



PART II DSS CONCEPTUAL DESIGN

ANNEX A: Requirements Assessment – Stakeholder Consultations



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Table of Content

1	Introduction	137
2	Definition of Terms and Concepts.....	138
3	Rationale and Methodology of the Consultation Process.....	140
3.1	Understanding of What Is Required	140
3.2	General Consultation Workshop Programme and Process.....	142
3.2.1	Working Session 1: Presentations 1 and 2.....	142
3.2.2	Working Session 2: Group Work: Selection and Clustering of Specific Concerns	143
3.2.3	Working Session 3 Group Work: Ranking of Concerns	144
3.2.4	Working Session 4: Group Work: Objectives, Criteria and Indicators etc.....	145
3.2.5	Working Session 5: Group Work: Models/Tools and Data	145
3.2.6	Working Session 6: Group Work: Institutional Arrangements.....	146
3.2.7	Working Session 7: Workshop Conclusions	146
3.2.8	Workshop Summary Outline	146
4	Analysis and Results	147
4.1	Executive Summary	147
4.2	Analysis	147
4.2.1	Identification and Ranking of the Specific Concerns	147
4.2.2	General Analysis of the Ranking Results.....	154
4.2.3	Analysis of the Ranking Results by NBI Theme	155
4.2.4	Analysis of the Workshop Results by Country and Sub-Region.....	162
4.2.5	Thematic Emphases at the Sub-Regional Level.....	163
4.2.6	Results from the Eastern Nile Sub-Regional Workshop	163
4.3	Results	165
4.3.1	From Ranking Results to the Identification of DSS Requirements	165
4.3.2	Step 1 - Identification and Clustering of the Specific Transboundary Concerns	166
4.3.3	Step 2 - Identification of Complementary or Otherwise Significant Specific Concerns	166
4.3.4	Specific Concerns Clustered into Areas of Concern.....	168
4.3.5	Comparison with Ongoing ENSAP and NELSAP Action Projects and Programmes	169
4.4	Areas of Concern, Sample Decisions and the DSS Outputs Suggested by them.....	178

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Acronyms

BOD	Biological Oxygen Demand
DSS	Decision Support system
EN Region	Eastern Nile Region
IWRM	Integrated Water Resource Management
NB	Nile Basin
NBI	Nile Basin Initiative
NEL Region	Nile Equatorial Lakes Region
SAP	Subsidiary Action Program
SVP	Shared Vision Program

1 Introduction

The purpose of this Annex is to describe the consultation process adopted by the consultant for the sub-regional and national stakeholder consultation workshops undertaken in November and December 2007 as a crucial component of the second, or analytical stage of the DSS conceptual design.

It continues in Chapter 2, with definitions of important concepts and terms adopted by the Consultant for reasons of consistency.

Chapter 3 presents an outline of the consultation rationale as suggested by the Terms of Reference and understood by the Consultant. The chapter includes a detailed account of the workshop process in terms of both process and the outputs achieved by it at important workshop milestones. The Chapter closes with a table comprising a generalised workshop agenda which identifies which sessions were used at the sub-regional and which at the national workshops.

Chapter 4 has three parts. The first describes how the specific water resource management and development concerns emanating from the consultation process were analysed and used, ex-post the 2nd Regional Workshop (Entebbe 28/29 January 2008), to specify overall “areas of concern”. The second suggests, very concisely, sample decisions that relate to the “areas of concern” and the outputs that the DSS needs to provide in order to support the decision makers in their regard. The third simply presents the training needs assessment results (also obtained from the consultation workshops).

2 Definition of Terms and Concepts

The consultation process described below required a consistent understanding of terms such as objectives, criteria, outputs and the like. Yet these often prove difficult to craft by untrained stakeholders and can be ambiguous or mean different things to different people. Accordingly, it was necessary to fix the definitions of these terms for use throughout the consultative process.

The results are set out, with supporting examples, in the following table:

Term	Short definition (NBI-DSS context)	Example 1	Example 2
Concern	Issue, domain of decision making for which the DSS shall provide support, as defined through stakeholder consultations	Floods and droughts	Irrigation
Objective	Goal of the decision making process, expressed in terms of criteria to be maximised or minimised	Minimize loss of lives and livelihoods due to flooding	Maximise agricultural production Maximise efficiency of water use
Intervention	Set of actions aimed at addressing the concern; an Intervention comprises several possible Alternatives.	Investment in flood defence works and/or land use management	Expansion of irrigated area
Alternatives	A possible strategy (in terms of specific actions within an intervention) available to the decision-maker to achieve (or move towards) the Objective(s)	1. Flood defence walls 2. Attenuation dams 3. Land use management Implies specific values for the above (location, dimensions, material...)	1. Sprinkler irrigation 2. Surface irrigation 3. Drip irrigation Implies specific values for the above (area, lining of channels...)
Output	Performance of the system to a specific decision (Alternative) in terms of criteria	Frequency and magnitude of losses due to flooding for a given Alternative	Increase of agricultural production and water use efficiency for a given Alternative
Externality	External influence not controlled by Nile Basin decision making processes	Increase of meteorological extremes due to climate change	Trends in global terms of trade that affect crop market prices and the opportunity cost of water
Criterion	Standard of judgement to evaluate the desirability of an Alternative in relation to an objective, to be fulfilled, maximised or minimised according to the decision-makers preference	Losses of life Material losses	Value of agricultural production increase Cost-benefit ratio for an investment Water productivity

Term	Short definition (NBI-DSS context)	Example 1	Example 2
Indicator	Indicators describe the state of the system to tell us to which extent the criteria are satisfied. Indicators can be measurable (quantitative) or descriptive (qualitative).	Probability and magnitude of losses: Number of times a certain threshold of flow is exceeded in a flood prone area for the simulation period; expected losses of life and material losses corresponding to this flow	Value of additional production expected (\$/year) Cost-benefit ratio Amount of water per 1000 calories required (m ³ /1000 calories)
Constraint	Requirement(s) or thresholds that must be met by any acceptable (feasible) solution	Probability of loss of human lives higher than once in 100 years unacceptable	Water productivity of less than 250 m ³ per 1000 calories not acceptable from a policy point of view

3 Rationale and Methodology of the Consultation Process

According to the Terms of Reference the consultation workshops are intended to:

.....focus on an analysis of key decisions to be supported, and the identification of functionality and outputs of the DSS to support these decisions.

This work package shall include the following tasks:

- *examine current and (projected) future processes and processes adopted for decision making on planning and management of water resources at regional (SVP) as well as sub-regional levels (SAPS)*
- *identify key overall decisions (policy/planning) that will be supported by the NB DSS*
- *identify specific decisions to be supported with respect to IWRM of the Nile basin water resources, focusing on the planning of sectoral projects such as*
 - *food production*
 - *energy production*
 - *navigation*
 - *watershed management*
 - *wetlands management*
 - *drought and flood management*
 - *etc*
- *this exercise shall result in clear identification of:*
 - *what the **outputs** of the DSS shall be (in order) to support investment planning*
 - *what **data/information** and **tools** the DSS needs (in order) to support the decisions etc*
- *identify a set of **core criteria and indicators** that will be used as performance measures in evaluating alternative investment/development options and hence the DSS has to deliver to support investment decisions – the indicators will have direct relevance to, and should be used to assess achievement of the NBI goals ie **to achieve sustainable socio-economic development through the equitable utilisation of, and benefit from the common Nile Basin resources** – indicators would be identified with respect to:*
 - *overall state of the system and performance in terms of water use conservation, efficiency¹, sustainability and loss management*
 - *sectoral benefits: irrigation/agriculture, hydropower, flood and drought risk reduction, navigation*
 - *trade-offs: inter-sectoral and inter-regional (country)*
 - *(equitable) distribution of benefits from planned projects*
 - *economic, social and environmental sustainability of the basin sub-systems*
 - *impacts on eco-systems*
 - *social impacts*
 - *resilience to external factors, such as climate change*

3.1 Understanding of What Is Required

The situation analysis carried out during stage 1 of the study identified a large list of specific concerns at the national and sub-regional levels. These were studied by Working Group 5 at the

¹ It is essential that efficiency is correctly defined for the scale at which is applied, ideally physical or application efficiency at point of use; economic efficiency at the basin level and various types of distribution efficiency in between.

1st Regional Workshop which consolidated the raw list into 42 specific concerns and suggested that they could be allocated to one or more of 11 thematic categories – Table 3.1 refers.

Table 3.1 Results from Working Group 5 at the 1st Regional Workshop

Thematic Categories (11)		Specific Concerns (42)	
Climate Change and Variability	Biodiversity conservation	Intra- and inter-annual fluctuation;	Social and cultural beliefs and norms
Environmental Management	Conflicts in water use (pastoralists etc)	Irrigation	Socio-Economic Targets
Fisheries Management	Coping with droughts and floods;	Lack of capital for investment	Soil/Bank erosion
Floods/Droughts Management	Declining water levels in lakes and rivers	Land use, Cover change, impacts on runoff	Tourism
Food security	Drainage of Marshlands for agriculture;	Monitoring for hydro- meteo forecasting	Use of carbon credit to finance power project
Hydropower Development and Power trade	Drought Prediction	Need for improved data collection and management for fisheries development	Water Quality - agro-chemical seepage
Navigation	Financing mechanisms	Need for Water Resources (S & GW, others) assessment	Water Quality - eutrophication
River basin monitoring and Water Resources Assessment	Flood Forecasting and Preparedness	Need to improve conservation to cope with CV e.g. through Rain water harvesting	Water Quality - pollution
Socio-Economic issues	Floods and Droughts	Optimal utilization of available water resources	Water Quality - salinisation
Water Conservation and Allocation	Food Security	Population structure/settlement patterns	Water resources availability
Water Shed Management	Improving and developing navigation potential	Poverty Reduction	Water supply and sanitation
	Inadequate tools for WR planning	Rain fed agriculture	Water use efficiency, demand management
	Increased energy demand	Sedimentation of hydraulic infrastructure	Watershed degradation (Destruction of natural forests),
	Increased flow variability ,	Sharing/exchange of real time data	Wetlands degradation

Based on all this; the mandate of the Workshop in question; the instructions of the Project Management Unit (endorsed by the workshop) and the terms of reference, it is the Consultant's understanding that the following was required.

First, the eleven “**Thematic Categories**” identified by Working Group 5 were to be reduced if possible, along with their supporting concerns, into a smaller number (within which the **Specific Concerns** requiring decision support can be cross referenced with sectors – see below) . Clearly the results should be consistent with the three themes suggested by the **NBI** goals:

- Theme 1** Society
Theme 2 Economy and
Theme 3 Natural Resources

However, for the purpose of DSS conceptual design and at the specific request of the Client, a fourth Theme was added thus:

Theme 4 Regional Collaboration

Since the **Thematic Categories** were essentially an Output of the Inception Phase and were effectively accepted by participants at the 1st Regional Workshop (subject to possible reduction as instructed) it was agreed with the Client that it would be neither necessary nor wise to open the subject to further consideration. Having converged on a consensual set of such categories, it would have been counterproductive to risk divergence during the analysis stage. This is particularly so given that it would be necessary to capture and consolidate possible divergences resulting from 11 consultative processes (nine country and two sub-regional workshops).

Based on all this, the Consultant concluded that the overall consultation workshop process should have seven working sessions involving between them:

- one introductory presentation about the NB DSS
 - five technical presentations:
 - three briefings to guide the break-out groups
 - five break-out group sessions.
- and
- nine plenum sessions

Opening and closing formalities were adapted in each case to suit local preference and practice.

However, although they followed the same overall logic, the sub-regional and national consultations differed slightly in scope and detail. The following section describes the overall process in detail and closes with a general workshop agenda which *inter-alia* indicates which of the steps were followed at the sub-regional and which at the national workshops.

3.2 General Consultation Workshop Programme and Process

3.2.1 Working Session 1: Presentations 1 and 2

3.2.1.1 Presentation 1: What is a DSS and what can it do?

This presentation revisited, built on and disseminated more widely, but in a simple fashion, the awareness raising message delivered in the training/awareness raising workshops that preceded the consultation workshops. In doing so, it highlighted the conceptual design under preparation by the Key Water Resource Modeller who was responsible for preparing the presentation material.

3.2.1.2 Presentation 2: Thematic Categories, Sectors and Specific Concerns

This presentation was intended:

- i) to remind participants of the NBI goal and the themes that it incorporates.
- ii) Explain the derivation of the two dimensional cross reference linkage matrix² having for its vertical axis the Thematic Categories (by now reduced to 10) and for its horizontal

² Which was the approach agreed at the 1st Regional Workshop

- axes, the sectors. The specific cell, or cells in which participants place a Specific Concerns is relevant to the data capture as will be made clear in sub-section 3.2.2 below.
- iii) Introduce the participants to the concept of the Specific concern and explain how they had been reduced from the 42 considered necessary to carry over into this Analytical Stage by the participants at the 1st Regional Workshop to 31 for analytical purposes
- iv) Guide participants in the selection, clustering and ranking of the Specific concerns relevant to the participants' constituency (sub-regional or national)

Figure 3.1 Conceptual Hierarchy

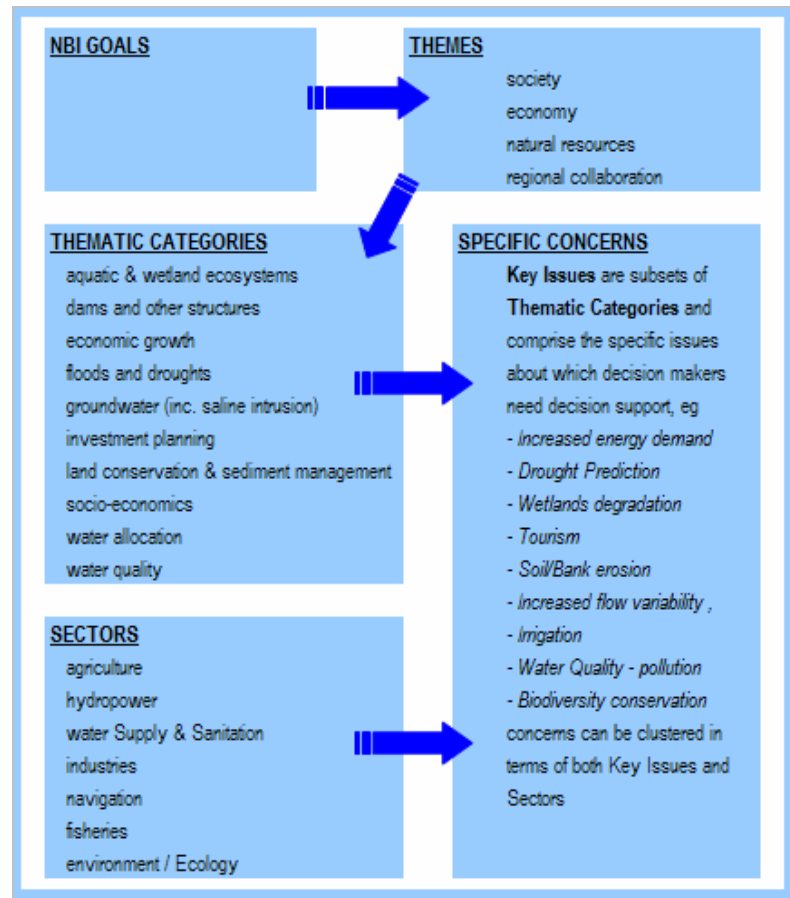


Figure 3.1 refers to the conceptual hierarchy. It specifies the 10 Thematic Categories (vertical axis of the cross reference linkage matrix) and seven Sectors (horizontal).

3.2.2 Working Session 2: Group Work: Selection and Clustering of Specific Concerns

After a plenum briefing the participants were divided into break out groups each of which was provided with the set of the 31 Specific Concerns developed by the consultant from from the 1st Regional Workshop – see Table 3.2. Each group was required to select (ideally) between 10 and 12 of the 31 Specific Concerns that they felt were most relevant to their interests (national or sub-regional as appropriate) and to allocate them to one (or more) cells in the cross reference linkage matrix.

When they had finished doing this, the plenum was reconvened whereupon spokespersons from each break-out group presented their group's results. Specific Concerns thereby selected were then scored based on the number of time that they had been selected. Then, by means of a facilitated plenum discussion, a final list of 10 to 12 Specific Concerns was compiled. This usually meant that the Concerns selected by each of the working groups were automatically included, with the remainder selected by consensus from the lower scoring Concerns.

Table 3.2 Specific Concerns Carried Forward from the 1st Regional Workshop

Biodiversity conservation	Increased energy demand	Rain fed agriculture	Water Quality - pollution
Conflicts in water use (pastoralists etc)	Increased flow variability	Sedimentation of hydraulic infrastructure	Water Quality - salinisation
Coping with droughts and floods;	Intra- and inter-annual fluctuation;	Sharing/exchange of real time data	Water resources availability
Declining water levels in lakes and rivers	Irrigation	Soil/Bank erosion	Water supply and sanitation
Drainage of Marshlands for agriculture;	Land use, Cover change, impacts on runoff	Tourism	Water use efficiency, demand management
Drought Prediction	Need to improve conservation to cope with CV e.g. through Rain water harvesting	Use of carbon credit to finance power project	Watershed degradation (Destruction of natural forests),
Flood Forecasting and Preparedness	Optimal utilization of available water resources	Water Quality - agro-chemical seepage	Wetlands degradation
Improving and developing navigation potential	Population structure/settlement patterns	Water Quality - eutrophication	

3.2.3 Working Session 3 Group Work: Ranking of Concerns

The output of this session comprised the first workshop result: a ranked shortlist of **Specific Concerns** as agreed by the participants. It began with a plenum briefing on the ranking process to be adopted by the break out groups, each of which worked on the agreed list of Specific Concerns resulting from the previous session.

The ranking criteria concerned the four themes suggested by the NBI goals: namely, Society, Economy, Natural Resources and Regional Collaboration, and the first step was to allocate each of these a weighting factor that reflected the importance of these themes as perceived and agreed by the group members according to the national or sub-regional imperatives (as appropriate). Weighting factors ranged from 1 to 4, but were not “either or” in that it was possible to assign the same score to more than one of the themes.

Having allocated weighting factors to each of the themes, the groups then proceeded to score the Specific Concerns, again using scores of 1 to 4 in a similar fashion, such that the score suggested the relevance of each Specific Concern to the four NBI themes. Thus if a Specific Concern was of extreme relevance to a particular theme it would be scored 4, whereas if it had no relevance, it would be scored 1. As with the weighting factors for the themes, the Specific Concern scores were again not “either or”.

By this means, each group produced weighted scores for each of the selected Specific concerns – see Appendix A1, tables A1.1, A1.2, and A1.3 which show how this was done by the working groups at the Uganda workshop.

Table values provided by each group were then averaged to produce overall weighted scores which in turn were used to produce the ranking – tables A1.4 and A1.5 refer.

3.2.4 Working Session 4: Group Work: Objectives, Criteria and Indicators etc

In order to support about a decision regarding options for addressing a particular **Specific Concern**, it is necessary to understand, identify or specify:

The **Objective** that the option is intended to achieve or contribute to. Thus if the Specific Concern is water pollution, then a suitable Objective could be “water pollution levels reduced to 20% of current levels by 2020”.

For this a range of **interventions** might be possible. Interventions can be categorised as regulatory, institutional or infrastructural (or indeed a combination of any or all of these). Either way, the **output** for a given intervention, following the same example, will be reduced water pollution.

There are also likely to be **externalities**, which in this case could be a lack of harmonisation of water quality regulations (or their enforcement) between riparians.

Equally, for each type of intervention, there may be **alternative** approaches. The DSS in fact, is intended precisely to support decisions regarding which of the possible alternatives would be the most desirable or advantageous.

To test which of the alternatives is the most desirable or advantageous requires **criteria**, which it will be recalled are the standard of judgement to test the desirability of an alternative. In order to be tested, criteria in turn require **indicators**, which again it will be recalled tell us to which extent the criteria are satisfied.

The object of this session was to draft - for each of the selected Specific Concerns - appropriate Objectives, select interventions, identify externalities and alternatives; and to craft relevant suitable criteria and indicators that can be applied equally to each alternative. However, it has been the Consultant’s experience that without adequate orientation, people find it difficult to craft criteria and indicators, often confusing them with activities or outputs. Accordingly this working session began with a briefing session provided by the consultant (Presentation 3).

Table A1.6 illustrates how this working session was completed by Uganda working group 3 which dealt with the third ranked Specific Concern “Water Quality – pollution”.

3.2.5 Working Session 5: Group Work: Models/Tools and Data

The output of this session comprised the second workshop result. It will be seen from Table A1.6 that by the start of this working session the results capture form has two sections that have yet to be completed namely: “model category” and “data/information”. In general terms, a particular kind of criteria requires a particular kind (or kinds) of model(s) to quantify the indicator(s) necessary to test the criteria. Equally, the nature of the indicator defines the nature of the data or information that the model needs in order to evaluate.

The purpose of this working session is to identify i) which models the DSS should incorporate (in its architecture) or use (via an interface to stand alone models) in order to test the criteria selected and ii) what kind of data the model needs in order to quantify the indicators.

Participants were provided with a brief presentation (Presentation 4) defining what is meant by the term “model” or “tool”; scale aspects and data/information requirements etc. After the presentation they returned to their break out groups for the purpose of completing the results capture forms.

Their results were discussed, revised and agreed en-plenum.

Table A1.7 shows the completed form for Uganda Group 3.

3.2.6 Working Session 6: Group Work: Institutional Arrangements

The output of this working session comprised the third workshop result in the form of a participatory training needs assessment of key DSS stakeholder institutions.

The session began with a presentation of key institutional concepts in river basin management, after which the participants were invited, en-plenum, to brainstorm the institutions that would be concerned with the DSS in the relevant country or sub-region. For this purpose, institutions were classified as follows:

- Institutions that can request demands for DSS services?
- Institutions that provide knowledge?
- Institutions that provide data?
- Institutions that enter/manage the data base?
- Institutions that could provide modelling services?

Once the list was compiled to everyone's satisfaction, the break out groups were reconvened and charged with undertaking a multi-criteria training needs assessment, again using scores from 1 to 4, Table A1.8 refers.

Results from each of the groups were consolidated (Table A1.9) and used to rank existing capacities (Table A1.10) and training priorities (Table A1.11).

3.2.7 Working Session 7: Workshop Conclusions

The final session of the workshop was more or less a formality. It provided an opportunity for the consultant to review - on the participants' behalf - the process followed and the corresponding results. This was usually followed by a brief closing statement either by one of the participants or a guest of honour if relevant.

3.2.8 Workshop Summary Outline

Table A1.12 presents a summary outline of the general consultation workshop process, it includes an indication of which steps not included in the sub-regional workshops (because considered unnecessary).

4 Analysis and Results

4.1 Executive Summary

It will be recalled from the preceding chapter that the stakeholder consultation process was intended to deliver three results:

- i) a ranked shortlist of **Specific Concerns** as agreed by the participants;
- ii) stakeholders' suggestions for **criteria, indicators** and the associated **models/tools** and **data/information** requirements necessary to support intervention decisions with respect to the Specific Concerns
- iii) a **participatory training needs assessment** of key DSS stakeholder institutions

The three sections which follow present these results in the form of an analytical synthesis, supported by three appendices, the first of which comprises a summary of the rationale and methodology of the consultation process followed in the sub-regions and member countries; the second presents the raw results obtained from the workshops while the third presents the workshop minutes. It should be noted however, that the analysis - which largely involves ranking of the various concerns - could not include fully the results from the EN Sub-regional workshop. This is because the plenum could not reach consensus with respect to the ranking. Accordingly, the resulting concerns are introduced synoptically as a separate sub-section (4.2.6) at an appropriate point in the narrative.

4.2 Analysis

4.2.1 Identification and Ranking of the Specific Concerns

The process by which Specific Concerns specific to each sub-region or country was described in sub-section 3.2.2 above. The results are presented in the next sub-section. It should be noted however, that at the client's request, participants at the various consultation workshops were discouraged from introducing concerns additional to the 31 carried over from the 1st Regional Workshop (and listed in table 3.1 above). This proved to be only partially workable in most cases. In some cases participants introduced new concerns, in others they i) suggested concerns conceptually similar to, but not articulated the same as examples in the original list; ii) combined two concerns in one or iii) suggested concerns that are actually interventions or externalities etc. Even so, the Consultant applauds the valuable and enthusiastic work of the participants across the board. Accordingly the "raw" results are presented, as ranked by the various workshops, for reference and by way of acknowledgment of the participants' efforts in Table 4.1 below. Nonetheless **for analytical purposes**, it has been necessary to smooth out inconsistencies – the colour coding used in Table 4.1 identifies clearly where these are the case. New concerns have been largely retained as proposed; conceptually similar concerns have been re-articulated for consistency; "compound" concerns have been unbundled and the ranking adjusted accordingly and those concerns that are actually interventions, externalities or objectives etc have been rearticulated as concerns where it is possible and rejected where it is not. The results are set out in Tables 4.2 and 4.3; but it is stressed once again, that these modifications have been considered necessary to streamline and homogenise the analytical process.

Table 4.1 pt 1 Ranking of Concerns as Articulated at the Consultation Workshops

Rank	Burundi	DR Congo	Egypt	Ethiopia	Kenya
1	Efficient water management in agric. & energy	Watershed degradation (destruction of forests)	Water resources availability	Irrigation development	Declining water levels in lakes and rivers
2	Drought and flood forecasting	Land use conflicts (parks/agriculture/cattle)	Water quality	Watershed management	Biodiversity conservation
3	Optimal utilisation of available water resources	Tourism	Optimal utilisation of available water resources	Hydro-power development	Irrigation
4	Soil management and conservation	Water supply and sanitation	Agriculture & livestock production	Drought	Water supply & sanitation
5	Intra- and inter-annual climate fluctuations	Water resources availability and optimal use	Coping with droughts	Water supply and sanitation	Increased energy demand
6	Water supply and sanitation	Hydropower projects (use of carbon credits)	Coping with floods	Flood preparedness	Watershed degradation
7	Biodiversity conservation	Lake water quality (pollution, salinity)	Increased population density	Wetland management	Water conservation, rainwater harvesting
8	Water quality	Industrial development and settlement patterns	Sedimentation and erosion		Water quality (urban and industrial pollution)
9	Equitable water distribution	Fisheries: Transboundary conflicts	Water supply and sanitation		Coping with floods (fore-casting) and droughts
10	Increased energy demand	Biodiversity conservation (protected areas)	Navigation improvement & development		Water quality: Agro-chemicals (eutrophic.)
11	Wetland management	Complementarity rainfed agriculture and irrigation	Investment planning		Land use, cover change, impacts on runoff
12	Population structure/ settlement patterns	Drawdown of lake levels, decrease of river flow	Increased energy demand		Improving & developing navigation
13	Development of navigation and tourism				
14					
	colour codes:				
	no change required	compound issue	new issue	needs to be re-articulated for reasons of consistency	externality, intervention, objective, irrelevant as currently articulated etc

Table 4.1 pt 2 Ranking of Concerns as Articulated at the Consultation Workshops

Rank	Rwanda	Sudan	Tanzania	Uganda	Sub-region NEL
1	Watershed degradation (destruction of forests)	Water availability	Water resources availability	Increased energy demand	Water quality – pollution
2	Climatic change	Drought	Declining water levels in lakes and rivers	Watershed degradation (destruction of forests)	Water resources avail./ use / management
3	Increased energy demand	Access to water	Water quality - pollution	Water quality - pollution	Coping with floods and droughts
4	Water supply and sanitation	Sediment management	Optimal utilisation of avail. water resources	Water resources availability	Increased energy demand
5	Optimal utilisation of available water resources	Water quality	Water use efficiency, demand management	Rainfed agriculture	Watershed degradation, wetland degradation
6	Tourism	Water supply and sanitation	Biodiversity conservation	Biodiversity conservation	Water conservation – rainwater harvesting
7	Wetland degradation	Hydropower development	Irrigation	Water supply and sanitation	Water use efficiency demand / management
8	Flood and drought control	Water use in agriculture	Water quality - eutrophication	Wetlands degradation	Water supply and sanitation
9	Water quality – pollution	Watershed management	Water supply and sanitation	Coping with droughts and floods	Irrigation
10	Irrigation, drainage of wetlands for agriculture	Wetland management	Watershed degradation (destruction of forests)	Irrigation	Biodiversity conservation
11		Floods	Increased energy demand	Population structure/ settlement patterns	Population structure/ settlement pattern
12		Navigation	Wetlands degradation	Conflicts in water use (pastoralists etc)	Sedimentation of hydraulic infrastructure
13		Aquatic weeds			Improving / developing navigation potential
14		Tourism			
	colour codes:				
	no change required	compound issue	new issue	needs to be re-articulated for reasons of consistency	externality, intervention, objective, irrelevant as currently articulated etc

Table 4.2 pt 1 Ranking of the Revised Concerns

Rank	Burundi	DR Congo	Egypt	Ethiopia	Kenya
1	Water use efficiency, demand management	Watershed degradation (destruction of forests)	Water resources availability	Irrigation	Declining water levels in lakes and rivers
2	Drought Prediction Flood Forecasting and Preparedness	Not considered relevant	Water quality	Watershed degradation (Destruction of natural forests)	Biodiversity conservation
3	Optimal utilisation of available water resources	Tourism	Optimal utilisation of available water resources	Increased energy demand	Irrigation
4	Soil/Bank erosion	Water supply and sanitation	Irrigation Rainfed agriculture Livestock	Drought Prediction Coping with droughts (and floods)	Water supply & sanitation
5	Intra- and inter-annual fluctuation	Water resources availability Water use efficiency, demand management	Coping with droughts	Water supply and sanitation	Increased energy demand
6	Water supply and sanitation	Use of carbon credit to finance power project	Coping with floods	Flood Forecasting and Preparedness	Watershed degradation (Destruction of natural forests),
7	Biodiversity conservation	Water Quality - pollution Water Quality - salinisation	Population structure/settlement patterns	Wetlands degradation	Need to improve conservation to cope with CV e.g. through Rain water harvesting
8	Water quality	Population structure/settlement patterns	Soil/Bank erosion		Water Quality - pollution
9	Water resources availability Water use efficiency, demand management - repeat	Transboundary conflicts with respect to fisheries	Water supply and sanitation		Flood Forecasting and Preparedness Coping with droughts and floods;
10	Increased energy demand	Biodiversity conservation	Improving and developing navigation potential		
11	Wetlands degradation	Irrigation Rain fed agriculture	Investment decision support is the principle function of the DSS, investment planning is therefore a cross cutting issue		Land use, Cover change, impacts on runoff
12	Population structure/settlement patterns	Declining water levels in lakes and rivers	Increased energy demand		Improving and developing navigation potential
13	Improving and developing navigation potential Tourism				

Table 4.2 pt 2 Ranking of the Revised Concerns

Rank	Rwanda	Sudan	Tanzania	Uganda	Sub-region NEL
1	Watershed degradation (destruction of forests)	Water resources availability	Water resources availability	Increased energy demand	Water quality – pollution
2	Intra- and inter-annual fluctuation;	Coping with droughts and floods;	Declining water levels in lakes and rivers	Watershed degradation (destruction of forests)	Water resources availability
3	Increased energy demand	Water resources availability	Water quality - pollution	Water quality - pollution	Coping with floods and droughts
4	Water supply & sanitation	Soil/Bank erosion	Optimal utilization of available water resources	Water resources availability	Increased energy demand
5	Optimal utilisation of available water resources	Water quality	Water use efficiency, demand management	Rain fed agriculture	Watershed degradation (Destruction of natural forests), Wetlands degradation
6	Tourism	Water supply and sanitation	Biodiversity conservation	Biodiversity conservation	Need to improve conservation to cope with CV e.g. through
7	Wetland degradation	Increased energy demand	Irrigation	Water supply and sanitation	Water use efficiency demand / management
8	Coping with droughts and floods;	Irrigation Rain fed agriculture	Water Quality - eutrophication	Wetlands degradation	Water supply and sanitation
9	Water Quality - pollution	Watershed degradation (Destruction of natural forests)	Water supply and sanitation	Coping with droughts and floods	Irrigation
10	Irrigation Wetlands degradation - repeat	Wetlands degradation	Watershed degradation (destruction of forests)	Irrigation	Biodiversity conservation
11		Flood Forecasting and Preparedness	Increased energy demand	Population structure/ settlement patterns	Population structure/ settlement pattern
12		Improving and developing navigation potential	Wetlands degradation	Conflicts in water use (pastoralists etc)	Soil/Bank erosion
13		Aquatic weeds			Improving / developing navigation potential
14		Tourism			

Table 4.3 pt 1 Revised Ranking of the Concerns Including Unbundled Compound Concerns

Rank	Burundi	DR Congo	Egypt	Ethiopia	Kenya
1	Water use efficiency, demand management	Watershed degradation (destruction of forests)	Water resources availability	Irrigation	Declining water levels in lakes and rivers
2	Drought Prediction	Tourism	Water quality	Watershed degradation	Biodiversity conservation
	Flood Forecasting and Preparedness				
3		Water supply and sanitation	Optimal utilisation of available water resources	Increased energy demand	Irrigation
4	Optimal utilisation of available water resources	Water resources availability	Irrigation	Drought Prediction	Water supply & sanitation
		Water use efficiency, demand management	Rainfed agriculture	Coping with droughts (and floods)	
			Livestock		
5	Soil/Bank erosion				Increased energy demand
6	Intra- and inter-annual fluctuation	Use of carbon credit to finance power project		Water supply and sanitation	Watershed degradation (Destruction of natural forests),
7	Water supply and sanitation	Water Quality - pollution	Coping with droughts	Flood Forecasting and Preparedness	Need to improve conservation to cope with CV e.g. through Rain water harvesting
		Water Quality - salinisation			
8	Biodiversity conservation		Coping with floods	Wetlands degradation	Water Quality - pollution
9	Water quality	Population structure/settlement patterns	Population structure/settlement patterns		Flood Forecasting and Preparedness
					Coping with droughts and floods;
10	Water resources availability	Transboundary conflicts with respect to fisheries	Soil/Bank erosion		
11	Increased energy demand	Biodiversity conservation	Water supply and sanitation		Land use, Cover change, impacts on runoff
12	Wetlands degradation	Irrigation	Improving and developing navigation potential		Improving and developing navigation potential
		Rain fed agriculture			
13	Population structure/settlement patterns		Increased energy demand		
14	Improving and developing navigation potential	Declining water levels in lakes and rivers			
	Tourism				

Table 4.3 pt 2 Revised Ranking of the Concerns Including Unbundled Compound Concerns

Rank	Rwanda	Sudan	Tanzania	Uganda	Sub-region NEL
1	Watershed degradation (destruction of forests)	Water resources availability	Water resources availability	Increased energy demand	Water quality – pollution
2	Intra- and inter-annual fluctuation;	Coping with droughts and floods;	Declining water levels in lakes and rivers	Watershed degradation (destruction of forests)	Water resources availability
3	Increased energy demand	Soil/Bank erosion	Water quality - pollution	Water quality - pollution	Coping with floods and droughts
4	Water supply & sanitation	Water quality	Optimal utilization of available water resources	Water resources availability	Increased energy demand
5	Optimal utilisation of available water resources	Water supply and sanitation	Water use efficiency, demand management	Rain fed agriculture	Watershed degradation (Destruction of natural forests), Wetlands degradation
6	Tourism	Increased energy demand	Biodiversity conservation	Biodiversity conservation	
7	Wetland degradation	Irrigation Rain fed agriculture	Irrigation	Water supply and sanitation	Need to improve conservation to cope with CV e.g. through Rain water harvesting
8	Coping with droughts and floods;		Water Quality - eutrophication	Wetlands degradation	Water use efficiency demand / management
9	Water Quality - pollution	Watershed degradation (Destruction of natural forests)	Water supply and sanitation	Coping with droughts and floods	Water supply and sanitation
10	Irrigation	Wetlands degradation	Watershed degradation (destruction of forests.)	Irrigation	Irrigation
11		Flood Forecasting and Preparedness	Increased energy demand	Population structure/ settlement patterns	Biodiversity conservation
12		Improving and developing navigation potential	Wetlands degradation	Conflicts in water use (pastoralists etc)	Population structure/ settlement pattern
13		Aquatic weeds			Soil/Bank erosion
14		Tourism			Improving / developing navigation potential

4.2.2 General Analysis of the Ranking Results

Table 4.3 shows that in-all, 30 concerns were selected by one or more the workshops; of these however, four – namely aquatic weeds, conflicts in water use, livestock and transboundary conflicts with respect to fisheries– are new. Thus of the original 31 concerns 26 were considered relevant by one or more of the workshops. It is interesting to subject the 30 concerns to additional ranking procedures – Table 4.4 refers where the concerns are ranked according to the total number of times that they were selected, and the number of times they were ranked in the first three at the workshops. Of the 17 concerns ranked 12th or higher, 13 were also ranked in the first three by at least one of the workshops:

- **Biodiversity conservation**
- **Coping with droughts and/or floods**
- **Flood Forecasting and Preparedness**
- **Increased energy demand**
- **Irrigation**
- **Optimal utilisation of available water resources**
- **Soil/Bank erosion**
- **Tourism**
- **Water Quality - pollution**
- **Water resources availability**
- **Water supply & sanitation**
- **Water use efficiency demand / management**
- **Watershed degradation (destruction of forests)**

Similarly, of the 16 concerns ranked in the first three by at least one of the workshops, 12 were also selected by at least 4 of the workshops:

- **Biodiversity conservation**
- **Flood Forecasting and Preparedness**
- **Increased energy demand**
- **Irrigation**
- **Optimal utilisation of available water resources**
- **Soil/Bank erosion**
- **Tourism**
- **Water Quality - pollution**
- **Water resources availability**
- **Water supply & sanitation**
- **Water use efficiency demand / management**
- **Watershed degradation (destruction of forests)**

All this suggests a general consistency in the rankings, although there are some surprises. Water Supply and Sanitation was selected at all of the workshops for instance, yet only achieved a ranking of 3rd or above at one – in fact its ranking tally was 1st at one workshop, 4th at two workshops, 5th and 6th at one workshop each, 7th at two workshops, 9th at two workshops and 11th at one.

Not surprising however, are the prevailing concerns about the availability and use of water.

- **water resources availability** for instance was selected at 7 workshops and was ranked 3rd or above at 4;
- **declining water levels in lakes and rivers** was selected at 3 workshops and was ranked 3rd or above at 2;
- **water use efficiency, demand management** was selected at 4 workshops and was ranked 3rd or above at 1: and
- **optimal utilisation of available water resources** was selected at 4 workshops and was ranked 3rd or above at 1.

Similarly, environmental factors featured consistently in one way or another:

- **water quality (pollution)** for instance was selected at 6 workshops and was ranked 3rd or above at 4;
- **watershed degradation (destruction of forests)** was selected at 8 workshops and was ranked 3rd or above at 4; and
- **biodiversity conservation** was selected at 6 workshops and was ranked 3rd or above at 1

Yet surprisingly, although wetland degradation was selected at 7 workshops, its ranking tally was 5th and 7th at one workshop each, 8th at two workshops, 10th at one workshop, and 12th at two.

4.2.3 Analysis of the Ranking Results by NBI Theme

It is also interesting i) to cluster the concerns according to the four Nile Basin themes³ (society, economy, natural resources and regional collaboration – Table 4.5 refers) ii) to rank them within their clusters and iii) to see which are the most important within each cluster: Tables 4.6 to 4.9 refer.

For **Society**, water supply and sanitation clearly emerges as the most pressing concern, even though with the exception of one country, it does not in the top three of any other workshop rankings. It is followed closely by increased energy demand, which was ranked 3rd or above in 3 workshops, and by irrigation which was ranked 3rd or above in 2 workshops.

For **Economy**, increased energy demand and irrigation dominate the concerns. They are followed by coping with droughts and floods which ranked 3rd or above at 2 workshops.

For **Natural Resources**, watershed degradation, which ranked 3rd or above at 4 workshops emerges as the most pressing concern. Next was water resource availability which also ranked 3rd or above at 4 workshops. Third was wetland degradation yet as we have seen it did not score 3rd or above at any workshop.

Finally, for **Regional Collaboration**, perhaps not surprisingly, the first two most pressing priorities are the same as for Economy, namely increased energy demand, irrigation while the third is coping with droughts and floods.

The thematic question is revisited below in sub-section 4.2.5 which explores thematic emphases at the sub-regional level.

³ noting that it is possible for a particular issue to appear in more than one cluster

Table 4.4 Consolidated Rankings

RANK	BY TOTAL N° OF WORKSHOPS WHERE THE CONCERN WAS SELECTED	N°	RANK	BY N° OF WORKSHOPS WHERE THE CONCERN WAS RANKED IN THE 1st 3	N°
1	Water supply & sanitation	10	=1	Water pollution (all kinds)	4
=2	Increased energy demand	9	=1	Water resources availability	4
=2	Irrigation	9	=1	Watershed degradation (Destruction of natural forests),	4
=4	Coping with droughts and/or floods	8	=4	Increased energy demand	3
=4	Watershed degradation (destruction of forests)	8	=5	Coping with droughts and floods	2
=6	Water resources availability	7	=5	Declining water levels in lakes and rivers	2
=6	Wetland degradation	7	=5	Irrigation	2
=8	Biodiversity conservation	6	=8	Soil/Bank erosion	1
=8	Improving / developing navigation potential	6	=8	Biodiversity conservation	1
=8	Water Quality - pollution	6	=8	Drought Prediction	1
=11	Population structure/ settlement pattern	5	=8	Flood Forecasting and Preparedness	1
=12	Soil/Bank erosion	4	=8	Intra- and inter-annual fluctuation	1
=12	Flood Forecasting and Preparedness	4	=8	Optimal utilisation of available water resources	1
=12	Optimal utilisation of available water resources	4	=8	Tourism	1
=12	Rain fed agriculture	4	=8	Water supply and sanitation	1
=12	Tourism	4	=8	Water use efficiency, demand management	1
=12	Water use efficiency demand / management	4			
=18	Declining water levels in lakes and rivers	3			
=18	Water quality	3			
=20	Drought Prediction	2			
=20	Intra- and inter-annual fluctuation	2			
=20	Need to improve conservation to cope with CV e.g. through Rain water harvesting	2			
=23	Aquatic weeds	1			
=23	Conflicts in water use (pastoralists etc)	1			
=23	Land use, Cover change, impacts on runoff	1			
=23	Livestock	1			
=23	Transboundary conflicts with respect to fisheries	1			
=23	Use of carbon credit to finance power project	1			
=23	Water Quality - eutrophication	1			
=23	Water Quality - salinisation	1			

Table 4.5 Clustering of Concerns According to the NBI Themes

CONCERN	CLUSTER				COMMENT/EXPLANATION
	SOCIETY	ECONOMY	NATURAL RESOURCES	REGIONAL COLLABORATION	
Aquatic weeds	yes	yes	yes	yes	relevant to the economy because of the affect of water hyacinth on navigation
Biodiversity conservation	yes	yes	yes		relevant to the economy because of eco-tourism
Conflicts in water use (pastoralists etc)	yes	yes			
Coping with droughts and floods	yes	yes		yes	
Declining water levels in lakes and rivers	yes	yes	yes	yes	
Drought Prediction	yes	yes		yes	relevant to regional collaborafon because of data sharing
Flood Forecasting and Preparedness	yes	yes		yes	
Improving / developing navigation potential		yes		yes	relevant to regional collaborafon because of water hyacinth
Increased energy demand		yes		yes	
Intra- and inter-annual fluctuation			yes	yes	relevant to regional collaborafon because of data sharing
Irrigation	yes	yes		yes	
Land use, Cover change, impacts on runoff			yes	yes	
Livestock	yes	yes			
Need to improve conservation to cope with CV e.g. through Rain water harvesting	yes	yes			
Optimal utilisation of available water resources		yes	yes		
Population structure/ settlement pattern	yes	yes	yes		
Rain fed agriculture	yes	yes			
Soil/Bank erosion		yes	yes	yes	
Tourism		yes			
Transboundary conflicts				yes	
Use of carbon credit to finance power project		yes		yes	
Water quality	yes	yes	yes	yes	
Water Quality - eutrophication	yes	yes	yes		relevant to the economy because of the affect of water hyacinth on navigation
Water Quality - pollution	yes	yes	yes	yes	
Water Quality - salinisation	yes	yes		yes	relevant to regional collaborafon because of agricultural run-off
Water resources availability	yes	yes	yes	yes	
Water supply & sanitation	yes				
Water use efficiency demand / management		yes	yes	yes	
Watershed degradation (destruction of forests)			yes	yes	
Wetland degradation			yes	yes	

Table 4.6 Consolidated Rankings of Concerns Relevant to Society

RANK	BY TOTAL N° OF WORKSHOPS WHERE THE CONCERN WAS SELECTED	N°	RANK	BY N° OF WORKSHOPS WHERE THE CONCERN WAS RANKED IN THE 1st 3	N°
1	Water supply & sanitation	10	=1	Water quality	4
2	Irrigation	9	=1	Water resources availability	4
3	Coping with droughts and/or floods	8	=3	Coping with droughts and floods	2
4	Water resources availability	7	=3	Declining water levels in lakes and rivers	2
=5	Biodiversity conservation	6	=3	Irrigation	2
=5	Water Quality - pollution	6	=6	Biodiversity conservation	1
7	Population structure/ settlement pattern	5	=6	Drought Prediction	1
=8	Flood Forecasting and Preparedness	4	=6	Flood Forecasting and Preparedness	1
=8	Rain fed agriculture	4	=6	Water supply and sanitation	1
=10	Declining water levels in lakes and rivers	3			
=10	Water quality	3			
=12	Drought Prediction	2			
=12	Need to improve conservation to cope with CV e.g. through Rain water harvesting	2			
=14	Aquatic weeds	1			
=14	Conflicts in water use (pastoralists etc)	1			
=14	Livestock	1			
=14	Water Quality - eutrophication	1			
=14	Water Quality - salinisation	1			

Table 4.7 Consolidated Rankings of Concerns Relevant to Economy

RANK	BY TOTAL N° OF WORKSHOPS WHERE THE CONCERN WAS SELECTED	N°	RANK	BY N° OF WORKSHOPS WHERE THE CONCERN WAS RANKED IN THE 1st 3	N°
=1	Increased energy demand	9	=1	Water quality	4
=1	Irrigation	9	=1	Water resources availability	4
3	Coping with droughts and/or floods	8	3	Increased energy demand	3
=4	Water resources availability	7	=4	Coping with droughts and floods	2
=5	Biodiversity conservation	6	=4	Declining water levels in lakes and rivers	2
=5	Improving / developing navigation potential	6	=4	Irrigation	2
=5	Water Quality - pollution	6	=7	Biodiversity conservation	1
8	Population structure/ settlement pattern	5	=7	Drought Prediction	1
=9	Flood Forecasting and Preparedness	4	=7	Flood Forecasting and Preparedness	1
=9	Optimal utilisation of available water resources	4	=7	Optimal utilisation of available water resources	1
=9	Rain fed agriculture	4	=7	Soil/Bank erosion	1
=9	Soil/Bank erosion	4	=7	Tourism	1
=9	Tourism	4	=7	Water use efficiency, demand management	1
=9	Water use efficiency demand / management	4			
=15	Declining water levels in lakes and rivers	3			
=15	Water quality	3			
=17	Drought Prediction	2			
=17	Need to improve conservation to cope with CV e.g. through Rain water harvesting	2			
=19	Aquatic weeds	1			
=19	Conflicts in water use (pastoralists etc)	1			
=19	Livestock	1			
=19	Use of carbon credit to finance power project	1			
=19	Water Quality - eutrophication	1			
=19	Water Quality - salinisation	1			

Table 4.8 Consolidated Rankings of Concerns Relevant to Natural Resources

RANK	BY TOTAL N° OF WORKSHOPS WHERE THE CONCERN WAS SELECTED	N°	RANK	BY N° OF WORKSHOPS WHERE THE CONCERN WAS RANKED IN THE 1st 3	N°
=1	Watershed degradation (destruction of forests)	8	=1	Water quality	4
=2	Water resources availability	7	=1	Water resources availability	4
=2	Wetland degradation	7	=1	Watershed degradation (Destruction of natural forests),	4
=4	Biodiversity conservation	6	4	Declining water levels in lakes and rivers	2
=4	Water Quality - pollution	6	=5	Biodiversity conservation	1
6	Population structure/ settlement pattern	5	=5	Intra- and inter-annual fluctuation	1
=7	Optimal utilisation of available water resources	4	=5	Optimal utilisation of available water resources	1
=7	Soil/Bank erosion	4	=5	Soil/Bank erosion	1
=7	Water use efficiency demand / management	4	=5	Water use efficiency, demand management	1
=10	Declining water levels in lakes and rivers	3			
=10	Water quality	3			
12	Intra- and inter-annual fluctuation	2			
=13	Aquatic weeds	1			
=13	Land use, Cover change, impacts on runoff	1			
=13	Water Quality - eutrophication	1			

Table 4.9 Consolidated Rankings of Concerns Relevant to Regional Collaboration

RANK	BY TOTAL N° OF WORKSHOPS WHERE THE CONCERN WAS SELECTED	N°	RANK	BY N° OF WORKSHOPS WHERE THE CONCERN WAS RANKED IN THE 1st 3	N°
=1	Increased energy demand	9	=1	Water quality	4
=1	Irrigation	9	=1	Water resources availability	4
=3	Coping with droughts and/or floods	8	=1	Watershed degradation (Destruction of natural forests),	4
=3	Watershed degradation (destruction of forests)	8	4	Increased energy demand	3
=5	Water resources availability	7	=5	Coping with droughts and floods	2
=5	Wetland degradation	7	=5	Declining water levels in lakes and rivers	2
=7	Improving / developing navigation potential	6	=5	Irrigation	2
=7	Water Quality - pollution	6	=7	Drought Prediction	1
=9	Flood Forecasting and Preparedness	4	=7	Flood Forecasting and Preparedness	1
=9	Soil/Bank erosion	4	=7	Intra- and inter-annual fluctuation	1
=9	Water use efficiency demand / management	4	=7	Soil/Bank erosion	1
=12	Declining water levels in lakes and rivers	3	=7	Water use efficiency, demand management	1
=12	Water quality	3			
=14	Drought Prediction	2			
=14	Intra- and inter-annual fluctuation	2			
=16	Aquatic weeds	1			
=16	Land use, Cover change, impacts on runoff	1			
=16	Transboundary conflicts with respect to fisheries	1			
=16	Use of carbon credit to finance power project	1			
=16	Water Quality - salinisation	1			

4.2.4 Analysis of the Workshop Results by Country and Sub-Region

Throughout the consultancy process to date, the client has repeatedly stress that the proposed DSS is intended to be client oriented facility, with the member countries being the clients. Accordingly, it is helpful to map each of the concerns onto each of the countries: Table 4.10 refers.

Table 4.10 Concerns Mapped onto Countries

CONCERN	NEL						EN			N° of Countries
	Burundi	Rwanda	Tanzania	Kenya	Uganda	DR Congo	Sudan	Ethiopia	Egypt	
Water supply & sanitation	■	■	■	■	■	■	■	■	■	9
Increased energy demand	■	■	■	■	■	■	■	■	■	8
Irrigation	■	■	■	■	■	■	■	■	■	8
Watershed degradation (destruction of forests)	■	■	■	■	■	■	■	■	■	8
Coping with droughts and floods	■	■	■	■	■	■	■	■	■	6
Water resources availability	■	■	■	■	■	■	■	■	■	6
Biodiversity conservation	■	■	■	■	■	■	■	■	■	5
Water Quality - pollution	■	■	■	■	■	■	■	■	■	5
Wetland degradation	■	■	■	■	■	■	■	■	■	5
Flood Forecasting and Preparedness	■	■	■	■	■	■	■	■	■	4
Improving / developing navigation potential	■	■	■	■	■	■	■	■	■	4
Optimal utilisation of available water resources	■	■	■	■	■	■	■	■	■	4
Population structure/settlement pattern	■	■	■	■	■	■	■	■	■	4
Rain fed agriculture	■	■	■	■	■	■	■	■	■	4
Tourism	■	■	■	■	■	■	■	■	■	4
Soil/Bank erosion	■	■	■	■	■	■	■	■	■	3
Declining water levels in lakes and rivers	■	■	■	■	■	■	■	■	■	3
Water quality	■	■	■	■	■	■	■	■	■	3
Water use efficiency demand / management	■	■	■	■	■	■	■	■	■	3
Drought Prediction	■	■	■	■	■	■	■	■	■	2
Intra- and inter-annual fluctuation	■	■	■	■	■	■	■	■	■	2
Aquatic weeds	■	■	■	■	■	■	■	■	■	1
Conflicts in water use (pastoralists etc)	■	■	■	■	■	■	■	■	■	1
Land use, Cover change, impacts on runoff	■	■	■	■	■	■	■	■	■	1
Livestock	■	■	■	■	■	■	■	■	■	1
Need to improve conservation to cope with CV e.g. through Rain water harvesting	■	■	■	■	■	■	■	■	■	1
Transboundary conflicts	■	■	■	■	■	■	■	■	■	1
Use of carbon credit to finance power project	■	■	■	■	■	■	■	■	■	1
Water Quality - eutrophication	■	■	■	■	■	■	■	■	■	1
Water Quality - salinisation	■	■	■	■	■	■	■	■	■	1

The table confirms once again the predominating interest in water supply and sanitation, improved energy supplies, irrigation and watershed degradation.

In terms of priority, the next cluster of concerns comprises coping with floods and droughts and water resources availability which are concerns in 6 countries each.

Next comes biodiversity conservation, water quality and wetland degradation – 5 countries each, and flood forecasting/preparadness and navigation with four.

It is interesting to note however, that down to this point and with the exception of population settlement patterns there is a great commonality of interest between the NEL and EN sub-regions; but for the remaining concerns not only are they more applicable to the NEL sub-regions, but also a more sub-regional focus emerges.

4.2.5 Thematic Emphases at the Sub-Regional Level.

It is interesting to assess this divergence in terms of the NBI themes. Table 4.11 refers, it relates the total number of times that a concern is selected by theme in each of the two sub-regions and confirms that in each, economy is the most important theme. However, whereas society, natural resources and regional collaboration are more or less equally and significantly less important in the EN sub-regions, in the NEL sub-region, there is a clear hierarchy with natural resources coming second, regional collaboration third but closely followed by society.

4.2.6 Results from the Eastern Nile Sub-Regional Workshop

The results of the Eastern Nile Sub-Regional Workshop have not been included in the Analysis Report so far as the respective ranking was missing. This is why the following section now presents a separate summary.

13 concerns were raised at the EN sub-regional workshop. As with the concerns raised at the other workshops, not all were articulated as per the standard nomenclature needed for analytical purposes (as explained in section 4.2.1 above). Table 4.12 lists the concerns as articulated at the workshop and matches them with the standardised articulation. As with the results of the other workshops, the Consultant acknowledges the risk of subjectivity and inaccuracy with regards to the re-articulation, which it is stressed once again is necessary to standardise concern articulation for analytical purposes.

It will be seen that re-articulation of the concerns reduce the total number from 13 to 12.

Table 4.11 Thematic Trends in the Sub-Regions

CONCERN	NEL						EN			N° of SELECTIONS IN NEL				N° of SELECTIONS IN EN				
	Burundi	Rwanda	Tanzania	Kenya	Uganda	DR Congo	Sudan	Ethiopia	Egypt	SOCIETY	ECONOMY	NATURAL RESOURCES	REGIONAL COLLABORATION	SOCIETY	ECONOMY	NATURAL RESOURCES	REGIONAL COLLABORATION	
Optimal utilisation of available water resources										n/i	3	3	n/i	n/i	1	1	n/i	
Population structure/settlement pattern										3	3	3	n/i	1	1	1	n/i	
Rain fed agriculture										2	2	n/i	n/i	2	2	n/i	n/i	
Tourism										n/i	3	n/i	n/i	n/i	1	n/i	n/i	
Soil/Bank erosion										n/i	1	1	1	n/i	2	2	2	
Declining water levels in lakes and rivers										3	3	3	3	0	0	0	0	
Water quality										1	1	1	1	2	2	2	2	
Water use efficiency demand / management										n/i	3	3	3	n/i	0	0	0	
Drought Prediction										n/i	1	n/i	1	n/i	1	n/i	1	
Intra- and inter-annual fluctuation										n/i	n/i	2	2	n/i	n/i	0	0	
Aquatic weeds										0	0	0	0	1	1	1	1	
Conflicts in water use (pastoralists etc)										1	1	n/i	n/i	0	0	n/i	n/i	
Land use, Cover change, impacts on runoff										n/i	n/i	1	1	n/i	n/i	0	0	
Livestock										0	0	n/i	n/i	1	1	n/i	n/i	
Need to improve conservation to cope with CV e.g. through Rain water harvesting										1	1	n/i	n/i	0	0	n/i	n/i	
Transboundary conflicts										n/i	n/i	n/i	n/i	n/i	n/i	n/i	n/i	
Use of carbon credit to finance power project										n/i	1	n/i	1	n/i	0	n/i	0	
Water Quality - eutrophication										1	1	1	n/i	0	0	0	n/i	
Water Quality - salinisation										1	1	n/i	1	0	0	0	0	
										TOTALS	13	25	18	14	7	12	7	6

Notes "n/i" indicates that the concern was not included in the theme

Table 4.12 Concerns Raised at the Eastern Nile Sub-regional Workshop

CONCERN AS ARTICULATED	STANDARD ARTICULATION(S)
increase water availability	water resource availability
optimise water utilisation	optimal utilisation of available water resources
optimise available water resources utilisation options	optimal utilisation of available water resources
conserve and improve water quality	water quality
increase agriculture and livestock production	irrigation
	rainfed agriculture
	livestock
conserve soil and water	watershed degradation (destruction of forests)
cope with droughts	coping with floods and/or droughts
contribute to meet energy demand through hydropower	increased energy demand
cope with floods	coping with floods and/or droughts
increase irrigated agriculture	irrigation
improve water supply and sanitation coverage	water supply and sanitation
reduce sedimentation of hydraulic structures	Soil/bank erosion
improve and develop navigation potential	Improving/developing navigation potential

4.3 Results

4.3.1 From Ranking Results to the Identification of DSS Requirements

The foregoing analysis, although very interesting in the way that it identifies macro concerns that are relevant to the overall DSS architecture, is less easy to apply to the finer details of its conceptual design. This is because the workshop results are both weighted and representative of different countries and sub-regions where the composition, experience and vested interests of the participants varied. Accordingly, the methodology used to identify those concerns that need to be retained and prioritised for defining the DSS requirements has not been based on a strictly mathematical analysis of ranking results.

Instead, a three-step approach to concern selection was adopted:

1. **First**, “key trans-boundary concerns” were identified. These are concerns that were found to be i) important at more than half of the workshops; ii) high ranking in at least several countries, and iii) where a strong cause-and-effect chain (upstream-downstream) can be identified.
2. **Secondly**, the remaining concerns were reviewed by the Consultant in order to identify other important ones that i) are high ranking and complementary to those arising from the first step; or ii) were selected by several countries and with a clear regional aspect.

3. **Thirdly**, a check was made as to whether or not there are any concerns that were raised as a high priority concern in one country but not captured by the above two categories. This was not the case.

The concerns selected by this process were then clustered into broader “areas of concern” for the purpose of DSS conceptual design.

4.3.2 Step 1 - Identification and Clustering of the Specific Transboundary Concerns

Specific transboundary concerns constitute the core, or irreducible skeleton of a DSS suitable for the Nile Basin. For the purpose of this exercise such concerns have been selected according to the following criteria (which are suggested by the Consultant):

- **Criteria 1:** they should have been selected at at least 1 sub-regional workshop;
- **Criteria 2:** they should have been selected at a minimum of 6 of all the workshops;
- **Criteria 3:** they should be ranked 3rd or above in at least 2 country workshops in overall terms
- **Criteria 4:** they should be ranked 3rd or above in at least 2 country workshops in terms of regional collaboration

In addition, they should be characterised by clear cause and effect (upstream/downstream) implications.

Table 4.13 refers – it is developed from Table 4.10 and identifies the relevant concerns by means of bold type. These are:

- | | |
|-------------------------------|--|
| • Increased energy demand | for which the cause and effect linkages concern i) strong regional links in decision making on power generation and trades, along with existing and potential transboundary grids, and ii) the impact on stream flows of storing water for hydropower generation |
| • Irrigation | for which the cause and effect linkage concerns the effect on water availability due to irrigation which is the biggest consumer of water in the NB |
| • Water quality/pollution | for which the cause and effect linkage concerns the cumulative affect of upstream pollution on downstream water bodies |
| • Water resource availability | for which the cause and effect linkage is direct because water abstraction upstream affects its availability downstream |
| • Watershed degradation | for which the cause and effect linkage concerns the erosion upstream and deposition downstream |

4.3.3 Step 2 - Identification of Complementary or Otherwise Significant Specific Concerns

As made clear in section 4.2.6 above, a purely ranking based selection of concerns to be addressed by the DSS is not ideal. Clearly, however, the concerns resulting from Step 1 are nonetheless based largely on the objective results of the ranking analyses described in sections 4.2.2 to 4.2.4. In order therefore to achieve a more comprehensive and representative capture of concerns for purpose of DSS conceptual design it is necessary to subject the remaining concerns to a more subjective, strategic review. It will be recalled from section 4.3.1 (second step) that the purpose of this review is to identify additional concerns that i) are complementary to those arising

from the first step; or ii) despite lower rankings were selected by several countries (4 or more for the purpose of this exercise) and with a clear regional aspect.

The results are shown in Table 4.14 (where the results of step 1 are identified by the blue highlight). The rationale behind most of the selections will be self-evident; but where this is not so, they are explained as follows:

- wetland degradation is complementary/relevant to watershed degradation because wetlands are an important multi-function watershed component
- population structure/ settlement pattern is complementary/relevant to coping with droughts and floods because of potential compromise of flood plain functions that can arise from human settlements
- aquatic weeds is complementary/relevant to navigation because of the operational difficulties and disruption that they cause

Table 4.13 Identification of Key Trans-boundary Concerns

CONCERN	NEL							EN					N° of Country workshops	N° of s/r workshops	Total N° of workshops	3rd+		Criteria 1	Criteria 2	Criteria 3	Criteria 4	Total Score
	Burundi	Rwanda	Tanzania	Kenya	Uganda	DR Congo	Sub-regional	Sudan	Ethiopia	Egypt	Sub-regional	Workshops				Regional Collaboration						
Increased energy demand												8	2	10	3	3	1	1	1	1	4	
Irrigation												8	1	9	2	2	1	1	1	1	4	
Water Quality - pollution												5	1	6	4	4	1	1	1	1	4	
Water resources availability												6	2	8	4	4	1	1	1	1	4	
Watershed degradation (destruction of forests)												8	2	10	2	3	1	1	1	1	4	
Coping with droughts and floods												6	2	8	2	1	1	1	1		3	
Declining water levels in lakes and rivers												3		3	2	2	1		1	1	3	
Soil/Bank erosion												3	2	5	3	3	1		1	1	3	
Biodiversity conservation												5	1	6	1		1	1			2	
Improving / developing navigation potential												4	2	6			1	1			2	
Water supply & sanitation												9	2	11	1		1	1			2	
Water use efficiency demand / management												3	1	4	1	2	1			1	2	
Wetland degradation												5	1	6			1	1			2	
Aquatic weeds												1		1			1				1	
Conflicts in water use (pastoralists etc)												1		1			1				1	
Drought Prediction												2		2	1	1	1				1	
Flood Forecasting and Preparedness												4		4	1	1	1				1	
Intra- and inter-annual fluctuation												2		2	1	1	1				1	
Land use, Cover change, impacts on runoff												1		1			1				1	
Livestock												1	1	2			1				1	
Need to improve conservation to cope with CV e.g. through Rain water harvesting												1	1	2			1				1	
Optimal utilisation of available water resources												4	1	5	1		1				1	
Population structure/settlement pattern												4	1	5			1				1	
Rain fed agriculture												4	1	5			1				1	
Tourism												4		4	1		1				1	
Transboundary conflicts												1		1			1				1	
Use of carbon credit to finance power project												1		1			1				1	
Water quality												3	1	4			1				1	
Water Quality - eutrophication												1		1			1				1	
Water Quality - salinisation												1		1			1				1	

Table 4.14 Identification of Complementary or Otherwise Significant Concerns

CONCERN	Ref	NEL							EN				N° of Country workshops	N° of s/f workshops	Total N° of workshops	3rd+		Complementary to Ref N°	Low rank but multiple selection
		Burundi	Rwanda	Tanzania	Kenya	Uganda	DR Congo	Sub-regional	Sudan	Ethiopia	Egypt	Sub-regional				Workshops	Regional Collaboration		
Increased energy demand	1											8	2	10	3	3		n/a	
Irrigation	2											8	1	9	2	2		n/a	
Water Quality - pollution	3											5	1	6	4	4		n/a	
Water resources availability	4											6	2	8	4	4		n/a	
Watershed degradation (destruction of forests)	5											8	2	10	2	3		n/a	
Water supply & sanitation	6											9	2	11	1			yes	
Coping with droughts and floods	7											6	2	8	2	1		yes	
Biodiversity conservation	8											5	1	6	1			yes	
Improving / developing navigation potential	9											4	2	6				yes	
Wetland degradation	10											5	1	6				yes	
Optimal utilisation of available water resources	11											4	1	5	1			yes	
Population structure/settlement pattern	12											4	1	5				yes	
Rain fed agriculture	13											4	1	5				yes	
Soil/Bank erosion	14											3	2	5	3	3		yes	
Flood Forecasting and Preparedness	15											4		4	1	1		yes	
Tourism	16											4		4	1			yes	
Water quality	17											3	1	4				yes	
Water use efficiency demand / management	18											3	1	4	1	2		yes	
Declining water levels in lakes and rivers	19											3		3	2	2	4		
Drought Prediction	20											2		2	1	1	7		
Intra- and inter-annual fluctuation	21											2		2	1	1			
Livestock	22											1	1	2					
Need to improve conservation to cope with CV e.g. through Rain water harvesting	23											1	1	2					
Aquatic weeds	24											1	1	1			9		
Conflicts in water use (pastoralists etc)	25											1		1					
Land use, Cover change, impacts on runoff	26											1		1			5		
Transboundary conflicts	27											1		1					
Use of carbon credit to finance power project	28											1		1			1		
Water Quality - eutrophication	29											1		1			17		
Water Quality - salinisation	30											1		1			17		

4.3.4 Specific Concerns Clustered into Areas of Concern

As a result of the foregoing analysis, we are now left with a total of 25 specific concerns. However, it was agreed at the 2nd Regional Workshop (Entebbe 28/29 January 2008) i) that some of these specific concerns are cross cutting, namely all those concerning water quality; and ii) that despite its pressing importance at the national level, water supply and sanitation has very limited significance at the basin level (at least for the time being). In addition, the workshop agreed that climate change, which is a driving force behind many of the specific concerns, is an externality which will have to be increasingly factored into the decision making process (possibly in terms of scenarios or criteria concerning both adaptation and mitigation).

Removing all references therefore to water quality and water supply/sanitation brings the total list of specific concerns down to 20:

- Aquatic weeds
- Biodiversity conservation
- Coping with droughts and floods
- Declining water levels in lakes and rivers
- Drought Prediction
- Flood Forecasting and Preparedness
- Optimal utilisation of available water resources
- Population structure/settlement pattern
- Rain fed agriculture
- Soil/Bank erosion
- Tourism
- Use of carbon credit to finance power project

- Improving / developing navigation potential
- Increased energy demand
- Irrigation
- Land use, Cover change, impacts on runoff
- Water resources availability
- Water use efficiency demand / management
- Watershed degradation (destruction of forests)
- Wetland degradation

These can be clustered into “Areas of Concern”, and in some cases into several, see table 4.15.. At this stage the Consultant decided to include livestock because of i) its great economic and social significance in the basin and ii) its significant water demand as a sector. As will be seen below, Table 4.15 has been used in developing the conceptual design of the DSS. Therefore, because it is essential - in order to promote ownership and maintain momentum - that the conceptual design captures national and subregional concerns (to the greatest practical extent). Table 4.15 also provides therefore, an indication of the relevance of “Areas of Concern” to each of the national and subregional stakeholders as suggested by the occurrence and ranking of the specific concerns associated with an “Area of Concern” by each of the consultation workshops. In more detail, the designation “**high priority**” means that the average ranking of a particular country’s specific concerns that are relevant to the area of concern in question, is 7.5 or greater (analysis of the results by the Consultant showed that 50% of all specific concerns selected by the stakeholders ranked 7.5 or above, and 50% less than 7.5). Similarly “**priority**” means that the country in question selected at least one specific concern relative to the area of concern, but that the average ranking of the specific concern(s) did not equal or exceed 7.5. Blank cells signify areas of concern for which a particular country did not select any relevant specific concerns.

4.3.5 Comparison with Ongoing ENSAP and NELSAP Action Projects and Programmes

The NBI philosophy is that investment projects are identified and implemented at the subsidiary level, i.e. through NELSAP and ENSAP. Projects currently being implemented under the two SAPs should therefore reflect interests of the countries with respect to development of opportunities and addressing of key transboundary water concerns. It is helpful therefore at this stage to compare these areas of concern with ongoing ENSAP and NELSAP projects.

As far as NELSAP is concerned, the document “Strategy for Scaling Up NELSAP Investment Projects (endorsed March 2005) describes a three track approach. Track 1, which is intended to build on earlier results is concerned with multi-purpose development that includes: power generation and trade; irrigated agriculture, watershed management, transboundary parks and navigation. Its Development Objective, is “*Investment Projects implemented in power generation and trade and natural resources management and development delivering energy and meeting deficits for productive multipurpose use and sustainable livelihoods*”.

Track 2 is intended to promote economic growth and stability through major cooperative inter-country action in new geographic areas and sectors. Its Development Objective is “*Investment projects implemented in multiple Nile water related sectors delivering benefits to ensure sustainable livelihoods*”. According to the document, these water related sectors include:

- Agro-industrial production
- Re-afforestation management
- Water hyacinth control
- Large scale fishing
- Hydro-power
- Navigation for trade and tourism
- Tourism management
- Use of modern irrigation and rainwater harvesting techniques

Table 4.15 Areas of Concern and Specific Concerns

COUNTRY/SPECIFIC CONCERNS	AREAS OF CONCERN							
	Water Resources Development	Optimal Water Resources Utilization	Coping with Floods	Coping with Droughts	Energy Development	Rainfed and Irrigated Agriculture	Navigation	Watershed and Sediment Management
Burundi	high priority	priority	high priority	high priority	priority	high priority	priority	priority
Rwanda	high priority	high priority		priority	high priority	high priority		high priority
Tanzania	high priority	high priority		high priority	priority	high priority		priority
Kenya	high priority	high priority	priority	high priority	high priority	high priority	priority	high priority
Uganda	high priority	high priority	priority	priority	high priority	high priority		high priority
DRC	high priority	priority	high priority	priority	high priority	priority	high priority	high priority
Sudan	priority	priority	priority	high priority	high priority	high priority	priority	priority
Ethiopia	high priority	high priority	high priority	high priority	high priority	high priority		High priority
Egypt	high priority	high priority	priority	high priority	priority	high priority	priority	priority
aquatic weeds						aquatic weeds are known to thrive where fertiliser run-off is high	water hyacinth is a widespread constraint on effective navigation in the basin	

COUNTRY/SPECIFIC CONCERNS	AREAS OF CONCERN							
	Water Resources Development	Optimal Water Resources Utilization	Coping with Floods	Coping with Droughts	Energy Development	Rainfed and Irrigated Agriculture	Navigation	Watershed and Sediment Management
biodiversity conservation		there is a nexus between biodiversity and sustainable watershed services (see Harris's melbourne festival lecture 2000)						there is a nexus between biodiversity and sustainable watershed services (see Harris's melbourne festival lecture 2000)
coping with droughts and floods		sound water management contributes to drought mitigation	self-evident	self-evident				floods can cause major morphological changes; and are themselves made worse by watershed degradation
declining water levels in lakes and rivers	self-evident	self-evident						
drought prediction				self-evident				
flood forecasting and preparedness		operating rules for dams can be modified as a flood preparedness measure	self-evident					

COUNTRY/SPECIFIC CONCERNS	AREAS OF CONCERN							
	Water Resources Development	Optimal Water Resources Utilization	Coping with Floods	Coping with Droughts	Energy Development	Rainfed and Irrigated Agriculture	Navigation	Watershed and Sediment Management
improving / developing navigation potential		allocation of water for navigation purposes at the cost of other applications is a key resource management decision					self-evident	
increased energy demand	hydropower development is a possible way to increase the power supply	allocation of water for hydropower reduces its availability for other uses such as irrigation because demand patterns differ significantly			self-evident			
irrigation	new irrigation requires the development of new withdrawal and possibly storage infrastructure	irrigation is a large user of water, and allocation for it reduces its availability for other (possibly higher value) uses such as hydropower and industry		irrigation is a drought mitigating strategy		self-evident		

COUNTRY/SPECIFIC CONCERNS	AREAS OF CONCERN							
	Water Resources Development	Optimal Water Resources Utilization	Coping with Floods	Coping with Droughts	Energy Development	Rainfed and Irrigated Agriculture	Navigation	Watershed and Sediment Management
land use, cover change, impacts on runoff						self-evident		self-evident
livestock						livestock is a significant economic sector in the NB, and is also an important primary livelihood for much of its population. but as well as pasture/fodder, livestock also needs drinking water, which in turn may require the development of watering points		
optimal utilisation of available water resources	self-evident connections to the area of concern	self-evident connections to the area of concern				the allocation of water for irrigation may affect its availability for household, or higher value uses		

COUNTRY/SPECIFIC CONCERNS	AREAS OF CONCERN							
	Water Resources Development	Optimal Water Resources Utilization	Coping with Floods	Coping with Droughts	Energy Development	Rainfed and Irrigated Agriculture	Navigation	Watershed and Sediment Management
population structure/settlement pattern			human settlements represent significant economic activities and benefits that can be compromised by floods, yet the unwise siting of such settlements can exacerbate flooding when they affect the performance of flood plains					
rain fed agriculture						rainfed agriculture is a net consumer of water, and farming system diversification can change catchment characteristics		

COUNTRY/SPECIFIC CONCERNS	AREAS OF CONCERN							
	Water Resources Development	Optimal Water Resources Utilization	Coping with Floods	Coping with Droughts	Energy Development	Rainfed and Irrigated Agriculture	Navigation	Watershed and Sediment Management
tourism	stored water provides amenity value and water sports potential	trade-off between amenity value and productive potential in other sectors					there is a large existing and potential nexus between navigation and tourism; increased tourism may represent increased demand for navigation, or alternatively improved navigation services might catalyse increased tourism	tourists are drawn to pristine, not degraded environments
use of carbon credit to finance power project					self-evident connections to the area of concern			
water resources availability		self-evident connections to the area of concern		self-evident connections to the area of concern				

COUNTRY/SPECIFIC CONCERNS	AREAS OF CONCERN							
	Water Resources Development	Optimal Water Resources Utilization	Coping with Floods	Coping with Droughts	Energy Development	Rainfed and Irrigated Agriculture	Navigation	Watershed and Sediment Management
water use efficiency demand / management	where water is scarce in comparison to the demands upon it, it is important to use it efficiently (in both physical and economic terms), this may require <i>inter-alia</i> the development of infrastructure to increase return flows, or to transfer water saved in one location for use in another	where water is scarce in comparison to the demands upon it, it is important to manage demand rather than satisfying it.				it is important to understand and apply efficiency targets that are appropriate for a particular scale (ie engineering efficiency at scheme level and economic efficiency at basin level), it is also important to provide effective mechanisms for reallocating saved water in the most advantageous fashion		
watershed degradation (destruction of forests)	watershed degradation decreases the manageability of water, and hence its development potential							self-evident connections to the area of concern
wetland degradation		if wetlands are to be sustainable, there is a maximum that can be safely withdrawn for other uses				agricultural run-off can compromise the sustainability and biodiversity of wetlands		self-evident connections to the area of concern

Track 3 is concerned with the preparation and implementation of new consultative, in-country Nile projects. Its Development Objective is “*People centred productive and sustainable use of in-country shared Nile water resources reaching economic cooperation*”. The following focal areas refer:

- Agriculture
- Re-forestation
- Wetland conservation
- Fisheries
- Hydropower
- Watershed management
- Flood and drought control
- Tourism
- River basin planning and development

Programmes currently being implemented under this aegis include:

- Mara River Basin Project Transboundary IWRM Project (Kenya and Tanzania)
- Sio-Malaba-Malakisi Catchments Transboundary IWRM Project (Kenya and Uganda)
- Kagera River Basin Transboundary IWRM Project (Burundi/Rwanda/Uganda/Tanzania)
- Lakes Edward and Albert Fisheries Pilot Project (Uganda/DRC)
- Lake Victoria Environmental Management Project II (Burundi/Rwanda/Kenya/Uganda and Tanzania)
- Regional Rusumo Falls Hydropower and Multipurpose Project (Rwanda/Burundi/Tanzania)
- Regional Interconnection Project (Rwanda/Burundi/Kenya/Tanzania/DRC).

With the exception of transboundary parks as a specific concern, the profound nexus between the NELSAP and the areas of concern identified above is clear.

With respect to ENSAP, initiatives focus on the following areas:

- **Irrigation and drainage**, under the aegis of the Eastern Nile Irrigation and Drainage Study, which itself is targeted at the following projects:
 - Irrigation and Drainage Project for Egypt
 - Irrigation and Drainage Project for Ethiopia
 - Irrigation and Drainage Project for Sudan
- **Energy** under the aegis of the Eastern Nile Regional Power Trade Investment Program. This is intended to promote regional power trade through coordinated planning and development of power projects and transmission interconnection in the context of multi-purpose water resources development.
- **Flood forecasting and preparedness**, under the aegis of the Eastern Nile Flood Preparedness and Early Warning – Phase I. FPEW I is planned for 3 years of implementation. It comprises three key components:
 - Regional Coordination
 - Pilot Flood Preparedness and Emergency Response
 - Flood Forecasting, Warning and Communication Systems
- **Optimal water resources allocation and development** under the aegis of the Eastern Nile Joint Multipurpose Program which is targeted at:

- Improved Livelihoods & Well-being
 - Accelerated economic development & growth
 - Increased Regional cooperation & integration
 - Improved Environment
 - Increased Access to Hydro-power
 - Improved management of watershed
 - Productive agricultural use of water resources
 - Water conservation improved
 - Flood/drought preparedness improved
- **Watershed degradation** under the aegis of the Integrated Watershed Management for which expected benefits will include erosion control leading to decreased siltation and sedimentation in downstream river/reservoir reaches, which will increase reservoir life, improve hydropower production and irrigation efficiency, as well as protect critical aquatic habitats. A second important regional benefit, which the sub-project will generate, is an overall increase in land productivity, which will yield higher agricultural outputs, and thus enhance food security and alleviate poverty.

Thus, as with the NELSAP initiatives, there is also a very close conformity between the identified areas of concern and the NELSAP foci.

4.4 Areas of Concern, Sample Decisions and the DSS Outputs Suggested by them.

For the purpose of conceptual design of the NB DSS, it is necessary at this stage of the analysis to suggest sample decisions typical of those that are likely to be supported in respect of the eight areas of concern, and thereafter to suggest also the nature of the DSS questions and outputs necessary to support these decisions.

Table 4.16 which consequently follows has been developed in a step wise fashion, beginning with a preliminary version proposed by the consultants in the first draft of this report (issued 13th January 2008) based on the consolidated results of stakeholder consultations. A second version was begun at the 2nd Regional Workshop (by Working Group A) and completed by experts at the NBI, followed by further amendments by the consultants.

The alternatives, sample decisions, questions and DSS outputs (criteria) in table 4.16 are formulated to guide the identification of models and data required for these outputs to be calculated. In the course of DSS design they have been translated into a set of core models and evaluation routines that can, together with (geo)statistical analysis and report generation tools, describe the individual alternatives and produce the required outputs (see Annex B, summary in the Main Report). A list and description of criteria the models can directly and reliably produce is provided in Annex B, section 4.5.1.

Table 4.16 Areas of Concern, Sample Decisions and Supporting DSS Outputs

Water Resources Development				
<p>This concern area focuses on those interventions targeted at altering the time and space distribution of water in the basin. Typical measures that are addressed are: storage reservoirs, water conservation interventions for reducing system losses, etc. Sectoral interventions, such as hydropower and irrigation are treated separately. As storage reservoirs can be part of sectoral development, some of the key questions are also relevant in those cases.</p> <p>Relevant examples from the Nile Basin include existing and contemplated storage dams for power generation, such as the Rusumo Falls in the NEL region, the Mandaya, Karadobi, Dal 1 dams in the EN. Existing storage schemes include the Roseries and High Aswan Dams, etc. Also potential benefits and adverse impacts of interventions planned to reduce system losses shall be studied with the help of the DSS. These are few examples and over time it is anticipated that the need to develop further regulation and conservation works demands flexible DSS design to address pertinent issues.</p> <p>The DSS shall be able to provide information required to identify potential merits and adverse impacts of such interventions. Examples of such decisions and key questions, which can be answered through the information generated by the DSS are given below.</p>				
Objective	Possible Alternatives	Sample Decisions	DSS Questions	DSS Outputs (Criteria)
Increased availability of water throughout the basin	<ul style="list-style-type: none"> • A few, large, basin level storage structures • Myriad small local level water harvesting schemes • Water conservation projects (loss reduction) 	<ul style="list-style-type: none"> • Selection of investment alternatives (e.g. small number of large, basin level storage facilities, or large number of small, local level storage facilities, or a combination of various alternatives?) • Configuration of the overall (macro level) system-wide water development plan • Determination of features of development schemes (location, scale of development, size of components) 	<ul style="list-style-type: none"> • What are the magnitudes of demands that the storage alternatives could fulfil? • What is the yield of the upstream catchment at the point of interest for the planned scheme at different levels of reliability? • What would be the reliability of a storage reservoir to meet the demands imposed on it? How would the reliability be affected due to climate change and variability? • What is the impact (+/-) of the intervention alternatives on flow: system wide water balance; peak and minimum flow at designated points? • How would key environmental assets be affected due to the flow regulation resulting from each alternative? 	<p>Bio-Physical/Environment</p> <p>Change in volume of water available:</p> <ol style="list-style-type: none"> 1. System wide (water balance) 2. At designated points in the river network (such as environmental hotspots, other points of interest) <p>Impact in salt-water intrusion (as a result of flow regulation upstream)</p> <p>Change in sediment movement downstream</p> <p>Effect on navigable water reaches (draft, length of reaches, etc)</p> <p>Change in annual dead storage volumes due to upstream sediment trapped etc</p>

			<ul style="list-style-type: none"> • What are the economic impacts of the alternative schemes? How many people will be displaced due to the planned storage scheme? • How would the flow regulations resulting from each alternative affect societies downstream? • What is the impact of each alternative on fisheries gene pools • Who is better/worse off for each alternative ? 	<p>Socio-Economic</p> <p>Change in benefits due to upstream sediment trapped</p> <p>Impacts on Navigation (gain/loss of revenue as a result of implementing alternative)</p> <p>FIRR/EIRR (or B/C) of alternative; or economic and financial unit costs of increased water</p> <ol style="list-style-type: none"> 1. No of people to be located (from reservoir area) 2. Change on no of people with access to safe water
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Optimal Water Resources Utilization

The focus here shall be those planning decisions required to enhance utilization of available water resources. It focuses on mainly non-structural interventions that would lead to more sustainable and efficient utilization of available water resources. Examples of interventions that fall under this category are joint/coordinated operation of reservoirs, demand management, modernization of agricultural practices (in subsequent phases), etc.

Objective	Possible Alternatives	Sample Decisions	DSS Questions	DSS Outputs (Criteria)
Increased efficiency of water use at the basin level resulting from increased engineering efficiency at user level	<ul style="list-style-type: none"> User financed water saving equipment and infrastructure Subsidised water saving equipment and infrastructure Demand management by means of a basin wide, rights based; water resource pricing mechanism Changed operating rules for large storage dams A combination of the above 	<ul style="list-style-type: none"> Comparison of alternative ways of increasing system efficiency, e.g. <ul style="list-style-type: none"> – basin wide resource priced demand management mechanism – investments in water saving infrastructure and equipment – subsidising of increased engineering efficiency at user level – introduction of penalties for wastage – changes of operating rules for dams 	<ul style="list-style-type: none"> Where in the basin exist opportunities for enhancing the physical and/or economic efficiency of water use? Where are the major losses in the system? How would water utilization be enhanced if available storage is operated in a coordinated manner? Can water be allocated advantageously to high value uses without compromising access to it by the poor under the possible alternatives? What are the investment implications for making water more economically mobile? What are the economic benefits accruing to each alternative? 	<p>Bio-Physical/Environment</p> <p>Net gain in water availability at basin and specific locations</p> <p>Impact (+/-) of contemplated alternative on downstream water flow</p> <p>Socio-Economic</p> <p>Net financial and economic productivity of water at basin level</p> <p>Impacts on recession agriculture downstream (reduction in grain production, etc)</p> <p>FIRR/EIRR (or B/C) of alternative; or economic and financial unit costs of increased water</p>

Coping with Floods

Priority with respect to this area of concern would be to support flood risk-management efforts in riparian countries. Main focus in the first phase of the DSS shall be to provide information on characteristics of flood prone areas, flow generation, assessing impacts of storage reservoirs on flood control, etc.

Objective	Possible Alternatives	Sample Decisions	DSS Questions	DSS Outputs (Criteria)
Reduced losses of life and livelihood in flood prone areas	<ul style="list-style-type: none"> • Changed operating rules of large storage dams • Flood management infrastructure • Restored flood plain functions • A combination of the above 	<ul style="list-style-type: none"> • Determination / selection of the most feasible flood-control schemes or mechanisms, e.g. <ul style="list-style-type: none"> – Changing operating rules of existing dams – Building of new dams for flood control purposes – Restoration of flood plain functions 	<ul style="list-style-type: none"> • What would be the impact of contemplated alternatives on flood peaks and areas of inundation? • What are the flood peaks at designated points of interest, with and without planned interventions? • How much flood damage can be avoided if storage reservoirs can be operated differently? Which operation rule produces the least flood damage? • Which parts of the basin are flood prone? What is the type of land-use practiced in these areas? • What are the average annual flood damages? • How would the proposed interventions affect downstream countries? • What the economic costs and benefits of each alternative 	<p>Bio-Physical/Environment</p> <ul style="list-style-type: none"> Peak flow conditions at designated points along the river network Changes to inundation patterns at designated flood prone areas Flood mitigation/control benefits Changes to the annual hydrograph and regime cycles that would impact capture fisheries <p>Socio-Economic</p> <ul style="list-style-type: none"> FIRR/EIRR (or B/C) of alternatives

Coping with Droughts

Priority in this area of concern shall be to support drought management efforts. Examples of areas where the DSS can contribute include identifying priority areas for interventions, evaluating degrees of vulnerability to drought impacts, evaluating performances of selected planned/implemented measures in alleviating drought impacts, etc.

Objective	Possible Alternatives	Sample Decisions	DSS Questions	DSS Outputs (Criteria)
Effective drought adaptation and mitigation strategies	<ul style="list-style-type: none"> Adapt to increasing drought conditions by increasing storage facilities Adapt to increasing drought conditions by increasing (conjunctive) use of groundwater Mitigate droughts by crop diversification and changing farming systems A combination of the above 	<ul style="list-style-type: none"> Comparison of alternative measures to enhance the resilience of the system to drought and reduce vulnerability Development of adaptation and mitigation strategies 	<ul style="list-style-type: none"> What are the historical patterns of drought (rainfall, flow, etc) in the basin? What are the inflow and climatic conditions in the short and medium term? (rainfall and flow forecasting) What are the degrees of vulnerability to drought (for different parts of the basin) How would performance of the system improve with respect to coping with drought if managed differently? (for example, if more flow regulation is provided?) How would the system respond to anticipated shortages How would the proposed interventions affect downstream countries? What are comparative costs and benefits of adaptation versus mitigation measures? What are the economic benefits accruing to each alternative? 	<p>Bio-Physical/Environment</p> <p>Information on severity of drought (Drought index and comparisons with earlier events)</p> <p>Predictions of flow conditions for short to medium term</p> <p>Operational updates on status of water availability in the basin (reservoirs, lakes, river flows, etc)</p> <p>Effect on availability of water during times of drought</p> <p>Socio-Economic</p> <p>FIRR/EIRR (or B/C) of alternatives</p>

Energy Production

This concern area focuses on development of hydropower potentials in the basin. The DSS shall support the efforts in the planning and management of hydro schemes.

Objective	Possible Alternatives	Sample Decisions	DSS Questions	DSS Outputs (Criteria)
Reliable power at adequate levels throughout the basin	<ul style="list-style-type: none"> Regional power trading based on a common grid and existing capacity Increase the installed hydropower generating capacity Feed into a common grid Focus on national or sub-regional self sufficiency 	<ul style="list-style-type: none"> Selection of investment alternatives Determining scale of development for new schemes Optimisation of scheme design and operation rules to best suit emerging needs Evaluation of hydropower compared to other possible solutions to the energy problem 	<ul style="list-style-type: none"> How much generation capacity is available in the Nile Basin (by country)? How much energy can be generated for a given configuration (of storage and power plant)? What are the economic benefits accruing to each alternative? How would existing hydropower generation schemes be affected due to the planned alternative (energy produced, unit cost, etc) What is the overall system-wide benefit in terms of energy generation under the various alternatives? What are the tradeoffs (sectoral and by country) necessary under each alternative? 	<p>Bio-Physical/Environment</p> <p>Increase in energy supplies (GWh/y); contemplated alternative and system wide</p> <p>Socio-Economic</p> <p>Unit costs of energy</p> <p>FIRR/EIRR (or B/C) of alternatives including tradeoffs with other alternatives (thermal, etc) and sectors (irrigation, flood control, etc)</p>

Rain fed and irrigated agriculture

This area focuses on assessing current productivity and production levels of both rain fed and irrigated agriculture, supporting efforts to increase food production through relevant interventions, etc.

Objective	Possible Alternatives	Sample Decisions	DSS Questions	DSS Outputs (Criteria)
Undeveloped irrigation potential fully realised in a sustainable fashion	<ul style="list-style-type: none"> • Run-of-river schemes • Storage based schemes • Groundwater based schemes • Conjunctive use schemes • Supplementary irrigation schemes 	<ul style="list-style-type: none"> • Selection of investment alternatives • Prioritisation of areas for irrigation development • Determining type and scale of development for new schemes • Optimisation of scheme efficiency • Minimisation of negative impacts 	<ul style="list-style-type: none"> • Which parts of the basin rely on rain fed agriculture (spatial information)? And which parts rely on irrigation? • What is the productivity level of agriculture in the Nile Basin? For rain fed and irrigated agriculture; what are the contributions of each to food production/security in the basin? • What are the crop water requirements for major growing areas in the Nile Basin? • How would rainfall variability affect crop production? • What is the effect on environmental/riparian streamflows for the various alternatives? Is there a hidden economic cost? • How much water is required for the specific irrigation developments in question? What is the trade-off with other uses (by sector and u/s – d/s) • What are the economic benefits accruing to each alternative 	<p>Bio-Physical/Environment</p> <p>Distribution of crop growing areas (rain fed and irrigated, spate)</p> <p>Change (+/-) in grain production and effect on community livelihood (poverty alleviation) (comparison among alternatives);</p> <p>Crop water requirements for selected points of interest</p> <p>Effect in flow at designated points (environmental stream flow) and overall system water balance</p> <p>Socio Economic</p> <p>Impact on human livelihoods</p> <p>Economic productivity of water at basin or sub-basin level</p> <p>FIRR/EIRR (or B/C) of alternatives</p>

Concern Area: Navigation

The focus in the first phase of DSS development would be to identify how navigation might be affected by contemplated interventions and support efforts to minimize the adverse impacts. In addition, more proactively, if required, navigation benefits can be considered in the planning and management of storage schemes. Interventions for improving channels or lake navigation may also be considered

Objective	Possible Alternatives	Sample Decisions	DSS Questions	DSS Outputs (Criteria)
Navigation in the Basin not constrained by inadequate draft depths	<ul style="list-style-type: none"> • Increase and maintain draft depths by releases from storage dams • Increase and maintain draft depths by dredging • A combination of both 	<ul style="list-style-type: none"> • Selection between alternatives • Optimisation of operation rules (releases from storage dams) to minimise impacts on navigation potentials of rivers and lakes downstream 	<ul style="list-style-type: none"> • Which parts of the river system are navigable and what are their characteristics (length of reach, width, depth, minimum depth requirements, etc) • What is the likely impact of an upstream development (water abstraction, flood releases, flow regulation), etc • What would be the impact of sediment transport on navigation potential? • What are impacts of anticipated climatic variability on navigable reaches and lakes for each alternative? • What would be the annual transport capacities of the reaches (tons) and what is their economic value for the alternative approaches? • What are the economic benefits accruing to each alternative 	<p>Bio-Physical/Environment Impacts on navigation potential of navigable reaches and water bodies</p> <p>Socio Economic FIRR/EIRR (or B/C) of alternatives</p>

Watershed and Sediment Management

Potential scope of DSS with respect to this area of concern would be evaluation of impacts of alternative land use/cover on hydrology of the river system, estimation of sediment yield, reservoir sedimentation, etc.

Objective	Possible Alternatives	Sample Decisions	DSS Questions	DSS Outputs (Criteria)
Economic development in the basin not constrained by excessive sediment or un-natural turbidity cycles	<ul style="list-style-type: none"> • Large scale terracing • Agroforestry • Sediment interception structures 	<ul style="list-style-type: none"> • Comparison of alternative strategies • Identification of priority areas of intervention • Determining sizes of dead storage for reservoirs 	<ul style="list-style-type: none"> • Which watersheds of the Nile Basin are most severely degraded? How does this relate to population pressure? • What is the sediment yield distribution by basin/watershed? • What is the expected sediment yield with/without a planned intervention? • What are the economic benefits accruing to each alternative 	<p>Bio-Physical/Environment</p> <p>Change in sediment movement (quantity)</p> <p>Change in reservoir/canal sedimentation downstream</p> <p>Changes in channel morphology downstream</p> <p>Change in erosion rate</p> <p>Effect on water availability</p> <ol style="list-style-type: none"> 1. System wide water balance 2. Change in peak/minim flow downstream <p>Change in hydrology of wetland: Depth of water, areal extent, flow hydrograph, etc;</p> <p>Socio Economic</p> <p>FIRR/EIRR (or B/C) of alternatives</p>