BUILDING PUBLIC KNOWLEDGE FOR MOBILIZING ACTION IN IWRM

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ABSTRACT: The Water Action Network (http://WaterActionNetwork.org) incorporates swarm theory for effective application of exploding mobile technologies to aid water resources practitioners in better harnessing the full spectrum of community involvement for Integrated Water Resources Management (IWRM) at all scales. The goal of the Water Action Network is to direct users searching for water-related information in about three online selections to immediate opportunities for action. The system provides a hierarchical, basin-level structure that quickly focuses to a locality and water topic of most immediate interest to the user. After scanning introductory facts and selecting an authoritative link if more detailed information is desired, users may choose one of several related involvement opportunities to convert their interests into concrete actions. Example actions could include joining a local watershed group, donating time or money to a local project, collaborating on draft legislation, implementing a conservation practice, or attending a public meeting. It is believed that through exhaustive analysis of the actions pursued, as well as the direct benefit of the actions themselves, the Water Action Network can further IWRM goals.

KEY TERMS: swarm theory / intelligence, social networking, taxonomy, content management system

INTRODUCTION

Swarm intelligence (Miller 2007) is the coordinated actions of simple individuals in a group without direct leadership that can still solve extremely complex problems efficiently. Examples of swarm behavior in the animal kingdom include bees evaluating new home options, ants foraging activities, termite mound building, or caribou fleeing a wolf. A human example is the way a brand may now become quickly popular through online social networking opinion and rating websites (Brymer 2008). There is no single charismatic leader directing the swarm, nor does a facilitator guide the collaboration. Instead, thousands of individuals each contribute their skills and sense to reach a common goal, often with better results than even complex algorithms might attain. Unlike an organization, though, no entity *owns* the goals of the swarm; rather the goals arise naturally from common, indispensible needs.

Interest groups (such as a local watershed restoration group) may have important impacts on water issues in a locality, and thus the energy, land, air, social, cultural and economic issues to which water is integrally linked. However, each individual in an interest group is constrained by its group's mission, structure, and funding. Furthermore, an interest group must plan activities and investments ahead of time, which limits its ability to respond quickly to changes in the environment. The Water Action Network strives to develop creative tools and methods to more thoroughly exploit the wide-ranging capabilities and creativity of individuals *acting independently* in *all their areas* of interest and expertise. We seek to explore how organic development of their combined choices of actions may contribute to full-scale IWRM and the resolution of intractable, complex issues.

FRAMEWORK

The Water Action Network (http://WaterActionNetwork.org) is being created to explore methods of enhancing spontaneous community participation in support of integrated water resources management (IWRM). The Network is designed to provide an online framework for organizing and directing users to a suite of actions they might be interested in performing as a means of promoting the goals of IWRM. This research has enumerated a number of key components needed to implement such a framework:

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Taxonomy – The term Taxonomy refers to methods of sorting information into searchable classification schemes (Slowkow, 2010). The Water Action Network taxonomy for implementation in an online environment should include key topics for the basin or watershed level. The taxonomy is then used to develop sophisticated search tools, tagging mechanisms, stored preferences and knowledge base algorithms to allow rapid access to the preferred entry point for users into their personal view of local water issues and options. Although each basin will have some of its own terms and categories to describe its unique challenges, the system is being designed to allow a new system to be more quickly implemented from an existing library of water vocabularly, organzational page templates, and other components being developed.

Knowledge Distillation – Even an eight page summary of a 250 page state water availability study may represent an excessive amount of information for most citizens today to digest or act upon. Instead, every concept presented in the Water Action Network will focus on one-page, strictly-formatted templates of highly-visual, interactive content to target cognitive grasp within thirty seconds to a minute that may still provide sufficient background and focus to direct the user to explore the action alternatives for that topic. Most internet users spend less than sixty seconds on the average site (BBC News, 2002) and the user's attention span appears to be ever-declining as better search tools reveal more directly interesting content daily. Thus, adhering to these distillation guidelines should permit the user to better focus attention on action alternatives before interest begins to wane or moves elsewhere on the internet.

System Configuration – Content management systems (CMS) are being compared in this research to determine which allow the best variety of contribution techniques to be applied. All data will be stored in a CMS database to simplify individual contributions and to separate content from display for maximum system flexibility. The selection criteria include life-cycle costs, hosting options, database flexibility, and storage costs. Even though the initial pilot can only take advantage of one system configuration, by managing all content in a database, the system should be more easily ported to other CMS and platforms as it matures. Search engine optimization (SEO) will also be important to simplify access and increase use.

Exhaustive Links – Water-related websites specifically related to a locality should be linked as exhaustively as possible for users who like examining more specific information before making a decision to act. The focus, however, should not be on the homepage, but rather the donation, events, or *get involved* pages, as well as specific information pages for the expansion of the distilled knowledge excerpted. For any one topic, however, users are likely to view only a few links at a time, since each topic will be focused on that location and subject (e.g., conservation rebates for their local service provider).

Mobility – Although this online system will work well on a desktop or laptop computer, the ultimate goal is to attempt to achieve user actions with three selections from a cell phone so as to allow users to become informed and involved in some way with minimal effort. This will be especially important in many developing nations in which electrical access and costs limit computers, but cell phones are often used for advanced purposes by a large percentage of the population.

Social Networking – Facebook, Twitter, and a variety of other online and traditional social networking tools will be essential to the viability of the Water Action Network by helping users share its utility with their friends and associates.

Viral Videos – YouTube and other online video platforms can showcase local actions and their impacts by piquing the interest of local news outlets and social networks to publicize the Water Action Network and thus encourage its expansion.

Water Models and Research – Although water information must be severely distilled to afford citizens with direct courses of action, as the system matures, online optimization models and other tools may be incorporated to help inform action-based efforts and integrate the Water Action Network more directly with other IWRM resources.

Visualization – Defining problems is often best accomplished by applying digital mapping technologies, so it would be particularly helpful to include a topical map for the user's specific area of focus on every page. Interactive mapping tools might further permit facts and various action options for the current topic to be explored more easily. Charts and graphs that can reduce the complexities of a problem might also be effective motivators to encourage users to act.

Organic Growth – All interested community members should be able to contribute to the framework itself in their area of expertise. It should also be effectively integrated with other IWRM-focused local systems to form a unified whole.

Moderation – To test swarm theory, it is important not to include blogs or other tools in the framework itself that might permit strong positions to be expressed. This should allow people to act unperturbed by outside influences, and limit those influences of the system itself. Therefore, the system will be monitored continually and adjusted to permit individuals to choose their own actions as independently as possible and counteract any negative effects external blogs and social networking tools may impose on users' actions. This is perhaps one of the most important risks to monitor and mitigate in order for the Water Action Network to become a feasible IWRM support mechanism.

Responsibility – A login or computer tracking tool must be used to prohibit Network access to individuals seeking to subvert the framework's guidelines or design. Tracking is also necessary to focus information to the user's locality. Perhaps of equal importance, tracking can also be used to reward active participants.   A comprehensive security plan must also be in force to protect user profiles and system integrity.

Analysis – Every action performed through the Water Action Network will be tracked to determine what the public finds worth investing in, participating in, and changing. This information may then be used to richly inform other IWRM processes and projects.   Analysis will also determine if the benefits of Water Action Networks justify the costs and risks.

BENEFITS

   The Water Action Network will contribute to traditional collaborative models such as Shared Vision Planning and Public Meetings in several ways:
   * Help define problems by indicating which current topics are drawing interest and how those users are acting
   * Reveal missing and incorrectly calibrated community interests, leading to inclusion of additional stakeholders
   * Allow actors to reflect their multi-interest viewpoint more holistically, not as a representative of a single stake
   * Gauge a wider swath of the population, rather than a smaller, appointed or elected sample
   * Reduce the time needed for project concerns, donations and labor to be acquired and applied
   * Allow many non-integrated activities to proceed simultaneously to still effectively contribute to shared goals
   * Encourage more direct participation and thus ownership of the outcomes, rather than requiring government dictums

POTENTIAL ISSUES

   One of the most critical aspects of swarm theory is that each individual coordinates *independently* and *intelligently*. However, powerful community interests with strong positions could derail or subvert actions by rallying individuals to a cause. Therefore, the development of the Water Action Network will always require careful diligence to prevent undue influence, even in the facts and links provided, which will be a challenging task. Usage will require entire communities to trust the integrity of the system, and quantified benefits must be measureable, if water providers and government entities are to be persuaded to recognize a role for the Water Action Network in the IWRM toolbox.

   Another potential issue is the knowledge and time required to catalog the unique facts and actions for each basin. This can be minimized by initiating each basin Water Action Network as a collaboration of community experts and adventurous citizens to provide an even greater sense of ownership in its ultimate success. Since action options could include donating time or money to a particular local goal, users who already participate in various interest groups may find it directly to their benefit to quickly get involved. For these reasons, the cost, flexibility and ease-of-development for even non-technical users will be primary goals of the system design.

WATER ACTION NETWORK PILOT PROJECT: STATE OF COLORADO

   This research has been founded on ongoing efforts to develop an understanding of water rights, issues, and organizations throughout the State of Colorado to serve as a pilot application of the Water Action Network. The ultimate goal is to deploy and market a Water Action Network for Colorado (Herzog 2011) in conjunction with Water2012 (CFWE 2011). Water 2012 is a celebration of water anniversaries that will be used to raise awareness of water issues and organizations statewide throughout the entire 2012 year. One of the primary goals of the Colorado Foundation for Water Education in sponsoring Water 2012 is to develop mechanisms to developing enduring ways to improve our share water future, which provides a compelling rational to explore the Water Action Network as part of the solution.

   Through conflict resolution seminars, note-taking and minutes review of a wide-variety of state and local water meetings, and through redesigning the Colorado Division of Water Resources public website (http://water.state.co.us), a number of themes have emerged that will be developed into an hierarchical list to use in the initial development and expansion of system taxonomy. Following each topic or theme is a brainstorming list of sample actions that the community can refine.
   * **Conservation**
     * Indoor, outdoor, commercial, industrial, agricultural, xeriscape, your local programs (rebates, etc.)
       Actions – join conservation program / group, find rebates, reduce water usage, support or draft legislation
   * **Dam Safety**
     * dam owners responsibilities, jurisdictional, livestock water tanks, erosion control ponds, flood control
       Actions – remove vegetation and pests that can compromise dam integrity, breach illegal ponds, detain water

- **Drought Management**
  - o Increase storage, conjunctive use, water availability studies, water gap, statewide water supply initiative
  - <u>Actions</u> – replace lawn with xeriscaping, reuse or collect rainwater where permitted, support mitigation projects
- **Environment**
  - o Biology, phreatophytes, state and federal candidates, threatened and endangered species, nonnative species
  - <u>Actions</u> – donate water rights to the instream flow program, catch and release, donate to species protection
- **Funding**
  - o Federal, state and local grants and loans, ways to donate to projects of interest, business sponsors
  - <u>Actions</u> – apply for grant or loan, support programs, donate to projects or organizations of interest, marketing
- **Flood Management**
  - o Encroachment, modeling, warning systems, floodplain protection, mitigation, prevention, detention
  - <u>Actions</u> – donate time or fund floodplain protection, buy flood insurance, place fill, improve detention times
- **Ground Water**
  - o Mining, augmentation plans, recharge, ground water rights, designated basins, Denver basin, nontributary
  - <u>Actions</u> – install recharge or settling basin, support community projects that reduce ground water dependency
- **Hydrography**
  - o Real-time and published streamflow, models, tools, satellite monitoring system, doppler gauges
  - <u>Actions</u> – review nearby structure gauged streamflow and models, volunteer, donate to monitoring programs
- **Hydrogeology**
  - o geological survey maps, aquifers, issues, modeling and depletion tools, contaminant transport
  - <u>Actions</u> – join aquifer management group, promote recharge, limit depletion, help build groundwater models
- **Interbasin Compact Committee / Basin Roundtables (IBCC / BRTs)**
  - o Framework, consumptive and non-consumptive needs, conservation, Identified Projects and Processes (IP&Ps), studies, alternatives to agricultural transfers, portfolio tool, new supply development options
  - <u>Actions</u> – attend an IBCC meeting, apply for a basin water supply reserve account grant, join a basin roundtable
- **Interstate Compacts**
  - o Colorado/Upper Colorado, Republican, Arkansas, Rio Grande, South Platte, Costilla, Animas-La Plata
  - <u>Actions</u> – join organizations that cross state lines, promote interstate water trading options and projects
- **Irrigation**
  - o Canals, ditch companies, ditch management, water conservation and water conservancy districts
  - <u>Actions</u> – join conservancy district, reduce ditch losses, install improvements, optimize crops and rotations
- **Recreation**
  - o Recreational in-stream flow programs, hunting, fishing, parks, preservation, recreational designations
  - <u>Actions</u> – don't pollute, buy hunting and fishing licenses, clean up nature areas, support scenic designations
- **Reuse**
  - o WISE partnership, other current and proposed options, challenges, graywater, stormwater, dual systems
  - <u>Actions</u> – collect rainwater if meet permit requirements, support provider reuse projects, install dual systems
- **Water Banking**
  - o Super Ditch, Pre-1929 leasing in event of a lower basin call, agriculture fallowing and water leasing
  - <u>Actions</u> – participate in or start a water bank in your basin to support community goals, learn from other states
- **Water Education**
  - o university, trade school, organizational, service provider, conflict resolution, interest based negotiations
  - <u>Actions</u> – create public outreach materials, promote an education campaign, take a class, get a water degree
- **Water / Energy interface**
  - o Hydrofracking, pumpback renewable energy storage, micro-hydropower, geothermal, energy/water audits
  - <u>Actions</u> – Install geothermal or micro-hydropower, support pumpback storage projects, schedule a home audit
- **Water Legislation**
  - o Colorado Water Congress, existing, proposed, Colorado Revised Statutes, rulemaking, policies, rules
  - <u>Actions</u> – contact your state or federal representative about upcoming legislation, vote, draft or sign a proposal
- **Water Quality**
  - o Salinity, TDS, acid mine drainage, non-point sources, NPDES, emerging pollutants, reporting
  - <u>Actions</u> – direct roof runoff to infiltrate, reduce farm runoff, irrigate for salinity management, remediate an area
- **Water Rates**
  - o Statewide water rates comparison tool, other western cities and world comparisons, methods, why differ
  - <u>Actions</u> – compare water rates, understand cost components / projects, set goals to reduce your water bill

- **Water Rights**
  - Existing, obtaining, administration, prior appropriations system, usufructory rights, conditional, augmentation, subdivision planning, substitute water supply plans, conflict resolution, water court / referee
  <u>Actions</u> – purchase water rights, submit a water supply plan for a proposed subdivision, attend water court
- **Water Supply Projects**
  - existing, in progress, proposed, global settlement and other east-west slope negotiations, interstate options
  <u>Actions</u> – donate to purchase in-stream water rights to include in a water supply project, comment on impacts
- **Water Transfers**
  - Agricultural buy & dry, alternatives, leases, transbasin diversions, transaction costs, water court decree
  <u>Actions</u> – draft or support legislation to permit alternatives to agriculture transfers, donate expertise or funding
- **Watershed & Land Management**
  - Local watershed groups, protection, restoration, management, pest control, densities, counties, floodplain
  <u>Actions</u> – join watershed group, volunteer for cleanup / pest control, donate to project, support city planning
- **Well Permitting**
  - residential, commercial, geothermal, abandonment, rainwater collection, monitoring, gravel pits, protection
  <u>Actions</u> – register an existing well, collect rainwater, protect a well head, permit a gravel pit or residential well

Colorado-based water organizations, blogs, news, and education sites will be fully categorized for action opportunities and informational references with the assistance of qualified contributors and subject matter experts. **A**ll pages and action options will be tested and optimized for both web and mobile usage to the extent possible, with the possibility of developing one or more mobile applications for specific action purposes. Where applicable, enhancements, upcoming opportunities and other important Water Action Network developments will be broadcast through both traditional media and online social networking tools. Videos of interviews, meeting highlights, educational animations, contributors, action options, and hot topics will be posted on YouTube to promote the site through internet sharing, increasing its fun factor.

<u>Water Models and Visualization Tools</u> – Colorado State University and other institutions have several tools that may be included to enhance the initial deployment of the Water Action Network pilot at http://wateractionnetwork.org/Colorado.

- [MODSIM-DSS](#) is a river basin Decision Support System used in communities throughout the state to visually develop data in ERSI ArcGIS and optimize network flows (Labadie, 2011).

- [eRAMS](#) is a web-based GIS application to interactively develop location based information for modeling purposes to improve watershed water quality planning (Arabi, 2011).

- [Colorado's Water Supply Future Portfolio and Trade-Off Tool](#) allows users to explore a mix of strategies to close the state's projected water supply gap (CWCB, 2010).

- [Map Search (AquaMap)](#), [CDSS tools](#), [HBGuest](#) and [SMS](#) [web services](#) will be used to access streamflows, structures, well data, water rights, and other statewide water resources data (DWR, 2010).

System analysis will begin with system deployment in conjunction with the launch of Water2012 on January 1, 2012. Site features and marketing will be continually adjusted to meet numerical targets for site visits and visit-conversions-to-action. If the pilot proves successful, a methodology will be developed in early 2013 to allow Water Action Networks to be deployed at various scales and in disparate regions and cultures. A variety of training tools and support systems would then be developed to allow interested water resources managers to begin to incorporate a Water Action Network as component of any IWRM strategy. It is anticipated that such systematic application of less directed, but more comprehensive facilitation for citizen choice should better inform other IWRM planning and implementation processes, in addition to providing immediate IWRM benefits from the myraid actions themselves that the system could theoretically help to facilitate.

CONCLUSIONS

Swarming is already an important aspect of modern society through the use of Facebook, Twitter, LinkedIn, YouTube, Google, Wikipedia, mobile devices and a variety of related and emerging communication and collaboration technologies. IWRM efforts should leverage this emerging power to activate everyone in the entire basin community to continually act on their interests to help mold their shared water future each day. Water Action Networks will attempt to capitalize on these trends to better involve the creative problem-solving skills and wide-ranging expertise of each individual to promote a more holistic level of understanding and participation in IWRM as it continues to evolve.

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