STRENGTHENING IWRM EDUCATION IN SOUTH ASIA

Which boundaries to cross?

March 2009

SaciWATERs

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Summary of findings and recommendations

This report analyses how the higher education part of South Asia's water resources knowledge system has responded to the changing societal demands on water resources use, management and governance practices and approaches. The report seeks to answer the following question.

Is South Asia's water resources higher education system responding to the new (IWRM) challenges that face the water sector and South Asian societies and communities, if so, how, and what can be done to strengthen and support that transformation?

The new challenges in mind are those of ecological sustainability, of secure livelihoods and eradication of poverty, and of democratic governance. In 2001-2002, the first study of this kind was done (SaciWATERs, 2002). The Crossing Boundaries project of SaciWATERs in 2008 commissioned five regional inventories and four profiles of innovating education institutes with IWRM study programmes to revisit the situation in four countries: Bangladesh, India, Nepal and Sri Lanka.

Since 2000 the patchwork of water resources education programmes in the South Asian subcontinent has become more colourful and diverse. The dominant colour is still that of water resources engineering and hydrology focused education. Nevertheless, new initiatives are being taken, new programmes established and existing programmes adapted to address the three challenges. Among these the ecological challenge is receiving most response. The second and third challenge, livelihood security/poverty alleviation and democratic governance, come some distance behind that of ecology/environment. They are still very meagrely addressed. There are no real signs that gender & water is receiving more systematic attention in water resources education, except for some isolated courses.

A major finding is that in the policy sphere very little has happened and is happening as regards higher education in water resources. Change and innovation seems to be coming from the bottom, not from the top, that is, individual departments and universities are the innovators.

The key finding of the study as regards the demand for IWRM-type graduates in the South Asian region is that at present the demand for interdisciplinary professionals is confined to the development sector, namely, donors and funders and some NGOs, particularly, large ones with an international presence, though some demand for these skills can also be seen to emerge in the corporate sector. A growing need for interdisciplinary professionals is felt in the government as well, both by those who are in as well as outside the Government; however, a visible demand still needs to be created on scale.

The study suggests that the following 'things to do' are among the logical next steps to take for enhancing the transformation of water resources education in South Asia (see section 2.5 for more detailed description of each item).

1. Establish a South Asia IWRM education programmes network : There seems to be clear sense in a broader network or partnership of IWRM-interested water resources education programmes / institutes at South Asian national and South Asian regional level, across engineering, environmental science and social science/humanities programmes.
2. Exchange experience with regional IWRM capacity building networks in other parts of the world : Reform of water resources education is a global process, and there are possibly many lessons to be learnt for other regional IWRM capacity building networks, particularly those in the South.
3. Development of country-specific outplacement/employability strategies for IWRM graduates : These strategies have to include concerted effort to 'open up' government employment for IWRM-trained water professionals.
4. Develop a broadly-based South Asia IWRM fellowship programme : To strengthen and support the ongoing transformation of study programmes in the direction of more 'comprehensive' approaches to water and as a strategic tool for enhancing gender balance in water resources education.
5. Establish social science water resources education programmes : The South Asian water resources education landscape would be significantly enriched with the establishment of more social science water resources education programmes, as demand for governance, management and regulation expertise is likely to increase.
6. Strengthen the South Asia IWRM and interdisciplinary knowledge community : To expand the volume and enhance the quality of the IWRM and interdisciplinary water resources knowledge in South Asia.
7. Capitalise on Crossing Boundaries expertise : The Crossing Boundaries project aims to put expertise gained in the project on offer for other programmes and institutes.
8. Crossing Boundaries – phase 2 : A follow up and expansion of the Crossing Boundaries project with a larger number of partners and larger (geographical) scope is envisaged.

This list of eight 'next steps' will be developed into a concrete action plan in the course of 2009, for which everyone's collaboration and support is invited.

Chapter 1

Assessment of changes in South Asia's higher education on water resources 2000-2008

Peter P. Mollinga

1.1 Introduction : context and objectives

Across the world water managers, policy makers, educators, researchers, and the general public are struggling to achieve a 'paradigm shift' in water resources management. What this means is that the public policy approach to water resources management is shifting, or should be shifting, from a technical infrastructure creation, water harnessing, and supply enhancement perspective to a 'comprehensive' or 'integrated' perspective that addresses the multi-dimensionality of water resources use and management, acknowledges the multiple values of water, and includes the diversity of water resources 'stakeholders' in water use, management, and governance. This perspective implies the internalisation of three basic developmental challenges into 'normal water resources professionalism':

1. The challenge of ecological sustainability ;
2. The challenge of secure livelihoods and eradication of poverty;
3. The challenge of democratic governance.

There is a lively debate and practice in different regions and at different levels on how to achieve such internalisation, involving very different viewpoints, intense contestation, with no consensus in sight. A lot of this debate and practice happens under the label of IWRM, integrated water resources management. The diversity of opinions and strategies for action that are associated with IWRM illustrate the emerging nature of the 'new paradigm'.

The present process of change in the basic orientation of water resources management is, we suggest, not very well captured by the idea of a shift from one paradigm to another. It is much better understood as an ever present contestation of multiple paradigms, with some more dominant in some periods of history and others in other periods. Public policy approaches to water resources management shift over time with changing societal priorities, though such change by no means happens automatically and smoothly. It tends to involve a lot of effort and struggle. Each of the three challenges listed above has a constituency promoting it actively, as has the 'old paradigm'. Environmental movements and green political parties for instance are promoting ecologically sound use and management of water resources. The supporters of the Millennium Development Goals primarily focus on reducing poverty, through better water resources access and management, among other things. The Water Integrity Network(WIN) is an international NGO seeking to address the issue of corruption in the water sector, while many governments attempt to, or are under pressure to pursue, 'good governance' agendas. The existing water bureaucracies and building companies actively seek to promote investment in water infrastructure, defending their turf and professionalism[1].

This process of contested change is also happening in South Asia – at different levels, with different intensities, and with different outcomes. One clear sign of this is the increasing attention to 'water conflicts', from the realisation that 'business as usual' scenarios seem to have run their course, and that increasing competition for a scarce resource, new societal priorities, economic and demographic growth, climate change, and other factors require a change in perspective.

A change in perspective requires a change in the knowledge system. More comprehensive and integrated approaches to water resources use, management and governance, require a more comprehensive and integrated water resources knowledge base. Since the early 2000s SaciWATERs, the South Asia Consortium for Interdisciplinary Water Resources Studies has attempted to contribute to the transformation of South Asia's water resources knowledge system from a pro-poor, human development perspective (www.saciwaters.org). The main vehicle for that effort has been the Crossing Boundaries project (www.saciwaters.org / CB / cbhome.asp)[2]. Fully operational from 2006, the project focuses on the establishment and strengthening of IWRM Masters programmes in Bangladesh, India, Nepal and Sri Lanka [3] , accompanied by a series of supporting activities including staff trainings, publication of readers, interdisciplinary action-oriented research, short-term training programmes, international conferences, and several other activities.

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[1] The term 'adaptive management' is gaining popularity in the global discourse, often in the context of adaptation to climate change, but also conceived more broadly. The image of contesting paradigms and shifting balances of influence on decision making fits with the notion of 'adaptiveness'. However, both the terms integration and adaptation beg a similar set of questions: integration of what, adaptation to what, with what purpose, and to whose benefit? Rather than spending time on general definitional questions, it seems more important to address the latter specific set of questions for the situation one finds oneself in.

The project provides Masters Fellowships to about 160 fellows, 85% of whom are women. The project aims to strengthen the position of women in the water sector in this manner, and also includes women water professionals networking and gender and water research activities.

The Crossing Boundaries project was designed on the basis of an inventory of the status of higher education on water resources conducted in 2001-2002 (reported in Higher Education on Water Resources in South Asia: Towards Capacity Building for IWRM, SaciWATERs, June 2002). This inventory looked at the same question that this study and report has looked at.

Is South Asia's water resources higher education system responding to the new (IWRM) challenges that face the water sector and South Asian societies and communities, if so how, and what can be done to strengthen and support that transformation?

The answer to the first part of this question in 2002 was not extremely encouraging (see Box 1.1 for the conclusions of the 2002 inventory). Water resources education was primarily civil engineering and hydrology focused, and there were few signs indeed of change, certainly not of an overall change or response to the new challenges. But there were a few – innovative institutions in the 'core' of the water sector that had decided to chart a new course and reorient their education programmes. Some of these became partners in the Crossing Boundaries project. The project strategy adopted was to engage with the transformation process from the bottom rather than the top. The project has brought together innovators to jointly develop new approaches to water resources education. After more than three years down that road, and working in four countries, we are confident to state that the transformation 'can be done' (see Part 3 for accounts and assessment of Crossing Boundaries partner institutes activities).

The immediate question now is - how can this positive experience be outscaled and upscaled? Four programmes in the whole of South Asia are perhaps the proverbial drop in the ocean. Another question is – even if such programmes can be created, is there a demand for the new 'hybrid professional'? A third question is – is a broader educational response to the new challenges emerging, or is the scenario still as bleak as in 2001-2002?

To address these questions the Crossing Boundaries project decided to undertake a second inventory, roughly seven years after the first one was done. Studies were commissioned in the four Crossing Boundaries countries, with India divided in North and South, given its size. The overall study had the following three objectives.

1. Produce an inventory study on the state of the art of higher water resources education in South Asia.
2. Assess the demand for 'new water professionals' with a broader interdisciplinary profile than the 'conventional' engineering and hydrology focused profiles.
3. Develop ideas on how to facilitate reform of higher education on water resources in this broader direction.

This chapter reports the overall outcomes of the study. It particularly addresses objectives 1 and 2. The 'what next?' question (objective 3) is addressed in chapter 2. The chapter summaries ideas generated by participants in the Crossing Boundaries project' international conference on Water Policy in South Asia held in December 2008 in Colombo, Sri Lanka. The first results of the inventory study were presented there in a separate session, and participants invited to suggest ways ahead. These suggestions are briefly compared with outcomes of the commissioned regional studies and partner institute profiles.

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[2] The full title of the project is Crossing Boundaries. Regional Capacity Building on IWRM and Gender & Water in South Asia. It is financially supported by the Government of the Netherlands (Directorate General for International Cooperation DGIS, Ministry of Foreign Affairs). Project partners are Centre for Water Resources (CWR), Anna University, Chennai, Tamil Nadu, India; Postgraduate Institute of Agriculture(PGIA), University of Peradeniya, Peradeniya, Sri Lanka; Bangladesh Centre for Advanced Studies (BCAS), Dhaka, Bangladesh; Institute of Water and Flood Management (IWFM), Bangladesh University of Engineering and Technology (BUET), Dhaka, Bangladesh; Nepal Engineering College (NEC), Kathmandu, Nepal; Tata Institute of Social Sciences (TISS), Mumbai, India; Irrigation and Water Engineering group, Wageningen University, Wageningen, the Netherlands; SaciWATERs (South Asia Consortium for Interdisciplinary Water Resources Studies), Hyderabad, India.

[3] Expansion of activities to Bhutan and Pakistan is envisaged.

Box 1.1: Conclusions higher education on water resources inventory study 2002

- There is heavy bias in the higher education of WRD towards engineering and other technical disciplines in terms of the course content, with exclusion of social science disciplines.
- There is hardly any link of the course content with live problems from the field areas. The designing of the courses is based on formats supplied by central agencies far removed from field conditions.
- Poor infrastructural and financial support for maintaining professional practice for WRD capacity building in universities and colleges.
- Declining interest in the WRD subject as a professional discipline in terms of decreased student strength for the programme and weak job market.
- Lack of up-gradation of teaching skills and methodologies in majority of the universities.
- Lack of up-gradation /assessment of teaching programmes for WRD.
- Weak research base for WRD teaching- no incentives, facilities and funds which in turn lead to weak teaching programmes.
- Brain drain of the better skilled in WRD because of lack of opportunities within the country
- Government jobs for the output of WRD graduates are declining. Private sector and NGO sector cannot compensate for that in terms of salary level and job security.
- Large proliferation of engineering colleges in the private sector with civil engineering as one of the disciplines but very often of poor quality in countries like India, But in Pakistan these are the more expensive and sought after colleges compared to government colleges.
- Some innovative attempts to broaden the scope of WRD education in water focused institutes are in evidence and they are potential points for locating pilot experiments to initiate IWRM capacity building programmes.
- Formal database for capacity building for IWRM is weak. However, there does exist a practical and experiential knowledge base that is scattered over time and space. This needs to be tapped for building up IWRM capacity.
- All teaching is formal and class room based. This means that graduates of WRD have to be retrained for any job that they do.
- Most WRD education focuses on designing for heavy irrigation projects that support irrigated agriculture while water management in low rainfall areas is neglected.
- Social context of technological choices for specific areas is not duly recognized and WRD graduates are trained to decide purely on technical considerations.
- The WRD course content and training is gender blind.
- There is no awareness of water policy and water history issues.
- A study and appreciation of traditional water management knowledge base and practice by the various communities is conspicuous by its absence but needs to be tapped.
- State ownership of water resources and 'National Water Policies' controlled by the government as opposed to people-oriented water issues and concerns that emerge from below – has geared the WRD and its education for serving the 'government needs'. These do not necessarily' coincide with those of the people – leading to a 'governmentalisation' of not only of thinking of WRD but also of its education, planning, and practice.
- The traditional knowledge base of communities for water management has been marginalized by the domination of the education paradigm of WRD.
- The plethora of 'trainings' through fragmented and isolated programmes creates an illusion of capacity building as it is difficult to train the students that are the output of a system of education (based on colonial origins) that is based on drilling of information through rote. In the name of discipline, creativity and questioning spirit is discouraged. The minds are trained to execute what is taught and not to 'think' with originality and freedom.

Each of the five regional studies involved three components.

a) Inventory study of curricula of selected educational institutions (re-visit of earlier institutions and selected new ones).
b) Assessment of the demand of water professionals (mainly their 'employability').
c) Assessment of literature and policy documents and interaction with policy makers on opportunities and constraints for higher education reform in the field of water resources.

Part 2 (chapters 3-7) gives summaries of the main findings of the regional studies. The longer versions of these reports are available on the SaciWATERs and Crossing Boundaries website. The extensive annexes with information on individual study programmes are available for consultation in hardcopy version in the SaciWATERs office in Hyderabad, India.

The Crossing Boundaries partner institutes conducting IWRM Masters programmes were invited to write an account and self-assessment of the changes and challenges of the past few years in designing and implementing the new programmes. These are included in Part 3 (chapters 8-11).

Together, the different components of this document provide a state of the art description of the ongoing transformation of higher water resources education in South Asia in the direction of more 'comprehensive', 'integrated' and 'adaptive' approaches to water resources management. Such a transformation is, indeed, slowly happening, as the subsequent text will show. Chapter 2 will be the basis for the design of an action plan to address the many challenges on that route.

1.2 Water resources education in South Asia : slowly broadening out

Since 2000 the patchwork of water resources education programmes in the South Asian subcontinent has become more colourful and diverse. The dominant colour is still that of water resources engineering and hydrology focused education – this is the case in all four countries/five regions studied: Bangladesh, North India, South India, Nepal and Sri Lanka. There certainly is no discernible massive change in the orientation of higher water resources education. Nevertheless, new initiatives are being taken, new programmes established and existing programmes adapted to address the three challenges mentioned in the first section. Among these the ecological challenge is receiving most response. There is a clearly observable trend of stronger focus on the environmental and ecological aspects of water resources management. This partly happens within existing engineering and hydrology programmes, but more prominently in environmental studies programmes that (also) focus on water resources. This pattern is visible in all the four countries.

In the past decade a substantial number of new environment-oriented study programmes with a focus on water resources have been established in Bangladesh (see chapter 3). The increase in student numbers in the environmental study programmes offering water resources courses is noticeable. The Department of Environmental Science (DES) of Jahangirnagar University (JU) shows enhanced enrolment from 12 in 2002 to 30 in 2008. The Department of Environment Management of the Independent University of Bangladesh (IUB) initiated the Masters in Environment Management programme in 2006, enrolling 12 students. This number has also risen to 30 in 2008. The spread of courses over the categories technical/engineering, social/managerial, and environmental/ecological is more balanced in the environmental programmes than in the engineering programmes. While in Bangladesh, in the engineering programmes that were studied, engineering courses constitute two-thirds of the total, in environmental programmes environmental course constitute just over half of the total. Similarly, in Sri Lanka, the number of degree programmes focusing on environmental engineering and management has clearly increased over the past decade (see chapter 7).

The second and third challenge, livelihood security/poverty alleviation and democratic governance, come some distance behind that of ecology/environment. They are still very meagrely addressed. There are no real signs that gender & water is receiving more systematic attention in water resources education, except for some isolated courses.

Across the regions field-based knowledge is identified as an important gap in most education programmes, particularly by students, indicating some degree of remoteness of water resources education programmes from ground realities.

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[4] The geographical scope of the present survey is four countries, being Bangladesh, India, Nepal and Sri Lanka, while in the 2001-2002 survey Pakistan and Bhutan were also included. For the current exercise we focused on the countries of the partners institutes, with an eye on follow up activities.

[5] Further information on the methodology of the regional studies is included in Annex I, and Annex II for the Partner Institute profiles.

Some examples of innovation in water resources education programmes

The North India chapter (chapter 4) presents a description of a recently (2007) established water resources management Masters programme at TERI University, New Delhi. The programme is very innovative and explicitly positions itself as educating students in an 'integrated' manner. As a case example it expresses many of the opportunities and challenges of such programmes.

- It has a good mix of different kinds of courses (environmental, governance / socio-economic, hydrology / engineering, communication & methods).
- The inflow of students is from a varied background; many from the life sciences.
- Project work in a water organisation is an important part of the programme.
- The 'development sector' is the main envisaged employer, notably international NGOs and development organisations.

One challenge that the programme faces is that the students function as cheap consultants during their project work, while the employment chances in the organisations they work in are not very good. Bilateral and multilateral development organisations prefer more experienced employees. The actual job market for the graduates may become the consultancy market. The corporate sector may prefer male employees (while most students in the programme are female), and a broader orientation of 'environmental management'. Students feel competition from the more 'specialised' institutes like the IITs (Indian Institutes of Technology).

Some of the themes, discussed in more detail below, clearly emerge here. The TERI programme is a bottom-up initiative from a university – no government policy or other top-down factor enforced or induced its initiation. The employment situation is as yet unsettled. The IWRM-type professional profile still has to find and carve out its institutional space. What this programme also suggests is that a more broadly based water resources programme is likely to attract more female students that engineering/hydrology programmes do. The latter are almost exclusively populated by male students. This resonates with experiences in other places, like Wageningen University, the Netherlands and Peradeniya University, Sri Lanka.

The Faculty of Social Sciences & Humanities at Rajarata University of Sri Lanka offers a three year Bachelor of Arts (BA) General Degree programme with a significant water resources management component. The 2002 SaciWATERs inventory study lists only one course under this Department. Subsequently however, the department has offered this three year degree programme to undergraduate students with the option of majoring in Water Resources Management. The Department of Social Sciences contributes to the courses offered that cover aspects of IWRM in a significant manner. This programme perhaps is the only such social science water resources programme offered by a university at degree level.

In the South India region the Water and Land Management Institute (WALMI) in Aurangabad, Maharashtra seems to be the training institute most abreast of the new developments in the water sector. However, similar institutes in other Indian States are much less dynamic. An innovative example in the field of training is the Groundwater governance in Asia: capacity building through action research in the Indo-Gangetic basin and Yellow River basin training programme. This programme was initiated by IWMI (International Water Management Institute) in collaboration with the Institute of Rural Management, Anand (IRMA) and the Chinese Academy of Sciences, China with an objective to impart interdisciplinary training to officers and professionals in the realm of groundwater management in these two prominent river basins of Asia. The project was supported by the Challenge Programme on Water and Food and was carried out over the period April 2005 to July 2008. The exercise sought to create a cadre of 80 future young and senior leaders of groundwater sectors of the basin states who would be better equipped for proactive and informed groundwater governance in the region. The basic purpose of the project was to contribute to the enhancement of the capacity of existing institutions in the basin states involved in groundwater research and management to undertake more integrated, multi-disciplinary and sustainable approaches to groundwater governance. The underlying philosophy of the course was that the government set-up for groundwater governance is predominantly technocratic and needs to be sensitized more to management issues and challenges. The course consisted of two parts: i) a four week intensive class room course; and ii) a 12-week training/crosscutting research programme under live field conditions.

Where does innovation come from?

The third element of the study was to look at policy changes in the higher education and water resources domain that further or hinder the outscaling and upscaling of IWRM education. The main finding is that in the policy sphere very little has happened and is happening as regards higher education in water resources. Change and innovation seems to be coming from the bottom, not from the top.

This is evidenced by developments in Bangladesh. The issue of reforming water resources education is occasionally mentioned in national level policy documents, but this has not lead to any concrete action. Policy making at university level seems to be more vibrant, as illustrated by the establishment of a series of new study programmes in the past decade. Departments usually take the policy decisions, which get implemented through a process (often cumbersome) formulated by the University (see for instance chapters 3, 7 and 8 for details of such procedures) – the bottom line being that such change is possible. The South India region shows the same pattern – the decision to change the study programme basically lies with the educators, as do the reasons not to change it (see chapter 5).

The process of formulating the IWRM programme at Peradeniya University, Sri Lanka involved a series of consultations, discussions, brainstorming, and validation with the stakeholders of the Sri Lankan water sector at various levels (see chapter 10). Academics from the Boards of Studies of Agricultural Engineering, Agricultural Economics and Extension along with professionals in the water sector institutions worked together to identify the core of the IWRM programme. The course outline was later presented and validated with institutions working in the water sector such as the International Water Management Institute (IWMI), the Irrigation Department, the Mahaweli Authority of Sri Lanka, universities, and private sector institutions including Unilever Ceylon Limited. The Sri Lanka study suggests that the adoption of a national water resources policy might strongly enhance the prospects of IWRM education and the employability of its graduates, as has happened with environmental studies programmes (see below and chapter 7).

1.3 The demand for 'hybrid', IWRM professionals

Like in many innovation situations, the innovation of water resources education in an IWRM direction is a bit of a Catch-22 situation: if there are no jobs with the organisations recruiting on an IWRM-type profile there is not likely to be a great interest in graduating in such a programme, but if there are no graduates exemplifying the capabilities of IWRM-type professionals, employers are unlikely to change their recruitment policies and job profiles.

The main finding of the North India study as regards 'demand' can be used as a general finding, by and large corroborated by the experience in the other regions.

"The key finding of the study as regards 'demand' is that at present the demand for interdisciplinary professionals is confined to the development sector, namely, donors and funders and some NGOs, particularly, large ones with an international presence, though some demand for these skills can also be seen to emerge in the corporate sector. A growing need for interdisciplinary professionals is felt in the government as well, both by those who are in as well as outside the Government; however, a visible demand still needs to be created." (Chapter 4, section 4.2)

In the government sector in all four countries studied there is a recognised need for IWRM-type professionals, but a concrete demand exists to a limited extent only. In many cases the recruitment criteria are still strongly focused on civil engineering qualifications. This is for example the case in the South India region, where the entry requirement for government jobs in water resources are Bachelor's degrees in engineering – thus creating a disincentive for undertaking postgraduate studies.

There are several ways through the 'demand' deadlock. The most general way is step-by-step change over time. The Crossing Boundaries project partner institutes generally see no major problems in finding placements for their relatively small numbers of IWRM graduates. Once placed, employers will see the benefits of the broader orientation and skill set, and so forth. This is a likely process to happen because there is a clearly articulated need for IWRM-type professionals, expressed by government, civil society as well as corporate employers. This need has to be slowly translated into concrete demand.

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[6] It is the only social science water resources management programme that we have come across in this study. However, it is practically impossible to check all universities, notably in India, and therefore there is a chance that other such programmes do exist in the region.

[7] This example was reported in the longer version of the North India regional study, but not included in the short version that is part of this document.

There are concrete openings for employment of IWRM graduates in the government sector in some places. The LGED (Local Government Engineering Department) of the Government of Bangladesh established an IWRM unit in 2003 to support national level project management and implementation. Most of the employees of this unit are trained on IWRM either locally or abroad. The LGED has recently created a new position, Additional Chief Engineer (IWRM), next to the Chief Engineer. This might be considered as a significant breakthrough in terms of mainstreaming IWRM in Bangladesh. However, IWRM related academic requirements in the water related organization's recruitment policy is still almost non-existing.

The South India region provides an interesting example of the establishment of Multi Disciplinary Project Units (MDPUs) for government projects of water resources development and management, as well as the invitation of so called Support Organisations (NGOs) to provide certain (non-technical) services in such projects. In Andhra Pradesh an effort is underway to incorporate this in the normal government organisational structure under the label 'change management'. Such developments show that part of the practice of water resources development and management is running ahead of the educational system. These projects/units as well as NGOs find it difficult to recruit the type of expertise required. Simultaneously, less than half of the available seats in the water resources engineering education programmes studied in this region are filled. Here, practical logic demands a rethinking and reshaping of the educational and recruitment approaches in the water resources sector.

More specific approaches than gradual step-by-step are also possible and required. Most importantly, breakthroughs are necessary in government recruitment policies. The Crossing Boundaries partner institutes are undertaking such liaison activities with regional employers and all are planning to intensify these. This can be achieved through close interaction with potential employing agencies in the design of education programmes, and subsequently during the implementation/teaching phase. Such interaction brings graduates in direct contact with potential employers and allows educators to sense and adapt to societal needs and demands. The study has identified a number of examples of this, highlighting several instruments that can be used for this purpose.

Both the IWRM programme at PGIA Peradeniya, Sri Lanka and the IWRM (Interdisciplinary Water Resources Management) programme at nec,Nepal have involved stakeholders, notably potential employers of graduates, in the design of the study programme. PGIA is organising yearly Water Professionals Days where academics and practitioners meet, and where IWRM students present their work. In this manner a close link between research and education on one side and policy and practice on the other can be established and maintained.

In the government sector in all four countries studied there is a recognised need for IWRM-type professionals, but a concrete demand exists to a limited extent only. In many cases the recruitment criteria are still strongly focused on civil engineering qualifications. This is for example the case in the South India region, where the entry requirement for government jobs in water resources are Bachelor's degrees in engineering – thus creating a disincentive for undertaking postgraduate studies.

1.4 Assessment

The good news is that we are not alone as Crossing Boundaries project partners. Since 2000 several new education programmes have been started with a more comprehensive and integrated profile than the conventional disciplinary water programmes, and also changes have been made in existing programmes in the IWRM direction. These innovations are particularly seen in the environmental sphere. It seems that ecology and environment issues are starting to be incorporated into water resources education programmes, and that environmental studies programmes give more attention to water. As regards the social, economic and political dimensions of water resources management, the change is much less pronounced, but there also we have found examples of innovation.

The fact remains that there is still a long way to go and many boundaries to cross to achieve a critical mass of education programmes having internalised the new water resources management challenges. Many of the 2002 conclusions listed in Box 1.1 above still apply. One would obviously not expect all water resources education programmes to become interdisciplinary and integrated programmes, incorporating all three challenges listed. There is need for specialised programmes, in the natural and engineering disciplines, as well as in the environmental, social, economic, political and geographical disciplines for instance. The emergence of new water education programmes in these latter fields thus needs to be welcomed and supported. However, for 'integration' to become real and have a broader impact on policy and

in society, a larger number of institutes and programmes needs to address the integration question explicitly, in education as well as research, as research is the main source of the education content.

It is clear that the move in this direction, that can be discerned, is emerging from the bottom-up rather than from the top-down. Universities, or in most cases departments and individuals within them, are the innovators, as well as some training institutes. On the whole, existing education policy does not constrain such innovations, even when there are always institutional complexities in changing curricula, adapting admission criteria, et cetera. The present education policy frameworks give institutes and programmes sufficient flexibility and autonomy to make the changes they want. When groups of innovators decide changes are necessary, they generally seem to be achievable.

There is little indication that reform of water resources education is prominently on the policy agenda in the countries and regions studied. There is very limited attention for it in the policy domain. This means that a logical next step in supporting the transformation process in water resources education in South Asia should start from the (growing) collection of institutes and programmes that seek to internalise IWRM challenges in their programmes to a larger or smaller degree, rather than begin at the macro policy level and the adaptation of 'enabling conditions'. Faculty involved in such programmes have very clearly and empathically expressed interest in such exchange and networking when the studies that are reported in this document were conducted. Such networking could then possibly translate into advocacy for certain desirable policies.

The most important 'enabling condition' for reforming water resources education is that of the employability of graduates. The practice of water resources development and management projects seems to be running ahead of education content and recruitment procedures, meaning that suitable expertise is difficult to find and when found difficult to employ. Breakthroughs are necessary in this area, and might be feasible as reshaping of the present structures would provide benefits on many sides. Experimentation with institutional forms that enhance multi-disciplinarity/integrated approaches is ongoing and should be upscaled/regularised.

Chapter 2

Boundaries to cross

Challenges and opportunities in the supply and demand of new water knowledge

Peter P. Mollinga

2.1 Introduction

The aim of the Crossing Boundaries project is to create and strengthen Masters Programmes in which hybrid, sociotechnical, transdisciplinary water professionals are trained, in turn contributing to the gender balance in the profession. The underlying reasoning is that for the paradigm change we want to bring into the water sector, water professionals are needed who are able to work with the three challenges mentioned in chapter 1: the internalisation of ecological sustainability concerns, human development concerns, and democratic governance concerns into water professionals' expertise. In the Crossing Boundaries project we are attempting this in four places. In Bangladesh in the Institute for Water and Flood Management (IWFM), Bangladesh University of Engineering and Technology (BUET); in Sri Lanka in the Postgraduate Institute of Agriculture (PGIA), Peradeniya University; in Nepal in the Nepal Engineering College (nec); and in India in the Centre for Water Resources (CWR), Anna University. This is with the help of two other partners, the Bangladash Centre for Advanced Studies (BCAS) in Dhaka, Bangladesh and the Tata Institute of Social Sciences (TISS) in Mumbai, India. The four locations of our efforts are engineering locations, one on the agricultural engineering side, and three on the civil engineering side. These are institutes that train water professionals for the mainstream water resources agencies, as well as for research institutes, NGOs, and the corporate sector.

After three years we are confident to say that it is possible to redesign water resources curricula into more interdisciplinary programmes (see Part 3 for case descriptions). However, education reform is a long and slow process, and it is far from completed in the four institutes – it will never be completed in a way. Furthermore, four institutes and education programmes in the whole of South Asia is the proverbial drop into the ocean. It is only a beginning, and a small component of transforming the South Asian professional water resources knowledge system.

This chapter looks at the challenges and opportunities for broader-based water resources knowledge system transformation. It summarises the responses of participants in the Water Policy in South Asia international conference held in Colombo, Sri Lanka, December 2008, to the three questions listed in Box 2.1.

Box 2.1: Questions for 'Upscaling IWRM education in South Asia: which boundaries to cross?' session in the international Water Policy in South Asia conference, Colombo, Sri Lanka, 20 December 2008

1) What can be practically done (and by whom and how) to expand and strengthen comprehensive, integrated, interdisciplinary water resources education programmes?

2) What can be practically done (and by whom and how) to increase the effective demand for 'hybrid' water professionals?

3) What can be practically done (and by whom and how) in the policy domain to improve the enabling conditions for IWRM type water resources education programmes?

In the session in the Colombo conference, the first results of the commissioned studies were presented, and participants' feedback invited – in the session discussion and through a written form. In the next three sections of this chapter these suggestions of conference participants are listed under certain rubrics [8]. Subsequently this feedback is briefly compared with the findings of the commissioned studies.

The fifth and last section of the chapter summarises the challenges and opportunities that seem to us to be of particular (strategic) relevance, and for which feasible action plans and/or projects can be envisaged. The preliminary listing of eight such 'next steps' will serve as the basis for the design of an 'outreach plan' for a set of new initiatives pertaining to outscaling and upscaling of IWRM-type education programmes in South Asia, and outplacement and employability of interdisciplinary water professionals in the region. The components of the outreach plan will, to a large extent, have to be country-specific. The outreach plan will be implemented by the Hyderabad, India based Crossing Boundaries team together with the CB Partner Institutes in Bangladesh, India, Nepal and Sri Lanka. As part of this we hope to establish new collaborations and projects with international, South Asian regional, as well as national organisations and networks.

[8] Most suggestions have been incorporated in the lists. Excluded were general remarks and comments without a direct practical application. 37 forms were handed in.

2.2 Strengthening water resources education programmes

Below suggestions noted by the conference participants are listed on how interdisciplinary water resources education programmes might be strengthened. The categories of suggestions are the following.

a) Networking and platform creation/strengthening for exchange of knowledge and experience, as for knowledge generation is a clearly identified need. The suggestions can be understood as different ways to strengthen the IWRM/interdisciplinary water resources education 'epistemic community' and 'community of practice'.

b) There is support for the idea of not being held back by disciplinary boundaries in the design of education programmes.

c) Many suggestions were made about the relevance and attractiveness of IWRM type programmes. The main gist is, firstly, that a lot needs to be done in terms of awareness raising on the need for such programmes, and secondly that the IWRM programmes have to be very closely linked to 'real problems' in society and concrete demands for knowledge and expertise.

The PGIA Crossing Boundaries partner institute, apart from developing its IWRM education programme in interaction with stakeholders, also effectively networked with other capacity building programmes, notably CapNet. This helped to build better links with government departments. Another activity in this line is the organisation of an Annual Water Professional Day (WPD) – Symposium on Water Resources Research in Sri Lanka, yearly in October. Six symposium proceedings on Water Resources Research in Sri Lanka have been published (www.gissl.lk). The idea of the symposium is to bring people working in the water sector together to a common forum to highlight the national issues in the water sector. Students of IWRM are actively involved in organizing the event and also get the opportunity to present their research findings.

In all the Crossing Boundaries partner institutes with a research programme a Research Advisory Committee has been formed in which societal stakeholders participate. Apart from its direct function for the impact-oriented research activities that are being undertaken by the partners, this also provides an opportunity for liaising with the water policy and practice domain.

Platforms for knowledge exchange and generation

- Good research and exchange of ideas, technology etc. by people from all the fields/disciplines of knowledge – through workshops, seminars at various levels.
- Expand beyond IWMI, TERI, SaciWATERs – involve broader sections of academia, as well as local actors and organisations
- Continuous development/improvement of the curriculum through networks with support from international organisations, like UNESCO, FAO, etc.
- Develop solid teaching resources; upscaling outreach through the involvement of more institutions capable of managing hybrid educational programmes
- Encourage collaboration (scholarships, research, courses, projects) between university departments (e.g. engineering and sociology) through competitions, funding support
- Launch award for best interdisciplinary Masters thesis
- Rector's study tour of Crossing Boundaries Partner Institutes
- Ask UNESCO to find resources for new partners who want to change education programmes along SaciWATERs lines
- Expand scope of the Crossing Boundaries project
- Exchange of visiting faculty/experts for quality education
- Map online, distance and regular courses and make these known more widely through variety of media
- Hold a dialogue (on an ongoing basis) with premier academic institutions on the need for such programmes – create and invite institutions and universities to join; biannual multi- university plus practitioners meeting workshop on IWRM education – invite participation by govt education department and ministries
- Increased partnership with more institutions within a country and regions; partnerships with general universities
- Lastly but most importantly – desperate and urgent need to evolve a common "lingua franca" to bridge pure academics and practitioners policy makers at all levels including the grassroots... this is a vital step towards crossing boundaries..

Comprehensiveness of education programme and field exposure

- Avoid any subject/discipline as separate; include all subjects and each student should learn basics/fundamentals of ecology, hydrology
- Strong component of research methodology - important for field studies

- Undergraduate modules for positivist faculties (engineering, physical sciences) so other ways of thinking can penetrate before 'cement' sets.
- Convergence around understanding of poor and marginalised water users; representation of multiple voices; use of multiple methodologies
- Ideally we need to have a 5 year integrated, interdisciplinary, 'policy focused' programme
- Ministry of Water Resources and Ministry of Human Resources Development may make arrangements to introduce course on IWRM in all colleges and universities, jointly with the help of NGOs and private partners
- Amalgamate (eco-hydrology, eco-hydraulics etc.) rather than have separate programmes in ecology, hydrology, hydraulics etc.

Making (IWRM) water resources education attractive and relevant

- More advertising and marketing of education programmes
- Credible quality assurance; external examination/assessment
- Travelling road show of 'shining' (outstanding) programmes to inspire other institutions
- Organisations like SaciWATERs, IWMI, UNESCO-IHE etc. are well placed to kick-start activities – national agencies can continue
- Need to understand what kind of professionals are required to address the issues
- Needs assessment of education and training
- Education is about 'politics': challenging dominant views requires alliances with other societal actors
- Emphasise relevance for the sector and practical skills in masters programmes
- Propagating the essence of water for all; creating awareness of scarcity as a possible source of conflicts
- Develop interest in water and IWRM in social science departments.
- Make courses outcome-based to attract students from other disciplines such as health, international relations, politics
- Give society what they need
- Introduction of best water management and irrigation practices for the users by the concerned government departments
- Create employment opportunities where possible
- Sensitise education policy makers (ministers, VCs and Rectors)/ reform the existing curricula of key physical and social science programmes / introduce short term training courses
- Take it to the old water bureaucrats – make them feel the need; organise meetings, seminars, symposiums for this
- Generate demand from the working field by awareness raising
- Link outputs of academic work to practice: a) build strong linkages to development aid financing institutions to ensure that practice is informed by a sound evidence base ; b) build and foster networks of hybrid practitioners – electronic listserve; c) proactively engage the corporate sector; d) enable feasible curriculum; e) enable flexible delivery from classroom to distance education, from full time to part time
- Call for good research proposals and select depending on ideas closely applicable to the local environment; avoid the old traditional research and running around the bush.
- Introductory course on water resources in different disciplines so that optional paper can be taken later on (would raise interest for water resources management as a topic).

2.3 Increasing demand for 'hybrid' water professionals

Many Colombo conference participants interpreted the question on 'increasing demand' in terms of student demand for this field of study, rather than employability of IWRM type graduates. The harvest of suggestions is therefore less rich, that is, less practical, than in the previous section. Furthermore, it is not easy to think of concrete suggestions on this issue. One participant writes "Policy changes of the institutions in the water sector. How to do – I do not know." Increasing demand is clearly a nut not yet fully cracked. The ideas that come out most clearly are, firstly, the need to advertise/showcase to possible employers and to decision makers the experience and achievements of the IWRM/interdisciplinary graduates and the education programmes, and, secondly, to identify 'ambassadors' of different kinds to influence employment opportunities.

The findings discussed in chapter 1 suggest that in the world of water resources management practice experimentation is going on with institutional arrangements that allow the building of multi-disciplinary teams. In that sense the education sector is lagging behind in supplying suitable expertise (see also 2.4).

How to increase demand for IWRM / interdisciplinary water professionals?

- Offer sandwich/refresher courses for working professionals
- The increasing scarcity of water may increase demand for water professionals
- Because local people understand first the need for something to be done to improve the water situation, demand for hybrid water professionals has to come from those dealing with water issues – state governments, CSOs, corporates
- Existing water professionals need to play a role in educating the policy makers
- Do need assessments
- Creating recognition by the government
- Breaking barriers or stereotyping on the professionals and promoting the holistic approach/education by the institutions and the government
- Creating platform or like association on creating opportunities for the interested water professionals and the like
- This requires significant work in terms of policy advocacy – networks and alliances could help and senior water professionals who understand the value of IWRM acting as catalysts and advocates
- Showcase work of IWRM professionals to possible employers
- Showcase the diversity and relevance of the content of the programme
- Start short-term awareness programme for academic administrators and senior faculty in their institute
- Institutionalise the training in local institutions and tailor make the courses as per demand
- Training has to be flexible to allow for training existing bureaucrats who can act as agents of change
- Enhance the legitimacy of the degree with maybe IHE
- Need to establish specialised institute like IIT in water resources management.
- SAWA (South Asian Water) fellows can be the 'brand ambassadors'.
- Invite irrigation agencies and brief them about the need for and what the four Partner institutes are doing, include environmental agencies, consulting firms, IFIs.
- Work with politicians and make it mandatory to include social scientists and other professionals
- Sensitize potential employers, do a job profile survey among the potential employers, develop curriculum involving a consortium of universities and colleges.
- Networking of graduates after the course is very important.
- Design demand driven programme on basis of gaps in past experience of WRD/WRM
- Enlist tutors with practical experience

2.4 Improving enabling conditions at policy level

There is considerable overlap in the responses to the question about how to create enabling conditions at policy level with the previous two issues. Suggestions for awareness raising, and the identification of 'ambassadors' and 'champions' appear under all three questions. There is a call for starting water resources education much before higher education, at primary school level. This can be considered as an enabling condition also.

For instance, the Environmental Education and Awareness group of the STD (Social Transformation Division), TERI, New Delhi, India reaches out to school and college students. They target mainly school students and sensitize them on the importance of water conservation and hygiene; issues such as the importance of conserving water, how it can be conserved without affecting our lifestyle and the effects of the consumption of contaminated water on human health are elaborated [9].

We strongly support school-level initiatives, but it is outside the mandate that SaciWATERs and the Crossing Boundaries project have defined for themselves. Other organisations and programmes are active in this domain. The basic strategy to create a more favourable environment that is suggested is that of building networks and partnerships, to get programmes off the ground and to influence policy.

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[9] This example was reported in the longer version of the North India regional study, but not included in the short version that is part of this document.

The findings discussed in chapter 1 suggest that the single most important policy-level change is government recruitment policy for water resources agencies. There are no real constraints in education policy for water resources education reform, though neither are there any stimuli. Awareness raising, network building and policy advocacy should therefore primarily focus on recruitment policy/demand side issues (see chapter 1).

Start earlier at school/primary and secondary education level

- Train the trainer programmes for primary / high school teacher training
- At all levels by Department of Education
- Because everybody uses water and uses more when they get richer, water education should start at primary school level
- It is far more important to introduce IWRM or water related education to undergraduate level as well as secondary education with the help of government
- Awareness programmes from the schooling level on conservation and economical use of water
- Run a water syllabus in school in regional languages. Need for quiz competitions for children, documentaries on TV, pamphlet distribution

Build network of key people, ambassadors, and champions ; engage in partnerships

- Identify in bureaucracy 'key people' who could bring change
- Build leadership programme for water sector
- Educate and involve closely people working on policy issues on water
- Much of this is happening in large donor-funded programmes where government is involved with a range of stakeholders – for example UN habitat and GWA have just signed a cooperation agreement for capacity building and mainstreaming gender is water for Asian cities over the next 1-2 years. Partnerships that can influence policy are important.
- Meeting of Rectors/Vice Chancellors teaching water at tertiary education system at South Asia level
- Having national meeting/conferences of people/professionals from all universities (at least in case of Nepal) will help to start similar programme in other universities.

Influence policy

- Lobby for enabling policy for hybrid water processionals and enabling credit for mature applicants to academic programmes – NO SUCH THING IS POSSIBLE TODAY, at least in India as opposed to universities overseas. Make available scholarships for such applicants and programmes - remove age barrier in this (35 years or below for example in UK)
- Involve people from the local areas; involve minorities
- Donors such as World Bank, ADB and others can influence/ask countries to start this programme if they feel it is necessary for improving water resources management
- Produce a critical mass of water professionals
- Water Ministers and Education Ministers conference in collaboration with SAARC and UNESCO at South Asia level
- Education policy makers must be influenced – probably awareness campaign is the only method that could be adopted
- Policy domain may be influenced by popular demand of the users

Miscellaneous suggestions

- Women and children should be educated and mobilised by using electronic media and religious teaching
- Promoting water literacy
- Improve infrastructure and research for the water resources programmes
- Promote self-employment for the water resources graduates
- Exchange of programmes and students
- All the Administrative Departments must learn first how to coordinate, the identify all the relevant stakeholders, then, step by step, by organising forums, identify action plans
- Market research by academicians

2.5 Eight next steps

Following the findings and ideas presented in this document, and the general experience gained through the Crossing Boundaries project, the following 'things to do' seem to be among the logical next steps to take. This list will be (further) developed into a concrete action plan in the course of 2009.

9. Establish a South Asia IWRM education programmes network

There seems to be clear sense in a broader network or partnership of IWRM-interested water resources education programmes/institutes at South Asian national and South Asian regional level, across engineering, environmental science and social science/humanities programmes. This would imply bringing together representatives of education programmes and institutes in South Asia that are transforming their programmes along IWRM lines, in part or in toto. To begin with, a number of national level (for India possibly sub-national level) meetings/workshops can be envisaged of representatives of such programmes/institutes, with relevant policy actors, employers and capacity building funders also invited (2009). This could evolve into a yearly or biannual regional South Asia meeting of IWRM education stakeholders when there is an identified need. Rectors/Vice Chancellors meetings at national and/or regional level may be thought of as a next step (early 2010), as well as a Water Resources and Ministers meeting at South Asia level (late 2010).

10. Exchange experience with regional IWRM capacity building networks in other parts of the world

Reform of water resources education is a global process, and there are possibly many lessons to be learnt for other regional IWRM capacity building networks, particularly those in the South. One such initiative is underway – it hopes to bring representatives of Crossing Boundaries (South Asia), Concertación (Andean region, Latin America) and WaterNet (Southern Africa) together in Kampala, Uganda in November 2009 for exchange and discussion.

11. Development of country-specific outplacement/employability strategies for IWRM graduates

Crossing Boundaries Partner Institutes are working on this for their own batches of graduates, but this is an issue of general importance. It has to include concerted effort to 'open up' government employment for IWRM-trained water professionals. Networking with key actors, and identification of 'ambassadors' and 'champions' for different types of advocacy may be a crucial element, as may be active liaising with and responding to needs of ongoing 'integration' initiatives in professional practice.

12. Develop a broadly-based South Asia IWRM fellowship programme

To strengthen and support the ongoing transformation of study programmes in the direction of more 'comprehensive' approaches to water resources a fellowship programme, sourcing potential employers, governments, national and international foundations, and lending agencies and donor agencies would be highly beneficial. It is also a strategic tool for enhancing gender balance in water resources education. Related to fellowship programmes could be competition/awards programmes for best theses, young professional awards, etc.

13. Establish social science water resources education programmes

The South Asian water resources education landscape would be significantly enriched with the establishment of more social science water resources education programmes. Existing programmes are overwhelmingly natural science based, while programmes with a social science starting point are virtually non-existent. However, demand for governance, management and regulation expertise is likely to increase, constituting the logic for such programmes. SaciWATERs and TISS, Mumbai are taking the initiative for one such programme: the establishment of a 'South Asia Water Policy and Governance' Masters Programme.

14. Strengthen the South Asia IWRM and interdisciplinary knowledge community

To expand the volume and enhance the quality of the IWRM and interdisciplinary water resources knowledge base the 'epistemic communities' and 'communities of practice' active in this field need to be strengthened and supported. Instruments for this could include South Asia level publication tools (cf. SAWAS South Asian Water Studies www.sawasjournal.org), South Asia level water resources research platforms like conferences and workshops, targeted comparative research programmes, programmes to document professional experience for education purposes, innovation platforms and competitions, and others.

15. Capitalise on Crossing Boundaries expertise

The Crossing Boundaries project aims to put expertise gained in the project on offer for other programmes and institutes. This can be in the form of consultancy and advisory services, education material/course modules, subject-specific expertise, facilitation services, and other forms. This can be done at South Asian as well as national level by the different project partners. The envisaged network under the first item could be an avenue for making this expertise useful.

16. Crossing Boundaries – phase 2

A follow up and expansion of the Crossing Boundaries project along the following lines is envisaged:

a) Expand the geographical scope to include programmes/institutes in Bhutan and Pakistan;
b) Expand the number of institutes/programmes directly involved in the project in each country;
c) Undertake curriculum development follow-up activities with present partner institutes;
d) Strengthen interdisciplinary research capacity by targeted support and training activities.

Chapter 3

Bangladesh

Md. Golam Rabbani

3.1 Inventory of water resources curricula

Five leading universities that offer higher education programmes on water resources were selected to develop the inventory study of curricula. Table 3.1 shows the names of the universities and corresponding departments/institutes that were studied. All these departments, except the Institute of Water and Flood Management (IWFM), offer B.Sc. (Hons), Masters and PhD programmes on Water Resources.

Table 3.1. Five leading academic institutions that offer water resources higher education in Bangladesh

Name of the University	*Name of the Department/Institute/School*
Bangladesh University of Engineering and Technology (BUET)	Department of Water Resources Engineering (WRE)
	Institute of Water and Flood Management (IWFM)
Bangladesh Agricultural University(BAU)	Department of Irrigation and Water Management (DIWM)
University of Dhaka (UoD)	Department of Soil, Water and Environment (DSWE)
Jahangirnagar University (JU)	Department of Environmental Science (DES)
Independent University of Bangladesh (IUB)	School of Environmental Management (SEM)

Table 3.2 shows that the enrolment of Masters and PhD students has not changed much in the past ten years in the longer-established institutes (like DWRE, IWFM, DIWM, DSWE). Noticeable however, is the increase in student numbers in the environmental study programmes offering water resources programmes. The Department of Environmental Science (DES) of Jahangirnagar University (JU) offers water related courses in the Masters and the PhD programmes. Table 2 shows that a significant change has taken place in terms of enrolment of number of students, especially in the Masters programme on Environmental Science: it has increased to 30 in 2008, while it was only 12 in 2002, at the beginning of the programme. The Department of Environment Management of Independent University of Bangladesh (IUB) initiated the Masters in Environment Management programme in 2006. They still do not offer any PhD programme. But again, the number of students for this programme was only 12 in 2006, while it has risen to 30 in 2008. This suggests that environmental study programmes with a focus on water resources are gaining popularity.

Table 3.2. Brief profile of the institutes that currently offer water resources higher education in Bangladesh

Department / University	*No. of Faculty*	*Degrees offered*	*Degrees in*	*No. of students*	
				10 years ago	*Current (2007/2008)*
WRE / BUET	10	PhD	WRE	2	2
		Masters	WRE	40	40
IWFM / BUET*	16	PhD	WRD	0	3
		Masters	WRD	30	20
		PGD	WRD	30	30
DIWM / BAU	15	PhD	IWM	1-2	4
		Masters	IWM	20	22
DSWE / UoD	24	PhD	SWEM	1-2	1-2
		Masters	SWEM	40	40
DES / JU	8	PhD	ES	0	1-2
		Masters	ES	12	30
DEM / IUB	9	PhD	EM	0	0
		Masters	EM	12	30

WRE-Water Resources Engineering; WRD-Water Resources Development; IWM-Irrigation and Water Management; SWEM-Soil, Water and Environment Management; ES- Environmental Science; EM-Environmental Management

* None of these students are under the SaciWATERs Crossing Boundaries programme. They are part of regular courses of IWFM, BUET.

Details of changes in the course curricula of the programmes studied over the past 10 years are given in Table 3.3. The course curriculum of the programmes in three of BUET (DWRE and IWFM), BAU (DIWM) and JU (DES) has been adapted. Recently, IWFM added a number of courses in the Masters, PhD and PGD (Post Graduate Diploma) programmes to make the curricula more interdisciplinary. DWRE included several new topics in the existing courses. DIWM started offering several new courses. What these changes and additions suggest is that the civil engineering oriented programmes have diversified and broadened the treatment of 'water' in their programmes, and introduced a (very) limited number of components broadening the approach to water, both methodologically and substantively. Among new substantive components/courses, the ecologically oriented ones stand out. Introduction of social science components remains very limited. The environmental programmes, DSWE of UoD and DEM of IUB started very recently. Within these few years, they have realized the need to modify the course curriculum to make it more effective and multidisciplinary, as they informed during interviews.

The reasons for curriculum change given by faculty in the institutions visited are given in Table 3.4. The strongest stated reason for change is responding to demands and needs in society and changes in the water resources scenario, and secondly maintaining or increasing education standards.

Table 3.3. Major changes in the course curriculum in water resources programmes in the last decade in Bangladesh

Department/ University	*Programme (Masters and PhD)*	*Major Courses*	
		Approximately 10 years ago	*Current (recently included into earlier courses / programme)*
BUET/WRE	Water Resources Engineering	Fluid Mechanics Open Channel Hydraulics River Engineering Ground Water Hydraulics Sediment Transport Hydraulic Structure Irrigation & Drainage Engineering Statistical Methods in Hydrology Hydraulic Structure & Design Mathematical Modeling Hydraulics Port & Harbour Engineering	Coastal Zone Management (CZM) River Basin Management (RBM) Computational River Morphology IWRM Water Resource Economics Operation and Maintenance in Water Resource System
BUET/IWFM	Water Resources Development	Alluvial River Processes Hydrologic Information System Hazards and Risk Analysis Environmental Economics Hydrologic Statistics Choice of Water Management Technologies Agricultural Water Management Integrated Water Resources Management	Gender and Water Water Quality Management Interdisciplinary Field Research Methodology in Water Management Climate Change Risk Management Disaster Management Advanced Watershed Hydrology Remote Sensing and GIS in Water Management Groundwater Resources Assessment
BAU / DIWM	Irrigation and Water Management	Irrigation system design Drainage Engineering Irrigation System Evaluation Groundwater Development Watershed Management Economics of Water Resources Projects Irrigation System Planning and Management Surface Water hydrology Mathematics for Water Engineering	River Engineering and Flood Management Water and Environment GIS in Water Resources Crop Climatology Water Resources Planning Computer Programming and Application
UoD/DSWE	Soil, Water and Environment	Analytical techniques and experimental design Sustainable Resource Management Advanced Soil Chemistry, Coastal and Wetland Soil Management, Chemistry of water pollution, Water Treatment Technology Water Resource Management Marine Ecosystem Environmental Microbiology Environmental Impact Assessment	Analytical Techniques and Experimental Design Sustainable Resource Management Advanced Soil Chemistry, Coastal and Wetland Soil Management, Chemistry of water pollution, Water Treatment Technology Water Resource Management Marine Ecosystem Environmental Microbiology Environmental Impact Assessment

JA/DES	Environmental Science	Advanced techniques in environmental analysis Environmental Issues: Bangladesh perspective Environmental Radiation Environmental Management System Aquatic Ecology Industrial Waste: Treatment and Management Plans Natural Resources Management Environmental Pollution and Public Health	Global Climate Changes and Development Agro industrial pollutants and management
IUB/SEM*	Environmental Management		Sustainable Development Environmental Science and Pollution Control Policies Environmental Performance Evaluation Disaster Risk Management Wastewater Management Global Climate Change and Adaptation Water Resources Management Water Quality Environment Environmental Toxicology Environmental Biology, Ecology and Conservation

* This programme was initiated in 2006

Table 3.4. Reasons for changes/modifications in the programme / course curriculum of WRHE in the last decade in different institutions

Department/ University	*Programme (Masters)*	*Major reasons for changes*
BUET / WRE	Water Resources Engineering	• The present need in water resources management in Bangladesh • It is not only the country demand but also global demand • Changes also complement engineering component of water resources education
BUET/IWFM	Water Resources Development	• There is need of bringing multidisciplinarity in water resources higher education • Changes were made to bring more management aspects into the courses, to fit to the vision of the post graduate program (i.e., multidisciplinary / interdisciplinary education). • It is a demand from the leading water related organizations in the country • Change in the contents and teaching method of the programme now provide better opportunity to learn field based education • To address exiting and future challenges (e.g. hazards and disaster)
BAU / DIWM	Irrigation and Water Management	• Present demand to fulfill the national economic goals in water and irrigation sector. • We need to upgrade ourselves to meet international standard of education
UoD/DSWE	Soil, Water and Environment	• To meet the present demand
JA/DES	Environmental Science	• It is a demand from the students • To improve education standard

With regard to the relative attention in the course curriculum to different knowledge areas, findings show clear variations, as depicted in Table 5. It can be noted that in the upper three, engineering programmes social and managerial topics are not very strongly present (except in IWFM), but more strongly than environmental courses. In the lower three, environment-oriented course programmes, social and managerial courses are on the whole similarly present as in the in the engineering programmes, though in all three programmes rather than primarily in one as among the three engineering programmes. Obviously, environmental courses are very strongly profiled in the environmental programmes. The presence of engineering courses in the environment focused programmes is low, but higher than the environmental courses in the engineering programmes. Table 5 shows that the spread of courses over the different categories is more balanced in the environmental programmes than in the engineering programmes. While in engineering programmes engineering courses constitute two-thirds of the total, in environmental programmes environmental course constitute just over half of the total. How to interpret this is not fully clear. As the environmental programmes are recently established there is perhaps less 'path dependency' and more freedom to design more broadly based programmes in response to societal demand. It may also be the case that engineering courses have a stronger disciplinary orientation in general.

Table 3.5. Details of different aspects of knowledge in course curriculum of water resources higher education (WRHE)

University	*Programme (Masters)*	*Total courses (No.)*	*Courses related to different aspects of knowledge in WRHE*		
			Engineering / Technological	*Social / Managerial*	*Ecological / Environmental*
BUET / WRE	WRE	24	20	3	1
BUET / WRE	IWFM	31	15	12	4
BAU / DIWM	IWM	21	15	4	2
UoD / DSWE	SWE	21	5	7	9
JA / DES	ENVS	17	3	4	10
IUB / SEM	ENVM	24	4	6	14

Table 3.6 presents some strengths and weaknesses of the water related programmes as perceived by students of these programmes.

Table 3.6. Students' perception of strengths and weaknesses of the programmes on water resources

Programme (Masters)	*Strengths*	*Weaknesses*
Water Resources Engineering of WRE	Theoretical aspects of water related issues are taught well Teaching method is appreciable Can meet present job requirement in many organizations	The course curriculum is not fully research based.
Water Resources Development of IWFM	Innovative approach in water management. Creating partnership between water professionals and civil society. Creating skilled manpower. New research in water sector Increasing awareness among the policy makers	Lack of opportunity to Utilize the knowledge
Irrigation and Water Management of BAU	Focused on national demand Meet the international standards to some extent Field based education	Poor equipment supply and lab facilities Mainly theoretical Need more well trained teachers
Soil, Water and Environment of UoD	The current programme addresses natural resources issues including water, environment and soil It is now more practical and field orientated	Insufficient lab facility Courses are not enough Social and economic issues are not covered in this programme Lack of job facility
Environmental Science of JU	The programme offers in depth knowledge on various issues related to environment and water It also addresses country issues	Lack of field based knowledge
Environment Management of IUB	It provides lab facility Courses are relevant to national priority issues	Field oriented courses need to be introduced

The overall conclusions that can be drawn from the above are the following.

a) Long-standing water resources education programmes are responding to societal demand and needs, though largely within the confines of their own disciplinary orientation; innovation seems to be more strongly pronounced in newly established environmental studies programmes.

b) These environmental studies programmes have a more diverse, perhaps interdisciplinary, conception of their own field than the engineering programmes;

c) Environment and ecology related topics are finding their place in water resources education increasingly, most pronouncedly through (mostly newly established) environmental studies programmes; social and managerial topics have received less of a boost, though they are also gaining more attention.

d) Field-based knowledge is identified as an important gap in most education programmes, indicating some degree of remoteness of education programmes from ground realities.

3.2 Demand for water professionals with an IWRM-type profile

Twenty three water professionals were interviewed to assess the demand for water professionals with an IWRM-type profile, including leading water professionals, senior representatives of relevant government and non-government organizations, donor agencies and corporate sector. IWRM-type water professionals, IWRM event organizers and IWRM event participants were also interviewed. In addition, available job advertisements and recruitment policies were analyzed to explore the demand of water professionals with an IWRM profile.

Interviewees identified a number of major challenges for water professionals. These included management of surface water quality, declining of groundwater level, chemical contamination of ground water, protection of water resources from saline intrusion, water scarcity, climate induced water related hazards including flood/recurrent flood, drought, cyclone and storm surge, river bank erosion, sedimentation of river beds, and SLR (Sea Level Rise). Some institutional problems were also mentioned by a number of respondents. These were lack of coordination and integration within the government sectors and outside the sectors, e.g. agriculture, health, education, and resources constraint (both technical and financial).

83% of the respondents mentioned that there is a need for changing or modifying water resources higher educational programmes in Bangladesh. Some of the respondents clearly mentioned that an engineering degree is not sufficient for designing, planning and implementing a water related project. Rather, an engineer with additional skills or specialization on social science, environmental management issues etc. would be more effective and pragmatic. The respondents stated a number of reasons why water resources higher education should employ a multidisciplinary approach, as depicted in Figure 3.1.

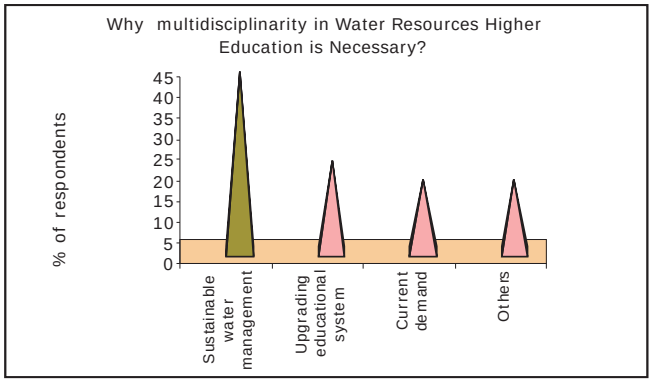

Figure 3.1. Reasons for multidisciplinarity in water resources higher education

In response to a question on the need of IWRM type water professionals for sustainable water resources management in Bangladesh, all the leading water professionals and most of the senior representatives of GOs, NGOs and development partners clearly mentioned the need for IWRM type water professionals. Corporate sectors representatives are not very aware about this topic. Existing IWRM professionals agree that the demand of IWRM expertise has increased slightly. IWRM event organizers and participants also have similar views on the subject. About 90% of the respondents strongly believe in the need for water professionals with an IWRM type profile.

What these interview findings clearly suggest is that there is a broad awareness that more broadly based approaches in the water sector are required, that education programmes need to be adapted accordingly, and that there – thus – is a need for IWRM-type professionals. However, a felt need does not necessarily translate in concrete demand.

Leading water professionals, senior representative of relevant government organizations and NGOs, development partners and corporate groups were interviewed on job requirement and recruitment policy issues. Some of the organizations provided some old and recent job advertisements. The interviews and advertisements showed that there is demand for water professionals with an IWRM profile in some of the organizations, especially in LGED (Local Government Engineering Department). LGED established an IWRM unit in 2003 to support national level project management and implementation. Most of the employees of this unit are trained on IWRM both locally and abroad. They strongly recommend the need of IWRM type of professionals in the system but it will take time to incorporate it in the recruitment policy mainly due to the long bureaucratic processes of the government, as mentioned by the executives of the IWRM unit of LGED. However, the LGED has recently created a new position, Additional Chief Engineer (IWRM), next to the Chief Engineer. This might be considered as a significant breakthrough in terms of mainstreaming IWRM in Bangladesh. However, IWRM related academic requirements in the water related organization's recruitment policy is still almost nil. Many of the respondents stated that things are improving internally.

3.3 Policy decisions on water resources education

The National Water Policy (1999) clearly states that the government will take all necessary means and measures to manage the water resources of the country in a comprehensive, integrated and equitable manner. However, the academic

side of water resources gets little attention in this document. This document itself (section 2) says that it will be reviewed and revised as necessary, but in the last 10 years no reviews were undertaken.

The National Water Management Plan (2004) addresses water issues in such a manner that it fosters inter-organizational cooperation and provides details of how, when and by whom the various components of the Plan would be implemented. This document states the requirement of major efforts in education. It clearly mentions the issue of restructuring and strengthening, where appropriate, of water resources and agriculture research institutions to undertake systematic research and analysis of water and land management issues and problems arising both nationally and internationally. However, it did not include or consider involvement of any of the educational institutions of the government in the future institutional framework to implement relevant programmes.

Mohammed Moniruzzaman Miah Commission (2003) was formed in 2003 to improve the quality of education and initiate a set of reforms. The Commission submitted its report to the Government in March 2004. It recommends improvement of the quality of higher education but the available summary version does not indicate any specific subject.

The conclusion that can be drawn from this is that the issue of reforming water resources education is occasionally mentioned in national level policy documents, but that this has not lead to any concrete action. National policy momentum on water resources education seems to be absent.

Policy making at university level seems to be more vibrant. A number of universities have taken policy initiatives to change/modify water resources educational programme in last 10 years, as discussed above. The Chairs/Directors of departments/institutes of several public and private universities were interviewed to assess university level policy decisions. Most of them explicitly mentioned that the university is trying to promote multidisciplinary education that addresses water and environment, socio-economic development, technological aspects, policy and institutional mechanism etc. In all the universities where interviews were done, policy decisions to start new water resources higher education programmes were taken and implemented except at BAU (see Table 3.7). The North-South University is going to teach a new Masters Programme in Environmental Science from January 2009. This is a clear indicator of change happening in water resources education, particularly on the environmental side of water resources management, as already outlined above.

On the issue of changing the course curriculum, all the universities formed committees/boards to explore possible policy options. Most of the universities decided to include new courses in the past ten years. The procedures are summarized in Table 3.8. It can be concluded from this information that the department usually takes the policy decisions, which get implemented through a process (often cumbersome) formulated by the University.

Table 3.7. Year of starting water resources higher education programmes in different public and private universities

University		*Department*	*Programme*	*Starting Session*
Public University	Bangladesh University of Engineering and Technology	IWFM	Masters in WRD	2000-2001
	Jahangirnagar University	DES	Masters in Env. Science	2005-2006
	Dhaka university	DSWE	Masters in Soil, Water and Environment	2000-2001
	Bangladesh Agricultural University	DIWM	Masters in Irrigation and Water Management	1964-1965
Private University	North South University	DES	Masters in Env. Science and Management	2008-2009
	Independent University, Bangladesh	DEM	Masters in Env. Management	2006-2007

Table 3.8. Process of changing water resources curricula

University	*Department*	*Process of Making changes in the Programme (Committee / Board / Committee)*
Bangladesh University of Engineering and Technology	IWFM	Post Graduate Coordination committee is authorized for making the change
Jahangirnagar University	DES	Academic Committee (headed by Department Chair) ----Dean Office (headed by faculty dean)---------Academic Council (require an external expert and headed by Pro-vice chancellor)----Syndicate (Headed by Vice-Chancellor)
University of Dhaka	DSWE	Academic Committee (headed by Department Chair) ----Dean Office (headed by faculty dean)---------Academic Council (require an external expert and headed by Pro-vice chancellor)----Syndicate (Headed by Vice-Chancellor)
Bangladesh Agricultural university	DIWM	Present Hierarchical committee system for modification, changing and reformation
North South university	DES	Department Committee (Headed by Chairman) ---Curriculum Committee (Pro-Vice Chancellor and an external expert)---Academic Council (Headed by Vice Chancellor)
Independent university, Bangladesh	DEM	Departmental Internal committee is authorized to make any changes in their syllabus or course design

Chapter 4

North India

Vishal Narain [11]

4.1 Higher water resources education in North India: assessment of some leading programmes

Table 4.1 provides an overview of the programmes chosen for this study.

Table 4.1. Overview of water resources management programmes chosen for the study

Name of Programme/University	*Batch Size*	*Year of inception*
Msc (Water Resources Management), TERI University, New Delhi	18-20	2007
M.Tech (Water Resources Development), Indian Institute of Technology, Roorkee	50	-
M.Tech (Hydraulic and Water Resources Engineering) [12] , Indian Institute of Technology, Kharagpur	6-9 (sometimes it is much smaller; 2-9)	2005
M.E. (Civil) in IWM/ M.E. (Civil) in WRE, WREMI, The M.S. University of Baroda, Samiala	10 10	1984 2001
B.Tech (Agricultural Engineering), Choudhury Charan Singh Haryana Agricultural University, Hissar	24-30	1989

TERI University: an innovative new programme

Of the programmes listed in Table 4.1, perhaps the MSc (WRM) programme offered by TERI University, New Delhi could be considered to be interdisciplinary. TERI University, Delhi launched the MSc Programme in Water Resources Management in the year 2007, and it is now in its second batch. The basic philosophy of this programme is that it is important not only to look at technology, but also to look at management and policy aspects of water. Students go through such courses as Environmental Law and Policy, Sustainable Development, Integrated Impact Assessment and Environmental and Resource Economics along with courses in the realm of hydrology and ecology. They even go through a course on Communication skills and a course on Research Methodology. From a technical angle, the distinguishing feature of the programme is that in contrast to conventional programmes such as M.Tech (Civil Engineering) that focus more on the hydrology aspects, and programmes such as M Tech.(Environmental Engineering) that focus more on aspects of water quality, the TERI programme , attempts to integrate the dimensions of water quality and quantity.

TERI University offers this programme in parallel with two of its other programmes, namely, the MSc in Natural Resource Management and the MSc in Environmental Management. It has a common entrance examination for students of these programmes and at the time of seeking admission, students indicate their preferences. They go through the same (common) course work in the first semester. In the second semester, they go through compulsory courses specific to each stream. In the third semester, there are two common (compulsory) courses and then students pick up a number of electives, of which at least three must be from the specific stream in which they are enrolled.

Table 4.2. Curriculum of the MSc (WRM) programme offered by TERI University, New Delhi

Semester I	*Semester II*	*Semester III*
• Communication skills (2) • Ecology (4) • Environmental Chemistry (4) • Environmental law and policy (4) • Applied Mathematics (3) • Environmental Geosciences (4) • Introduction to sustainable development (1) • Environmental monitoring laboratory (3) Total: 25	• Water quality management (4) • Hydrology and watershed science (4) • Geoinformatics for natural resource management (4) • Water conservation (4) • Basic course in environmental and resource economics (4) • Statistical techniques (3) Total: 23	*Compulsory courses* • Integrated Impact Assessment (4) • Research Methodology (4) Total : 8 *Elective courses* • Integrated watershed management • Water resources optimization and water quality modeling • Resource Economics (4) • Water and wastewater treatment processes and design • Glacier Hydrology • Governance and management of natural resources (4) • Groundwater hydrology and management • Advanced statistical techniques

[11] The chapter has been extracted from the full report and edited by the compiler.

[12] Since 1994 the programme had been called M.Tech (Water Resources Engineering). The name of the programme was changed in the year 2005; it is now called M.Tech (Hydraulic and Water Resources Engineering).

From an inter-disciplinary perspective, the break-up of the weights, assigned to different subject spheres is as follows (total 56 credits compulsory course work).

- Ecology/environmental sciences 23
- Hydrology 8
- Governance/management/public policy: 13
- Communication/research methods 12

Courses more specific to the realm of hydrology and environmental engineering dominate the list of electives to impart a specialization in WRM, as per the philosophy of the programme.

In semester IV, students are expected to do their major project, in which they work with an organization on a subject of their interest. The programme basically seeks to train professionals for the development sector and the university has a placement cell that helps the students get placed with prospective organizations. Organizations such as WWF, WaterAid, UNESCO, and UNDP are being targeted for their major project as well as final placements. The major project, in which the students work for a short while with some organizations, serves as some kind of launch pad for the main careers and many people are expected to get absorbed in the organizations for which they carry out a major project. However, according to one of the key faculty members interviewed the choice of major projects is driven more by the projects on offer by the potential organizations, on which the students then work under the guidance of a faculty member. Thus, the major project turns out to be a way of procuring cheap consultancy of the faculty of the institute. This, according to the faculty member interviewed, needs to be revisited such that a large part of the major project is done in-house.

From interviews with students and faculty of this programme, it appeared that there is a requirement for the kind of interdisciplinary water professionals being groomed by this institute in several NGOs. However, NGOs do not attract good talent because they do not pay well enough. Corporations do employ such professionals in their EHS (Environmental Health and Safety) Division. However, they prefer male students, while the large majority of students in the MSc (Water Resources Management) Programme are female [13]. Besides, they have a preference for students with MSc Environmental Management. Though there is a demand for these skills in bilateral and multilateral organizations, they look out for people with some experience, rather than freshly groomed professionals. According to one of the key faculty members interviewed, the major employers of such students are likely to be consultants in the future.

The students interviewed were quite convinced of the need and rationale for an inter-disciplinary programme to tackle water related challenges and were appreciative of the programme curriculum. However, they expressed the view that while an inter-disciplinary programme widened their horizons and gave them a chance to explore subjects that they had been interested in but could never explore in the past, it also tended to make them a 'jack of all trades'. Some of them said that it put them at a disadvantage vis a vis their counterparts at IITs and other institutes, that had stronger, specialized technical skills. They also felt that they wanted more laboratory oriented exposure and work. They felt that the syllabus was too compressed and too much had to be covered in too short a span of time.

The technical orientation in existing water resources education programmes

The programmes offered by the other four institutes studied seem to be of a predominantly technical orientation. Courses touching upon water resource management in these programmes tend to focus primarily on engineering and technical aspects. Courses in the realm of governance/public policy or social subjects occupy an extremely insignificant proportion of the total credits. In some programmes, this calculation itself means little since these courses are offered only as electives.

Students of the programmes offered by these four institutes were interviewed to assess their perceptions and interests. In general, there seems to be a strong sensitivity among the students to water issues of a national significance such as urban sprawl, wastewater storage, water pollution and water scarcity. Particularly, students were found to be very sensitive to water quality issues. There seems to be some discontent with the course curriculum in terms of its design and structure, and students feel the need for a more inter-disciplinary approach as against the present technical orientation. A discontent also seems to be in terms of the inadequacy of the state to deal with the recurrent problems of floods and droughts as well as the inability of the education infrastructure to adequately train professionals and draw on their expertise to deal with these issues. Further, they regret the relatively little importance given to field exposure and practical training, the seemingly high

[13] This is also true of the other two programmes offered by the institute, and this has been a trend over all the batches in the previous years. Most of these students come from a life sciences background.

course load and the emphasis on the semester system. Commercialization of education is another area triggering off some angst.

Faculty members from the various programmes were also interviewed in order to understand and assess their perspectives. Their interests drew mainly from such technical subjects as hydrology, water resources engineering, design of farm irrigation systems, simulation modeling for water management studies, hydropower engineering and irrigation water management. All faculty members emphasized the need for optimizing scarce water resources in times of growing scarcity and multiplying pressures on water and how that was an important factor in the design and genesis of the respective programmes that they represented. There was a convergence among the most important objectives of the respective programmes, namely, the optimization of the use of scarce water resources using the latest and most sophisticated tools and techniques.

Most of these programmes have an element of dissertation and field work that allows students to explore real life situations and problems. However, the emphasis seems to be mainly on engineering and technical solutions. The management and social aspects are more like a side output, necessitated by the fact that students need to deal with water users and farmers for the conduct of these studies. This, as put by one of the faculty members, gives a 'social touch' to the studies. Management, governance or social issues per se are not subjects of research and investigation.

Faculty members expressed an interest that along with the engineering and technical subjects that are currently taught, these programmes need to be made more inter-disciplinary. They suggested the inclusion of courses like economics of irrigation agriculture and behaviour science of irrigated agriculture. It was also felt that participation and interaction of students with professionals in the field of natural resource management might be useful, along with the teaching of best management practices through case studies, water quality issues with particular emphasis on source of pollution and possible remedial measures, live demonstration projects and management principles.

Even when faculty spoke of interdisciplinarity, the listing of subjects for inclusion tended to stop at the positivist sciences such as computer programming, statistics and optimization and simulation. They did not go on to mention subjects like governance of natural resources, public policy, gender issues and development studies. Others saw interdisciplinarity as a sort of add on, 'icing on the cake', that was needed, but not at the expense of the technical subjects.

The faculty members' perception of IWRM conforms to the general and varied notions of the concept. It is worth noting, however, that one faculty member described the concept as a 'romantic dream'. While they did feel that their respective courses conformed to the notion of IWRM, they tended to approach the concept much more from a technical angle. Another faculty member pointed out with a degree of apparent cynicism that the notion of IWRM is essentially funding driven and that it would tend to be driven and dominated by the discipline of water resource engineering.

4.2 Is there a demand for interdisciplinary water professionals?

The key finding of the study as regards 'demand' is that at present the demand for interdisciplinary professionals is confined to the development sector, namely, donors and funders and some NGOs, particularly, large ones with an international presence, though some demand for these skills can also be seen to emerge in the corporate sector. A growing need for interdisciplinary professionals is felt in the government as well, both by those who are in as well as outside the Government; however, a visible demand still needs to be created.

Demand in the development sector

Some examples of the 'demand' in the development sector are the following. At one time TERI (The Energy and Resources Institute), New Delhi had a small group of water resource professionals constituting an area called Water Resources Policy and Management within the institute's Policy Analysis Division, it has now grown into a full-fledged independent division of its own. It comprises nearly a dozen professionals cutting across disciplines as sociology, anthropology, law, economics and engineering. While at one time the group was dominated mainly by engineers and natural scientists, today it has a wider mix of people with a great diversity of professional backgrounds. This example illustrates changes in some research and education organizations.

In the private sector, there are some organizations such as WIPRO Water, WIPRO Ecoenergy and Doshion Limited that have some demand for interdisciplinary water professionals. At the same time, companies like ITC are venturing into

contract farming; they wish to engage in village level activities such as building check-dams and implementing watershed management projects. Here, too, we notice some demand for inter-disciplinary water professionals. The other related area that presents a demand for such professionals is in corporates that seek candidates in their EHS (Environmental Health and Safety) Division. However, for these positions, candidates with a background in Environmental Management tend to have an upper hand over those with training in natural resource or water resources management.

Donors and funders, too, have a clear demand for interdisciplinary water professionals, though they tend to value professionals with substantive relevant work experience. For instance, discussions with a senior representative of the Ford Foundation revealed that the current interests of the foundation in the sphere of water management are primarily in terms of its implications for poverty and rural livelihoods, more so in dryland areas. The building and strengthening of common property resource institutions for the management of water is an important area of activity. This clearly requires some interdisciplinary skills, in terms of an understanding of local institutions and social dynamics. Likewise, the USAID (United States Agency for International Development) takes an inter-disciplinary approach to water management through one of its major initiatives called WENEXA (Water-Energy Nexus Activity) that emphasizes the linkages between the use of water and energy resources for agricultural, urban and industrial use. In a collaborative PPP (Public-Private Partnership) under the WENEXA programme, USAID provided technical assistance to the Nagpur Municipal Corporation to design, develop and implement an innovative wastewater recycling and reuse project. A recent job advertisement for a Deputy Chief of Party for WENEXA indicated the requirement for an applicant to have a master's degree in such subjects as groundwater hydrogeology, agricultural engineering or water and rural management and at least ten years' experience in the management of water, energy or natural resources. Thus, while an interdisciplinary background is valued, so is a sufficiently long period of development-oriented work experience.

An important challenge confronting some of these organizations, especially those engaged in research and development, is the difficulty in getting people with an interdisciplinary profile. This makes it much more difficult to fill positions through advertisements; very often positions have to be re-advertised. Sometimes, these positions are filled through head-hunters or private human resource firms that also need to be sensitized to the need for professionals with inter-disciplinary skills. More often than not, these positions tend to be filled through word of mouth and personal contacts and references. The reason for this approach is that a requirement for inter-disciplinary skills is much more difficult to articulate, than the requirement for conventional, mono-disciplinary skills, like engineering. Nevertheless, positions for some of these organizations are advertised on their web-sites and in magazines/journals like Down to Earth and The Economist.

Demand in the government

A common sentiment among the interviewees (especially professionals in NGOs and research organizations) was regarding the strong need for but absence of a demand for interdisciplinary water professionals in the government. While an understanding of IWRM issues is slowly gaining ground, the perception among non-government respondents (and reality as well, as confirmed by interviews with representatives from government organizations)is that this sector leans strongly towards technocratic approaches to water management. However, over time, the nature of water management problems has changed, and pressures on water have increased and so has the need for greater stakeholder involvement and IWRM type of approaches. In these circumstances, it will be necessary to break from the engineering orientation of the water sector. This view was expressed by many of the respondents.

Two sub-sectors of the government were identified as having a strong need for interdisciplinary water management. One is the urban drinking water sector; several respondents were of the view that organizations like DJB (Delhi Jal Board) and DDA (Delhi Development Authority) need to be more interdisciplinary in their orientation, while they function as little more than construction agencies. The other sub-sector where this need was identified as being very strong is the realm of groundwater management. Further, on certain aspects of water management, more capacity-building will be needed in the future, as well as more organized data. One such area is climate change, and its implications for water availability.

Within the government, the Ministry of Water Resources is the nodal ministry for water resources management. In this ministry, there are two principal organizations, namely, the CGWB (Central Groundwater Board) and the CWC (Central Water Commission). At present, the composition of these organizations is predominantly technocratic. The CWC is manned predominantly by engineers who are recruited through the Indian Water Engineering Service. These professionals could be considered to be counterparts of civil engineers trained in hydrology. The other major component of the water professionals in the CWC are scientists trained in hydrology and hydro-geology. The CGWB, too, is dominated by

professionals of a technical profile, namely, scientists and engineers; they are recruited through the UPSC (Union Public Services Commission).

Senior representatives from MOWR who were interviewed felt that many of the ministry's programmes fail because these professionals are weak on social and managerial skills. A senior representative of the MOWR identified this predominantly technical orientation as 'the most important constraint to effective water management in the country'. He lamented somewhat vehemently that in particular, professionals in the Central Groundwater Board are mainly concerned with mapping, monitoring and tapping the resource, rather than systematically managing it. A bureaucrat who had had a long period of association with the CPCB expressed the view that engineers tended to be weak on aspects of ecology and sociology, and an association with the bureaucracy distanced them further from civil society.

Senior bureaucrats interviewed in these organizations expressed the view that engineers and scientists in these organizations need to be trained in managerial and organizational aspects so that they can perform their tasks more effectively. A senior bureaucrat from the Ministry of Water Resources felt that there is a need for a 3-tier inter-disciplinary training on water resources management, involving farmers, panchayats and irrigation department officers. Irrigation is the single largest user of freshwater and irrigation engineers are the most important link between the government and water users.

The need for interdisciplinary water professionals is also recognized in government sub-sectors that are closely related. A senior bureaucrat from the Indian Forest Service, for instance, emphasized that water cannot be separated from forestry. A watershed approach is being adopted for the sustainable management of forest resources. The large chunk of professionals in the country's Forest Department has a background in science and engineering. A need for interdisciplinary water professionals can thus be seen even in the forestry sector.

Demand in NGOs

Many respondents felt that NGOs, especially the smaller ones working at the grass-roots level tend to be at the other extreme of the spectrum; while they are rich in social skills and mobilization of people, they are left wanting on the front of technical knowledge and expertise. Thus, there is a need for a greater interdisciplinary orientation in both the government as well as non-government sectors. One tends to be stronger on the hard skills and weak on the soft ones, while the other is in a situation that is the converse of this. Besides, though NGOs need such skills, they are not always in a position to afford high salaries, and therefore, unable to draw good talent. This is not to say, however, that some self-motivated professionals do serve these organizations with a fair measure of zeal and commitment.

4.3 Policy dimensions

India's NWP (National Water Policy) of 2002 emphasizes the need for an interdisciplinary approach to water management, as well as the need for awareness and training on this front, but remains silent on the subject of higher education. The policy makes a case for 'a perspective plan for standardized training', encompassing such elements as training in information systems, sectoral planning, project planning and formulation, project management, operation of projects and their physical structures and systems and the management of water distribution systems; it states that such training should extend to all the categories of personnel involved in these activities as also the farmers. However, the policy statement does not take the argument to its logical conclusion by remaining more or less silent on the subject of higher education in this context. Perhaps the reason for this is that water resources education is not really the domain of the Ministry of Water resources. A senior bureaucrat who had been closely associated with the MOWR for the last four years revealed that higher water resources education indeed was not a subject of discussion in the ministry's meetings.

The dearth of institutes, programmes and recent initiatives on the front of inter-disciplinary water education was emphasized in most of the interviews. In fact, one respondent said that given the current nature of water management problems and their importance in the country, there should be 'at least half a dozen institutes in each state' engaged in interdisciplinary research, teaching and training on water issues. However, as the 2002 SaciWATERs study (see chapter 1) already showed, the existing education and training institutes though large in number, only provide this capacity to a limited extent, a situation that is changing, though very slowly, as the current study shows.

There have been some efforts to improve agricultural engineering education. The Indian Society of Agricultural Engineers (ISAE), the Indian Council for Agricultural Research (ICAR) and the All India Council for Technical Education (AICTE)

have made some efforts to streamline the curriculum. The ICAR appointed a committee to bring uniformity into education and curriculum of the agricultural universities (Singh 2000).

The committee, however, was mainly concerned with relevant inputs of basic sciences, agriculture sciences, basic engineering, applied engineering and agriculture engineering in the course curriculum. The committee also suggested the introduction of electives in these curricula in order to bring in a focus on regional issues. In general, a review of the efforts to streamline and refine the curriculum, as documented in Singh (2000), suggests that these efforts have tended to stay focused on engineering aspects, and the inclusion of subjects in the realm of management or social science has received scant attention.

Discussions with a senior representative of the ICAR suggest that though the ICAR has more recently constituted core committees for the review of course curriculum, none of these touch on aspects of water resources education per se. Besides, the thrust of these changes has tended to stay focused on engineering and technical courses. Similar observations can be made about some efforts to review curriculum of engineering colleges by the AICTE, where inter-disciplinarity is dealt with within the natural sciences (see, for instance, JNCASR/AICTE 2003).

There are now reported to be about 12 WALMIs (Water and Land Management Institutes) through the length and breadth of the country that are engaged in training farmers, irrigation engineers and other stakeholders in water management. More lately, they could be seen as engaged in some training of an interdisciplinary nature, in that they have taken up programmes for training farmers, engineers and other actors in the PIM (Participatory Irrigation Management) process. However, one critique of these WALMIs has been that they, too, have tended to be weak on the social science skills (Meinzen-Dick, Raju and Gulati 2000). [14]

An important reason for the lack of an interdisciplinary orientation on water management is an education system that trains people on disciplinary lines. People typically train either in a social science discipline or in a natural science discipline and follow it up with a Masters in the same field, in an effort to specialize. As put by one of the respondents, 'IITs do not offer any inter-disciplinary training on this front and do not offer a level playing field to social scientists to engage in a debate on water management issues… in the Indian education system, it might be unusual for someone with a B.A. in Pharmacy to do a PhD in engineering; while this might be quite possible in the west'. Such inflexibilities, as well as academic 'pecking orders' (the hard sciences are for the 'bright and capable students', the humanities and social sciences are for the 'not so bright') are important constraints for realizing more integration in water resources education.

Within the Government, the principal constraint to the integration of social, technological and environmental skills seems to be the fragmentation within the government among a large number of ministries and organizations engaged with water management and the absence of integration and interaction among them. This view was expressed by several of the interviewees who had been associated with different departments and ministries associated with water management. For instance, a senior official who had a long association with the CPCB noted the complete absence of interaction between the MOEF and MOWR. He expressed the view that in the MOEF, too, sociological aspects were neglected in practice even though we talked increasingly about economic and social impact assessment.

While ecological, legal and technological aspects had begun to be integrated in the Ministry, much remained wanting on the front of integrating social concerns. A demand for interdisciplinary water professionals cannot be created unless the traditional fragmentation in water management is overcome.

4.4 Assessment

A major message of this study is that Water Resource Management still needs to emerge as a discipline and a profession. At present, the engineering-orientation of water resources education can be seen to be located in a paradigm that relies on supply side augmentation of water resources. When India embarked on the path of planned economic development, dams were seen as temples of modern India and as being pivotal to planned agrarian change and economic development.

[14] Discussions with a senior water professional revealed that WALMI Aurangabad got off to a good start; however, now there is a crisis of faculty. After the retirement of the first generation faculty, faculty has not been recruited and the reason given is that there has been a halt to recruitment in the Irrigation Department in the state since the 1980s. For a different assessment of WALMI Aurangabad, see chapter 5. In general, the impression seems to be that the WALMIs are going down-hill.

This necessitated an emphasis on construction and civil works. However, with hydrological, technological and financial constraints rapidly emerging for tapping additional water resources, a paradigm shift towards integrated water resource management would become more necessary than is thought at present.

Conventional curricula imparting education on water resource development/management are confined to the agricultural and civil engineering domains. Some recent initiatives, however, do point towards greater interdisciplinarity, such as the launch of the MSc (Water Resource Management) programme by TERI University. It is in these programmes that water resource management could be seen to emerge as a discipline. However, it is likely to take considerable effort and time to reorient conventional engineering- oriented programmes towards more inter-disciplinary ones, emphasizing the integration of social and managerial aspects of water management with technological and ecological ones. This would require attitudinal changes in the more conventional faculty as well as a greater effort at demonstrating the demand for inter-disciplinary professionals.

The suggested way forward is to focus on the following elements of an intervention strategy:

1) Demonstrate the relevance of an interdisciplinary approach to water resources management by focusing on the relationship between technological/ecological and managerial factors.
2) Sensitize, in particular, segments of the bureaucracy on the potential for IWRM approaches and build their skills to allow them to focus on social and managerial aspects of WRM.
3) Partner and network with institutions like IWMI, IRMA, IIFM and IITs for the design of course curriculum for such programmes.
4) Work with regulatory bodies like AICTE and ICAR for the inclusion of social science related courses vis a vis water resources management.

A regularly posed question in such reorientation is whether interdisciplinarity compromises basic disciplinary strengths; that is, does it produce a jack of all trades? The answer to that question perhaps lies in the end-product that an academic programme seeks to create. There are some areas, like in the development sector, where an interdisciplinary orientation is absolutely necessary on account of the nature of activities with which they are engaged, and where at present, the bulk of the demand for interdisciplinary water professionals is concentrated. Though the need for an interdisciplinary orientation is felt strongly in the government, a demand still needs to be created. This need appears to be very strong in three sub-sectors; namely, groundwater, urban drinking water and irrigation.

There is a recognized need for capacity building of the government particularly at the grass-roots level, involving the Agriculture Departments, Irrigation Departments, State Groundwater organizations and Command Area Development Authorities. The benefits of an interdisciplinary approach to water management need to be demonstrated and communicated at that level. This might be a first step towards creating a demand for interdisciplinary water professionals in this sector. The other way to do this is through an expression of requirement for interdisciplinary expertise in donor-funded projects implemented by the state machinery. For the government, perhaps a viable route might be to train and sensitize officials in the realm of interdisciplinary IWRM.

Academically, an entry-point for the operationalization of interdisciplinary education on water resources management is through the use of analytic approaches that link up the social and natural sciences. That is, technical/ecological subjects are not only taught as courses separate from those on governance, management and public policy, but the linkages between the two are demonstrated. These analytic approaches help us understand the implications of ecological/natural factors on the design of institutions for governance (see Narain 2004 for a review).

Chapter 5

South India

R. Doraiswamy [17]

5.1 Inventory water resources curricula

The South India study covers totally five institutes, of which four institutes provide a post graduate degree in water resources and one institute is engaged in training and research on water resources. These five institutes are:

1) National Institute of Technology (NIT), Warangal, Andhra Pradesh
2) Jawaharlal Nehru Technology University (JNTU), Kukatpally, Andhra Pradesh
3) University Vishweshwaraya Engineering College, Bangalore, Karnataka
4) Tamil Nadu Agriculture University (TNAU), Coimbatore, Tamil nadu
5) Water and Land Management Institute (WALMI) in Aurangabad, Maharashtra.

The National Institute of Technology, Warangal is a revisit from the earlier study carried out in 2001-2002 by SaciWATERs.

Technical focus

The syllabus from the institutes shows that the post graduate degree courses not only focus on the standardized engineering subjects like Fluid Mechanics, Hydrology, Dam Construction and Hydraulics but also other courses within the technical domain. Courses of other disciplines like Environmental Sciences, covering Environmental Legislation, Remote Sensing, Project Economics, Planning and Management, Irrigation Management and Crop and Soil characteristics are adopted. A review of the syllabus of M Tech and ME Water Resources shows that some of the topics, although taken from different disciplines still focus on the technical aspects of these topics. A shift can thus be found in the programme from conventional engineering disciplines to disciplines that are popular in present days, while maintaining technical focus.

Field exposure

Most faculty members emphasize the need for social and managerial topics in a postgraduate degree in water resources. They justify the consideration for social sciences through guiding the students in preparing the questionnaire to interview stakeholders and other data collection tools. It is reported that the only way in which the students get exposed to social dimensions of water resources is during their project work in the second year.[18] In the PG degree most part of the second year is said to be allocated for project work in which students taken up field oriented projects go to field. This again depends on the kind of the topic selected by the student for his/her project. Interaction with the students shows that about 70 per cent of the students opt for project work that limits itself to the laboratory. A small percentage of students express that there is a need to incorporate topics like water policies, environmental sciences, interface between the water projects and people. One of the strong recommendations that emerge during the discussion is that the students do not have enough exposure to field problems. Thus, demand for more and more interaction with institutions working on water resources. It is a strong suggestion of the faculty that the government and other agencies engaged in water resources projects should provide internship opportunities to the students. The faculty confidently says that this will help students practically engage in multidisciplinary issues and develop IWRM water professionalism.

The dilemma of interdisciplinarity

The faculty and students interviewed opine that the need of the hour of any course is to be able to fit into societal needs, requiring modification of courses towards interdisciplinary content – when attention is drawn to social and managerial issues by the interviewer. There is a clear confirmation that the wisdom from different disciplines needs to be applied to make water resources education more meaningful. However, students state no constructive effort is made by the faculty to lay emphasis on social dimensions of water resources. In relation to interdisciplinary water education programme, most of the faculty feels that it is difficult to accommodate the essence of all disciplines in a PG water education programme. The reason is that the focus or the attention paid to the details of the engineering topics like hydrology, watershed, hydraulics, river basin management and remote sensing gets diluted. The very objective of imparting to the students profound knowledge on technical aspects gets defeated. Further, the students get more and more focused as they are moving through higher education and they get into research mode in particular topics. The general perception of most of the faculty is that incorporating social aspects may not be good idea in PG degree courses.

[17] The chapter has been extracted from the full report and edited by the compiler.

[18] The field visit or industrial training as it is generally called is compulsory in the undergraduate education programme in which the students are taken to sites for a period of two weeks.

The thinking thus seems caught in a very common dilemma: how to maintain technical 'depth' while broadening the perspective? The answer to this dilemma lies in defining the skills sets/competencies that (different types of) water professionals should have acquired at graduation. Another part of the answer to the dilemma is that part of the issue is about how technical courses are taught (see the Partner Institute profiles in part 3 of this document for some more discussion).

New issues, concepts and tools

A number of issues, concepts and tools have emerged on the agenda of water policy; including Participatory Management, Public Private Partnership, Gender, Restructuring of Water Resources Department and User Pays Principle are by and large. These are also part and parcel of many development programmes in water. Most of the faculty members are aware of participatory management - formation of users' institutions for water management for various uses of water. The participation of women in conservation and utilization of water resources is highlighted. However, there is little interest shown towards incorporating the intricacies of the relation between the engineering knowledge of water with these social issues. One of the education programmes does have a course titled sustainability of project and project economics. However, the institutes have no courses or sections incorporated on financial sustainability of the water bodies in relation to the User Pays Principle. The standard reply to these issues is that there will be different people with various professional backgrounds engaged in water resources and they all deliver their task tuned to their expertise – a perspective of multi-disciplinarity. Thus, bringing social issues, including management aspects on board in the PG degrees in water resources, is far from reality.

The predominance of a multi-disciplinary perspective is also clear in statements as regards the need for changing government recruitment policy. The faculty and the students feel that the water problem in coming years will become much more competitive, giving way to all kinds of conflicts. These problems could be addressed with a holistic approach towards water resources management, recruitment of water professionals by the department, and promoting more water professionals. All departments in the universities and institutes working fully or partly on water related issues need to be motivated to develop constructive approach. There is a strong feeling that the recruitment pattern by the government and other agencies should change. Graduates from various disciplines should be given place in water resources development activities. As a team it is possible to bring out the integrated approach towards water management, better than any professional from any particular degree concentrating on all aspects.

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other agencies should change. Graduates from various disciplines should be given place in water resources development activities. As a team it is possible to bring out the integrated approach towards water management, better than any professional from any particular degree concentrating on all aspects.

Approval of programme changes

The courses offered in PG degree water resources from the institutes have undergone changes in the recent period. Some of these changes are incorporating courses on environmental engineering, project economics, remote sensing, watershed projects and river basin management. The education programmes are guided by the AICTE (All India Council for Technical Education) and NIT (National Institute of Technology), the institutes engaged in offering these courses have liberty to propose changes to the existing syllabus. The proposed changes in courses are sent finally to AICTE, NIT and ICAR (Indian Council of Agricultural Research) for concurrence. It is said that AICTE and NIT set standards on the general technical course. These two agencies ensure that there is no fall in the standards and total deviation in the technical courses offered. The faculty members express that so far, they have not faced any difficulty in bringing changes to syllabus. In other words AICTE or NIT have not stopped bringing changes to the existing syllabus.

Box 2.1: Questions for 'Upscaling IWRM education in South Asia: which boundaries to cross?' session in the international Water Policy in South Asia conference, Colombo, Sri Lanka, 20 December 2008

1) What can be practically done (and by whom and how) to expand and strengthen comprehensive, integrated, interdisciplinary water resources education programmes?

2) What can be practically done (and by whom and how) to increase the effective demand for 'hybrid' water professionals?

3) What can be practically done (and by whom and how) in the policy domain to improve the enabling conditions for IWRM type water resources education programmes?

In order to improve the quality of the education programme, a separate assistance is being provided to technical institutes under the Government of India programme called Technical Education Quality Improvement Programme (see Box 5.1).

IWRM

Most of the faculty feel that their water resources education programme is in line with IWRM, if not fully at least to a large extent. Some of the projects taken up by the centres do have elements of inter-relationships with social and economic development. For instance, projects like watershed development and irrigation management in large canal irrigation cannot escape the interrelationships between the physical component and social component. Similarly, there are several workshops organized by the education centres under the banner IWRM covering different dimensions of water (see Box 5.2).

Box 5.2: IWRM workshops carried out by one of the sample institutions

1. National Workshop on Interlinking of Rivers: Concerns and Issues, December 4-6, 2003, Bangalore University and Karnataka Environment Research Foundation (KERF)
2. International Workshop on Integrated Water Management, January 2001. Bangalore University and International Ecological Engineering Society.
3. One day workshop on wetland management (TEQIP supported), Bangalore University and KERF and Sustainable Resources Department, November 2005.
4. Natural Resources Management for Sustainable Development, 2004, Bangalore University and KERF

Limited interest for water resources degrees

It is quite evident from Table 5.1 that the number of students joining postgraduate degrees in water resources is lower than the seats available in the respective departments in all four institutions. The students' priority for the education programmes starts with software followed by structures, construction, geo-technical, transportation, electronics and water. The M Tech/ME in Water Resources comes as the last option. It is reported that one of the sample institutes experienced poor numbers students joining PG degree water resources – for many years this institute got only one student. Yet another institute which has 20 seats is facing a worse condition, as there is no student for PG water resources for the current year.

The study reveals a number of reasons for low interest in PG degrees in water resources. Of these, the foremost reason is that the entire water bodies' development is by and large controlled by the government. There are no regular employment opportunities for the students of water resources. Yet another important reason for low numbers is that the scope towards career development and financial prospects are better in the I.T. sector than in water resources. There are instances, where some of the post graduates in water resources have gone into the IT sector as software engineers. The IT sector also brings in opportunities abroad and the first look out of engineers is to explore opportunities abroad. A small percentage of students also admitted that because they could not get into other courses in PG degree and also due to unemployment joined PG degree in water resources .[19]

Table 5.1. Total seats available and current status in PG degree education programmes in water resources

Degree	*Course Name*	*Class Strength*	*Current Status*	*Department*	*Institute*
M.Tech	Water Resources Engineering	18	0	Department of Civil Engineering	National Institute of Technology, Warangal.
M.E	Water Resources Engineering	10	5	Department of Civil Engineering	University Vishweshwaraya College of Engineering, Bangalore
M.Tech	Water Resources and Environmental Technology	25	20	Water Resources Centre	Jawaharlal Nehru Technological University, Hyderabad
M.Tech	Soil & Water Conservation	5	2	Department of Soil and Water Conservation	Tamil Nadu Agricultural University, Coimbatore

Training institutes

The Water and Land Management Institute (WALMI) at Aurangabad, Maharashtra is widely known as a prime training institute in water and land management in India. This institute is engaged in water education through training different stakeholders, especially employers and farmers, in doing research, providing courses to under- and postgraduate students, doing consultancy, organizing workshops and issuing publications. The assessment of the training curriculum – topics covered, training calendar, faculty and their profile - gives a clear sense of an inter-disciplinary water resources institute. This institute has a blend of faculty representing Engineering, Agriculture, Social Sciences, Science (Computer & Hydraulics) and Integrated Watershed Development & Management (IWDM). Eminent scientists, professors and engineers from abroad and within the country are invited for sharing their field experiences in workshops, seminars and in several orientation courses related to Irrigation Water Management conducted by this institute (see Box 5.3).

The Maharashtra Engineering Training Academy (META), Nashik (previously known as Engineering Staff College) is one of the prestigious institutes of the Water Resource Department and Public Works Department of the Government of Maharashtra and was established in 1964 to impart induction training to directly recruited engineers from Maharashtra Public Service Commission to Irrigation Department and PWD. Now the Academy also gives training to in-service engineers of Water Resources Department and Public Works Department to get them acquainted with the recent technological changes.

Box 5.3: Outline of courses provided by WALMI

- Water Resources Management
- Operation & Maintenance of gravity Irrigation Systems
- On-Farm Water Management,(Improved surface irrigation techniques)
- Land development
- Drip & sprinkler irrigation,(Planning, design, O & M aspects)
- Drainage of Agriculture lands
- Drainage of Agriculture lands
- Conjunctive use of surface & ground water

[19] Although, the study aimed at PG degree, there was an opportunity to interact with some of the PhD scholars working in department providing water resources. Most of the PhD scholars openly admitted that they are pursuing PhD as it is compulsory for promotions. These scholars are already employed in universities and institutes.

- Planning, design, O & M of L.I. schemes & K.T. weirs
- Water auditing of irrigation systems
- Benchmarking of Irrigation systems
- Soil-Water-Crop Relationship
- Water Management of Irrigated Crops
- Hydraulics & Flow Measurement
- Computer Applications in Irrigation Water Management (IWM)
- Agricultural Extension and Rural Sociology
- Socio-Economic and Organizational Aspects of IWM
- Participatory Irrigation Management
- Training of Farmers
- Integrated Watershed Development and Management
- Modern Education Technology
- Training of Trainers

5.2 The demand for 'hybrid', IWRM water professionals

Recruitment policy and water resources education

There is a direct relation between the employment policy and the future of water resources education programmes in South India. In Andhra Pradesh, Karnataka and Tamil Nadu, the recruitment for the water resources department is carried out through public service commission established by each state. They are called Karnataka Public Service Commission, Andhra Pradesh Public Service Commission and Tamil Nadu Public Service Commission. Further, the trend in absorbing the water professionals depends on the establishment of departments in each of the States. Table 5.2 shows that the BE/B Tech and Diploma are the basic requirement to join the Water Resources Organisation/Irrigation Department [20]. Further, the data indicates that there are no regular recruitment programmes in the case of Karnataka and Tamil Nadu.

Table 5.2. Employment trend in each of the states as reported by the respondents

State	Year	No. of Posts for WRO/ID	Previous recruitment	No. of Posts for WRO/ID
Andhra Pradesh	April 2008	1100	Info NA	Info NA
Karnataka	August 2007	648 AEs (BE/BTech) 562, JEs (Dip)	1984	Info NA
Tamil Nadu	December 2007	250	2006*	450
Maharashtra	October 2007	200	Info NA	Info NA

*It is said that there was a gap of almost 10 years in recruitment in Tamil Nadu.

The fact that the undergraduate degree of B.E or B Tech with civil/mechanical engineering is the eligibility to get into water resources organization and irrigation department, according to the respondents means that there is little interest of students to pursue a post graduate degree in water resources. In addition, candidates with a PG degree in water resources have no incentives like direct recruitment for particular, higher posts. The candidate with a postgraduate degree in water resources is treated on par with an undergraduate civil engineer.

In 2004, graduates with Agriculture Engineering degree protested against the non-recruitment of Agriculture Engineering professionals into I & CAD department. These graduates demanded the government of Andhra Pradesh to recruit graduates from Agriculture Engineering on par with B.E./B Tech Civil and Mechanical Engineers. This resulted in taking about 30 graduates from Agriculture Engineering degree into I & CAD Department. However, the government did not make

[20] In Karnataka, irrigation department is renamed as water resources organization. In A.P. it is called as Irrigation and CAD (I&CAD) and in Tamil Nadu it is called as Water Resources Department under PWD Ministry.

changes in recruitment policy through any amendment. Hence, the condition to recruit B E /B Tech Civil and Mechanical Engineers remains the same in terms of eligibility to enter the I&CAD Department (see Box 5.4 for an example from Andhra Pradesh).

Earlier, recruitment was broadly under Engineering Services and Public Works Department. The staff working on Roads and Buildings was transferred to Irrigation and vice versa. Of late, the States have adopted the policy of recruiting staff separately for irrigation/water resources department and roads and buildings. As a result, the experience of the staff working in each department could be utilized in the same sector. This reform enables the department to sponsor staff to undergo water education programmes so that such staff could be better utilised in the same department. However, deputation to higher education programmes is yet to start.

In Tamil Nadu, the establishment of a separate department called Agriculture Engineering in the Ministry of Agriculture enables clear bifurcation of activities between the mainstream Agriculture Department activities and the Agriculture Engineering Department. The main focus of the Agriculture Engineering Department is soil and water conservation activities like rainwater harvesting in watersheds and irrigated areas. Most of the command area development activities are undertaken by the Agriculture Engineering Department. An advantage of a separate Agriculture Engineering department is that it helps professionals from agriculture engineering to enter government employment.

Box 5.4
ANDHRA PRADESH PUBLIC SERVICE COMMISSION; NOTIFICATION NO.22/2007
Assistant Executive Engineers in A.P. Engineering Service in I & CAD, PH & ME and R&B Engineering Services (General Recruitment)

		Zonal-wise Breakup of provisional vacancies								Age as on 1/7/2007	Scale of Pay
Post Code	Name of the Post	Z-1	Z-2	Z-3	Z-4	Z-5	Z-6	City cadre	Total	Min. Max.	Rs.
01	AEE in I & CAD Civil Engg. Branch.	55	123	127	259	277	240	-	1081	18 - 38 (For Age relaxations See Para - 3)	9285 – 21550 (RPS =2005)
02	AEE in I & CAD Mech.Engg. Branch.	07	15	16	33	35	30	-	136		
03	AEE in PH & ME Civil Engg. Branch.	07	12	10	12	03	-	-	43		
04	AEE in R&B Civil Engg. Branch	12	24	16	40	23	38	20	173		
05	AEE in R&B Electrical Engg. Branch	N.B.: Under GSR 526-E of G.O.Ms.No. 674, Dated 22/10/1975 The Electrical Estt. has been declared as Special Estt. Hence no Zonal Regulation Is applicable to these posts as per Para-8 of above said G.O.							28		
								Total :	1461		

Post Code	Name of the Post	Essential Educational Qualifications
01	AEE in I & CAD in Civil Engg. Branch.	Must possess BE/B Tech in Civil Engineering Branch of a University or an equivalent qualification.
02	AEE in I & CAD in Mech. Engg. Branch.	Must possess BE/B Tech in Civil Engineering Branch or Mechanical Engineering Branch of a University or an equivalent qualification
03	AEE in PH & ME in Civil Engg. Branch.	Must possess BE/B Tech in Civil Engineering Branch or Mechanical Engineering Branch of a University or an equivalent qualification
04	AEE in R&B in Civil Engg. Branch	Must possess BE/B Tech in Civil Engineering Branch of a University or an equivalent qualification
05	AEE in R&B in Electrical Engg. Branch	Must possess BE/B Tech in Electrical Engineering Branch of a University or an equivalent qualification

Source: www.appsc.ap.nic.in

Institutional arrangements for multidisciplinary team: change management

Generally, senior staff of organizations employing water professionals does acknowledge the importance of 'broader' approaches in a general sense [21]. The interviews suggest that there is a positive move towards multi-dimensional approaches, despite the limitations in the existing socio-political system, in which each disciplinary group lobbies to safeguard their interest. In practice IWRM, and recruiting IWRM-type staff, remains a major challenge, despite the shift in the discourse.

There are different institutional arrangements within government departments to recruit professionals from various disciplines, like the establishment of societies and wings with special provision. These are mostly project based teams of staff members from various disciplines, normally called as multi disciplinary project unit (MDPU). The MDPU of Tamil Nadu Irrigated Agriculture Modernisation and Water Bodies Restoration Programme, the MDPU of Jalasamwardhana Yojana Project working on Tanks projects in Karnataka, and the Sujala Watershed Project in Karnataka are some of the examples where a multi-disciplinary project unit has been established. One of the objectives is that the professionals experienced in interdisciplinary approaches bring multi-dimensional wisdom from different dimensions of water. The heads of these MDPUs and I&CAD, Andhra Pradesh express that the unsuccessful effort to bring in changes in the approach of the existing staff is the main reason to bring in professionals from outside with the background of different disciplines.

In departments where establishment of MDPUs is not favoured, the services of NGOs, also called as Support Organisations are solicited, and professionals from various disciplines are hired on a contract basis through the open market and through the Support Organisations. These experiments do involve regular staff in utilising these professionals in order to motivate the existing department staff to modify their approach towards water resources. This is being tried out under the notion 'Change Management'. The argument put forth by the departmental organizations is that the involvement of support organizations mostly focuses on the social aspects of water, including management of information. Furthermore, the services of such support organizations are for a stipulated time. The representatives of the government agencies say that the regular departmental staff view the task entrusted to support organizations as something which they don't have to acquaint with and learn themselves. Once the support organizations leave the field after completion of their task, the gap is experienced by the department top officials. 'Change Management' enables the regular staff to engage with professionals from different disciplines and carry out these task on their own as part of the routine work. The debate undertaken by the head of TNIAMWARM project in Tamil Nadu, is whether to hire the services of support organizations or to establish multidisciplinary units at various levels of the department structure.

The discussions also reveal that recruiting professionals from different disciplines is not going to solve the problem in totality. For instance, most social science professionals lack exposure to the physical dynamics of water resources. Thus, the exercise of crafting professionals from social science background into different dimensions of water resources still remains a challenging task [22].

The I&CAD Department in Andhra Pradesh, realizing the importance of an integrated approach towards water resources development gave ample opportunity to the recruited staff to get exposed to various dimensions of water resources . Among these staff, those who showed keen interest in learning about the multiple dimensions of water were encouraged to work with NGOs associated with I&CAD. Further, these staff members are sent to foreign countries to learn more about water resources [23] . These staff members are posted at the head office to work on macro level issues. In addition to newly recruited staff, professionals from different disciplines are hired on contract basis to work at head office.

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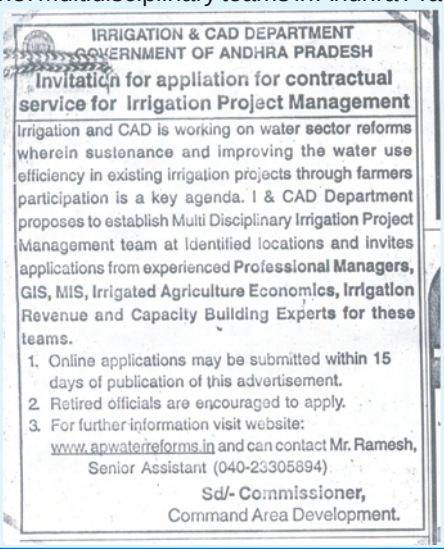
[21] Not surprisingly, representatives of civil society organizations in the water sector who were interviewed strongly supported the move towards integrated approaches it water resources development and management. They find it difficult to employ engineers for their projects.

[22] Due to non-availability of interdisciplinary water professionals either by degree or by experience, I&CAD, GOAP has taken special approval from the Chief Minister to hire services of nearly 200 retired engineers on contract basis. The reason for hiring retired chief engineers is that they have put in service in water resources and are exposed to different issues and situations in irrigation management.

[23] Out of the 256 staff who underwent training about 36 showed interest in interdisciplinary approach. Of these 11 are doing extremely well and have gone to Japan for training.

I&CAD carried out several studies and workshops on various aspects of irrigation management. One of the studies focused on institutional strengthening in the irrigation sector. The outcome of the study was to extend the multi disciplinary professionals model tried at Head Office to projects and field level. This study also evolved an institutional arrangement in which the multi-disciplinary professionals fit into existing system of irrigation department and farmers organizations to make difference in water management. A special effort was made to get the approval from the government to recruit professionals from multi discipline on contract basis. An advertisement was given formally in leading English and Telugu Newspaper and also put in the official website www.apwaterreforms.in (see Box 5.5).

Box 5.5: Multidisciplinary teams in Andhra Pradesh



IRRIGATION & CAD DEPARTMENT
GOVERNMENT OF ANDHRA PRADESH

Invitation for appliation for contractual service for Irrigation Project Management

Irrigation and CAD is working on water sector reforms wherein sustenance and improving the water use efficiency in existing irrigation projects through farmers participation is a key agenda. I & CAD Department proposes to establish Multi Disciplinary Irrigation Project Management team at Identified locations and invites applications from experienced **Professional Managers, GIS, MIS, Irrigated Agriculture Economics, Irrigation Revenue and Capacity Building Experts for these teams.**

1. Online applications may be submitted within 15 days of publication of this advertisement.
2. Retired officials are encouraged to apply.
3. For further information visit website: www.apwaterreforms.in and can contact Mr. Ramesh, Senior Assistant (040-23305894)

Sd/- Commissioner,
Command Area Development.

The AP irrigation projects are grouped into 11 Chief Engineers Offices and each of these offices will be provided with professionals from different disciplines. One of the senior officers feels that this arrangement, although it is based on contract basis and for a specific period, the long term objective is to make the policy makers realize the need for such an approach in water management. It is hoped that this arrangement would turn out into regular set up of the department in the long run.

5.3 Assessment

The picture that emerges from the description of the water resources higher education programmes is that they are rather firmly locked in a technical perspective. There is awareness of changes in the water sector, and of new problems and demands in water resources management, but these have found their way into existing education programmes only to a very limited extent. The dominant approach is a multi-disciplinary one: a call for teams and approaches that mobilize a variety of disciplines. The next logical question would, of course, be what it takes to allow fruitful collaboration among this variety. That question seems not yet to be part of the educators' discussion. There was a strong statement by students about the lack of field exposure. More exposure and interaction with 'real life' water problems might be a route towards thinking through the requirements for multi-disciplinary collaboration and integrated approaches. Of the latter the need is acknowledged in general.

The practice of organizing water resources development and management projects is moving in the direction of establishing MDPUs (Multi Disciplinary Project Units), and inviting Support Organisations to be part of such project to provide certain services. In Andhra Pradesh an effort is being made under the banner of 'change management' to internalize this into the normal departmental organizational structure. The strong message that this practice contains is that ground-level water resources management interventions are running ahead of the education system. The water resources education system is not providing the kind of expertise required for this type of approach. This is directly experienced by both government organizations and civil society organizations in their staff recruitment efforts.

At the same time the existing water resources engineering education programmes are facing a lack of entrants – they are not very popular. In the four institutes studied, less than half of the available seats are currently filled. This is, reportedly, due to the official recruitment entry criteria of government departments not requiring postgraduate degrees, the lack of recruitment in past years, and the pull of other sectors, notably IT, with better salaries. The recruitment criteria are exclusively engineering focused. In a state like Maharashtra the stagnation of the educational sector is partly compensated by WALMI as a specialized water resources training institute, but this is not the case (to the same degree) in the other states.

It would seem that this situation creates a logic for rethinking and reshaping some of the educational and recruitment arrangements. Though there are disciplinary and professional territories to defend, these territories seems to be shrinking, while combined broadening of the educational and recruitment profiles would seem to have benefits on all sides. The trick is to mobilize the decision-making energy to achieve this shift.

Chapter 6

Nepal

Bala Raju Nikku [24]

6.1 Introduction

"We know that some people would read this as a call to abandon all 'sound scientific training' and make everything 'social and fuzzy'. Quite the contrary is the case. We strongly believe in sound understanding of physical processes, as of social process. But we also believe that the two are connected, and that acquiring the awareness and learning methods for understanding of these connections should be part of every professional's education. In this respect it doesn't matter whether the subject of study is more narrow and disciplinary or more holistic and interdisciplinary. A reflexive attitude and skills are an essential part of a more humane water science and technology." (SaciWATERs, 2002:4).

To explore the message of this quotation, taken from the report of the 2001-2002 inventory of higher water resources education in South Asia, the Nepal study looked at the five study programmes listed in Table 6.1.

Table 6.1. Selected programmes and institutions

Programme	*Institute*
Msc in Environmental Management	Schemes College of Environment Management, Pokhara University affiliate
Msc in Environmental Science	College of Applied Science (CAS), Tribhuwan University affiliate
Msc in Environmental Science	Kathmandu University
Masters in Water Resource Engineering (ME)	Institute of engineering (IOE) Tribhuwan University
B.Sc. in Agricultural Science (Hons)	Himalayan College of Agriculture Science Technology (HICAST), Purbanchal University affiliate

The reasons for the selection these five programs for the study were the following.

1. Two (ME in Irrigation Engineering (TU), and MSc in Environmental Sciences (KU)) were covered in the 2001-2002 study.
2. The sample covers all four universities that are offering water related courses in Nepal.

6.2 Assessment of curricula

"If education is really to be a means of reducing social inequities and redressing the skewed course of development followed in the last few decades, it shall have to be reckoned as a site of struggle for power. The classroom shall have to relocate the power to critique and change – to decide what shall count as legitimate content for curricula, to choose enabling pedagogies, negotiated when, where and ultimately for what purposes. The educational discourse would need to consciously give voice to the silenced majority and redefine its objectives by valuing their lives on their terms." (Rampal, 2000:2523).

In this section a brief assessment of the curricula of the five selected water resources education programmes is given.

Focus group discussions with students

Among others, the students of Masters in Environment Management stated that they are Masters of None and Jack of all Trades because their course is much more interdisciplinary than other courses. They are confident that the degree that they are going to acquire will help them to compete in the global scenario. Though the MSc in Environmental Management course has an interdisciplinary goal, in the context of Nepal, only students from the Science stream can join this course.

The students from the MSc Environmental Science in general stated that their course is more ecology driven and it should include social aspects, economics and management also. However, they also added that their course is more interdisciplinary than other courses like engineering.

[24] The chapter has been extracted from the full report and edited by the compiler.

The students of Agriculture Science and Engineering courses especially expressed that they do not have clear idea about interdisciplinarity and integrated water resources management as these concepts were not discussed in their courses in detail. The students of Masters in Water Resource Engineering stated that integrated water resources management is the 'integration of environment, social, economical, design, and planning and management aspects in water resource'. Integration of all aspects is necessary in this field, they opined. Without social, environmental, economic aspects no proper analysis of the problem can be done. However, their course appears technical with a low focus on social, economic and political aspects of water resources management.

The focus group discussions with students from different colleges/ courses suggest that the majority of them are not clear about concepts like interdisciplinarity and/or multidisciplinarity, irrespective of their course training. They attached different meanings to interdisciplinary study. Regarding IWRM, majority of the students are aware but felt that this concept was not adequately represented/discussed in their courses. None of the courses covered under this study had an explicit nature of interdisciplinary, environmental awareness.

The water component is treated in a fragmented way in the courses covered by this study. For example, its use in irrigation and crop water requirements in BSc in Agriculture course and Water and pollution in Environmental Management course and as an engineering subject in the ME in Water Resource Management.

The priority to do thesis research in water issues varies across the programmes. The research priorities of the students are guided by urgent or hot topics like global climate change rather than specific local issues. Some students are of the opinion that the courses are designed more on the bases of market needs than on any theoretical or foundational approaches. For example, Master in Environmental Management and Masters in Environmental Science are offered by two different Universities.

Interviews with faculty members

The majority of faculty members teaching these programs are positive about integrated water resource management (IWRM) as an approach that is feasible and to be promoted. However, other members are critical about this approach and raised questions about the relevance of interdisciplinary training in a country like Nepal. A faculty member who teaches at an Environmental Management programme shared that;

> IWRM is in debate. IWRM means sustainable use of water which sounds good. IWRM is a recently introduced concept, yet to know how to put it in implementation level in Nepal. It is confined only within a talk/discussion. Interdisciplinary approach to water management is very important. There are several complexities and uncertainties regarding types and belonging of this natural resource. It is really difficult to put decision process from different sectors at one place. For management, it is taken only for immediate solution. In addition fast changing society, diverse topography has further added complexity in the management of water. There is high demand for inter-disciplinary water professionals. The major problem during the management of water is lack of interdisciplinary perspective and it has several technical limitations.

Another faculty member with a training in Environmental Science and Engineering at Masters Level stated that;

> The way of teaching at both BSc and MSc levels in Nepal is text book oriented. The courses still lack management and sustainability aspects; and technological applications are also missing. Students should also be acquainted with the issues like conflict management and resettlements. Since the environmental science course was designed by a specialist long time ago, it is unable to involve other necessary aspects that should be incorporated according to the present needs of the country. We have also a problem of teachers because teachers who teach science don't know about management and vice versa as they are only one subject expert and lack interdisciplinary aptitude.

A faculty member with 26 years of experience in engineering education stated that;

> A master's course on IWRM is about 80 percent technical part and 20 percent social, economical and environmental part. Students must know the spatial and temporal distribution of resources while planning the project so that the students come out with managerial and technical capabilities. Water resources are an interdisciplinary subject. The course will be superficial if there would be less technical part. I am critical about interdisciplinary courses though there is a demand for interdisciplinary water professionals in NGOs, INGOs etc. But they can't implement projects and will be limited skills in designing new projects or technical evaluation of the

projects. The main objective of the course is to create specialists not generalists in water resources management.

Faculty members who received a PhD training abroad stated that;

> There is necessity of interdisciplinarity in courses offered at Masters level if not at Bachelor level. Unfortunately the education system is still dominated by unilateral thinking. Incentives, appreciation and internship are necessary elements in present scenario of higher education in Nepal. There should be more practical methods in teaching. There should be more of research, case studies and field work based learning methods. The demand for the students with multidisciplinary skill is less in the context of Nepal. There occurs disciplinary resistant or dominance in Nepal. The higher education policy should be thoroughly reviewed to suit to the changing needs of the country.

In conclusion, the majority of the faculty members involved in teaching these courses are of the opinion that interdisciplinary nature of study will help students to understand, link and examine the relationship between education and environment. The students will acquire foundational knowledge of theoretical issues and concepts, and also look at past and current trends in water management in the country. Unfortunately this approach is missing in Nepal.

6.3 The demand for water professionals

The key finding of this chapter is that there is a growing demand for interdisciplinary water professionals. However, this demand is confined largely to the development sector and teaching and research institutions.

Perspectives of water professionals

The majority of professionals interviewed irrespective of their present job stated that there is a growing demand for water professionals in general. However, no specific positions have been created for people who are trained in interdisciplinary water studies.

The professionals from INGOs (international NGOs) and the donor sector mentioned the relevance of the interdisciplinary approaches and difficulties in implementing this approach. They also mentioned the lack of policies as one of the main reasons for the lack of interdisciplinary trained water professionals. The business sector stated that they need technically sound professionals, but that it is an advantage if these professionals are also aware of current concepts like IWRM. The local NGOs are in favour of IWRM and some of them use these concepts in implementation of their projects.

Evidence from interviews with senior government bureaucrats suggest that in Nepal there is huge scope for water professionals as the country is rich in water resources. The country needs to know how to harness this resource much more efficiently and sustainably. To do so the country needs interdisciplinary water professionals who can understand the complexities of physical, social and political domains. According to a water bureaucrat:

> The concept of IWRM was started in the 1980s and in 1987, it was formally established in Nepal. In 2005, this concept was incorporated in planning. It is a kind of art that should be designed according to the reality and the situation. The principles included in IWRM differ with the place (different countries) and the situation. To have it in implementation level it is time consuming and in our context it is more difficult to implement because the organizational structure is complex. It is more structural than functional. However, awareness is arising in present context. The projects related with water resources, though they talk about IWRM in their implementing task, it is still not as such. They work in a part but think they are covering the whole sector. Here, trained water professionals having knowledge of IWRM are really lacking though it has high demand in present.

Student perspective

The students of Environmental Management felt that there are specific jobs in the government for people who are technically trained (for example water resources engineering) but not for them. The limitation is that there is no specific policy in the country to recognize the environmental managers or scientists and to use their services. Students who achieve a degree in environment science/management hope to gain jobs in certain municipalities, hydropower projects, international NGOs like ICIMOD, ISO and other NGOs but not in the government departments.

6.4 The policy dimension

Higher education is a relatively recent phenomenon in Nepal. In 1959, following the recommendation of the National

Education Planning Commission, Nepal's first university the Tribhuvan University (TU) was established. The major purpose of establishment of TU was to meet Nepal's requirements for skilled human resources. In 1992, the first private University, the Kathmandu University was established after the government of Nepal opened up higher education to private sector investment (see Sijapati, 2005). The Purbanchal and Pokhara universities are charted in the recent past only. These two regional universities were primarily intended to oversee the existing higher education campuses in the region and develop their own programmes in an environment of competitiveness in the higher education system (Lohani, 2001).

According to some a weakness of government education policy is placing emphasis mostly on quantitative increase: expansion of new educational institutions without giving due reference to regional needs and potentials and with access to educational opportunities greatly restricted to the underprivileged communities and their needs (Vir, 1988). Poudel (1999) states that "in a country where only 13 percent of students pass out annually at the higher education, opening up new universities is not the only way forward. At a time when the country's higher education is suffering from low pass rate and non-use of scarce resources, the government's proposal to open up four new universities in a country with 50 percent literacy rate smacks of immaturity and visionless policy". In addition to this, one can see the dominance of non-academic institutions in research. The post 1990 period witnessed the mushrooming of private research centres and NGO's due to the availability of foreign funds (Hachhethu, 2004: 229, also see Sharma, 1997).

Technical higher education

In 1847, one year before Governor General Lord Dalhousie approved the building of the Upper Ganga Canal (UGC) and the Bhimgoda barrage in 1848, Thomason College of Engineering was established at Roorkee, India. The college also educated Nepal's first engineers, Kumar Narsing Rana and Kishore Narsing Rana, who were involved in the design of Patan's water supply system completed in 1905 and the Pharping Hydropower plant. Several decades later Nepal sent about 250 students to Roorkee University to be trained as engineers. They were expected to work on the 10,800 MW Karnali Project. Since the project did not materialize, most of the graduates began working for the government, which is the employer of the majority of the nation's educated engineers.

In 1942 the Engineering school was established and was transformed to Nepal Engineering College in 1959, the year TU was established. Two campuses Pulchowk and Thapathali were established under the Institute of Engineering (IOE) of TU in 1972. The IOE updated its course to Diploma level engineering only in 1976 with support from the World Bank. The IOE was twinned with Paisley Technical College in Glasgow and their staff was sent to Britain and the United States for obtaining higher-level education. In 1982, the three years diploma course was upgraded into a full-fledged Bachelor's level course. By mid 1980, IOE had a pool of Nepali Engineers with specialization in hydraulics, water resources, hydrology, irrigation and water supply engineering.

The Institute of Agriculture and Animal Sciences (IAAS) started graduate-level programmes in agriculture in 1976 and in 1987 in animal sciences. The Institute of Forestry (IOF) was established in 1981. Another institute formed was the Institute of Science and Technology (IOST) that regularly offered postgraduate courses and a PhD level program.

After 1990 when democracy was reinstated, the liberal environment has led to creation of engineering colleges by the private sector. The first, Nepal Engineering College (nec) was established in 1994 with an affiliation from TU and later with the newly established Pokhara University (PU). More private colleges have since been established also with affiliation from Purbanchal University.

Discussion

The higher education policy and its evolution in the last 100 years in Nepal offer interesting insights into the policy process. The successive governments in Nepal largely used the supply side of higher education as the main strategy while paying scant attention to the demand side and growing needs of the higher education sector. Expansion of 'the higher education pie' has simply been assumed to automatically improve access to higher education for a larger segment of the disadvantaged groups (Sijapati, 2005). At the same time the majority of the educational institutions of higher education in the country are confined to urban centres mainly in Kathmandu valley, depriving the rural youth, especially women, from access to the higher education opportunities.

The policy evolution regarding the promotion of water education in Nepal is influenced by the engineering and technocratic approaches to water issues and management. We do not find evidence of consistent policy efforts that promote

interdisciplinary water education in the country. Gyawali and Dixit (1994) argue that new initiatives are required for interdisciplinary research to reach a better understanding of the existing living and non living natural environments, human-built systems and symbolic systems, as well as of the complex interlinkages among them even as they are subject to constant changes.

The policy process in Nepal is guided by donor interests. A report prepared to analyse the policy and programmes of the Ministry of Education and Sports says that education policy and planning is guided more by the suggestions from donor countries. The preliminary draft report on Institutional Structure for Educational Development, prepared by Institutional Linkage Programme (ILP) and Danish University Education (DUE) for the ministry says that 71 per cent of the suggestions from the donor agencies turns to be "fitting for the last decision" whereas, only 31 per cent of the suggestions made by the parliament reaches implementation stage.

6.5 Conclusions and recommendations

There is a great need to include water management from the point of poverty alleviation, gender equity, social discrimination, and livelihood in the present context of Nepal for which management of water should have an interdisciplinary approach. However, such an approach is generally lacking. There are some professionals who are working in the water sector who are learning by doing; self learning and sharing knowledge on interdisciplinary approach.

Strengthening of interdisciplinary perspectives and skills can be achieved in two ways;

- Providing training with regard to interdisciplinary approaches to those water professionals who are purely technical. According to many respondents the Nepal government should take as its first approach to create interdisciplinary water professionals by giving appropriate training.
- Incorporating interdisciplinary courses in academic subjects at student level. According to a respondent, students should learn through seeing and practical knowledge; for instance, they should be taught at the field level like nearby water resources area. Likewise, the school students should also have some course on water management focusing on integrated approaches.

Students (irrespective of their degree) should be trained to face the complexities of current water management practices and the need for collaboration between different professionals. With increasing specialization, there is less opportunity for interdisciplinary exchange of knowledge. Methods to teach interdisciplinary (water) studies require different teaching methods differing greatly from traditional lecture methods. The faculty should be trained in interdisciplinary problem based learning approaches, critical appraisal and reflective questioning. Further attention is needed on how students can develop interdisciplinary team skills. The higher education policy in Nepal should address these issues as priority issues.

Robert Chambers describes the standard professional attitudes, reflexes, and standard science of engineers and other professions with the term ‘normal professionalism’. It is the thinking, values, methods and behaviour dominant in a profession. “Reproduced through education and training and sustained by hierarchy and rewards, it tends to specialized narrowness.” (Chambers, 1988:68). This 'specialized narrowness' is what is still dominant in higher education in Nepal, including water resources higher education.

Chapter 7

Sri Lanka

Kapila Goonasekere [25]

7.1 Introduction

Of the 15 universities of Sri Lanka's national university system under the Ministry of Higher Education, at least 13 universities are providing higher education in water resources in one form or the other. The Faculties of Agriculture, Faculties of Engineering, and Faculties of Social Sciences offer supporting course components in their respective Bachelor programmes. There is no degree programme in the university system that covers all aspects of water resources management as an integrated discipline except for the degree programmes offered by the Faculty of Social Sciences at Rajarata University and the Faculty of Science at University of Kelaniya.

As regards postgraduate education a similar trend can be observed. However, this may be changing, as is shown by the postgraduate programme offered by the Postgraduate Institute of Agriculture (PGIA), Peradeniya University (see chapter 10).

Government agencies such as Department of Irrigation (DI), Mahaweli Authority of Sri Lanka (MASL), Government Department of Agriculture (DOA), Water Resources Board (WRB), National Water Supply and Land Reclamation Bureau (NWSLRB), Forest Department (FD), Ministry of Environment have their own forms of water education/training. There are national non-governmental organisations (NGOs) and international non-governmental organizations (INGOs) who conduct awareness programmes on water resources in their programmes of water supply and community development activities. However, most of these programmes are of short duration and specific in their content.

7.2 Curricula and present status of selected water resources education programmes

The five institutions selected for the detailed study are the following.

1. Department of Civil Engineering, Faculty of Engineering, University of Peradeniya
2. Post Graduate Institute of Science (PGIS), University of Peradeniya
3. Department of Civil Engineering, Faculty of engineering, University of Moratuwa
4. Department of Zoology, Faculty of Science, University of Kelaniya
5. Faculty of Social Sciences & Humanities, Rajarata University

Water resources education at the University of Peradeniya

During the decade of 1990-2000, the University of Peradeniya has reviewed and revised all curricula of the Faculties coming under its ambit in keeping with the government higher education policy. The curriculum content has been significantly revised to provide a much broader scope of learning compared to the programme listed under the 2002 SaciWATERs study. The changes made indicate an increasing awareness of the need to include components of economics, management, arts, humanities, political, and social sciences to produce a graduate with a wider exposure to interdisciplinary subject matter in addition to the technical subject matter.

The BSc (Civil) engineering degree programme offered by the Department of Civil Engineering has undergone major revisions during the period of 2003 to 2006. The four year degree programme consisting of 8 semesters has a Civil engineering core along with compulsory General Electives and Technical Electives: total of 9 credit units of technical electives and 12 credit units of general electives need to be completed to be eligible for honours. The general electives are to be selected from either social, political sciences, arts, humanities or economics and management).

The Postgraduate Institute of Science (PGIS) is the postgraduate arm of the Faculty of Science, University of Peradeniya, established in 1996. The PGIS offers two MSc programmes with a water resources management component.

1. MSc in Water Resources Management (WRM) offered by the Board of Study in Earth Sciences.
2. MSc in Environmental Science (ES) which has environment biased components that address issues of water pollution, wetlands, agricultural practices etc.

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[25] The chapter has been extracted from the full report and edited by the compiler.

The MSc WRM programme was not listed in the 2002 SaciWATERs study because it was offered by the PGIS from 2004. One notable aspect lacking in this postgraduate programme is the social and economic components of water resources management.

The MSc ES postgraduate programme was listed in the 2002 SaciWATERs study, but the course content has undergone considerable change. New subjects areas have been introduced with a larger base of optional courses. Though this programme has a water resources component the programme has a biology and environmental bias with only 2 credit units of social and economic components.

Water resources education at the University of Moratuwa

The BSc (Engineering) degree programme of the Department of Civil Engineering produces civil engineers with a common core of engineering courses with a minor in water engineering and infrastructure or environmental engineering. These are the BSc Engineering degree programmes with a water bias. The course is design, construction, and management oriented with little or no social sciences aspects.

The Hydraulic and Water Resources Engineering Division offers water related courses for the undergraduate civil engineering programme. Hydraulic engineering at undergraduate level covers the first, second, third and fourth years of the Degree course specializing in Civil Engineering. Students are also made aware of the environmental impact of projects related to water resources and coastal engineering. During the final year many undergraduates carry out research projects in hydraulic engineering. Field visits are also organized to enhance the student exposure to practical problems.

The Division of Environmental Engineering offers 'Fundamentals of Environmental Engineering' and 'Environmental Engineering Design' compulsory for all Civil Engineering students. Optional subjects offered by the Division, for those students who are interested in following a career in Environmental Engineering or Management are as follows;

- Environmental Management
- Environmental Pollution Control
- Water and Wastewater Treatment
- Environmental Impact Assessment

The BSc programme is very much engineering biased with planning and management components. Compared with the 2002 SaciWATERs study there are minor changes in course outlines of the water related subjects. However, there is no social science component.

At the University of Moratuwa, the Department of Civil Engineering offers many postgraduate degree programmes out of which three degree programmes are of significance in relation to water education.

- Master of Science Degree / Postgraduate Diploma in Environmental Water Resources Engineering and Management.
- Master of Engineering Degree / Postgraduate Diploma in Environmental Engineering and Management.
- Master of Science Degree / Postgraduate Diploma In Environmental Management.

Of these three postgraduate degree programmes the Master of Science Degree/Postgraduate Diploma in Environmental Water Resources Engineering and Management is the main water related programme. The other two programmes have a heavy environment bias with water related course components.

The Master of Science Degree/Post graduate Diploma in Environmental Water Resources Engineering and Management has its beginning in the postgraduate training offered by the UMSL in Hydraulic Engineering commenced in 1981, as a collaborative program with the Institute of Hydraulic Engineering (The Netherlands). Following a 10 year period of collaboration with Institute of Hydraulic Engineering (IHE) during which postgraduate training in hydraulics and hydrology, the Department of Civil Engineering evolved the above postgraduate courses covering Water and Environmental Engineering. The course participants are professionals, mostly engineers, from different institutions dealing with water resources. This programme has major course components offered by the Division of Hydraulic and Water Resources Engineering.

Water resources education at University of Kelaniya

The Faculty of Science, University of Kelaniya offers BSc (General) and BSc (Special) degree programmes in Environmental Conservation and Management, offered by the Department of Zoology. The theme of the two degree programmes is natural resources management and conservation where water resources management and conservation is a considerable component. These two degree programmes were not included in the 2002 SaciWATERs study because they were introduced in 2006, with minor revisions in 2008. In designing the course structure the stakeholders consulted were the CEA (Central Environmental Authority), Provincial Environmental authorities, and some industries. Advice and expert opinion also has been sought from several University Professors in the Universities in Sri Lanka, Professors attached to two foreign Universities (The Netherlands and Australia). Though the degree programme is mainly on environmental concerns the course content is very much integrated in its approach, which aligns itself with national environmental policy. This degree programme shows that national policy can considerably influence the content of the degree programme based on national needs, a successful approach to introducing higher level education in environmental conservation and management.

Water Resources Education at the Rajarata University of Sri Lanka (RUSL)

Water resources education at RUSL is done by two faculties of the university, Agriculture and Social Sciences and Humanities. The Department of Soils & Water Resources Management of the Faculty of Agriculture offers courses at undergraduate level which has considerable water related course components with an IWRM course similar to most agriculture faculties of the universities. The Faculty of Social Sciences & Humanities at RUSL offers a 3 year Bachelor of Arts (BA) General Degree programme with a significant water resources management component. The 2002 SaciWATERs study lists only one course under this Department. Subsequently however, the department has offered this three year degree programme to undergraduate students with the option of majoring in Water Resources Management. The Department of Social Sciences contributes to the courses offered that cover aspects of IWRM in a significant manner. This programme perhaps is the only such programme offered by a university at degree level. The faculty also offers a 4 year BA Special degree programme on Environmental Management that includes water resources management. However, the programme is heavily biased towards environment, economics, and management.

General observation

The available higher education programmes are not specifically designed to provide IWRM type training in the country. Generally the programmes do have a subject specialty bias depending on which faculty or department offers the programme. It is revealing to note that within the same university similar programmes are being duplicated particularly due to this traditional discipline bias and barriers of compartmentalized education as shown by the examples of UPSL and UMSL.

7.3 Type of jobs expertise required and prospective employers' views

National institutions

Interviewing a Directorate level officer of the ID (Irrigation Department) revealed that the policy of the institution is to recruit civil engineering graduates or NDT or equivalent certificate holders for planning, design, construction, operation and management of water resources. In addition, ID recruits engineering assistants by selecting young individuals who have completed GCE “A” level examination and training them at the Irrigation Training Institute (ITI) at Galgamuwa. He was quite emphatic that the training provided by the ITI is adequate to meet the job responsibilities for different levels of these technical employees.

Another fact that emerged was the difficulty of recruiting young civil engineers to the existing vacancies. The main reason for this phenomenon is the job opportunities available to immediately graduated engineers in private sector construction projects, both local and abroad, with attractive salary benefits and the option to live in an urban environment. The job opportunities in the ID are in remote locations and the salary benefits are not competitive. Over 20 vacancies are unfilled and he expressed grave concern about the absence of a younger generation of engineers.

A similar trend is experienced by the Faculties of Engineering of the universities of Peradeniya and Moratuwa. Two senior staff members interviewed from those universities revealed that it has become difficult to recruit civil engineering graduates to academic staff positions. They too adduced the reason to the job opportunities available in the construction sector with attractive benefits package which far supersedes what the universities offer.

Nevertheless, a survey of vacancies showed that most state sector vacancies of institutions dealing with water resources are for civil engineering qualifications – a long standing tradition.

Non-governmental Organizations

A number of water related vacancies appeared in the newspapers within the month of November 2008 in this category. Interviewing representatives of two local NGOs, World Vision and Plan Sri Lanka, indicated that they require water professionals for strategic planning, support at higher level and on need basis. On skills requirement the response was that water professionals need skills in multiple use of water, integrated water use, and norms, national policies and best practices. For the training needs of the already employed their response was short term training programmes aligned to plan projects and national programmes. On recruitment policy the response was contracting consultants for specialized work and employing medium level experts. Recruitment is done through paper advertisement or through personal contacts. On expected future water related problems the response was water scarcity, inequalities in coverage, quality of drinking water supply, pollution, ground water depletion and water management. On skills required to address such problems the response was community mobilization, institutional support and low cost technology for resource management. One responded stressing the requirement of proper need assessment with stakeholder participation. Surprisingly none of them were aware about institutions training water professionals.

Donor agencies

The World Bank (WB), Asian Development Bank (ADB), and United States Agency for International Development (USAID) were the donor agencies selected for this study mainly because of their involvement in funding water related projects in Sri Lanka. Both WB and ADB are very clear and detailed in their recruitment policies. Most employment opportunities are international with attractive remuneration package and therefore highly competitive. The educational requirements are a university degree in water resources, hydrology, agricultural or civil engineering, with preference for complementary training/work experience in other subject areas in rural development or other related fields; preferably at post-graduate level or its equivalent. This alone indicates the type of educational requirement and the disciplines considered in recruitment of a suitable person. A minimum of 10 years professional experience in the water sector is a requirement. Thus employment opportunities are for very senior water professional and not applicable in the case of a fresh IWRM type graduate.

The programme officer of USAID had the opinion that water professionals employed for projects do not possess sufficient skills to perform their job responsibilities. Also on training he was specific that short training to supplement skills will be sufficient for their requirements.

Private sector

The private sector also absorbs water related professional staff. A sample advertisement that appeared in news papers recently for a water supply project required BSc Civil Engineering with 3-5 years experience for immediate recruitment. Because of the ongoing donor assisted projects on community water supply, irrigation rehabilitation etc. many private sector companies undertake design and construction on contract. These contracts provide considerable opportunities for fresh graduates to find employment in water related fields. One could expect a boom in such opportunities for years if peace is regained in the north and east of country in the near future in view of the rehabilitation and reconstruction needs.

7.4 Policy dimensions

Education and Higher Education come under two line Ministries, Ministry of Education and Higher Education at present. These were under a single line Ministry, the Ministry of Education and Higher Education until 2005. The Ministry of Education is responsible for the primary and secondary education, while the Ministry of Higher Education is responsible for university level education covering both undergraduate and postgraduate studies.

Available literature and documentation show that there is no subject specific national education policy. The Ministry has issued broad guidelines to the Universities to diversify the curricula to include interdisciplinary subject matter and to introduce new degree programmes to provide better employment opportunities in the education reforms introduced in 1997.

Individual universities have the academic freedom to decide and offer new degree and training programmes with interdisciplinary flavour. As such revisions and introduction of degree programmes in new disciplines are largely done by academics of different faculties based on national policies and needs, in consultation with stakeholders in effecting these revisions.

One good example is the national environmental policy. The national environmental policy was formulated by the authorities with broad consultation of all stakeholders, and assisted by lending organizations such as WB, ADB and donor organization such as UNESCO. The National Environmental Act was passed by the Parliament without problems and the National Environmental Authority was established to implement the legislation. This created the opportunities to the universities to provide higher education training to fill in the gaps in expertise to implement the national environment policy in the country as evidenced by the number of diverse postgraduate level training programmes on environment available in different universities.

With regard to water, the national water resources management policy that had been formulated has faced a stalemate in the national legislature due to lack of consensus and the politically sensitive nature of the subject of water.

Section 9 of the National Water Resources Policy Document (2005) specifically mentions that;

> The NWRA in exercising its mandate will promote research, training and capacity building of water sector agencies to meet IWRM goals. Facilitate mobilising partner institutions such as Universities, Research organizations, Govt. departments, private sector institutions and NGO for consultation and awareness to promote stakeholder commitment for water resources management. NWRA will commission water related research.

If a National Water Resources Management Policy is finally accepted by all stakeholders by removing the contentious issues then similar to the National Environmental Act it could provide universities the opportunity to actively participate in the role of IWRM capacity building as institutions involved in education and research.

The process of offering a degree curriculum

Interviewing senior academics indicated that before a new degree programme is introduced there is broad consultation of faculty staff, other stakeholders such as alumni, government and non-governmental institutions for a needs assessment and the content of subject matter. Once this is approved at the Faculty Board or Coordinating Committee level (in the case of postgraduate institutes) the curriculum or the course contents are reviewed by the University Senate comprising academic members of all faculties. If the revisions are for an existing degree programme it can be implemented following Senate and Governing Authority Approval.

Once the programme is approved by the senate and the governing authority of a university a new degree programme is reviewed by the discipline specific Standing Committee of the UGC before approval is granted by the UGC. If the new programme is a postgraduate degree, once it is approved by the Board of Management of the Institute it is again reviewed by the University Senate and the Governing Authority prior to approval. The programme has to be reviewed by the Standing Committee on Postgraduate Education and Research of the UGC before the approval is granted for the implementation. It is mandatory for all new degree and postgraduate programmes to follow this standard procedure.

Constraints

The process of higher education is not without its constraints, particularly at the basic degree level. The effect of civil unrest in the 1980s was to disrupt the proper functioning of the national university system. Therefore, functioning of the national universities with a synchronized academic calendar has been a serious constraint to student mobility among universities. Similarly, within a university also the faculties have not been able to synchronize their academic calendars for intra-faculty student mobility to provide the best out of the semester based course unit system, a primary reason for duplication of courses among faculties.

The traditional discipline bias and dominance of certain institutionalized professional disciplines also has introduced constraints to the introduction of interdisciplinary course curricula within a university. This fact is very clear from the duplication of similar postgraduate programme within a university as seen above.

The limited library facilities, the expensive nature of books and periodicals, and limitations in available funding have seriously constrained the opportunity of providing independent learning to students. The availability of internet has eased this problem to some extent.

Role of private sector education providers

During the last three decades many privately sponsored educational institutions with links to foreign universities have commenced providing higher educational opportunities in Sri Lanka. These opportunities are mainly demand driven and fee levying. They provide higher education to the large pool of individuals qualified but deprived of entering the national higher education system mainly due to inadequate capacity, mostly in the fields of IT, Business Management, Accountancy, which have a very high demand due to assured employment opportunities. Private higher educational institutions have shied away from providing higher educational opportunities in other fields of study either due to protests from the national university system, other social, and political pressures or due to the non-lucrative nature of those fields of study from a business point of view. None of these institutions have national recognition by the UGC, though most such education opportunities are accredited by recognized foreign universities. Among these institutions only the Aquinas College of Agriculture, which has provided diploma level education in the country over a long period, has received recognition from the UGC.

New initiatives – IRQUE project

A project, Improving Relevance and Quality of Undergraduate Education (IRQUE) was implemented by the Ministry of Education in collaboration with the University Grants Commission from 2003, with duration of project till 2009. The objective of the project is to "Improve the relevance and quality of undergraduate education to ensure that university graduates effectively contribute to economic development and social harmony." This project was initiated with a loan agreement with the World Bank to the value of US $ 51 million. The long-term objective of the government is to reorient and improve tertiary education so that it is more supportive of the country's social and economic development needs.

Higher education policy on water resources education

From the foregoing discussion it is apparent that a national policy on water resources management is yet to be accepted and implemented to provide any guidance on capacity building. The Higher Education Ministry was not present as a stakeholder in the national water resources policy formulation, whereas other Ministries directly or indirectly involved in water resources management and use have been adequately represented. However, there is involvement of university academics as stakeholders. Individual universities have identified trends and national policy issues particularly with regard to providing employment oriented multi-disciplinary training in fields of interest or to cover the gaps in knowledge for those are already in employment in such fields.

Many such initiatives are driven by international lending agencies and donor agencies that fund projects of such policy formulation. For example, environmental impact assessment of development projects funded by international lending agencies, donor agencies and international INGOs implementing various development projects have driven the national university system to introduce these aspects to the curricula of degree level as well as short training programmes to cover the gaps in knowledge because there is a demand created for such training by professionals already employed or employment opportunities created by such development projects.

7.5 Conclusions

Water resources education curricula

Different universities have adopted different approaches to water resources education. There are opportunities in some universities to major in water resources education in a particular discipline with a significant component of water resources related subjects in the curriculum. Other universities offer discipline-based degrees supplemented by needed water resources components.

Resource limitations in terms of funds, personnel, and facilities have slowed this process to a great extent by restricting the flexibility given to the students for such an orientation. The intense competition in the traditional, discipline-based, and compartmentalized structure of the university system for ownership of such programmes has prevented the necessary cooperation and sharing among faculties, departments, and even within faculties of the same higher educational institution, thereby duplicating efforts.

Postgraduate programmes are available in some universities on water resources education particularly aimed at enhancing the capacity of those who are already employed in various water sector institutions. These Postgraduate programmes of specific duration do not have the flexibility or sufficient time frame for in depth coverage of required disciplines.

Most NGO and INGO type employers prefer short training programmes of 2-3 months duration where as National Institutions have supported longer duration professional type degree programmes.

Overall the job skills required by different types of employers are very diverse making it difficult to target a fixed duration postgraduate diploma/MSc degree programme.

Demand for IWRM type professionals

Limited and highly competitive employment opportunities are available in the field of IWRM for graduates with considerable IWRM experience nationally and internationally. There is a traditional predominance of the professional disciplines in the water sector of Sri Lanka. Therefore the possibility of employment of other types of water professionals is limited to the National Institutions responsible for water resources management. There is a demand for water professionals with limited experience for field level employment in national and international NGOs. There are many short term and long term consultancy and advisory assignments available for experienced IWRM type professionals in the NGO and INGO sector.

National water education policy

There is no national policy at present on water education per se in the field of education and higher education. The Ministry of Higher Education (MHE) which is responsible for national education policy provides broad policy guidelines. The higher educational institutions are encouraged to offer degree programmes of diverse nature based on national needs and demand that will be funded through the government's funding arm, the University Grants Commission (UGC).

Higher educational Institutes are given the academic freedom to introduce multi-disciplinary IWRM degree/training programmes that are relevant and of quality. The Education reforms of 1997, with the introduction of semester based course unit system to facilitate interuniversity and intra university interaction to produce employable graduates with multidisciplinary orientation, has been the broad national policy.

National water resources policy

The emphasis on integrated water resources management is driven by international lending agencies and donor agencies rather than by an indigenous demand. As such there is no real conviction or commitment to the ownership of the concept by the different state agencies responsible for water resources.

Ownership of the formulated water resources policy and its implementation through enactment of supporting legislature is shunned by different actors responsible, due to the politically sensitive ownership of water, water rights, and transferability of water rights.

Recommendations

1. A firm national education policy on synchronization of academic calendars of a given university, if not the national university system, will facilitate truly interdisciplinary water education in the universities.
2. A possible approach that can be adopted by the universities to accommodate the diverse needs of different types of employers is to conduct discipline based course modules of short duration leading to a certificate based on existing demand. This can be followed by granting a Diploma/degree/postgraduate degree based on the number of such modules completed by the participant. This could facilitate the adequate coverage of a particular discipline as required by some institutions requiring professional training while meeting the short term training required by other institutions.
3. With the removal of contentious and controversial issues of national water resources policy and its implementation with ownership of stakeholders similar to the National Environmental Policy, will be the start of IWRM. This could pave the way for establishment of an institutional mechanism to implement the policy. The institutional mechanism will then be able to promote IWRM type water resources education through its relevance and thereby create the demand for such education and training.

Chapter 8

Water resources education at the Centre for Water Resources, Anna University, Chennai, India

Prakash Nelliyat

8.1. Introduction

The Centre for Water Resources (CWR) is one of the pioneer centres in Anna University, a premier institution of technical education in India. The University started as a Survey School in 1794 and has served the nation for more than two centuries. It is globally recognized for quality education in the field of engineering and technology. At present the University has three campuses with 15 departments and 20 inter-disciplinary centres/institutes/schools. The University offers 33 undergraduate programmes, 53 post graduate programme and a PhD programme. (www.annauniv.edu).

After the formation of Anna University, the Hydraulics Division of the Department of Civil Engineering was upgraded as the Centre for Water Resources in 1979 and became the first centre under the University. The centre expanded very rapidly with financial support from many agencies including USAID, Ford Foundation and Department of Science and Technology. The centre emerged as a strong interdisciplinary team, as it had experts from Civil Engineering, Agriculture, Agronomy, Economics, Environmental Studies and Sociology. The centre was also a pioneer in offering a Master degree in engineering called ME Irrigation Water Management. The mission of the centre is "to develop the human resources potential through capacity building by teaching, research, training and dissemination of research results for sustainable development and management of land and water resources" (unpublished record, CWR).

CWR has completed more than 70 research and consultancy projects on different aspects of water resources development and management. At present 6 projects are progressing. Most of the projects are directly linked to policy development of Tamil Nadu state. One example of this is the Centre's study on Tank modernization and institutional transformation, a project that lasted 10 years with the support of a Ford Foundation grant. Another major project carried out by the center was 'Water resources management and training project' with the financial support from USAID. The centre was also involved in many large scale consultancy projects at the national level in collaboration with the Indian Institute of Technology (IIT), Madras and Indian Institute of Management (IIM), Bangalore.

The thrust areas for future research of CWR include urban water management, rain water harvesting, hydrology of tank watersheds, groundwater modeling and management, drought analysis and management, waste water reuse, participatory irrigation management, performance evaluation of irrigation systems, water quality management, irrigation scheduling, application of GIS and remote sensing, micro irrigation, and experimental hydraulics.

At present the academic programmes of the centre include BE Agriculture and Irrigation Engineering, ME Hydrology and Water Resources Engineering, ME Irrigation Water Management, ME Integrated Water Resources Management, MS by Research, and PhD. More than 500 masters and 44 PhDs have been completed so far. Presently 36 candidates are working on their PhDs with specialization in drought assessment, application of GIS, groundwater engineering, urban storm water modeling, rain water harvesting, waste water reuse, tank system rehabilitation, irrigation sociology, gender issues, and other topics.

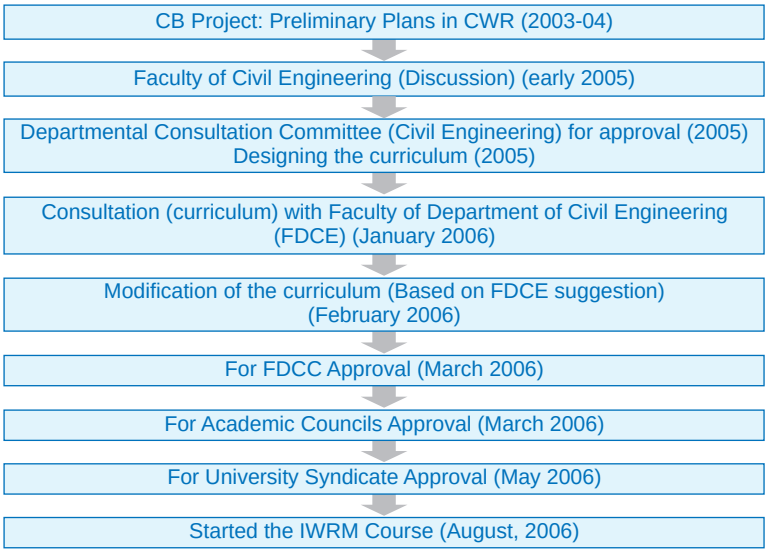
The introduction of the post graduate programme on Irrigation Water Management (IWM) in 1981 was a landmark in the evolution of the curriculum in the centre. This programme has moved away from the hard core engineering approach in irrigation water management and incorporated subjects like Irrigation Sociology, Agriculture/Irrigation Economics and Participatory Irrigation Management in the curriculum. Moreover, the mega Ford Foundation project on Tank modernization and institutional transformation gave emphasis on agriculture extension programmes with farmer's participation. Already during 1985 – 1990 the centre was involved in research projects like waste water reclamation and gender & water issues, which are now gaining attention among policy makers.

From early 2000 onwards the emphasis of the centre shifted to Integrated Management of Water Resources with river basins as the focal point. Emerging water sector problems of the state such as water scarcity, over-extraction of ground water, water quality degradation due to industrial and domestic wastes, and water conflicts were the precipitating factors that led to a shift towards integrated management. It was during this period that preliminary steps were initiated for the Crossing Boundaries Project.

8.2 Approval and curriculum development

The approval process

After the Crossing Boundaries project was sanctioned, CWR has gone through many official procedures in the University to start the IWRM programme at master's level (Figure 8.1). The whole procedures began in early 2005 and obtained the University Syndicate approval in May 2006.



Development of the Curriculum for Integrated Water Resources Management (IWRM)

The first activity after the commencement of the Crossing Boundaries programme curriculum development of the master's (IWRM) programme. This was completed and finalized (obtained university permission) before August 2006, when the CWR selected the first batch of ME IWRM students. The curriculum (4 semesters) consists of 10 compulsory papers, 6 electives out of 9 prescribed papers, and project work as given below in Table 8.1.

Table 8.1. Curriculum for ME (IWRM)

Semester	*Paper / Subject*
Semester 1	(1) Probability and Statistics for Water Resources (2) Advanced Irrigation Engineering (3) Hydraulics and Hydrology (4) Integrated Water Resources Management Elective 1 Elective 2
Semester 2	(1) System Analysis in Water Resources (2) Drainage Engineering and Land Management (3) Participatory Irrigation Management (4) Gender Issues in Water Resources Management Elective 3 Elective 4
Semester 3	(1) Irrigation Economics (2) Field Research Methodology Elective 5 Elective 6 Project Work – Phase 1
Semester 4	Project Work – Phase 2
	Electives i. Irrigation Water Quality and Modeling ii. Watershed Conservation and Management iii. Computation Methods in Water Resources Management iv. Ecology and Environmental Impact Assessment of Water Resources Development v. Rehabilitation and Modernization of Irrigation Systems vi. Advanced GIS in Water Resources Management vii. Soft Computing in Water Resources Management viii. Soil Sciences and Agronomy ix. Remote Sensing and GIS for Water Resources

The curriculum has been revised recently (August 2008) and will come into effect from 2009. It is very clear that the IWRM curriculum has developed as planned into an interdisciplinary course with a good combination/balance of engineering, physical & biological sciences and social sciences. Topics like Integrated Water Resources Management, Gender Issues in Water Resources Management and Field Research Methodology were exclusively introduced for the IWRM Programme and new to the centre. All these subjects address various social aspects of the water sector including gender concerns and scientific methods through which to approach these issues. Moreover, Participatory Irrigation Management and Irrigation Economics (which were introduced by the centre long back and revised within the IWRM framework) also cover the institutional and economic components of water resources management. In CWR, social science components have always been important. However, after the Crossing Boundaries project started substantial changes occurred in the centre that has made the curriculum more interdisciplinary.

8.3 SAWA Fellows

Selection

CWR has so far selected 31 ME students for SAWA (South Asian Water) fellowships in three batches. For the first and second batch an advertisement was posted in a national daily by Anna University for its regular Master's programme, in which the ME, IWRM – Fellowships and eligibilities were mentioned separately. For the third batch apart from the general University advertisement CWR prepared a separate advertisement poster and dispatched to around 100 key engineering institutions in the country and the Director CWR send a requisition letter to the heads of the various water resources institutions to depute the suitable staff for the IWRM programme.

Box 8.1 SAWA Fellows Poster

The number of students selected each year with their disciplinary background is given below (Table 8.2). Two of the second batch students were departmental candidates (Assistant Engineers), working with Public Works Department, Government of Tamil Nadu.

Table 8.2. SAWA Fellows' disciplinary background

Qualification	*First Batch*	*Second Batch*	*Third Batch*
B. E. Civil Engineering	7	10	7
B. E. Civil Engineering with MBA			1
B.E. Agriculture Engineering			5
B.E. Agriculture Engineering with MBA			1
Total	7	10	14

Table 8.3. Disciplinary background PhD Students

Qualification	*No. of Students*
ME Irrigation Water Management	2
ME Hydrology and Water Resources	1
Msc Environmental Science	2
Total	5

Apart from the Masters Fellowships, the Crossing Boundaries Project in CWR is offering five PhD fellowships. Since the PhD programme emphasizes on interdisciplinary areas, the Centre also considered social science background students for admission, as well as students from environmental sciences. 17 candidates were interviewed. The disciplinary background of the selected candidates is given in Table 8.3. The selected candidates joined the Centre on January 3, 2008. Subsequently they finalized their course work and research proposal and are presently engaged in their research project.

Training Programmes for SAWA Fellows

Besides the above regular training as part of the curriculum, all IWRM (Masters and PhD) students have obtained Field Research Methodology training, along with other partner institute candidates. In the training both the theoretical and practical (rigorous field exposure / visits and exercises) aspects on different socio-economic data collection tools were emphasized. The first batch of ME students and PhD fellows obtained their training through Tata Institute of Social Sciences (TISS), Mumbai and the second batch of ME students through SAGUN and Nepal Engineering College at Nepal. The major areas covered in the Nepal training were: (a) paradigm shift in water resources management, (b) participatory research, (c) gender and equity issues in water resources management, (d) social stratification and equity, (e) social structure, power and participation, and (f) participatory research tools (transect walk, social and resource mapping, pair-wise ranking, matrix ranking, time-line diagram, time-trend diagram, mobility map, daily routine diagram, seasonal calendar, cause and effect diagram, institutional diagram, flow diagram, focus group discussion and interviews). The training enriched the student's knowledge in participatory and field based research with practical exercises and helped in designing their individual research proposal in a more interdisciplinary manner.

The five PhD SAWA Fellows participated in the training workshop on Research Methods: Principles and Practices conducted by TISS at Mumbai from April 17 to 30, 2008. The major areas covered in the training were: (a) significance of social science inputs for water resources engineering, (b) interdisciplinary research, (c) research-with-an-impact, (d) philosophical foundations of research and scientific knowledge, (e) research design, (f) literature review, (g) method of data collection, (h) statistical analysis, (i) qualitative research methodology. The Training enriched the students' knowledge, particularly in gathering qualitative information with the help of appropriate methods. At the end of the training all the students designed and presented their research. Resource persons from TISS and SaciWATERs and the Research Coordinators from Partner Institutes provided valuable comments to the students.

The second batch SAWA (ME, IWRM) fellows (10 students) participated in the Field Research Methodology Training Programme from October 1-13, 2008 at Nepal. The training was jointly organized by SAGUN and Nepal Engineering College.

CWR in collaboration with DHAN Foundation – one of the leading NGOs in South India working in water resources management - organized a training programme on Field Research Methodology from August 1-5, 2008 at Madurai, Tamil Nadu for SAWA fellows.

8.4 Research

Themes and topics

The broad area of research CWR selected for the Crossing Boundaries project is Urbanisation and its impact on Water Resources, in South Chennai. The 5 PhD SAWA fellows are working on various sub themes related with the above issue;

1. Impact of urbanization on ground water quality, sanitation and health.
2. Impact of urbanization on environmental sustainability of peri-urban water bodies.
3. Flooding: urbanization and drainage implications for sustainable development.
4. Water market and its socio-economic dimensions.
5. Solid waste disposal and its environmental impacts: with special reference to ground water pollution.

The master students' project work also concentrated on issues related to urbanization and it impacts on water resources (see Tables 8.4 and 8.5).

Table 8.4. Key findings first batch ME-IWRM research projects

Topic	*Key Findings*
Water Supply and Sanitation Status in Ramapuram: A Peri-urban Village Panchyat of Chennai City	• Inadequate water supply and sanitation with respect to the population growth is the major problem faced by the Ramapuram Village Panchayat and the implications are more on the poor • Degradation of groundwater quality is severe in the villages primarily due to the inadequate sewage and solid waste management practices. • Women are facing more problems because of the inadequate water supply and sanitation • For providing better water supply and sanitation facilities to the public adequate financial, technical and managerial assistance is required for the panchayat.
Dynamics in Water Resources Utilization in Peri-urban Areas: A Case Study of Somangalam Village Near to Chennai City	• The agriculture activities in the village has very much reduced in recent period and people are shifting to non-agriculture work • Village is having good water resources (both surface and ground water) with good quality • Somangalam played a significant role in supplementing the city water scarcity through water market at peak summer years
Impact of Urbanisation on Land Use in the Peri-Urban Chennai: A Case Study of the Catchment and Command Areas of Chembarambakkam Tank	• Land use change in the command area of Chembarambakkam Tank is significant than its catchments with respect to urbanisation • Agricultural activities drastically reduced in the command area • Urbanization has improved the socio-economic status of the people in the villages (peri-urban areas) of the command • Since the irrigation water demand has been reduced considerably Government can use the Chembarambakkam Tank for meet the increasing demand of Chennai city
Building an Enabling Environment of a Drainage Course to Meet the Urban and Peri-urban Water Needs	• The ground water resources at Kosesthaliyar river basin played a significant role in compensating the city water demand particularly during the drought period. • However the continues extraction of groundwater adversely affected the environment and economic activities in the basin and may become a threat to the ecological sustainability • Urgent need for controlling the over extraction of ground water through the strict policies and legislation is required for an enabling environment for the basin
Flood Auditing of Urban Areas, South Chennai	• Rigorous land use change with respect to rapid urbanization is the root cause of flood in south Chennai. • Frequent flood in south Chennai has adversely affected socio-economic life of the people • Developed a flood audit model for south Chennai. • Suggested appropriate flood mitigation measures • pointed out the need for participatory approach of the stakeholders in flood management
An Index for Studying the Water Bodies for Capturing Changes on Urban and Peri-urban Context	• The urban rural gradient is not taking in a linear direction, but in a complex non-linear gradient • More urbanization has been taking place in the villages on the western part of Tambaram taluk compare to the eastern part. • In the highly and moderately urbanized village most of the water bodies has disappeared and degraded and lost its utility. But in the least urbanized villages water bodies are present and non-polluted.
Water Budgeting and Gender Issues in Drinking Water Supply in Chennai City	• The public water supply in Triplicant has improved / increased during the years of 2006 and 2007 compared to 2005, primarily due to better rainfall. • The low income group people are depending on public source for drinking purpose, while middle and higher income group depend on public and package water • Women are more responsible in collecting water than men. During the water scarcity period low income group women suffer a lot (in the form of time and effort for fetching water from distend sources and or stay on queue) than the rich.

Table 8.5. Details of the second batch ME-IWRM research projects

Training	*Period*	*Location*	*No. of Faculty*
Field Research Methodology	1-6-06 to 30-6-06	Spain & Netherlands	2
Field Research Methodology	11-8-06 to 21-8-06	Dhaka	3
Integrated Water Resources Management	9-9-06 to 19-9-06	Sri Lanka	3
Gender and Water Management	8-10-06 to 20-10-06	Hyderabad	3
Water and Equity	3-10-07 to 12-10-07	Pune	2
Water and Ecosystems	26-11-07 to 2-12-07	Nepal	2
Water and Economics	9-3-08 to 14-3-08	Delhi	2
Field Research Methodology	5-5-08 to 12-5-08	Nepal	2
Total			19

Research Advisory Committee (RAC)

For obtaining the expert suggestions and the smooth functioning of the research component of the CB Project, CWR formed a Research Advisory Committee. The committee consists of water resources professionals from various agencies include government departments, academic and research institutions and NGOs. Some of the members are policy decision makers.

Stakeholder analysis, participation in public meetings and collaboration with NGOs

SAWA Fellows are frequently conducting stakeholder meetings and focus group discussions in their study area for obtaining stakeholders feedback on research issues. Besides, students are attending various public meetings (associated with their research issue) including public hearings organized by Government Departments and NGOs. These are opportunities to obtain a broader social perspective on the issues and contact with many stakeholders. SAWA fellows are collaborating with the NGOs like Care Earth, DHAN Foundation, SUSTAIN, and EXNORA. All these organizations key representatives are members in CB Project's Research Advisory Committee. Now, these organizations are supporting SAWA fellows during their field level data collection.

8.5 Staff Training

19 faculty members from CWR attended the various training programmes organized in connection with the CB Project (Table 8.6). The broad areas selected for the staff training programmes were extremely important and very much related with Integrated Water Resources Management (IWRM) concepts. Most of the faculty who attended the training are teaching or planning to teach the relevant subject to the IWRM course. The knowledge obtained from the training programmes is incorporated in the curriculum.

Participation by CWR Representatives in World Water Week 2007 at Stockholm

Dr. N. K. Ambujam, Professor, CWR participated in the 2007 World Water Week, held from August 12-18, 2007 at Stockholm, Sweden. One of the side events of the 2007 World Water Week was the seminar on Crossing Boundaries: Meeting Future Challenges Capacity Building in IWRM and Gender & Water in South Asia organized by the Irrigation and Water Engineering Group at Wageningen University, The Netherlands on August 13, 2008. Dr. Ambujam presented a paper, entitled 'Water Supply and Sanitation in Chennai City Perils of a Peri-Urban Interface'. Dr. Prakash Nelliyat, Research Coordinator, CB Project, CWR also participated in the event, since he was an invited participant of the World Water Week by Stockholm Water Institute.

Teaching case development

As the part of CB project CWR developed three case studies for use in teaching, along with other Partner Institutes. These case studies are interdisciplinary in nature. Training on developing teaching cases is provided by the CB partner institute TISS (Tata Institute of Social Sciences).

a) Declining Fisheries and Dwindling Livelihoods: A Case Study from Krishnagiri Reservoir
b) Socio-economic Impact of Ground Water Pollution: A Case Study from Orthapalayam Village, Tamil Nadu.
c) Issues Related to Rural to Urban Water Transfer: Lessons from Two Cases, Tamil Nadu, India.

8.6 Employability of CWR Graduates and SAWA Fellows

Generally, graduates from CWR have been well placed in reputed organizations within government, academia (research), NGOs, consultancies and international organizations. Those who have been placed in various water resources departments under the State Government (such as Public Works Departments, Irrigation and Agricultural Engineering Department, Tamil Nadu Water Supply and Drainage Board, Chennai Metro Water, etc.) and the National Government.

Since CWR Graduates are generally recognized in the job market (water resources management job market), it is important that the IWRM programme specifically places its students in the job market as well. Unfortunately the first batch, which completed the ME IWRM Programme, is yet to be employed in the water resources management field. Out of seven candidates, 5 are teaching in private engineering colleges (for Civil Engineering graduates), one is working in a software company and one candidate is not employed.

A separate centre known as Centre for University Industry Collaboration (CUIC) is functioning in Anna University for selecting/recruiting suitable candidates for various departments and industry. CWR intimated to the CUIC about the IWRM programme and through this one of our first batch (SAWA) candidate was recruited in a software company. Since the CUIC is a collaborator of industries, the maximum appointed will be in the industrial sectors and not necessary in the water sector.

8.7. Challenges

Suitable candidates for SAWA Fellowships

CWR is receiving reasonably good response for the fellowship advertisements. The major constraint is that due to the huge demand for graduates in industry, particularly in the information technology sector in general, there is a shortage of bright students wishing to pursue a Masters programme in water resources management. With the intention of increasing the number of employed female water professionals to join the course, CWR widely advertised the IWRM programme with special requests to various water resources departments which come under centre and state governments, NGOs, etc. Unfortunately, so far only two candidates are deputed by the department. In this regard a part time/evening programme has a good scope if the practical constraints (like availability of the faculty and other staff and administrative clearance from the university etc.) can be managed.

Curriculum development

Further revision in the curriculum is suggested by some of the students who have completed the course. According to them since IWRM is a management area /subject, more specific papers with regard to management should be developed and incorporated in the curriculum. Students also feel a paper on computer applications in IWRM is important.

Faculty training

As the majority of CWR faculty members have an engineering background and don't have prior exposure in social sciences, they are experiencing certain problems in understanding the social aspects of water sector emphasized in the trainings. Hence the fundamentals or basics related to the concerned subjects should be covered in a simplified manner in the initial days of the training. The maximum number of classes should be taught by resource persons who are interdisciplinary in nature and specialized in the water sector.

Employability of SAWA Fellows in the water sector

At present, various water resources institutions including apex agencies like the Ministry of Water Resources, Government of India, emphasize Integrated Water Resources Management. Moreover, international agencies like the World Bank, UNDP, UNEP, consulting companies and NGOs are also putting more emphasis on IWRM. Even national bodies such as the Central Ground Water Board, Central Water Commission, National Water Development Agencies and state departments (Water Resources Organization - PWD, TWAD Board, Metro Water Board, etc.) require more IWRM graduates. The above agencies should give priority to IWRM graduates in their recruitment.

Sustainability of the programme.

It is extremely important to think about the sustainability of the project especially after five years when the financial support terminates. Discussions with students revealed that along with their interest in IWRM course (due to its relevance in recent times), good fellowships (Rs. 10000/- per month to masters students and Rs. 12500/- per month to PhD students) also played a significant role in attracting candidates to join the programme. Fellowship support after the CB project is over needs to be explored. Placement of candidates is also important. The general opinion among the faculty is that if the IWRM students are in high demand in the job market, the programme will sustain longer. Hence, identifying the appropriate placement area or institutions for SAWA Fellows is urgently required.

Chapter 9

Interdisciplinary Water Education in Nepal

Experiences of Interdisciplinary Water Resources Management Programme at Nepal Engineering College

Ashutosh Shukla [26]

9.1 Introduction

Nepal Engineering College (nec) started its Interdisciplinary Water Resources Management (IWRM) Programme beginning July 20, 2007. The programme has succeeded receiving partial support under the Crossing Boundaries (CB) Project for a period of five years, from 2007 to 2011. The IWRM Programme underway at nec has four interrelated components;

I) Masters course in Interdisciplinary Water Resources Management (IWRM);

ii) non-degree and professional courses in IWRM tailored to specific needs of the water professionals and clientele agencies;

iii) problem based research and knowledge dissemination on issues relevant to Nepal

iv) networking with relevant institutions engaged in promoting integrated and interdisciplinary perspectives in water resources planning, development and management.

The Masters course in Interdisciplinary Water Resources Management is an important component of the IWRM Programme underway at nec. The programme aims at producing water professionals with interdisciplinary skills and capacity to respond to established and emerging challenges in water resources management. Another important component of the programme is problem based research and dissemination of pertinent knowledge on the issues relevant to integrated and interdisciplinary perspectives in water resources management. In pursuing interdisciplinary research nec has been focusing on upper reaches of the Bagmati river basin, which provides an opportunity to look into numerous cross-cutting issues relating to agricultural, domestic, industrial and environmental water uses and stresses resulting from competitive water use across different sectors, involving pollution, conflict and ecosystem degradation. Alongside of engagement in academic training and research, the IWRM programme is also focusing on developing non-degree and professional courses designed for professionals engaged in government agencies and development organizations and networking with relevant institutions within the country and outside in furthering ongoing initiative of interdisciplinary water education, research and knowledge dissemination.

9.2 Vision and mission of nec

nec is affiliated to Pokhara University (PU), which is one of the five universities in Nepal under government funding, through the University Grants Commission (UGC). nec follows the regulations set by PU with regards to admissions, evaluation, scholastic probation and award of degrees. The vision of nec is to evolve as the centre of higher learning, excelling in academics, engaging in education, research and technology transfer as three faceted functions, in the best interest of the society, nation and humanity.

The mission statement of nec is:

i. Providing the youth with the best opportunities and environment for higher education and research in engineering, technology and allied sciences, to help them attaining high level of academic excellence, scientific temper, technical and professional competence and life-skills.

ii. Train and develop youth as total person, ready to serve the society and people to alleviate their sufferings and improve their quality of life.

iii. Inculcate the values, to appreciate the need for ethical standards in personal, social and public life, to become leaders, to have voice to influence society and the nation and to uphold a just social order.

The initiative of starting and developing the IWRM Programme at nec stems from a long process of thinking and action that began in 2005. nec started a Masters course in Natural Resources Management in 2005 that has been a significant initiative in terms of diversifying educational engagement in non-traditional disciplines, beyond engineering.

[27] The chapter has been extracted from the full report and edited by the compiler.

This course with an interdisciplinary curriculum focus helped building appreciation for interdisciplinary education among the faculty and students of nec. In March 2005, nec also came up with the proposal for establishing a Water Resource Management and Training Centre, to function as an independent centre within nec. Promotion of interdisciplinary water education, research and knowledge dissemination was in the core of the vision of this initiative. Though this centre could not be established for several reasons, the initiative was successful in creating enough impetus for starting higher education and research in water resources in the following years.

The idea of developing an interdisciplinary course in water resources management at nec was strongly supported by National Water Resources Strategy formulated in 2002 that emphasized promotion of integrated approach in water resources development. This policy document established the need for qualified manpower that could pursue integrated water resources planning, development and management. Water Resources Strategy led to development of National Water Plan that laid out framework for the promotion of integrated water resources development. A number of non-governmental organizations working in water sectors adopted the integrated perspectives in designing and implementing their development programme. The most significant has been the initiative of Helvetas, a Swiss INGO that took up village level water resources planning in mid-western and far-western regions of the country. All these further established the need of qualified manpower that can pursue water resources development in an integrated perspective.

The supportive policy environment and established demand of human resources in water sectors encouraged nec to start a postgraduate course in water resources management. The exercise of curriculum development in interdisciplinary water resources management was already in progress when nec was identified as one the partner institutions (PIs) under the Crossing Boundaries Project. The support under CB Project helped reinforcing this initiative at nec that led to developing the Masters course in Interdisciplinary Water Resources Management (MIWRM).

A number of organizations extended intellectual support in the process of conceiving and developing the IWRM Programme at nec. These include: Nepal Water Conservation Foundation (NWCF), Farmer Managed Irrigation System Trust (FMIS-Trust) and Jalshrot Vikash Sanstha (JVS), which are considered think-tanks on water resources issues in the country with strong intellectual and research capacity.

The Masters course in Interdisciplinary Water Resources Management, leading to MSc degree, underway at nec beginning November, 2007, has been designed to training water professionals with interdisciplinary knowledge and skills in the analysis, development and management of water resources. The course emphasizes social, ecological, institutional, political, and gender concerns in water resources alongside technical and financial concerns in achieving productive, equitable and sustainable water resources development agenda. The graduates upon completion of the course are expected to be able to;

i. Pursue an interdisciplinary approach in managing water resources.
ii. Critically assess water resource as a social and economic good and its linkage to national, regional and local economy and well being of people.
iii. Respond to challenges of water conflicts within the wider context of social, economic and environmental challenges locally, nationally and internationally.
iv. Recognize and critically treat political process as an important element of allocation and distribution of water resources.

The duration of the course is two years, extended over four semesters. It includes 44 credit hours of course work and 16 credit hours of thesis. Eligible to apply for admission to the course are students who have completed a minimum of 15 years of education, and their Bachelor degree from a recognized university/institution in Science and Technology (Engineering, Basic Sciences, Applied and Natural Sciences).

9.3 Curriculum development

The curriculum of the Masters course in Interdisciplinary Water Resources Management was developed through a long process of consultation with stakeholders. These included planners and policy personnel, water resources professionals, educationists and researchers.

The course curriculum has been designed to include: i) Basic Courses, ii) Integration Courses, iii) Application Courses, and iv) Masters Thesis.

Basic Courses

These courses are developed to provide the basic knowledge in water sciences, engineering and ecology in order to develop the foundation to which integration and application courses could be embedded. The basic courses included in the curriculum include;

I. Hydrological science (IWM 611.3)
ii. Water Flow and Hydraulics (IWM 612.3)
iii. Role of water in productive activities (IWM 613.3)
iv. Society and Water: Public Health, Livelihood and Ecosystem (IWM 614.3)
v. EIA and GIS Applications in Water Resources (IWM 615.3)
vi. Presentation, Writing and Reporting Skills (IWM 616.2)

Integration Courses

These courses integrate natural science with the social components and intend to impart needed knowledge and skills in comprehending the effects of social components in choosing technology and management options in water resources management. The integration courses include;

I. Economics of Water Resources Management (IWM 621.3)
ii. Gender, Poverty and Social Inclusion (IWM 622.2)
iii. Conflicts in Water Management (IWM 623.3)
iv. Legal and Policy Dimensions of Water Management (IWM 624.3)
v. Water Induced Disaster and Risk Management (IWM 711.3)

Application Courses

These courses deal with specific knowledge and skills needed in planning, designing and implementing water resources development and management. The courses build upon the basic and integration courses and add to them specific skills needed in pursuing Integrated Water Resources Management. The application courses include;

I. Integrated Water Resources Management (IWM 712.3)
ii. Field Research Methodology (IWM 713.4)
iii. Power, Authority and History (IWM 714.2)
iv. Elective

Elective Courses

Elective courses are meant to provide specialized knowledge and skills in the area of students' professional interest and career aspirations. As of now, the following four elective courses have been approved by the subject committee and academic council of Pokhara University;

I. Groundwater Management (IWM 750.3E)
ii. Management of Irrigation Infrastructure and Services (IWM 751.3E)
iii. Climate Change, Livelihood and Adaptation (IWM 752.3E)
iv. Land Degradation and Management (IWM 753.3E)

Masters Thesis

Thesis work based on field based research has been included as integral part of academic curricula. The thesis work has been made equivalent to 16 academic credits, amounting to 26.7% of the academic weight. Students are expected to identify and develop research questions, which are interdisciplinary in nature, conduct field based inquiries/investigations and analysis to lead to thesis write up.

The curriculum has been designed to be evolutionary and based on a learning process. As such, the subject committee and academic council of Pokhara University have approved the objective and description of the courses. This offers liberty to teachers/resource persons of concerned subjects in developing the teaching agenda within the framework of the approved course description. This offers the opportunity of continued integration of newer knowledge in the teaching agenda.

Approach to curriculum delivery and students' evaluation

Interactive and inquiry based learning has been the methodology adopted in the delivery of the courses. This involves guided learning, class room presentations, field based inquiry and interaction with relevant resource persons on specific issues. The resource persons identified for each subject are among the most qualified persons in the country with several years of teaching/research or professional experience in the water sector.

The evaluation of students is based on internal assessment, session works and semester examinations. The internal evaluation carries 60% of the academic weight while Pokhara University conducts an external semester examination to evaluate the remainder 40% of weight in each subject.

9.4 Students' enrolment

The enrolment of the first batch of 15 students in the Masters course in IWRM was completed in November 2007. The admission of second batch of 18 students was completed in October 2008. The two batches of students are pursuing their studies in semester-III and semester-I, respectively. As of now there are 32 students in the programme. One of the students admitted in 2007 has dropped the course. Beginning the academic session of 2008-2009, nec has decided to limit the number of seats to 20 in each intake.

Under existing enrolment criteria, candidates who have completed Bachelor level courses in engineering/technology, basic and applied sciences, agriculture and forestry are eligible to apply for the admission in the course. The admission is given on merit, based on past academic achievements, performance in the entrance test and an interview.

In the admission of academic year 2007-2008, total of 57 candidates applied for the course, of which 44 candidates qualified for the interview based on the performance in the written entrance test. The selection of 15 candidates for admission to the course was made based on merit. Similarly, in the academic year 2008-2009, a total of 50 candidates submitted their application for admission, of which 49 appeared in the entrance test and 40 qualified for the interview. The final selection of 18 candidates for admission was made based on merit. The admission announcement for both batches was made in national dailies and also the admission information was circulated to relevant educational and research institutions, government agencies and development organizations.

The submission of applications for admission by 57 candidates in the first batch and 50 candidates in the second batch shows an encouraging response of prospective students towards the course. In the two batches of students admitted to the course so far, the majority were fresh graduates, who had completed their bachelor level courses within the last one or two years. Only 3 out of 15 students in the first batch and 2 out of 18 students in the second batch were in-service candidates. Though selection criteria have been developed to encourage in-service candidates, with some experience of working in water sectors, applying for the course, the response of in-service candidates, so far, has not been very encouraging. One reason identified for this has been that the course is located at nec, Changunarayn campus which is away from Kathmandu and also the classes are scheduled from 1:30 to 6:00 p.m. This schedule of classes is not found friendly to the in-service candidates because the office hours in most government and non-governmental organizations in Nepal are from 10:00 to 5:00 p.m. In order to encourage in-service candidates applying for the course, nec is planning to relocate all Masters courses to the city centre beginning February 2009.

The profile of the students admitted to the course in two batches, based on the area of bachelor level studies, is presented in Table 9.1. This shows that the majority of the students admitted to the course are those with civil engineering, environmental science, microbiology/biotechnology and basic sciences background. The course has great relevance to those with agriculture and forestry backgrounds; however, the number of students with these backgrounds admitted to the course has been limited so far. The reason for poor interest of students from these backgrounds may be because the institutions offering bachelor level courses in these areas are located outside Kathmandu valley. This shows greater need of advertising the course to reach the students outside Kathmandu valley.

SAWA Fellowships

Provision of SAWA Fellowship under CB Project is to support the process of developing the cadre of women water professionals in the participating countries. The fellowship covers waiver of tuition fee, opportunity of regional exposure visit and training and a subsistence allowance for the two years duration of the course. Accordingly, SAWA Fellowship is offered to 8 female and 2 male students admitted to the course each year.

Table 9.1 Students profile by the area of Bachelor degree

Area of Bachelor Degree	*No. of Students*		*Total*
	Batch 2007	*Batch 2008*	
Engineering: Civil Engineering Electrical Engineering Computer and Electronics	 7 1 1	 5 - -	 12 1 1
Microbiology and Biotechnology	-	3	3
Environmental Science	2	3	5
Agriculture	1	-	1
Forestry	1	-	1
Basic Sciences*	1	7	8
Total	14**	18	32

* Basic Sciences includes physics, chemistry, biology and similar disciplines
** Of the 15 students admitted to the course in 2007 batch, one student has dropped

At nec, the selection of candidates for SAWA Fellowship has been by merit, based on their past academic achievements, performance in the written test and interview at the time of admission. As of now SAWA Fellowship has been awarded to 10 students each in the first and second batches, thus there are 20 SAWA Fellows (16 female and 4 male) pursuing their studies. The provision of fellowship has created popularity for the course among prospective students. In both batches the number of female students applying for the course has been significant. Encouraging response from female candidates for the course may be partially due to the provision of SAWA Fellowship.

In both batches a significant number of fee paying students have also been admitted, which are called Non-SAWA students. There are currently five fee paying students in the first batch and eight fee paying students in the second batch. The fee paying students are required to pay tuition fee of Rs. 200,000.00 for the two years duration of the course. The distribution of SAWA and Non-SAWA students by sex in both the batches is presented in Table 9.2. The fee paying students are invariably male students.

Table 9.2. Distribution of SAWA and non-SAWA students by sex at nec

Batch	*SAWA Fellows*		*Non-SAWA Students*		*Total*	
	Male	*Female*	*Male*	*Female*	*Male*	*Female*
2007	2	8	4	-	6	8
2008	2	8	8	-	10	8
Total	4	16	12	-	16	16

Regional exposure for SAWA Fellows

All 15 students of the 2007 batch participated in a regional training programme (SAWA Fellow Training) organized during September 1-14, 2008. This included 10 SAWA and 5 Non-SAWA students currently pursuing their studies in the second year. The training was focused to participatory field research methodology that involved in-house training on PRA/PLA tools and field practice in rural setting. This training provided the students opportunity to interact with the SAWA fellows from other three PIs and learn in a cross-cultural environment. The exchange of information among the students from different PIs enhanced their appreciation for the course.

9.5 Faculty training and research

nec has realized the importance of faculty training and their academic advancement in order to enhance the instructional and research capacity in the areas of interdisciplinary water resources management. nec has always been supportive towards academic and professional enhancement of the faculty members and offers paid study leave to the faculty members seeking academic advancement, leading to Masters and Doctoral degrees. This also applies to in-house faculty engaged in the instruction of courses in IWRM.

Staff training

Staff training opportunities under CB Project have been instrumental in supporting the capacity building initiative of nec in the areas of interdisciplinary water education and research. A total of 12 faculty members from nec have attended staff training courses to date. These courses are meant to enhance instructional capacity of the faculty members. The details of staff training attended by nec faculty during 2007-2008 is provided in Table 9.3.

Table 9.3. Details of staff training attended by nec faculty during 2007-2008

Staff Training Location	*No. of Participants from nec*	*Training Focus*
Field Research Methodology in Bangladesh	1	Qualitative and Quantitative Research Techniques and Participatory Research Methodology
Integrated Water Resources Management in Sri Lanka	1	IWRM Process
Gender, Water and Equity in Pune, India (October 3-12, 2007)	2	Social differentials, equity and gender concerns in water resources
Water and Ecosystem in Kathmandu, Nepal (November 25-December 3, 2008)	2	Ecosystem Services, Livelihood and Ecosystem Management
Water and Economics in New Delhi, India (March 9-17, 2008)	2	Economics of Water Resources Management
Participatory Field Research Methodology in Kathmandu (May 6-14, 2008)	4	PRA/PLA Tools
Total	12	

The faculty members who attended the staff training are actively engaged in teaching relevant courses in iWRM.

Research agenda and research focus

Research is integral component of iWRM Programme at nec that seeks continued engagement of faculty and students in interdisciplinary research. The objectives set for research component under iWRM Programme at nec are, to;

I. develop the capacity of students and faculty in interdisciplinary research
ii. promote innovative, problem based and social learning research involving interdisciplinary perspective in research design and methods of analysis.
iii. develop knowledge base on operationalizing IWRM, and providing policy feedback for further strengthening IWRM processes.
iv. provide meaningful contribution to addressing pertinent problems in the study area through continued linkages with the stakeholders.

The focus the IWRM research at nec is on “Livelihood Security and Changing Patterns of Water Use in Upper Bagmati Basin”. Upper reach of the Bagmati basin has been identified as the study area for following reasons:

I. The study area is hot spot of water issues and provides opportunity to look into cross-cutting issues relating to water.
ii. The area is located in the vicinity of nec and hence provides opportunity to be used as learning lab for continued research.
iii. Secondary sources of information pertaining to the study area are easily accessible and also working in the proposed study area provides opportunity to maintain continued communication with various stakeholders.

Seventeen researchable issues, relevant to the study area, have been identified to be focused in students' and faculty research initiatives.

Students' research

The first batch of students, admitted to the IWRM Programme in 2007, is currently engaged in identifying and developing their research questions. The process adopted in the identification and finalization of the research topic, and the research questions to address, leading to development of research concept note by respective student, is shown in Figure 9.1.

Figure 9.1. Process followed in the identification and development of research questions by the students

The list of research problems identified by the students for their Masters thesis research is given below. They are expected to finalize their research concept note and get it approved by research committee at nec by mid February, 2009.

1. Impact of Rural Hill Road on Agro-Hydrology and Livelihood: Analysis of Hill Road Network in Sipadol VDC in Bhaktapur District
2. Electricity Outage in Kathmandu Valley: Implications to Livelihood and Adaptation Strategies
3. River Degradation and Livelihood Impacts: Analysis of Solid Waste Disposal in Hanumante River in Bhaktapur
4. River Water Quality and Health Impacts: Assessing Vulnerability and Adaptive Strategies of Urban Poor in Manohara Informal Settlement
5. Agricultural Intensification, Agro-Chemical Use and Water Pollution Interlinks in Manohara Basin: Analysis of Current State and Future Trends
6. Trajectory of Degradation of Bagmati River: Dynamics of Social, Institutional and Policy Processes
7. Graded Tariff as Management Tool to Address Water Scarcity: Case Study of Community Water Supply Scheme in Dadhikot VDC
8. Spatial Variability of Water Quality in Hanumante River: Establishing Links to Aquatic Ecosystem and Livelihood
9. Meander Migration and Stream-Bank Erosion in Manohara River: Assessment of Livelihood Changes and Adaptation Strategy of Farming Households
10. Changes in Ecosystem Services Resulting from Land Use and Land Cover Changes in Manohara Basin
11. Dimensions of Conflict Emerging from Changing Water Rights in Manohara Sub-Basin
12. Management Challenges Resulting from Urbanization and Livelihood Changes: Case Study of Mahadev Khola Rajkulo in Bhaktapur District
13. Livelihood Links of Flood Forecasting in Manohara Basin
14. Sand Mining in the River Terraces of Manohara: Analysis of Consequences and Social and Institutional Response

Faculty research engagement

The faculty at nec is also engaged research involving interdisciplinary perspective in problem formulation and analysis. Ongoing faculty research activities at nec are:

i. Action Research on Multifunctional Water Users' Association in collaboration with INPIM-Nepal and FMIS-Trust.
ii. Role of Leadership in the Irrigation System Performance- Case Study of Selected FMISs in Chitwan in collaboration with Beijer Institute, Stockholm School of Economics, Sweden.
iii. Institutional Response to Internal and External Shocks in Community Managed Irrigation Systems.

9.6 Employability of the Graduates

No study has been done to date to ascertain employability of the graduates, in exact number, upon completion of the Masters course in IWRM at nec.

However, a number of agencies, which are engaged in the development and management of water resources in Nepal, were contacted in the course of seeking their support in curriculum development and research. All the agencies found the academic curriculum matching with the technical competence of manpower required by them. They all also indicated

employment prospects of the graduates and their willingness to create positions where IWRM graduates could fit in.

It is, however, expected that majority of the graduates in first 2 to 3 batches would be employed in non-governmental organizations. This is because there is established demand of manpower with interdisciplinary perspectives in water resources planning, development and management. The government agencies in the country still have a more stringent recruitment procedure and defined disciplinary cadre.

This is the appropriate stage for nec to network with the government agencies and development organizations in promoting employment prospects of the graduates. This will help establishing the exact manpower needs in different agencies which will lead to promoting employability of the graduates.

9.7 Areas of Improvement

The IWRM Programme at nec succeeded in producing remarkable results in a short period of time. However, there are several areas to improve in order to sustain and accelerate the progress made.

Faculty development

Development of faculty strength is crucial to sustaining the IWRM Programme at nec. The majority of teaching faculty in IWRM Programme are visiting faculty, who are engaged on part-time basis. Therefore, the contact between faculty and students is limited to a short period of time. This has already started appearing as a bottleneck in developing the programme. It may not be possible to recruit faculty demanded in the cross-section of areas in the IWRM course, but it would be highly desirable to create at least half of the needed faculty strength within nec. One possibility is training the faculty who have had their prior academic training in areas close to IWRM from within nec, and engaging them in taking up full or part of the teaching responsibility in different courses. This would mean encouraging the faculty members to attend short-term courses offered by different organizations within the country and outside and also encouraging them to attend classes as walk-in students in the IWRM Programme. Another possibility could be developing modular courses, specially designed to support the faculty development needs of nec.

The provisions of staff training under CB Project helped in capacity building of faculty members to some extent. The faculty members who attended the staff training have been contributing in teaching of the courses. However, there have been only limited opportunity and that too for a short period of time. The initiative of staff training under CB Project needs continuation so that at least two or more faculty could be trained in each area of IWRM focus.

Networking

nec has made some progress in developing networking with the organizations engaged in water resources development and management and education and research in the area within the country and outside. However, this needs to be taken up more vigorously. Networking for exchange of information and publications, collaborative research and exchange of faculty and researchers would be the most desirable initiative. This would add to the strength of the programme in long run.

Employment promotion

nec has to concentrate on promotion of employment of graduates pursuing their studies in the IWRM Programme. This will require campaigning with the employer agencies and interaction with policy personnel. Enhancing the visibility of the programme at the policy level is essential element with regards to creation of employment avenues in government agencies.

Capacity building in interdisciplinary research

This is another crucial area for nec to improve in order to sustain IWRM Programme. One approach could be inviting faculty members with several years of experience in interdisciplinary research from relevant institutions (preferably from the PIs under CB Project) to spend six months to one year time at nec. He/she may help consolidating ongoing efforts of pursuing interdisciplinary research at nec. Funds to support the visit of such resource persons may be explored from CB Project or from other sources.

Chapter 10

A New Generation of Water Professionals for IWRM

The Experience of the Postgraduate Institute of Agriculture, University of Peradeniya, Sri Lanka

M.I.M. Mowjood and L.W. Galagedara [28]

10.1 Postgraduate Institute of Agriculture and Board of Study in Agricultural Engineering

The Postgraduate Institute of Agriculture (PGIA) was established in the University of Peradeniya in 1975 as the pioneer of postgraduate education in the field of agriculture. The objective was to meet the demand of manpower in agricultural and related sectors at postgraduate level. The Institute operates under the direction and control of the Board of Management. The PGIA comes under the University Grants Commission (UGC) of the Ministry of Higher Education of the Government of Sri Lanka. The programmes offered by the PGIA are accredited by the UGC.

PGIA offers a diverse range of higher degree programmes to fulfil the goals of the institute at international standards. The academic programmes of the PGIA are developed and implemented by eleven Boards of Study (BS)[29]. At present, PGIA offers 29 postgraduate programmes.

Box 10.1: PGIA

Vision: to be a centre of excellence in postgraduate education, research and outreach in agriculture and related fields to serve the needs of the government, industry and the global community.

Mission: to be a national and regional centre for postgraduate education, research and outreach by providing a theoretically sound and practically oriented training to produce competent, innovative and dedicated persons to foster national development of agriculture and allied fields. (www.pgia.ac.lk)

The BS in Agricultural Engineering has been offering a postgraduate programme (MSc, MPhil and PhD) in Agricultural Engineering under three main disciplines, i.e. Soil and Water Engineering, Post Harvest Technology and Farm Machinery and Mechanization from 1975. The curriculum of Soil and Water Engineering has been constantly reviewed to accommodate changes in the water sector. In 2001, this programme was revised and renamed as Integrated Water Resources Management (IWRM). Currently, the Board of Study in Agricultural Engineering offers three major programmes of study.

1. Integrated Water Resources Management (IWRM)
2. Agricultural and Biosystems Engineering(AgBE)
3. Geo-informatics (GeoInfo)

10.2 Development of the IWRM programme

The IWRM programme has been designed considering the national educational needs of Sri Lanka's water and related sectors and also aiming at expanding the education initiatives in the South Asian region. Some of the reasons for the development of an IWRM degree programme at the PGIA are as follows;

1. Increase in competition to meet the demand for water by different sectors.
2. Increasing trend in water pollution and its consequences on health, sanitation and the ecosystem.
3. Sectoral approach in water management and lack of coordination among the institutions in the water sector.
4. Rising conflicts in water issues among the users.
5. Global acceptance of IWRM as a concept for solving water issues (countries in the UN system, including Sri Lanka, have agreed to implement IWRM to resolve water crises).
6. Perceived future demand for professionals with IWRM training.

Human resource development on IWRM is a prerequisite for implementation of the IWRM concept. Thus a new degree programme on IWRM was formulated since the conventional postgraduate programme did not generate the human resources requirement for the emerging new trends and challenges.

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[28] This chapter is slightly edited and shortened from the full report by the compiler.

[29] Agricultural Engineering, Agricultural Biology, Agricultural Economics, Agricultural Extension, Animal Science, Bio-Statistics, Business Administration, Crop Science, Food Science & Technology, Plant Protection and Soil Science.

The IWRM programme aims at producing interdisciplinary professionals in water resources management with knowledge, skills and competency from a scientific, technological, economic, social and environmental perspective for sustainable use of water resources. The integration of different disciplines is made to;

a) Assess, analyze and improve water resources, water allocations and hydro-ecosystems while developing methodologies to implement policies and legislature related to all aspects of water in the country,
b) Effective communication and dialogue, conflict management, and formulate awareness programmes in managing water resources and water related issues and
c) Facilitate integrated research and development of water related sciences benefiting the students, stakeholders, and the community while protecting the environment.

In the process of formulating the programme, a series of consultations, discussions, brainstorming and validation were held with the stakeholders of the Sri Lankan water sector at various levels. These events have been reported in the minutes of the meeting of BS in Agricultural Engineering. Academics from the Boards of studies of Agricultural Engineering, Agricultural Economics and Extension along with professionals in the water sector institutions worked together to identify the core of the IWRM programme. The course outline was later presented and validated with institutions working in water sector such as the International Water Management Institute (IWMI), the Irrigation Department, the Mahaweli Authority of Sri Lanka, Universities, and private sector institutions including Unilever Ceylon Limited. This provided a sense of ownership among the stakeholders in addition to publicity to a wider audience.

The courses are offered by three boards of studies (Agricultural Engineering, Agricultural Economics & Business Management and Agricultural Extension) from the beginning of the IWRM programme (see Table 10.1). These include compulsory and elective courses. This programme is unique compared to other programmes at the PGIA. The course schedule for the entire programme is tailored to individual students based on his or her background and needs since the students are coming from various disciplines such as engineering, biological or physical sciences, agriculture and humanities.

Many organizations in Sri Lanka identified PGIA as an appropriate organization to launch this programme in view of its long years of experience, wide range of courses offered, availability of competent staff and the involvement of professionals in the water sector in teaching and research programmes for more than 25 years. There were many well wishers who supported this programme at the beginning which included the National Water Partnership and Unilever Sri Lanka.

PGIA developed the curriculum and obtained the approval from the Board of Management, Senate and the Council within a short period of time. The flow chart below illustrates the steps and the time frame of the initiation of IWRM degree programme.

Figure 10.1. Development steps in formulation of IWRM programme

Table 10.1. Courses offered by different Boards of Study in the IWRM programme

BS in Agricultural Engineering	*BS in Agricultural Economics & Business Management*	*BS and Agricultural Extension*
Hydrology and Meteorology	Water Resources Economics I & II	Water and Society
Water for Agriculture	Project Analysis	Social Research Methodology
Water Quality for Agriculture & Environment	Environmental Valuation	Environmental Sociology
Groundwater Development	Managerial Resource Economics	
Soil Mechanics		
Water and Industry		
Water Application Systems		
Fluid Mechanics		
GIS for Natural Resources Management		
Health, Sanitation and Wastewater Management		
Water Supply		
River Basin Planning and Management		
Environmental Impact Assessment		
Application of Remote Sensing in Agriculture		
Advanced Irrigation Water Management		

The programme has been strengthened with the support from various institutions. Unilever Sri Lanka provided 5 fellowships per year including research funds until 2005. The PGIA has succeeded in obtaining further support through a regional initiative for Capacity building on IWRM and gender & water in South Asia under the Crossing Boundaries (CB) Project. The CB project has helped the programme at the PGIA through curriculum development, fellowships for students (SAWA Fellows), facilitate students to participate in regional programmes, training of staff, and funds for research, from 2006 – 2012. Cap-Net Lanka, the country chapter of the global Cap-Net, the international programme for Capacity Building in IWRM, hosted at the PGIA, has provided an added value for outreach through networking of capacity building institutions and some line ministries in Sri Lanka. The Cap-Net programme has helped to build awareness of IWRM through its capacity building activities for professionals, decision makers, farmers, school children etc. (www.capnetlanka.org)

10.3 Enrolment in the IWRM programme

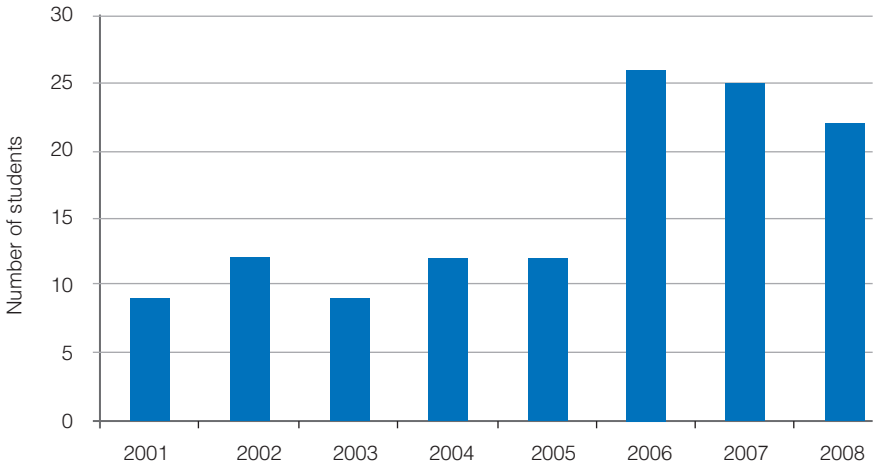
Applicants for IWRM should posses a bachelor degree in Agriculture, Engineering, Humanities, Medicine, Natural Science or any other equivalent qualification from a recognized institute of higher education acceptable to the BS in Agricultural Engineering. The number of students enrolled in the IWRM programme with different basic qualification, for the last 8 years are given in the Table 2 and Fig.2. Though the number enrolled (selected) has slightly decreased from 2006 to 2008, number of applicants to the programme has increased over the years.

Table 10.2. Number of students enrolled in the PGIA IWRM programme

Basic degree	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*Total*
Agriculture	5	3	8	7	7	17+2*	17+1*	12	79
Engineering	1	2	-	2	3	1+1#	3+1*	5	19
Science	1	5	-	1	1	1		4	13
Art	-	-	1	1	-	3+1*	1	-	7
Medicine	-	-	-		1	-	-	-	1
Others	2	2	-	1	-	-	2	1	8
Total	9	12	9	12	12	23+3*	23+2*	22	122+5*

* - PhD candidates, # - Foreign student

Figure 10.2. Student enrollment in each year (CB project was implemented from 2006 onwards)



In addition to fresh graduates, working water professionals from institutions such as the Irrigation Department, the Mahaweli Authority of Sri Lanka, the Water Supply and Drainage Board, the Department of Agriculture, universities, the Central Environmental Authority, research institutions and NGOs have enrolled in the programme. The programme was able to attract people from different backgrounds such as agriculture, engineering, social science and medicine (Table 10.2). A total of 122 students have been registered up to 2008, out which 26 have graduated while others are yet to complete. The first batch of SAWA fellows has graduated in 2008. At present, there are 39 students (last two batches) following the courses. Both fresh graduates and working people are enrolled in the IWRM programme. Table 10.3 provides the number of the students trained or being trained from institutions in the water sector.

Table 10.2. Number of students enrolled in the PGIA IWRM programme.

Table 10.3. Number of people trained or being trained from the water sector

Institutions	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*
Water Supply and Drainage Board	-	-	-	-	1	2	2	3
Universities	1	2		-	-	1	1	6
Department of Agriculture	-	-	1	-	-		4	-
Mahaweli Authority/Irrigation Department	-	1	-	1	-	1	1	-
Research Institution	-	-	2	-	-	-	-	-
NGO's	1			1	2	3	1	1
Fresh graduates/others	7	9	6	10	9	16	8	12

Photo 10.1. First three batches of students and staff during their visit to Unilever

10.4 Intervention of the Crossing Boundaries project in the IWRM programme

Representatives from SaciWATERs made several mission visits to meet staff of IWRM programme at the PGIA from 2002 onwards to explore the possibilities to initiate a regional programme in IWRM. The PGIA contributed to the development of a combined proposal with SaciWATERs. As a result, the Crossing Boundaries (CB) project, regional capacity building on IWRM and gender & water in South Asia was started from 2006 offering 10 SAWA fellowships per year for female students to follow the postgraduate degree programme (6 MSc and 4 MPhil) in IWRM at the PGIA. In addition, five PhD fellowships have also been awarded for interdisciplinary research in IWRM.

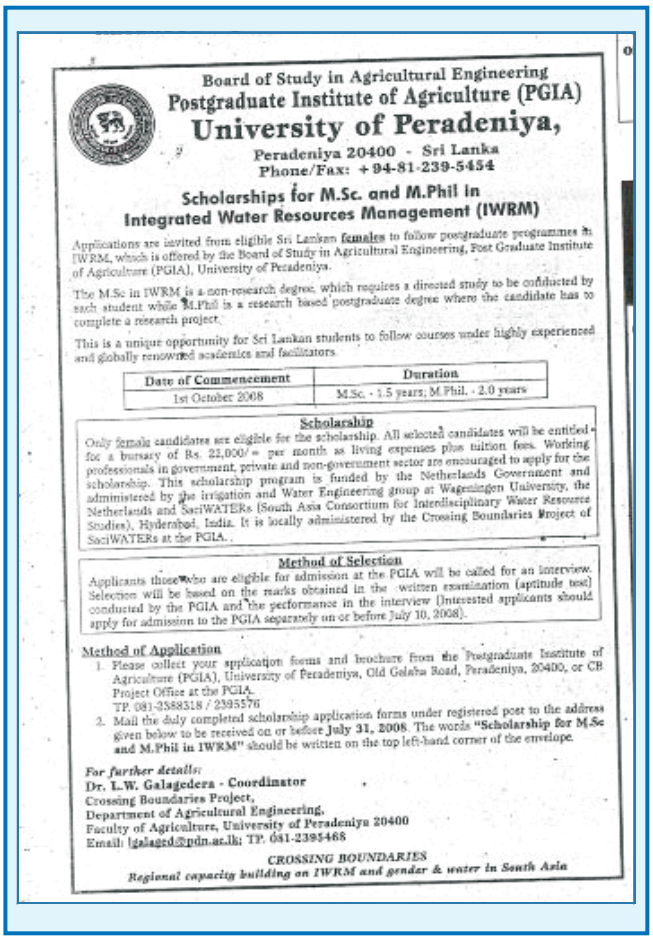
In addition to fellowships and research, CB project has helped to improve the curriculum and train the academic staff. These interventions from the CB project during last three years have substantially improved the capacity of the staff to teach and supervise the research programme of the students. Some of the interventions of the CB project to improve the IWRM programme are given below.

Curriculum development

Two new courses have been introduced and the content of an existing course has been modified. The two new courses introduced were.

i. Interdisciplinary field research methodology
ii. Gender and IWRM

The Interdisciplinary field research methodology course provides an opportunity to conduct a short term interdisciplinary research with innovative methodology compared to the conventional approaches. The second course is introduced to provide an understanding on gender mainstreaming. The existing course content of the River Basin Planning and Management course was modified to include more IWRM principles and application at river basin level water management. At the same time, delivery of other subjects also has been improved by the respective teachers with experience as well as by incorporating materials acquired through the staff training programmes. New approaches have been adopted to facilitate student learning. Some examples are; student engagement in organizing and making a presentation in a workshop on national water policy with the participation from institutions from the water sector (report available at www.cap-net.org); preparation of leaflets on water pollution and distributing them among the public; conducting a public awareness programme on IWRM; field visits to study the equity issues (access to water and sanitation facilities).



Board of Study in Agricultural Engineering
Postgraduate Institute of Agriculture (PGIA)
University of Peradeniya,
Peradeniya 20400 - Sri Lanka
Phone/Fax: +94-81-239-5454

Scholarships for M.Sc. and M.Phil in
Integrated Water Resources Management (IWRM)

Applications are invited from eligible Sri Lankan females to follow postgraduate programmes in IWRM, which is offered by the Board of Study in Agricultural Engineering, Post Graduate Institute of Agriculture (PGIA), University of Peradeniya.

The M.Sc in IWRM is a non-research degree, which requires a directed study to be conducted by each student while M.Phil is a research based postgraduate degree where the candidate has to complete a research project.

This is a unique opportunity for Sri Lankan students to follow courses under highly experienced and globally renowned academics and facilitators.

Date of Commencement	Duration
1st October 2008	M.Sc. - 1.5 years; M.Phil. - 2.0 years

Scholarship

Only female candidates are eligible for the scholarship. All selected candidates will be entitled for a bursary of Rs. 21,000/= per month as living expenses plus tuition fees. Working professionals in government, private and non-government sector are encouraged to apply for the scholarship. This scholarship program is funded by the Netherlands Government and administered by the Irrigation and Water Engineering group at Wageningen University, the Netherlands and SaciWATERs (South Asia Consortium for Interdisciplinary Water Resource Studies), Hyderabad, India. It is locally administered by the Crossing Boundaries Project of SaciWATERs at the PGIA.

Method of Selection

Applicants those who are eligible for admission at the PGIA will be called for an interview. Selection will be based on the marks obtained in the written examination (aptitude test) conducted by the PGIA and the performance in the interview (Interested applicants should apply for admission to the PGIA separately on or before July 10, 2008).

Method of Application

1. Please collect your application forms and brochure from the Postgraduate Institute of Agriculture (PGIA), University of Peradeniya, Old Galaha Road, Peradeniya, 20400, or CB Project Office at the PGIA.
   TP. 081-2388318 / 2395576
2. Mail the duly completed scholarship application forms under registered post to the address given below to be received on or before **July 31, 2008**. The words **"Scholarship for M.Sc and M.Phil in IWRM"** should be written on the top left-hand corner of the envelope.

For further details:
Dr. L.W. Galagedera - Coordinator
Crossing Boundaries Project,
Department of Agricultural Engineering,
Faculty of Agriculture, University of Peradeniya 20400
Email: lgalaged@pdn.ac.lk; TP. 081-2395468

CROSSING BOUNDARIES
Regional capacity building on IWRM and gender & water in South Asia

Fellowship for students (SAWA Fellows)

Thirty SAWA fellowships have been offered in three batches to female candidates since 2006. Call for applications for the SAWA fellowships were carried out through a brochure, a leaflet, letters and advertisements in a national newspaper as shown above.

Around 100 (22 in 2006; 20 in 2007; 56 in 2008) applications for SAWA fellowships were received during the last three years. This is an indication for the increased demand for the IWRM programme over the years. Interviews were held after the preliminary screening and qualifying through the aptitude test held by the PGIA to select the potential candidates. Organizational representation, relevance, qualifications and diversity, potential ability to contribute to IWRM training, age and geographical distributions were the main criteria in selecting the students at the interview. This process gave wide publicity about the IWRM programme.

Regional exposure for the SAWA fellows

Two batches of students of SAWA fellows have participated in the regional training programmes in Mumbai and Nepal in 2007 and 2008, respectively. These programmes helped the students to strengthen their capacities while gaining additional knowledge and exposure to situations in other countries in water management and to build up linkages with fellow students from other partner institutions from South Asia. This helped them to appreciate the importance of a collective approach in resolving complex issues in the field. Students had a chance to interact with students from India, Bangladesh and Nepal on their studies and research work.

Training of staff

During the 3-year period of the CB project, 19 staff members have been trained by 8 different staff training programmes held in South Asian countries, the Netherlands and Spain (Table 10.4). Further, four staff members have been trained on case studies development. They will be trained to teach case studies in the IWRM programme. These training programmes have strengthened the capacity of staff members both in teaching and interdisciplinary research in IWRM.

Table 10.4. Details of staff training

Staff Training	*No. of Staff*	*Courses Participant Staff Teaches in*
Interdisciplinary Field Research Methodology -Spain and the Netherlands	2	Interdisciplinary field research methodology
Field Research Methodology - Bangladesh	3	Water Resource Economics I & II Hydrology and meteorology Interdisciplinary field research methodology
IWRM - Sri Lanka	5	River basin planning and management Hydrology and meteorology Water and society Gender in IWRM Advanced irrigation & water management Groundwater development
Gender and Water India	3	Gender in IWRM
Water and Equity - India	2	Water and Society
Water and Ecosystem - Nepal	2	Hydrology and Meteorology Advance Irrigation & Water Mgt
Water and Economics - India	2	Water Resource Economics I & II Environmental Valuation

Interdisciplinary research programme

Research funds have been allocated for 5 years under the CB project to conduct impact-oriented interdisciplinary research with respect to water management. In achieving this objective, five PhD research fellows are working on five different thematic areas of water pollution in the upper Mahaweli River. A research coordinator has been appointed to coordinate research activities of PhD fellows as well as SAWA fellows. A common research proposal was developed under the theme of "Water pollution of upper Mahaweli River from Kothmale to Randenigala reservoir" after a series of both local and regional workshops. Five PhD researchers carry out research under five sub thematic areas with respect to water pollution.

(i) Solid waste disposal and water pollution
(ii) Health and sanitation
(iii) Financing and cost recovery in water projects
(iv) Low cost wastewater treatment techniques
(v) Soil erosion and landslides

Two staff members from the institute attended a staff training on research proposal preparation and developed the common proposal by considering comments during the training as well as series of meeting held with research advisory committee members and stakeholders.

10.5 Achievements

After launching the IWRM programme in 2001, 127 students in total were attracted by the programme. Most of them were

fresh graduates while some were already employed in water related institutions (Government and NGOs). So far 26 have completed the programme.

Those who did not come from government institutions secured employment at different institutions such as the International Water Management Institute (IWMI), the Central Environmental Authority, Department of Agriculture, the Mahaweli Authority of Sri Lanka, the Road Development Authority (hydrology division), universities, NGO's etc. A few students who completed IWRM are continuing their higher studies (PhD) in local and foreign universities. Table 10.5 provides the information on the institutions where IWRM students/graduates have been employed (some have completed the degree and others are yet to complete their research component). It is noted that some students were able to get employment before completing the IWRM programme due to their good performance in the recruitment exam and interview as compared to others.

Table 10.5. Institutions and IWRM graduates

Institutions	*Number*
University (Lecturers)	8
Institutions in agriculture sector	7
Universities (Higher studies)	6
NGO's	5
Mahaweli Authority/Irrigation Department	4
National Water Supply and Drainage Board	3
Administration services	3
Education services	3
Coastal conservation	2
Road Development Authority (Hydrology division)	2
Other	6

Students of the IWRM programme have presented several research papers in national and international symposiums, workshops and conferences and published in national journals.

The Annual Water Professional Day (WPD) – Symposium on Water Resources Research in Sri Lanka is one of the visible outreaches of the IWRM programme. Six symposium proceedings on Water Resources Research in Sri Lanka have been published (www.gissl.lk). The sixth annual symposium was successfully held on October 1, 2008. The idea of the symposium is to bring people working in the water sector together to a common forum to highlight the national issues in the water sector. Students of IWRM are actively involved in organizing the event and also get the opportunity to present their research findings. This yields an added momentum to the IWRM programme.

10.6 Suggestions for improvement

The IWRM programme has been formulated at the expense of the Soil & Water Engineering course programme and has been conducted for seven years. Now, it is an appropriate time to review the programme in all aspects: curriculum, student enrolment, programme management, research, advocacy, impact etc. The following concerns and questions have to be discussed in the review process;

- What is special about the IWRM programme compared to conventional programmes?
- What is the required course content?
- What types of innovation are necessary in class room teaching and field studies?
- The graduates are master of what?
- Generalization vs. Specialization?
- Integration at which level?
- How do we market the programme?
- What is the market for the graduates?

Curriculum review

Staff meetings of the IWRM programme noticed and discussed that coordination among the courses is necessary to avoid repetition, while also identifying the missing gaps. Courses are still offered as individual courses with little integration among them with poor sequencing. These deficiencies will be addressed during the review. An initiation has already been taken to compile the course material with lessons plans, objectives, reading materials, case studies, assignments, quizzes and evaluations from each staff. These have to be reviewed collectively to ensure that the objectives of the IWRM programme are achieved through an effective teaching and research programme.

Student enrollment

It is a fact that SAWA fellowships have played a major role in increased student interest and enrolment. However, the water sector is yet to be motivated and convinced to use this IWRM programme effectively to train their staff members (training abroad is more attractive for the staff than local training). Visibility of the programme has to be increased at the highest level of policy makers and at the relevant institutions. Advocacy for recruiting the IWRM graduates in the water sector is essential for marketing the programme.

Delivery of the programme

There is a problem of management with regard to fulltime and part time students. Since scholarships are given only for few students, other fee paying students would like to be part time students. It was noted that a significant number of students could not complete their research work or could not submit their thesis for completion. Monitoring each student on their performance of course work and research is necessary to guide them in advance to complete the programme in time and also to achieve the objective of the programme.

Research

Research in IWRM is a new experience for the staff members teaching the IWRM courses. Interdisciplinary research was not emphasized before the intervention of CB project. Students reading for PhD and MPhil under the CB Project work as a team in a common research proposal. Interdisciplinary research is a challenge for the programme and needs further support and intervention for further improvement.

10.7 Conclusion

The IWRM postgraduate degree programme has been developed by a pool of academics with experience in teaching and conducting research in the water sector. Support and assistance from stakeholders (individuals and institutions) strengthened the programme. The intervention of the CB project has helped to bring the IWRM programme at the PGIA to a new height through fellowships, curriculum development, training staff and providing an opportunity for students to participate at regional trainings workshops. More importantly, the interdisciplinary research programme has been introduced and supported through research funds, PhD fellowships and research staff. An increased number of applications for the programme over the years is a testimony to the popularity of the IWRM programme at the PGIA. However, strategies for marketing the IWRM programme and the product (IWRM graduates) are to be developed and pursued for the long-term sustenance of the programme.

When we look back the whole process of formulation of our postgraduate degree programme on IWRM and the successful implementation during past seven years, we realized that we have gone beyond the conceptual stage and working towards implementing IWRM on the ground. We are confident that the new generation of water professionals produced through the IWRM programme at the PGIA is better prepared to face challenges in the water sector in this country as well as in the region.

Chapter 11

Postgraduate Education Programme of Institute of Water and Flood Management, BUET towards building IWRM Professionals

Hamidul Huq[30]

11.1. Introduction

Bangladesh University of Engineering and Technology (BUET; www.buet.ac.bd) is the first public Engineering University of Bangladesh, experienced in offering engineering education for more than six decades. The Institute of Water and Flood Management (IWFM; www.buet.ac.bd/iwfm) is one the four institutes of BUET. The IWFM was set up in 1974. It is located in the heart of Dhaka city, neighbouring Dhaka University.

The Institute, since its inception, pursues research and capacity development in the field of water and flood management. It also provides advisory and consultancy services to government and non-government organizations in water sector.

Box 11.1: Vision and mission

The vision of IWFM is to be a premier institute for the advancement of knowledge and development of human resources in water and flood management.

Mission of IWFM is:

- To promote integrated water resources management
- To generate knowledge through basic and applied researches
- To share knowledge and expertise with other organizations
- To develop professionals in water management
- To provide expert advisory services

11.2 IWFM

Faculty and expertise

IWFM has eight Professors, five Associate Professors and three Assistant Professors. All the faculty members have a doctoral degree except one Assistant Professor who is currently doing her doctoral programme in University of Windsor, Canada. The faculty members are specialised in the areas listed in Box 11.2.

Almost all faculty members of IWFM received IWRM related training organized by SaciWATERs/Crossing Boundaries. The faculty members are continuously engaged in research work through different projects in partnership with local and foreign institutions. IWFM has effective networks with different government agencies and non-government research organizations.

Library and Internet

Apart from central Library of BUET, there is one rich library in IWFM that provides students and the teachers with the opportunity of study in augmenting their knowledge to be strengthened adequately to win over the challenges of maintaining continuous improvement of quality education.

The students and teachers have access to internet services in order to explore and collect relevant study materials as well as get connected with the forums and networks of academic world.

Box 11.2: Expertise areas of IWFM

Floodplain hydrology; water resources systems modelling; water resources engineering; water resources planning and management; integrated water resources management; interdisciplinary water resources management research; gender mainstreaming in water management; surface and groundwater flow and transport processes; modelling and management; irrigation and water management; environment, floodplain sedimentation, river engineering; mathematical modelling, turbulence, river hydraulics; urban water management, coastal engineering; river engineering; river and floodplain management, Geo-informatics in water management, Stochastic modelling of hydrologic Information; Hydrology, irrigation and water resources development; Water resources systems modelling, Groundwater hydraulics, contaminant transport processes, numerical modelling of groundwater flow and transport, Surface water-groundwater interactions, Stochastic groundwater hydrology, Computational fluid dynamics modelling; Time series analysis,

[30] Edited by the compiler.

Forecasting, stochastic modelling and simulation, Artificial data generation, Risk-based water resources planning, agricultural water management, climate change modelling, water demand assessment; Geo-informatics, hydro-informatics, web-based modelling, ontology, Java based API; Coastal engineering, coastal environment, estuarine processes, turbulence modelling for stratified flow; Fate of trace pollutants in the environment, reduction of pollution from industrial waste, river and wetland ecology, artificial infiltration systems.

Laboratory

IWFM has an equipped laboratory for the students and teachers for conducting technical research. IWFM has partnership with Local Government Engineering Department and Bangladesh Water Development Board in using their project sites as social laboratory and field research areas for the students of IWFM.

Research programmes

IWFM conducts researches with major emphasis on water resources management in floodplain environment, river and coastal hydraulics, wetland hydrology, hazard management, urban water management, irrigation and water management, environmental impact of water development, water resources policy. Since its establishment, the IWFM has carried out about 100 research projects in the fields of hydrology, morphology, river mechanics, coastal hydraulics, groundwater, agriculture, water management and environment. The research activities of IWFM are carried out independently and in collaboration with government departments, academic and research institutes both local and foreign.

11.3 The academic programme

Since 2003 the IWFM offers post graduate degrees for professionals and fresh graduates with the goal of creating water manager/professionals with strong knowledge of Integrated Water Resources Management (IWRM). As IWRM is a multi-disciplinary field, requiring a holistic understanding of water resources system with a good blend of engineering, agricultural, socio-economic and environmental analyses, a multi-disciplinary course curriculum is pursued. The multi-disciplinary programs are aimed at engineers, planners, hydrologists, agriculturists, physical and social scientists.

A student must earn a minimum of 24 credit hours including a project for which 6 credit hours is assigned for the Post Graduate Diploma in WRD. Candidates with Bachelor's degree in Engineering, Agriculture, Physical science, Biological science, Environmental science, Urban & Regional Planning, Economics, Agricultural Economics or an equivalent degree can enter the Post Graduate Diploma in WRD programme.

MSc in Water Resources Development

A student must earn a minimum of 36 credit hours including a thesis for which 18 credit hours for the degree of MSc (WRD). Candidates with Post Graduate Diploma in WRD or Bachelor's degree in Civil Engineering, Water Resources Engineering, Agricultural Engineering or Environmental Sciences can enter into the MSc WRD programme.

PhD in Water Resources Development

A student must earn a minimum of 54 credit hours of which a maximum of 45 credit hours are assigned for a thesis. The entry requirement for PhD programme is a MSc in WRD or a MSc in Civil Engineering / Water Resources Engineering / Environmental Engineering / Agricultural Engineering or Masters in Engineering.

IWFM offers 30 courses, each of 3 credit hours, in its Post Graduate programmes. The courses are listed in Box 11.3.

IWRM in IWFM's Academic Programme

Since 2005, IWFM has become a partner Institute of a South Asia wide project Crossing Boundaries – Regional Capacity Building in IWRM and Gender and Water in South Asia. Through this partnership support, IWFM/BUET first developed a team of faculty members to update its knowledge about IWRM and then reviewed its course curricula. The revised courses got approval of the appropriate authority of BUET and the IWFM has been teaching these revised courses since the October 2006 semester.

Box 11.3: IWFM courses

Post Graduate Diplomas	*MSc/PhD Courses*
• Watershed Hydrology • Soils and Soil Water • Hydrogeology and Groundwater • Watershed Hydrology • Soils and Soil Water • Hydrogeology and Groundwater • Data Management and Statistical Analysis • Socio-economic Analysis • Environmental Analysis • Surveys in Water Resources Projects • Principles of Hydraulics (non-credit course)	• Special Studies • Alluvial River Processes • Advanced Watershed Hydrology • Hydrologic Information System • Gender and Water • Hazards and Risk Analysis • Remote Sensing and GIS in Water Management • Environmental Economics • Hydrologic Statistics • Hydrologic Design for Water Use • Groundwater Resource Assessment • Water Resources System Analysis • Choice of Water Management Technology • Interdisciplinary Field Research Methodology in Water Management • Agricultural Water Management • Water Development Project Planning • Integrated Water Resources Management • River and Floodplain Management • Coastal Zone Management • Urban Water Management • Water Control Structures • Risk Management Water Quality Management

11.4 Students of IWFM and SAWA Fellows

Table 11.1 gives an overview of IWFM's students in the Postgraduate programme in Water Resources Development (WRD):

Table 11.1. Status of post graduate students in WRD of IWFM

Session	*No. of PGD Students*	*No. of MSc Students*	*No. of PhD Students*
October 2008	30	32	01
October 2007	20	24	04
October 2006	09	61	07
October 2005	- -	11	01
April 2005	14	26	
April 2004	13	38	
April 2003	29	28	
April 2002	24		
October 2001	24		

SAWA Fellows

IWFM started awarding SAWA fellowships to the PGD, MSc and PhD students since the October 2006 semester under the five years Crossing Boundaries project. A total of 55 fellowships can be offered during this five years project period, of which five are PhDs. As of the October 2008, there are 10 MSc SAWA Fellows from the first batch (October 2006 semester), five MSc and two Post Graduate Diploma from the second batch (October 2007 semester) and seven MSc and six Post Graduate Diploma from the third batch (October 2008 semester) studying Water Resources Development in IWFM. Out of 13 PhD students five are SAWA Fellows. Two MSc SAWA fellows from the first batch have already been graduated.

SAWA Fellow selection

Applications are invited among from the already selected students for the post graduate programme in WRD of IWFM through public announcement in daily news papers, at least two, consecutively for two days. Announcement is also put up on BUET's website. After sorting out, by the assigned faculty team, the applicants are invited for viva. The viva board is a composition of Director and senior faculty members of IWFM, the Crossing Boundaries Project Coordinator, Research Coordinator, Representatives from BCAS and SaciWATERs. The selection is made on the basis of applicant's performance in the viva and marks in the admission test plus records of results in previous degrees. Female candidates are given priority.

Central focuses of SAWA Fellowship

Though, all the students of IWFM are equally given attention in teaching and research work, the SAWA Fellows are to follow some principles: they must finish their degree within the given period of fellowship; they must take three courses – IWRM, Gender and Water, and Interdisciplinary Field Research Methodology compulsorily. There is a partnership arrangement of IWFM with two leading government organisations in water sector: Bangladesh Water Development Board (BWDB) and the Local Government Engineering Department (LGED), to create enabling environment for the SAWA Fellows' research work for their thesis. These organisations have been providing the SAWA Fellows with all the possible support in terms of information, local guides, logistics, organising stakeholders' consultations, helping in primary data collection and so on. These two organisations are also the 'boundary partners' of SAWA Fellows.

The SAWA Fellows are brought to LGED's water management project site for their one week practicum of the 'Interdisciplinary Field Research Methodology' course, which is an integral part of this course. All the students including the SAWA Fellows of 'Interdisciplinary Field Research Methodology' course are brought to field site of Bakkhali Rubber Dam project of LGED in Cox's Bazar for a week long planned activities that include practices of research methods, techniques, tools of interdisciplinary research covering the study of various aspects of this Rubber Dam project. The students are divided into small groups of four/five members prior to the field trip. Each group develops a field research proposal that they execute in the field exercise. Every group has to prepare a daily report of their field research. Every student has to sit for exam during this field study itself. Every group has to prepare field research report and present in the class within one week of the practicum.

SAWA PhD and MSc Fellows are interviewing the Rubber Dam project beneficiariesSAWA Fellow training

SAWA Fellows Training

The SAWA Fellows are provided with two weeks training on IWRM, Gender, Equity, and Interdisciplinary Research at South Asia regional level where they are provided with theoretical and practical inputs. They also get opportunities to share their ideas, experience and knowledge with fellows from other countries as well as learn from different actors.

SAWA Fellows are in a field exercise of research Tools as part of Regional Training in Nepal

SAWA Fellows are also given preference as regards participation in regional and international water seminars to contribute as well as to learn and augment their knowledgeability in IWRM.

11.5 Conclusion

IWFM, BUET is the pioneer of offering higher education in IWRM in Bangladesh. Not only in education, IWRM is new to the water professionals and other actors in water sector in Bangladesh. Its partnership with the Crossing Boundaries project of Wageningen University and SaciWATERs contributed to creating an enabling environment in a public technical university like BUET to initiate a challenging higher education programme, which is embedded in interdisciplinarity.

IWFM believes in team work and practice. Most of the faculties are trained up in IWRM and they are keen to bringing an innovative teaching approach and make their students actively involved in education and research processes. They take promotion of an interdisciplinary approach in engineering education for water resources management as a challenge. Throughout the whole six months period of BUET's celebration of 60 Years of Engineering Education in Bangladesh, the IWFM efficiently used all the scope and opportunities of putting IWRM on discussion and debates through its Crossing Boundaries project activities, such as a regional seminar, a national seminar, short courses, and joint conferences with other partners and alliances. All these have contributed in popularising IWRM in IWFM's Postgraduate Programme.

A weakness of IWFM is not having a multidisciplinary team of faculty members and planned initiatives of network development with different research and academic institutions for creating a broad landscape of education and practices of IWRM. However, over a period of time IWFM may become a very strong research and academic institute in promoting IWRM in postgraduate programmes of other universities, both public and private, through building alliances.

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ANNEX I: TERMS OF REFERENCE REGIONAL STUDY

Commissioned Study on 'Water Education Policy in South Asia'

TERMS OF REFERENCE FOR LOCAL CONSULTANT FOR NATIONAL/REGIONAL INVENTORY AND ASSESSMENT

Name of consultant:
Country /region:
Time frame:

Objectives of the overall 'Water Education Policy in South Asia study

The Crossing Boundaries (CB) project at SaciWATERs, Hyderabad (see www.saciwaters.org) is undertaking a study on water resources education policy in South Asia, with the following objectives.

1. Produce an inventory study on the state of the art of higher water resources education in South Asia.
2. Assess the demand for 'new water professionals' with a broader interdisciplinary profile than the 'conventional' engineering and hydrology focused profiles,
3. Develop ideas on how to facilitate reform of higher education on water resources in this broader direction.

The study will involve three components:

a) Inventory study of curricula of selected educational institutions (re-visit of earlier institutions and selected new ones);
b) Assessment of the demand of water professionals (mainly their "employability");
c) Assessment of literature and policy documents and interaction with policy makers on opportunities and constraints for higher education reform in the field of water resources.

The results of the study will be presented at the 'Water Policy in South Asia' conference in Colombo, Sri Lanka, 17-20 December 2008, in a special session on water resources education in South Asia.

The working title of the report of the full study is The Future of Water Resources Education in South Asia: Inventory, Assessment and Reform. National/regional level inventories and assessments of water resources education are an important input into the study. The present TOR refers to these national/regional level studies. Other contributions to the final report are envisaged to come from Crossing Boundaries partner institutes, and other individuals and organisations.

Design of the national/regional level study:

The local consultant will deliver a consolidated national/regional level report, with annexes as described below. The overall approach of the national/regional level studies is to start from the 2000/2001 inventory (which formed the basis of the design of the CB project), revisit the institutes and outcomes of that study, while adding a number of elements/questions and other institutes/programmes as required and appropriate. The aim is to make the studies more comparable in design than was possible in 2000/2001, even when we have to allow for local specificities also in the present 2008 studies.

The design of the national/regional level studies is to collect information on the three components of the overall study specifically for the specific country/region.

Component 1: Inventory study of curricula

Assessment of curricula of a select number of water resources education programmes in the country/region under study will be undertaken through the following activities.

1. The consultant will select five leading/important/representative water resources education programmes in the study region. The existing CB partner programmes will be excluded from this as knowledge on this is already available in the CB project (NEC Nepal; CWR Chennai; IWFM Dhaka; PGIA Peradeniya). However, other water resources education programmes in the same university/college other than the CB programme could be considered if such programmes exist.
2. The consultant will collect curriculum information for each of the five programmes. This involves a programme description and 'end terms' if available, a course list, course descriptions (reading lists/syllabi if available); credit points of courses. The consultant will assess the relative attention to engineering/technical, social/managerial, and ecological topics. The leading question is to what extent and in what way an 'IWRM perspective' is part of the programme design.
3. The consultant will interview at least two key faculty teaching in each programme, and organise a focus group discussion with students of the programme. For the key faculty basic questions are: what is the philosophy of the programme and its courses; have the programme and courses changed in the past 8 years (either in terms of content, teaching method, objective/orientation); if so, what were these changes and what were the reasons/drivers for them. For the students the main question is: what do they consider to be the strengths and weaknesses of the programme. The general question in the background is: is something happening in water resources education or not?; is it responding to new challenges (assuming that such challenges are perceived to exist).

The consultant will consolidate the results of these activities into a chapter of the final report. This component of the study will include the following annexes:

Annex 1: List of five selected water resources education programmes in the study region (with full location/institute details); reasons for selection these five; list of other programmes/institutes considered/looked at in making the selection.

Annex 2: Curriculum information on the five selected water resources education programmes

Annex 3: Protocols of interviews with faculty and students.

Component 2: Assess demand for water professionals with an IWRM-type profile

This component will be mainly interview-based. It will consist of the following activities.

1. Interviews with five leading water professionals to collect their views on the demand for (as distinguished from need for) IWRM-type water professionals.
2. Interviews with senior representatives of water resources professionals' employers in the country/region of study (including government, NGO and private sector) (3 sub sectors in govt., 3 NGOs, 3 donors, 2 corporate) on their demand/need for IWRM type water professionals.
3. Collect and analyse job advertisements for water professionals in the country/region studied in the past five years (collect from newspapers, internet and other sources – interviewees may be sources for this also; assess/classify type of jobs and types of expertise requested).
4. Identify and assess recruitment policies for water professionals of water resources professionals' employers (interview topic for interviewees under 1. and 2.)
5. Interview five IWRM-type water professionals on demand for their expertise.
6. Inventory short-term training programmes for IWRM-type skills and knowledge (use interview (ee) s under 1., 2., and 5. to identify these and ask their assessment; , interview 2 organisers and 2 participants on trends and experiences.

The consultant will consolidate the results of these activities into a chapter of the final report. This component of the study will include the following annexes:

Annex 4: Interview protocols of interviews under component 2; sample of representative job advertisements; list of training programmes focusing on IWRM-type skills.

Component 3: Collect and assess literature and policy decisions on water resources education

1. Identification of policy decisions on water resources higher education since 2000, and assess their implementation; Identify new water resources education initiatives and describe and analyse their approach

   This activity aims to assess which policy decisions, by government and universities, or any other organisation (like national/regional education boards, standing committees on education, for instance), have been taken regarding higher education on water resources that have affected/aimed to affect content, scope, form and/or objective/orientation of water resources education programmes. Methodology of this component is likely to be country/region specific, as the institutional framework for water resources education will vary from country/region to country/region. Target is to identify 5-10 key informants in the field that can be interviewed on this question and speak with some authority on it given their position and experience. Particularly interesting would be accounts of new initiatives that have been started since 2000, as being indicators of change processes.

2. Search and analyse literature assessing or commenting on water resources education in South Asia (focus post-2000) for the study country region

   In this activity the consultant will collect, list and assess any relevant literature on water on water resources education in the country/region.

The consultant will consolidate the results of these two activities into a chapter of the final report. This component of the study will include the following annexes:

Annex 5: Description of methodology followed for activity 1 (search method, list of people contacted/interviewed, organisations screened, etc.), resulting in list of 5-10 people (to be) interviewed.
Annex 6: Protocols of the 5-10 interviews under activity 1.
Annex 7: Description of literature search: search method and list of references; copies of literature found will be made available to SaciWATERs/CB (in hardcopy or softcopy).

The report

The structure of the report will be as follows.

1. Introduction (including general description of the methodology of conducting the study).
2. Chapter on component 1
3. Chapter on component 2
4. Chapter on component 3
5. Discussion and conclusion (including summary of main findings)

Annexes

ANNEX II: TERMS OF REFERENCE PROFILE PARTNER INSTITUTE

Extract from Terms of Reference of the Consultancy

(…)

2. Objectives and scope of work

The Crossing Boundaries (CB) project at SaciWATERs, Hyderabad (see www.saciwaters.org\cbhome) is undertaking a study on water resources education policy in South Asia. The preliminary outcome of this study will also be presented at the International Conference on Water Resources Policy in South Asia to be held in Colombo in December, 2008.

The objectives of this study are:

- Produce an inventory study on the state of the art of higher water resources education in South Asia.
- Assess the demand for 'new water professionals' with a broader interdisciplinary profile than the 'conventional' engineering and hydrology focused profiles,
- Develop ideas on how to facilitate reform of higher education on water resources in this broader direction.
- We would want to delegate to you the responsibility of compiling a document for the same from XXXXX. The working title will be: 'The Future of Water Resources Education in South Asia : Inventory, Assessment, Reform'. The study needs to specifically document the following:
- Nature of Institute and Programme where it is being located and the kind of water professionals who have been/are being trained throughout.
- Reasons for rethinking the curriculum for the institute and the reasons for rethinking the nature of water resources as a whole.
- The change in the institutional curriculum with the introduction of the CB project and how is it different from the previous situation.
- A documentation of the employability of graduates from the institute, substantiated with data if possible.
- Bring out the strengths and weaknesses of the programme and suggestions for improvement/development in the future
- Any suggestions that you would like to add.

(...)

SaciWATERs

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