ECONOMIC ANALYSIS

A. Introduction

1.   The proposed project will improve the supply of skilled human resources in Baise Municipality to meet the demands from industry and support the transformation of the local economy in its effort to achieve sustainable and inclusive growth. The proposed project will be the fourth ADB-financed technical and vocational education and training (TVET) investment project in the People's Republic of China (PRC), and will play a demonstration role for the sector and provinces in multilevel TVET.

2.   The expected impact of the project is economic development and industrial transformation of Baise municipality. There are four outputs: (i) **Output 1: TVET quality improved and capacity developed.** This will (a) develop an integrated MLT system that provides curricula linking vocational secondary, college, and undergraduate levels of TVET; (b) implement a competency-based approach to curricula, instruction, and assessment in priority areas across different majors and course levels; (c) upgrade teacher skills through pre-service and in-service professional development; (d) upgrade assessment and quality assurance based on industry standards; (e) develop curriculum in entrepreneurship and employability skills; and (f) develop a TVET teacher training center; (ii) **Output 2: Chengbi campus constructed and environmental sustainability promoted.** The component will construct phase 2 teaching and residential buildings and facilities in the new Chengbi campus. The component includes the construction of 12 buildings with a total of 160,693 square meters.[1] A 3.86 million kilowatt-hour (kwh) photovoltaic power system will be installed, and campus roads, sport facilities, slope protection, and other school facilities will be constructed. Teaching and laboratory equipment for the new campus will be financed by domestic funding. The Green Sustainability Center will ensure development of green principles in campus management, curriculum development, and community outreach; (iii) **Output 3: TVET Innovation and relevance promoted.** The component will support strengthening school–industry partnerships, expanding regional cooperation activities, and implementing strategic research.; (iv) **Output 4: Project implementation managed.** This will ensure efficient and effective project implementation of the project.

3.   The project will generate a significant number of professionals with post-secondary education and vocational trainings over a 25-year period. These additional professionals will be better skilled and more competent having been provided with adequate training at Baise University. The project will accomplish this by (i) improving teaching facilities in the newly expanded campus, (ii) improving teaching and learning materials, (iii) developing competency-based standards and curricula, and (iv) strengthening industry placements and cooperation programs. The project is aligned with ADB's Strategy 2020,[2] the recommendations from the midterm review of the strategy that emphasized promoting TVET to address the human resource agenda, and the education sector strategic plan. It also aligns with ADB's country partnership strategy, 2011–2015[3] for the PRC.

B. Economic Rationale

4.   The economic analysis reviews recent growth and employment trends in the Guangxi Zhuang Autonomous Region to establish the basis for its positive assessment of future labor demand in occupations that are the focus of the proposed project.

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[1] An overview of the campus construction, equipment, and special features is in Appendix 5 of the project administration manual.
[2] ADB. 2008. *Strategy 2020: Working for an Asia and Pacific Free of Poverty.* Manila.
[3] ADB. 2012. *People's Republic of China: Country Partnership Strategy (2011–2015).* Manila.

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5.   **Supply.** In 2012, the total number of TVET schools in Guangxi was 319, compared to only 123 in 1995. There are also 49 skilled workers' schools, which are also considered broadly defined, lower level TVET schools. The total enrollment of TVET students in Guangxi increased from about 180,600 in 1995 to about 964,600 in 2012. The annual growth rate of TVET admissions was 18% from 1995 to 2012, higher than the 0.6% growth rate of ordinary senior high school admissions. The total enrollment of TVET schools, as a ratio of total enrollment of university enrollment, in the Guangxi Zhuang Autonomous Region increased from 51% in 2005 to over 159% in 2012.

6.   Since 2008, with total admissions in TVET schools exceeding admission targets every year, Guangxi has invested over CNY7.5 billion in school development, including newly built campuses with a total area of 3.3 million acres, newly added spaces of 3.27 million square meters, newly procured equipment estimated at CNY1.65 billion, and about 2.5 million new books.[4] In Baise, total admissions of TVET students are increasing rapidly. For instance, in 2013, total admission was 167% of the targeted figure. The number of TVET graduates in 2012 was 214,900, compared to 49,600 in 2005. With the increase in student body enrollment, Guangxi's per capita TVET enrollment ranking climbs to the medium range among all provinces and regions.

7.   **Demand.** The TVET enrollment data, by field, reflects the growing demand for specific skills by secondary and tertiary industries. Employment data for Guangxi revealed that there is a growing demand for skilled workers in recent years (2008–2012) within Baise, with employment rising by an average of 6.5% annually. However, the traditional agriculture industries are shrinking in terms of the number of workers they employ, exhibiting a decreasing annual growth rate, while employment in the secondary and tertiary industries are exhibiting increasing annual growth rates. Overall, the figures show that employment opportunities are shifting away from primary towards secondary and tertiary industries, which require more skilled workers. The recent wage statistics in Baise show that sectoral wage levels are growing at a similar pace. Using these panel data, future employment and wage levels by sector were projected by the project preparation team and they show that Baise University's enrollment structure by majors is consistent with the pattern of the employment growth trend in Baise. **Table 1** shows Baise's population, number of employees, total wage, and average wage in major years since 1950. The wage level forecasts were used to calculate the economic internal rate of return (EIRR) of the project.

Table 1: Baise Population, Employees, Total Wage, and Average Wage (1950–1995)

Year	Population	Employees	Total Wage	Average Wage	Year	Population	Employees	Total Wage	Average Wage
1950	165	1.1			1995	356	21.94	101,951	4,647
1965	205	5.59	2,591	464	1996	358	21.37	107,239	5,018
1978	289	11.16	6,357	570	1997	359	20.95	111,195	5,308
1980	300	13.72	9,133	666	1998	361	19.95	115,420	5,785
1981	305	14.17	9,505	671	1999	362	18.97	118,284	6,235
1982	311	14.37	10,280	715	2000	364	18.78	131,778	7,017
1983	315	14.14	10,746	760	2001	366	18.46	172,894	9,366
1984	320	14.27	14,157	992	2002	367	17.53	196,683	11,220
1985	326	14.55	14,822	1,019	2003	368	17.11	203,781	11,910
1986	331	15.23	18,843	1,237	2004	372	17.21	230,662	13,403
1987	335	15.89	21,862	1,376	2005	374	17.20	262,172	15,243
1988	338	16.40	28,109	1,714	2006	379	17.13	303,376	17,710
1989	341	17.41	31,266	1,796	2007	386	17.37	368,641	21,223

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[4] Ministry of Education of the PRC. 2012. *Educational Statistics Yearbook of China*. Beijing.

Year	Population	Employees	Total Wage	Average Wage	Year	Population	Employees	Total Wage	Average Wage
1990	344	18.41	36,283	1,971	2008	392	16.54	430,470	26,026
1991	346	19.17	40,696	2,123	2009	399	16.71	461,585	27,623
1992	350	20.07	49,078	2,445	2010	382	17.50	510,560	29,175
1993	352	21.23	65,770	3,098	2011	385	17.67	563,194	31,873
1994	354	21.40	89,265	4,171	2012	389	19.64	663,007	33,758

Source: Guangxi Statistical Yearbook (1950–1994).

8. At the regional level, enrollment in 2012 was 312,754 and the number of graduates was 261,830, indicating a rather quick growth of the TVET student body. Enrollment by field indicates that processing and manufacturing accounts for the largest number of students, with new admissions of 60,618 students and 60,919 graduates in 2012. This is followed by information technology, with 57,418 new admissions and 51,927 graduates. Over 95% of TVET graduates are employed within 6 months of graduation, demonstrating their high demand. The trend of Baise University's new admissions by fields during 2011–2013 is congruent with that of Guangxi. New admissions increased from 1,607 in 2011 to 2,792 in 2013, a faster pace than the regional average. Baise University's long-term enrollment target is 18,000 students. Accordingly, the incremental increase in students due to project will be 5,050, due to the added campus construction of 160,691 square meters and a per student facility space of 25.02 square meters according to state regulation.

9. Baise's employment and wage data are listed by sector for 2010, 2011, and 2012 in **Table 2**. The data shows that there is a growing demand for specific skills by secondary and tertiary industries. Construction, community services, real estate, and health care saw the most significant growth of total employment in the past 3 years, while the hotel and restaurant sectors, and construction, rental, and energy and water supply industries led the growth of average wages. The trend in Baise is consistent with Guangxi where more jobs are created in the secondary and tertiary industries, which require more skilled workers. Although the average wage rates for different sectors are all increasing, the 2012 levels are still below 2011 national averages in all sectors.

Table 2: Baise's Employment and Wages by Sector

Employment	2012				2011				2010		
	Nat. Ave.	Ave. Employee	Total Wage	Ave. Wage	Ave. Employee	Total Wage	Ave. Wage	Ave. Employee	Total Wage	Ave. Wage
AFAF	22,687	4,448	80,942	18,197	4,711	82,168	17,442	4,876	78,279	16,054
Mining	56,946	9,563	450,285	47,086	7,912	389,021	49,168	8,760	328,535	37,504
Manufacturing	41,650	32,201	1,282,204	39,819	28,754	1,006,308	34,997	30,053	921,455	30,661
E & W	58,202	9,552	392,838	41,146	9,666	350,893	36,302	9,560	282,307	29,530
Construction	36,483	7,590	205,627	33,096	7,079	143,237	20,234	3,596	58,870	16,371
TSD	53,391	7,034	181,264	25,770	7,103	166,096	23,384	7,493	148,624	19,835
Hotel/restaurant	31,267	1,311	23,659	37,856	1,436	21,797	15,179	1,622	22,307	13,753
Real estate	46,764	1,151	35,046	30,448	1,081	23,476	21,717	939	20,467	21,797
Rental	53,162	1,523	36,056	23,674	2,130	25,929	12,173	1,517	28,248	18,621
Community service	35,135	173	4,666	26,971	75	1,517	20,227	78	1,241	15,910
Education	47,734	39,055	1,324,633	33,917	40,303	1,291,552	32,046	40,707	1,225,240	30,099

Health	52,564	17,896	563,405	31,482	16,665	485,141	29,111	14,825	405,152	27,329

AFAF = agriculture, forestry, animal husbandry, and fishery; Ave = average; E&W = energy and water; Nat = national, TSD = transportation, storage, and delivery.
Sources: Guangxi Statistical Yearbook (2011–2013); China Statistical Yearbook (2013).

C.   Economic Viability

10.   **Main assumptions**. The economic benefits of the proposed project are estimated as the incremental value of higher earnings that workers can expect to receive in the labor market as a result of improved skills attributable to the proposed project. A standard method of cost-benefit analysis was used to calculate the EIRR (i.e., the discount rate that makes the net present value of costs and benefits equal). Key assumptions used in the economic analysis include the following:

(i)   total project capital investment cost excludes price contingencies, fees, and taxes and is spread across the duration of the project implementation;

(ii)   project benefits will accrue over a period of 20 years;

(iii)   the incremental number of graduates due to the project is assumed to be 5,050 and to remain at that level throughout the project life of 20 years;

(iv)   incremental earnings for graduates are assumed to work as full-time employees[5] in their program-related employment (assumed to be at least 5 years) at a conservative 10% salary premium, which is added to the existing average annual salary;[6]

(v)   a discount rate of 12% is applied in the calculation of the EIRR; and

(vi)   EIRR values adjusted for dropouts and unemployment, or 95% of the graduates, will successfully obtain employment.[7]

11.   **Economic costs.** An economic analysis of the project has been undertaken with all projected costs and benefits at constant 2014 prices and measured using the domestic price numeraire method. Economic costs identified for the project are project investment, operating and maintenance, and replacement costs. Traded components are converted into economic prices using a shadow exchange rate factor of 1.08.

12.   **Economic benefits.** There are economic benefits of the proposed project that were difficult to quantify. These include (i) spillover effects to non-project TVET institutions in Baise and Guangxi, (ii) benefits to non-regular students (short-term trainees) and the augmented capacity of the project TVET institutions to train more part-time and short-term students in Baise, and (iii) skills upgrading of non-participants working with TVET graduates. These additional project benefits are recognized but are difficult to quantify.

13.   To quantify the project benefits, the incremental human capital—measured by the wage increases of graduates—is used. The return of college and/or vocational school education is high worldwide. A recent study by H. Zhong on the return of higher education in the PRC shows that there is a 7.5% return on wages per year of higher education.[8] The study also finds that for the working cohort that entered the workforce after 1993, the annual return to college education is 7.5% on average. This translates to a 30% incremental wage level for a regular 4-year college education. To keep the analysis conservative, an assumption has been made in this economic analysis by the project preparation consultants that there will only be a 10% incremental wage rate

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[5] It is assumed that all employment opportunities are full time.

[6] Recent studies including those using Guangxi and other provinces survey data show that the return of post-secondary (college and TVET) education varies from 11% to 35% (e.g., http://www.doc88.com/p7768769096437.html; http://news.sina.com.cn/comment/2000-1-14/52469.html; and http://news.163.com/14/0304/08/9MFS7O6C00014 AED.html).

[7] Averaged according to Baise University's graduates placement reports.

[8] H, Zhong. 2011. Returns to Higher Education in China: What is the Role of College Quality? *China Economic Review.* pp. 260–275.

for each student. Furthermore, an assumption has also been made that skills earned from higher education and vocational training in Baise University can last for 5 years before new skills are required in the market. This assumption is also conservative since more education leads to a higher ability to self-study, thus skill upgrading is more likely to arise for the educated cohort.[9]

D.   Economic Internal Rate of Return and Sensitivity Analysis

14.   The monetized value of the benefits compared with projected economic costs of the project yields a base EIRR value of 16.7% and a net present value of CNY249.64 million.

Table 3: Economic Internal Rate of Return Results

	Cost			Benefits		
Year	Investment	O&M	Total	Human Captial	Total	Net Benefits
2015	117.10		117.10			(117.10)
2016	178.62		178.62			(178.62)
2017	182.39		182.39			(182.39)
2018	92.62		92.62			(92.62)
2019	31.45		31.45			(31.45)
2020		16.76	16.76	137.41	137.41	120.65
2025		23.58	23.58	169.72	169.72	146.14
2030		28.48	28.48	216.61	216.61	188.13
2035		33.75	33.75	276.45	276.45	242.71
2040		35.95	35.95	352.83	352.83	316.88
					EIRR =	16.7%

EIRR = economic internal rate of return, O&M = operation and maintenance.
Source: HJI's estimate.

15.   The sensitivity analysis indicates that the EIRR is robust against all negative changes such as costs, enrollment and/or employment, or productivity, and project benefit delays. Even with a combination of 20% operation and maintenance (O&M) costs overrun and a 20% reduction of benefits, the project EIRR still exhibits 13.4%, a value higher than the cut-off level. In Table 4, we provide the results of the sensitivity analysis, which considered the negative impacts of O&M costs, benefit reductions, and project benefit delays. The capital cost overrun has not been considered since the project costs already considered contingencies, making it adequate to address the negative impacts on capital costs. For benefit reduction, it can be either enrollment reduction, unemployment rate increase, or lowered incremental productivity. The corresponding switching values are provided as well.

Table 4: Summary of Economic Internal Rate of Return Sensitivity Analysis Results

Change Variable	Percent Change in Variable	Recalculated EIRR	ENPV (12%) (CNY million)	Switching Value	Sensitivity Indicator
1. Increase in O&M costs	20%	16.4%	229.34	235%	0.10
2. Benefit reduction	20%	13.8%	88.72	30%	0.86
3. Increase in O&M costs and benefit reduction	20%	13.4%	68.43		0.98
4. Delay in benefits by 1 year		14.7%	146.89		
Base EIRR[a] =	16.7%				
Base NPV @12% =	249.64 CNY million				

EIRR = economic internal rate of return, ENPV = expected net present value, NPV = net present value, O&M = operation and maintenance.
[a] Base EIRR is estimated based on incremental enrollment calculated by the with and without project scenario comparison. The average annual salary of new graduates will follow the market rate based on projections to 2032.
Source: ADB estimate.

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[9] An assumption has been made that 95% of the graduates can find full-time jobs in their program-related employment and remain in the same employment over at least a 5-year period with wage premium.