

## ECONOMIC ANALYSIS

### A. The Project

1. The project will help improve the capacity and effectiveness of technical and vocational education and training (TVET) in Nanning that is focused on social services. TVET in the People's Republic of China (PRC) attracts large numbers of rural students, including a high proportion of poor. TVET education is viewed by rural and poorer families as a pathway to improved job prospects and an urban livelihood. The project will support improved capacity to provide TVET training and upgrade buildings, campus facilities, and equipment at Nanning Health School (NHS) and Nanning No. 4 Vocational and Technical School (NVTS). This is envisioned to improve the quality of training in these TVET schools and the qualifications of graduates. Over a 25-year period, a total of 31,028 students consisting of 15,087 nurses, 1,591 rural doctors, and 14,350 kindergarten teachers will successfully graduate and join the work force. This is expected to improve the delivery of public social services in Nanning.

2. These project interventions are expected to improve the quality of training for 5,850 students annually, including an additional 1,850 students due to expanded facilities. Moreover, the strengthened capacity of the TVET institutions will be able to sustainably and effectively produce well-trained skilled workers with high potential for employment in the health and vocational sectors. Greater industry involvement and participation in program planning and development of competency-based standards and curricula will ensure the development of demand-driven skills training. Improved cooperation among the TVET institutions, industry, and government agencies will allow the TVET system to be more responsive to the changing needs of employers, and a facilitator of public services reform and improvement.

### B. Economic Analysis

3. The economic analysis was undertaken in compliance with Asian Development Bank guidelines.<sup>1</sup> Conventional economic viability analysis, using economic internal rate of return (EIRR) calculation, has been applied in determining the viability of NHS. The analysis for NVTS uses a simple cost-benefit analysis that estimates the net present value of the annual stream of economic benefits derived from investments made in preschool education. The annual stream of economic benefits is estimated by a factor of the annual stream of economic costs over a 25-year period. Three scenarios of low, medium, and high rates of return were estimated by applying a range of estimated rates of return on investments on early child care and education (ECCE) that have been generated by three major studies conducted in the United States.<sup>2</sup> The reliance on the results of other studies stems from the difficulty in quantifying the potential economic benefits of ECCE derived over the long term.

4. **Major assumptions in the economic analysis for Nanning health school.** The quantified economic benefits accruing to the project investments of NHS are based on (i) the generated income earnings of graduates over the life of the project; (ii) reduced cost of medical treatment due to illness, resulting from improved delivery of medical services by better-skilled nurses and rural doctors; and (iii) reduced losses in productivity due to illness.

5. Key assumptions used in the economic analysis include (i) capital investment is spread across the duration of project implementation (5 years); (ii) incremental operational costs were assumed to be 2.0% of the total capital cost; (iii) replacement of equipment is assumed to be

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<sup>1</sup> ADB. 1993. *Guidelines for the Economic Analysis of Projects*. Manila.

<sup>2</sup> The studies, conducted in Michigan, Illinois, and North Carolina, are cited in J. MacGillvary and L. Lucia. 2011. *Economic Impacts of Early Care and Education in California*. Berkeley: UC Berkeley Labor Center.

carried out every 5 years; (iv) government budgetary allocation for student subsidy is estimated at CNY3,080/student/year, consisting of yearly expenses per student for books (CNY600), room and board (CNY400), and tuition (CNY2,080); (v) benefits will accrue over a period of 20 years after project implementation; (vi) project life is assumed to be 25 years; (vii) the number of NHS graduates is assumed to remain at its 2018 level throughout the project life;<sup>3</sup> (viii) an incremental increase of 10% in salaries of NHS graduates is assumed;<sup>4</sup> and (x) a discount rate of 12% is applied in the calculation of the EIRR.

**6. Benefits generated by Nanning health school.** NHS is expected to produce an incremental 933 new graduates annually, consisting of 844 nurses and 89 rural doctors. Over a 20-year period, NHS graduates, 95% of whom are assumed to find employment, are projected to generate total incremental income earnings of about CNY614.64 million. This new cadre will be better trained and more competent in delivering medical services, particularly in rural areas, where these services are much needed. A potential of 11.83 million persons,<sup>5</sup> about 9.24 million adults and 2.59 million children,<sup>6</sup> will have access to medical services provided by the new nurses and rural doctors, thereby allowing them to receive proper medical and effective prevention of common diseases. Improvement in medical services and delivery is envisioned to significantly reduce disease incidence, especially of gastro-intestinal diseases. The disease incidence rate<sup>7</sup> is expected to decline by 50%,<sup>8</sup> from 0.395% (without the project) to 0.1975% (with the project). It is estimated that 45,609 people (consisting of 35,632 adults and 9,977 children) would fall ill annually under the without-project scenario. With the project this is expected to decrease to 22,804 persons (consisting of about 17,816 adults, and 4,988 children). The total accumulated medical cost, including direct and indirect costs,<sup>9</sup> is expected to decrease from CNY30.82 million to CNY15.41 million. Missed workdays due to illness, without project, are estimated at 14.4 days

<sup>3</sup> It is conservatively assumed that the project investments will not directly lead to increased graduate numbers. However, the project TVET institutions have projected an increase in enrollment as a result of the proposed project.

<sup>4</sup> Individuals must undergo TVET training to qualify as nurses and rural doctors. Individuals without TVET training may only be employed in jobs with low skill requirements. In discussions with NHS staff, it was estimated that, on average, individuals without TVET training receive a salary about 10% lower than the salary that TVET graduates receive. Therefore, the incremental increase in salary is the difference between the salary of a graduate with TVET training and one who did not undergo such training.

<sup>5</sup> Estimate based on 13 nurses and doctors per 10,000 persons. <http://old.cpwf.org.cn/en/30Province1999-guangxi.htm>

<sup>6</sup> Data from China Statistics Press. 2012. Guangxi Statistics Bureau. Guangxi Zhuang Autonomous Region. *Guangxi Statistical Year Book 2012*. It was indicated that adults account for 72% of the total population and children for 28%.

<sup>7</sup> The disease incidence rate is based on the weighted average of the incidence rates for common illnesses, such as typhoid (10.27/100,000 persons), diarrhea (51.33/100,000 persons), and respiratory ailments (69.75/100,000 persons).

Typhoid incidence rate was obtained from: [http://d.wanfangdata.com.cn/periodical\\_gdwsfy200304004.aspx](http://d.wanfangdata.com.cn/periodical_gdwsfy200304004.aspx)

Diarrhea incidence rate was obtained from [http://en.cnki.com.cn/Article\\_en/CJFDTOTAL-YXWX201010033.htm](http://en.cnki.com.cn/Article_en/CJFDTOTAL-YXWX201010033.htm)

Respiratory disease incidence rate was obtained from [http://nurse.9med.net/upload/pdf/30/1804/103345\\_3719.pdf](http://nurse.9med.net/upload/pdf/30/1804/103345_3719.pdf)

<sup>8</sup> J. Bunker. 2001. The Role of Medical Care in Contributing to Health Improvements within Societies. *International Journal of Epidemiology*. 30(6), pp.1260–1263. The author indicated the incidence rate of respiratory diseases can be reduced by about 40% with effective medical care. The World Health Organization indicates potential reductions in morbidity as a result of improvements in water supply and sanitation, complemented by effective awareness programs and medical services, are 80%–100% for cholera and typhoid, and 40%–50% for diarrhea diseases, dysentery, and gastroenteritis.

<sup>9</sup> Direct costs include medical treatment, medicines, laboratory tests, transportation, food, lodging, and cost of special items such as herbs. Indirect costs include lost wages due to missed work time by the patient, household members and close family friends who take leave from work to care for the sick as well as productivity losses due to nonmarket activity losses such as housework. Cost of medical treatment/person/year is based on the weighted average of cost of medical treatment/person/year for typhoid (CNY2,957.27), diarrhea (CNY797.70), and respiratory ailments (CNY250).

out of a total 288 workdays per year,<sup>10</sup> a loss of about 5% in labor productivity. Benefits from reduced productivity losses resulting from missed workdays are expected to be very significant, as these will be generated from a broader base of the Guangxi economy. With improvement in health and disease prevention among the benefited population, it is envisioned that the number of missed workdays will be reduced by 50%, resulting in total economic benefits of CNY1,554.15 million over the projected period.

7. Other economic benefits include (i) upgrading of workers who will benefit from the project's development of curricula and uniform certification standards despite not participating in the TVET program; (ii) skills upgrading of non-participants working with TVET graduates; (iii) higher skills and earnings of nurses and rural doctors trained in the training bases; and (iv) the economic value of skills acquired by trainees who do not complete the TVET training course before graduating, who will have the same employment prospects they had prior to training. These benefits are recognized but are not quantified, due to the diffused nature of the benefits, and not included in the cost-benefit analysis. If these benefits had been quantified and included into the analysis, the EIRR would be higher.

8. **Nanning health school economic costs.** Economic costs are in constant mid-2013 prices and measured using the domestic price numeraire method. Specific costs identified are project investments, operation and maintenance, and replacement costs. Traded components are converted into economic prices using a shadow exchange rate factor (SERF) of 1.08.<sup>11</sup> The total cost is estimated at \$52.3 million, from which all price contingencies, taxes, and interest charges were excluded. The incremental annual operation and maintenance costs have been assumed to be 2% of capital costs. Government student subsidies (about CNY3,080/student/year, for tuition, books, and educational materials) and room and board were included in the economic costs. The value of the foregone wage earnings of student trainees during their enrollment in TVET training is also included in the economic cost estimates.

9. **Economic internal rate of return and sensitivity analysis.** The economic analysis for NHS produced an EIRR of 14.5% and a benefit-cost ratio of 1.34.<sup>12</sup>

10. The sensitivity analysis indicated that the EIRR is not sensitive to changes in costs, enrollment, and productivity, because the resulting sensitivity indicator values are equal to or less than one. However, the EIRR value was less than the cut-off rate of 12% under a scenario of a 20% simultaneous increase in cost and decrease in enrollment (Table 1).

<sup>10</sup> C. Poulos, et al. 2011. Cost of Illness Due to Typhoid Fever in Five Asian Countries. *Tropical Medicine and International Health*. 16(3), pp. 314-323. March.

<sup>11</sup> The same SERF was applied for ADB. 2011. *Technical Assistance to the People's Republic of China for Technical and Vocational Education and Training Demonstration Project*. Manila; ADB. 2013. *Report and Recommendation of the President to the Board of Directors for the Gansu Jiuquan Integrated Urban Environment Improvement Project*. Manila. The SERF is derived by calculating the reciprocal value of the standard conversion factor estimated for China of 0.93 (i.e.,  $1/0.93 = 1.07527$ , or 1.08). Based on the project content, it was estimated that the local currency components account for about 88% of the project investment and the foreign currency component for 12%.

<sup>12</sup> The EIRR calculation table is available in the table 10 of the Full Economic Analysis, which is a supplementary document of the Report and Recommendation of the President.

**Table 1: Economic Internal Rate of Return Sensitivity Analysis–Nanning Health School**

Change Variable	Percent Change in Variable	Recalculated EIRR	ENPV (12%) (CNY million)	Switching Value	Sensitivity Indicator	Likely Occurrence
1. Increase in costs	20%	12.3%	7.48	23%	0.77	Medium
2. Decrease in enrollment	20%	13.9%	45.69	76%	0.21	Low
3. Increase in costs and decrease in enrollment	20%	11.6%	(9.84)	17%	0.99	Low
4. Delay in benefits by 1 year		12.5%	13.87			Low
5. Decrease in productivity	20%	12.1%	2.54	21%	0.83	Low
<b>Base EIRR = 14.5%</b>						
<b>Base NPV @12% = 63.01 CNY million</b>						
<b>Benefit-cost ratio = 1.34</b>						

( ) = negative EIRR = economic internal rate of return, NPV = net present value.

Source: Asian Development Bank estimates.

11. **Benefits generated by Nanning no. 4 vocational and technical school.** Investments in NVTS are intended to improve its capacity and buildings, campus facilities, and equipment for ECCE. There is growing international consensus that ECCE is critical to economic growth.<sup>13</sup> Cost-benefit studies of high-quality ECCE programs have consistently found substantial long-term benefits derived over the course of years and decades.<sup>14</sup> A study in the PRC indicated that increasing investment in early child development is one of the most cost-effective strategies for breaking the intergenerational transmission of poverty and improving productivity and social cohesion in the long-run.<sup>15</sup> It also improves prenatal care, raises the health status and nutritional standards of young children and improves the knowledge of mothers and primary caregivers about health, child care, and nurturing techniques. These benefits, in turn, help children achieve their full potential and enable the PRC to improve future competitiveness and overcome challenges from an aging population and the transition from a middle- to high-income economy. It has also been observed that at-risk students who attend preschool are less likely to (i) engage in criminal behavior as teenagers or adults, (ii) demonstrate antisocial behavior later in school, (iii) receive social services as adults, and (iv) engage in high-risk health behaviors such as using drugs or smoking<sup>16</sup> The effects are positive, long-lasting, and largest for the most disadvantaged. Research from the United States has found that ECCE programs for children from disadvantaged backgrounds have improved their (i) cognitive, social, and emotional development; (ii) readiness for school and performance; and (iii) chances to achieve (a) better educational outcomes such as test scores, grade retention, and high school graduation; and (b) better labor market outcomes and reduced criminal activity.<sup>17</sup>

12. Other benefits are lower criminal justice system costs, reduced welfare costs, savings for crime victims, and savings on school remedial services budgets. A study in Alaska indicated that ECCE increased high school graduation rates by 29%, college attendance by 20%,

<sup>13</sup> S. Boocock. 1995. Early Childhood Programs in Other Nations: Goals and Outcomes. *The Future of Children, Long-term Outcomes of Early Childhood Programs*. 5 (3).

<sup>14</sup> Pennsylvania State Education Association. 2010. *Invest in Early Childhood Care and Education, The Power of Great Education: PSEA's 20/20 Vision for the Future*.

<sup>15</sup> K. Wu et al. 2012. *Early Child Development in China*. World Bank eLibrary. <http://elibrary.worldbank.org/doi/book/10.1596/978-0-8213-9564-6>. This study concluded that enrollment in kindergarten is positively and statistically significantly correlated with weight, height, and cognitive and social development. The conclusion was replicated in impact evaluations in Latin America that determined that early education and preschool programs in Argentina and Uruguay raised children's language and math test scores, improved behavioral skills and positively effected long-term educational attainment.

<sup>16</sup> Pennsylvania State Education Association, *The Power of a Great Education: PSEA's 20/20 Vision for the Future*, January 2010 <http://www.psea.org/vision/>

<sup>17</sup> Oireachtas Library and Research Service. 2012. *Early Childhood Education and Care*, No. 4.

decreased crime incidence rate by 70%, decreased welfare dependence by 20%, and increased per capita income because of better employment.<sup>18</sup> ECCE also allows parents, especially mothers, to participate fully in the labor market, subsequently increasing economic output, jobs, and tax revenue as a result of the multiplier effect that increased spending has on other industries.<sup>19</sup> Increased participation by parents in the labor market increases purchasing power and spending and thereby increases demand for goods, services and jobs, both direct and indirect, in the ECCE sector and other industries. These studies have shown that ECCE investments have a ripple effect through the economy, with an economic impact comparable to government investment made to further economic development.

13. A costs–benefit analysis of ECCE has revealed impressive returns to the public on investment of \$1.73–\$7.16 per dollar invested.<sup>20</sup> These estimates of rates of return on investment are within the range estimated by the RAND Corporation, which indicated that each dollar invested in high-quality early childhood returns to society about \$1.80–\$17, depending on the nature of the early childhood program. Based on these results, the potential benefits generated by investments in ECCE, represented by investments in NVTs, are calculated. For the analysis, three estimates of return on investments derived from the studies are applied, to determine the benefits generated by investments in NVTs. These rates—\$1.73 for low, \$7.16 for medium, and \$17 for high—are discounted by a conservative 50% to reflect the current level of ECCE development in Guangxi, which is still at an early stage and might produce lower economic returns. For each scenario, economic costs are projected over a 25-year period.<sup>21</sup> The net present value of the annual cost stream was calculated at a 12% discount rate, valued at about \$44.74 million, and then multiplied by the assumed rate of return for each scenario (i.e., 0.87 for low, 3.58 for medium, and 8.5 for high) to calculate the generated economic benefits at each level. The analysis indicated that NVTs investments will generate benefits of about \$38.70 million at a low benefit–cost ratio, \$160.16 million at a medium benefit–cost ratio, and \$380.28 million at a high ratio (Table 2).

**Table 2: Benefits from Nanning No. 4 Vocational and Technical School Investments at Various Scenarios**

Item	Scenario		
	Low	Medium	High
Investment NPV @ 12% (CNY million)	272.91	272.91	272.91
Economic benefits NPV @12% (CNY million)	236.06	977.00	2,319.70
Benefit-cost ratio	0.87	3.58	8.50

NPV = net present value.

Source: Asian Development Bank estimates.

<sup>18</sup> McDowell Group Report. 2006. *Step-up Early Ed and Child Care – A Summarized Economic Impact Report on Early Education and Child Care Services in Alaska*. Prepared for the System for Early Education and Development (SEED), University of Alaska Southeast.

<sup>19</sup> MacGillvary and Lucia (footnote 4) indicated that it is usual for women to have their careers disrupted because of child care failure, i.e., care that is unreliable, unaffordable, or just unavailable. Period of non-employment usually lead to lower wages because of “skill depreciation”, loss of seniority, and sometimes being less likely to receive further training or mentoring due to questions of commitment.

<sup>20</sup> The figure of \$1.73 derives from L. Calman and L. Tarr-Whelan. 2005. *Early Childhood Education for All: A Wise Investment*. Recommendations arising from “The Economic Impacts of Child Care and Early Education: Financing Solutions for the Future”, a conference by Legal Momentum’s Family Initiative and the MIT Workplace Center. The figure of \$7.16 from J. A. Temple and A. J. Reynolds. 2011. Benefits and Costs of Investments in Preschool Education: Evidence from the Child-Parent Centers and Related Programs. *Economics of Education Review*. 26. pp 126–144.

<sup>21</sup> Project investment costs are at constant mid-2013 economic prices and estimated using the domestic price numeraire method. Other costs included in the analysis are (i) operating and maintenance costs; (ii) replacement costs, assumed to be 2% of capital costs; (iii) government student subsidy, of about CNY3,080/student/year covering tuition, cost of books and educational materials, and room and board; and (iv) the value of the foregone wage earnings of student trainees during their enrollment in TVET training.