

UNESCO-IHE, Institute for Water Education, Delft

1. Mission, vision and policy

For its mission the UNESCO-IHE Institute for Water Education envisions a world in which water is managed sustainably and equitably and in which all members of the society — particularly the poor — can enjoy the benefits of basic water services. The United Nations has given the Institute the mandate to play a global role in educating and training a new generation of water professionals, facilitating the development of capable organizations, providing an enabling environment for well-informed decision-making and improving integrated water management practices. The Evaluation Committee fully supports this mission since it directly connects to the needs of developing countries and countries in transition where global and regional changes are most pressing and where the capacity to effectively guide these changes should be improved significantly. UNESCO-IHE is in a unique position to perform this mission most effectively.

At the outset, it is noted that this is the first time that UNESCO-IHE has been part of the SENSE consortium. The Institute underwent a separate internal review in 2009 by the SENSE leadership and has since made several adjustments recommended in the previous review. These included a major strategic decision for UNESCO-IHE to evolve from a leading international education institute into an institute that places equal importance on both education and research. In line with this strategic change, the Institute has created the new position of Vice-Rector. New Academic Departments and Research groups were organized under new scientific leadership to harmonize research activities across the Institute. This reorganization has been guided by the introduction of six research themes, all about water, but all demanding multi-disciplinary input and all linked to international programmes (e.g., IWA, EU, and Panta Rhei).

It is also noted that a new Human Resources - Performance & Development Management System was developed and implemented that strengthened academic leadership and set specific academic and outreach targets for every staff member. Promotions are now clearly based on achieving high academic outputs, as well as professional involvement in the scientific community and with generating outreach/societal impact. The regulations of the PhD Program have been revised which has led to a streamlined program with improved supervision and professional skill development.

These changes have already contributed to a significant growth of the overall research program. In addition to the PhD programme, UNESCO-IHE has also employed up to 20 post-docs and more than 220 MSc researchers annually, who together form a thriving graduate research community. The great majority of the graduate students are from developing countries and countries in transition and typically work on research that is focussed on their own home countries. In parallel with the growth in the PhD program and the increased emphasis on research, the Institute's productivity in terms of the number of publications has more than doubled and the impact in terms of citations and societal impact has grown significantly.

The members of the Evaluation Committee were impressed by the leadership of the institute as a whole and on how well the Institute has fulfilled its mission by carrying out three main

activities: (i) Education at the MSc and PhD levels and non-degree programs (ii) Research to increase the knowledge base concerning the water environment (iii) Capacity development by strengthening water sector organizations and, knowledge networks. The Committee suggests that in addition to these three activities, the experimental research on basic hydrological processes in the field should be emphasized and consideration should be given to add this as the No 4 activity. The strategy to operate under the UNESCO flag is applauded and considered very effective in terms of worldwide impact by the Committee. Finally, the policy emphasize water governance and social science, in addition to hydrologic science and engineering, as a way to expose the students to a T-shaped education and training environment is ingenious

As for any institution that evolves in such a short time, some parts of IHE have grown at a rate different from others. Yet as most other institutes, common means (space, finances) are distributed according to algorithms which usually are reflective of the existing situation. The IHE management should be prepared to institute a flexible and dynamic division of common resources that mirrors how well the groups contribute to the mission of the institute

2. Research quality

The quality of the research in the institute is world class considering the following:

academic reputation (recognition and visibility): The academic reputation of UNESCO-IHE with regard to its work in developing countries is excellent mainly because the high quality of the graduates that are currently in educational, technical and governmental leading giving positions in their country

In the standard numeric evaluation, the institute performs well with impact index of 1.5 in the bibliometric analysis

Human resources of IHE are excellent. Financial resources are partly based on the ability of the Institute to obtain outside funding. Although it might be difficult to realize in the research funding system in the Netherlands, newly appointed professors would benefit from significant initial monetary support to do research and to write grant proposals

Organisation and internal processes would be aided by the development and implementation of a cross boundary research group collaboration matrix. This exercise should be initiated by the management but assure that cooperation occurs where it is needed but it also should help to make the different research groups improve their core activities.

3. Societal relevance

The mission of UNESCO-IHE dictates that partnerships be established with academic institutions, regional entities, United Nations Institutes, NGO's, banks etc. The list of achievements presented in this regard in the self-assessment report in which knowledge is transferred towards third world countries is very impressive. The crucial factor of the success achieved is the trans-disciplinary research design in which outreach (demonstration sites, policy briefs) is directly combined with research of the PhD students. Furthermore, the overall networking with alumni, integrating them into the education activities and encouraging their participation in the publications with IHE staff are very laudable.

4. PhD policy

Presently, the PhD program is carried out in collaboration with Dutch universities and with other international partners as joint degrees. The number of PhD fellows has increased from less than 70 in 2007 to more than 140 in 2013. Research output has also almost doubled in the last 7 years – the average citations per paper are far above world average and 20% of the papers are in the top 10% of the journals; several important awards have been received (IWA, Women in Science, Tison etc.)

The PhD program is adequately handled by the Office of Student Affairs and the Education Bureau providing significant personal attention to the students. A PhD guideline has been established to delineate clearly a set of rules proper for the IHE. It is a starting point to negotiate partnerships with other institutions. Indeed besides the Dutch universities, other partnerships with European and Asian institutes are now being pursued. This is very good.

The great majority of students were very satisfied about the courses offered, the facilities they have, and their accessibility to their teachers. There were, however, some issues about the amount of funds allocated to them for their housing, particularly in the case they have to take care of family members. They claimed that other students in traditional university settings received more funds.

The students offered a series of poster presentations and the members of the Evaluation Committee were greatly impressed by their eloquence, their scientific depth and their openness. It was greatly encouraging to see how well these students from all over the world presented themselves as such a cohesive way. The faculty and staff of IHE can be proud of such an achievement.

Finally, the concern of IHE on a heavy emphasis of the scores of their publications is justified since it is not necessarily the most appropriate metric of their unique quality. IHE works primarily in developing countries, publishes in open access journals in a field which has 'not so hot' journals. Since UNESCO IHE has published 45% of their papers in these top three water journals, the research quality of this institute is exemplary and better than their Relative Impact score of 1.5 indicates. The Assessment Committee notes that the fact that IHE spends so many words on their presentation on the numeric score indicates that they still are under pressure in defining the real nature of their intrinsic quality. The fact that matters is their quality in training and the quality of the achievements in the field in the third world and on both issues there can be no shred of doubt.

5. SWOT

The overall vision for the future is that the problems in the developing world will still grow and hence the mission of the IHE concomitantly will gain importance. The IHE faces the difficulty of having to operate in developing countries and at the same time to increase its 'academic level'. The current financial means need to be expanded in the years to come. The current direction of transiting to an international graduate school on water and development associated with existing Universities worldwide is valuable and encouraged.

6. Recommendations / suggestions on improvement

The Evaluation Committee considered the research and education accomplishments of UNESCO-IHE especially as they relate to developing countries as highly effective and comparable or better than other such efforts in world. To maintain this high level in the future the Committee has the following recommendations:

- The teaching and research of the masters can be continued at the level of the research groups; yet some research groups are too small and too busy with the MSc program and already cooperate effectively with other research groups in carrying out their research tasks. This structure should be formalized within IHE. We believe that there is merit to organizing the research at the level of the departments. This enables the research to exploit the synergies that can be generated through collaboration between research groups. Any future assessment of the strength of the research at the level of departments is likely to be highly positive. This will avoid the problem that has been encountered in assessing small research groups when any such cooperation is seen as diluting the performance of individual research groups. At the Institute level this type of cooperation is highly effective and is the reason that evaluation of the Institute is much more positive than most the Research groups.
- Highlight the unique leadership of IHE in the field of water science for developing countries worldwide; find ways to represent this better in the formal reports, including through numerical scores where possible.
- Explore possibilities to associate more strongly with the Universities worldwide in order to cope better with the demands of the developing countries in the domain of water science for the future.
- Maintain the UNESCO label, as this greatly helps the mission of IHE in connecting with their peers in the UNESCO system and gives the faculty access to the country leaders. In addition, the recognition of the students' degrees in their home country is greatly facilitated by the UNESCO label.
- Start a dialogue with the graduate students on the financial aspects and the means to alleviate some of the burdens of the high costs of accommodation.

Programme 10:	Aquatic Ecosystems	
Programme leader:	Prof. K. Irvine (since Oct. 2011)	
Research input 2013:	tenured staff:	2.1 fte
	total staff:	8.8 fte
Assessment scores:	Scientific quality	3
	Productivity	3
	Societal impact	3
	Viability	3

Introduction

The assessment of this group is based on the total six year review period that ended in 2012. The new and excellent leadership of Professor Kenneth Irvine who started at the end of 2011 is acknowledged by the reviewers but is only marginally represented in the current scores and narrative. The evaluation committee believes that under the leadership of Professor Irvine the scores can greatly improve.

Scientific quality

The assessment was hampered because the main scientific advances of the group since 2007 were not well articulated. While they are currently building synergistic collaborations with other IHE groups and external groups (since the arrival of K. Irvine in 2011), the actual form of the scientific collaborations needs to be clearly defined.

Ecosystem-scale, process-based research (N, P cycles) of sub-Saharan wetlands is a cornerstone of the program. Nevertheless, the activities being conducted appear to be routine, in that research of this type has been extensively conducted in other tropical systems. While the group's research may lead to significant new understandings about wetlands, it needs to be articulated as to how this research avenue may yield new insights. How is the research unique from that being conducted elsewhere?

The academic reputations of key staff with the exception of Professor Irvine, as judged from memberships on editorial boards, other professional activities and research program leadership (e.g., only ECOLIVE), are limited.

One of the problems that this relatively small group faces was the supervision and scientific coordination of the 116 MSc theses over a short period. The fact that the research results of the MSc thesis have not appeared in professional publications or scientific advancements is of concern and appears to be missing a wonderful opportunity. The review team believes that when the MSc theses with acceptable quality are managed creatively by the faculty, it could significantly contribute to additional scientific synthesis efforts.

Productivity

The group consisted in 2013 of 7 staff and 9 PhD candidates but only 12 articles appeared in peer reviewed publications. In addition, the key outputs listed are in journals with relatively low impact factors. Only K Irvine has a reasonable Hirsch Index. The group is involved in several collaborative projects but their specific responsibilities are not identified and it is not clear how much of the scientific leadership they are shouldering in these collaborations.

Mentoring and graduating doctoral students is a significant factor in determining productivity. The group has not graduated a PhD student since 2007; fortunately there are news ones in the current program. The MSc program could provide the opportunity to screen for potential PhD students, as well as support the research activities of ongoing PhD students

Overall, the scientific productivity has considerable scope for improvement.

Societal relevance

The general societal relevance of having sustainable and useful wetlands is without question. Further, wetlands are a natural way to form “communities of practice” since their use and management affect so many people – and the group is making use of this ecosystem feature. This is a strong point in the program’s favour since the group is involved in local capacity building, a vital component of sustainable use. Nevertheless, the group has not articulated how key results are passed on to local stakeholders or decision-makers (or how stakeholders help shape the research agenda). Is there a strategy in place to do this beyond participating on professional committees? One suggestion would be to make better use of the emerging forms of communication (e.g., websites, Facebook, Twitter, and so forth).

Vitality and feasibility (viability)

Two key issues are of major concern. First, no mention is made of capacity building of junior staff within the research group. Second, the Strategy, as articulated, does not chart new directions or offer mechanisms for addressing the weaknesses or threats identified by the SWOT analysis. The group is small and has not been especially productive since 2007. Although the new leadership has made strides to improve the weaknesses, it was not evident in the strategy presented in the Self Study

The future viability of the program rests clearly on the ability of Prof. Irvine to provide vision and leadership, and he is certainly capable of doing this. He is “forward” thinking and has identified the program challenges to be overcome in the next few years.

Recommendations

- The group’s focus in the past has been very narrow. It would be prudent for the new leadership to consider setting near-term research goals for the group. The current scores are contingent (and could improve) upon meeting these goals within three years. It is advisable that the Group’s progress be reviewed annually.

- The group is deeply focused on wetlands and their management, especially in sub-Saharan Africa. As such, IHE should either consider either changing the group's name to better reflect the narrow focus or expanding its research portfolio.
- The Group's research should be consolidated with one or more other IHE research groups in order to increase their critical mass and trans-disciplinarity. The Land and Water Development group seems to be the most obvious to join forces with. There are already joint projects and joint supervision etc. between these two groups, and the research impact of both groups could be significantly enhanced through the establishment of a larger group that combines their expertise to work toward common problems. It could also alleviate the high administrative burden associated with academic leadership of a Research group. The MSc program should stand by itself for the time being.
- The Group should aim to graduate 2-3 PhD students per year, with the chapters of the dissertations published in well-regarded professional journals.
- The Group should aim to demonstrate how the MSc theses are contributing to scientific advances, especially the broad understanding and management of aquatic ecosystems.
- The Group, especially the faculty, must aim to publish synthesis articles on wetlands (or another appropriate aquatic ecosystem topic) in high profile professional journals (e.g., *Ambio*, *Science*, *Frontiers*, *Biological Reviews*). For example, these could be timely reviews of contemporary aquatic issues (e.g., proliferation and consequences of chemicals, invasive species and the management of hybrid ecosystems) based on a synthesis of several of their research results.

Programme 11: Coastal Science & Engineering and Port Development Group

Programme leader: Prof. J. Roelvink

Research input 2013: tenured staff: 0.8 fte
 total staff: 11.5 fte

Assessment scores: Scientific quality 4
 Productivity 4
 Societal impact 4
 Viability 3.5

Introduction

The group is heavily focused on modelling, and the application of models to address problems of coastal erosion, in the context of climate change. The group has played an important role in understanding and modelling the behaviour of estuaries and coasts around the world through international collaborations. The group has developed a unique expertise in long-term, process-based modelling that has contributed to the understanding of channel-shoal patterns, quasi-equilibrium morphologies, etc. To the Netherlands also this area of activity is highly relevant. The group contributes to the maintenance of the long-standing reputation of Dutch civil engineers in this important area. Links with TU Delft and Deltares put them in a very good position to benefit from the resources available there.

Scientific quality

The work in many areas is achieving world class status, particularly in the contributions to the development of the DFlow-FM Code. An article on an open-source storm impact model XBeach has ranked top 1 most cited publication since 2008 in Coastal Engineering journal. The work of this group is very competitive at the International level. One of the staff members, Prof. Ranasinghe, has been awarded the AXA Chair in Climate change impacts and coastal risk in 2013, which is a testament to the excellent reputation of the group.

Both the number of PhD candidates and the successful PhD completions have increased. This makes their contribution to the SENSE postgraduate community very considerable. The atmosphere of the postgraduate academy at UNESCO-IHE seems to be highly stimulating to the students and the formal link with Delft Technical University aids in maintaining the high standards.

Despite the excellent quality of the research, the group may find it difficult to compete with larger international groupings due to its relatively small size. While the group has the opportunity to study the many estuaries) around the world, more fundamental scientific pursuit that arises from these has not been given adequate attention in the group's current plans.

Productivity

CSEPD's productivity is excellent. The group produces on average 7 peer-reviewed articles in journals covered by the Web of Science per year. The number of publications produced by this group has increased since 2007, with a slight dip being evident in 2010. The relative impact of the CSEPD publications is 2.27 which is twice the world average in this sector. This is reflected by the fact that 44% of the publications belong to the top 10% of publications in their field and 2% (1 publication) belongs to the top percentile. This is primarily influenced by the evident focus on the Engineering sector in terms of high impact journals. Furthermore, the scientific production of the PhD students is good as well, thanks to a very efficient cooperation with MSc students and staff. The group produced on average ~1.9 refereed article per staff each year, and about 3.1 refereed articles per fte each year. There is a significant increasing trend of higher publications in 2012 and 2013. About 50% of papers were published in top 10% cited journals. Serious international collaborations are evident. In 2013, a paper was published in Nature Climate Change, which showed that the effects of coastline erosion as a result of rising sea-level in the vicinity of inlets which have until now been dramatically underestimated.

Societal relevance

Coastal protection and restoration are extremely relevant topics. The vulnerability of the coastline in the presence of human impacts and climate change is a topical issue in many countries and the related scientific challenges are exciting. The research achievements of WSE-CSEPD provided a good contribution to the above topics. Furthermore, the attention that is placed on students from developing countries makes the activity of CSEPD particularly noteworthy in terms of societal relevance.

The group has played a key role in developing knowledge and tools that is accessible to the developing world through capacity building, research and advisory projects. It has maintained close collaborations with developed as well as developing countries. The group has an excellent international reputation. As a result it is part of the research consortiums that give advice to governments and international agencies on the world's largest estuaries (Yangtze, Mekong etc.)

Vitality and feasibility (Viability)

This group has grown steadily from 4 in 2007 to 7 members in 2013, and the group's scientific output has substantially increased. The new Coastal Engineering Professor has been awarded a prestigious AXA endowed chair in Coastal Risk and Climate Change. All of these signs point to the increasing vitality of the group.

However, to be viable in the long-term, the group must grow in size to neutralize the volatility of funding and staff turn-over. Even though the group is on a fast developing track, a strategic plan is needed to adjust its PhD and MSc programmes and to look for more post-docs and staff members.

As with all IHE Groups, the developing country focus (and the time required for education and capacity building) impacts on the time available for generating publications, developing

and implementing uptake strategies as well as for 'curiosity driven research' that is often the nucleus for new developments and the uptake of new ideas. Continued viability and success at the international level depends on the group managing these twin objectives.

Recommendations

- The productivity and quality of the CSEPD group is excellent. In addition the number of staff members in this group has increased in the review period. Despite this its efforts are limited by its relative size. Therefore, in order to maintain its leading research position, efforts should be undertaken to increase the size of the group, including through the appointments of post-docs.
- The review panel was under the impression that the focus of the research of the CSEPD Group was on the application of sophisticated models to solve problems in various parts of the world, including developing countries. The apparent focus on model applications (which may be inadvertent) should be balanced by an increased effort towards more "curiosity driven" research. The potential for novel findings exists, both in performing detailed research on key processes that must be captured well in the models, and through synthesis efforts based on the differences and similarities between places highlighted through the application of the models, taking into account the underlying climatic (including ocean climate), land use and socio-economic factors. This will add value to the current research of the group, even while keeping the focus on developing countries.
- The appointment of the AXA Chair represents an opportunity to clearly articulate a new vision for the group, including defining the boundaries and synergies between the different parts of the group. This will aid the group in capitalizing on both scientific challenges and funding opportunities, in collaboration with other IHE Groups, including, among others the HERBD Group.

Programme 12: Hydroinformatics Group

Programme leader:	Prof. D. Solomatine	
Research input 2013:	tenured staff:	3.5 fte
	total staff:	12.5 fte
Assessment scores:	Scientific quality	3.5
	Productivity	4
	Societal impact	3.5
	Viability	4

Introduction

The objective of the group is to conduct state-of-the-art research in Hydro informatics, including data-driven and hybrid modelling, process modelling, uncertainty analysis, model-based optimization and decision making, surge forecasting methods, and data assimilation. This is a high profile group who, over the years, have made a significant contribution to the development of Hydro-informatics.

Scientific quality

The work of this group is competitive at the international level, and serious international collaborations are evident. The number of successful PhD graduations has increased, as has the number of PhD candidates. The contribution to the SENSE postgraduate community is therefore quite considerable. The quality of the postgraduate cohort is high and the formal link with TU Delft helps to maintain high standards.

The group is also very good in terms of the level of contribution to scientific organisation and community service, through service in Editorial Boards and scientific committees. It is also very good in terms of the standard of international recognition through scientific awards. The group chair and some of the group members are internationally recognized leaders in the field.

The review panel feels that current research efforts are still somewhat constrained by the legacy of the past, and the score for science quality partly reflects this. For example, the research areas listed in the Self-Evaluation Report are individually fine, but together they did not articulate a clear and coherent vision for the future. This is disappointing for a group that aims to (and probably claims to) lead the world in the area of Hydro-Informatics.

Productivity

The group produced on average 1.15 peer reviewed articles per staff, and 1.9 refereed articles per fte each year. The productivity became significantly greater after 2012. There were 10% of total peer reviewed articles published in top 10% journals, and 2% in top 1% journals. The prestige of the journals where these contributions were published is very good, with some being in top journals. The publication list highlights a good internal organisation of the group, given that the contributions cover complementary subjects. The output is fully

consistent with the mission of the group and the overall mission to address societal challenges. Some of the publications are in emerging fields of research, such as the interaction and feedbacks between humans and environment.

The group has contributed to the best of its ability given the large teaching/course load that it seems to carry. The focus has been very strongly towards developing countries and this seems to mitigate slightly against achieving an excellent world class rating. Also, even while publication output is increasing, a large amount of effort is still directed to conferences. The review panel feels that this is a relatively large group that could have been more productive.

As with all IHE Groups, the developing country focus and having to spend much time on education and capacity building, impacts upon the time available for generating publications, developing and implementing uptake strategies as well as for doing 'curiosity driven research' that is often the nucleus for new developments. Continued viability and success at the international level depends on the group managing these twin objectives.

Societal relevance

The societal relevance of the topics studied by the group is very good, but could have been better. Attention is being given to emerging societal challenges and education, with a focus on developing countries. In spite of this, due to the nature of the work they do (e.g., development and application of informatics methods) the societal relevance is difficult to measure for this group. Much of the work comes across as being of a theoretical nature, which makes it a challenge to demonstrate societal relevance in the short term.

In spite of this limitation, as mentioned in the self-assessment, the group has done quite a lot of work in developing and testing computer technologies and models, teaching students, and bringing these techniques to end users. Since many tools are used not only in the Netherlands but also in many other countries, the societal relevance could be judged as "good".

The way this group is organized, societal relevance is brought out only when proper alignment of the group's work is made to the more scientific or water resources management oriented programmes within IHE. An example is the work the group has done in collaboration with the HERBD group. The group should aim to achieve similar results in collaboration with hydrology and water resources management groups within the IHE.

Vitality and feasibility (Viability)

We believe that the group has a lot of vitality and has very good prospects for the future. This group has maintained itself at about 20 members and is therefore large by IHE standards. The amount of funding that the group has raised is very good and the final outcome from research projects is noteworthy. The reviewers are of the opinion that the group was capable of applying new philosophies and approaches in education and research, by producing original and new results related to the interaction between humans, water and natural hazards. There is so much the group can do to utilize new technologies widely available in the developing world (e.g. cell phones) and combine these with analysis tools that will make the work of water professionals more effective.

The underlying philosophy of the group is promising. The research portfolio of the staff is full and the group regularly acquires funding for projects that makes it possible to hire new staff. The Hydroinformatics Laboratory, created in 2012, has the potential to support advanced and new forms of research. The attention of the group to addressing emerging research fields, with the ambition to play a leadership role at the international level, is particularly promising. The group lacks support of IT experts and infrastructure that would allow “translation” of the developed research ideas into software. Finally, the several rounds of rebuilding of key staff of the group together with the considerable teaching load in developing countries, may have limited the group’s full potential in research.

Nevertheless, it is important to maintain the group’s leading role in education for the developing world in Hydroinformatics. The key for success is balancing the basic and applied aspects of the research, and improving productivity by adjusting strategic plans. However, the leading role of the group may be threatened because more research organizations are moving into Hydroinformatics. There is a great potential for this group in the new “information” age – provided data-mining and data-based learning are brought out as key aspects in the strategic plans for the future.

Recommendations

- The review panel feels that current research efforts are still constrained by a legacy of the past. What is the vision for the future in Hydro-informatics at IHE? Where does this group wants to be? The group will benefit from clear definition and rationale for Hydro-informatics, looking to the future in the emerging “information age”. A vision statement and/or a strategic plan that is updated regularly will aid in setting the course for the future.
- The nature of the interactions of Hydro-informatics with other IHE groups is not well-defined. The role or purpose (i.e., support or independent research) of Hydro-informatics should be established and its relationship to the other research groups must be clarified. There is still a close cooperation with the HERBD Group, which again is a legacy of the past. The vision statement should elucidate, in addition, its plans for the future, and the nature of its relationship to all groups within IHE.
- The organization of the group impacts its societal relevance. We recommend that the group make a realistic effort at marketing its tools and conducting educational training programmes aimed at water professionals (including in developing countries), independently of its joint efforts with other IHE Groups.

Programme 13: Hydrology and Water Resources Group

Programme leaders: Prof. Dr. M.E. McClain (since 2013)
Prof. Dr. S. Uhlenbrook (until 2013)

Research input 2013: tenured staff: 3.5 fte
 total staff: 9.8 fte

Assessment scores: Scientific quality 4
 Productivity 4
 Societal impact 4
 Viability 4.5

Introduction

The mission of the Hydrology and Water Resources Research group is to contribute to a better understanding of hydrological processes from hillslope to basin scales, to improve techniques for data monitoring and handling, to improve modelling of processes within the hydrological cycle, and to interpret and present results for implementation of water resources management. The research activities of the group focused in three areas: hydrological processes near the earth's surface, ecohydrology, and basin hydrology and global changes. In general the committee found that this group has done well over the past 5 years and has the potential to achieve even more under Professor Michael McClain who recently became the chair of the group. We were impressed both by their ability to obtain outside research funding and by the social relevance of the research, but at the same time they have not made use of their research findings in diverse settings to publish synthesis papers in high profile journals. The latter should not be taken as a critique, because the emphasis of this group is on educating students from developing countries that are and will become leaders in their countries either in educational institutions or in government, but we believe that the potential exists to make even more of an impact on the global hydrology scene than they have done in the past, and this should not be under-estimated.

Scientific quality

Prof. Stefan Uhlenbrook has been a good leader. He took over as head of the group in 2005, when the research part of the program was essentially non-existent. By 2007 the group had grown to include 7 PhD fellows and published about 15 peer-reviewed papers per year. By 2013 the group nearly doubled in size through the addition of PhD candidates. In 2013 the group had 3.5 FTE in research and an amazing 36 refereed journal articles of good quality. On the average there were 10 refereed journals per faculty FTE which is a good average especially for an institution that has a heavy teaching load. Some of these articles were in high impact factor journals such as *Ambio* and *Nature Climate change*.

The faculty and PhD students are well-respected as evidenced by their awards, senior service roles, membership of editorial boards, and invitations to speak at conferences. The active alumni network is also a good sign that the IHE experience is a good one. Finally, while the group is engaged in numerous research activities throughout a wide research network, the major research advances were not well articulated. With the heavy

teaching load, low investment of IHE in funding research and the heavy emphasis on outside funding, this is understandable.

Productivity

The research foci (i.e., hydrological processes, ecohydrology, and global change) are of broad interest and the group has organized several interesting conferences and produced many relevant publications in well-respected journals. The number of refereed publications has dramatically increased since 2007. The articles address holistic hydrologic issues relevant to different geographic regions (e.g., southern Africa, Ethiopia) rather than focusing on particular hydrologic process and yet they are of broader international interest. There is a laudable trend of having students publish as first authors which is in agreement with the mission of the Institute

The number of PhD students of around twenty is good for the number of staff. The graduation rate with approximately six PhD students during the previous years and approximately the same number graduating next year show good productivity. The duration of six years acceptable in the European system is a long time for faculty or staff from developing countries to be away from their respective work situations.

The Hirsch Indexes of Professors McClain and Uhlenbrook are good but are low for most of the remaining faculty. It is not clear how much internal capacity building is done to develop professional skills of junior staff. The appointment of McClain in 2013 as Head of the Group is seen a positive step since Professor Uhlenbrook has taken on the position of Vice Rector.

Societal relevance

With respect to critical water issues, the group has a long history of research cooperation with local water authorities, development organizations and private sector partners. In all cases, specific research activities are co-designed and co-developed with key stakeholders. The impact of the group, therefore, on the social relevance was the most significant .

In addition, the faculty members, along with mentor students from developing countries conduct specialized classes in which the research outputs are incorporated into the educational and capacity building activities of the group in the form of case studies. In addition the group conducts specialized classes, organize field “lessons” to educate local authorities, and embed themselves in ongoing water development activities. The importance of the group’s activities is essential for the sustainable management of water in many developing countries, and several are described in the self-evaluation report.

Finally group members interact with local media in the regions where they work and contribute to the communication strategy of the institution.

Vitality and feasibility (Viability)

The Hydrology and Water Resources Group has in cooperation with the laboratory staff the analytical capacities to accommodate tracer studies using stable isotopes and synthetic DNA. The group was involved in obtaining high performance computational capacity. While the strategy for maintaining long-term viability is good, we remain concerned about the weaknesses and threats identified in their SWOT analysis as well as the drop-off in incoming MSc students. The decline is likely caused by greater interest in irrigation in developing

countries (supported by the fact that enrolment in “irrigation related groups is increasing). A realignment of the program structure to deal with the increase in the amount of water needed for irrigation during the dry phase of the monsoon could be an option.

Recommendations

- The academic staff in this group is experienced and well qualified. However, for continuity it is important that when a possibility exists, appointing a young and brilliant faculty member should be given high priority.
- The group’s main emphasis on raising research funds to increase the number of PhD students has obtained good results. This requires an open mind and a broad research portfolio. In addition to the excellent progress made by the group in the recent past, it is desirable in order to continue the trend forward, to formulate a research plan for the next five years with specific goals that address the group’s mission and ways to fund the envisioned activities.
- The review team is of the opinion that the HWR Group, in view of the work they do in many parts of the developing (and developed) world, across gradients of climate and socio-economic status, have a great opportunity to carry out synthesis efforts that bring out the similarities and differences between the various research locations and frame these in terms of the underlying controls. They should take it upon themselves to publish review and synthesis papers in high profile journals (such as, for example *Ambio*, *PNAS*) and even in regular hydrology journals. This recommendation does not apply only to this group but to all IHE Research groups.

Programme 14:	Land and Water Development	
Programme leaders:	Prof. Dr. Ir. Ch. de Fraiture (since April 2012) Prof. B. Schultz (until April 2012)	
Research input 2013:	tenured staff:	1.0 fte
	total staff:	10.7 fte
Assessment scores:	Scientific quality	3.0
	Productivity	3.0
	Societal impact	3.0
	Viability	3.0

Introduction

The assessment of this group is based on the total six year review period that ended in 2012. The new and excellent leadership of Professor de Fraiture who started in 2012 is acknowledged by the reviewers but is not represented in the current scores and narrative. The evaluation committee believes that with the new leadership the group is in a good position to achieve substantial progress.

Scientific quality

The group has a long history of research that has been narrowly focussed on irrigation and drainage. As such, the scope of research undertaken has been limited and the journals in which they have published have been focussed on technologies with limited impact beyond this focus.

There has, however, been a clear progression since the appointment of Prof de Fraiture. The reviewers believe that this is a good appointment and that there is already an upward trajectory in terms of the quality of research being produced. This is also seen in the increasing number of publications and the journals now being targeted. However, the Academic Reputation of the group remains below average as judged by professional awards, editorships, and speaking invitations and it is also clear that over much of the past 6 years there has been limited output that would be considered high quality.

PhD output has been steady at around 1 graduating PhD student per year, but it is difficult to assess the quality of these, as there is no evidence of journal articles arising from them. The Chair noted that PhD theses as monographs have been preferred until now and that the "sandwich programme" model limits truly original research.

The previous 2008 assessment and the low scores achieved then are noted. There seems to have been a progression since 2012, but little seems to have changed in the years 2008-2012.

Productivity

Productivity since 2008 has been low with only a single journal article published in 2010. There has been an increase since then, but productivity over the review period is generally below expectation. There have been a number of “non-refereed” articles produced. These are important, but seem to have been the focus and in the case of conference proceedings have not been converted to journal articles.

The group has steadily produced 1 PhD graduate per year. There is now an increase in the number of PhD students and the review group notes the opportunity for new PhD’s through the increasing number of MSc students attracted to this field of study.

Overall, the scientific productivity of the group has considerable scope for improvement.

Societal relevance

The societal relevance of the research, particularly in the developing world is clear and the group has done a good job ensuring that their research has an impact. The research that is taking place (in collaboration with other IHE groups) is well embedded in local communities and seems to have opportunities to provide important benefits to people “on the ground”. In addition, products such as the FAO level guidelines highlight the broader relevance of this group’s research beyond single field sites. It is important to maintain links to international groups such as IWMI and the high profile of Prof de Fraiture is significant in this regard.

However, the moderate score awarded reflects that the appointment of the Chair is a recent development and the reality of the extent of the impact that a small group can make.

Vitality and feasibility (Viability)

This is an area of major concern. Despite the appointment of a new staff member (to start later in 2014) and the recent appointment of a dynamic Chair with a strong vision for the future, the reviewers are concerned that the small staff complement are not in a position to take advantage of opportunities offered by the increasing student numbers in the associated MSc programme and the strong development focus (including irrigation) in the IHE target countries.

The group has raised concerns about their ability to attract “research” rather than “development” funding and that their applied research focus limits their ability to publish in high impact journals. However, this should rather be seen as an opportunity, not a limitation, especially given the group’s stated intention to “leverage” their existing resources to ensure stronger research quality and productivity in the future. This should also be seen in the context of suggestions below regarding the broader research strategy and opportunities where the group could be consolidated with other groups at IHE (see recommendations below). The challenges will be substantial if additional support is not forthcoming soon.

The staffing complement is low and several members have low productivity. There is no mention of how this aspect will be addressed, nor on any recruitment plan to cover staff that will retire within the next 6 years and how this will link to the group’s future vitality and feasibility.

Recommendations

- It would be prudent to consider setting near-term goals for the group, with the current numerical scores being contingent upon meeting these goals within three years, and the condition that the Group's progress be reviewed annually.
- The group's focus is very narrowly on irrigation rather than the broader themes of "land and water" or "food security". Given their small size, a meaningful contribution to these two broad themes is unlikely. The group should consider developing the "ecological irrigation" theme more fully and make this an area of focus. There are clear opportunities in a theme of this nature to incorporate the rapid way in which traditional/ smallholder systems are changing with the rapid uptake of new and newly available technology such as cell phones, cheap motorized irrigation pipes etc.
- The Group's research should be consolidated with one or more other IHE research groups in order to increase their critical mass and trans-disciplinarity, while the MSc program can stand by itself for the time being. The Aquatic Ecosystems group appears to be the most obvious to join forces with. Although there are already joint projects, joint supervision etc. between the two groups, the review group believes that the research impact of both groups could be significantly enhanced through the establishment a larger group focused on the need to produce more food without compromising the ability of natural system to provide other services. This provides an opportunity to bring irrigation engineers and ecologists together at IHE – in line with the larger vision articulated by the Chair. It could also alleviate the high administrative burden associated with academic leadership of a Research group.
- The Group should graduate 2-3 PhD students, and the dissertations published in well-regarded professional journals.
- The Group should clearly demonstrates how the MSc theses are contributing scientific advances, especially the broad understanding and management of "ecological irrigation" and/or "water for food".
- The Group, especially the faculty, must aim to publish synthesis articles on these new themes (or other appropriate topics) in high profile professional journals (e.g., PNAS). For example, these could be timely reviews of contemporary issues relating to land and water management (e.g., water for food, water-food-energy nexus, balancing the needs of humans and the environment etc.) rather than based (and building) on focused or localized research results.
- The group, and IHE as a whole, should consider how they use Post Docs in their research. The intention that Post Docs remain in their home countries is laudable, but in programmes where Post Docs are utilised, they seem to be utilised as field workers who facilitate the research rather than scientists generating publications.

Programme 15: Pollution prevention and resource recovery

Programme leader: Prof. P. Lens

Research input 2013: tenured staff: 1.7 fte
 total staff: 27 fte

Assessment scores: Scientific quality 4
 Productivity 4
 Societal impact 3.5
 Viability 3.5

Scientific quality

The Group has developed joint MS and PhD degrees with international institutions, which is a special achievement and is giving the Group good visibility. If the Group and the partner institute provide equal support and rigour, this approach can be a successful way of increasing the international impact of the Group. It is very important to have good quality control mechanisms in place in case one side significantly decreases support and the quality of the program on that side decreases significantly.

The group has developed a process for bio-precipitation and recovery of metals applicable to industrial areas of developing countries that can mitigate local pollution. The group should look for other processes / eco-technologies which fit the concept of resource recovery and can expand the portfolio of useful technologies.

Productivity

The generation rate of 25 papers in refereed journals per year by 4.4 FTE is good; about 20% of these are in the top 10% of journals ranked according to quality, which is quite an achievement. Three senior faculty have recently left the group so the new members of the Group will have to compensate for this.

There has been a strong increase in the number of PhD candidates during the reporting period, for which the Group is to be commended. However, the teaching load appears to be high and it is suggested that the Group assess the relative amount of effort placed on teaching compared to research.

The Group has made good contributions to the development of their profession. The Group Chair is editor of the Reviews of Environmental Science and Biotechnology Journal that has an Impact Factor of 2.3. They also contributes to policy briefs for several learned societies; it has 2 online courses and finally its output of PhDs is higher than average (20 in the last 7 years).

Societal relevance

The group is very interconnected to the social media through the use of You Tube, blogs, and special programmes, which serve to raise awareness of pollution prevention and resource recovery issues in the general public. However, care must be taken to prevent such activity from consuming too much time.

The outstanding societal relevance of the Group's main research areas (cleaner production, resource recovery, and development of eco-technologies) is constantly rising with a growing world population. It is appreciated that the Group is careful to select organisations to collaborate with based on clear criteria, such as the potential of establishing joint degrees, the availability of reliable research facilities, and geographical location, in order to make best use of their time.

The links maintained with their alumni, particularly by stimulating them to contribute to the journal edited by the Group Chair, are warmly welcomed.

Vitality and feasibility (viability)

The seniority distribution and the scientific profile have improved via recent recruitments of younger staff members. However, the scientific staff is exclusively male, and a better gender balance will provide female role-models that are important for the Group.

The Group has demonstrated its ability to function in a large number of areas and demonstrates its ability to adapt to new problems

Recommendation

Due to historical reasons, there is some overlap in research areas between this group and the SE group. The PPRR Group should explore areas not directly related to sanitation, such as industries where the topics of cleaner production, resource recovery, and eco-technology development have great potential. For the areas that are in the purview of both the SE and PPRR Groups, close collaboration is highly desirable.

Programme 16: Hydraulic Engineering and River Basin Development

Programme leaders: Prof. A. Mynett (since 2009)
Prof N. Wright (until August 2007)

Research faculty 2013: tenured staff: 1.6 fte
total staff: 15.9 fte

Assessment scores: Scientific quality 3.5
Productivity 4
Societal impact 4
Viability 3.5

Introduction

This Group deals with a very important area within UNESCO-IHE. The preliminary assessment of the scientific interests and production of the Group gives the feeling that the research activity covers a large spectrum of topics that may appear on first glance fragmented. The self-evaluation report lists 4 major research themes that do not look intimately connected. This situation seems to be the result of the historical legacy of the Group, which experienced a recent change of the Chair and is still adjusting to changes in the research environment.

Scientific quality

The group has a steadily increasing scientific productivity that in topics that have a long history, in view of the societal relevance of the related research challenges. The number of published items per full-time-equivalent is good. The Group produced significant contributions on the subject, spanning a wide range of problems related to river hydraulics, bridge safety, inundation modelling and Hydroinformatics. The academic reputation of the Group members is high and is increasing. Group members regularly attend international conferences and workshops and their contributions are generally well respected. Some of the Group members are leading scientists in their field. The presence of group members in governing boards is also significant. The quality of the PhD trainees is good/very good and their number is increasing. It is clear that Group members feel deeply committed to Education, which is in accordance with one of the primary missions of UNESCO-IHE. They supervise a large number of Masters and Ph.D. students.

During the face-to-face discussion the enthusiasm and motivation of the Group members clearly emerged. They came across as a very unified team, enthusiastic, with good ideas and a clear vision. The Chair has a very good perspective on the Group's activity and showed good leadership, but he is close to retirement. However, the leadership capabilities of other members are also impressive, something to build on for the future.

Productivity

The group produced on average 1.78 refereed articles per fte each year, and in particular the productivity increased to 2.4-3.1 in 2012 and 2013. There were 8 papers (about 12% of total

peer reviewed articles) in top 10%, and 0 in top 1% journals. The prestige of the journals where contributions were published is therefore appropriate and the publication list highlights a good internal organisation of the Group, given that the contributions cover complementary subjects. Furthermore, the output is fully consistent with the mission of the Group. The publication list still includes a large number of non-refereed contributions, therefore highlighting room for potential improvement. It is also relevant to note a steady number of publications directed to the general public.

In general the productivity of the Group in terms of scientific papers is not outstanding. Also, the visibility of the scientific production is not outstanding, but this might be related to the narrowly focused subject matter of their contributions. In fact, several articles are published in high profile journals, but the research questions are very specific or narrow. The Committee had the impression that high priority is given to teaching activities therefore limiting the scientific output. On the other hand, the Group appears to be highly productive in serving national agencies and foreign education programmes. It is also noteworthy that the Group members regularly attend international meetings and are in the process of organizing a very important and large-size international scientific conference. It is also relevant to mention a strong focus on developing regions of the world.

Finally, the group is very productive in securing funding. Group members are very active and leading scientists within EU projects, with a special focus on the mitigation of natural hazards.

Societal impact

The topics studied by the group have much societal relevance, as they are related to natural hazards assessment and mitigation. The group has a strategy to help solve real world problems and strengthening capacity in the developing countries. It is also important to note that the visibility of this group in the EU context is dominant.

The Committee is convinced that the effort to solve scientific challenges related to hydraulic engineering and river hydraulics should be further stimulated, as these topics are today less popular than in the past, yet their relevance for the public is high. The societal relevance of the research carried out by the HERBD group is also proved by the amount of funding that the group has been able to secure, which is noteworthy if compared with the average level of funding of the discipline and the number of full time equivalents in the Group. The Group is heavily involved in teaching and capacity leading in developing regions of the world and therefore the societal relevance of their research and educational efforts is indeed very significant.

Vitality and feasibility (Viability)

The Committee shared concerns about staffing levels and turn-over. The Chair of the Group is close to retirement and some important Group members are about to leave. The steady increase of the capacity of the group since 2011 and success in the start of several new research projects clearly indicate that the group is motivated and well organised. However, the turn-over is indeed a potential threat. The Committee noticed that there are opportunities that could be exploited in terms of growing capacity of the some of the current members. However, it is clear that new human resources are needed and it is also clear that the group would need to gain more full time equivalents. The human resources of the group appear

rather limited if compared with the efforts that might be required to reach the target of a broader perspective.

Recommendations

- The Committee recommends that the Group makes an effort to develop a consistent recruitment plan, which should be laid down well before the retirement of the Chair, in order to manage the situation in a proactive way. Staff replacement is an opportunity if it is efficiently managed.
- The Committee feels that the Group needs to make an effort to better brand itself. A more structured and integrated vision is needed in order to overcome possible fragmentation. The Committee is convinced that the Group has the potential to improve its visibility by focusing on more general and relevant research questions.
- Furthermore the Committee is convinced that higher priority should be given to research as the Group members appear to be over-committed to their education mission.

Programme 17: Sanitary Engineering

Programme leader: Prof. D. Brdjanovic

Research input 2013: tenured staff: 2.8 fte
 total staff: 12.9 fte

Assessment scores: Scientific quality 3
 Productivity 4
 Societal impact 4
 Viability 4

Introduction

Prof. Gary Amy, professor of Water Treatment Technology in the Urban Water and Sanitation Department, was also responsible for the Sanitary Engineering field in the period 2007-2008. In 2009 a separate Research group Sanitary Engineering was installed with the appointment of Dr. Damir Brdjanovic as Research group leader and Professor in Sanitary Engineering.

Scientific quality

The Group has published in high quality journals such as *Water Research*, and *Science* has just accepted one of its articles. The Group has also helped to start a journal for developing countries (*Journal of Water Sanitation and Hydrology for Developing Countries*). It has contributed to a set of important IWA textbooks in its domain. The Group also has a wide range of novel experimental programs in various developing countries.

This Group is just getting started after being formed by a re-organization of Institute activities in about 2009. The average publication rate is 8 articles per year, with 12 and 13 for each of the last 2 years, so the rate is increasing. The publications have above world average impact.

Productivity

The number of students has risen to full load of the available facilities. In the past five years the Group has established an impressive network of contacts in developing countries. They installed a series of novel pilot plants in developing countries and they have the potential to become a leading hub in the world in the field of sanitary engineering. They have the foresight to focus on long term cooperation and client bonding.

The Group has produced 73 publications in 2013, only 18 of which have been in refereed journals. The quality of output of the group would be enhanced by a higher rate of publishing in internationally competitive peer-reviewed publications.

The Group is very active in capacity development in developing countries; their impact on the research in these countries has been magnified through the thousands of individuals that have been trained by them in these countries, especially in Iran and in the Mediterranean.

Societal relevance

The Group deals very directly with the quality of life in developing countries, for example by predicting flooding events and removing sources of fecal contamination via improved waste treatment methods. They are not afraid to deal with the very basics of sanitation. They deal effectively with stakeholders such as the EU, financial institutions, and foundations that are interested to invest in sanitary projects for countries in need of new, low cost technologies.

Vitality and feasibility (viability)

The new sanitary engineering laboratory developed at UNESCO-IHE is a nice achievement and will be important in the Group's future education and research activities. The Group has a good proportion of tenured staff and a very large amount of third party funding. They are ready to take risks in terms of investing in a replacement and a new faculty position; and are now looking for individuals in the areas of urban water systems, urban drainage and sewerage.

They have the vitality to expand their activities, driven by societal needs as they arise in the developing world.

In view of the great importance of sanitation to society, and taking into account the unique role that IHE can play world-wide, the SE Group is in a very good position to make important advances in the solution of this major environmental problem.

Programme 18:	Water Management Group	
Programme leader:	Prof. P. van der Zaag	
Research input 2013:	tenured staff:	4.2
	total staff:	13.6
Assessment scores:	Scientific quality	4.5
	Productivity	4.0
	Societal impact	4.5
	Viability	4.5

Introduction

The group has articulated a clear mission, which is to contribute to developing and managing water systems that are socially, economically and environmentally sustainable. In their oral presentation they demonstrated clear and high ambition to be the leading group in the world in the area of water management, which we applaud. They are not there, but have the potential and our scores reflect this.

Scientific quality

The Committee was greatly impressed with the scientific quality of the group's research which we believe is approaching world standards and has great societal relevance. Overall, this is very strong, dynamic group undertaking innovative and meaningful research.

The group members have an excellent international standing and have produced an impressive number of publications in high-quality journals. In addition, they provide service through membership of Editorial Boards and participation in the governance of scientific associations. The group has a steadily increasing production in very relevant topics and with a wide and forward-looking vision. The bibliographic indices of the group members are outstanding, confirming their excellent international reputation. It has an excellent teaching and research network within the Netherlands and all over the world. In addition, the group plays a leading role in capacity building for integrated water resources management, in particular in developing countries

Productivity

The group produced on average 0.93 peer reviewed articles per staff, and 2.1 refereed articles per fte each year. The productivity became higher after 2011. There were 25 papers (17% of total peer reviewed articles) in top 10%, and 2 in top 1% journals. The productivity is very good, in spite of many challenges faced in converting societally relevant research to articles in peer-reviewed international journals. The citations received by the contributions were also very numerous, therefore confirming the societal relevance of the research output. The contributions covered a broad range of topics related to water management and much attention was devoted to developing countries. The effort of the group to produce

publications for the general public and professional publications is noteworthy. This kind of output is extremely important for developing countries.

Societal impact

The group undertakes directly societally relevant research in Asia and in Africa predominantly. It is clear that contributing to the knowledge and development of instruments for sustainable development is the main target of this group. The group is very efficient in seeking relevance of the scientific output and development impact. One excellent strategy is to conduct research jointly with local partner institutions and knowledge partners, as well as the relevant stakeholders and potential end-users. A lot of research is jointly carried out with local partner institutions. The dialogue with stakeholders is a key step in the activity of the group. This has enabled the knowledge gained from the group to be applied in the real world very effectively. It is also relevant that a significant part of the research output is directed to practitioners and potential users of the knowledge generated. Indeed, the achievements of the group in terms of capacity building for addressing relevant problems related to water security, with particular emphasis on developing regions, are very substantial. The group also played an important role in shaping water policies and creating platforms for research and training.

Vitality and feasibility (Viability)

The Committee believes that the group has very good prospects for the future. The underlying philosophy is promising. The fund raising capacity of the group is substantial, the internal organisation is very solid and efficient and the current composition of the group is promising, with the presence of numerous young members. The excellent international standard of the group members provides enormous opportunities in terms of international links. It is a key to maintaining the group's leading role in education and research for the developing world.

Recommendations

- The group chair and some of the group members are internationally recognized leaders in the field of water management. The Committee recommends that the group aim even higher and become true global leaders in this field. The aim of providing a unifying leadership to global water management efforts is ambitious, but is feasible.
- The group performs excellent research together with local stakeholders on the ground, specifically in Africa. It will be very valuable to prepare high level synthesis papers from the accumulation of their research outputs and publish them in high-profile journals.
- The research activities of the group were heavily focused on Africa. It may be helpful to expand research activities to Asia and other regions to further enhance the visibility of the group. The water accounting project supported by FAO provides such an opportunity to link the group to more countries, including China and India.

Programme 19:	Water Supply Engineering	
Programme leaders:	Prof. M. Kennedy (since 2010) Prof. G. Amy (until 2009)	
Research input 2013:	tenured staff:	3.2 fte
	total staff:	11.5 fte
Assessment scores:	Scientific quality	3.5
	Productivity	4
	Societal impact	4
	Viability	4

Scientific quality

We agree with the Group that its top achievement is its 14 PhD graduates, together with the MSc students who do research related to PhD dissertation topics and the publications that result from this research. Another very important Group achievement is the process for arsenic removal by waste iron coated sand that has been applied full scale in developing countries. The research group gets good international visibility from its research that is published in leading international journals. The senior staff members are regularly invited to give speeches at international conferences, and junior members and students have received several best paper awards.

Since 3 top faculty have left, the good junior faculty that have recently been hired are expected to develop in ways that will keep the Group strong.

Productivity

The Group is very active in capacity development in developing countries. We consider it likely that the individuals that have been trained in these programs have significantly improved the quality of water produced in these countries, and that the Groups' research has been magnified through the individuals that have been trained (e.g. more than 1000 people over the 5 year period). In addition, they installed pilot plants which led to the building of full scale plants in refugee camps. Water quality control processes that they have developed are now gaining general acceptance.

Societal relevance

The Group's primary focus on technology development for the supply of sufficient, good quality water in developing countries is highly societally relevant. The implementation of technological advancements is achieved via a strong network with Dutch drinking water industry and related industries (i.e. technology suppliers) but is always geared towards the real stakeholders such as water utilities, refugee camps and universities in the developing world. The group's contributions to the development of full scale drinking water installations for iron, arsenic and chromium removal have considerable, measurable impact in various countries, some of which are quite difficult to operate in.