Integrated Water Cycle Management in Kazakhstan

Tempus

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Chapter 3

Management Skills for Bulding Capability, Capacity and Impact

3. Management skills for building capability, capacity and impact

3.1 Literature search and literature review

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The term 'literature' in this context simply means everything that has previously been published and includes written material, data, graphics and illustrations. The chapter mainly deals with written information, although a great deal of data can be obtained for secondary analysis (see Chapter 3.4 Metadata management in water management). Use of published material permeates all phases of academic and professional research from selection of research topics, establishment of context, selection and justification of methods to discussion of results and comparison with earlier findings. It goes without saying then, that the task of finding the most relevant information to address a research problem and critical evaluation of its quality and relevance is absolutely fundamental to systematic research of all types. No investigation takes place in a vacuum, each study forms part of a sequence that progressively adds knowledge and understanding. So it is vital to ensure that new work is based on the firmest foundations and the function of a literature review is to present a critical evaluation of the relevant parts of the existing body of research in a particular topic area in order to establish which issues require new or further study. Figure 3.1.1 highlights the important points that will be covered in this section.

In many cases, of course, effective review of the literature will establish the solution to a problem – after all a vast amount of research has already been undertaken. The skills required for information search and review are among the most transferable and important in higher education and are an important part of the skills expected by employers of graduates. This chapter places these skills within the context of a complete research project, which includes a component of primary data collection but it will

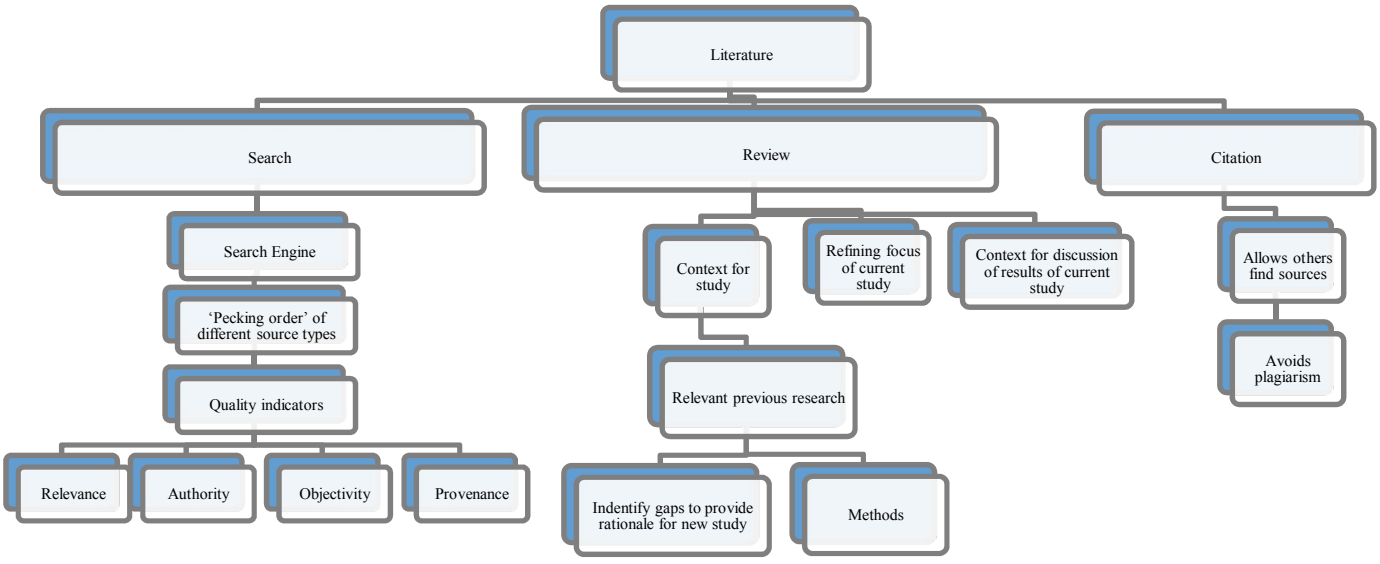

Figure 3.1.1 Literature search and review - where to find information and what to do with it

be apparent to all students that these are the primary skills required for writing essays and preparing talks (both, of course, also important business skills).

Literature search

In the modern world of connected computers, libraries, government and professional websites, databases and atlases of all types, the problem is not a lack of information but a surfeit. A few keystrokes bring a torrent of words, pictures and diagrams and the task is to pan this for the few nuggets of gold that it contains. Figure 3.1.2 places the main sources of information into a rough 'pecking order' with the best at the top. This is not completely set in stone and valid information can be found in all of these places – what the list does is rank them in terms of the ease with which the criteria outlined can be established with confidence. Not all material is of equal quality and it is important to evaluate its relevance (does it help to answer the immediate topic under study?), authority (does the material have sufficient quality assessment and quality control indicators to make it credible?), objectivity (what are the potential biases of the originators?) and provenance (how easy is it to see who has produced the information?).

The task of assessing the quality of the results of

Figure 3.1.2 Different literature sources and their main characteristics

using internet search engines is undoubtedly not as straightforward as it is for peer reviewed journal articles retrieved via an academic database such as Web of Science, given the expert review process required to publish material in the journals. Table 3.1.1 gives a series of questions on website quality that might help with the task of evaluating some of the indicators outlined above (and included in Figure 3.1.1) The greater the number of 'yes' answers, the greater the confidence.

Table 3.1.1 Checklist for assessing quality of websites

Quality indicator	Example Questions	Yes	No
Authority	Is it clear who is sponsoring the creation and maintenance of the page?		
	Is there information available describing the purpose of the sponsoring organization?		
	Is there a way of verifying the legitimacy of the page's sponsor? For instance, is a phone number or address available for information?		
	Is it clear who developed and wrote the material? Are his/her qualifications for writing on this topic clearly stated? Is there contact information for the author of the material?		
Accuracy	Are the sources for factual information given so they can be verified?		
	Is it clear who has the responsibility for the accuracy of the information presented?		
	If statistical data is presented in graphs or charts, are they labelled clearly?		
	Are there errors you can substantiate in the data presented?		
Objectivity	Is the page and the information included provided as a public service?		
	Is it free of advertising?		
	If there is advertising on the page, is it clearly separated from the informational content?		
	Are there any other signs of bias?		
Currency	Are there dates on the page to indicate the following: When the page was written? When the page was first placed on line? When the page was last revised or edited?		
	Are there any other indications that the material is updated frequently to ensure currency of the data?		
	If the information is published in print in different editions, is it clear what edition the page is from?		
	Are the links on the page up-to-date?		
Coverage	Is there an indication that the page has been completed and is not still under construction?		
	If there is a print equivalent to the Web page, is there clear indication of whether the entire work or only a portion of it is available on the Web?		
	If the material is from a work that is out of copyright (as is often the case with a dictionary or thesaurus), has there been an effort to update the material to make it more current?		
	Is there any other evidence of omissions?		
	Does it cover the subject adequately?		

The modern age has made the task of looking for all of the types of information listed in Figure 3.1.2 much easier than it has ever been before. This, paradoxically, has not necessarily made it

any less time consuming. It is therefore sensible to develop strategies that are appropriate to the immediate task at hand. General reading to support study of a subject such as water quality management may best be started with books, which synthesise material to produce an overview. Actually visiting a library is therefore an efficient way of browsing through what is available since the Dewey classification they use helpfully places all the volumes on a subject right next to each other on the shelf. Academic textbooks also provide useful links to other research. An underestimated search strategy is to talk to people – getting an experienced researcher interesting in a potential project may easily result in access to their literature collection as well as recommendations on what to look for and where to find it. Remember that research begins with a question, and identifying this problem can actually be the hardest part. The key to getting expert help is to prepare well and ask good questions – people are far more likely to help if they feel that the student will be an asset rather than a burden.

Computer literature search engines cover a large number of databases but vary in coverage and content. Different databases may be optimal for the different types of sources listed in Figure 3.1.2, for example, or may be better suited to searching in English, Kazakh or Russian. Frustratingly they do not all use the same searching algorithms – only some use Boolean operators (AND, OR and NOT [6]), only some permit wildcards (a question mark for single characters or an asterisk for multiple characters) and there may be different rules for indicating that an exact word match is required. Effective searching may require refining of search terms within an initial wide search or addition/subtraction of the retrieved item sets[7]. It is important to try searching with alternative terminology, using a dictionary or thesaurus if required, since the creators of the indices in the database may not have used the same terms or spellings. Since all of these features can potentially be very useful, it is frustrating that there is no common standard and it is sensible to seek advice from library or academic staff or to spend a little time learning the protocol of a particular search engine. The best strategy, at least initially, may be trial and error.

As demonstrated in Figure 3.1.3 once some relevant papers have been found the task of finding others is rapidly made more straightforward. All peer reviewed journal articles, and many other technical and academic literature, cite the sources of the information that they have utilised and modern databases provide links to newer material that draws on and develops the information from the original paper. Once the important or interesting people working in the area have been identified, author searches can locate other material they have published

Literature Review

Simply locating information does not complete the process, the major task is to evaluate what has been found and to assemble a structured answer to the problem posed, supported by evidence. The 'literature review' is a specific section in a university dissertation or a journal article that establishes context but the skills of review and the presentation of supporting evidence from published material is required in other sections too. It is important to justify selection of data gathering and analytical methods in the method section and to discuss results in the context of what has gone before in the review of results and discussion (it is not usual to include new information in the conclusion section).

It is important to emphasise that the review needs to be a *critical* evaluation that presents a picture of the current state of knowledge and identifies the major questions that remain (at least one of which is presumably being addressed in the new study). This is not always easy to do and most first drafts[8] (and indeed many submitted literature reviews) are more like lists – Smith (2012) did x, Jones (2013) found y and the findings of Bloggs (2014) were a and b. The (more difficult) critical

[6] AND – will result in a set of records containing all of the terms specified

OR – will result in a set of records containing any of the terms specified. They will not necessarily be contained in the same record. This will be a larger set of records.

NOT – will result in a set of records excluding terms that specified.

[7] Water AND Quality AND Management will frequently obtain a different result from searching on each term separately and then excluding all results that do not fall into all three retrieved data sets.

[8] Note to students everywhere – NEVER hand in your first draft!

review process involves the application of the quality indicators discussed above and the conclusions drawn (from those sources deemed to be of sufficient quality to merit inclusion in the review). As discussed, these include relevance (the review highlights the way that cited literature helps to answer the immediate topic under study), authority (the review critiques sources that may not have sufficient quality assessment and quality control indicators to permit its findings to be seen as conclusive, or weights the evaluation to rely more on those that do), objectivity (the potential biases of the originators are discussed where relevant and utilised to develop a comparison of differing schools of thought). It is important to notice that this evaluation is achieved by using critical faculties, the giving of comments or judgement based upon comments or opinions that analyse and make judgements on the work

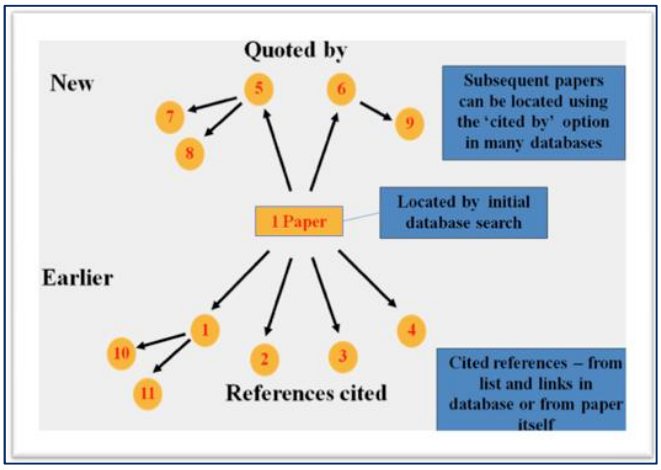

Figure 3.1.3 The best source of published information is other published information

reviewed. This should not be confused with the more everyday use of the word criticise meaning to express disapproval of, or dissatisfaction with, someone or something. A critical evaluation in the sense of making a considered assessment, needed for literature, may involve some evaluation of weaknesses but the presumption is that the process is setting out to identify and use the *good* material. The critical review, therefore, simply presents the evidence. Decisions about what to include should reflect the project and the literature review must be structured to present a logical development for the reader.

Citation and referencing

It is important to acknowledge the sources of information and failure to do so is plagiarism, defined by the Encarta Dictionary as:

"the process of copying another person's idea or written work and claiming it as original"

Direct quotation is one way of avoiding plagiarism but should be used sparingly to provide a definition, to set out something in somebody's own words (e.g. in an accident report) or where the quotation is succinct, amusing or apt. Direct quotes may add authority if the originator is especially famous in the field but equally they can be used as evidence to support a contentious claim, where it is convenient to put a controversial position into somebody else's words. Quoted definitions may come from dictionaries, learned bodies or other sources to provide clarity or authority. Contrasting definitions may be quoted to illustrate different uses of the same terminology by, for example, different professions.

In general the most straightforward way to avoid plagiarism is to add value. The process of selection, evaluation and application discussed in the previous section will places material used into a different narrative from its original application. However, it is necessary to cite the source and give credit for another person's idea, opinion, or theory together with any facts, statistics, graphs, drawing or indeed any pieces of information that are not common knowledge. The citation is given to allow proper acknowledgement of the previous work, provides important supporting evidence that demonstrates the foundations on which the current study is constructed and also to permit readers to find the source material for themselves. It is important to note that another person's idea, opinion, or theory needs to be cited even if paraphrased (edited into a new way of expressing the ideas). Illustration, such as graphs or drawings should be referenced in the figure caption (include the words 'adapted from' if some changes have been made but the basic form is derived from earlier work). Different universities or academic journals specify the way to present the information and to link the reference list to the text via citations in work submitted to them.

Conclusion

This section has discussed literature search and review with respect to a single piece of academic research but the process underpins all scholarship. It is the method by which an understanding of a subject is acquired and gives insight into the key issues, the theory that has emerged, evaluation of practice in a range of situations and the ways that research has been undertaken. When writing an article or report on a single study, a formal

literature review shows the context within which the research was undertaken by displaying an understanding of the relevant theory and how it was applied to similar or related instances in the past.

3.2 Data management

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Contemporary water management decisions use many sources and forms of data. This chapter discusses the implementation results of data management activities in the water sector carried out in five countries of the Central Asia region. Geoinformation systems, remote sensing tools and databases have been applied worldwide for improving water resources management with differing levels of success (Choi et al., 2005). Water management organisations, equipped with data management tools will have better capacities to adapt their decision-making in the changing availability and scarcity of water resources. Application of data management tools for improving collection, storage and processing of data and information are the first step towards improved water governance.

Changing patterns of water use and climate change realities require adaptive and resilience capacities of the national water management organizations (WMO) across all levels of water sector hierarchy (grass-roots, river basin and national). Information and communication technologies (ICT) are believed to act as technical artefacts and to facilitate stakeholder communication, support decision making in complex societal context, i.e., integrated water resources management (GWP & INBO 2009). E-government paradigm could help to bridge the gap between governments and citizens on different aspects of the livelihoods and development.

Early attempts were focused on collection, systematization and analysis of the generic data related to the water sector in the Central Asian region with still significant gaps (technical, human and financial capacities) for application of such technologies at the lowest operational level of water management, i.e., where the full dimensions of variables, interactions and complexities are observed and most importantly everyday politics of water is done (Abdullaev et al., 2012). In a case of Central Asian states, water management is still mostly state business, operational level includes – district and provincial WMO (Abdullaev & Rakhmatullaev 2013).

The material evidence suggests that almost all Central Asian countries have made considerable progress (improvements in e-government readiness index and world e-government ranking) in implementation of e-government steps (UNDP 2008). For example, all national water authorities of the region have their web sites (Table 3.2.1). One can find major materials on water management. However, there are no web links of lower WMOs.

Table 3.2.1 Summary of web site features of national water management authorities in Central Asia

Country	Website address	About Ministry (Organizational structure, relevant institutions)	News and Events in water sector	Online feedback form or emails	Useful downloads (materials, reports, laws)	Links to sub-ordinated WMOs
Kazakhstan	http://minagri.gov.kz	+	-	+	-	-
Kyrgyzstan	http://www.river-basins.kg	+	-	+	-	-
Tajikistan	http://www.mwr.tj/ru	+	+	+	+	-
Turkmenistan	http://www.minwater.gov.tm	+	-	+	+	-
Uzbekistan	http://www.agro.uz	+	+	+	-	-

Data management activities were designed and implemented with consultations of national WMO needs, i.e., integrated into the regular, daily practices. For example, compulsory reports preparation is automated (e.g., VX-1 and VX-2). The process has been designed as a bottom-up one, with full involvement of the partner WMOs from planning through implementation stages.

Therefore, partner WMOs have greatly contributed to the selection of the type, structure, content, interface and format of the data management tools creating clear ownership of the process by partner WMO. The strategic approach was generation of political support from national water agencies of partner countries.
The *Database* has been designed to store and use the digital, tabular data on water resources, water use, hydraulic facilities, hydrological settings, socio-economic and administrative conditions of the location (basin, irrigation system). The database architecture has been designed with application of the open-source script language and database. In fact, users can easily insert and modify (administer) database without the help of professional programming specialists. Both data base interfaces and user manuals were prepared in local languages in order to make easy the use of the data base and GIS tools.

Remotely sensed satellite images, Digital Elevation Models (DEMs), Google Earth, different thematic paper maps and geographical coordinates of water infrastructure, recorded by GPS receivers are used for water resources management. Application of the GIS and RS tools to assess size and location of the irrigated areas is the most important contribution to improve water resources management planning and allocation (Bastiaanssen, 1998). Table 3.2.2 depicts the results with qualitative impact indicators across the Central Asian countries.

The most promising signals of strong political support from the national water authorities of Kyrgyzstan, Uzbekistan, Tajikistan and Turkmenistan were their statements on the use of the database as a main tool for reporting within their respective national water hierarchical systems. In Kazakhstan, national government is funding the national program on water sector data management.

Access to the database has been one of the critical aspects. Partner WMOs are not eager and ready to right away share data with 'outsiders' – organizations, people who are not working in water sector. Therefore, at the moment access to the databases is restricted (user names and passwords) to only the staff of respective WMOs. Thus in order to address this critical issue, the database has been designed with the administration menu incorporated into the database.

GIS and RS tools are differing from the database due to quite high requirements to expert skills.. Thus professional consultants were hired to train and prepare maps, i.e., collaboration local WMOs digitized with GPS hydraulic infrastructure, provided paper based thematic maps. On other hand, professional consultants prepared DEM, GIS land use maps. GIS maps are not required to be prepared for each season or year but rather updating them every 4-5 years for basin planning. Hiring professional staff with GIS skills is not feasible in the current conditions due to the low wages of WMO staff. Therefore, recruitment of a growing number of companies or experts on GIS is an option for updating of the LULC maps.

Table 3.2.2 List of main indicators (impact) on data management activities in the pilot areas – Note: + (positive progress); - (no progress); +/- (mixed progress); n/a – no comment

Indicator	Political Support	Database System	Access to data &information	GIS/RS maps	Application Status	Follow up by partners
Kazakhstan	+	n/a	n/a	+	n/a	n/a
Kyrgyzstan	+	+	+	+	+	+
Tajikistan	+	+/-	+/-	+	-	+/-
Turkmenistan	+	n/a	-	+	+/-	+/-
Uzbekistan	+	+	+	+	+	+

The application of database for everyday operations has shown various /mixed results across the pilot areas. For example, in Kyrgyzstan and Uzbekistan at present databases are filled with retrospective data for 2005-2011, and from 2012 the database is being used for day-to-day operations. In other pilot areas unfortunately that database is not fully used. Some data turned to be to collect due to the loss of the paper reports which used to be stored in unfitting conditions at the offices of district (rayon) and provincial (oblast) WMOs.

3.3 Geographical Information Systems for Water Management

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Introduction

New developments in water management practice are

- Geographical information systems (GIS),
- remote sensing technologies and remote sensing data,
- databases in meteorological or hydrological service authorities,
- automatic gauges on rivers,
- decision rules for automatic reaction or alarming the public,
- web-based mapping and
- multiple other technologies and applications.

GIS allows the digital collection, presentation, storage and manipulation of spatial data. Differently to printed or scanned maps, GIS based system offers the adding of data, the combination with diverse other data and a structured analysis and query by experts of water management or via web-based solutions in the internet for public information or stakeholders involvement. GIS based systems or applications are the basis for modern and technologically attractive solutions in integrated water cycle management (IWCM). Multiple tools and models based on GIS are applied in hydrology to store, structure, analyse or monitor the data in the spatial context of catchments or watersheds.

The subchapter summarizes very briefly actual developments in GIS coupled systems used
(1) for the groundwater recharge modelling in German landscape planning and as part of expert systems for the usage in practice by competent authorities and consulting companies, and
(2) in the Saxonian flood forecast system which includes dynamic real time measurements, digital maps, decision rules, automatic information of competent authorities and much more as a modern system to protect the society against hazards.

GIS coupled systems

Assessment of groundwater regeneration on the basis of decision rules and GIS based data.

The aim of the local study on the GIS application based on digital data for groundwater recharge for issues in analysis and assessment of landscape planning was first of all the spatial determination of the annual local groundwater recharge, which depends on land use, slope inclination, climate and soil texture. The analysis is based on the method for the assessment of the (quantitative) regeneration of groundwater developed for different German land uses by Renger & Strebel (1980). The method was further developed and adapted for the application with GIS. Key information layers used for the calculation are (1) precipitation and temperature data, (2) approximation rules to determine the usable field capacity of the soil based on soil maps (3) the Haude-evaporation equations differentiated by land uses. Information e.g. about (a) soil compaction, (b) humus content, (c) horizons of the soil, (d) level or depth of the surface near groundwater is added and used for detailed investigation by combining the data with diverse matrices to help the user to link the different data and decision rules. The data integration diagram is found in Figure 3.3.1. The full method including the decision rules for the data combination is available on www.mulbo.de or in the literature.

The assessment firstly structure the data layers in the GIS. Decision rules are converted into mathematical rules and applied in the GIS. The calculated results are classified in local applicable classes of groundwater recharge. Considering Germany, the regeneration of groundwater is estimated as being very low in the south of Saxony-Anhalt. Referring to a yearly precipitation rate of only 480 mm identified by the nearest meteorological station, at the agricultural-meteorological bureau in Querfurt, the local estimation of yearly 0-150 mm groundwater recharge depending on different land uses, soil types and precipitation is valid for the total area investigated (Figure 3.3.2). The Figure also shows the heterogeneity of the groundwater recharge.

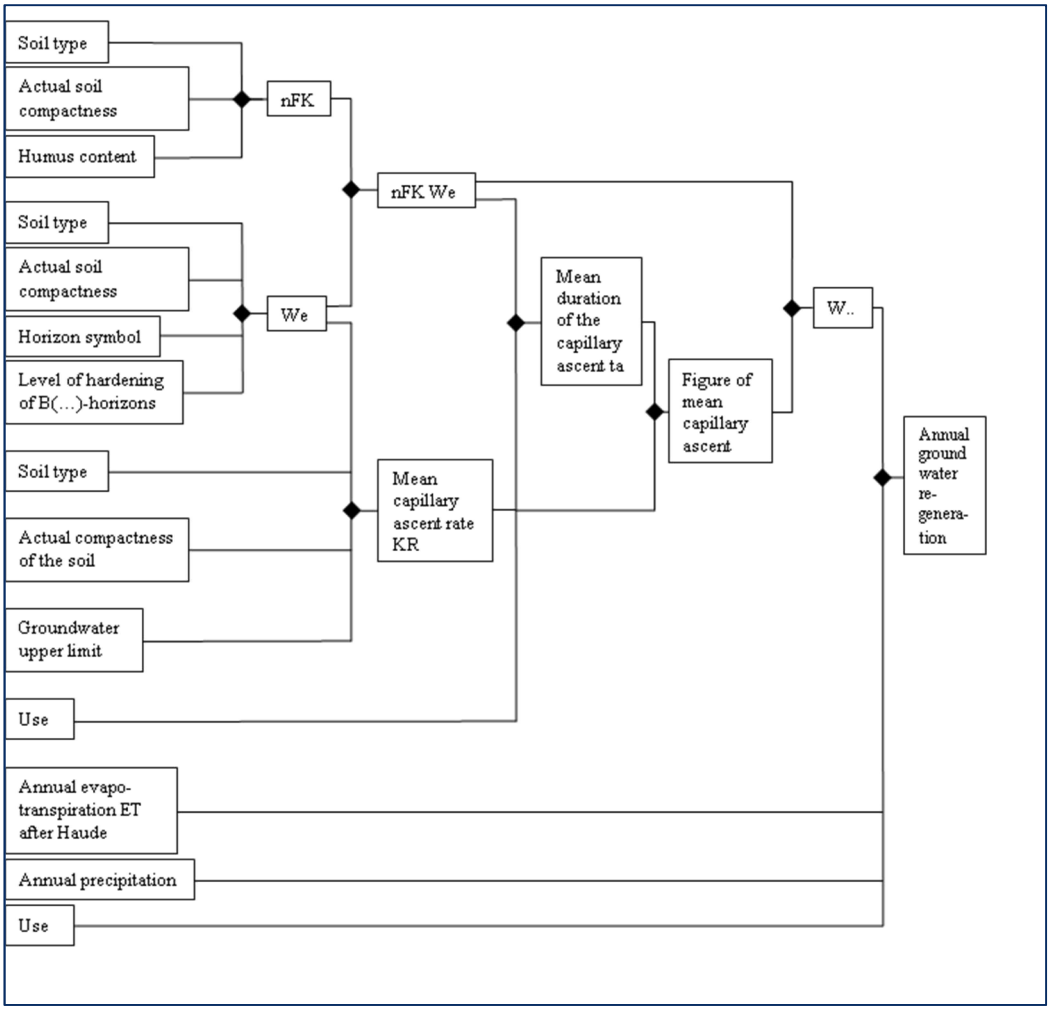

Figure 3.3.1 Analysis and assessment of groundwater recharge – data integration diagram of the Renger & Strebel (1980) method.

Example: Saxonian information system for flood prevention

Large costs of housing and infrastructure destructions caused by an extraordinary flood and as result of not predicted extensive rains in the river Elbe catchment in the year 2002, have been the starting point for the development of a digital information and forecasting system on key aspects of flooding related activities in Saxony (see www.umwelt.sachsen.de/umwelt/wasser/en/index.html). The information system includes data on contextual description, interactive maps, explanations about map and data content, Web Map Services (WMS), and the possibility to download GIS-Data and maps in pdf-format.

The flood information service organized by the Saxon Flood Centre is responsible for flood information and early warnings for all main rivers. The flood information is provided directly to each competent authority with flood defence responsibilities and also to the (private) public. Information can be automatically delivered to the

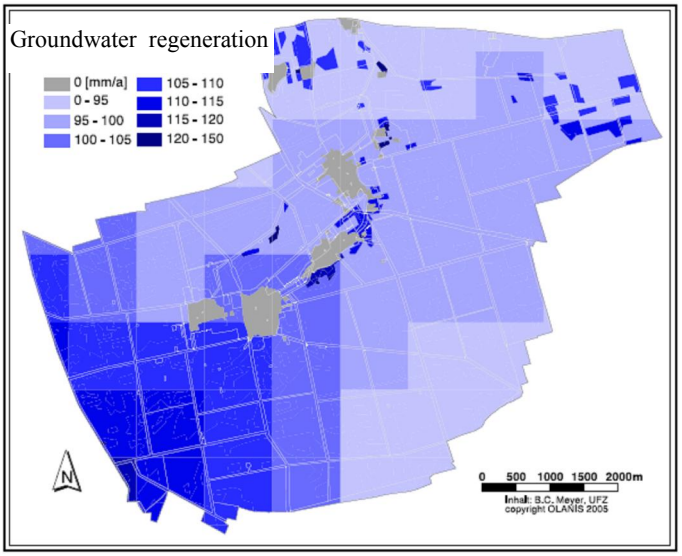

Figure 3.3.2 Groundwater recharge in Barnstädt (Saxony-Anhalt; Germany) based on the Renger & Strebel (1980) method

customers (competent authorities, fire departments etc.) following alarm stages (flood level thresholds) about flood levels, flood warnings or flash flood hazard e.g. by warning messages via SMS. The following input data are being received by the center on the basis of automatic measurement points regularly: (1) actual (every 15 minutes) automatic readings of more than 100 flood level gauges; (Figure 3.3.3); (2) the precipitation forecasts of the German Meteorological Service (DWD); (3) the flows (m^3) and water levels (m) of reservoirs provided by the State Dam Monitoring Centre (4). In addition, relevant hydrological and meteorological data for the upper river Elbe and its tributaries in the Czech Republic are provided by the Czech Hydro-Meteorological Institute and support the management of international trans-boundary river management.

The flood information system contains (1) an automatic flood level and a precipitation data recall unit; (2) an information management system (database) and forecasting models for the River Elbe and the tributaries, (3) the public internet platform and (4) an automatic information distributor sending SMS and computer files.

Products and results of active projects in the Saxon Flood Centre are e.g.

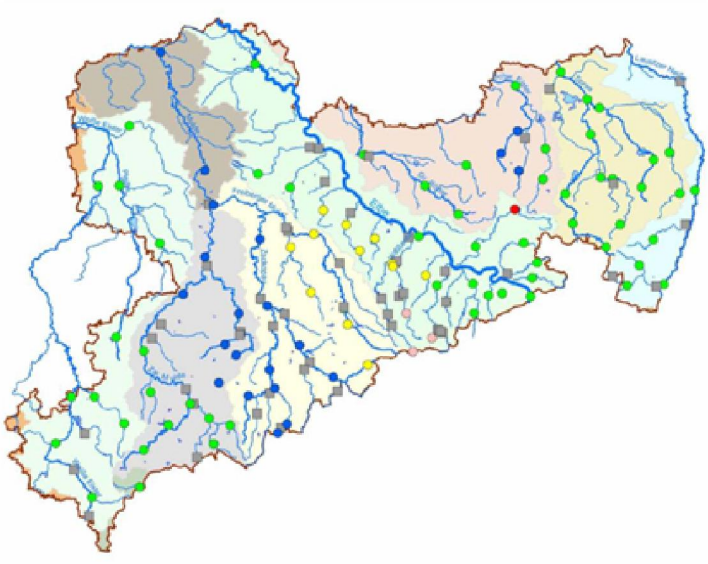

Figure 3.3.3 Map of gauges in Saxony including information on alarm levels. (http://www.umwelt.sachsen.de/umwelt/wasser/en/4722.htm) The map includes information about catchments, rivers and measurements on gauges (precipitation, runoff) and levels of alarm.

- **Elbe-Atlas:** The atlas gives an overview of the flooding hazard in the catchment of the River Elbe. Maps are based on small scale topographic data at a map scale 1:100.000. The Aim is to highlight the potential risks that exist also even behind protective measures (Figure 3.3.4).

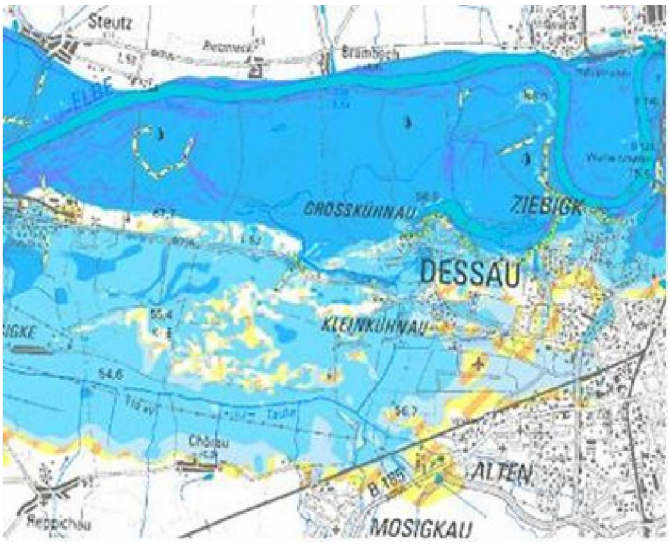

Figure 3.3.4 Flood hazard (as darker the blue colour as higher the water will be in case of flooding)(http://www.umwelt.sachsen.de/umwelt/wasser/en/4716.htm)

- **Municipal Flood Maps**: For municipal purposes and for effective flood protection of the settlements, detailed pilot studies on the "Preparation of municipal flood information maps" were developed including examples for transboundary cities
- **Software** was developed on "interactive risk mapping for the municipal flood protection". It visualizes the alarm escalation plans of municipals and provides a quick and comprehensive overview of endangered objects depending on the level of the flood water
- **Flood Generation Area Mapping**: This type of areas are protected and mainly located in the low mountain ranges and hills. They are characterised as areas where extreme runoff after heavy precipitation or short-time melting of snow is potentially generated. The category shows the importance of the capability of seepage and water retention in these areas for the originating and the level of floods (Figure 3.3.3).

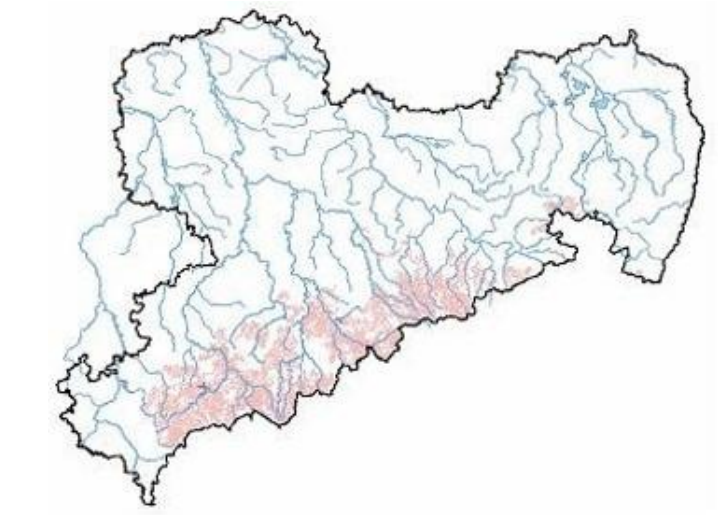

Figure 3.3.5 Flood generation areas in Saxony (http://www.umwelt.sachsen.de/umwelt/wasser/en/4713.htm)

Based on geographical information systems flood prevention for Saxony and also the planning of landscape as shown by the example of groundwater recharge is more effective if compared with standard methods applied since long time in science and practice. The subchapter reflects the increase of methods capabilities when using the actual technology development in GIS combined with databases, decision rules and web interfaces including web mapping for policy, administration and general public. Web Map Service (WMS) is the standard protocol for serving geo-referenced map images over the Internet that are generated by a map server using data from a GIS database. This WMS specification was developed by the Open Geospatial Consortium in 1999 and provides open software codes usable for further developments of content and technologies without new obligations to pay for software packages like ARCGIS.

3.4 Meta-analysis and its application to water management

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Introduction

This section is designed to introduce the student to the techniques of meta-analysis which may allow direct comparisons of the reported impact of different studies in water management to be made. The techniques have historically been used in medicine in order to improve the statistical power and precision of assessment of multiple separate medical interventions such as different clinical trials. However, there is considerable scope for the application of such methods to other disciplines including water management where divergent outcomes make direct comparisons difficult. The section will raise students' awareness of the benefit of pooling results of previous studies as well as describing methods to achieve this. The principle of publication bias is explored together with means of detecting it via the use of funnel plots. Techniques to adequately weight the influence of differing sample-sized studies are also described.

Background

One notable feature of studies that attempt to gauge or assess the effectiveness of water management interventions are that outcomes of interventions may be applied to catchment, country or regional districts in such a way that direct comparisons are difficult to make. Retrospective studies or systematic reviews of historical and contemporaneous studies are also often difficult to compare directly and for this reason, best practice is often difficult to identify.

Where multidisciplinary approaches have been undertaken or when water management issues are transboundary, it is important to consider methods to be able to directly compare the effectiveness of interventions where outcomes are either measured in different ways, the sample sizes differ, or the interventions deployed diverge. Such approaches to combine different studies that attempt to assess a particular intervention are generally referred to as meta-analyses and have historically been chiefly applied to medical studies, in particular, for the direct comparison of multiple clinical trials.

Principle of application

Prior to undertaking meta-analysis, students should screen the studies considered in order to ensure there is sufficient rigour of design and analysis. The benefit of undertaking meta-analyses is that greater statistical power and greater precision is afforded by combining the outcomes of different studies such that the true value or worth of a particular management practice is better estimated. This benefit can be visualised in the forest plot (Figure 3.4.1) where outcomes of 10 research studies are summarised as the numeric ratio of an intervention vs non-

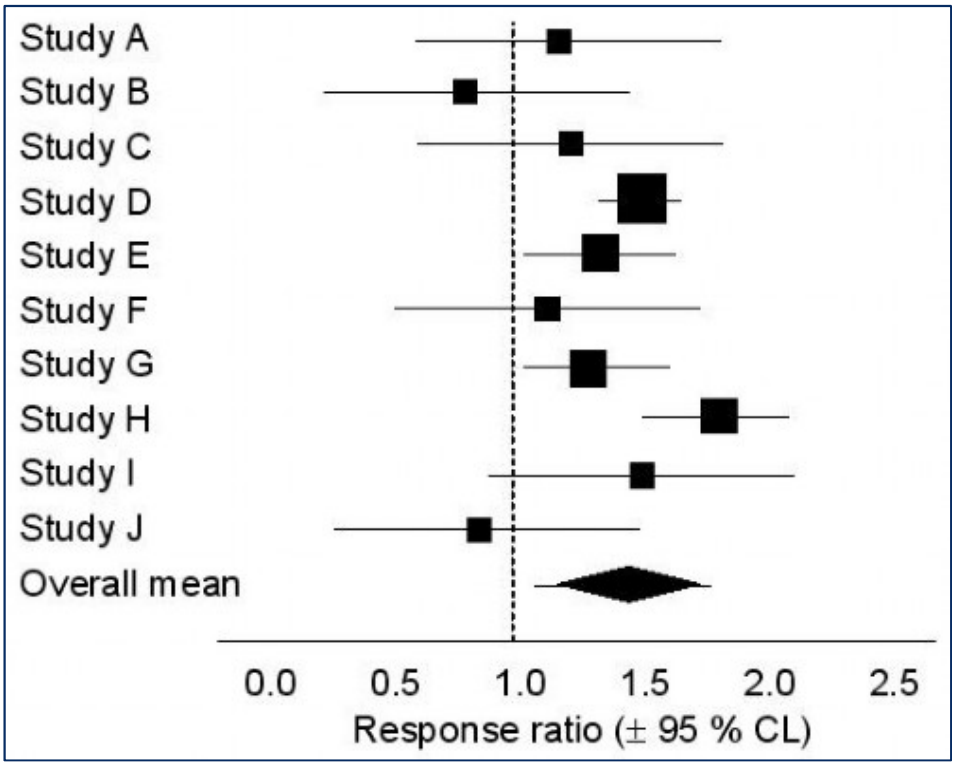

Figure 3.4.1 Forest plot depicting a typical output of a meta-analysis. Outcomes of 10 studies are shown as response ratios together with their associated confidence intervals. The mean impact calculated by meta-analysis is depicted on the bottom line

intervention. A zero effect (Null hypothesis) results in a value of 1 shown by the dotted line. Here, it can be seen that 2 studies (B and J) resulted in a negative impact of the intervention. In addition, 4 further studies (A, C, F and I) although showing a positive effect did not demonstrate statistical significance. However, pooling of the 10 studies reveals that in fact the overall mean impact with at least 95% confidence was positive. It is also interesting to note that the relative sample size of the studies is shown in proportion to the size of the box and that the range of the 95% confidence intervals is inversely proportional to this size. Study D is clearly the largest and by inference is likely (but not certain) to have the largest influence on the overall effect.

Meta-analyses also allow the detection of publication bias which may lead to historically erroneous conclusions on the success or impact of interventions. The underlying principles and techniques of meta-analyses have wide ranging applications and there is considerable scope for their application to diverse areas in environmental sciences including water chemistry and water management.

For researchers attempting to undertake a meta-analysis, the first important principle is that different outcomes of "success" of a water management intervention can be standardised. A standardised intervention score may be described as an "effect size" as commonly employed to gauge the effectiveness of medical interventions. However, the principles may be directly applied to numerous disciplines where the outcome measure has a numerical or at least an ordinal measure of success. The second important principle in meta-analysis is the principle that studies having greater sample sizes should be afforded proportionately greater weighting in the calculation for the overall statistical significance and associated confidence intervals of an intervention. However, this should be balanced against the possibility that smaller well designed studies are ignored.

Standardising the measurements - effect sizes

Where the impact of a measured intervention can be expressed as a mean, it is possible to construct a simple measure of effect size by comparing two means relative to their standard deviation

Cohen's d is a commonly measure and is defined as the difference between two means divided by the standard deviation for the data, i.e.

$$d = \frac{\bar{x}_1 - \bar{x}_2}{s}.$$

Where d = Cohen's d statistic, xbar1 xbar2 the two sample means, s the pooled standard deviation.

Since there are two likely different sample means and two different standard deviations it is important to pool the two sample standard deviations into one measure which can be done using the following procedure:

$$s = \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}}$$

Where s=pooled standard deviation, s12

In the same sense that a true, meaningful effect size in a clinical intervention should be determined by clinical expertise, patient experience and knowledge of previous studies, so such expert knowledge in water management, water chemistry, human health or ecological diversity should serve as guidance for what is and what is not a meaningful and successful water management intervention. In the absence of such knowledge, Cohen's d effect shifts of 0.2 to 0.3 may be considered a "small" effect, around 0.5 "medium" and greater then 0.8 a "large" effect.

A modification of Cohen's d is known as Hedges g where a correction is made for the population effect size which is likely to be biasedly estimated by the pooled sample standard deviation.

$$g = \frac{\bar{x}_1 - \bar{x}_2}{s^*}$$

Where s* is an adjusted pooled standard deviation and requires a gamma function correction.

A more detailed account of employed procedures may be found in Borenstein et al. (2009). Further commonly deployed standardised effect measures include odds ratios (as shown in Figure 3.4.1) and relative risk measures.

Publication bias and funnel plots

An important principle of statistical inference, and one that is highly intuitive to a casual observer, is that larger sample-sized studies, provided fundamentals of good experimental design are employed, will better estimate the "true effect" of any intervention in comparison to smaller studies. To illustrate this, suppose 35 studies of varying sample sizes have been undertaken to investigate the impact of a particular intervention. For example, suppose that tertiary water treatments to remove nutrients have, in reality, a low positive impact on the diversity of macro-invertebrate communities, fishery quality or physico-chemical parameters and that these effect sizes were plotted against the sample size across the 35 studies. One might therefore expect the larger studies to be closer to the true effect size and for smaller studies to diverge from this true result proportionately to the sample size. Another important feature of such a meta-analysis is that this divergence should be non-systematic with regard to the direction of the difference, thus showing randomness and natural variation that is inversely proportional to the sample size. This variation can be visualised by means of a funnel plot (Figure 3.4.2) where each individual study is indicated by each point, the overall effect (with 95% confidence interval) is shown alongside the zero effect as indicated by the Ho position.

The funnel plot is a basic but important tool for researchers to investigate the possibility of publication bias when comparing the results of multiple studies. In Figure 3.4.2 (A) it can be seen that studies with larger sample sizes have convergent agreement with each other and can therefore be considered as more reliable indicators of the true outcome. In this case the true outcome is that the intervention had zero effect (consistent with Ho). There are more studies reporting smaller sample sizes and these tend to have a greater divergence from this effect size as sample sizes decrease as random, natural variations become proportionately more important. Notably in Figure 3.4.2 (A), there is little evidence of asymmetry indicating a distribution of results across a range of studies which report effect sizes far greater than the true effect as well as interventions where the intervention had equally negative impacts with equal frequency. This spread of results is entirely consistent with statistical theory and indicates that there is insufficient evidence of any publication bias. Figure 3.4.2 (A) researchers may therefore be confident that the reported effect is a true reflection of the effectiveness (or non-effectiveness) of the intervention. However, if the outcome of any meta-analysis produces a funnel plot such as that illustrated in Figure 3.4.2 (B), where there is considerable asymmetry in the plot with a notable "absence" of studies in the lower left of the plot, but with small size studies reporting positive effects of interventions, then researches should very cautious in interpreting findings. Figure 3.4.2 (A) illustrates likely "cherry picking" and publication bias – arising

from the possibility that studies showing negligible or negative impacts of interventions are intentionally or unintentionally not published. This may be because the original researches did not want to submit non-significant or contrarian articles to journals, or that journals reviewers or editors may not want to publish them.

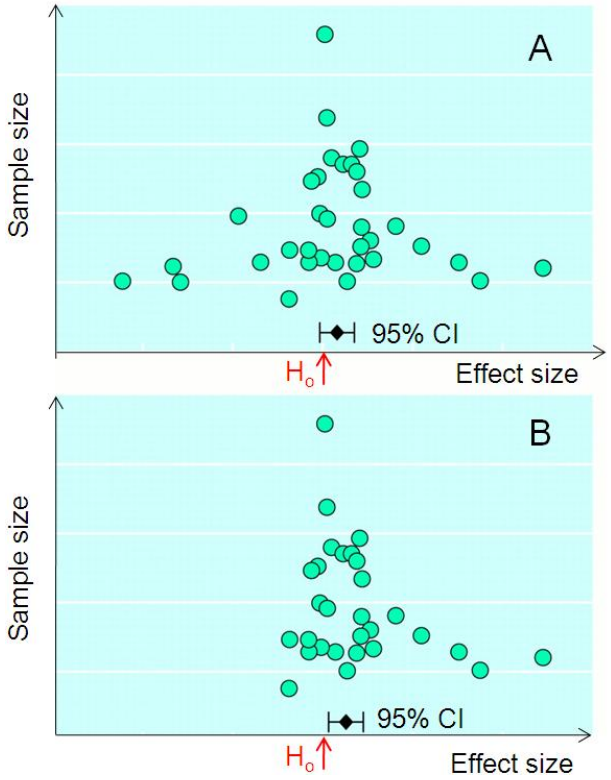

Figure 3.4.2 Symmetric (A) and asymmetric (B) funnel plots comparing no publication bias (A) and evidence of publication bias (B) where small sized samples showing a negative effect size have not been published.

In A the small positive overall effect size with its 95% confidence interval is consistent with the Null hypothesis. Researches should correctly fail to reject the Ho and therefore conclude that there was insufficient evidence that the intervention was successful. In contrast, in B, publication bias results in a shift of the overall effect size such that its 95% confidence is non-overlapping with Ho. In this case, researchers would wrongly reject Ho and erroneously conclude that the intervention had been successful. [Figure. adapted from Sutton et al. (2000)]

Ecological impacts of water management using meta-analysis have not been regularly reported, suggesting considerable scope may exist for their application. Haxton et al. (2008) investigated effects of (i) dewatering on macroinvertebrates, (ii) a hypolimnetic release on downstream aquatic fish and macro invertebrate communities, and (iii) flow modification on fluvial and habitat generalists and in general reported negative effects of management practices. Publication bias was also evident in several of the reported meta-analyses.

Fixed effects and random effects models

As discussed above, intuitively we might imagine that in combining the results of different studies, that the outcomes of larger studies should have a greater influence on the average results reported in meta-analyses than smaller studies. Parameter estimates e.g. population means have proportionately reduced variances in accordance to sample size and as a consequence the inverse of the variance is commonly used to weight the relative influence of each study on a series of study estimates. One weakness of such an approach is that a very well designed study, showing unusual/unexpected results, but of relatively small sample size will have its outcome made virtually negligible if the meta-analysis contains other very large studies. Another feature of a fixed effect model is that the underlying population being studied, and by inference, any confounding variables is homogenous. In reality, this is seldom the case since many factors e.g. divergent methods, outcome variables, sampling locations result in considerable heterogeneity in outcomes. In order to overcome these weaknesses in fixed effects models, a second, random effect variance component can be applied as an unweighting factor. In practice, the application of this component can have two extreme effects. If the observed effect sizes of the different studies are highly homogenous then the unweighting will be negligible. In other words the influence of the sample size on the weighting of the samples will be maximised. On the other hand, if the effect sizes of the studies are highly heterogeneous, the unweighting component will be very large and may result in negligible inverse variance weighting such that the overall outcome measure is simply an unweighted average of all the studies.

Conclusion

Researchers and students who wish to apply the techniques discussed here are strongly advised to consult the cited literature for detailed descriptions of required procedures. Where correct decision-making is critical, for example, in forming a policy decision based on scientific knowledge, there are clear benefits in maximising the data from which such decisions are formed. There also exist dangers where publication bias

may falsely advocate certain interventions. Correctly applied meta-analysis can enhance and overcome these factors resulting in robust decision making.

3.5 Basin planning

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Introduction

The introduction of integrated water resources management principles (IWRM) is a long process of perfecting the decision-making system on all levels of water management. One of the main IWRM elements is the development of the **Basin Plans**. This chapter describes the necessity of basin planning and the difference between basin plans and the traditional schemas of water resources management, practiced by Central Asian (CA) countries. Moreover, the chapter describes the planning cycle and conditions necessary for the development and implementation of basin plans.

Before the independence of Central Asian states in 1990th, the state determined policies regarding water resources management (water policy). The general schemas of overall usage and the protection of water resources known as the "Scheme of complex use and protection of water resources" (SCUPWR) were developed regularly (every 5 years). After the collapse of the Soviet Union, the existing systems of water resources management changed. However, many analogous patterns remained, which may have leaded to the irrational use of water resource.

Management based on administrative principle leads to the domination of local interests at the expense of the development of the basin. Although water laws in Central Asia guarantee the participation of different stakeholders, many of them cannot participate because the planning process is extremely fragmented and carried out by separate bodies. Therefore, this approach does not allow the consideration of all interests and it is proved to be ineffective. Uncoordinated activities and conflict over water resources lead to water loss. Moreover, the issues of environmental protection are evaluated as a secondary issue, preventing solutions from being found.

There are a lot of different methodological approaches in the process of basin planning, such as the ***Methodology for the Transboundary Waters Opportunity Analysis***. The main idea of this methodology is to find mutual beneficial results of all activities for all parties. This methodological instrument is mostly used by the joint river basin organizations for studying the relevant issues and choosing optimal decisions.
Another example of such a methodology is the Strategic Environmental Assessment (SEA). This Assessment uses different instruments, including carrying out basin development scenarios, risk assessments, and modeling and forecasts of possible ecological consequences. The SEA is used in the process of basin plan development for identifying current ecological problems of the basin and discussing the most optimal preventive measures.

Concept of basin planning

The underlying basis for these methodological approaches is the ***Concept of basin planning,*** which was developed by the WMBOCA Program (Water Management and Basin Organizations in Central Asia), financed by the EU. The Concept is based on the EU Water Framework Directive. Its main principles are described below.

The first IWRM principle – the management on the basin level based on hydrographical borders – guarantees stable and equitable water supply independently of water user location (upstream or downstream).

The second IWRM principle emphasizes its participatory approach. The most important advantage of IWRM and basin planning is inter-department coordination through the establishment of basin councils or coordination groups.

One more fundamental principle of basin planning is the comprehensive analysis of the current situation. Based on this analysis, the problem register (a list of problems) is developed and the problem prioritization is conducted.

Scheme of complex use and protection of water resources" (SCUPWR)

CA countries still use the SCUPWR for planning and developing territories. However, it is possible to use SCUPWR and basin plans together as their differences complement each another.

Table 3.5.1 Comparison of the main characteristics of SCUPWR and Basin Planning

	Basin Planning	SCUPWR
Scale and style of water resources management	Basins, sub-basins of different scales. Mainly decentralized water resources management.	National main river basins. State centralized water resources management.
Stakeholders participation	Participation in Plan development	Distribution of information on main scheme's elements
Technical solutions in comparison with institutional projects	Both variants are equally presented	Technical solutions are dominant
Ecological aspects of WRM	Ecological aspects are prioritized	Ecological aspects are considered together with other sectors
Financial/economical aspects	Detailed elaboration of each action, different sources of financing, economical instruments	Common financing for all actions, mainly state financing; payments for pollutions is one of the financial instruments

See Table 3.5.1 for a comparison of SCUPWR and basin plans.

As seen from the Table 3.5.1, SCUPWR is not a barrier to developing the Basin Plan. The Basin Plan is a more flexible document that could incorporate the research and analysis from the SCUPWR. For CA countries, when state financing is limited, Basin Plans are easier to implement due to the decentralization of financing and the opportunity to apply for alternative sources.

The development and introduction of Basin Plans provides water bodies (through specific/dedicated basin councils) with the opportunity to conduct comprehensive analysis and assess the current situation as well as to implement water use planning for the basin on the short-term (2-3 years), mid-term (5-7 years) and long-term (10-15 years) perspectives. Many factors are considered during basin planning: inter alia economical development tendencies, population forecasts, increasing signs of climate change influence, and other factors which could have an effect on basin development.

Basin Planning and Basin Plans

The planning cycle is the basis for basin planning (Figure 3.5.1). The Basin Plan can be used at each level: at the governmental and inter-governmental level as well as at the level of small river basins. According to the schema below, there are seven main steps in the planning cycle for IWRM.

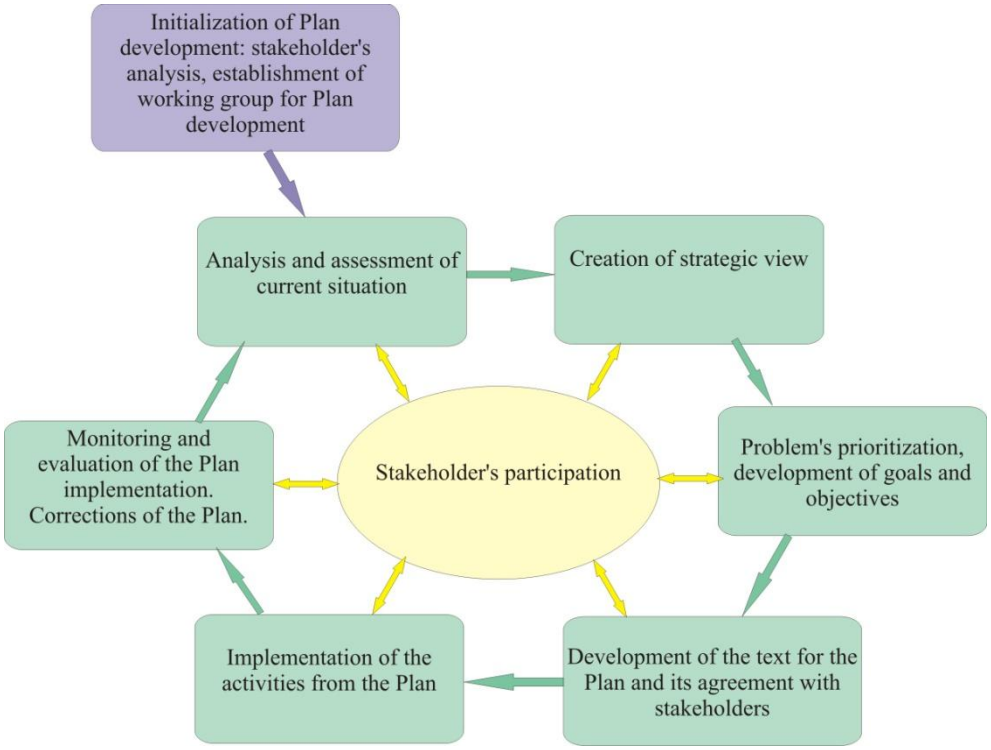

Figure 3.5.1 Basin planning cycle (CAREC 2013)

The main element in basin planning is the participation of stakeholders in each step of planning and implementation. Since the development and implementation of the Plan based on the principle of maximum involvement of stakeholders, the platform or deliberative body for the implementation of joint actions is necessary. Such deliberative bodies take many forms. In some cases, they can include non-formal organizations (consultative bodies) and, in other cases, formal basin organizations. The most prevalent types of basin organizations are committees, commissions, water management organizations, and councils.

Each member of such a consultative body can take part in the process of the Plan's development as follows:

- Support the consumption and ecological interests of the basin;
- Assist in corrective actions aimed to improve legislative and standard acts;
- Establish a list of problems and choose which goals and objectives are most important;
- Implement the monitoring and evaluation of the Basin Plan development, thus ensuring that the Plan is effective in its development and reducing the negative consequences;
- Distribute information about each step of the Plan's development. Influence the opinions of the communities on realized activities;
- Lobby the interests of one's sector during the forming of priorities, etc.

At the same time each member of the process can participate in the realization of the Plan. Participation can take different forms, starting from the common coordination of the Plan to its implementation.

The Water Codes of Kazakhstan, Kyrgyzstan and Tajikistan foresee the establishment of Basin Councils in each large-scale hydrographical basin. Basin Councils in Kazakhstan were already established in 2005-2006.

The development of Basin Plans is a long and labor-intensive process that demands certain costs. (Fig. 3.5.2) However, taking into account the flexible approach for the development and realization of the Plan as well as the attention to local detail in each concrete case, financial costs and applicable mechanisms of financing are different in every situation.

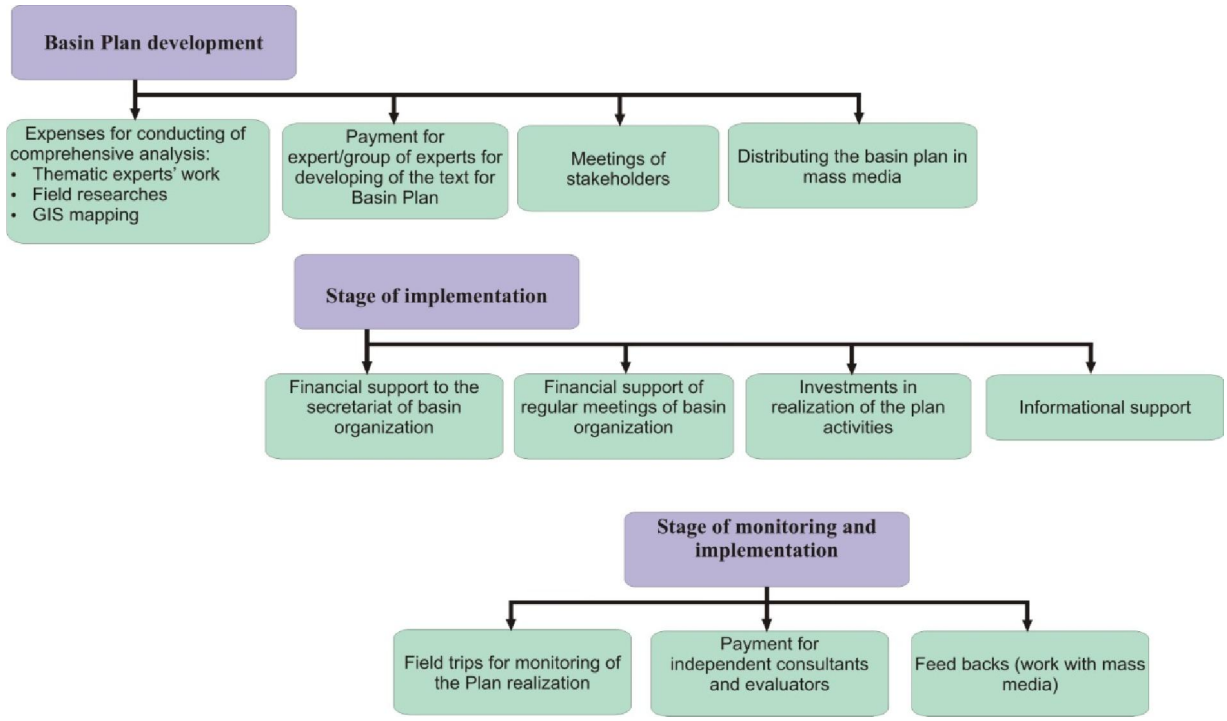

Figure 3.5.2 Financial costs (CAREC 2013)

At the stage of developing the ***Basin Plan***, financial costs can be minimized. For example, members of the Basin organization itself could conduct the analysis of existing situation, thus avoiding extra costs. Different parties of the basin, who are interested in the region's sustainable development, could gather the necessary data. Members of the Basin Council or volunteers could form a group to write the text of the Plan.

The ***stage of implementation*** is the most costly (in both money and efforts terms); however, the measures determined in the short-term Plan do not necessarily require large financial investments, thus providing more time to find the financial sources for the measures, included in long-term Plan. For example, local communities could implement the measures aimed at planting greenery in rural territories, collecting garbage, cleaning the springs, etc. This stage also allows the opportunity to attract investment from state programs or businesses as part of their social corporative responsibilities. Attracting donor funds for the implementation of separate measures is also possible.

The ***stage of monitoring and implementation*** of the Plan as well as the stage of development could be implemented without large financial costs through the members of Basin organizations or communities. The state monitoring of the measures, implemented under the state programs is also possible.

Conclusion

The Basin Plans are based on the specifics of each basin. However, during the development and implementation of the basin plans, the following main principles should be taken into account:

- The basis for the Plan should be the comprehensive analysis of the existing situation and the establishment of a list of existing problems;
- Unidentified problems should be ranged and prioritized. The most pressing problems will serve as a basis for the Plan;
- The Basin Plan is not a static document and should be revised and specified if necessary; the development of new basin plans should become a regular and widely applicable practice;
- The most important principle in basin planning is the involvement of all stakeholders in all stages of development, including the realization and monitoring of the Basin Plan's implementation. The opinions of all stakeholders should be taken into account, and each matter of dispute should be solved by finding compromise;
- Basin organization, formal or informal, is key to the sustainability of the mechanisms of basin planning;
- One of the most important issues in the process of basin planning is financing. Therefore, all accessible mechanisms of financing and its combinations should be

used for the implementation of the measures of the Plan.

Despite the fact that the introduction of IWRM principles is a long and labor-intensive process, currently in all CA countries, there are measures aimed to improve national laws to introduce management basin principle and the development and implementation of basin plans to the region.

3.6 Working in partnership

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Introduction

This chapter describes key legislative aspects driving the increased requirements for collaborative working in a European context and defines key terminologies before providing an overview of the benefits, processes and challenges associated with collaborative working in the multi-sector arena of integrated water cycle management. It concludes with a case study describing an example of partnership working within the EU.

The legislative context

Over the last decades, a raft of European and national policy measures have included specific requirements for government agencies, public organisations, private companies, community groups and individuals to work together collaboratively (Benson et al., 2013). In 1998, the UNECE Aarhus Convention on access to information and public participation states that sustainable development can only be achieved through the involvement of all stakeholders (UNECE, 1998). Following on from this, the EU Water Framework Directive (EU WFD, 2000) states that, the success of the Directive relies on cooperation and coherent action at European, national and local levels, as well as involvement of the public. Article 14 of the WFD requires Member States (MS) to "encourage the active involvement of all interested parties […] in the production, review and updating of the river basin management plans" (EU WFD 2000). The EU Floods Directive (2007) contains almost identical language with regard to the production, review and updating of flood risk management plans. The Integrated Pollution Prevention and Control Directive (IPPC, 2008) requires that the public is given effective opportunities to participate in permitting decisions, and public participation forms a key component of the Strategic Environmental Impact Assessment Directive (SEA, 2001).

Many terms are used, often inter-changeably, in both scientific literature and policy to describe such collaborative efforts each with its own definition (see Table 3.6.1). As a starting point to understanding the various terminologies, Carnwell and Carson (2005) suggest it is useful to discriminate broadly between processes for collaborative working (e.g. consultation) and the range of formal and informal groupings required to enable these processes to occur (e.g. Learning Alliance).

Why work together?

Whilst data on which to quantify the benefits of collaborative working is scarce (Slater et al., 2007;; Reed, 2008), there is overwhelming support for the approach across a range of sectors from health care provision to urban development and transport planning (Carnwell and Carson, 2005; Frantzeskaki et al., 2013, Genç and ÖykülIyigün, 2011). In reviewing the literature, a wide range of reasons for organisations and individuals working in partnership are cited; from being a mechanism to enhance democratic legitimacy (Pahl-Wostl et al., 2007) to the development of innovative policies which can be implemented with greater ease (van Herk et al., 2011). The EU WFD's guidance document on public participation (CIS, 2003) identifies the rationale for public participation as leading to improved decision-making by enabling decisions to be based on science, shared knowledge and experiences, enabling those affected by decisions to influence the decision-making process support the development and consideration of novel and innovative options and ensure that solutions adopted are workable and acceptable within national and local contexts.

Specific benefits of collaborative working identified include raising levels of public awareness onenvironmental issues, and making use of knowledge and expertise of a wide range of stakeholders thus improving the quality and creativity of plans and measures adopted. It is stated that collaborative working approaches generate solutions which have higher levels of public acceptance, commitment and support, decreasing levels of litigation, and misunderstandings, and hence fewer delays and more effective implementation of agreed measures (CIS, 2003). Working collaboratively can facilitate the breakdown of legislative and institutional barriers to implementing change and provide a more consistent, comprehensive approach which makes the best use of available resources in a coordinated and cost-effective way.

Table 3.6.1 Overview of descriptors commonly used to describe various aspects of collaborative working

Descriptors	Term	Definition
Common descriptors for groupings	Stakeholders	Individuals who have something at stake e.g. are impacted by or have influence on the decision being taken.
	Collaboration	A bond, union or partnership, characterised by mutual goals and commitments' (Carnwell and Carson, 2005)
	Partnership	A shared commitment, where all partners have a right and an obligation to participate and will be affected equally by the benefits and disadvantages arising from the partnership (Carnwell and Carson, 2005)
	Learning Alliance	A group of individuals or organisations with a shared interest in innovation and the scaling up of innovation in a topic of mutual interest (Batchelor and Butterworth, 2008).
Common descriptors for processes	Information sharing	Provide public access to information on the decision-,making process (CIS, 2003)
	Stakeholder consultation	An activity which gives the public an opportunity to react to plans and proposals developed by the authorities. Consultation is used to gather information or opinions from those involved to develop solutions based on this knowledge. The process does not concede any share in decision-making, and professionals are under no formal obligation to take on board people's views (CIS, 2003)
	Active involvement / public participation	Stakeholders actively participate in the planning process by discussing issues and contributing to their solution. Essential to active involvement is the potential for participants to influence the process (CIS, 2003)
	Partnership working	A spectrum, ranging from informal networking forums, consulting and sharing information and intelligence, through formal strategic alliances where partners come together to achieve common goals by changing the way that they work (Rocket Science 2006)
	Social learning	Capacity building of individuals and organisations; seen as an alternative complimentary policy instrument in governance. Increases ability to handle uncertainty and change (van Herk et al., 2011)

Building and working in partnership

There is no single correct way to undertake collaborative working (CIS, 2003), with a variety of forms of partnership working in a number of ways. However, various authors have identified a generic 'elements of good practice'in public participation which are reported to facilitate successful working partnerships (van Herk et al., 2011; CIS, 2003; Reed et al., 2008). These include:

- Stakeholder participation should be considered as early as possible within and continue throughout the decision-making process
- Key stakeholders need to be identified, analysed and represented systematically
- The role of each partner is identified and clear to all partners
- The aim and objectives of the partnership are agreed among all stakeholders at the beginning of the process
- Methods for collaborative working and communication should be tailored to the decision-making context
- Highly skilled facilitation is essential to facilitate the development of a supportive atmosphere where suggestions, ideas and conflicts are addressed in a timely manner
- Local and scientific knowledge should be integrated

Morris (2006) identifies that key individuals – or local champions – are critical in the early stages of partnership building to both bring on board other partners and strengthen commitment to the process. As in many arenas of life, trust is hard won but easily lost; openness, good communication, equivalent status between partners, shared experience and transparency are all crucial components in building the patience and mutual trust required to enable new ways of working to be developed and implemented.

However, whilst striving to be inclusive, for practical reasons (e.g. time, space and availabilities constraints) it may not be feasible to include everybody with an interest in a particular field on all issues. In its guidance for public participation under the EU WFD, CIS (2003) also acknowledges that effective public participation does not necessarily require everybody to participate in all decisions. It recommends the use of stakeholder analysis to evaluate potential partners against a range of locally pertinent criteria such as the relation of the stakeholder to the issue concerned, the scale and context at which the stakeholder acts, who they represent (e.g. regulator, user, etc.), their capacity for engagement and their political, social and wider environmental context.

Based on the above discussions, the following section sets-out the key stages in building a successful partnership:

- Establish the decision-making context e.g. issue to be addressed
- Undertake a stakeholder analysis to identify key stakeholders
- Invite key stakeholders to a meeting and evaluate the need for further stakeholder involvement
- As a partnership, collaboratively identify aims and objectives for the partnership
- Ensure partners are committed, willing and have required resources
- Develop partnership terms of reference which clarify:
    - the roles and remits of all stakeholders,
    - working structures and practices including arrangements for sharing information and monitoring and review of activities undertaken
- available resources
- Start work!
- Review, evaluate and use information generated to enhance working processes

An EU case study of partnership working in practice: Reducing water consumption in the graphics corporate sector, Denmark (taken from CIS, 2003)

With an overall aim of reducing their environmental impacts, the Graphics Business Sector Association, graphics companies and the Danish Environmental Protection Agency (EPA) developed a partnership to work proactively towards reducing water consumption within the graphics sector. Partnership activities focused around selected companies undertaking demonstration actives (involving testing the use of new equipment) and the sharing of new knowledge and results generated. Demonstration equipment was purchased using project finances, with partners providing co-financing in terms of allocation of staff time to work on demonstration activities. The partnership is reported to have successfully addressed several challenges commonly identified as barriers to changing

practice including working collaboratively with competitors (e.g. information on environmental problems and related improvement opportunities disseminated through business and Danish EPA networks), lack of interest / motivation of companies to improve environmental performance (i.e. awareness raising of potential incentives) and lack of access to financing (e.g. combination of project and co-financing to buy and test new equipment). Benefits cited include a 70-90% reduction in water consumption and the development of a positive attitude by a business sector towards implementing cleaner practices. Further benefits include the generation of robust data on feasibility and incentive measures that policy makers can use in the further development of environmental regulations, supporting the development of regulation that is workable within the sector's current operating parameters. The initial project funding made from the government budget was later saved in terms of reduced costs for wastewater treatment plant operators.

Conclusion

Collaborative working is recognised as a key component of the development and implementation of a sustainable economy, leading to its inclusion as a specific requirement within a diversity of European, national and local legislations covering water management from a variety of perspectives. With regard to the water cycle, all 7.2 billion people on planet earth are stakeholders i.e. we all rely on, can influence and be impacted by water resources. Hence, we should all be involved in decisions taken on how to manage this essential and finite resource. With so many stakeholders to consider, water cycle management falls under the definition of a 'wicked problem'; extraordinary, complex problems where decisions taken within one part of the cycle may create new problems elsewhere in the cycle. When facing such complex issues, it is clear that no one individual, organisation or sector has the knowledge or skills to tackle a challenge of this magnitude. It is within this context that collaborative working offers real scope to support us all in moving towards developing and implementing an integrated approach to water cycle management.

3.7 Project and Management skills

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Introduction

This sub-chapter will address the skills necessary for the successful management of your working environment in general. It will then focus more specifically on the skills required for the development of a successful research project such as that required to be completed within a Masters programme.

Soft skills

Soft skills are defined as personality traits appropriate to the workplace –personal attributes that enhance an individual's interactions, job performance and career prospects. These could be, for example, conflict resolution, negotiation skills, personal effectiveness and persuasiveness, creative problem solving, strategic thinking, team building and/or marketing skills.

Such skills can be remembered by the acronym - OCEAN - which allow an individual to control both their own emotions and those of others by being:

- Open
- Conscientious
- Extrovert
- Agreeable
- Neurotic (in the sense of managing one's own and another's anxiety to become more productive)

In short, the acquisition of these attributes creates 'fluid intelligence' which is the capacity to think logically and to solve problems in novel situations, independent of learned knowledge in a chosen discipline. It requires the development and application of a new non-scientific vocabulary. These skill and interaction are described in figure 3.7.1:

Management in the business Environment

Approaches to business practices

Business practices in the past were developed at a time when it was important to increase manufacturing output. Therefore those who were

technically trained, concentrated on the many challenges of addressing problems in the industry including compliance with government directives and working within a limited budget. There was little time to address relationships with colleagues or indeed consider how to reassure the population with positive information about improvements. The benefit to the organisation was emphatically more important than the benefit to the individual.

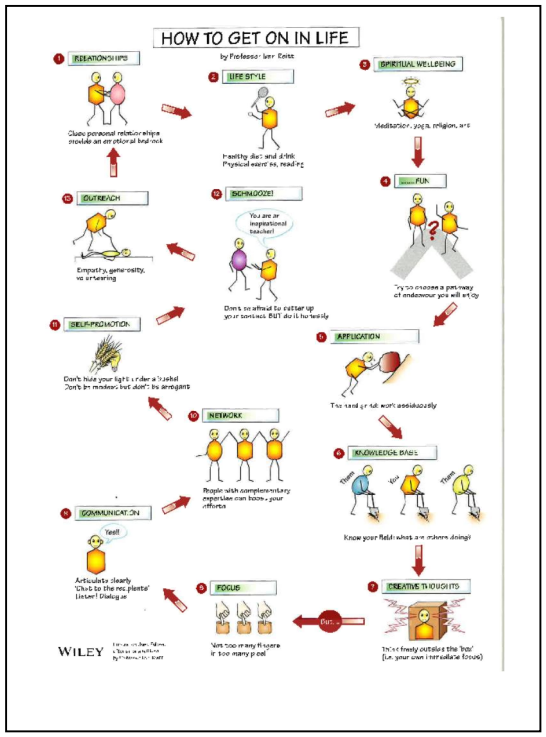


Figure 3.7.1 How to develop and use 'soft skills'. Presented with the permission of Professor Ivan Roitt. Middlesex University

Recently there has been a breakthrough in understanding that business skills require a strong ability to work with all sections of the population, as well as internationally, and that there should not be a narrow focus on technical achievements. Although there is resistance to a multi-disciplinary approach, businesses are interested in practical as well as technical skills especially if these can be expressed with English language competence.

Corporate best practice

Given that soft skills are a necessary part of everyday business interactions, It is important that learning such behavioural skills or 'people skills' is introduce to training courses thus enabling professionals to interact purposefully and effectively with colleagues and customers. This forms an important part of an individual's contribution to the success of an organisation especially those who are customer-facing and sales driven and can yield a significant return for an organisation, especially one that wishes to grow internationally.

The results of this training will produce more modern, reliable, motivated and harder working employees and counter unhelpful behaviour and entrenched attitudes in the workplace and will enable easier interaction with other international businesses who recognise and value such skills.

Whilst it is acknowledged that most employees will have been trained to the required standard of functional expertise, soft skills will transform an employee in the following ways:

a) strong work ethic
b) positive attitude
c) clear communications
d) time management
e) problem solving
f) acting as a team player
g) self confidence
h) ability to learn from criticism
i) flexibility and adaptability to new situations
j) working well under pressure
k) ability to manage conflict by negotiation

Research and project management skills

The Research Project forms a major part of an MSc programme and this section is designed to help you to select the topic of your project, define you research question(s)/ hypothesis(es)[9] design your research, select your research tools and understand the issues involved in the execution and management of a research project.

The Basis of Good Research

A good research project should start by asking a series of question as identified in the following table:

- A research question identifies a knowledge deficit in a subject area and will define the methodology chosen for a research project A study may set out to answer a number of research questions.
- A hypothesis is a statement which emerges from a research question and refers to a relationship between two or more variables.

Why?	Why am I doing this project? What is the context? What is the rational?
What?	What are the aims of the project? What are the objectives? What are the ethical issues related to the context and the research questions?
How?	What is the methodology: 1. Quantitative 2. Qualitative Where will I get the information (literature review, experimental)? What are the methods to be used for data collection (analytical, survey, interview, observation)? What are the methods to be use for data analysis? What are the ethical issues related to the methodology used?
Who?	Who should provide me with 1. Supervision 2. Permission/ access 3. Ethical permission 4. Risk assessment
How long?	What timescale?

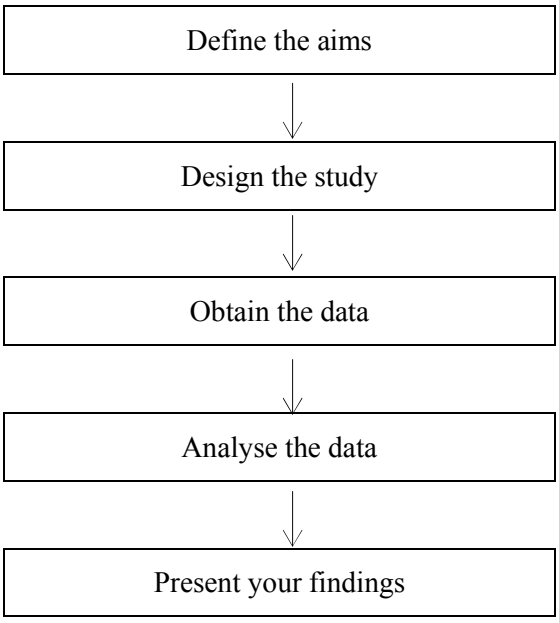
The project design therefore should include the following features:

- it should be about a well-defined topic, acceptable to both academic institutions and professionals in the field of practice;
- it should involve novel ideas, an openness to review and include constructive criticism of research undertaken to-date, and contain analytical components;
- it should be focussed and not too general – remember you have limited time and resources;
- it should always be designed in advance – the research aims must be determined first and then an appropriate methodology selected to meet them. For example, it is never correct to carry out an experiment and then look for ways of analysing the data – experiments should be designed to match a well-justified data analysis plan.

The stages that make up any empirical investigation are summarised in Figure 3.7.2.

We noted above the importance of designing the study in advance. Here, then, we shall consider in more detail the work that needs to go into research before its commencement.

Figure 3.7.2 Stages in an empirical investigation



Defining the aims of the investigation

This means choosing the general area of the research, and then determining the specific research question(s) and hypotheses that you wish to investigate. These issues need to be decided at the very beginning of the investigation.

The starting point must be defining the broad subject area – for example, air pollution, land contamination (biological), land contamination (chemical), etc., or even a sub-theme within them such as acid deposition/effects or agricultural runoff. Identifying the broad subject area is important as you need to locate the specific topic of the research in its academic and, if appropriate, practical context. This provides the framework within which the topic of interest is situated, and you will have to map this framework as part of a literature review.

Before drawing up the specific questions and hypotheses which the research will address, you will need to do some preliminary investigation. There are two aspects to this:

- Specifying the nature of the topic, as derived from a review of the current literature and the development of an analytical framework within which your consideration of the research question(s) will be set; and
- Identifying what it is you anticipate achieving through the investigation – your project aims.

You need to give careful consideration to both these aspects before finalising the way in which you express the questions/hypotheses. The form of expression is most important in that it must be absolutely clear what you are going to investigate and what you hope to achieve as a result of the research.

The aims also need to be defined as precisely as possible because they condition the approach to the collection and analysis of data, as we shall see below. Note, then, that they must be defined before the specification of the form of the study – otherwise you may find that the design of your study does not allow you to answer the research questions, or that you have not obtained all the relevant data.

Designing the study

The design of the study must be determined by the need to generate data appropriate to the investigation of the research question(s). It must also be realistic in terms of being an achievable body of work in the timescale and budget available.

There are three aspects to this.

Nature of required data and its sources

You need to identify clearly what data will be required in order to meet your project aims and from where you are going to obtain it.

The conclusions that can be drawn from the study will depend on the amount and quality of the data which are obtained. It is, therefore, important to decide what needs to be measured or observed, the total number of measurements to be made (sample size), etc.

Methodology for data collection

You need to identify the particular approach to collecting the data necessary for your project aims and how you are going to carry out the study. A general classification of research strategy is into experiments and observational studies and these forms of study are considered in detail in the next study unit.

The size of the investigation (for example, the number of measurements to be taken or the number of people to be interviewed, and the complexity of any experiment or questionnaire) will depend on the resources available for its completion as well as on its aims. It is important to consider whether the investigation is worthwhile, and to balance the cost of carrying it out against the desired level of precision of the results.

Approach to data analysis

Having collected the data, you will need to analyse it in relation to the research questions/hypotheses. In terms of the design of the study, you need to be aware of the general approach that you intend to take and how this will yield the results that you need to meet your project aims.

It is important to test your design by carrying out a pilot study. This should cover all aspects of the study – we consider the role of pilots for questionnaire surveys in the next unit, but the use of measuring equipment and other technical methods of data collection should also be checked. You should also ensure that you will be able to

analyse the data as intended. If any problems are found, changes will have to be made to the design, or possibly even to the aims of the study.

Project management

You need to treat research just like any project at work or in other parts of your life. It needs to be approached systematically and you need to develop a practical plan for the whole investigation – preliminary groundwork, the proposal, the study itself, and the analysis and presentation of results. You will need to give this careful consideration and identify exactly what is involved in carrying out the research for the project, how long each aspect is going to take and what this means for the final completion date. You should split the work into logical steps – for example, when the research will commence and finish, the study itself, the analysis phase, drafting and then finalising the project report – and set out intermediate targets for completing each.

The final presentation date should be seen as a fixed target.

You need to think ahead and start to identify what needs to be done in order to achieve each of these targets, when you need to do things by and what you need to have done before you can do the next thing – for example, obtaining access to particular facilities or preparing for conducting an interview. Clearly, you will not be able to do this in very much detail at first, but as you progress with the work, it will become increasingly evident what is involved in the next stage.

It is, then, an on-going process of reviewing where you are and identifying what needs to be done in the future in order to keep making progress towards the major goals identified in your plan.

Putting a timetable to this overall plan of work is also difficult at an early stage, but will be clearer as you progress. You may find it useful to identify some very broad targets in respect of key goals as follows:

- when to start your literature review;
- a provisional date for completing the research proposal; and
- a provisional date for completing the final report.

This provides the first basis for outlining a timetable, which can then be developed into more detail with specific tasks related to goals.

The essence of time management is the drawing up of written plans as a way of forward planning, organising the work and maintaining control over its progression. In developing your plans, bear in mind the following points:

- write down your goals and what you need to do to achieve them – and keep this under review to ensure that you always have a clear idea of the tasks involved, as far as you can see at any particular time;
- divide your time into manageable sections organised around, firstly, your main project goals and then, as you progress with the work, sub-goals and particular tasks – for example, plan when you want to complete your project proposal and then divide that time into sections for reading, analysis, writing up, etc.;
- use monthly and weekly schedules to organise your work and review progress;
- build in some contingency time – research can often take longer than you think and you may need some leeway to allow for over runs (for example, because you cannot access laboratory facilities at the time you anticipated, or a key person to see is ill when you had planned to see them);
- as far as possible, stick to your schedule – but do not be afraid of revising it as circumstances change;
- make sure that you put aside time for yourself – it is important to keep your approach to the project fresh and the best way to achieve this is to give yourself time away from it as well as time working on it. Part of this might be to give yourself rewards for meeting certain targets or achieving major goals – something to look forward to when a particular body of work has been completed.

Note, though, that time management is not something to be perfected for its own sake. Do not get bogged down in complex, sophisticated schedules which mean you lose sight of what you are trying to achieve. Time management plans are a tool to help you get the work done. Make them work for you, rather than becoming their slave and spending more time on the plans than you do on the research!

The sample research plans which follow are provided as examples of the way in which plans may be drawn up.

Examples of project timetable presentations

Activity	December 2012	January 2013	February 2013	March 2013	April 2013	May 2013
Literature review and definition of project aims.	x	x				
Obtaining ethical approval and access		x				
Data collection		x	x	x		
Data analysis			x	x	x	
Draft report				x	x	
Final report					x	x
Presentation and *Viva voce*						x

Task	*Date*
Literature search, reading and definition of research questions and project aims	***Oct 2012- Feb 2013***
Water sampling	***14/01/13-18/01/13***
Sample handling, preparation and analysis	***Jan 2013-Feb 2013***
Write-up and chapter corrections	***Apr 2013-May 2014***
Editing and Printing	***May 2014***
Submission of Thesis	***15 May 2014***

Planning fieldwork

Wherever you plan to carry out fieldwork, it is essential that you obtain written consent for access to any sites for the duration of your study. In the first instance, you should seek access from the Chief Executive/Senior Manager of the company/companies owning and/or operating at the location. You need to seek not only access/approval for the study, but also the name of an appropriate individual with whom you should liase with during site visits if any issues arise.

Remember that when you are engaged in fieldwork, you are a representative both of your profession and of your University. At all times you must act in accordance with professional and University regulations.

The following **checklist** identifies the most important considerations:

- ✓ Ensure that you have the necessary ethical approval and access clearance documented before you commence your fieldwork
- ✓ Be rigorous about ensuring that you have informed consent
- ✓ Adhere to health and safety and security regulations in the area of your fieldwork
- ✓ Respect the property of both individuals and organisations
- ✓ Always carry identification with you, and be prepared to show this on request
- ✓ When you have made appointments with people in the course of your fieldwork, be punctual – you may have to wait, but you should not make others do so
- ✓ When an individual or organisation has been particularly helpful, a letter of acknowledgement on completion of your fieldwork will be appreciated
- ✓ Maintain the confidentiality and security of your data during collection, transport and storage

3.8 Learning for the Future: Competences in Education for Sustainable Development

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Introduction

This Textbook chapter is devoted to the development of skills and competencies of the faculty of universities, institutes and colleges in Kazakhstan, working in the field of sustainable development, namely, - on water resources and water management issues, as well as coaches, trainers and experts from international and non-governmental organizations working for environmental education and education for sustainable development (ESD).

Modern Kazakhstan desperately needs qualified educators: teachers, experts and trainers who have advanced knowledge, skills and competences in and for sustainable development. The lack of qualified educators can be a serious barrier to the successful implementation of the "Concept of Green Economy" in Kazakhstan and to integrate green development approaches and principles into everyday teaching – learning processes, behaviour and daily life of Kazakhstani society.

The United Nations Economic Commission for Europe (UNECE) Strategy for ESD was adopted by ministers and other officials from Education and Environment Ministries from across the UNECE region at their joint High Level meeting. The meeting also launched the United Nations Decade of ESD in the region (2005-2014).

"**The Strategy's overall objective** is to equip people with knowledge of and skills in sustainable development, making them more competent and confident while at the same time increasing their opportunities for leading healthy and productive lifestyles in harmony with nature and with concern for social values, gender equity and cultural diversity" *(UNECE, 2005).*

"Sustainable development is described by the UNECE Strategy for Education for Sustainable Development as being underpinned by an ethic of solidarity, equality and mutual respect among people, countries, cultures and generations; it is development in harmony with nature, meeting the needs of the present generation without compromising the ability of future generations to meet their own needs. The definition of sustainable development is consistent with both the United Nations Declaration on the Right to Development, as set out in General Assembly resolution 41/128 of 4 December 1986, and the Rio Declaration on Environment and Development" *(United Nations, 1992).*

"Key themes of sustainable development include among other things poverty alleviation, citizenship, peace, ethics, responsibility in local and global contexts, democracy and governance, justice, security, human rights, health, gender equity, cultural diversity, rural and urban development, economy, production and consumption patterns, corporate responsibility, environmental protection, natural resource management and biological and landscape diversity" *(UNECE, 2005).*

Education, in addition to being a human right, is a prerequisite for achieving sustainable development and an essential tool for good governance, informed decision-making and the promotion of democracy. Therefore, education for sustainable development can help translate our vision into reality. ESD develops and strengthens the capacity of individuals, groups, communities, organizations and countries to make judgments and choices in favour of sustainable development. It can promote a shift in people's mindsets and in so doing enable them to make our world safer, healthier and more prosperous, thereby improving the quality of life. Education for sustainable development can provide critical reflection and greater awareness and empowerment so that new visions and concepts can be explored and new methods and tools developed *(UNECE, 2005).*

Objectives

Kazakhstan as well as other Central Asian (CA) countries - Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan is united by common natural ecosystems: mountains and glaciers, transboundary water sources, shared cultural roots and deep links at the ethnic and political levels. Following the break-up of the Soviet Union in 1991 and subsequent independence, CA countries have faced the challenges of political transition coupled with the transition to market-based economy. This has impacted greatly on the ability of the countries to tackle sustainable development issues including the social issues - education, culture, values, etc. New time and new approaches

require new development of qualified personnel in general and educators personally. Today lack of knowledge, skills and competences of educators for sustainable development in schools, colleges, universities is one of the main challenges in Kazakhstan and widely in CA.

In XXI century the world faced new challenges of climate change, lack of water, energy and food, low level of literacy. A level of education of a society shows a level of the society development. This is why a proper understanding of a role of education in a society becomes a crucial theme in education systems in many countries. People come back to national traditions, values, environmentally-friendly way of thinking, behaviour, and decision-making. The UNESCO principles: learning together, learning from each other, learning by doing, learning for a better future – become slogans for many schools, universities and societies.

While implementing ESD, the following areas should be addressed: improving basic education, reorienting education towards sustainable development, increasing public awareness and promoting training. The development of a sustainable society should be seen as a continuous process of learning and change, involving a variety of actors providing guidance and leadership in formal, non-formal and informal learning. This requires a corresponding enhancement in the competences of educators, leaders and decision makers at all levels of education.

So this textbook chapter's objective is to promote the educators' competences in ESD widely in Kazakhstan and describe in depth their role in learning process in universities as key higher education's institutions, as well as to motivate teachers and students of Kazakhstani universities to implement the competences in ESD in their behaviours, daily practices, decision-making processes and life.

Materials, methods, results and discussions

Kazakhstan and other CA countries, due to their geopolitical location, have a unique opportunity to take part in the processes of environmental protection and sustainable development in both the European and Asian-Pacific regions. Participation in the ESD processes in both regions provides the CA countries with a chance to study the best experiences of its partners, exchange by best practices and compare priorities. In addition, the CA sub region can implement the most appropriate practices while taking into consideration the national conditions, priorities and needs.

CA and other UNECE Environment and Education Ministries had recognized at the Belgrade "Environment for Europe" Ministerial Conference in 2007 that competences of educators were a frequent bottleneck in achieving ESD. Hence, the lack of educator competences often hinders learners to acquire the values, skills and knowledge that empower them to contribute to sustainable development and take informed decisions and responsible actions for environmental integrity, economic viability, and a just society for present and future generations.

In response to this concern the UNECE Expert Group on Competences in ESD was established under the UNECE Strategy for ESD in 2009. The Group developed a framework of core competences for educators. The framework is intended as a guide to what educators should know, what they should be able to do, how they should live and work with others, and how they should be if they are to contribute to ESD. The competences are clustered around three essential characteristics of ESD - a holistic approach; envisioning change; and achieving transformation.

The Expert Group on Competences in Education for Sustainable Development received the mandate to prepare:

a) General recommendations for policy-makers, so as to provide them with a tool to integrate ESD into relevant policy documents with a view to creating an enabling the environment for the development of competences across all sectors of education, with particular emphasis on formal education;
b) A range of core competences in ESD for educators, including their definition as feasible, to serve as a tool to facilitate the integration of ESD into all educational programmes at all levels, as well as guidelines for the development of these competences among educators.

The Expert Group comprised representatives appointed by member States and partners from across the UNECE region. They included academics, Government officials and experts from international and non-governmental organizations.

The Expert Group took into account diverse local, national, sub-regional and regional circumstances, as well as the global context, and sought to ensure that recommendations were framed in ways that reflected the diversity of the UNECE region.

Recommendations for policymakers (scope)

The policy recommendations are to be addressed at five levels: international, regional, national, subnational and organizational. These recommendations for policy makers highlight the key points for action, namely professional development in education, governing and managing of institutions, curriculum development and monitoring and assessment. Although these recommendations address Competences for educators across formal and non-formal education, as well as informal learning, they pay particular attention to formal education, in line with the mandate. These recommendations address all key aspects of education systems, but only insofar as they may have a direct impact on the Competences.

Recommendations for the professional development in education

Empowering educators must be central to any professional development initiative.

Educators are important agents for change within education systems. Effective educational transformation is dependent upon educators being motivated to bring about change, as well as being capable of and supported in doing so.

Provide training and education in ESD for those in management and leadership positions in educational institutions.

Leadership and management are key determinants of success in educational transformation at the institutional level.

Continuing professional development for educators underpinned by the Competences should be provided.

Practicing educators also need an opportunity to develop the Competences if the system is to be transformed, such as through critically reflective practice.

Particular attention should be paid to developing the Competences among educators who work in higher education.

Institutions of higher education play a crucial role in preparing future leaders and specialists in a variety of fields, including education. A prerequisite is the respecting the contribution of academic freedom to knowledge generation.

The Competences

This section describes the core competences in ESD for educators as required by the mandate of the Expert Group. The Competences in this document relate specifically to ESD rather than to education more generally. The Competences are presented in this document in a table followed by more detailed explanations. The column headings represent essential characteristics of ESD, namely:

a) *Holistic approach*, which seeks integrative thinking and practice;
b) *Envisioning change*, which explores alternative futures, learns from the past and inspires engagement in the present; and
c) *Achieving transformation*, which serves to change in the way people learn and in the systems that support learning.

The clustering of competences in the table rows is inspired by the report of the International Commission on Education to UNESCO. The following framework was chosen as it is comprehensive and presents a meaningful set of categories that reflect a wide range of learning experiences:

a) Learning to know refers to understanding the challenges facing society both locally and globally and the potential role of educators and learners (*The educator understands....)*;
b) Learning to do refers to developing practical skills and action competence in relation to education for sustainable development *(The educator is able to....);*
c) Learning to live together contributes to the development of partnerships and an appreciation of interdependence, pluralism, mutual understanding and peace *(The educator works with others in ways that....);*
d) Learning to be addresses the development of one's personal attributes and ability to act with greater autonomy, judgment and personal responsibility in relation to

sustainable development (*The educator is someone who....).*

The competences for educators in education for sustainable development are summarized in the table below.

Conclusion

The competences in ESD described in this document are those of educators and not of learners, although both are intricately related. They go beyond the competences that individual educators would have in order to provide a good quality education in their discipline. This set of competences is not a "minimum standard" to be met by all educators, but rather a goal to which all educators should aspire. It is not intended to prescribe behavioural outcomes; it provides a framework for the professional development of educators and is of particular importance to individuals, groups and institutions that have a multiplier effect, such as educators of educators *(UNECE, 2011).*

"... the model of development that is evident across the globe is unsustainable. We are faced with the urgent need to recast our ways of living, away from ones that rely on the unsustainable consumption of resources, the degradation of ecosystems and the exploitation of people, towards a model that strives to enhance the well-being of all human beings within the limits of our planet" *(UNECE, 2011).*

The UNECE Strategy for ESD makes clear that ESD takes place in formal, non-formal and informal settings. While the document emphasizes formal education, the competences identify the knowledge and abilities of all educators, including, but not limited to, teachers. Education happens not only through formal learning and teaching, but also through facilitation and support of non-formal educators who operate in informal and social contexts. Many educators do not carry the title of "teacher".

The document was prepared by the UNECE Expert Group on Competences for ESD and published with the support of the Dutch Government.

Table 3.8.1 Competences for educators in education for Sustainable Development

	HOLISTIC APPROACH ***Integrative thinking and practice***	***ENVISIONING CHANGE*** ***Past, present and future***	***ACHIEVING TRANSFORMATION*** ***People, pedagogy and education systems***
Learning to know *The educator understands....*	• the basics of systems thinking • ways in which natural, social and economic systems function and how they may be interrelated • the interdependent nature of relationships within the present generation and between generations, as well as those between rich and poor and between humans and nature • their personal world view and cultural assumptions and seek to understand those of others • the connection between sustainable futures and the way we think, live and work • their own thinking and action in relation to sustainable development	• the root causes of unsustainable development • that sustainable development is an evolving concept • the urgent need for change from unsustainable practices towards advancing quality of life, equity, solidarity, and environmental sustainability • the importance of problem setting, critical reflection, visioning and creative thinking in planning the future and effecting change • the importance of preparedness for the unforeseen and a precautionary approach • the importance of scientific evidence in supporting sustainable development	• why there is a need to transform the education systems that support learning • why there is a need to transform the way we educate/learn • why it is important to prepare learners to meet new challenges • the importance of building on the experience of learners as a basis for transformation • how engagement in real world issues enhances learning outcomes and helps learners to make a difference in practice
Learning to do *The educator is able to...*	• create opportunities for sharing ideas and experiences from different disciplines/places/cultures/generations without prejudice and preconceptions • work with different perspectives on dilemmas, issues, tensions and conflicts • connect the learner to their local and global spheres of influence	• critically assess processes of change in society and envision sustainable futures • communicate a sense of urgency for change and inspire hope • facilitate the evaluation of potential consequences of different decisions and actions • use the natural, social and built environment, including their own institution, as a context and source of learning	• facilitate participatory and learner-centred education that develops critical thinking and active citizenship • assess learning outcomes in terms of changes and achievements in relation to sustainable development
Learning to live together *The educator works with others in ways that....*	• Actively engage different groups across generations, cultures, places and disciplines	• Facilitate the emergence of new worldviews that address sustainable development • Encourage negotiation of alternative futures	• challenge unsustainable practices across educational systems, including at the institutional level • help learners clarify their own and others worldviews through dialogue, and recognize that alternative frameworks exist
Learning to be *The educator is someone who....*	• Is inclusive of different disciplines, cultures and perspectives, including indigenous knowledge and worldviews	• Is motivated to make a positive contribution to other people and their social and natural environment, locally and globally • Is willing to take considered action even in situations of uncertainty	• is willing to challenge assumptions underlying unsustainable practice • is a facilitator and participant in the learning process • is a critically reflective practitioner • inspires creativity and innovation • engages with learners in ways that build positive relationships

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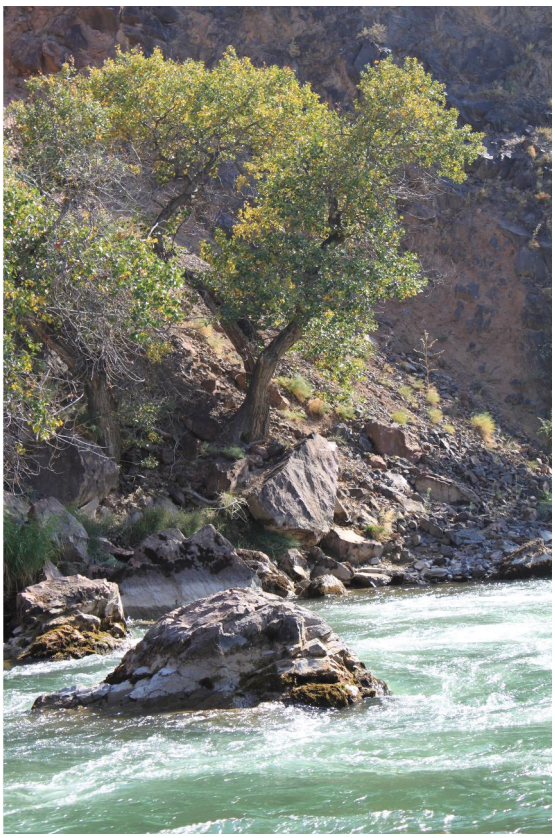

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