**China**

# Liaoning Baishi Reservoir Construction Project

Report Date: January 2003

Field Survey: November 2002

## 1. Project Profile and Japan's ODA Loan


Beipiao, Liaoning Province, PRC

Baishi Multipurpose Dam sluice gate

### 1.1 Background

Although in 1993 Liaoning Province posted its highest agricultural yield on record at 16.96 million tons, demand for food within the province was projected to exceed this level in 2000, with forecasts of around 18.54 million tons, and there were calls for agricultural development targeting further increases in productivity. In order to meet increasing demands for food, the focus of the Ninth Five Year Plan (NFYP) in Liaoning Province was placed on (1) the systematic development of agriculture targeting blanket advances in the agriculture, forestry and fishery industries, (2) intensified irrigation construction, and (3) improvements in unit yield by bolstering the use of science and technology, with the aim of achieving average annual increases of 2.5 million tons in food production.

In 1988, the Liao River triangle was designated one of the nation's ten Important Agricultural Development Zones by the central government, and consolidated development of agriculture resources has conventionally been promoted in this region. Nevertheless, in consequence of the lack of progress with water resource development on the Daling River, the region was prone to flooding in the rainy season and water shortages in the dry season, with floods damaging social infrastructure and decreasing harvests, and water shortages impeding agricultural and industrial production and civic life. The construction of the Baishi multi-purpose dam was planned as a means of addressing these problems and of bolstering irrigation construction in the region (a map showing the location of the dam is given on page 2).

### 1.2 Objectives

The project involved the construction of a multi-purpose dam on the Daling River at Shangyuan, Beipiao in Liaoning Province, principally aimed at flood control and irrigation water supply, but also targeting increased food production on downstream arable land, as well as municipal water supplies, power generation and pisciculture.

### 1.3 Project Scope

(i) Multipurpose dam (max. storage capacity: 1.6 billion $m^3$)

(ii) Crest spillway (10m (width) × 11.7m (height) × 15 gates)

(iii) Drainage holes (4m (width) × 5.5m (height) × 16 gates)
(iv) Power generation facilities (4,000kw × 2、1,600kw × 1)
(v) Incidental works
(vi) Consulting services

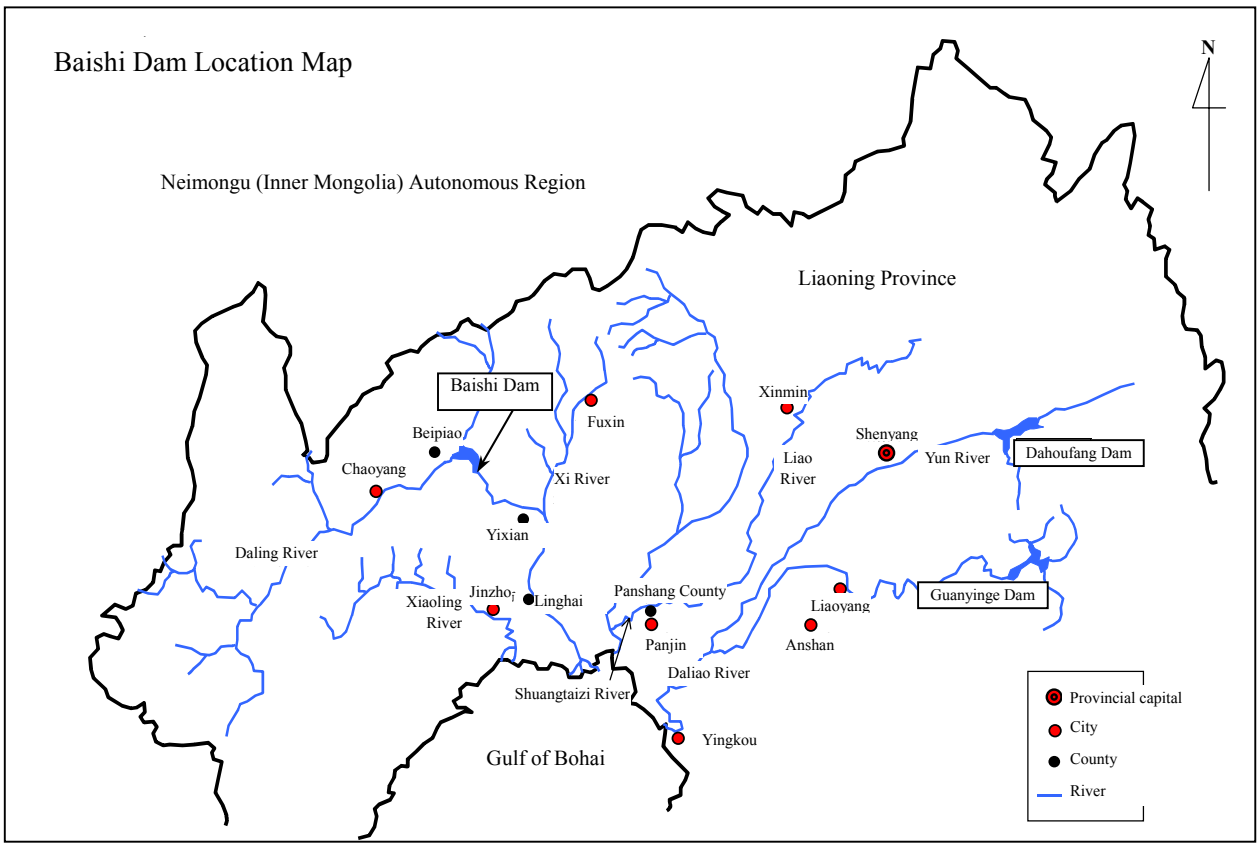
The yen loan covered all foreign currency funds necessary for the above work.

### 1.4 Borrower/Executing Agency

Ministry of Foreign Trade and Economic Cooperation, PRC[1]/Liaoning Province Water Resources Department

### 1.5 Outline of Loan Agreement

| | |
|---|---|
| Loan Amount<br>Loan Disbursed Amount | 8,000 million yen<br>7,997 million yen |
| Exchange of Notes<br>Loan Agreement | December 1996<br>December 1996 |
| Terms and Conditions<br>-Interest Rate<br>-Repayment Period<br>(Grace Period)<br>-Procurement | <br>2.3%<br>30 years<br>(10 years)<br>General untied |
| Final Disbursement Date | August 2002 |




[1] The current Ministry of Foreign Trade and Economic Cooperation. As of 1999, the borrower was changed to the government of the People's Republic of China (Ministry of Finance).

## 2. Results and Evaluation

### 2.1 Relevance

When this project was formulated, the lack of headway with water resource development in the Daling River basin had resulted in a high probability of flooding during the rainy season and the occurrence of water shortages in the dry season, and the combination was crippling agricultural production and hampering development within the region. At the time, the issue of increasing food production was the object of both national and provincial government focus, and from a related perspective, the objectives of constructing a multi-purpose dam aimed principally at flood control and ensuring irrigation water supplies as well as at municipal water supplies, were deemed relevant.

However, rapid industrialization and increases in the urban population occurring during project implementation resulted in the relative importance of municipal water supplies increasing over water for agriculture, thus the focus of this project was also shifted to municipal water supplies. As confirmed during this survey (November 2002), there was a shift in Liaoning Province policy underpinned by the increased urgency of supplying water to Fuxin, a city that was suffering severe shortages of both municipal and industrial water, when the changes to the priority weighting of the project's various objectives were first mooted around 2000.

Furthermore, since dam construction was completed in 2000, the flooding of the dam has failed to progress (approx. 200 million $m^3$ vis-à-vis a maximum storage capacity of 1.6 billion $m^3$; details are given in the "Effectiveness" section hereunder), predominantly due to exceptionally low rainfall in recent years. Moreover, the Liao River triangle was designated a National Environmental Protection Area two years ago, which expanded the range of protected areas and put a halt to unrestricted development of agricultural resources.

Against this background, as of November 2002 the central government had still not given the green light for the distal irrigation development project that was planned during appraisal in connection with agricultural water supplies, and the prospects for future authorization appear bleak. The paddy fields in the central region of Panjin city, an area that was projected to benefit from this project, are currently receiving the majority of their water from other, non-project sources. On the other hand, with increased weighting being assigned to municipal water supplies, the feasibility study (F/S) for a conveyance pipe project to supply water to Fuxin city was given the go ahead in October 2002 and construction is scheduled to start in 2003, with completion targeted for 2005.

Accordingly, the Baishi Dam is currently positioned as "contributing to the easing of water shortages for development of the western areas of Liaoning Province"[2]. In view of the major fluctuations in rainfall that characterize the basin covered by the project, flood control, one of the project's primary objectives, continued to be relevant at evaluation. Additionally, with regard to agricultural water supplies, despite a priority shift towards municipal water supplies, the change in the weighting of project objectives is considered to be consistent with current needs. As the above indicates, the objectives of this project have retained their relevancy.

[2] A statement made by the vice director of the Liaoning Province Water Resources Department. Western areas indicate regions to the west of Fuxin city.

## 2.2 Efficiency

### 2.2.1 Project Scope

Dam design values were modified after a comparison of appraisal plans and actual results, and the duration of consulting services was scaled back. However, the changes had no significant impact on either the implementation schedule or project costs.

### 2.2.2 Implementation Schedule

Dam construction went ahead essentially as per the appraisal plans and was completed on schedule, with operations commencing in September 2000. However, final acceptance procedures for project completion had yet to be executed at the time of this survey according to China-side definitions[3].

Of the incidental works, resident relocation operations, which were covered by local currency funds, are complete. The rerouting of the railway and relocation of stations, however, are still at the planning/design stage, although this has no notable impact on the operation of the dam per se. The principal reason for the hold ups in the implementation schedule was changes made by China to Jinzhou-Changde railway engineering, which required adjustment because the original construction standards could not be applied. Accordingly, the rerouting of the railway will need several more years to complete.

### 2.2.3 Project Cost

The local currency portion of project costs was subject to an increase of around 23%. The executing agency reports that, in addition to increases in civil engineering costs, this was primarily due to changes in resident compensation standards which elevated compensation costs above the planned level. The cost of railway and station relocation has not been included as the work has yet to be completed.

## 2.3 Effectiveness

### 2.3.1 Operational Status of Dam

Since the dam was completed in 2000, water levels in the Daling River have been constantly low, which means that, as stated in the "Relevance" section, the flooding of the dam has not progressed. Specifically, against planned reservoir volumes of 814 million cubic meters during the rainy season and 1,027 million cubic meters during the dry season, the average reservoir volume over a year is currently approximately 200 million cubic meters. Accordingly, the monthly peak water level had failed to reach the planned target at the time of this survey (November 2002). In terms of inflow volumes, the results have been extremely poor since dam completion at 426 million cubic meters in 2001, and 220 million cubic meters in 2002 (up to October), against a planned level of approximately 1.2 billion cubic meters (Table 1). Maximum flow rates during the 2000, 2001, and 2002 flood seasons were all lower than planned levels at 450 cubic meters per second ($m^3/s$), 540$m^3/s$ and 350$m^3/s$, respectively. In consequence, the reservoir volume is well below the target level. The outcome of the low reservoir volume has been a flow volume in the region of 200 million cubic meters for 2000-2002 (up to October). A look at rainfall during the last six years reveals that it only exceeded average precipitation forecasts (544mm) in 1998; in all other years it was 70-80% of the forecast level.

[3] At the survey time point, a final summarization of project cost results was in progress. The work was completed during 2002, and final acceptance by the Chinese government is scheduled for 2003. Since the procedures have yet to be undertaken, in Chinese terms the dam is still under trial operation.

Although the reduced flow volumes may be attributed to the lower rainfall than predicted , the possibility of an influence by upstream water use conditions exists, and there is a need for more detailed surveys in order to clarify this point. The scale of the dam was planned on the basis of hydrological analysis from the last 36 years. Rainfall in China is characterized by marked annual and seasonal disparity and despite the anomaly of continuously low levels of precipitation during recent years, careful hydrological analysis will be necessary in connection with the timing when the dam construction brings effects.

Since fees collection for irrigation water supplies was commenced in 2002 there are figures available for irrigation water supplies results in this area. However, water intake from the sluice gates for municipal and industrial water supplies is currently under investigation, and thus it was not possible to confirm all the results. Accordingly, only limited effects have been observed to date. The status for each item is shown below.

Table 1: Baishi Dam Inflow and Flow Volume Results

Unit: 100 million $m^3$

| Year | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 |
|---|---|---|---|---|---|---|---|
| Planned level | 12.97 | 12.97 | 12.97 | 12.97 | 12.97 | 12.97 | 12.97 |
| Annual inflow results | 17.24 | 6.71 | 16.62 | 4.97 | N.A. | 4.26 | 2.2 |
| Annual flow volume results | — | — | — | — | N.A. | 2.33 | 2.07 |

Source: Baishi Multi-purpose Dam Management Office

### 2.3.2 Flood Control

Since dam completion, maximum rainfall intensity was 44.7mm per hour (August 10) in 2000 and 38.1mm per hour in 2001. In addition to these figures, a study of maximum monthly precipitation (mm/month) and a hearing with Baishi Dam Management Office have demonstrated that at no time has the amount of rains reached to the point where flood damage would have been caused if it had not been for the dam. In consequence, no calculations of the cost of potential damage as a project effect have been undertaken. At appraisal, the Baishi dam flood control area was calculated to be 64,667 hectares and the average annual direct cost of flood damage to be 34.942 million yuan.

### 2.3.3 Agricultural Water Supplies

Downstream from the dam there is one sluice gate from the Daling River for irrigation water supplies in Linghai city. Irrigation water supplies to downstream regions using water intake from the Daling River until October 2002 are shown in Table 2. The actual result for paddy fields was 13.82 million cubic meters against a target level of 226.4 million cubic meters (2000), and for reed beds, 23.28 million cubic meters against the target of 91.36 million cubic meters (2000). As mentioned earlier, the main reason for the extremely low water supplies is the water shortages that have resulted from consecutive years of low rainfall.

Table 2: Agricultural Water Supplies from the Daling River: Planned & Actual

| | Paddy fields | | Reed beds | |
|---|---|---|---|---|
| | Supply volume (10 thousand $m^3$) | Supply area (hectares) | Supply volume (10 thousand $m^3$) | Supply area (hectares) |
| Pre-implementation (1990) | 620 | 333* | 6,097 | 28,967 |
| Post-implementation targets (2000)<br>( ) = project induced increase | 22,640<br>(22,020) | 14,000 | 9,136<br>(3,039) | 15,300 |
| Actual (Jan. – Oct. 2002)<br>[ ] = ratio to target | 1,382<br>[6.1%] | 1,300<br>[9.3%] | 2,328<br>[25%] | 13,300<br>[87%] |

Source: JBIC appraisal data, Baishi Multi-purpose Dam Management Office

The project was predicted to increase irrigation water supplies from the Daling River by 220.2 million cubic meters per annum for paddy fields and 30.39 million cubic meters per annum for reed beds for a total of approximately 251 million cubic meters. The annual increase of 220.2 million cubic meters generated by the Baishi dam was expected to cover an additional 6,700 hectares[4] of paddy fields in the downstream cities of Linghai and Panjin, or a total additional area of 13,400 hectares. However, since the paddy fields in Panjin are being irrigated from another water source and not the Daling River, water from the project facility is being used exclusively to supply Linghai. According to Linghai Municipal Irrigation Office, the effects of the Baishi dam are being realized in Linghai city's 1,300 hectares of paddy fields, an area that falls below the planned level. The arable land that was planned for paddy has been converted to fields, and farmers are cultivating alternative crops, such as corn, due to their reluctance to grow rice having been diminished by successive years of low rainfall.

The additional paddy area of 6,700 hectares in Linghai would require implementation of a distil irrigation facilities project, but with water shortages continuing over several years, the project has yet to be given the green light. Regarding reeds, all water supplies were to be directed to the reed beds in Panjin. Although supply volumes are still extremely low as compared to the planned levels (roughly 25% up to October 2002), approximately 13,300 hectares, or 87% of the initially planned area, is currently being irrigated.

### 2.3.4 Municipal & Industrial Water Supplies

Results of municipal and industrial water supply volumes for eight of the nine dedicated sluice gates on the Daling River are currently under investigation (as of January 2002) in order that Baishi dam can begin collecting tariffs from next year (Table 3). The supply regions are Beipiao, Yixian, Fuxin and Jinxhou, but no reliable data on supply results have been obtained to date.

Work on a priority project to lay conveyance pipes to supply water to Fuxin city is currently underway. Plans envisage a total design conveyance volume of 285 thousand tons per day, with the project to be implemented in two phases; the Phase I construction of a 165 thousand ton per day conveyance pipe is tabled for 2005 completion, the Phase II construction of a 120 thousand ton per day conveyance pipe for 2013. With the completion of these pipes, Fuxin city will become the primary beneficiary of municipal and industrial water supplies from the Baishi dam.

Table 3: Daling River Sluice Gate Locations and Design Intake Volumes

| No. | Name | Location | Affiliation | Use objective | Design supply capacity ($10^4m^3$/year) |
|---|---|---|---|---|---|
| 1 | Yixian Water Supply | Yixian, south bank of Daling River | Yixian Water Supply Company | Municipal | 360 |
| 2 | Ling River Water Resource | 10km east of Yixian, north of Daling River | Fuxin Water Supply Company | Municipal | 2,000 |
| 3 | Power Plant Water Resource | Linghai Dayexiang | Dondgang Electric Co., Ltd. | Industrial/municipal | 3,650 |
| 4 | Jincheng Water Resource | Linghai Jincheng, east bank of Zhen River | Jincheng Paper Co., Ltd. | Industrial/municipal | 2,658 |
| 5 | Linghai Irrigated Area | Eastern Linghai | Linghai Water Resources Dept. | Agrarian irrigation | |
| 6 | Linghai Water Resource | Linghai Dalinghezhen linghecun | Linghai Water Supply Company | Municipal | 244 |
| 7 | No.6 Plant Water Resource | Linghai Xinzhuanzixiang Damingcun | Jinzhou No.6 Petrochemical Plant | Industrial/municipal | 3,650 |
| 8 | Liuduan Water Resource | Linghai Xinzhuanzixiang Liuduancun | Jinzhou Water Supply Company | Municipal | 2,550 |
| 9 | Liaohe Chemical Water Resource | Linghai Youweixiang Dongwangcun | Liaohe Chemical Fertilizer Plant | Industrial/municipal | 2,500 |
| | | | | | **Total 17,612** |

Source: Baishi Multi-purpose Dam Management Office Data

[4] As stated by Mr. Zhang Shu Xiang of the Planning and Design Institute, Liaoning Province Water Resources Department who was in charge of the Baishi dam F/S. The JBIC appraisal materials did not specifically identify beneficiary regions, however, the Panjin paddy fields appear to have been included in the map of beneficiary regions.

### 2.3.5 Power Generation

Power generation results are as shown in Table 4. Since the water level in the dam failed to attain the power generation limit after installation of the generation unit was completed in 2000, there are no results for power generation for that year. In 2001 and 2002, the continuous bouts of dry weather kept the dam's reservoir volume low, and although the generator operated at 60% capacity in some months, there were also periods when the operating rate was 30%. Results for annual power sales, at around 30% of planned levels, are extremely poor in comparison with initial targets (power is supplied to the North China Grid network and it is not possible to specify beneficiaries).

Table 4: Power Generation Results

| | | 2001 | | | | | | | | | | | | 2002 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep |
| Net transmission volume (MWh) | Actual | 0 | 0 | 0 | 0 | 247 | 345 | 3,488 | 2,621 | 0 | 316 | 0 | 305 | 795 | 90 | 404 | 1,526 | 2,195 | 1,119 | 1,041 | 366 | 194 |
| Capacity factor (%)* | Actual | 0 | 0 | 0 | 0 | 3.46 | 4.8 | 46.9 | 35.9 | 0 | 4.2 | 0 | 4.1 | 11.1 | 1.4 | 5.7 | 22.1 | 31.8 | 16.2 | 14.6 | 5.12 | 2.81 |
| Operating ratio (%)** | Actual | 0 | 0 | 0 | 0 | 34 | 34 | 67 | 67 | 0 | 33 | 0 | 35 | 33 | 33 | 33 | 67 | 67 | 67 | 67 | 33 | 33 |
| Sales volume (MWh/year) | Planned | 26,020 | | | | | | | | | | | | 26,020 | | | | | | | | |
| | Actual | 6,876.70 | | | | | | | | | | | | 7071 (results for Jan. – Sept.) | | | | | | | | |

Source: Baishi Multi-purpose Dam Management Office Data

### 2.3.6 Fish Culture

Breeding pond areas and fish catches are as shown in Figure 5. As with other effects, low rainfalls since water storage was commenced in 2000 have resulted in major shortfalls in the water level and the area of the dam reservoir against the design figures, and thus yields from fish culture turn out to be low. Another reason for the low catches is that the fish are not ready for hauling since little time has elapsed since the fry was introduced. The catches are sold to contractors in the city of Chengchun in Jilin Province.

Table 5: Pisciculture Indicators

| Year | | 2000 (dam completion) | 2001 | 2002 at November survey |
|---|---|---|---|---|
| Breeding pond (ha) | Planned | 6,400 | 6,400 | 6,400 |
| | Actual | 939 | 2,200 | 2,748 |
| Yield* (tons) | Planned | 820 | 820 | 820 |
| | Actual | 0 | 15 | 200 |

Source: Baishi Multi-purpose Dam Management Office Data

### 2.3.7 Financial Internal Rate of Return (FIRR) and Economic Internal Rate of Return (EIRR)

Recalculation of both FIRR and EIRR has not been attempted due to the virtual absence of project effects at the time of the current survey.

## 2.4 Impact

### 2.4.1 Impact on Regional Development – Agricultural / Industrial Production

As stated in the "Effectiveness" section, at the present time little progress has been made with the

water level in the dam due to low rainfalls, thus any impact attributable to the project has been severely limited. To date, there has been no potential flood damage that could have been held back by the dam, and the dam has supplied hardly any agricultural, municipal or industrial water. Therefore, the impact from the project has been very little.

### 2.4.2 Environmental Impacts

In terms of the quality of dam water, water volumes have increased since completion and although improvements have been made when weighed against the design, the target standards established at appraisal have yet to be reached. This is considered to be mainly attributable to the fact that upstream sewerage measures have yet to be implemented. Measures to address sewerage in Chaoyang, Beipiao and the upstream regions of Liangshui River are the focus of government discussion and there are plans to construct sewerage disposal facilities with respective capacities of 100 thousand and 50 thousand tons per day in the cities of Chaoyang and Beipiao, which are currently at the preliminary preparation stage.

Between 1996 and 2002, 1.03 billion yuan was pumped into water and soil retention in the Daling River basin in connection with the implementation of inflow sedimentation controls and topsoil retention regulations, and related projects in upstream regions of the Baishi dam have resulted in the successful afforestation of an area spanning 3,000km$^2$. An afforestation project is currently underway in western Liaoning Province with provincial government-level cooperation (Agriculture Bureau, Forestry Bureau, Water Resources Department, Environmental Conservation Bureau). Afforestation in the vicinity of the dam is allegedly being undertaken by the local municipality (Beipiao).

### 2.4.3 Impact of Involuntary Displacement & Resettlement

Project plans anticipated that involuntary displacement would involve 5,208 households and 18,712 people, and in fact, 5,976 households and 18,656 people were relocated. The Lama temple was relocated in September 2000, and the entire component is scheduled for completion in May 2004.

Compensation payments were in line with the standards established by Beipiao municipality and relocation was undertaken as per the plans; communications, infrastructure developments in resettlement areas were also completed as intended.

The executing agency is of the opinion that the residents involved in the relocation were generally satisfied with the government's policy, procedures and the process, and no particular demands have been made. Since resettlement, improvements have reportedly been made to various aspects including residences, transportation, water supplies, and culture, and favorable progress has also been made with working conditions.

Within the confines of this survey, the relocation of residents is believed to have progressed without issues for the following reasons.

- The dam's management office also made reference to successful domestic instances of relocation and consideration was given to improving the living standards of the resettled individuals.
- Procedures, processes and so forth were undertaken in conformity with government provisions.
- In principle, the residents targeted for resettlement determined where they would be moved to of their own volition, and where possible, more favorable locations were selected after a comparison with the current area (Initial plans envisaged that the majority would be resettled within Beipiao city boundaries. However, since the chosen location was at some distance from the city center and soil quality meant that there was limited land available for farming, a location was selected with more favorable conditions in terms of soil quality and access to the

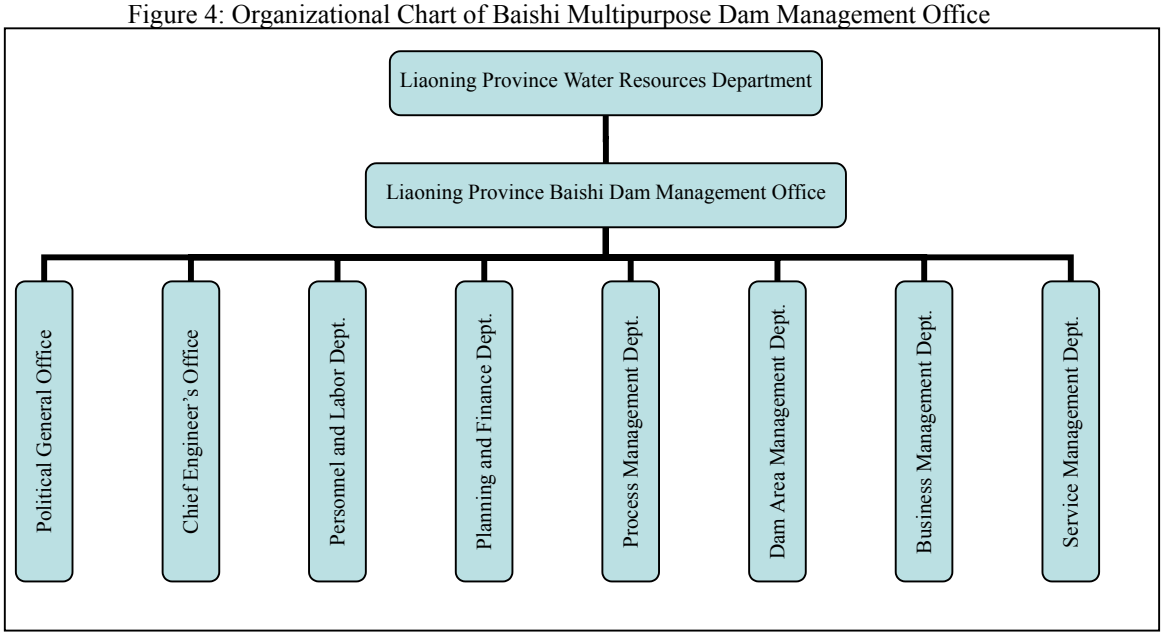
city, etc., with the result that roughly 50% of the group elected to live outside the city). Interviews conducted with a number of the residents who had been resettled revealed that they were satisfied with relocation procedures and conditions and that living standards improved since resettlement.

## 2.5 Sustainability

### 2.5.1 Organizational Capability

When this survey was undertaken, the Liaoning Province Baishi Dam Management Office was responsible for operation and maintenance activities (operation, maintenance, flood control, water supply management)[5]. The organization of the Baishi Dam Management Office has remained virtually as it was when established during dam construction. It has 125 staff and comprises eight departments, namely, Political General Office, Chief Engineer's Office, Personnel and Labor, Planning and Finance, Process Management, Dam Area Management, Business Management, and Service Management (Figure 4). Four of the departments are directly involved in the operation of the dam, i.e. the Chief Engineer's Office, Process Management, Dam Area Management and Business Management departments, which encompass a total of 50 personnel. Any shortages are covered by staff loans from other agencies or using temporary staff.

Figure 4: Organizational Chart of Baishi Multipurpose Dam Management Office




### 2.5.2 Technical Capability

The technical capabilities of the personnel involved in maintenance work are now being judged by educational history and specialist qualifications. Specialist qualification certification evaluates the personnel's technical capabilities based on a government prescribed assessment method (years of service, work ability, educational history, a written thesis and research results, etc., are assessed by a

[5] The Water Resources Department reports that since final acceptance procedures have yet to be undertaken the office is a project unit under direct Water Resources Bureau control, however, once the final acceptance is complete it will belong to a water supply bureau affiliated to the department's head office.

specialist committee). Moreover, the abilities and performance of the personnel are subject to annual evaluation, and retraining is provided for staff members who have recorded a poor performance in its evaluation. In the event that technical skills do not meet the demands of scientific and technological advances and/or newly introduced technologies, the personnel receive continuous education (academic education, short-term training in specialist technologies, training postings, etc.) and new personnel are recruited (specialists and university graduates, etc.) in line with the policies and plans for personnel development at Baishi dam. As this demonstrates, attention is being paid to the technical capabilities of personnel.

### 2.5.3 Financial Status

Since the dam was operating on a trial basis until last year, official budget requests were not commenced for its maintenance and operation budget until this fiscal year; 6.59 million yuan was allocated against a request for 8 million yuan (total for maintenance, personnel costs, taxes, etc.). The dam construction management office reports that the budget is sufficient for appropriate operation and maintenance at this time.

### 2.5.4 Present Situation and Future Prospects for the Dam

The Baishi dam and ancillary facilities are currently being operated and maintained in favorable condition, and since the management office has lined up a group of engineers and is implementing intensive servicing activities no major breakdowns or problems have been observed.

Simulation analysis was undertaken for sediment and the proposal to construct 12 drainage holes in a concentrated configuration was selected, as it would allow the maximum volume of sedimentation to be discharged. In brief, the average sediment discharge rate is predicted to be 33% for the first 30 years, 41.9% for years 31-50, and 55.7% for years 51-100. As stated in the section on environmental impacts, reservoir capacity is being maintained via measures to prevent water and soil washout. The Baishi Dam Management Office reports that the volume of sedimentation for 2001 through 2002 was 12 million tons, which is roughly equivalent to 3% of the 370 million ton sedimentation volume projected in the F/S for the first 25 years of the project cycle. Thus there are currently no matters that require singling out for particular attention.

For the future, it is anticipated that project effects, such as municipal water supplies, etc., will be realized once rainfalls return to average levels enabling progress to be made with the flooding of the dam and related projects, including the conveyance pipe development project that is currently in progress, are completed. Accordingly, it will be necessary to review the project's effectiveness status in 2005, the year that the conveyance pipe development project is scheduled for completion.

## 3. Feedback

### 3.1 Lessons Learned

The scale of the dam constructed via this project was planned on the basis of hydrological analysis from the last 36 years. However, the flooding of the dam has not progressed primarily because of exceptionally low rainfalls in recent years, and it is hoped that precipitation volumes will return to normal at an early stage so that the effects of the project may be realized. In drafting plans for and implementing future projects to construct multi-purposed dams careful analysis should be made of flooding volumes.

## Comparison of Original and Actual Scope

| Item | Plan | Actual |
|---|---|---|
| **1. Project Scope** | | |
| 1) Main dam | 1) Concrete gravity-type dam: height: 48.7m, width: 523m, maximum water level: 133.5m, maximum storage capacity: 1.6 billion $m^3$. | 1) Concrete gravity-type dam: height: 49.3m, width: 513m, maximum water level: 133.88m, maximum storage capacity: 1.645 billion $m^3$. |
| 2) Crest spillway | 2) 10m (width) × 11.7m (height) × 15 gates | 2) 12m (width) × 15.8m (height) × 11 gates |
| 3) Drainage holes | 3) 4m (width) × 5.5m (height) × 16 gates | 3) 4m (width) × 5.5m (height) × 12 gates |
| 4) Power generation facilities construction | 4) 9,600kw, 27.47 million kwh/year | 4) 9,600kw, 22.13 million kwh/year |
| 5) Consulting services | 5) 40M/M | 5) 36.5M/M |
| **2. Implementation Schedule** | | |
| 1) Design | Jan. 1996 – Mar. 1996 | As left |
| 2) Tender | Jan. 1996 – Sep. 1997 | As left |
| 3) Preparation, temporary works | Jan. 1996 – Sep. 1996 | May 1995 – Sep. 1996 |
| 4) Foundation work, etc. | Jun. 1996 – Jun. 2000 | As left |
| 5) Powerhouse construction | Mar. 1998 – Dec. 2000 | As left |
| 6) Metal work | Sep. 1999 – Dec. 2000 | As left |
| (dam completion / operational start-up) | — | (Sep. 2000) |
| **3. Project Cost** | | |
| Foreign currency | 8,000 million yen | 7,997 million yen |
| Local currency | 12,156 million yen (1,013 million yuan) | 17,416 million yen * (1,244 million yuan) * |
| Total | 20,156 million yen | 25,413 million yen * |
| ODA loan portion | 8,000 million yen | 7,997 million yen |
| Exchange rate | 1US$ = 100yen<br>1 yuan = 12 yen<br>(as of January 1996) | 1US$ = 121 yen<br>1 yuan = 14 yen<br>(average for 1996 – 2000) |

*These are the final project costs as confirmed at this stage (November 2002), railway rerouting costs have not been included as the final costs have yet to emerge (plans are to collate the costs by the end of the year).

## Third Party Evaluation
## Liaoning Baishi Reservoir Construction Project

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1. Viability of the Project

The western region of Liaoning Province has long been plagued by a shortage of water resources. In the region's Daling River basin, lagging development of water sources has led to floods in the rainy season and water shortage in the dry season. Flood disasters and draughts have significantly hampered production activities as well as daily lives in the region. To address these problems, the government of Liaoning Province has set its sight on putting in place a flood control system and developing water sources in the Daling River by designating this Project one of the priority projects under the 9th 5-Year Plan. Since the water supply situation has become tighter today than at the time of project formation, the priority of water supply has shifted from agricultural to urban use. Nonetheless, the Project has very high validity from the viewpoint of flood control and water resource development.

2. Efficiency of Project Implementation

The Project was implemented virtually in accordance with the work plan drawn up during the appraisal, completed on schedule, and commenced operation in September 2000.

The project cost in the local currency portion increased some 23%. This was attributable to a cost increase in civil works and higher-than-planned compensation payments for resettled residents whose houses were submerged under water, following the revised compensation standard.

3. Project Impact

Upon completion of the Project, 76% of the Daling River basin was placed under the flood control system, and the flood control standard of the region located downstream of the dam was raised from the level of flood probability occurring once in 20 years to once in 50 years. The Project played a key role in supplying agricultural water to Linghai City in the lower reaches of the River. For example, in April and May 2001 when droughts made it unable to plant rice in farmlands in Linghai City, more than 20 million cubic meters of water was supplied from the Baishi Dam to meet the pressing need of the City. With regard to water for urban use, a total of 202 million cubic meters of water is to be supplied to cities, including Fuxin and Jinzhou.

Designed as a multipurpose dam, the Baishi Dam is equipped with 9,600KW hydroelectric generators. Also, it has become one of the major tourist spots in the region, thereby contributing to tourism development.

As the environmental impact of the Project, the quality of water in the dam was affected. It is rated grade 4 and has failed to reach the initially targeted grade 3. This was attributable to inadequate flows of water caused by a continued spell of little rainfall and underdeveloped wastewater treatment facilities in the upstream of the dam. The governments at each level are alarmed of this problem and are planning to build waste water treatment plants with capacities of 100,000 tons and 50,000 tons per day respectively in Chaoyang and Beipiao. These projects are currently under preparation. With regard to resettlement, a total of 5,976 households and 18,656 people were relocated, of which 89%, or 5,306 households, moved outside the municipal boundaries. The municipal government made sufficient considerations for compensation and developing production and basic living infrastructure for the relocated populations, and those resettled seem to be satisfied with improved living conditions after resettlement. Located in the area to be submerged under water is Huining Temple, the largest existing Lamaism temple in the Northeastern China. This will be moved 1.5km away from the present location.

4. Project Sustainability

The Administrative Department of Baishi Dam of Liaoning Province is responsible for the management, operation and maintenance of the Project. Analysis of its organization, technology/human resources and finances reveals no particular problems in project sustainability.

5. Recommendations

As China undergoes rapid industrialization and urbanization into the future, water pollution is expected to increase. Thus maintaining the quality of water will be as important as or become even more important than water source development. Dam projects in the future should incorporate the preservation of water quality as a key element.