China's Natural Resources Database (CNRD)

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ABSTRACT

China's Natural Resources Database (CNRD) is a comprehensive database, developed to support the research on natural resources, social sustainable development and environmental security in China. This paper intends to introduce the background, contents, characteristics and application of the CNRD.

Keywords: CNRD, Attribute database, Spatial database, Table, Index

1 INTRODUCTION

The CNRD program was launched in 1987 and preliminarily completed in 1990. It was funded by the Chinese Academy of Sciences (CAS), as one of the key projects under the 'Seventh Five Year Plan'. The goal of the project is to develop a database, which can meet the information requirements of the research on natural resources, social economics and environment at the national and regional level in China. From 1991 onwards, continuously funded by the CAS, CNRD has been being maintained and providing data service to the Chinese research community. CNRD is managed and maintained by the CNRD project team at the CAS's Commission for Integrated Survey of Natural Resources (CISNAR).

2 CONTENT

CNRD is an application-oriented system on the information of natural resources and their exploitation and utilization. It consists of attribute databases, spatial databases, thematic map bases and the management tools with which the data could be shared through Internet.

2.1 Attribute databases

2.1.1 Data fields

Data fields include natural resources, population and labor resources, socio-economic indexes and macro-environment (Sun, Li, Ma & Zhao, 1992; http://www.sdb.ac.cn/)

2.1.1.1 Natural resources

Land resources (status of land use, land limitation etc), Water resources (quality, demand, water engineering etc.), Climate resources (temperature, rainfall, sunshine etc.), Forestry (forestry type, area, accumulated etc.), Grassland (type, area, capacity to feed animal etc.), Energy resources (solar energy, biological energy etc.).

2.1.1.2 Population and Labor resources

Quantity, educational level, the structure of age, sex, job and geographic distribution etc.

2.1.1.3 Socio-economic indexes

Integrated economic indices (e.g. GNP, GDP, social output value etc.), agricultural economic indexes (basic condition, sown area and yield, animal husbandry situation, output value etc), Industrial economic indexes (production, output value etc.); Urban economic indexes (land, population, transportation etc.)

2.1.1.4 Macro-Environment

Natural disasters (major floods and droughts), Environment-related data: Three wastes (waste water, waste gas and solid waste) discharge and control, etc.

2.1.2 Tables and indexes in the attribute database

There are 330 tables with more than 5800 indexes in CNRD.

2.1.3 Spatial and Temporal of the Data

The Data is identified to be the state level, provincial level, county level and station level. Some may be at water basin, reservoir, lake level etc.
The data of the state and provincial levels are yearly based from 1949-2000, the county level is mostly yearly based from 1980-2000 and the station level is yearly and monthly based from 1949-1999.

2.2 Spatial database (with scale of 1:4 million and 1:1million)

2.2.1 Transportation, river system, boundary, residential, elevation etc.

2.2.2 Thematic maps

Based on the CNRD, a series of maps of China natural resource and environment are produced.

2.3 Management tools

Database and Metadata Management Tools with Oracle DBMS and ARC/INFO on both Sun workstation and Windows NT were developed in CISNAR (J.Z. Zhang , Z.H. Li, 1998; D.C. Luo , L.L. Chen, 1996; B. Zhao,Q.H. Cai; 1998; http://www.im.ac.cn/sdb/index.shtml, 2000; CIESIN,1995).

3 DATA CLASSIFICATION AND CODING IN CNRD (Li, Liu & Peng, 1999)

All the data in CNRD is divided into 21 types at level 1 of the classification system. Level 2 is table while level 3 is index. Each type at level 1 includes some tables. Each table is composed of some indexes

3.1 Data type name and code at level 1

Each type at level 1 in the data classification system is given two bytes length codes. The codes consist of two English characters. Table 1 shows data type name and corresponding code in CNRD.

Table 1. Data type name and corresponding code in CNRD

Type name	**Type code**
Water resources	BA
Land resources	BB
Climate resources	BC
Biology resources	BD
Tourist resources	DO
General survey	DA
Population and Labor	DB
Investment	DP
Government finance	DE
Price	DF
People's livelihood	DG
Agriculture	DH
Industry	DI

Energy resources	DJ
Transportation, postal and telecommunication services	DK
Construction	DL
Consumer of commodities	DM
Trade	DN
Urban	DQ
Education, science, culture and public health	DR
Macro environment	CA

3.2 Table names and codes

Each table in CNRD is given 4-byte length code. First 2 bytes code shows which data type the table belongs to while last 2 bytes shows the table's order in its corresponding data type. The last 2 bytes consist of 2 digits (0 to 9). Fig. 2 is some example of the tables and codes in CNRD.

Table 2. Example of the tables and codes in CNRD

Table name	**Table code**
Present land use situation (by county)	BB01
Statistics of land suitability (by province)	BB22
Farmland area variation (by province)	BB42
...	
Water resources quantity (by province)	BA05
Water supply potential and actual water supply of the water conservancy	BA51
facilities (by water basin)	
Water consumption volume (by water basin)	BA52
….	
Monthly mean sunshine time for years in succession (by climate station)	BC01
Monthly mean temperature for years in succession (by climate station)	BC03
Monthly maximum extreme air temperature and the date of occurrence (by climate station)	BC04
Monthly minimum extreme air temperature and the date of occurrence (by climate station)	BC05
The beginning date, end date and accumulated temperature of the temperature not less than 0,5,10,15 centigrade (by climate station)	BC08
Monthly mean ground temperature for years in succession (by climate station)	BC10
Monthly mean ground temperature of 10 cm depth for years in succession (by climate station)	BC19
Average frost-free season and the beginning and end date of frost season for years in succession (by climate station)	BC09
Monthly mean precipitation for years in succession (by climate station)	BC12
Monthly evaporation for years in succession (by climate station)	BC14
Monthly mean relative humidity for years in succession (by climate station)	BC15
…	
The populations and its natural changing situation (by province)	DB01
The basic status of population (by county)	DB02
Age composition (by county)	DB07
Population by sex, education level (by county)	DB26
Illiterate and semi-illiterate population aged 15 and over (by county)	DB27
…	
Area and stand volume of various forest lands (by province)	BD07
Woods stand volume (by county)	BD13
Basic situation of the grassland resources (by county)	BD41
Natural grassland grade of quality and quantity (by province)	BD26
…	
Areas covered and affected by natural disaster (by province)	CA01
Main damage condition by natural disaster (by province)	CA80
Soil erosion and control (by province)	CA81
…	
Discharge and treatment of industrial waster water (by province)	CA03

Emission and treatment of waste gas (by province)	CA04
Discharge, treatment and utilization of industrial solid waster (by province)	CA05
Discharge and treatment of industrial waster water (by province)	CA51
Emission and treatment of waste gas (by city)	CA52
Discharge, treatment and utilization of industrial solid waster (by province)	CA53
…	
The basic status of agriculture (by county)	DH20
Gross output value of farming, forestry, animal husbandry and fishery (by county)	DH34
Number of major livestock (by county)	DH35
The crops seeded area and yield (by county)	DH41
Yield of major farm crops per hectare (by county)	DH43
…	

3.3 Index names and codes

Each index in CNRD is given 6 bytes length code. There are 2 types indexes. One is the key index of the table and the other is the common one. Table 3 shows some example of index name and code in CNRD.

Table 3. Example of index name and codes in CNRD

Table code	Index name	Index code
BB01	County/city code	AA0132
BB01	Data Produced Year	Y12000
BB01	Total land area	BB0102
BB01	Cultivated land area	BB0104
BB01	Paddy field area	BB0106
BB01	Dry land area	BB0108
BB01	Garden area	BB0110
BB01	Forest land area	BB0112
BB01	Grassland area	BB0114
BB01	Inhabited sites/industry and mining land	BB0116
BB01	Traffic land	BB0118
BB01	Area of waters	BB0120
BB01	Unused land area	BB0122
BD41	County/city code	AA0132
BD41	Published year	Y210000
BD41	Total land area	BD4106
BD41	Natural grassland area	BD4108
BD41	Utilizable area of natural grassland	BD4110
BD41	Theoretical livestock-supported capacity	BD4112

3.3.1 Names and codes of the key index of the table

The key index is a special column in a table in database. A value of key is used to identify a data record in a table. Same key index has same code in different table in CNRD. In Table 3, the County/city code is one of the key indexes of table BB01. Index County/city code has same code AA0132 in table BB01 and BD41.

3.3.2 Name and code of common index

The first 4 bytes of the codes shows which table the index belong to while last 2 codes show the index's order in its corresponding table. The last 2 bytes consist of 2 digits (0 to 9). In Table 3, the

indexes with code BB0102, BB0104, … BB0122 and BD4106, … BD4112 are the common indexes.

4. CHARACTERISTICS OF CNRD

4.1 Data integration

Large attribute database and spatial database are well integrated in CNRD, which provide strong support scientific research and decision-making regarding natural resources development and utilization at the national and regional levels.

4.2 Data diversity

Multiple scales and disciplinary of the data meet the needs of the studies at various groups (e.g. provincial, national, regional, and global).

4.3. Time series

Natural resource and environment conditions have been changing drastically in the past few decades in China. The time series of the data in CNRD record the major features of these changes. Which helps scientists to identify the dynamic patterns of natural resource and environment, as well as people to understand the driving forces of the changes in China.

5. Application of CNRD (Li, 1998; Xu, 1998)

CNRD also provides the data service to the scientific research worldwide. Hundreds of projects including the National key project, The key project of CAS, The project of scientific fundamental theory research, International cooperate research and so on and other users (undergraduate student, master and doctor candidate etc.) have been benefited by CNRD since 1991. Meanwhile, CNRD has taken part in the establishment of the renewable resources and environment center of WDC-D actively, as well as international cooperate projects.

For its excellent data service, the CNRD project team was awarded a prize from the Science Database Engineer of CAS.

6. Activities for next phase

CAS will support CNRD project sequentially next phase. CNRD team will try the best to develop and improve a better database system to meet the needs of the Geographic science research in China and worldwide. Besides the attribute database update, we will develop grid database (in 1km² or so) based on 1:1million map and attribute data at station (county or town) level and the database based on remote sensing data. Of course, to provide data for the user in China is still what we will do. Meanwhile, we will enhance the communication with friends out of China and try to do more in scientific data exchange and data application in Geographic science and related fields.

7. CONCLUSION

In conclusion, CNRD is a comprehensive database. It can meet the needs of natural resource and environment research and management in some extent and has been used by many users.

8. ACKNOWLEDGEMENTS

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[2]http://www.sdb.ac.cn/

[6] http://www.im.ac.cn/sdb/index.shtml

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P.S.

1. The URL of CNRD is http://www.data.ac.cn/ . The metadata shows the lengths of the various time series . Unfortunately most of the metadata is in Chinese. Now the data access is restricted. If user wants to use the data please contact: lzh@mail.cern.ac.cn.
2. The main data source is shown in Appendix.

10. Appendix

Type name	Type code	Main data source
Water resources	BA	1. Research results 2. Chinese water resources utilization , Planning and designing institute of water conservancy and water electricity, Water conservancy and electricity division, 1987 3. China Water Resources Status Report , water conservancy ministry 1997 to 2001, yearly 4. Long Term Water Resources Supply and Demand in China, 1996 5. Chinese water conservancy annual report, water conservancy ministry, 1987 to 1999, yearly 6. China resources information , China resources information editor commission, China environment science press, 2000 ...
Land resources	BB	1. Research results 2. Land use investigation at county level in China, 1986 3. Chinese land resources map with scale of 1:1 million land resources dataset, Chinese land resources map with scale of 1:1 million editor

		committee and Commission for integrated survey of natural resources, Chinese academy of sciences, Publishing house of Chinese people's university, 1991 4. National land statistical material , State land management bureau, 1987 to 1995, yearly 5. China resources information , China resources information editor commission, China environment science press, 2000 6. Other publications …
Climate resources	BC	1.Yearly/monthly climate report, Climate information center of State climate bureau 2. China resources information , China resources information editor commission, China environment science press, 2000 3. China surface climate material 1951-1980 ,Climate information center of State climate bureau, Climate publish house 4. Research results …
Biology resources	BD	1. China resources information , China resources information editor commission, China environment science press, 2000 2. China grassland resources dataset , China agriculture ministry etc., China agricultural science and technology press, 1994 3. National grassland investigation around 1990 4. Institute of grassland, Chinese agriculture academy of science 5. Statistic on national forestry resources 6. National forest investigation during 1984-1988,1989-1993,1994-1998 7. Institute of plant, Chinese academy of science 8. Other publications …
Tourist resources	DO	1. China resources information , China resources information editor commission, China environment science press, 2000 2. Other publications …
General survey	DA	1. Research results 2. Historical statistical data collection during 1949-1989 for each province in China , The comprehension department of state statistical agency 3. China statistical yearbook , China statistical publishing house, year by year 4. Comprehensive statistical data and material on 50 years of New China , Compiled by department of comprehensive statistics of national bureau of statistics, China statistics press, 1999 5. Other publications …
Population and Labor	DB	1. Research results 2. Historical statistical data collection during 1949-1989 for each province in China , The Comprehension department of state statistical agency 3. The yearbook of Chinese population statistics , the population department of state statistical agency, The Chinese statistical press, 1991 to 1994 4. The statistical data of population for each county in China , National public security ministry, from 1986 to 2000,year by year 5. Population census in China for year 1953,1964,1982,1990 6. China resources information , China resources information editor commission, China environment science press, 2000 …
Investment	DP	1. China statistical yearbook , China statistical publishing house, year by year 2. Comprehensive statistical data and material on 50 years of New China , Compiled by Department of Comprehensive statistics of National Bureau of Statistics, China statistics press, 1999 …
Government finance	DE	1. China statistical yearbook , China statistical publishing house, year by year 2. Comprehensive statistical data and material on 50 years of New China , Compiled by Department of Comprehensive statistics of National Bureau of Statistics, China statistics press, 1999

		…
Price	DF	1. China statistical yearbook , China statistical publishing house, year by year 2. Comprehensive statistical data and material on 50 years of New China , Compiled by Department of Comprehensive statistics of National Bureau of Statistics, China statistics press, 1999 3. Markets …
People's livelihood	DG	1. China statistical yearbook , China statistical publishing house, year by year 2. Comprehensive statistical data and material on 50 years of New China , Compiled by Department of Comprehensive statistics of National Bureau of Statistics, China statistics press, 1999 …
Agriculture	DH	1. Data from agriculture ministry of China, 1980 to 1999, yearly 2. Essentials of rural economic statistics during 1980 –1987 for each county in China , The rural economy survey department of state statistic agency, Department of rural economy statistics of National Bureau of Statistics 3. Essentials of rural economic statistics for each county in China 1988 to 1991,2000,2001, yearly, The rural social economy survey team of state statistic agency, Department of rural economy statistics of National Bureau of Statistics 4. The yearbook of Chinese rural statistics 1993 to 1999,yearly, The rural social economy survey team of state statistic agency, department of rural economy statistics of national bureau of statistics 5. Research results 6.Other publications …
Industry	DI	1. Material on industry census in China , 1985,1995 2. Comprehensive statistical data and material on 50 years of New China , Compiled by department of comprehensive statistics of national bureau of statistics, China statistics press, 1999 3. Historical statistical data collection during 1949-1989 for each province in China , the comprehension department of state statistical agency 4. Research results 5. Other publications …
Energy resources	DJ	1. China energy statistical yearbook 1991-1996 ,Compiled by department of industrial and transportation statistics, State statistical bureau, China 2. China energy statistical yearbook 1997-1999 ,Compiled by department of industrial and transportation statistics, State statistical bureau, China 3. China resources information , China resources information editor commission, China environment science press, 2000 4. Other publications 5. Calculated based on the data regarding climate, domestic animals and population, crop yield etc. …
Transportation, postal and telecommunication services	DK	1. China statistical yearbook , China statistical publishing house, year by year 2. Comprehensive statistical data and material on 50 years of New China , Compiled by Department of Comprehensive statistics of National Bureau of Statistics, China statistics press, 1999 …
Construction	DL	1. China statistical yearbook , China statistical publishing house, year by year 2. Comprehensive statistical data and material on 50 years of New China , Compiled by Department of Comprehensive statistics of National Bureau of Statistics, China statistics press, 1999 …
Consumer	DM	1. China statistical yearbook , China statistical publishing house, year by

of commodities		year 2. Comprehensive statistical data and material on 50 years of New China , Compiled by Department of Comprehensive statistics of National Bureau of Statistics, China statistics press, 1999 …
Trade	DN	1. China statistical yearbook , China statistical publishing house, year by year 2. Comprehensive statistical data and material on 50 years of New China , Compiled by Department of Comprehensive statistics of National Bureau of Statistics, China statistics press, 1999 …
Urban	DQ	1. China city statistical yearbook , The city social economy survey team, National Bureau of Statistics, 1995 to 1999,yearly 2. Other publications …
Education, science, culture and public health	DR	1. China statistical yearbook , China statistical publishing house, year by year 2. Comprehensive statistical data and material on 50 years of New China , Compiled by Department of Comprehensive statistics of National Bureau of Statistics, China statistics press, 1999 …
Macro environment	CA	1. Research results 2. The achievement of water conservancy construct during the past 40 years—statistical data of water conservancy ministry, 1989 3. China environment annual report, 1998,1999,2000 4.China environment yearbook, China environment yearbook press, 1991 to 1998,yearly 5. Environment statistical material, from 1981 to 1990,year by year 6. Report on the state of the environment in China, State environmental protection administration, 1996-2000, yearly 7. Risk assessment and strategies of agricultural disasters in China, Li Shikui etc., Atmosphere publication house 8. Report of the damage caused by disaster in China during 1949-1995, China national bureau of statistics and China civil administration ministry, China statistics press, 1999 9. Other publications …