Databases for improved management of the Kuiseb River Basin, by the KBMC: Considerations, recommendations and an Action Plan

By:

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A. Database for use by the Project Team, and information processing

The Geographer was asked to recommend database and information processing format(s) for hosting and referencing baseline information and other work produced in terms of this assignment, and to subsequently serve as initiating database for the KBMC. To achieve this it was important to consult with the rest of the team to find out what kinds of data they would make use of to compile the individual expert report. This was done by e-mail, see Annex 1. The query resulted in a very limited responses. The hydrology department within MAWF responded that they are making use of a hydrology database, however, no more specific information about kind of information, which variables and spatial and temporal extent of datasets was communicated. The second data set referred to by two of the consultants was the GIS database developed by the DRFN for the Kuiseb Profile. Based on these limited responses to the survey it can be concluded that most of the experts have compiled their reports without making use to any extensive datasets or databases that can be regarded to be useful to the KBMC and their decision-making. However, three different databases can still be developed, making use of the data referred to, i.e. the GIS data originally developed for the KBMC Profile, a Meta database describing this data, and other GIS data sources held by the Hydrology department in MAWF, and finally a searchable database comprising all experts reports and annexes to be produced for the Water Resource Management Plan.

Brief description of the three databases developed for the KBMC

GIS database

This database contains all the GIS files and related attribute data that have been created for the Kuiseb Profile. The database is ordered into a simple thematic structure, i.e. GIS files related to a theme, e.g. rainfall are all stored in the same folder, making the compilation of maps straight forward. Projects are saved in a separate folder on the same level as the theme folders.

Data format of the GIS database

All GIS files are in ArcView format, i.e. shape files (*.shp). ArcView is presently the most commonly used vector based GIS software in Namibia. The latest version of ArcView is called ArcGIS, which is a software package that provides far more analytical capabilities compared to ArcView, and a package that the KBMC should consider to use if the advanced GIS analysis is required by the committee. The ArcView shape files are compatible with ArcGIS which will make the use of the data in its present form possible without any complicated conversions.

All files are using the WGS84 map datum and decimal degrees. It is possible that other GIS data sets available for the basin are using the Schwartzeck map datum, however, the differences between these two projections are negligible for the area covered by the Kuiseb River Basin. The metadata for these GIS files are presented in the second database developed for this project, the Meta database.

The Meta Database

This database contains all the information about the different GIS datasets that have been located during this consultancy. Sources are the DRFN, MAWF Hydrology department and the Atlas of Namibia. The Meta database is a basic searchable database with the following fields: ID, Type, Format, File name, Description, Source and Link. The **ID** is just a unique identified for each file. The **Types** of data are: Text, Point, Polyline or Polygone. The **Format** of data is for instance ArcView shape file, Excel, Word. **File name** is the name of the file as stored on disk. The **description** field provides with additional information about the origin of the dataset and other descriptive information. The **source** gives an indication of which institution that has the original data. Finally the **link field** is a hyperlink that links the user to the dataset if it is on disk. Note that not all datasets are accessible via this Meta database. It is also important to note that this is a working database; it does not provide all necessary information required to locate each and every

dataset described. This database will have to be further developed and maintained by the KBMC according to the Action Plan 10 prepared for the geographic component of the WRMP. It is important that the Meta database of the KBMC does not try to replicate already existing data, i.e. to store copies of information already being maintained and stored elsewhere. Instead it will be important to provide direct on-line links to these databases. The modalities of such a link has to be analysed and developed on a case by case level, as format of stored data, and possibilities of remote access to existing databases will differ between different databases. The requirements for such a database will be further elaborated in section B. below.
The format of this Meta database is presently in Microsoft Access. However, if the KBMC intends to develop a more extensive Meta database with external links to the databases and data sets referred to in the Meta database, then a more advanced database engine would be required. For more details about the suggested design of such a database, see section B. below.

The searchable source material database

This database consist of all documents produced for the WRMP. All files are indexed and fully searchable via a web interface. All files together with the index and the search engine is stored on a CD, which makes distribution of the source material very convenient. Furthermore, the source material can be added to an existing web site, e.g. a KBMC web site and be made available to anyone with Internet access. The KMBC will be provided with the specialist software required for the indexing of source files. This allows KBMC to expand on the source documentation as new information of relevance to the WRMP is generated.

B. Database and GIS for the KBMC

Central to this task is to identify what databases the KBMC require. To answer this question all members of the KMBC were asked to give their views of how they perceive the database(s) and what data these should contain, and for what the stored data would be used. The query did not generate many responses, a total of three members of the KBMC gave their inputs, summarised below.

"…I have learned in the past that the issue about databases and appropriate software is almost as important as the study itself. It appears to me that the consultants wants to use a GIS application. I would recommend that the consultants consult your (GTRCs) drawing/GIS office to agree on compatible software. I believe that the database will be used to update and manage the existing and proposed outputs. These outputs will most probably be in the terms of reference." Nico vd Westhuizen.

"I have already given you my perspective based on what the PSC has discussed: the KBMC itself will require this database in order to be able to derive "informed decisions", such as license applications it is asked to comment on, and to serve the research community as well as incorporate their findings (e.g. water resources in dams in a particular year, or groundwater level status, or number of people in a given area). It will need to be "driven" by an institution, and Gobabeb is well placed to be this institution (this was previously proposed by others of the KBMC)." Dr. Joh Henschel, Gobabeb Training and Research Centre.

"The database should include metadata and, where useful and feasible, on-line links to other database systems. Replication of other database systems results in outdated and corrupted sets of data." Guido van Langenhove, DWA, MAWF.

Based on these three contributions from the KBMC the following recommendations towards the establishment of a KBMC database can be made:

1) It was stated that the design of the database and the software used for the database engine is as important as the data it stores. This is a true reflection. Therefore the geography expert consulted with a number of database experts to find out what would be the best solution for a database to be used by the KBMC. It was suggested that the KBMC purchases a server, running SQL server and uses a web interface for both maintenance of the system and user access to

data. A quote for the suggested system is given in annex 2. The initial Meta database developed by the geographer, based on the data used by the consultants appointed for the development of the WRMP was done using Microsoft Access. However, this is only a temporary solution as Access is mainly suited for single user desktop solutions. As is further elaborated in Action Plan 10, based on the suggestions made by database experts, it is recommended that the KBMC secures funding to establish a web based SQL database, which would allow the committee to develop a database that allows multiple users to simultaneous access and manipulation the data and, maybe most importantly, provides external users of the information with a platform independent interface, only requiring access to the Internet and a computer with a modern web browser. However, one should note that for further analysis of data stored in such a database, special software, e.g. ArcView or statistical packages would be required. It is also possible to develop web based GIS applications, giving users the possibilities to carry our limited map production, e.g. overlaying different themes, producing thematic maps and carry out some limited spatial analyses. However, the author would not recommend the KBMC to adopt this approach as the analytical capacity of such a web based GIS system is limited and functionality is commonly severely hampered by slow Internet connections. It is therefore recommended that data that is made available from the KBMC database via a web interface is made downloadable, allowing the user of the data to analyse the data using local specialist software.

2) GIS data is central to the KBMC, therefore a user-friendly GIS database needs to be developed. A first database will be provided to the KBMC, giving them access to all data collected by the DRFN for the Kuiseb Profile together with the freely available Atlas data (Mendelsohn et al., 2002), see section A. All these datasets are ArcView Shape files that can be used for map making and further analysis of the resources of the Kuiseb River Basin.

3) it was recommended that the Geographer consult with the drawing/GIS office of GTRC. This has been done and it has been confirmed that the centre has access to the ArcView package. The same applies for the MAWF and its Directorates. It is recommended that WGS84 is used as the map datum for the shape files, and geographic coordinate system is applied. These are standards that are fully compatible with modern GPSs. By deciding on a specific system the KBMC minimizes the risks of collecting data without knowing what projection was used. The standard to finally be adopted by the KBMC should also consider the format of reporting of geographic coordinates as GIS systems think in decimal degrees, while humans tend to find it easier to communicate using degrees, minutes and seconds. Commonly there is confusion between data collected in degrees, and decimal minutes and the more common format of degrees, minutes and seconds. To avoid these misunderstandings a clear standard should be defined that suits everyone involved in data collection and analysis within the KBMC.

4) If the KBMC require the database to support their decision making for license applications, serve the research community as well as incorporate primary data, then the suggested web based SQL server seems to be the right way to go. The SQL server will be able to handle these diverse data sources, even the GIS data (that would have to be manipulated using ArcView/ ArcGIS or any other compatible GIS software). A main advantage of the SQL server is that it is a professional database system allowing multiple users that can maintain and access the data using a web interface, which benefits already have been alluded to.

5) The driver of the KBMC database is a central issue. It has been suggested by several members of the KBMC that Gobabeb should house and operate the KBMC database. This is a good suggestion as this is a training and research centre situated in the basin. The institution has a long history of data collection, storage and analysis. However, if the KBMC wishes to share the information in the database to a wider group than just the researchers at Gobabeb, then the present Internet connectivity at Gobabeb will not be enough. However, if a sustainable solution to the present Internet problems at Gobabeb can be found then the Geographer agrees with the suggestion that Gobabeb would be a suitable host of the database(s). It is important for KBMC to realise that they will have to secure funding for the purchase, design and operation of this database, aspects that are further elaborated in the proposed Action Plan 10.

6) The importance of Meta data and the problems associated with replication of other databases into a new database was emphasised. This is a very valid point that also already was elaborated above. The Meta database that should be further developed and optimised by the KBMC should, when possible, have direct online links, allowing the user of the Meta database to access the required data from the primary databases located elsewhere. There are several advantages with this. By only having one data set at one location, i.e. in the primary database, the user is always using the most recent up to date information. Copies of databases often leads to outdated information as the institution sitting with the copy of the active database normally don't have the mandate, nor the resources to update the information. As was eluded above, the configuration of such direct linkages to primary databases has to be developed on a case-by-case basis. Central here is of cause data security and copyrights to the primary data. There are issues that the KBMC will have to negotiate with the individual institutions having databases that are of relevance to the KBMC.

Annex 1. Database Survey form

Survey of data used for the development of the KMBC WRMP

Dear KBMC WRMP Team member,
We are now well into our task of developing a water resource management plan for the Kuiseb Basin Management Committee. My role as the geographer on the team requires me to identify datasets (Table 1) and databases (Table 3) that would be of relevance to the plan and the KBMC. Now is the optimal time for this survey as all of you have spent time developing your individual expert contributions, and therefore would be well acquainted with the data that exists within your field.

A. Survey of datasets of relevance for the KBMC WRMP
I therefore kindly ask you to provide me with the following information about the data sources you have made use of, or are aware of, that are of relevance for the WRMP (please fill out one form per data set):

Table 1. Metadata form for datasets used for the development of the KBMC WRMP. Note that some of the requested information only applies to geo-referenced data. It is assumed that all datasets have a geographic extent, however, if you have used datasets that are not geographic, please add these as well. Please copy the table for each data set.

Dataset title	
Dataset reference date	
Dataset topic category (see table 2)	
Dataset type (tabular, vector GIS, raster GIS, satellite image, report, other publication)	
Creator of the dataset	
Point of contact (from where can the data be obtained)	
Geographical location by coordinates (if applicable)	
Geographical location by region (national, regional, Kuiseb River basin, specific part of the basin)	
Spatial resolution (if applicable)	
Reference system (e.g. WGS84, UTM)	
List of relevant attributes (comma separated)	

Table 2. Dataset topical categories

ISO 19115 Topic Categories
farming
biota
boundaries
climatology/meteorology/atmosphere
economy
elevation
environment
geo-scientific information
health
imagery/base maps/earth cover

B. Survey of databases of relevance for the KBMC WRMP

If you are working with, or are aware of any databases that would be of relevance for the KBMC, please provide me with the following information:

Table 3. Information about databases that would be of relevance for the KBMC. Please copy the table for each database.

Database title	
Database topic category (see table 2)	
Database content (list of relevant attributes is applicable)	
Point of contact, who is maintaining and/or hosting the database?	
Can KBMC make use of the database?	

I would appreciate your contributions before the 15th of July. Please send your reply to patrik.klintenberg@drfn.org.na

Regards,

Patrik

Annex 2 Quote for required hard and software for the KBMC database

Software required:

Logical Networks (Pty) Ltd
Vat No. 2137585-01-5 Reg. no. 98/082
Service Road, 161 Mandume Ndemufayo Avenue
P.O. Box 22772
Windhoek
NAMIBIA
Tel. +264-61-27 3900
Fax +264-61-27 3909
e-mail: sales@logical.com.na

Quote No: SDW 39630.436

Attention: Patrik Klintenberg
DRFN

NAMIBIA
Telephone: 264-61-377500
Facsimile: 264-61-230172
Quotation Date: 2008/07/01
Salesperson: Sarel de Waal

Item	Product Description	Qty	Unit Price	Extended Price	Item Code
1	Windows Svr Std 2008 Sngl OLP NL	1	N$6,354.00	N$6,354.00	P73-04190
2	Windows Server CAL 2008 Sngl OLP NL Device CAL	5	N$256.00	N$1,280.00	R18-02729
3	Windows Svr Std 2003 R2 w/SP2 32-bit/x64 English Disk Kit MVL CD	1	N$221.00	N$221.00	P73-02703
4	0	1	N$0.00	N$0.00	0
5	SQL Svr Standard Edtn 2005 Win32 Sngl OLP NL	1	N$7,751.00	N$7,751.00	228-04455
6	SQL CAL 2005 Sngl OLP NL Device CAL	5	N$1,416.00	N$7,080.00	359-01911
7	SQL Svr Standard Edtn 2005 Win32 English Disk Kit MVL CD/DVD	1	N$221.00	N$221.00	228-05236
8	0	1	N$0.00	N$0.00	0
9	0	1	N$0.00	N$0.00	0
10	0	1	N$0.00	N$0.00	0
11	0	1	N$0.00	N$0.00	0
12	0	1	N$0.00	N$0.00	0
13	0	1	N$0.00	N$0.00	0

Comments	

Subtotal:	N$22,907.00
VAT 15%:	N$3,436.05
TOTAL:	N$26,343.05

Terms and conditions:
Prices quoted are subject to change resulting from fluctuations in forex rates, government duties, taxes, surcharges, freight and other related costs.
US$ Rate:
This quotation is valid for 7 days.
Payment terms are strictly 30 days from date of delivery.
Delivery: 7 to 9 weeks from date of order
Ownership of all goods supplied remain vested in Logical Networks until payment has been received in full.
E&OE
The Standard Trading Terms and Conditions apply which are available for download at http://www.logical.com.na

Please do not hesitate to contact us if you have any further queries.
Sincerely yours,
Business Development Department

Hardware required:

Logical Networks (Pty) Ltd
Vat No. 2137585-01-5 Reg. no. 98/082
Service Road, 161 Mandume Ndemufayo Avenue
P.O. Box 22772
Windhoek
NAMIBIA
Tel. +264-61-27 3900
Fax +264-61-27 3909
e-mail: sales@logical.com.na

Quote No: SDW 39630.442

Attention: Patrik Klintenberg
DRFN

NAMIBIA
Telephone: 264-61-377500
Facsimile: 264-61-230172
Quotation Date: 2008/07/01
Salesperson: Sarel de Waal

Item	Product Description	Qty	Unit Price	Extended Price	Item Code
1	Server Tower ProLiant ML310 G5 DC Xeon 3065 (2.33Ghz), 1GB (1x1GB); 1x250GB HP SATA; DVD-Rom	1	N$7,630.00	N$7,630.00	470064-657
2	Memory UB 1GB PC2-6400 (1 x 1GB) Kit (DL320 G5p;ML110 G5; ML310 G5)	3	N$750.00	N$2,250.00	450259-B21
3	Hard Drives 500GB Pluggable SATA 7,200 rpm	3	N$3,121.00	N$9,363.00	395473-B21
4	Smart Array P400/256 SAS Controller (RAID 0,1,1+0,5,ADG) PCI-Express	1	N$4,131.00	N$4,131.00	405132-B21
5	0	1	N$0.00	N$0.00	0
6	0	1	N$0.00	N$0.00	0
7	0	1	N$0.00	N$0.00	0
8	0	1	N$0.00	N$0.00	0
9	0	1	N$0.00	N$0.00	0
10	0	1	N$0.00	N$0.00	0
11	0	1	N$0.00	N$0.00	0
12	0	1	N$0.00	N$0.00	0
13	0	1	N$0.00	N$0.00	0

Comments	

Subtotal:	**N$23,374.00**
VAT 15%:	N$3,506.10
TOTAL:	N$26,880.10

Terms and conditions:
Prices quoted are subject to change resulting from fluctuations in forex rates, government duties, taxes, surcharges, freight and other related costs.
US$ Rate:
This quotation is valid for 7 days.
Payment terms are strictly 30 days from date of delivery.
Delivery: 7 to 9 weeks from date of order
Ownership of all goods supplied remain vested in Logical Networks until payment has been received in full.
E&OE
The Standard Trading Terms and Conditions apply which are available for download at http://www.logical.com.na

Please do not hesitate to contact us if you have any further queries.
Sincerely yours,
Business Development Department