MINUTES
work meeting on RIVERTWIN project held during visit of T.Gaiser to Tashkent
(27.06 – 2.07.2005)

27.06.
First meeting under the RIVERTWIN project. Presented: T.Gaiser, Yu.Kh.Rysbekov, A.I.Tuchin, A.G.Sorokin, I.B.Ruziev, V.G.Prikhodko, O.Usmanova.
Work schedule for a period of T.Gaiser's visit was discussed (all participants).
General discussion was held (all participants).
Structure and operation of the HBV-Chirchik model was demonstrated per two program blocks:

- "Flow formation zone" (A.Sorokin, V.Tyugai) – results of HBV-IWS model (Fortran) adaptation to flow formation zones in Chirchik and Akhangaran river basins,
- "Distribution network" (A.Sorokin) – results of modeling distribution network in Chirchik-Akhangaran-Keles basin as executed in GAMS. Progress report on this block was presented with indication of achievements (as for 25 June) and planned future activities.

Issues related to preparation of input information for block "Flow formation zone" HBV-Chirchik were discussed.

28.06. – 29.06
Work program of T.Gaiser included consultations and assistance on EPIC model, database SOTER, preparation of data for SLISYS. Participated: G.Stulina, programmet G.Solodky, technician R.Sherkhodjaev.

30.06.
Development of future development scenarios was discussed (T.Gaiser, Yu.Kh.Rysbekov, G.Stulina, V.G.Prikhodko, I.B.Ruziev, O.Usmanova).

1.07.
Meeting in SIC ICWC information center (O.Usmanova, A.Sorokin, A.Kats, D.Sorokin, S.Zherelieva, V.Shakhov, T.Poltareva, A.Degtyareve). GIS, DB structure, its filling and DB interface were demonstrated.
Filling of DB with data on Kazakhstan (data is available) and Kyrgyzstan (data is not available), with its respective presentation in interface is not completed yet.
It is decided to created additional GIS layers on land use (G.Stulina, S.Zherelieva).

2.07.
Final meeting of work team (T.Gaiser, A.I.Tuchin, G.Stulina, A.G.Sorokin, O.Usmanova). Issues related to linking of the models were discussed (A.Tuchin reported). Summing up on T.Gaiser's visit to SIC ICWC.

Work progress is described below.

1 STATUS OF DATABASE

ATTRIBUTE DATA

A. Hydrological

Tables were created on the following parameters: river discharge per gauging station; water withdrawal in canal heads, per waterworks facility; water supply in canals at rayon boundaries, including for irrigation and non-irrigation needs; total withdrawal to rayons; discharge of collector-drainage waters per rayon per collector; industrial and municipal waste flows; volumes, inflow to and releases from reservoirs; water transfer between the basins; outflow from canals; outflow from collectors into rivers and canals.

There are 38 tables in the database; information lines – 15975; percentage of filling with data - 92%.

<u>Groundwater</u>

Tables with the following parameters: reference information: list of rayons, cities, deposits, basins, abstraction points, approved exploitable volume of groundwater; on-line information: hydrological indicators of aquifer, water use;

Total tables in the database – 7, information lines – 356, percentage of filling with data – 96%

B. Socio-economic and energy sector

Tables with the following parameters: reference information: list of rayons, cities; on-line information – Gross Domestic Product (GDP), structure of GDP, foreign trade turnover, capital investments, agricultural and industrial production volumes, market output prices, production price, purchasing prices, population, population development, migration, labor resources, employed population structure, salaries, job creation, per capita food consumption, per capita food production, industrial production, structure of industrial production, provision with running water and gas.

Total tables in the database - 20, information lines – 2576, percentage of filling with data – 91%

<u>Energy sector</u>

Tables with the following parameters: reference information, discharge, levels and generation per HEPS object, reference information on thermal stations. Total tables - 4, percentage of filling with data – 80%.

C. Water quality

Tables with the following parameters: reference information – list of sampling points; on-line information – biogenic elements and organic matters, metal content, salinity, physical and chemical parameters, organic pollutants and pesticides, ion composition;

Total tables – 7, information lines – 9046, percentage of filling with data – 98%

D. Agricultural production

Tables with the following parameters: reference information – list of republics, rayons, cities; seeding and harvesting dates; crops; specific crop water consumption; production; irrigated lands – cropped area per main crops, crop yield, total yield; rainfed lands - cropped area per main crops, crop yield, total yield; fish catch, fish processing; mineral fertilizers, livestock breeding.

Total tables – 13, information lines – 8421, percentage of filling with data - 95%.

E. Land Use

Tables with the following parameters: reference information – list of rayons, list of cities, soil texture, according to FAO's classification; list of republics; drainage area; drainage modulus; gross area (distribution of gross area); distribution of irrigated area depending on degree of salinization; distribution of irrigated area per irrigation source; farming forms (number and mean weighted area); distribution of irrigated area depending on productivity class; land fund; distribution of irrigated area depending on groundwater salinity; distribution of irrigated area depending on GW level; distribution of area per soil type.

Total tables – 11, information lines – 2043, percentage of filling with data - 90%.

Soil database (G.Stulina) is 80% completed, represented in EXCEL tables using coding of DB "SOTER". Missing data mainly relate to physical and water-physical parameters FC, WP, bulk density. 32 SOTER- units are selected for soil description. Each of the units has characteristics of terrain, soil and is described by typical soil profile.

Climate data on 6 weather stations for a period since 1980 to 2004 are given in full in SLISYS formats.

GEOMETRIC DATA (GIS)

A. Hydrological

Created layers: gauging stations, head intakes, rivers, canals, reservoirs, waterworks facilities, canal outflow points, collector outflow into rivers and canals, groundwater deposits, group groundwater abstraction

B. Socio-economic and energy sector

Created layers: administrative division – states: Uzbekistan, Kazakhstan, Kyrgyzstan – rayons in the basin, settlements, hydropower stations, weather stations.

C. Water quality

Created layers – industrial and municipal pollutants.

D. Agricultural production

Created layers – irrigated lands per rayon in project area.

C. Land Use

Created layers: soil types, ecological zones, conservation zones, mammal and bird habitats.

2 STATUS OF MODELS

A. HBV-CHIRCHIK (A.Sorokin)

Hydrological model is being developed in two directions:

- Adaptation of the HBV-IWS model to Chirchik and Akhangaran river basins for flow formation zone,
- Development of block for distribution network in Chirchik, Akhangaran, and Keles basins, including Syrdarya river reach in points of their outflow.

Hydrological base HBV-CHIRCHIK was developed. (Report "D9 Hydrological base of modeling (schemes, links) in the Chirchik basin" will be submitted in early August 2005).

5 sub-basins were selected in the Chirchik river basin – three sub-basins are along inflows to Charvak reservoir (Pskem, Koksu, Chatkal) and two sub-basins are downstream of Charvak reservoir – right tributary Ugam and left tributary Aksagata. Three sub-basins were selected in the Akhangaran river basin – the first one is along the Akhangaran river and its tributaries upstream of Akhangaran reservoir, the second one is downstream the reservoir along tributaries up to Sharkhinsky waterworks facility (right tributaries Dukan, etc. and left tributaries Naugarzan and others), and the third sub-basin is along tributaries downstream of Sharkhinsky waterworks facility (Shavazsay, etc.). The Keles river basin is represented by one sub-basin. Besides, sub-basin of Parkent rayon's rivers flowing into Left-bank Karasu (Parkentsay, Kyzylsay, etc.) is considered separately. Thus, Chirchik-Akhangara,-Keles basin in flow formation zone is divided into 5 + 3 + 1 + 1 = 10 sub-basins.

16 planning zones (water-management areas) were selected in the flow distribution zone. These zones are linked with each other through river, irrigation, and wastewater disposal networks, with 10 flow formation sub-basins, as well as with reservoirs, waterworks facilities, HEPS, thermal power stations, groundwater abstraction points, a water supply network "Vodokanal" and the main industrial and municipal pollution sources.

Structure of the distribution and disposal network in Chirchik, Akhangaran, and Keles basins was realized in GAMS and test calculations were made.

Further work plan on HBV-CHIRCHIK development is as follows:

- Realization of the accepted flow formation zone structure in HBV model (Fortran). This includes division of sub-basins into zones depending on altitude, their linking with major nodes (gauging stations) of the river network,
- Preparation of input information for HBV (Fortran) on flow formation zone, i.e. work with digital elevation model and GIS in part of distribution of input parameters among the selected zones (temperature, rainfall, land use and respective transpiration coefficients, soil physical characteristics, etc.),
- Calibration of HBV parameters for the flow formation zone,

- Linking the flow formation zone (Fortran) with distribution-disposal network (GAMS) and DB, testing HBV-CHIRCHIK.

B. WAVE-LARSIM -CHIRCHIK – (A.Tuchin)

WAVE-LARSIM is a hydrodynamic model of stream moving in open channels. The model is based on a system of partial differential equations derived from two-phase liquid mass and momentum conservation law, with assumption that the volume of solid phase (this case - salinity) is quite small and only forms medium ecology, while momentum conservation equations are written as for homogeneous liquid with variable density. The boundary conditions for the model are formed by outputs of HBV-CHIRCHIK, MODFLOW, Reservoir model and by physical and climatic characteristics of given year. Input data for the hydrodynamic model include: topographic map of relief; graphical layout of supply and discharge canals and collectors; time series of inflow with salinity and temperature values; graphs of temperature fluctuations and evaporation function. Modeling results are the series of tables representing stream parameters for a river section, the values of water plane and salinity, depending on status of the object and water inflow. The model operates in hydrological mode (together with the Reservoir model) and in ecological mode (together with QUAL2K- CHIRCHIK)

C. QUAL2K-CHIRCHIK – (A.Tuchin)

QUAL2K is a model that describes changes in water quality in river sections and reservoirs under influence of temperature and hydrodynamic factors. According to the protocol of February 5, 2005, specific QUAL2K-Circhik is needed for the ChAK basin in order to meet actually available data and general composition of the models from Hydrological block. The QUAL2K-Circhik is based on solutions of the WAVE-LARSIM model in part of hydrodynamic parameters and salinity. Besides, algorithm for calculation of temperature fields along the stream length was changed in QUAL2K-Circhik in order to consider stream movement in dry channel. Moreover, additional algorithm was included for linking time series of inflow, temperature, rainfall and evaporation function from climatic block. QUAL2K-Circhik uses interface of WAVE-LARSIM.

D. EPIC, SLISYS-CHIRCHIK (G.Stulina)

Monitoring data on cotton production in Fergana Valley, Uzbekistan were used in testing the EPIC model. Since earlier we received the model version EPIC 3060, preparation of data and calculations were executed in this version. Additional consultations were received on formation of input files and mistakes were analyzed. It was planned to use DB 2 database for formation of input files.

During visit of expert T.Gaiser, an attempt was made to apply approach - which is used for the Nechar basin - when input data to EPIC are directly taken from the database. However, a number of technical differences were found during this process, in particular:

- Hohenheim University uses WINDOWS NT4 as a main operating system, and we use WINDOWS XP.
- The University uses DB 2 database developed by IBM and we use ACCESS-2000.
- As an input tool, the University uses LOTUS, while we can use EXCEL.

We tried to run DB 2 in WINDOWS XP environment and copy into it information from an old DB 2 brought by the expert. But the problems occurring during the process seemed to be endless. Finally, the following was decided:

- The expert T.Gaiser creates analogue of his DB (DB 2 in WINDOWS NT4) under ACCESS-2000 in the near future.
- All tables and fields of the created DB are described in details by the expert.
- Within the created DB, an interface is developed for preparation of input data and control parameters for the EPIC model. This interface should also run EPIC and then input the output into the DB. The interface should operate both in Russian and English.
- EXCEL should be used for preparation of initial data.

T.Gaiser referred to similar interface developed by a team of American specialists. However, attempts to load it from Internet were unsuccessful. Besides, we are not certain that information structure in DB created by the expert and that in DB used in the American program are the same. It was agreed that the expert would send a new version of DB – ACCESS in one or two weeks.

Work plan for July-August:

- test the EPIC model by using data from pilot field in Fergana Valley;
- develop database interface for formation of input files for EPIC;
- link soil data with the soil map in GIS.

E. **ECONOMIC MODEL (A.Tuchin) – model of Planning zone,** an object, which consumes water resources per economic sector, with their following re-distribution (in time and space) and change in their quality. Within the framework of given project, Planning zone management is performed through water volumes under current (or as set in a scenario) development conditions in each rayon. Result of consumption in Planning zone is expressed in meeting water demand of population and different water-related sectors, among which only agricultural objects are modeled in details. Change in number and quality of water resources has direct impact on volume of agricultural production through water supply to crops and indirect impact through state of soils changing due to variation of soil salinity during leaching. The Planning zone is formalized in form of an open system with lumped parameters, where input is climatic characteristics, rayon's economic development indicators, inflow hydrographs per sector, and output is income, hydrographs and salinity of collector-drainage flow, as well as a range of socio-economic indicators as set by basin development scenarios. Productivity of irrigated plots is calculated by the **EPIC.** Water distribution among economic sectors is determined according to the scheme in **WEAP** model**.** Composition and structure of hydrological links (inflow – outflow) is determined by models **WAVE-LARSIM, MODFLOW** and **Qual2K.**

F. MOSDEW-CHIRCHIK (A.Tuchin) Regional Integrated model, which is based on common database and ArcGis architecture.

Hierarchical structure of the model objects is as follows:

- Basin (areal object),
- Rayons, catchment zone, irrigation zones, crop areas (areal objects),
- Rivers (linear objects),
- River sections, canals, collectors (linear objects),
- Cities, intake points, well clusters, wastewater discharge points (point objects).

According to the general scheme, order of modeling is as follows:

1. **Climatic block**. By using ArcGis tools, climatic parameters are distributed over the project area, with spatial resolution of 1 km^2. Historical series taken from weather

stations are used for model adaptation, and data of climatic scenarios are used for future analysis.

2. **Regional development scenarios block**. Proceeding from the analysis of current regional conditions and future regional development, indicators of probable changes in socio-economic characteristics of the basin are formed for the near 25 years (changes in population, production volumes, energy demand, etc.). Based on values of those indicators, new water demand, in terms of its quantity and quality, is formed per economic sector and for the basin as a whole.
3. **Hydrological block.** By using climatic parameters as input data and basic characteristics of project area, the Hydrological block (**HBV, MODFLOW, Reservoir model, WAVE-LARSIM, Distribution network model**) is started. As a result of the modeling, an infomedia, which can be referred to as ***hydrological infomedia*** is formed. A group of indicators is selected from this information for visualization of hydrological block output, and information collections for operation of the next blocks are formed.
4. **Ecological block.** Models in this block (**Qual2K, collector-drainage network model (MONERIS)**) use the information collections from the **Climatic** and **Hydrological** blocks plus additional data on inflow of chemical and biological pollutants. As a result of block operation, a new infomedia, which, similarly to previous one, can be referred to as ***ecological infomedia***. A group of indicators is also selected from this information for visualization of ecological block output.
5. **Economic block –** The block includes a set of models representing **agricultural productivity (EPIC, SOTER), regional agricultural economy** and **regional water demand (Planning zone model, SLISYS, WEAP).** Besides simulation calculations, operation of the models in the economic block includes optimization components reflecting management processes in agriculture and water distribution. Furthermore, the database, which uses soil productivity characteristics (**SOTER**) and regional infrastructure parameters (**WEAP**) is rigidly linked with actual time intervals. Thus, ***economic information layer*** has a complex composition, including both economic characteristics of objects and parameters of management in various contexts (such as institutional, legal, economic). Like as in above-mentioned blocks, part of information is used for visualization through GIS system.
6. **Resulting visualization and analysis**. At present, taking into account uncertainty regarding selection of a set of indicators from each ***information layer***, only their color spectrum is proposed.

T.Gaiser **A.Tuchin** **A.Sorokin** **G.Stulina**