.21 million by 2025
Over-abstraction depresses groundwater
Contamination of local sources
Bisalpur Dam, 120km to SW
Built 1987 for local irrigation and supply
Diverted to Jaipur 2006-2009, enlarged in phases
Rarely fills, rising fluoride and salt concentrations
Where next? A broken model, with serious linked vulnerabilities
Recreating a regenerative cycle in the Banas
Dr Mark Everard, 4th December 2017, Jaipur


Impacts on the lower Banas
Formerly connected
Water insecurity
Food insecurity
Wildlife-human conflict
Reduced flow to Chambal
River fragmentation
Recreating a regenerative cycle in the Banas
Dr Mark Everard, 4th December 2017, Jaipur


Tightly linked vulnerabilities
URBAN
TOURISM
WILDLIFE
IRRIGATION
RURAL
N
All facets of a tightly linked, multi-faceted socio-ecological system (SES)
Recreating a regenerative cycle in the Banas
Dr Mark Everard, 4th December 2017, Jaipur


'Wicked' problems in the Banas
Interconnected factors (STEEP):
Social
Technological
Environmental
Economic
Political
N
Compounded by:
Rising human population
Lifestyle change
Changing climate
Recreating a regenerative cycle in the Banas
Dr Mark Everard, 4th December 2017, Jaipur


What we'll cover today...
Welcome and background
'Wicked' problems, catchments and wetlands
Trends in Indian water management
Trends in the Banas catchment
Community-based regeneration in Rajasthan
Upscaling co-benefits in the Banas catchment
Recreating a regenerative cycle in the Banas
Dr Mark Everard, 4th December 2017, Jaipur


Community-based catchment restoration
Alwar District, North Rajasthan
Recreating a regenerative cycle in the Banas
Dr Mark Everard, 4th December 2017, Jaipur


Recreating a regenerative cycle in the Banas
Dr Mark Everard, 4th December 2017, Jaipur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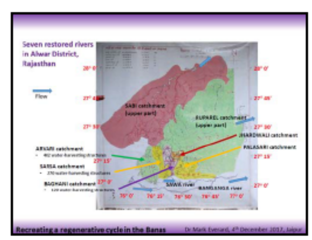
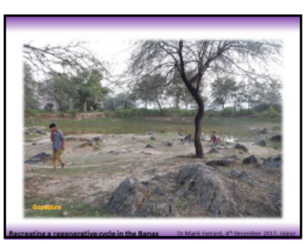
Dr Mark Everard, 4th December 2017, Jaipur

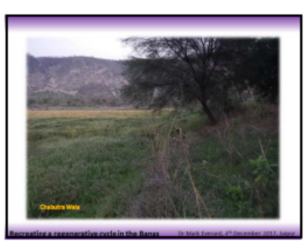

Recreating a regenerative cycle in the Banas
Dr Mark Everard, 4th December 2017, Jaipur


तरुणजल विद्यापीठ
TARUN BHARAT SANGH
Recreating a regenerative cycle in the Banas
Dr Mark Everard, 4th December 2017, Jaipur

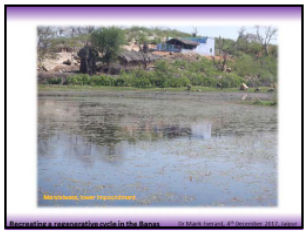

Recreating a regenerative cycle in the Banas
Dr Mark Everard, 4th December 2017, Jaipur

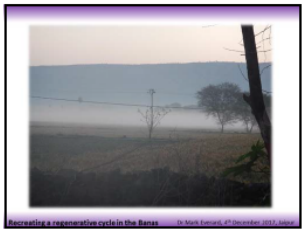

Seven restored rivers
in Alwar District,
Rajasthan
Flow
SABI catchment
(upper part)
RUPAREL catchment
(upper part)
JHAROWALI catchment
PALASARI catchment
ARVARI catchment
SARSA catchment
BAGHANI catchment
SAWA river
BANGANGA river
28° 0'
27° 45'
27° 30'
27° 15'
27° 0'
76° 0'
76° 15'
76° 30'
76° 45'
77° 0'
Recreating a regenerative cycle in the Banas
Dr Mark Everard, 4th December 2017, Jaipur


Gopalpura
Recreating a regenerative cycle in the Banas
Dr Mark Everard, 4th December 2017, Jaipur


Chabutra Wala
Recreating a regenerative cycle in the Banas
Dr Mark Everard, 4th December 2017, Jaipur


Recreating a regenerative cycle in the Banas
Dr Mark Everard, 4th December 2017, Jaipur






What we'll cover today...
• Welcome and background
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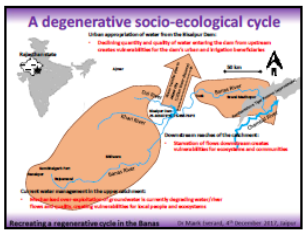
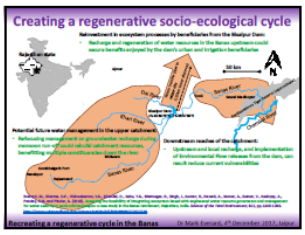
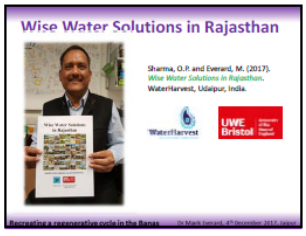

A degenerative socio-ecological cycle


Creating a regenerative socio-ecological cycle

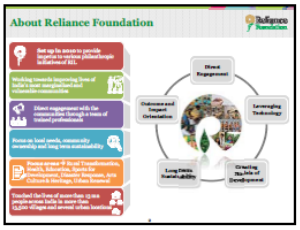

'Big picture' solutions
STEEP:

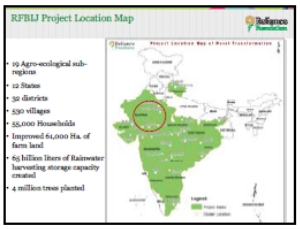

Wise Water Solutions in Rajasthan
Sharma, O.P. and Everard, M. (2017). Wise Water Solutions in Rajasthan. WaterHarvest, Udaipur, India.

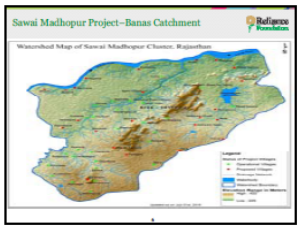

Further reading

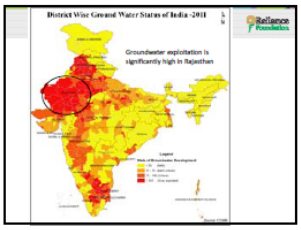

Reversing the cycle:
Recreating a regenerative socio-ecological cycle in the Banas catchment in semi-arid Rajasthan, India
Dr Mark Everard
Associate Professor of Ecosystem Services, UWE Bristol

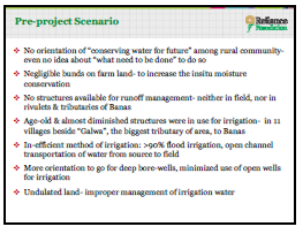
A2.2 Reliance Foundation initiatives, particularly in Rajasthan: Sunil Shrivastava

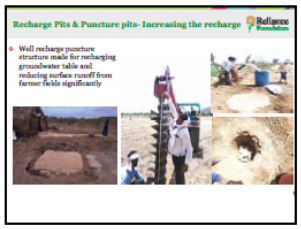


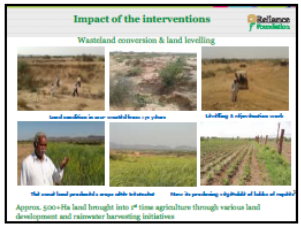


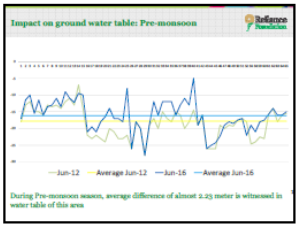


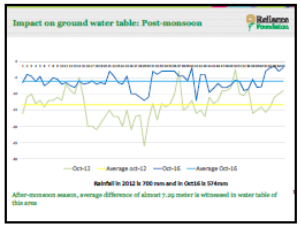








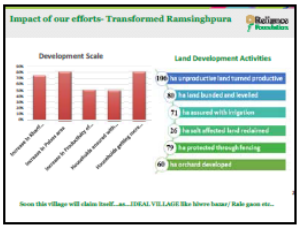


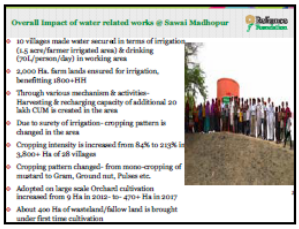


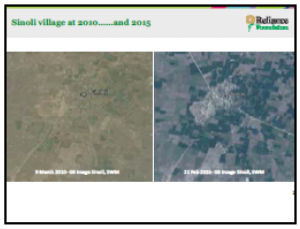

Enhancing agriculture income- Securing crops through Fencing
Total 900+Ha land got fenced through wire mesh fencing material
Kharif crop increased from just 265 Ha to 916 Ha increased cropping intensity
Total income from this land increased from 2.83 crore to 11.36 crore
Per Ha income increased from Rs.32, 490 to Rs.1.24 lakh
Requirements for basic living must be met first- then rest of security matters...


Cropping scenario changed- Orchards are preference now
Orchard area increased from 9 Ha to 470+ Ha in program villages
In first production season, farmers earned Rs.2.41lah/Ha from fruit selling
Potential of additional income of Rs.200 million is established in the area
Sustainability of increased income was equally important- Farming will be first profession someday..


Change in Cropping Pattern is Brining Prosperity – Case study of Ramsinghpura
This has changed the overall Socio-economic scenario of village..


Impact of our efforts- Transformed Ramsinghpura
Development Scale
Land Development Activities
ha unproductive land turned productive
ha land bunded and leveled
ha assured with irrigation
ha salt affected land reclaimed
ha protected through fencing
ha orchard developed
Soon this village will claim itself...as...IDEAL VILLAGE like hivre bazar/ Rale gaon etc..


Overall impact of water related works @ Sawai Madhopur
10 villages made water secural in terms of irrigation (1.5 acre/farmer irrigated area) & drinking (70L/person/day) in working area
2,000 Ha. farm lands ensured for irrigation, benefitting 1800+HH
Through various mechanism & activities- Harvesting & recharging capacity of additional 20 lakh CUM is created in the area
Due to surety of irrigation- cropping pattern is changed in the area
Cropping intensity is increased from 84% to 215% in 3,800+ Ha of 38 villages
Cropping pattern changed- from mono-cropping of mustard to Gram, Ground nut, Pulses etc.
Adopted on large scale Orchard cultivation increased from 9 Ha in 2012- to- 470+ Ha in 2017
About 400 Ha of wasteland/fallow land is brought under first time cultivation

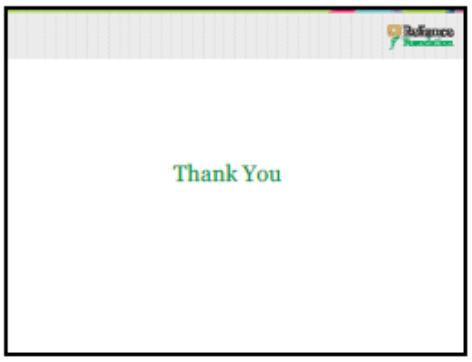

Sinoli village at 2010.....and 2015


Wasted land converted to irrigated agriculture land@ Jharkund Village 2012..... and 2015


Landuse/cover change in Jagmoda village from 2010 to 2015


Barren lands now have orchard!!, after secured irrigation @ Balaria Village


Community water Harvesting Structures
65 billion liters water harvesting capacity created


Thank You

A2.3 Masi-Bandi River Parliament initiative: Dr M.S. Rathore

MASHI RIVER BASIN WATER PARLIAMENT, RAJASTHAN, INDIA

Dr. M.S. Rathore

Centre for Environment and Development Studies, Jaipur, India

November 28, 2016, Bangkok

Water Governance

- Multi-dimensional challenges in Water Resources management
  - Growth in population, increased economic activity and improved standard of living lead to increased competition for and conflicts over limited fresh water resources.
  - Water management has moved from the sectoral approach to an integrated approach
  - In most countries water sector reforms are being carried out, governance and management needs more attention than water augmentation and access

Water Governance (Cont…)

- No single definition of governance and therefore, different approaches need to be followed.
- Some may see governance as questions of financial accountability and administrative efficiency while other may focus on broader political concerns related to democracy and human rights and participatory process.

Water Resource Management Approaches

- Treat water as a purely public good, to be managed by the government / public sector.
- Water sectors to be privatized to achieve better management and efficiency.
- Water a common pool resource. Government should act as a referee among interest groups - local as well as external (e.g. creditors and donors) and manage water resources as Trustee.
- Community based integrated management approach (Decentralized participatory approach) .

Approaches (Cont…)

- **The Techno-economic Approach**
- **The Integrated River Basin Management (IRBM) approach**
- **The IWRM Approach**

Approaches (Cont…)

- From top-down supply-driven approaches to bottom-up demand-driven approaches.
- These changes require improvements to water governance systems that include: more effective stakeholder dialogue, better vertical and horizontal sharing of information amongst stakeholders, conflict resolution at a range of different scales and planning procedures that are based on a vision that is common to relevant stakeholders.

Water Sector reforms in India

- India has a highly seasonal pattern of rainfall, with 50% of precipitation fall in just 15 days and over 90% of river flows in just four months. IPCC report indicates that in India water scarcity is going to become widespread in a future. (Indicators of stress)
- The conventional model of water resources management is based on **policies**, **laws and regulations** and **governance systems** or institutional framework of management.
- Status of Water resources has forced to go for reforms

Need for Reforms

- Inefficient surface water management
- Over-abstraction of groundwater
- Conflict between/among multiple users

Reform Actions

- The XII Five Year Plan - major paradigm shift in management of water resources in India.
- Institutional reforms
  - Establishment of basin authorities
  - Independent statutory water regulatory authority set up for each state- for appropriate pricing of water.
  - A permanent water disputes tribunal at the centre

Reform Actions (Cont…)

- Legal Reforms
  - Draft National Water Framework Bill (NWFB), 2016 and
  - Draft Model Bill for Conservation, Protection, Regulation and Management of Groundwater (CPRMG), 2016

circulated for national level debate and discussions.

Our Model of Mashi River Basin Parliament

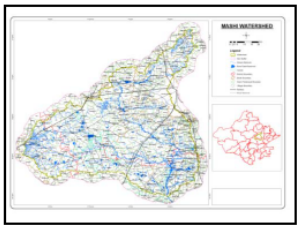
- **General Features of Mashi River Basin**
- **Water Management Issues in the Basin**
- **Proposed River Basin Parliament**
- **Key Governance Features of the Parliament**
- **Stakeholder Groups**

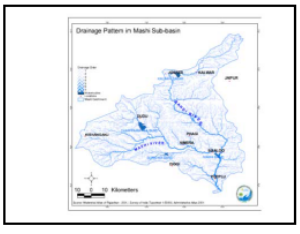
Geological formation, their lithology and chronological age

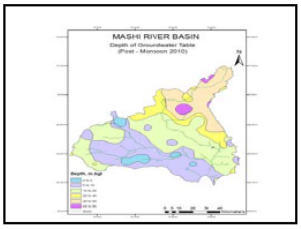
Age	Formation	Lithology
Quaternary	Unconsolidated	Recent & old alluvial and Aeolian(clay, silt, sand, pebble, gravel), Calcareous older alluvium(clay, silt, sand, pebble, gravel), laterite, Bhomagiri clay, ferruginous concretions
Cainozoic, Mesozoic	Consolidated Effusive	Basalt with/ without intertrappeans
Cainozoic, Mesozoic, Upper Palaeozoic	Semi-Consolidated	Sandstone, Shale, Limestone & Conglomerates
Cainozoic, Proterozoic	Consolidated Intrusive	Granite, Ultramafics & Dolerite
Cainozoic, Proterozoic	Sedimentary and Meta Sedimentary	Shale, Quartzite, Slate, Sandstone, Phyllite, Schist
Proterozoic	Sedimentary and Meta Sedimentary	Limestone & Dolomite
Proterozoic,Azoic	Meta Sedimentary	Schist, Phyllite, Slate, Gneiss, Marble
Proterozoic,Azoic	Meta Sedimentary	Charnockite, khondalite
Azoic	Basal Crystalline	Granite- Gneiss complex

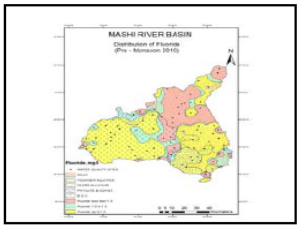
Soil Profile in the Mashi Sub Basin Catchment

Soil Texture	Area (Km^2)	Percentage of Catchment Area
Clay	1,521.7	25.9
Clay Loam	313.8	5.3
Loam	165.4	2.8
Loamy Sand	2,359.7	40.2
Sand	282.8	4.8
Sandy Clay Loam	59.8	1.0
Sandy Loam	863.0	14.8
Silt Loam	305.8	5.2
Total	5,872.0	100.0



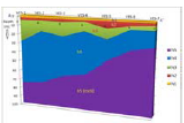






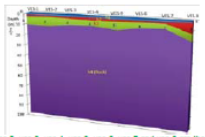
The layers configuration along Profile AA'

(From VES-1 to VES-7)



Ves-1,ves-2, ves-3, ves-4, ves-5, ves-6 and ves-7 are the vertical electrical soundings conducted along profile AA' at villages- Pachar, Gudha, Bobas, Begus, Bagru, Bhimpura and Harbanspura accordingly. h1 is top surface layer, h2 is second layer below h1, h3 is third layer below h2, h4 is fourth layer below h3, h5 is deepest layer, known as bedrock.

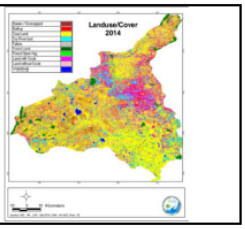
The layers configuration along Profile BB:



Ves-1,ves-2, ves-3, ves-4, ves-5, ves-6, ves-7 and ves-8 are the vertical electrical soundings conducted along profile BB', at villages- Pachewar, Kundli, Kanaiya, Lagariya, Phagi, Jharla, Kantoli and Chitkara respectively. h1 is top positive layer, h2 is second layer below h1, h3 is third layer below h2 and h4 is deepest layer, known as bedrock.

Land use Pattern in Mashi Sub Basin Catchment

Land Use/ Land Cover Class	2006 to 2010		2010 to 2014		2006 to 2014	
	Area	%	Area	%	Area	%
Forest Land	129.92	2.01	139.89	2.16	129.05	1.99
Forest Open Veg.	106.86	1.65	98.89	1.5	117.9	1.82
Land with Scrub	400.28	6.18	308.74	4.77	296.83	4.58
Land without Scrub	344.65	5.32	317.4	4.9	242.51	3.74
Barren / Outcropped	197.39	3.05	220.65	3.41	247.72	3.83
Built-up	142.77	2.2	220.69	3.41	261.24	4.03
Dry River bed	38.72	0.6	44.02	0.68	43.92	0.68
Crop Land	2823.4	43.6	2870.13	44.32	2998.74	46.84
Fallow	2238.23	34.56	2191.5	33.84	2092.88	32.32
Water body	53.85	0.83	66.08	1.02	75.21	1.16
Total area	6476	100	6475.99	100	6476	100



Distribution of number of landholdings by ownership and size in Mashi River Basin (2010-11)

Size of Holding (in ha.)	Individual Holdings		Joint Holdings		Institutional Holdings		Total Holdings	
	Number	%	Number	%	Number	%	Number	%
0.5	13509	13.21	5925	10.44	64	12.44	19198	12.28
0.5 - 1.0	17635	17.24	5830	10.27	106	15.79	23577	15.05
1.0 - 2.0	26030	25.45	10274	18.14	117	17.33	36421	23.26
2.0 - 3.0	15259	14.92	7943	14.01	92	13.63	23194	14.81
3.0 - 4.0	10054	9.84	6357	11.28	69	10.22	16190	10.34
4.0 - 5.0	5995	5.84	3789	7.06	35	5.19	9460	6.06
5.0 - 7.5	7487	7.32	4960	11.12	56	8.30	13611	8.63
7.5 - 10.0	3245	3.17	3197	5.96	27	4.00	6470	4.13
10.0 - 20.0	3006	2.94	4110	7.66	43	6.37	7159	4.57
20.0 & above	363	0.35	995	1.85	46	6.81	1404	0.90
All Classes	102265	100	53674	100	675	100	156614	100

Area of landholdings by ownership and size in Mashi River Basin (2010-11)

Size of Holding	Individual Holdings		Joint Holdings		Institutional Holdings		Total Holdings	
(in ha.)	Area	%	Area	%	Area	%	Area	%
0.5	3697	1.42	1370	0.60	21	0.52	5088	1.05
0.5 - 1.0	12813	4.88	4319	1.90	78	1.92	17212	3.41
1.0 - 2.0	37588	13.73	15006	6.62	177	4.36	52775	10.46
2.0 - 3.0	37348	13.64	19292	8.51	226	5.57	56865	11.27
3.0 - 4.0	34987	12.78	21142	9.32	241	5.94	56370	11.17
4.0 - 5.0	25208	9.21	16934	7.47	156	3.89	42299	8.38
5.0 - 7.5	44958	16.42	36621	16.11	346	8.52	81824	16.22
7.5 - 10.0	27806	10.16	27538	12.14	235	5.79	55579	11.02
10.0 - 20.0	38825	14.18	55210	24.35	556	13.69	94592	18.75
20.0 & above	10296	3.76	29429	12.98	2021	49.78	41746	8.27
All Classes	273727	100	226261	100	4060	100	504540	100

Water Management Issues in the Basin

- The soils of the region suffer variously in the different soil regions from excessive drainage, low water retentive capacity, moderate erosion by wind, and low fertility mostly in the upper northern part of the basin. Salinity, alkalinity, poor drainage accompanied moderate to severe erosion are the problem of the soils.
- Five hydrogeological formations viz; ***Younger Alluvium, Older Alluvium, Phyllite& Schist, Quartzite and BGC (Banded Gneissic Complex)*** are the main water bearing formation (aquifer) in the Basin.

Water Management Issues(Cont...)

- **Land Use:** The Cultivated area (including current and permanent fallow lands) accounts for 78.2 percent of total geographical area of the Basin. The forest area is around 3.6 percent and Barren/ un-culturable/ Wastelands 14.5 percent. Other categories are covering less than 5% area.
- **Surface Water:** The number of Water Harvesting Structures (WHS) constructed in with differential catchment is 3,087 with total water holding capacity is 112.23 Mm^3. Actual mean annual water yield to the Mashi sub basin is computed to be 203.95 Mm^3 (with all interventions).

Water Management Issues(Cont...)

- Rainfall occurs mainly during the monsoon season in, major portion of stream flow occurs only during these months. The annual dependable water yield at 50% is 59.6 Mm^3, while water yield at 75% dependability is 6.4 Mm^3 (13.3% of gross storage capacity).
- Major and Medium Projects: There are 3 M&M upstream projects in the Basin catchment. The live storage capacity of these three existing upstream project is 81.36 Mm^3.

Water Management Issues(Cont...)

- **Minor Projects**: 97 Minor projects with total live storage capacity of 90.64 Mm^3. There are large numbers of minor projects constructed in the catchment of Mashi Dam capacity of which exceeds its design yield which may have substantial impact on inflow to project.
- **Groundwater:** The total net annually assessed groundwater resource in the Mashi Basin is 2586.29 Mm^3 and groundwater draft 3497.64 Mm^3. The stage of groundwater development in the basin is 135.24 % and the basin is categorized as overexploited basin.

Water Management Issues(Cont...)

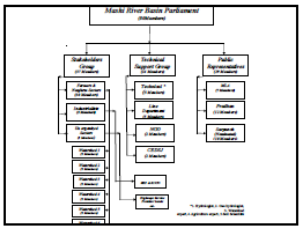
- Groundwater Quality: The average chlorides concentration was relatively stable and ranges from a minimum of 175 mg/l to a maximum of 474 mg/l during the period of 1984 - 2010.
- Fluoride concentrations are above the upper permissible limit for drinking water in most of the basin's area. The 100% non-potable water area belongs to quartzite aquifer unit in Mashi sub basin.
- Most of the area in the basin is affected by nitrates ion concentrations above permissible concentrations.

Water related Conflicts in the Basin

- Encroachment of catchment areas of water bodies, river bed, and streams.
- Sand mining from river bed
- Water pollution: dumping industrial waste and urban sewage in rivers/rivulets and groundwater.
- Sharing of surface and groundwater

Key Governance Features of the Parliament

- New approach of Participatory Community Management of River Basin
- Associated partner NGOs as field level implementation partners to facilitate community mobilization, formation of watershed groups, selection of PRI representatives, etc.
- Technical Support Group to; firstly, provide all technical inputs, second, formulate by-laws and structure, and third, handholding support for sustainability of the parliament.
- Stakeholder Groups



THANKS

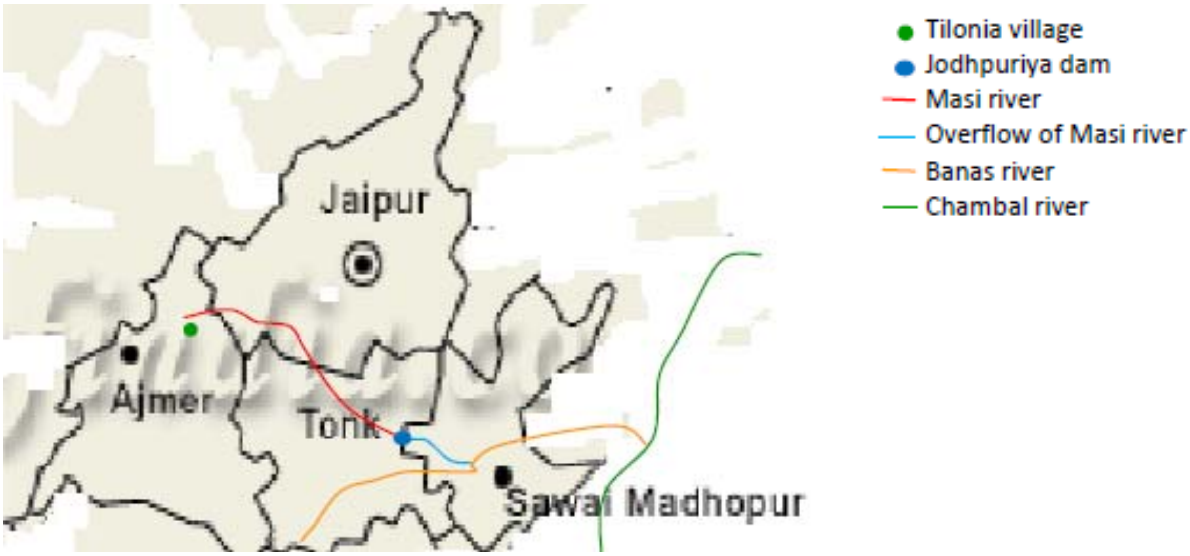
End of Annex 2

Annex 3: The 'Macro socio-ecological complex' in the Masi River

This Annex contains an overview of the 'Macro socio-ecological Complex' initiative in the Masi River catchment area, as sub-catchment of the wider Banas system. The source information is supplied by Bhanwar Lal Tailor, Secretary, Jan Vikas Sansthan Tilonia (JVST), with minor editing.

A3.1 Overview of the Masi River catchment

The Masi River is currently an inactive river due to blockages of its water sources. This river's catchment area potentially makes a major contribution to the Banas catchment. The origin of the Masi River is in Kishangarh Block, Ajmer District (Rajasthan, India). The Masi River is runs through to the Jodhapuriya Dam located in Piplu Block, Tonk District, Rajasthan. Overflows from the Jodhpuriya Dam feed into the Banas River.



A3.2 Problems encountered in the Masi River catchment

A range of problems have been identified in the Masi River catchment, including:

- River-bed sand mining
- Encroachments on river area
- Losses in environmental flow
- No proper agency to execute provisions of 'The Rajasthan River Basin and Water Resources Planning Act 2015'
- Ignorance by local CBOs
- Lack of awareness among people and local governance about regeneration of Masi River
- Due to the above problems, the livelihoods of rural population of the Masi River catchment area (Ajmer and Jaipur districts) being adversely affected

A3.3 Why is there a need, to include Masi river catchment area with 'Regeneration of the Banas-Bisalpur Socio-ecological Complex'

There is a need to include initiatives in the Masi River catchment within the wider River Banas regeneration programme in order to:

- To stop riverbed sand mining
- To control encroachments on river areas
- To recover losses in environmental flow
- To work for proper execution of provisions of 'The Rajasthan River Basin and Water Resource Planning Act 2015'
- To spread awareness among people and local governance about regeneration of Masi River
- To generate more livelihood options for rural population of the Masi River catchment area (additional two districts)
- To sensitize local CBOs

So, initiative that for 'Socio-ecological Complex' will spread in wider area (in four districts).

End of Annex 3

Report of the three-day workshop on

Regeneration of the Banas-Bisalpur Socio-ecological Complex

Monday 4th to Wednesday 6th December 2017

UWE Bristol | University of the West of England

JK LAKSHMIPAT UNIVERSITY
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