AIM Interim Report
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1. Water impact model regarding data collection and database construction

2. Relationship between two water basin systems establishing

3. Environment regarding data collection and database construction

4. Primarily evaluation on the results of impact study in China

1. Water Impact Model

1.1 Dam database

1.1.1 Table Data

. **Data sources:**

The table data are mainly from the original paper material provided by NIES, while others are from China Atlas (published in 1999).

. **Data input:**

There are totally 1983 dams and 20 variables for each dam in the database.

. County name’s translation

All the names are in Chinese phoneticize, such as Dam name, County name, Province name and River name. We met a lot of trouble during the translation. Sometimes, it takes a long time to determine a county’s name. Dam database in CISNAR, China Atlas (published in 1999), China administrative divisions manuals (from 1981 to 1995,year by year) were took as reference.

The main problem to determine county name as follow:

-Same English county name but different Chinese name (due to same pronunciation but different word)

- Same pronunciation but may be a county and also may be a city (due to the county’s incomplete Chinese phoneticize in original material)

-County name not included in year 1995 county name’s database

- Dam name, County name, Province name and River name cannot match each other.

For example, Luanhe is in Tangshan, Hebei province, but the wrong province name is “Hubei”.

. Some new dam information was collected and added into the database

83 dams/reservoirs information were collected and were added into the database.

Some of them are large reservoirs.

. Unresolved Problems

-Lack of some damps

There is still lack of some damps especially in Jiangsu province, Tianjin city and Taiwan province. The reason is there is no dam of those provinces in original material. Although we added some into the database it is still incomplete.

-Some county's name are still not be translated to Chinese

. **County's coding**

Give each county its 1995 GB code.

1.1.2 spatial data

. Dam's Location Sign

① Sign Dam Location on the Chinese 1995 county boundary map

② Move some dam's location (point) to the place where they should be (took the river map as background coverage and China Atlas as a reference).

Reservoir Distribution in China

Problems and methods to deal with them

① Some dam's location (county names) are not exact. In this case, we give it the more exact location. For example, Guantin reservoir , the location in original material is Zhangjiakou (city), but the city includes 13 counties and a shixiaqu. In fact, the reservoir is in Huailai (one of those counties which belong to Zhangjiakou city). Then we move the location to Huailai County.

② Some dam’s location were signed with the help of the dam’s mark, the river and residential point on the map while there are still some dam’s location are not exact. In this case, the location of the dam only shows it is in that county boundary.

③ There are 37 damps in Hong-Kong in original material. Considering it is only a small area in the map, it is difficulty to sign so many points in its boundary. So only few dams were signed on the map.

1.2 Lake database

1.1.1 Table Data

① Columns in the table:

. Lake code

. Lake name

. Longitude

. Latitude

. Lake area

.Data source

. Lake water’s character

- Fresh water lake: Salt concentration less than 1g/L
- Low-grad saltwater lake: Salt concentration from 1g/L to 35g/L
-Saltwater lake: Salt concentration from 35g/L to 50g/L
-Salt lake: Salt concentration bigger than 50g/L
- Dry salt lake: Brine or solid salt mine under ground
- Seasonal lake: Lakes storing water seasonally

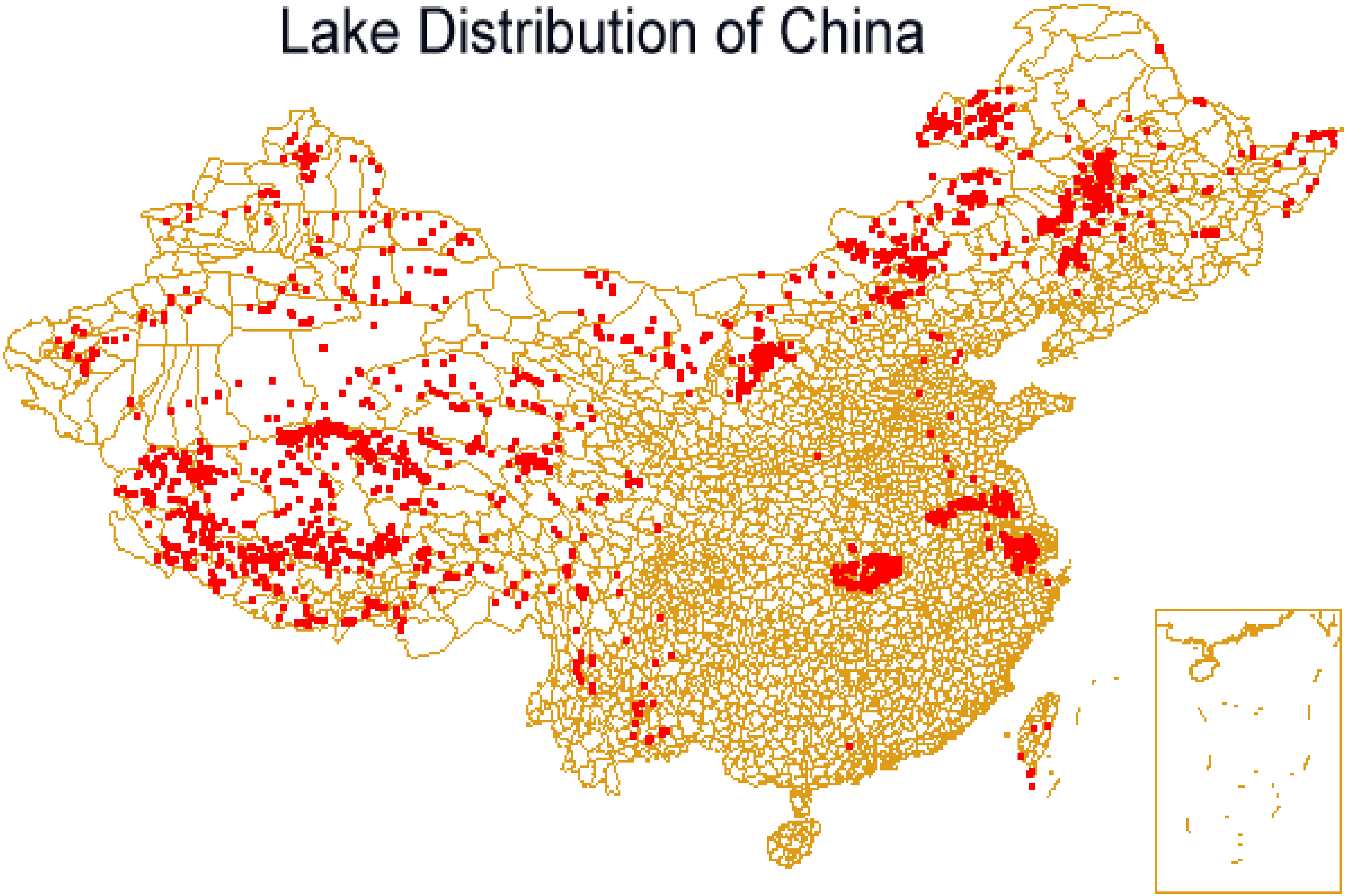
② Produced time of Original Data:

From middle of 70’ to the end of 1996

1.2.2 spatial data

Finish Lake’s Location Sign depending on their Longitude and Latitude.

Lake Distribution of China



1.3 Irrigation regarding database at second level water basin in China

There is no such data for water basin in China now. Even for province, there is no published data. As for county, only few provinces have such kind of data for their county but not published one. In order to meet the needs of the Model, some calculating was done depending on the material we collected.

1.3.1 *Input and used data*

. Irrigation area for each county, each province in China

. Share of various types of irrigation area in 1998 for each province in China

. Share of various types of irrigation area in 1998 for some county in China

. Area for each Water basin in China (Water Resources Ministry of China, 1987)

. 1995 County boundary map of China (CISNAR)

. Water basin map of China (CISNAR, 1997)

1.3.2.Output data

. Area in each water basin, see appendix 1

.Irrigation area in each water basin in 1998,see appendix 1

.Share of various types of water-saving irrigation area, see appendix 2

Enhancment ditch irrigation area

Piped Water irrigation area

Sprinkling Irrigation area

Drip Irrigation area

1. Area for each water basin

Basin-id	Basin Area
10110	354346.4
10121	33472.07
10122	2769.272
10130	56469.07
10200	160163.1
10300	240768.5
11000	52064.82
12100	347299.2
12200	57370.8
12300	307606.1
12400	478882.4
12500	275822.7
12600	1094674
12700	732408.8
12800	30202.8

2. Irrigation-Area for Each basin in 1998

BASIN-ID	Irrigation-Area(ha)
10110	114384.2
10121	12148.44
10122	153.56
10130	1631.746
10200	202660.2
10300	496494.1
11000	88435.49
12100	946612.3
12200	320676.8
12300	512450.6
12400	178999.3
12500	33803.66
12600	1612717
12700	24177.82
12800	17254.67

Appendix 2

Saving water irrigation area in 1998

Basin-id	Enhancment irrigation ditch (ha)	Piped Water (ha)	Sprinkling irrigation (ha)	Drip irrigation (ha)	Total (ha)
10200	81185.883	6997.041	61.435	19.122	88263.336
10300	203377.062	17426.568	174.263	48.796	221026.33
11000	64475.152	251.213	2738.142	58.882	67523.422
12100	690136.938	2689.711	29308.518	630.409	722765.88
12200	233794.016	910.926	9928.806	213.513	244847.36
12300	266498.5	19592.691	2910.235	3686.662	292688.13
12400	22935.164	11103.14	7698.827	734.518	42471.668
12500	4442.096	0.94	128.518	0.216	4571.77
12600	1174589.75	4787.404	49785.789	1111.862	1230275.3
12700	14527.281	56.213	615.526	13.176	15212.203
12800	2174.949	0	61.418	0	2236.367
51100	914.077	262.362	371.498	40.284	1588.22
51200	1013.757	7777.877	5509.536	111.454	14412.624
51300	25761.92	92598.188	81509.312	1831.166	201700.89
51400	8092.097	68248.766	65517.355	857.003	142715.63
51500	20803.277	161753.953	119765.688	2280.462	304603.5
51600	846.193	6710.556	5307.424	92.223	12956.408
51700	4157.734	31933.17	22623.088	457.391	59171.383
51800	4153.706	31902.09	22600.695	456.948	59113.441

1.3.3Data processing

. Area in each water basin

The data was generated by overlying the water basin map with provincial boundary map, and then was checked with related information.

. Share of various types of irrigation in the current irrigation area for each Second Water Basin

See fig. 3

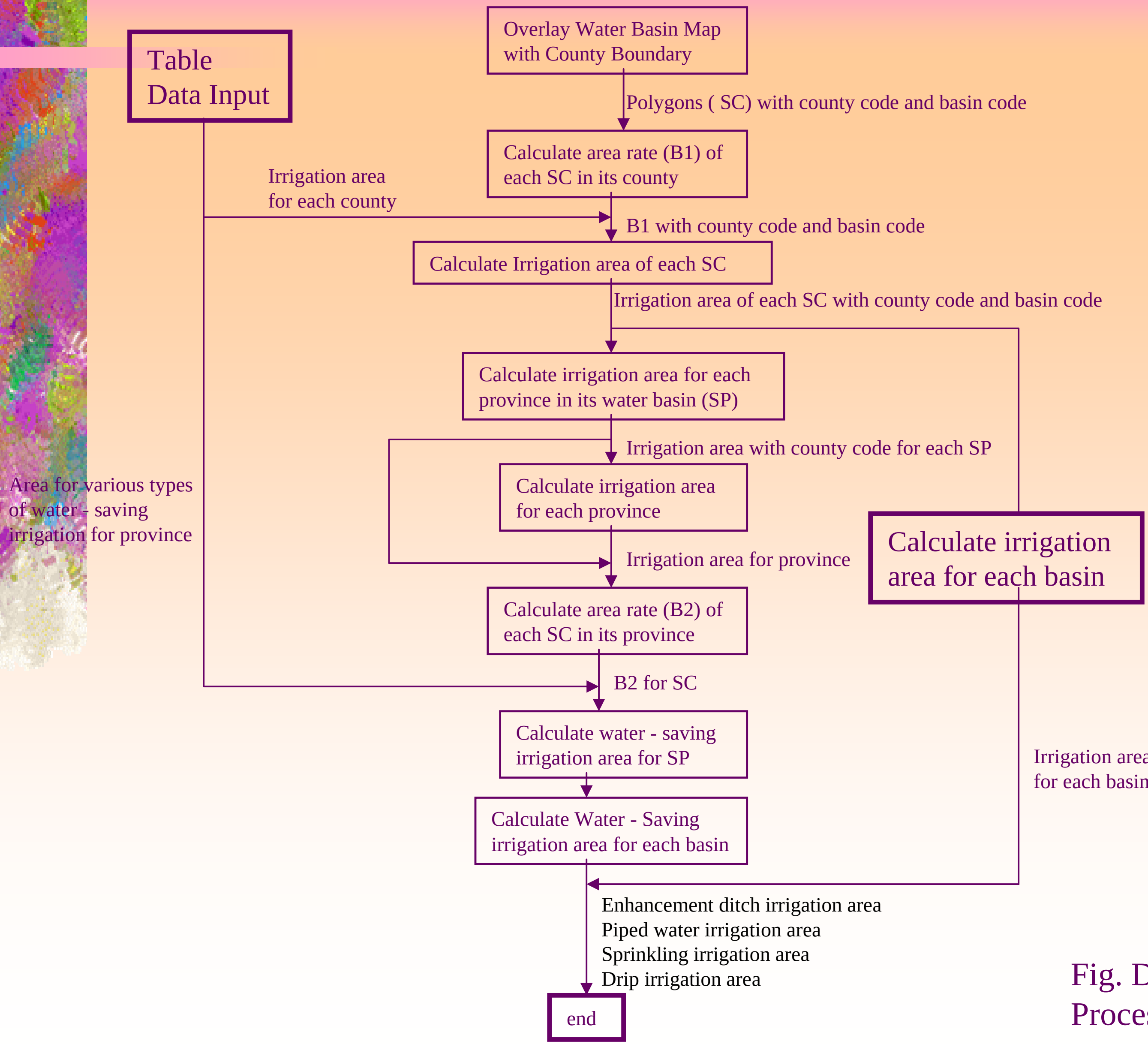


Fig. Data Processing

1.4 Total input on the water conservancy from year 1950 to 1998 in China

It is very hard to get this kind of data. A general idea can be getting from following data.

(1)Total financial input from central government is 354.807 billion, occupying 4% of the total financial output of central government.

Among them: Capital construction 202.411 billion

Operating expenses: 64.007 billion

Allowance of irrigation and water conservancy: 86.176 billion

Others: 2.213 billion

(2) Input from the masses: Over 100 billion

1.5Water-saving Irrigation

1.5.1 Water-saving Irrigation Plan

In China, the grain yield is effected by water supply badly. Generally, the arable land in fine irrigation condition can get double or treble grain yield. Therefore, to develop irrigation area is an important way to improve the crop yield in China. But there is not enough water to meet the needs of developing irrigation area. So the only way is to develop the water-saving irrigation though it needs a large input.

Depending on the situation, China Administrative Division of Water Resources has proposed 《The Plan in State Tenth Five Year Plan and the Developing Programming in 2010 of National Water-saving Irrigation 》. In this proposal, China is divided into seven regions. Each region ha s its own Water-saving Irrigation goal from 2001 to 2015.

1.5.2 Cost of Water-saving Irrigation

Generally, the costs to develop irrigation include expenditures for water-saving engineering, function and depreciation.

①The cost for water-saving engineering

Fixed Sprinkling irrigation: 15000 Yuan/ha

Half Fixed Sprinkling irrigation: 6000 Yuan/ha

Drip irrigation: 30000-45000 Yuan/ha

Enhancing the irrigation ditch to prevent it from water seepage：3000-7500 Yuan/ha (the cost depending on the quality demand of engineering)

② Depreciation (the cycle life for machines taken as 12 years)

③ Engineering Functioning: 195yuan/ha

The Ministry of Water Resources of China is now making the plan for water-saving irrigation. It is expected to be finished in the end of this year. In that case, maybe we can get some useful information from it.

1.6 Long Term Water Resources Supply and Demand in China at First Water Basin Level

1.6.1 Background

In 1996, Institute of Hydrology and Water Resources of Nanjing in China composed The Report on Supply and Demand of Water Resources in Long Term in China. It is not a published report. In the report, the year 1993 was taken as actuality situation year; a systematic research on Water Resources Demand in China in 21st Century was done. This was the second systematic research on water resources in China (First research was done is around 1986, 1980 taken as current situation year).

In 1999, the research results were published, called Water Resources Supply and Demand in China in 21 century. The systematic research results in the book are at first water basin level and can be taken as reference in AIM water impact model.

1.6.2 set up the relationship between two water basin systems

In the book, whole China was divided into 9 water basins. While the water basin map that CISNAR provided, and was used in AIM/China, has 12 water basins in total. In order to share the data from the two water basin systems, it is necessary to understand the relationship between them.

Appendix 4 shows the relationship of the two water basin systems.

Where: w1 to w9 are the water basins divided in the book, while A to L12 presents the basins divided by CISNAR.

The Relationship between CISNAR Water Basin System and Another

CISNAR	CISNAR	ANOTHER	CISNARWATER BASIN NAME IN ENGLISH
BASIN-ID	CCODE	WCODE	BASIN-NAMEE
51000	A		Heilongjiang
51100	A1	W1	Eergula he
51200	A2	W1	Mainstream of Helongjiang
51300	A3	W1	Nenjiang
51400	A4	W1	Second Songhuanjiang
51500	A5	W1	Songhuanjiang
51600	A6	W1	Mudanjiang
51700	A7	W1	Wusulijiang
51800	A8	W1	Wuyuerhe continental region
52000	B		Yalujiang Tumenjiang
52100	B1	W1	Suifenhe
52200	B2	W1	Tumenjiang
52300	B3	W1	Yalujiang
53000	C		Liaohe river and rivers in Liaodong Peninsula
53100	C1	W1	Rivers in Liaodong Peninsula
53200	C2	W1	Xiliaohe
53300	C3	W1	Liaohe river
53400	C4	W1	Hunhe
53500	C5	W1	Liaoxiyanhai water systems
54000	D		Haihe and Luanhe
54100	D1	W2	Luanhe and Jidong rivers
54200	D2	W2	Beisihe
54300	D3	W2	Yongdinghe
54400	D4	W2	Daqinghe
54500	D5	W2	Ziyahe
54600	D6	W2	Zhangweihe
54700	D7	W2	Tuhaihe and Majiahe
55000	E		Yellow river
55100	E1	W4	Upper reaches of Yellow river

55200	E2	W4	Lower reaches of Yellow river
55300	E3	W4	Upper reaches of Middle Yellow river
55400	E4	W4	Middle reaches of Middle Yellow river
55500	E5	W4	Lower reaches of Middle Yellow river
55600	E6	W4	Lower reaches of Yellow river
55700	E7	W3	Shadongbandao rivers
55800	E8	W4	Erduosi continental region
56000	F		Huaihe
56100	F1	W3	Upper and Middle reaches of Yangtze river
56200	F2	W3	Yihe river,Suhe river,Sihe river basin
56300	F3	W3	Subeilixiahe network of rivers
57000	G		Yangtze river
57100	G1		Upper reaches of Yangtze river
57101	G11	W5	Jinshajiang
57102	G12	W5	Yalongjiang
57103	G13	W5	Mainstream of Jinshajiang water system
57200	G2		Upper of Middle Yangtze river reaches
57201	G21	W5	Minjiang
57202	G22	W5	Tuojiang
57203	G23	W5	Jialingjiang
57204	G24	W5	Wujiang
57205	G25	W5	Mainstream of Upper of Middle Yangtze river reac
57300	G3		Middle and Lower reaches of Yangtze river
57301	G31	W5	Wanjiang
57302	G32	W5	Zishui
57303	G33	W5	Xiagjiang
57304	G34	W5	Hanjiang
57305	G35	W5	Boyang lake
57306	G36	W5	Middle and Lower reaches of Middle Yangtze river reaches
57400	G4		Lower reaches of Yangtze river
57401	G41	W5	Lower reaches mainstream of Yangtze river
57402	G42	W5	Taihu lake water system
58000	H		Fujian,Zhejiang and Taiwan water systems
58100	H1	W7	Fuchunjiang river

58200	H2	W7	Oujiang river
58300	H3	W7	Minjiang river
58400	H4		Coastal rivers in Zhejiang and Fujian
58410	H41	W7	Cao'ejiang river and Lingjiang river
58420	H42	W7	Feiyun river and Jiaoxi river
58430	H43	W7	Jinjiang river and Jiulongjiang river
58500	H5	W7	Water systems in Taiwan
59000	I		Zhujiang river and rivers in Guangdong,Guangxi and Hainan Island
59100	I1	W6	Xijiang river
59200	I2	W6	Beijiang river
59300	I3	W6	Dongjiang river
59400	I4	W6	Zhujiang Delta water systems
59500	I5	W6	Hanjiang river
59600	I6	W6	Rivers in Guangdong and Guangxi
59700	I7	W6	Rivers in Hainan island and South China Sea islands
10000	J		Rivers in southwest China
10100	J1		Yalu Tsangpo river,Henghe river and India river
10110	J11	W8	Yalu Tsangpo river
10121	J121	W8	Pengqu river
10122	J122	W8	Majia Tsangpo river
10130	J13	W8	Branches of India river
10200	J2	W8	Nujiang river and Yiluowadi river
10300	J3	W8	Nancangjiang river and Honghe river
11000	K	W9	E'erqisi river
12000	L		Water systems in continental rivers
12100	L1	W9	Water systems in Zhunge'er continental rivers
12200	L2	W9	Water systems in Yilihe continental rivers
12300	L3	W9	Water systems in Hexi Corridor continental rivers
12400	L4	W9	Water systems in Inner Mongolia continental rivers
12500	L5	W9	Water systems in Caidamu continental rivers
12600	L6	W9	Water systems in Talimu continental rivers
12700	L7	W9	Water systems in Qiangtang continental rivers
12800	L8	W9	Water systems of continental rivers in Qinghai Lake area

1.6.3 calculate the data at first water basin level

The data at 12 first level water basins is now being calculating depending on the data at first water basin level in the book Water Resources Demand in China in 21st Century, the relationship between two water basin systems and other material .There are 12 tables in total, appendix 5 is a example.

1.7 The status of water-saving in industry sectors (see appendix 7)

1.8 The plan on water use for unit product in main industry sectors (see appendix 8)

1.9 Other data

(1) Chinese water resources status report in 1999

(2) The collection on the schema of seven water basing's plan in China

(3) Evaluating on water and land resources and the plan of water-saving irrigation

2.Envirionment regarding data

(1) Datatbase with over 300 variables at province level, city level and industry sectors level in China in 1998

(2) Chinese environment regarding data at national, province city and industry sectors level in 1999,hundreds variables in total

3. Primarily evaluation on the results of climate change impact study on agriculture and water resources in China

In order to apply AIM/IMPACT model well in China, it is necessary to evaluate other group's results. Appendix 6 gives some findings of other study.

Appendix 6

Impacts of Climate Change on Agriculture and Water Resources in China

main findings from the recent impact studies in China

Potential impacts of climate change on agriculture and water resources in China have been a great concern of the Chinese government as well as the general public. In addition to the research activities conducted at national level, impact assessments at local levels have been looking at the effects on different crop varieties and areas with different characteristics. Several experimental models have been developed. Sponsored by AIM project, our research group assessed the impact of climate change on crop yields in China and concluded that global warming results in an overall increase in crop yields in China. Currently we are still working on the impacts on water resources. In terms of methodology for impact assessment, our work is conducted at macro level, looking at the impacts in China as a whole. However, other impact assessment activities in China focus on certain crops or a specific area. These assessment exercises often use different assumptions on future climate change. This has made the results from different impact study groups hardly comparable. It implies the complexity of the issue, and persistent efforts are needed. The main findings from the recent impact studies in China are summarized in the following.

1. Impacts on Main Crops in Their Key Producing Areas

1.1 Potential impact of CO_2 doubling on double-season rice production in Southern China

. Dynamic Rice Growth Model is driven by the regional outputs from GCMs; Rice production in the main producing areas is simulated and analysed.

. Modelling results suggest that under the climate conditions with doubled CO2, solar radiation will increase in the main double-season rice production areas and consequently, rice growth season will get longer. If the variety of rice is well selected (i.e. to plant high-temperature resistant breed with late ripeness), double-season rice production can be improved.

. If the current planted breeds and production techniques continue towards future changed climate, not only the increased heat resource cannot be fully used, the double-season rice yield may also decline.

1.2 Impacts of climate change on wheat production have been widely examined through experimental studies and production practices. The following conclusions have been drawn:

The majority of climate models reveal that, over the next 100 years, global average temperature will increase by 0.2~0.3^{o}C per decade. While atmospheric CO_2 concentration doubles, annual temperature in Northern China is likely to increase by 2.5^{o}C, with a larger increase in winter. Some models predict that under doubled CO_2, summer precipitation in Huanghuaihai Plain (one of the main winter wheat production areas) will slightly increase while it is likely to decrease in the winter. Winter drought may impose adverse impact on winter wheat production in this area.

. Within the context of global warming, the growth limit of winter wheat will move northwards. Along with the increase in CO_2 concentration, primary productivity and final yield of winter wheat will increase. Temperature rise in autumn and winter is beneficial for the growth and development of winter wheat, and reduces the cold spots. However, it also has negative impacts on winter wheat production, such as aggravating draughts, shortening growth period, spreading diseases etc. Hence, the balance of these positive and negative impacts is rather complex and determined by a wide range of factors.

. In Huanghuaihai Area, wheat has an ecological type of early and medium ripeness in general. In the past 50 years, wheat breed has experienced eight updating and replacements. And the dominating breed is evolving from winterness towards weak springness. Under changed climate and increased concentration of CO_2 and other greenhouse gases, wheat production in Huanghuaihai area will not change dramatically.

1.3 Impact on corn production in Northeast China

. Under the climate change scenarios with doubled CO2 from DKRZ OPYC model, if the current planted breed, soil conditions and planting techniques remain unchanged, the growth and development periods of corn in Northeast China will get shorter, and consequently corn yield will decline to various extent, depending on the planting time. Further, different distributions of climatic variables defined by different climate variations have varied impacts on the length of growth season and yield, even with noticeable geographical differences.

. Under the climate scenarios with constant climate variation, the magnitude of yield reduction in Changchu is far higher in comparison with other climate scenarios; while the yield drop in Shenyang stays the lowest under this scenario.

. Changes in natural climate variations may mitigate or aggravate the impact on yield imposed by the changes in average climate. While incorporating changes in climate variation, the yield decline in Changchu gets less than that resulting from the changes in average climate. Under the scenarios with changed number of rainfall days, yield of late-planted corn is even estimated to increase to some extent.

2. **Impacts on Water Resources and Water Cycle in China**

Climatic anomalies and human activities are the main factors affecting regional water resources. Impact of human activities is subjective and possible to control, while the impact imposed by climate anomalies is an objective phenomenon. Using distributed hydrological models, Zhang Jianyun from the Ministry of Water Resources assessed the potential changes in average annual runoff under 25 scenarios with various temperature and rainfall changes. He concluded:

2.1 in Haihe Basin: impacts of temperature change on surface evaporation, and consequently hydrological process, are assessed. Under 1ºC temperature in this basin, surface evaporation rises or declines by 5 per cent. This implies that the impacts on overall runoff is more sensitive to precipitation change, compared with temperature change. Areas with less average annual runoff are more sensitive to climate change.

2.2 in the middle reach of Yellow River: under 1ºC warming, evaporation in this area will increase by 6.1 per cent in average. Based on this, regional potential evaporation change was calculated. The results suggest that (1) in comparison with total runoff, surface runoff is more sensitive to climate change. With 4ºC warming and 50 per cent increase in precipitation, surface runoff and total runoff will increase by 61.4 and 36.4 per cent, respectively. (2) while temperature remains constant and precipitation increases by 25 per cent, surface and total runoff will increase by 46.6 and 31.8 per cent, respectively; while precipitation stays unchanged but temperature rises by 2.0oC, surface and total runoff will only decrease by 11.4 and 10.2 per cent, respectively. (3) impact of temperature on runoff depends on changes in precipitation. Under increased precipitation, temperature has more significant impact on runoff. (4) While precipitation decreases by 100 per cent and reaches zero, surface runoff drops by 100 per cent as well and not responses to temperature change any more. However, affected by underground runoff, total runoff only drops by 80 per cent or so, when precipitation declined by 100 per cent.

2.3 in Huaihe Basin: runoff in the areas north to the Basin is more sensitive to climate change than that in the southern areas; it is more sensitive in the east plain than that in the areas upper Bengbu. Generally, sensitivity of runoff in Huaihe Basin increases from the south to north, from mountainous to flat areas.

2.4 in Ganjiang and Hanjiang rivers of the Yangtze River Basin: runoff in the Yangtze River Basin is far more sensitive to precipitation than temperature. With the same magnitude of change, positive precipitation change has more significant impacts on runoff, compared with negative change. There is no notable difference in runoff changes resulting from positive and negative changes in evaporation.

2.5 in summary, water resources are far more sensitive to changes in precipitation, rather than temperature changes. Climate change has more significant impacts on surface runoff, rather than total runoff. Sensitivity of water resources to climate change increases from south to north, from mountainous to flat areas. Precipitation increase, in comparison with precipitation decrease, has more significant impact on runoff. The impact of temperature change on water resources depends on the changes in precipitation. Areas with less amount of water resources are more sensitive to climate change.

Due to the great complexities involved in the impacts of climate change on agriculture and water resources, compounded with the huge varieties of natural environment presented in China, most of the impact assessment exercises so far can only draw preliminary conclusions regarding one single aspect of the complicated issue. Further research initiatives are required to conduct more studies in depth.