EIB-GDN WORKING PAPER

IMPACT OF NACHTIGAL HYDRO POWER COMPANY'S INVESTMENTS ON VOCATIONAL EDUCATION AND TRAINING IN CAMEROON

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economics@eib.org
www.eib.org/economics

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Authors
Mary Nantongo (Department of Economics, Makerere University Business School
Email: mnantongo16@gmail.com
Mireille Ntsama (Africa Finance Corporation, Square Foundation and Faculty of Economics and Management, University of Yaoundé 2-Soa)
Email: ntsama@gmail.com
Nina Fenton (EIB)
Claudio Cali (EIB)

Expert advisors
Shahrokh Fardoust (research professor, Global Research Institute, College of William and Mary, United States)
Emmanuel Jimenez (Former executive director of the International Initiative on Impact Evaluation)

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Contents

Summary

This research investigates the impact of an intervention involving the renovation of school infrastructure and the provision of training equipment for vocational and technical schools in central Cameroon. The project is being implemented by Nachtigal Hydro Power Company (NHPC) as part of its local economic development plan in areas along the Sanaga River, where the company is building the Nachtigal hydropower dam. To estimate the project's impact on student enrolment, the study compares percentage changes for treatment schools with NHPC support, and control schools (without NHPC support) at several stages of the implementation timeline. This method is admittedly limited by its inability to control for selection bias. We use propensity score matching to estimate the impact on other outcomes including time devoted to farmwork on school days, knowledge about the dam's construction, and motivation to seek employment at the dam. The results suggest that NHPC's activities improved student enrolment at schools receiving the company's support. The intervention has also motivated students to consider non-farm employment because the study area is urban. However, while students in NHPC-supported schools are more likely to know about the dam's construction, the intervention has not been successful in motivating students to pursue employment opportunities there. The study was carried out between November 2019 and October 2020.

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1. Background to the study

As a renewable energy resource, hydroelectricity is considered an especially favourable alternative to fossil fuels because it contributes less to greenhouse gas emissions and hence climate change. The construction of hydropower dams can also have wide-ranging effects on communities near project sites. These could include beneficial effects — such as creating employment and improving access to markets — but also detrimental effects — such as losing agricultural land, displacing the population and destroying the natural environment (Tilt et al., 2009; Chandy et al., 2012). To mitigate such negative effects, dam construction companies, financing institutions and national governments generally put in place safeguards to support people's livelihoods and protect the environment.

The Nachtigal project is focused on the construction of a 420 MW hydropower plant on the Sanaga River in Cameroon. The European Investment Bank (EIB) is co-financing the project, alongside a large group of lenders including ten other development finance institutions and four local commercial banks, coordinated by the International Finance Corporation (IFC).[1] The Nachtigal Hydro Power Company (NHPC) is in charge of the design, building, operation and transfer of the project. In 2017 NHPC was granted a 35-year exclusive right to operate the dam under a concession agreement signed with the government of Cameroon. NHPC has an environmental and social management plan in place, complemented by compensation, resettlement, biodiversity, and economic development plans. These plans all focus on addressing the environmental and social impact of the dam's construction. As part of its economic development action plan, NHPC committed to renovating four classrooms in vocational schools and equipping them with training equipment.[2] In the short term, the company hopes that some graduates from these schools will meet the labour demand for the dam's operations. The long-term aim is to produce skilled labour for other technical sectors, which would contribute to economic development more generally.

Education is widely accepted to be a leading determinant of economic growth, employment and earnings (Ranis et al., 2001; Hanushek and Woessmann, 2010; Bhorat et al., 2016; Allais, 2017). Therefore, access to education is among the highest priorities on the development agenda, and thus enshrined in Sustainable Development Goal 4. Technical and vocational education and training (TVET) is growing in prominence on the global agenda as a major avenue for giving young people the skills necessary for transitioning into the world of work (UNESCO, 2016). Young people are key to inclusive growth and development, yet governments across the world are currently confronted by rising youth unemployment and underemployment (Gomis, 2020). TVET programmes to provide young people with appropriate skills for decent employment are becoming a key issue for policymakers as they seek to accelerate progress on the 2030 Agenda for Sustainable Development.

Compared to other global regions, sub-Saharan Africa has relatively low youth unemployment. In 2020 the youth unemployment rate (percentage of the total labour force aged 15 to 24) was estimated at around 17.2% in the world but only 14.5% in sub-Saharan Africa (World Bank, 2022). However, the unemployment rate does not fully represent the plight of workers in the region, where the lack of social safety nets such as unemployment insurance means most people cannot afford to be out of

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[1] https://www.eib.org/en/press/all/2018-295-strong-eib-support-to-nachtigal-hydropower-plant-in-cameroon
[2] https://www.afdb.org/fileadmin/uploads/afdb/Documents/Environmental-and-Social-Assessments/ESIA_Summary_Nachtigal.pdf

work. The vast majority of workers — around 89% of the workforce — have no option but to settle for jobs in the informal sector, characterised by low productivity, low income, and hardly any associated benefits (International Labour Office, 2020). In Cameroon, for example, unemployment has hovered at around 4% since 2010 (World Bank, 2022), but the World Bank reports that 71% of the workforce is underemployed, while a staggering 90% are employed in the informal sector (Sosale and Majgaard, 2016). The situation is even more precarious for women and young workers aged 15 to 34, who face higher unemployment rates, are more likely to be underemployed and are more concentrated in the less-productive informal sector (Filmer and Fox, 2014; Sosale and Majgaard, 2016; International Labour Office, 2020). Providing decent work is a real problem facing policymakers in Cameroon and in sub-Saharan Africa more generally.

However, technical and vocational education and training alone cannot solve the challenges of finding decent employment. A key factor determining whether people get jobs is job availability, which implies a need to address the demand side of the labour market, alongside industrial, social and economic policymaking. Nonetheless, technical and vocational education and training play an important role as a pathway to fostering entrepreneurship and youth employment and to promoting equity and gender equality. Unfortunately, its potential in much of sub-Saharan Africa is limited by several challenges, the greatest being the lack of adequate financing for infrastructure and other teaching facilities, which are vital for ensuring that learners receive quality technical and vocational education and training (Lolwana and Oketch, 2017; Oviawe, 2018).

Only a handful of studies have rigorously examined the effects of infrastructure financing on education outcomes (Snilstveit et al., 2015). Moreover, none have explored education outcomes in the technical and vocational education and training sector in particular. This research addresses this knowledge gap, investigating the impact of NHPC's investments in education infrastructure (classroom renovation) on the education outcomes of students in vocational schools in Cameroon.

The rest of the report is structured as follows. Section 2 describes the intervention and Section 3 reviews the literature. The theory of change is set out in Section 4; Section 5 details the objectives and research questions; and Section 6 presents the research methods. Sections 7, 8 and 9 report the results. Finally, the report is summarised in Section 10.

2. Description of Nachtigal Hydro Power Company's intervention and the study area

NHPC is developing the 420 MW run-of-river Nachtigal hydropower plant on the Sanaga River in Cameroon. The project aims to increase the availability of reliable renewable energy power and is meant to raise Cameroon's share of renewable energy to 75% and boost generation capacity by 30% (World Bank, 2018a).

Financing for the project is being provided through equity investments of €289 million (24%) and debt of €916 million (76%), with an expected total cost of around €1.2 billion. The equity investors are Electricité de France (EDF, 40%), the International Finance Corporation (IFC, 20%), Republic of Cameroon (15%), Africa 50 (15%), and Fund STOA (10%). The EIB[3] is co-financing the project with a large group of lenders, including ten other development finance institutions coordinated by the IFC.[4] Additional finance is being provided by four local commercial banks coordinated by Attijariwafa SCD Cameroon[5] (Islamic Development Bank and Islamic Corporation for Insurance of Investment and Export Credit, 2020). The dam is the first project financed through a public-private partnership arrangement in Cameroon, and also one of very few hydropower projects under such a partnership in sub-Saharan Africa (World Bank, 2018b). It is also the largest privately financed project in sub-Saharan Africa and expected to be a model for similar projects in the future. The project won Project Finance International's Global Multilateral Deal of the Year 2018.

The co-developers anticipated social and environmental risks from the large infrastructure project, as outlined in the environmental and social impact assessment reports first undertaken in 2011 and updated in 2016 (World Bank, 2017a). The intervention was designed to respond to some of these risks, based on the 2016 studies — particularly on local capacities and manpower — and consultations between NHPC, local people and other stakeholders impacted by the project undertaken between March 2015 and May 2016. As a result of these studies and consultations, an environmental and social management plan was approved in July 2016. It outlines four action plans aimed at mitigating the anticipated social and environmental risks of the project: two resettlement and compensation action plans, a livelihood restoration plan, the local economic development action plan (PADEL by its French initials) (World Bank, 2017a, 2017b) and compensation for social impacts (PGES by its French initials).

[3] https://www.eib.org/en/press/all/2018-295-strong-eib-support-to-nachtigal-hydropower-plant-in-cameroon

[4] The ten development finance institutions are African Development Bank (€130 million), Africa Finance Corporation (€50 million), EIB (€50 million), Agence Francaise de Développement (€90 million, CDC Group (€90 million), Deutsche Investitions- und Entwicklungsgesellschaft (€35 million), Private Infrastructure Development Group's Emerging Africa Infrastructure Fund (€50 million), FMO (€30 million), IFC (€110 million), OPEC Fund for International Development (€50 million) and Proparco (€60 million).

[5] The local banks, contributing a total of €171 million, are Attijariwafa SCB Cameroon, Banque Internationale du Cameroun, Société Générale Cameroun, and Standard Chartered Bank Cameroon.

Vocational centres were equipped via the PGES. In 2018, the PGES supported four schools in the target area by renovating one classroom in each and providing training equipment,[6] particularly for electronic workshops. Through these activities, NHPC hopes to build the vocational centres' capacity to provide quality training to students, meet the demand for labour for NHPC's operations, and provide skilled labour for other technical sectors more generally.

2.1. Importance of the Nachtigal project

The Nachtigal project is being developed by the Cameroonian company NHPC, created on 7 July 2016 by the Republic of Cameroon, EDF and IFC.

The project entails designing, building and operating during the 35-year concession period a reservoir and hydroelectric plant on the Sanaga River at the upstream Nachtigal Falls (65 km north-east of Yaoundé) and a 50 km, 225 kV transmission line to Nyom2 (north of Yaoundé).

From an administrative perspective, the hydroelectric facility and transmission line span five divisions and six subdivisions in central region of Cameroon: the Mbandjock subdivision of the Haute Sanaga division, the Ntui subdivision of the Mbam-et-Kim division, the Batchenga and Obala subdivisions of the Lékié division, the Soa subdivision of the Méfou-et-Afamba division, and the Yaoundé first subdivision of the Mfoundi division.

According to the World Bank (2017b), the project will have only moderate environmental and social impact as a run-of-river facility with a newly created low surface reservoir. The project's main potential social impact is physical and economic displacement through its effects on residential housing, farmland, fishing grounds, and sand quarry workers (World Bank, 2017b). Economic opportunities created by the project will generate social influx, with positive and negative effects such as greater vitality of the local economy, population growth, increased pressure on land, inflation, intercommunity conflicts, and public infrastructure overload. If workers are recruited locally, this will have positive effects (World Bank, 2017b).

About 1 500 direct jobs were expected or projected to be created during the project's peak construction phase, which will last about five years. Two-thirds of these jobs will be offered to people living within a 35 km radius of the project site. Dozens of jobs will also be created during the operation phase.

2.2. Project implementation timeline

On 10 November 2013, a joint development agreement was signed by the government of Cameroon, EDF, IFC and Rio Tinto Alcan Inc.[7] to develop a hydropower dam at Nachtigal Falls on the Sanaga River. A year later, on 10 November 2014, a decree of declaration of public utility for the dam, the electricity transmission line, and the departure and arrival source substations was signed by the Cameroonian minister of domains, cadastre and land affairs, giving NHPC the legal and official mandate to proceed with activities in the project area. On 5 March 2015 a regional observation and

[6] The equipment included bench tables, clamps, screwdrivers, current fitters, single monophase asynchronous motors, three-phase asynchronous motors, single monophase asynchronous generators, three-phase asynchronous generators, bicurve oscilloscopes, single-phase wattmeters, three-phase wattmeters, analogue voltmeters, analogue ampere meters and numeric voltmeters.

[7] Rio Tinto Alcan Inc. later left the agreement.

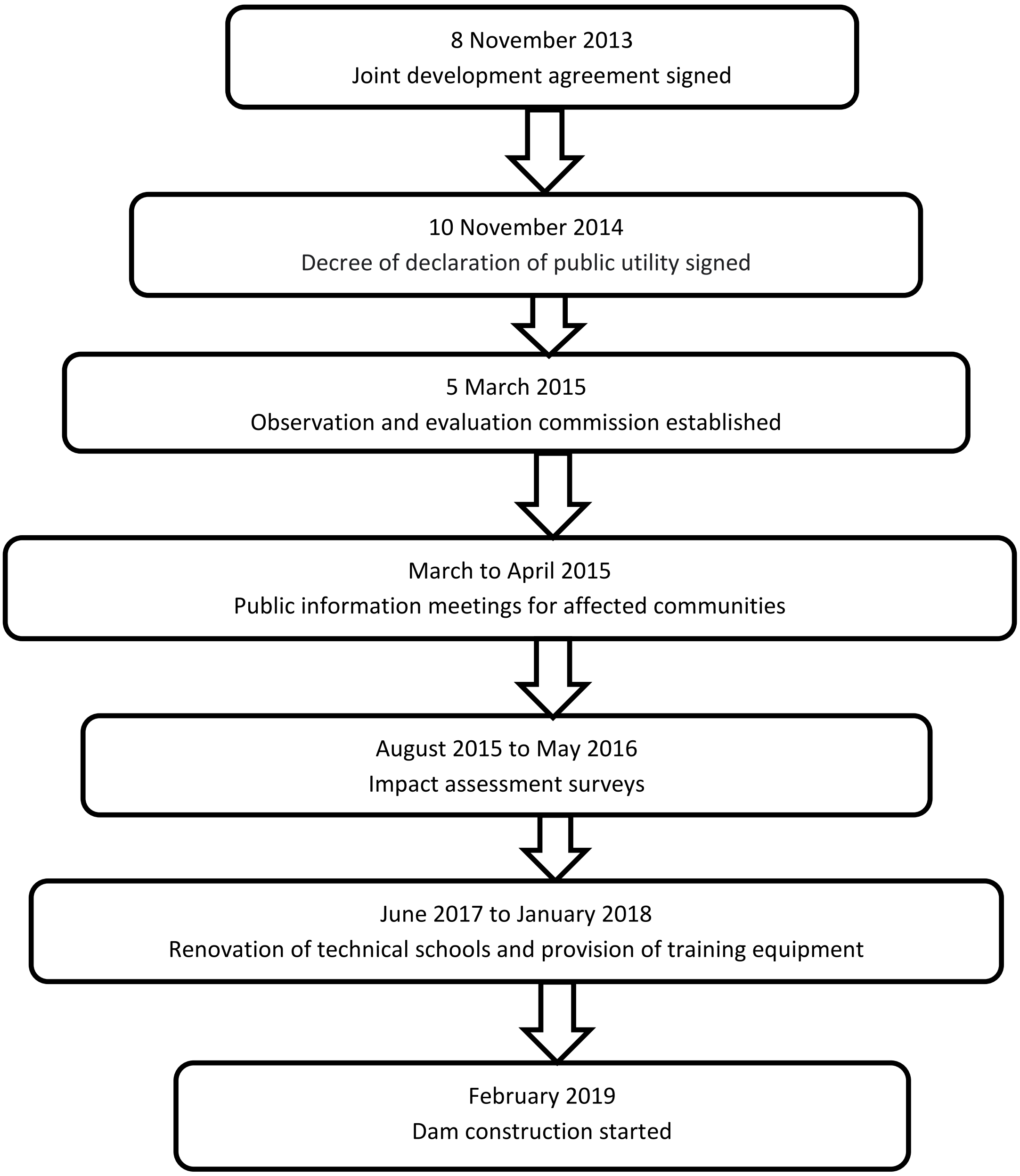
evaluation commission was established by the provincial governor to organise surveys of the people, land and properties expected to be affected by the project. Between March and April 2015, regional authorities and the project team organised public consultation meetings in the affected project areas. The surveys were then carried out between August 2015 and May 2016.

Based on findings from these community surveys and consultations, NHPC decided to make classroom renovation and equipping of vocational schools a component of its environmental and social management plan, particularly the plan for developing the local economy. NHPC hoped that some of the graduates from targeted schools would meet the immediate labour demand for the dam's operations, and that skilled labour for other technical sectors would be produced in the longer term, ultimately contributing to local economic development.

Consequently, on 22 June 2017 a partnership agreement was signed between the Ministry of Secondary Education and NHPC for the renovation of classrooms and provision of training equipment to four technical schools in project areas. The renovations were undertaken between June 2017 and January 2018, taking four to six months in each school. On 8 February 2018 an official handover ceremony was held at the Obala Technical High School, at which all targeted schools officially received the training equipment. Dam construction started in February 2019 and is still ongoing, with commissioning expected around 2023.

Figure 1 presents the timeline of intervention implementation.

Figure 1: Timeline of intervention implementation



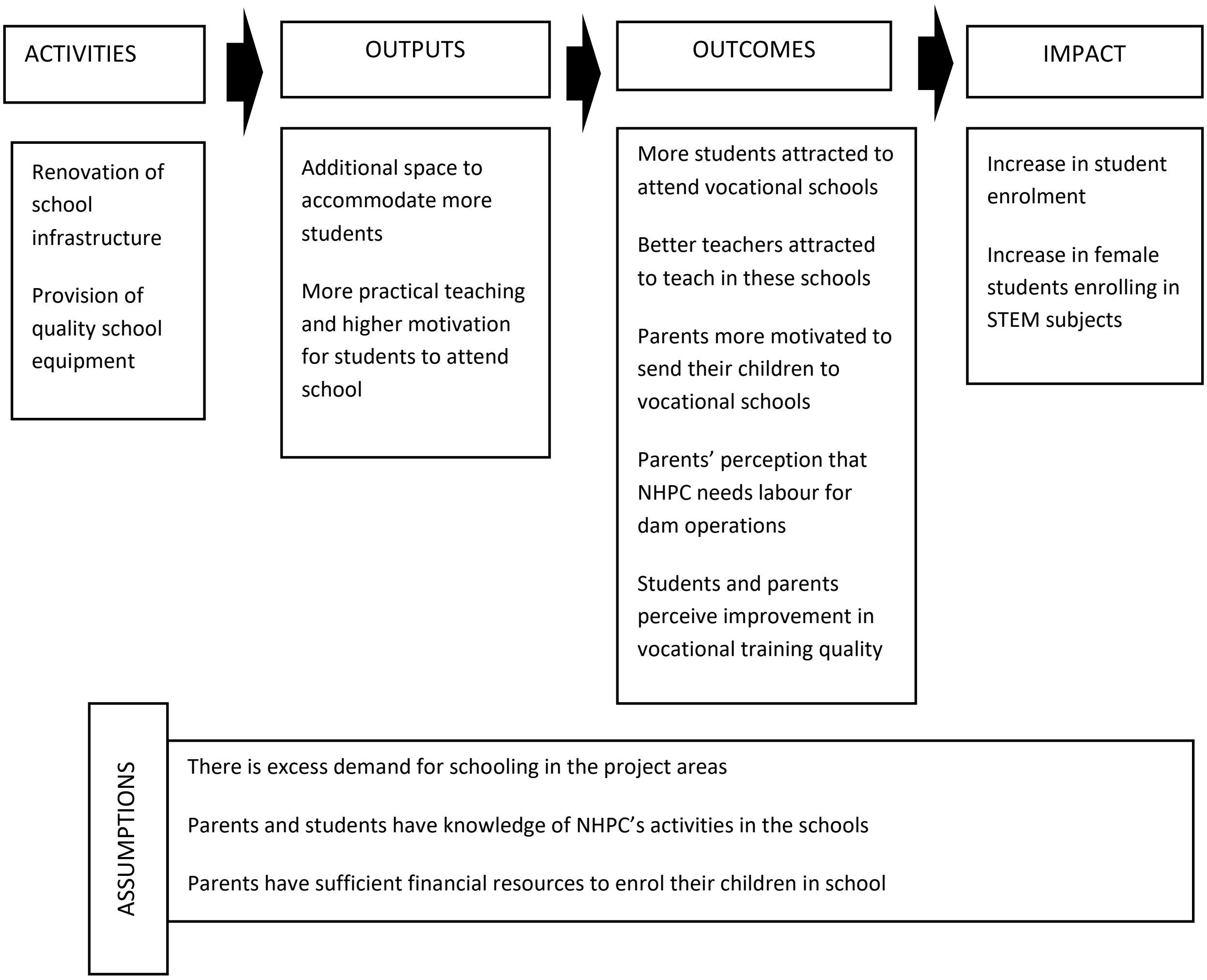
3. Theory of change

According to Neilson and Zimmerman (2014), improvements in school infrastructure may benefit education outcomes through two main channels: a) enhancing motivation at home and school, and b) increasing access to schooling. First, improving the learning environment through better facilities boosts students' learning experiences and expectations, leading to higher enrolment and attendance rates and lower drop-out rates (Hunt, 2008). Second, better facilities may attract better teachers and reduce teacher absence rates (Kazianga et al., 2015), in turn increasing parents' motivation to send their children to school and raising students' motivation to attend.

Finally, improvements to school infrastructure may improve access to schooling (Snilstveit et al., 2015), for example by providing additional space for new students.

The provision of quality training equipment may also increase schooling expectations among students and parents, thereby boosting motivation to enrol or stay in school or attend classes more often (Hunt, 2008). This theory of change corresponds to the causal chain framework in Figure 2.

Figure 2: Causal chain linking investments in infrastructure and school training materials and outcomes in student enrolment and school attendance



4. Literature review

4.1. Conceptual framework

The literature shows that both demand- and supply-side factors are important determinants of student enrolment. On the demand side, an important point to consider is that the decision on whether to enrol in a vocational school is made during adolescence, a period of intense physical, psychological and psychosocial change and stress. These transformational challenges — coupled with economic instability, rapidly changing labour markets and technological advancement — make career decision-making incredibly difficult for adolescents and can cause them to make poor career choices or opt out of school completely (Safarmamad, 2019). Consequently, several studies have been conducted to determine what factors can influence adolescents' career decision-making. Identified factors include personal characteristics such as occupational interests, perceptions, academic performance and gender (Esters, 2007; DeFeo, 2015).

In addition to personal factors, adolescents are also heavily influenced by other people, including parents, siblings, relatives, friends and peers, and school staff like teachers and headteachers (Sullivan and Larson, 2010). The influence of others is particularly relevant to adolescents' career decisions, considering the difficulties noted above.

The other group of demand-side factors influencing adolescents' career choices are socioeconomic factors. This includes the family's economic situation, parents' education level and the intrinsic value they place on education, parents' occupations, the opportunity costs of time, and the young person's expectation of future economic opportunities (Chernichovsky, 1985; Burke and Beegle, 2004; Gaunt, 2005; Fletcher, 2012; Kuno et al., 2021).

On the supply side, factors influencing school enrolment include the cost and quality of schooling and the educational infrastructure. Thus, factors such as teaching efficiency (exam pass rates), number of trained teachers, and number of classrooms all influence student enrolment. Furthermore, parents may be more reluctant to enrol their children in schools in a dilapidated condition or with inadequate or low-quality teaching materials. Access to schools is another important supply-side factor, as wider school coverage reduces students' travel time to school and hence boosts their motivation to enrol. In addition, where both technical and vocational education and training (TVET) and non-TVET schools are accessible, students will have a choice over which mode of instruction they prefer.

4.2. The gender gap in technical and vocational education and training

Rapid demographic pressures will make the task of absorbing the labour supply particularly challenging in developing countries — especially those in Africa — that do not participate in global supply chains. Moreover, existing gender gaps will widen further if female participation in science, technology, engineering and mathematics (STEM) continues to lag behind male participation, with adverse socioeconomic consequences.

As a result of wide gender inequalities and stereotypes, technical and vocational education and training programmes are often gender-biased, affecting women's access to and participation in specific occupational areas. Some vocational training programmes like dressmaking, hairdressing and cookery are associated with girls — very often those considered less academically gifted. In Benin, for example, such girls are derogatorily referred to as following the “c” option of the secondary school curriculum, denoting couture, coiffure and cuisine.

In this digital age, the demand for STEM graduates far exceeds its supply. UNESCO data show that, globally, only 7% of women choose to study engineering, manufacturing, or construction, compared to 22% of men. Of the students pursuing careers in information, communication and technology fields, only 28% are women. Recent studies have shown that the gap between men and women first manifests at the post-secondary level, before which there are no statistical differences between boys and girls in terms of enrolment and completion or cognitive capabilities (Rubiano Matulevich et al., 2019). This gap is commonly attributed to negative stereotypes — especially beliefs that STEM subjects are “masculine” and that female ability in STEM is innately inferior to that of males — and to the lack of role models.

5. Objective and research questions

5.1. Objective

The study's main objective is to identify the impact of NHPC's investments in vocational education and training at the Nachtigal Falls and surrounding areas along the Sanaga River in central Cameroon. Specifically, this research investigates whether changes in enrolment in vocational schools around the Nachtigal dam can be attributed to the company's investments in those schools in 2018. To meet this overall goal, the study addresses the following research questions.

5.2. Research questions

The primary research question is as follows: To what extent do NHPC's investments in school infrastructure, particularly in classrooms and quality training equipment, increase people's skills in technical fields? In other words, do the interventions aimed at equipping the vocational centres contribute to attracting students to STEM fields? This enquiry is the direct subject of questions 1 and 2 below, while questions 3 and 4 explore the extent to which employment opportunities presented by the dam's construction contribute to students' career prospects.

1. Does classroom renovation and the provision of quality training equipment lead to increased student enrolment in vocational schools?
2. Has the intervention motivated students to devote more time to non-farm employment?
3. Has the intervention increased students' knowledge about the dam's construction and the job opportunities it represents?
4. Has the intervention motivated students to take up employment at the dam, thus successfully building up the workforce for dam-related employment?

6. Research methods and strategy

6.1. Overall study design

The study employed a mixed-method research design, combining quantitative and qualitative techniques. The main sources of quantitative data were school administrative records and surveys administered to students and teachers. Because the Cameroon government imposed travel restrictions to curb the spread of COVID-19, survey data were collected with help from a field coordinator based in Cameroon.

Qualitative data were collected from document reviews and structured key-informant interviews with head and class teachers and with NHPC representatives. Further qualitative data were collected from focus group discussions, to better understand the data collected from students and teachers. Interviews were conducted in French.

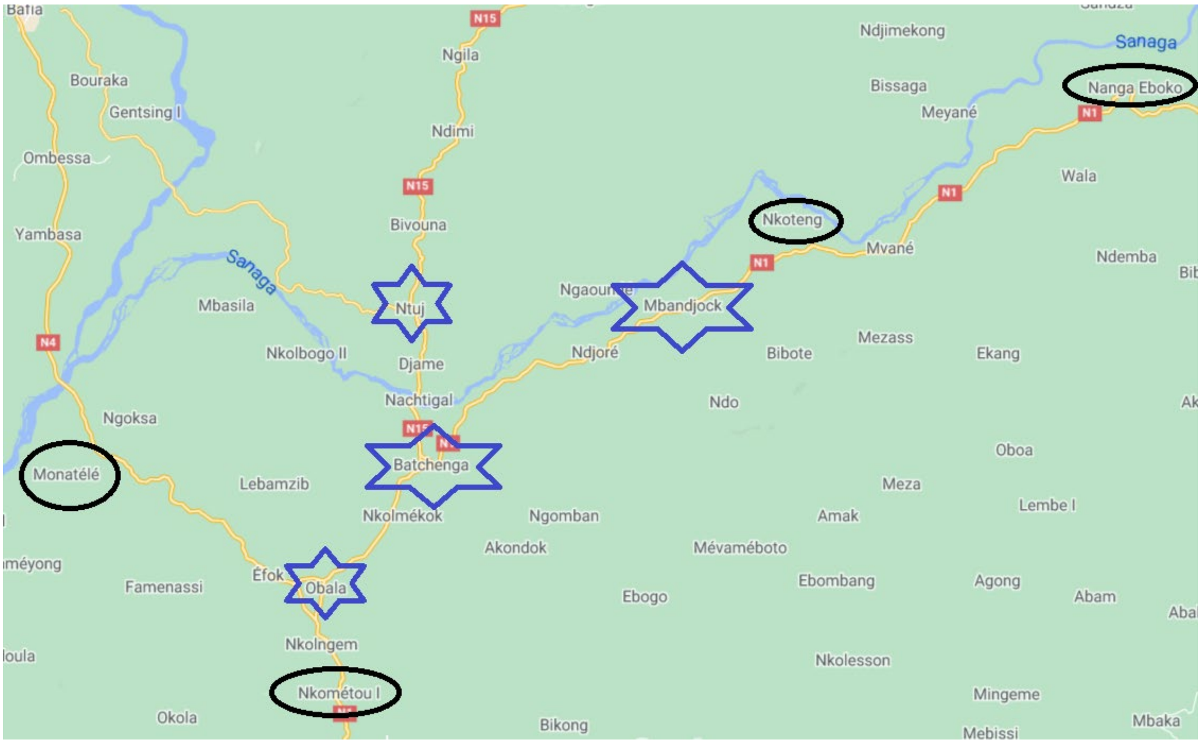
6.2. Study timeline and area

Data were collected between September and October 2020. The enumerators who carried out the survey all underwent training on data collection between 20 and 21 June 2020. Data collection began in September 2020 but had to be suspended as the pandemic caused the government to close schools. It resumed in mid-October 2020 when the schools were reopened. All respondents lived close to the dam site, namely in the cities of Obala, Ntui, Nkoteng, Nkometou, Batchenga, Mbandjock, Monatélé and Nanga-Eboko (Figure 3). Data were collected from treatment schools (with NHPC investments) and control schools (without NHPC investments) listed in Table 1.

Table 1: Schools where data were collected

Treatment TVET schools	Control TVET schools
Obala Technical High School	Nkometou Technical High School
Batchenga Technical Middle School	Monatélé Technical High School
Mbandjock Technical High School	Nanga-Eboko Technical High School
Ntui Technical High School	Nkoteng Technical High School

Figure 3: Locations of treatment and control schools



Source of map: Google Earth.
Note: Star refers treatment schools and Oval refers to control schools.

There are no other technical education institutions in the same cities as those that received NHPC grants. Therefore, the control group comprises schools in the cities closest to those of schools in the treatment group. The project area also has many schools following the general curriculum. NHPC informed us that the authorities in charge of vocational training selected which schools would receive the grants, giving priority to schools closest to the dam site.

6.3. Sampling strategy

The sampling strategy involved three levels of selection: schools (the level at which treatment is assigned), classes and students. The treatment group comprised the four schools receiving support from NHPC in the subdivisions of Obala, Mbandjock, Ntui and Batchenga. Another four schools that did not benefit from the intervention — the control group — were selected through discussions with NHPC and local education authorities, focused on ensuring maximum comparability with the treatment schools. For the survey, seven students were randomly selected from each class using the class register, giving a total sample 392 students: 196 from treatment schools and 196 from control schools.

6.4. Data

School administrative data were provided by the head teacher of each school. The data were collected at class (grade) level from 2015 (before the intervention) to 2019 (after the renovations and equipping of vocational schools). For each class, we collected data on the number of students enrolled, the gender split, and the number of students pursuing science or technology courses (also by gender).

The student survey tested personal characteristics with potential to affect enrolment, including age, gender and health condition, as well as motivations for attending a technical and vocational education and training school and (for treatment-school students) perceptions of the NHPC intervention and school. The survey questions also covered household characteristics such as household size, parents' literacy and level of education, and asset possession (to indicate family wealth).

The survey of class and head teachers covered demographics; teaching experience; perceptions of the school and the intervention, class and (for treatment-school teachers) the NHPC intervention; educational attainment; and distance of the school from their residence. In addition, a focus group discussion was held with all eight head teachers to complement the survey results.

6.5. Ethical issues

Our research aims were clearly explained to all participants (students, class teachers, and head teachers) in the questionnaire survey and focus group discussions before data collection. Collected data were anonymised to ensure the confidentiality of information provided by participants.

6.6. Estimation framework

To estimate the impact of NHPC support on enrolment, we computed and compared percentage changes in enrolment in treatment and control schools from 2015 to 2019. We then assessed how these changes are linked to the project implementation timeline.

Because this method cannot control for selection bias and the effects of other confounding factors, we acknowledge that it is less rigorous than alternatives such as difference-in-difference or matching methods, for which we lacked sufficient data points on school enrolment. However, our method allows intuitive identification of the impact of NHPC support using the few available yearly observations on school enrolment, enabling comparison of enrolment trends in treatment and control schools around the time of the intervention. Our method is thus akin to regression discontinuity.

For the other outcome variables of interest — students' farmworking time, knowledge of the dam's construction and plans to work at the dam after completing school — we used propensity score matching, in particular the nearest neighbour matching technique, then employed a probit or ordered probit model to test for treatment effects. Our estimation strategy is based on the equation below:

$$Y_i = \beta_0 + + \beta_1 T_i + \beta_2 X_i + \varepsilon_i$$

For farmworking time, Y_i is a count variable taking the value 1, 2, 3 or 4 depending on the amount of time a student spends on the farm on a typical school day. Specifically, Y_i equals 1 if the student spends no time working on a farm during a typical school day, 2 if they spend less than one hour doing so, 3 if they spend one to two hours, and 4 if they spend more than two hours.

For knowledge of the dam, Y_i is a binary variable that takes the value 1 if the student knows about the dam's construction, and 0 otherwise.

Finally, for post-school employment plans, Y_i is a binary variable equalling 1 if the student plans to seek a job on the Nachtigal dam after completing school, and 0 otherwise.

***T_i* is a dummy variable representing the treatment status for each student**. It equals 1 if the student is enrolled in a school that received NHPC support, and 0 otherwise.

X_i represents student and household characteristics. The student characteristics include age, gender, time spent per day on homework outside school, travel time to school, whether the student can access help with homework, whether the student has ever repeated a class, the student's subject specialisation, and parents' literacy. The household characteristics include household size, number of rooms, number of meals per day, whether a family member attended a technical and vocational school, and whether the family owns a farm. X_i also represents the reason the student attends their current school, denoted by a count variable taking the value 1 if it was their parents' choice, 2 if the student selected the technical and vocational school based on the perceived ease of subsequently finding a job, 3 if the student chose the school based on the quality of school infrastructure, and 4 if the student selected the school because it had good teachers.

The covariates were tested for statistical balance before and after matching to ensure sample similarity in the control and treatment groups. While this matching process improves our ability to control for selection bias due to observables, we still could not control for selection bias due to unobservables. A more rigorous approach would combine our matching method with a difference-in-difference method, thereby controlling for selection bias from not only observable but also fixed unobservable characteristics. Unfortunately, we could not employ a difference-in-difference method because we lacked student data for the pre-intervention period.

7. Descriptive results

7.1. School characteristics

This section presents the descriptive results from analysing school administrative data. These data were collected from the head teachers of the eight schools and covered the years 2015 to 2019. The section first reports results on the number of classrooms and quality of training materials, which were the focus of NHPC's intervention through classroom renovation and provision of training equipment. Next, the results detail trends in student enrolment, particularly revealing gender differences in the STEM fields, electrical engineering, civil engineering/masonry, and carpentry.

7.1.1. Availability of school infrastructure

As shown in Table 2, schools in the treatment group had, on average, one new classroom built in 2017. This increased their number of classrooms compared to schools in the control group, where the number of classrooms remained unchanged over the years.

Table 2: Number of classrooms

	Average number of classrooms					
	2015	**2016**	**2017**	**2018**	**2019**	**Mean**
Treatment group (4 schools)	22	23	24	24	24	24
Control group (4 school)	20	21	21	21	21	21
Overall (8 schools)	21	22	23	23	23	22

7.1.2. Quality of training equipment

Tables 3, 4 and 5 show that the quality of training equipment (self-reported by the schools) was generally poor for all three STEM fields, across both treatment and control schools, which shows the NHPC intervention was timely. Most schools reported that equipment quality was either bad or very bad in most years; civil engineering/masonry had the lowest quality, while electrical engineering fared best (Tables 3 and 4). The state of training materials for carpentry was also poor in most schools (Table 5). The results for electrical engineering suggest that the condition of equipment improved in treatment schools, which points to a positive contribution by the intervention.

Table 3: Quality of training materials for civil engineering/masonry in control and treatment groups

Year	Self-reported quality of masonry materials							
	Good		Acceptable		Bad		Very bad	
	Control	Treatment	Control	Treatment	Control	Treatment	Control	Treatment
2015		1	1		1		2	3
2016		1	1				3	3
2017		1			2		2	3
2018		1			1		3	3
2019		1			1		3	3

Table 4: Quality of training materials for electrical engineering in control and treatment groups

Year	Self-reported quality of electrical engineering materials							
	Good		Acceptable		Bad		Very bad	
	Control	Treatment	Control	Treatment	Control	Treatment	Control	Treatment
2015			1	1	3	3		
2016			2	3	1	1	1	
2017		1	1	2	1	1	2	
2018		1	1	2	1	1	2	
2019		1	1	2	1	1	2	

Table 5: Quality of training materials for carpentry in control and treatment groups

Year	Self-reported quality of carpentry materials							
	Good		Acceptable		Bad		Very bad	
	Control	Treatment	Control	Treatment	Control	Treatment	Control	Treatment
2015			1		2	2		1
2016					3	2		1
2017			1		2	2		1
2018		1	1		1		1	2
2019		1	1		1		1	2

7.1.3. Trends in student enrolment

The results in Table 6 highlight an upward trend in student enrolment from 2015 to 2019 in both treatment and control groups, suggesting that interest in enrolling into vocational training programmes has grown among students (or parents with respect to their children). However, schools in the control group have a slightly higher number of enrolled students than treatment schools, with respective annual averages of 635 students and 594 students.

Table 6: Average number of students enrolled

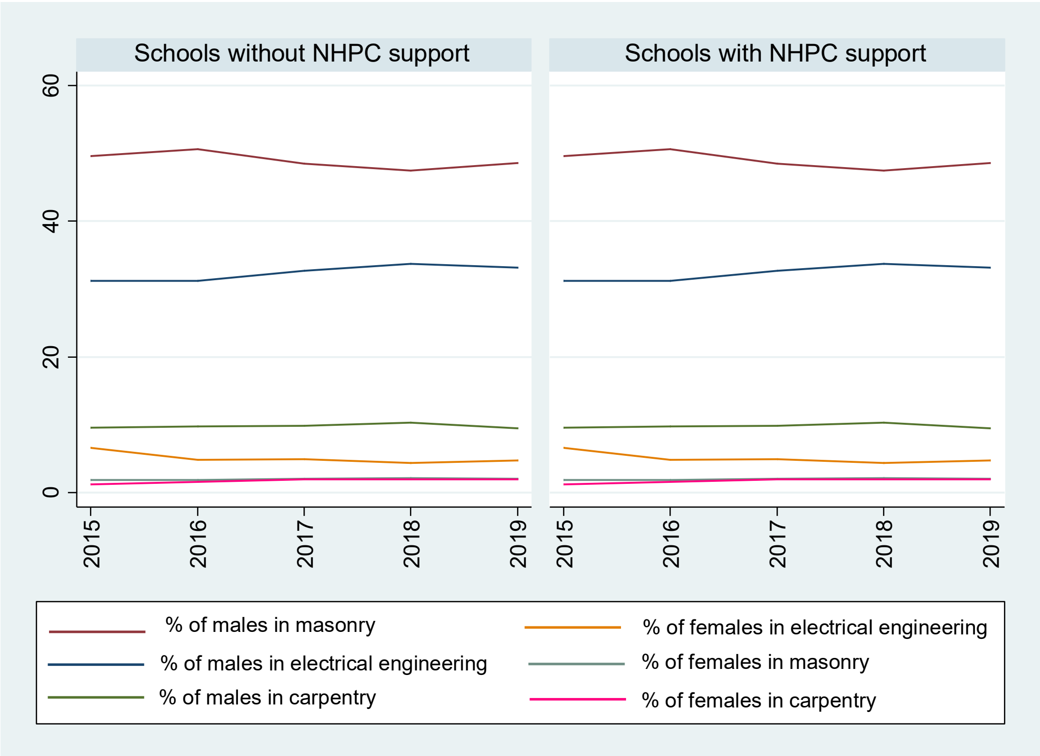
	Average number of students					
	2015	**2016**	**2017**	**2018**	**2019**	**Mean**
Treatment group (4 schools)	516	546	616	640	655	594
Control group (4 schools)	590	640	627	647	669	635
Overall (8 schools)	553	593	622	644	662	615

7.1.4. Gender gap in student enrolment

Turning to the STEM gender gap, Figure 4 shows a large difference in the enrolment of male and female students in all fields — electrical engineering, civil engineering/masonry, and carpentry. For instance, while masonry enrolment hovered at an average of about 50% for males over the five-year study period, the equivalent for females was just 2%. About 30% of male students were enrolled in electrical engineering, compared to only around 6% of female students. In carpentry, which had the lowest enrolment numbers, the male percentage is 10% whereas the female percentage is just 2%. These findings are not unique to this study but reflect a global phenomenon crossing national and regional borders (UNESCO, 2016).

The results show that student enrolments across the STEM fields remained relatively stable over the five years, and that the gender gap was also persistent. Finally, we find a balance in enrolments across schools supported by NHPC and those not receiving this support.

Figure 4: Enrolment of students in different subjects by gender (2015-2019, in %)



7.2. Student and household characteristics

This section covers the key student and household characteristics, students' perceptions of the NHPC intervention and school, and what factors motivated their school choice.

Table 7 shows that a typical student in the study schools is aged around 18 or 19, started school at about four years old, spends at least two hours on homework and another two hours working on a farm on a typical school day, and takes about half an hour to get to school. On average, sample students belong to a seven-member household, live in a four-roomed house, and eat at least two meals per day. These results also initially indicate that student and household characteristics are similar for respondents in treatment and control schools.

7.2.1. Gender distribution of students

With female students representing just 16% of the total sample, Figure 5 confirms the commonly known gender bias against female students enrolling at technical and vocational education and training schools. Nevertheless, as shown in Figure 6, a further breakdown of the data indicates that NHPC schools have more female students (21% of the total) than control schools (11%).

Table 7: Key student and household characteristics affecting school enrolment

		Student age	Household size	No. of rooms in family home	No. of meals per day	Starting school age	Daily time spent on homework outside school	Time spent working on farm on a typical school day	Journey time to school (mins)	No. of older siblings	No. of younger siblings
Schools with NHPC support											
	Mean	19.3	7.0	4.0	1.8	4.5	2.3	1.7	36.4	3.3	3.4
	Number of students	198	198	198	198	198	198	173	187	198	198
Schools without NHPC support											
	Mean	17.8	7.0	4.0	2.0	4.1	2.4	2.0	32.4	2.9	3.3
	Number of students	196	192	198	198	198	197	145	197	198	198
Total											
	Mean	18.5	7.0	4.0	1.9	4.3	2.3	1.8	34.3	3.1	3.3
	Number of students	394	390	396	396	396	395	318	384	396	396

Figure 5: Gender of students (total sample, in %)

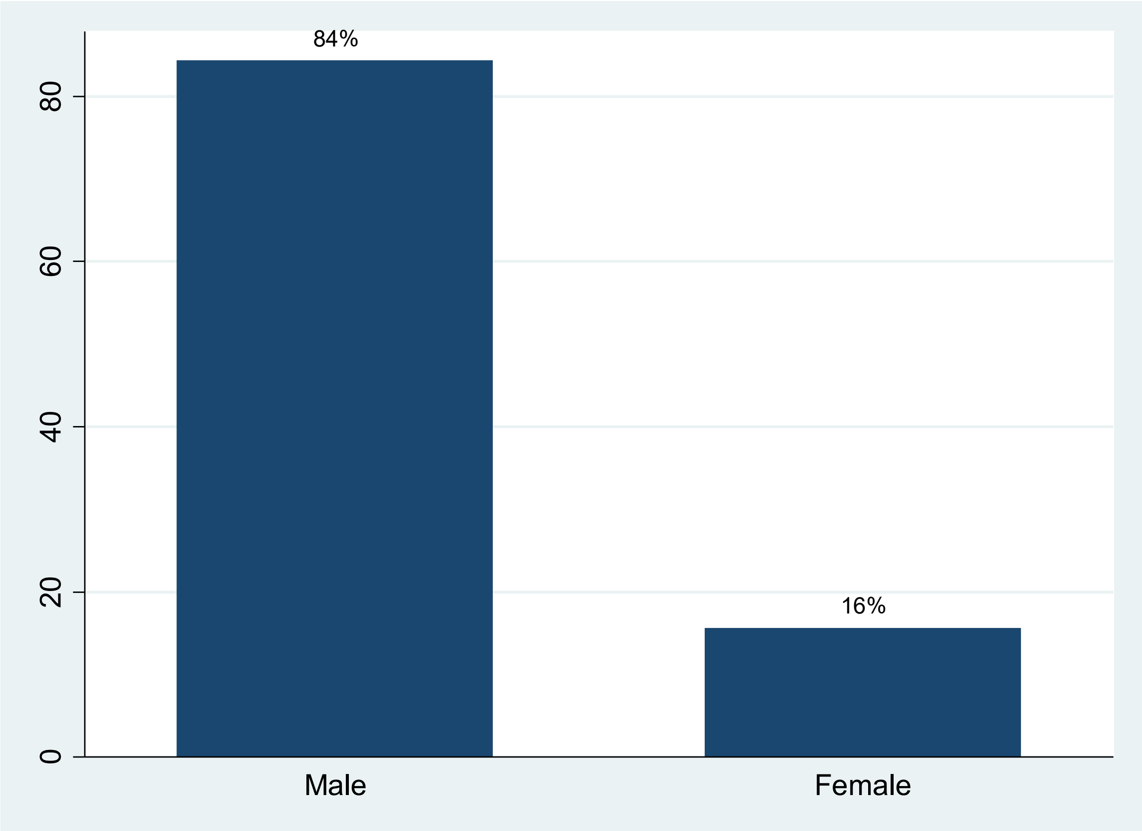
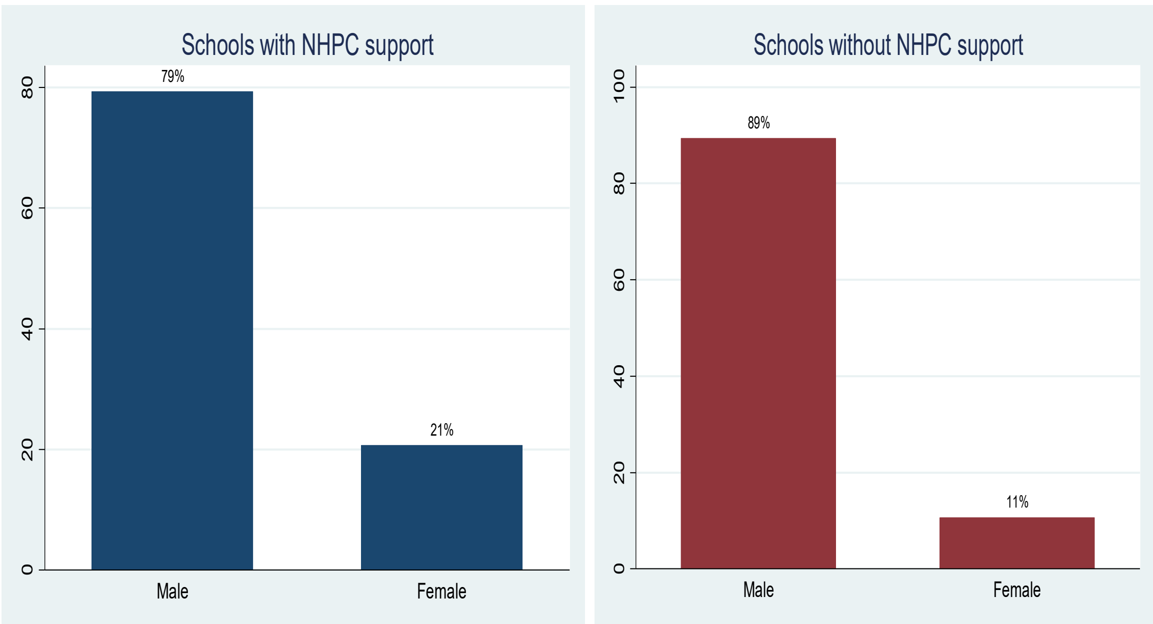


Figure 6: Gender of students enrolled in schools with and without NHPC support (in %)



7.2.2. Subject specialisation

When we further break down the students by their subject specialisation (Figure 7), we find that the largest group of students was enrolled in electrical engineering (40%), followed by civil engineering/masonry (30%), management (12%), mechanics (6%) and carpentry (3%). Female students are still underrepresented in the STEM subjects. As Figure 8 shows, female students enrolled in electrical engineering and civil engineering respectively represent only 6% and 3% of the total sample, whereas the respective percentages for male students are 34% and 36%. These results show that even among the few female students enrolled in technical and vocational education and training schools, the majority opt out of the STEM courses traditionally taken up by men.

Figure 7: Specialisation subjects of all students (in %)

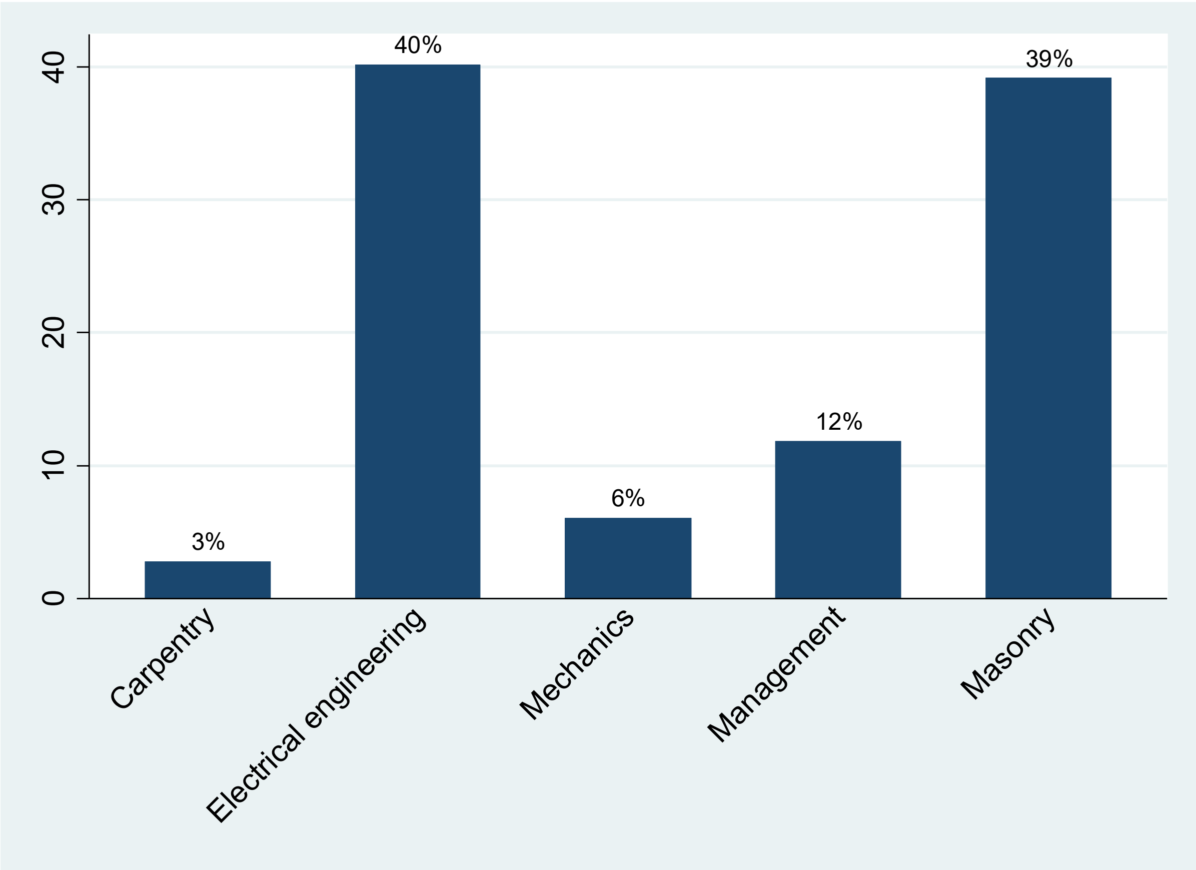
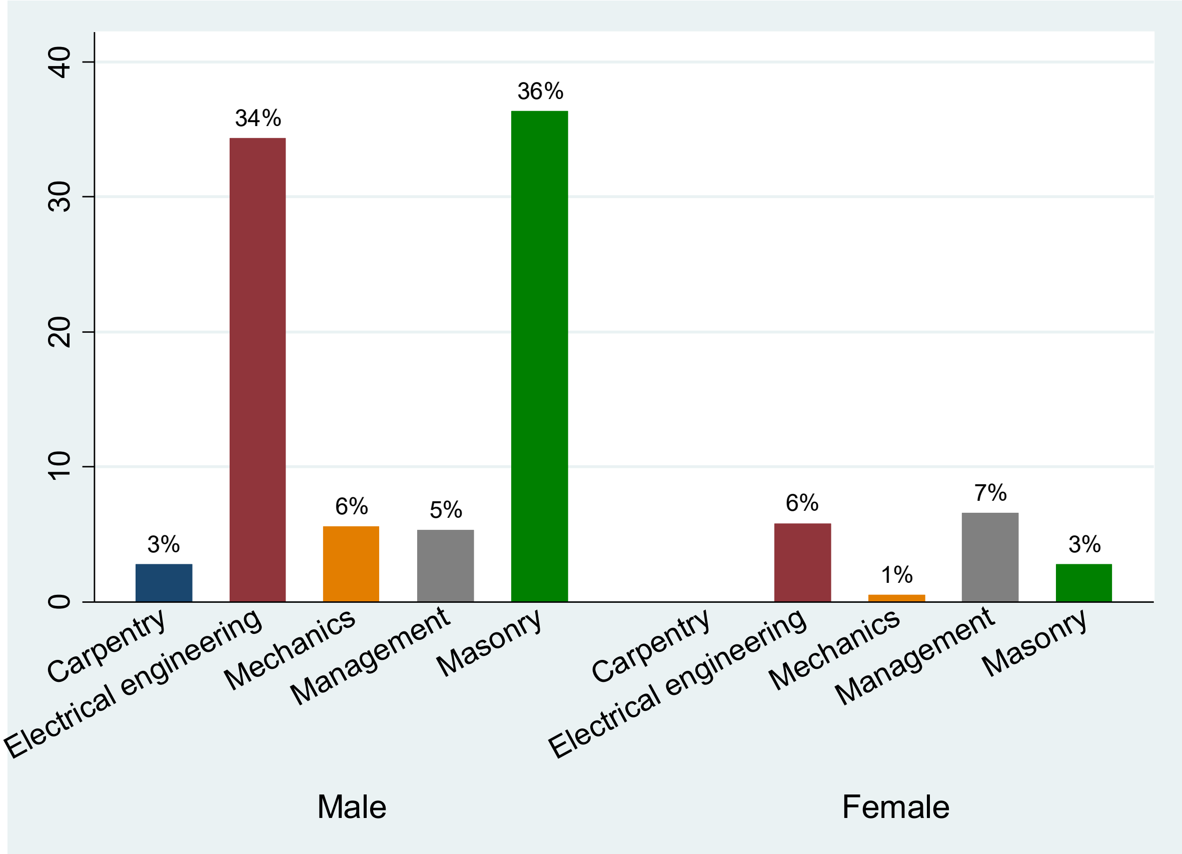


Figure 8: Specialisation subjects of male and female students (in %)



7.2.3. Factors motivating school enrolment

One factor that might influence a student's decision to enrol at a particular school or specialise in a particular subject is the potential impact on job opportunities after completing school. We therefore posed several questions testing students' knowledge of the job opportunities presented by the dam's construction in their area, and their perceptions of the intervention and motivations for attending their current school.

The majority (77%) of students reported that they knew about the dam's construction (Figure 9). Even in the schools that did not receive NHPC support, most students (63%) knew about the dam, compared to 90% in the NHPC-supported schools. As expected, the proportion of students unaware of the dam's construction was higher in the control schools (37%) than in the treatment schools (10%). It is somewhat surprising that so many students in NHPC-supported schools had no knowledge of the dam whatsoever (Figure 10).

Figure 9: Whether student knew about the construction of the dam (in %)

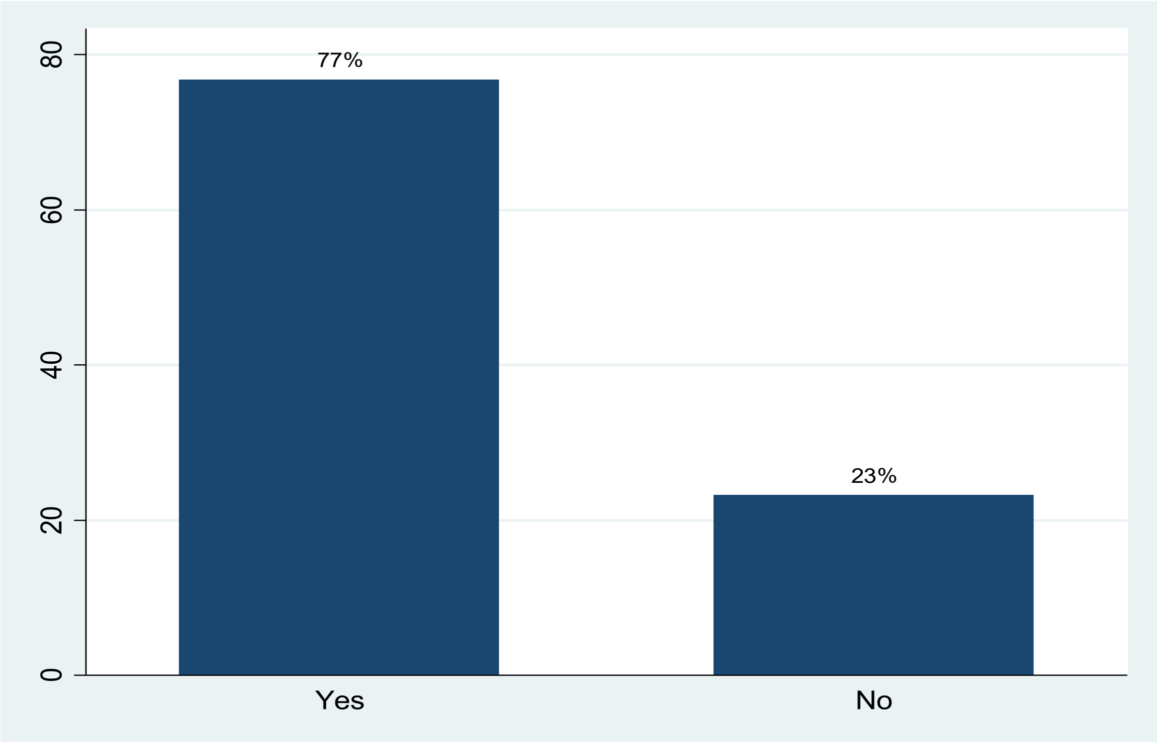
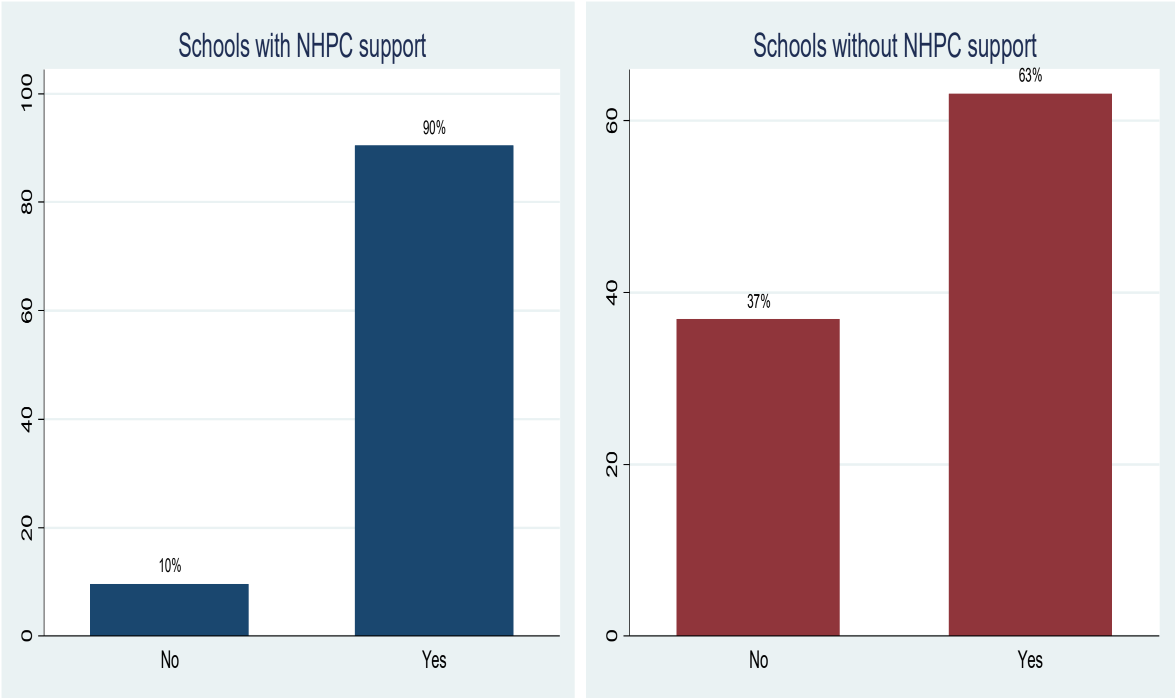


Figure 10: Students' knowledge about the construction of the dam in NHPC and non-NHPC schools (in %)



We then sought to understand whether students aspired to pursue employment opportunities at the dam after completing school. As presented in Figure 11, the results show that 62% of all students surveyed plan to work at the dam. Looking at school type (Figure 12), we find that the proportion of students planning to work at the dam is higher in schools without NHPC support (66%) than in NHPC-supported schools (58%). This difference may be attributable to treatment-school students (and their parents) being more familiar with NHPC's project activities and therefore, having a more realistic view of employment prospects at the dam. With dam construction expected to be completed by 2023, discussions with current students in NHPC-supported schools show that they may be less optimistic than those in non-supported schools about opportunities for construction work by the time they graduate. Moreover, as the dam is expected to provide fewer than 100 jobs during the operation phase, catering for only a fraction of students graduating from local schools, NHPC-supported school students are likely aware that future opportunities for employment at the dam are limited.

Figure 11: Whether students plan to work at the dam after completing school (total sample, in %)

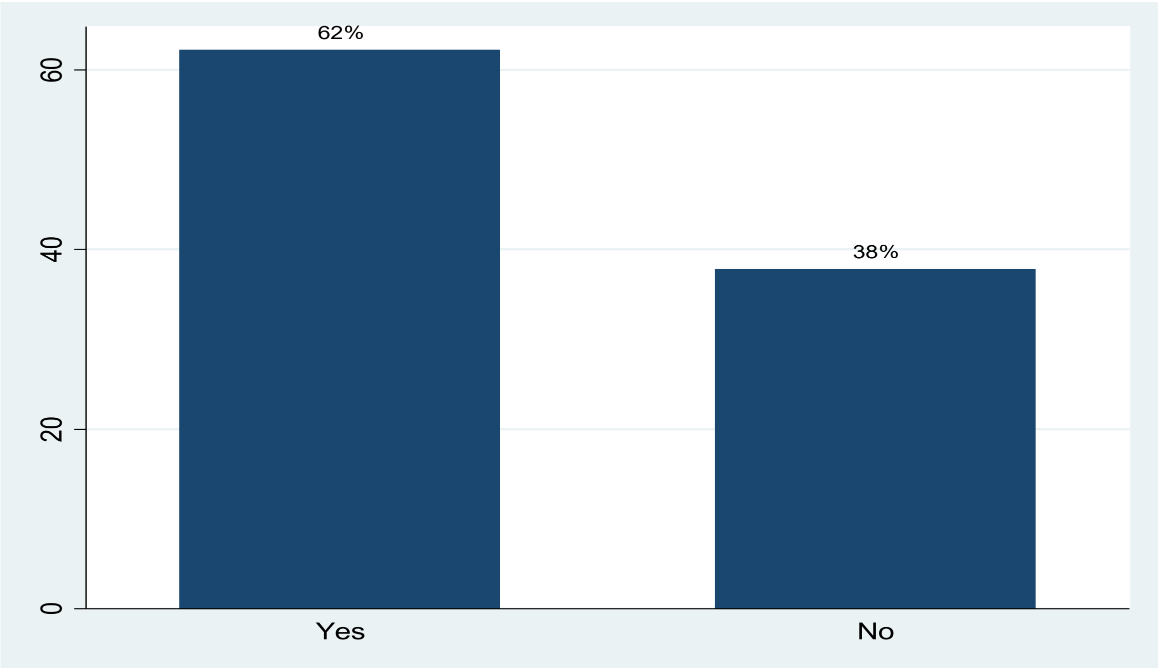
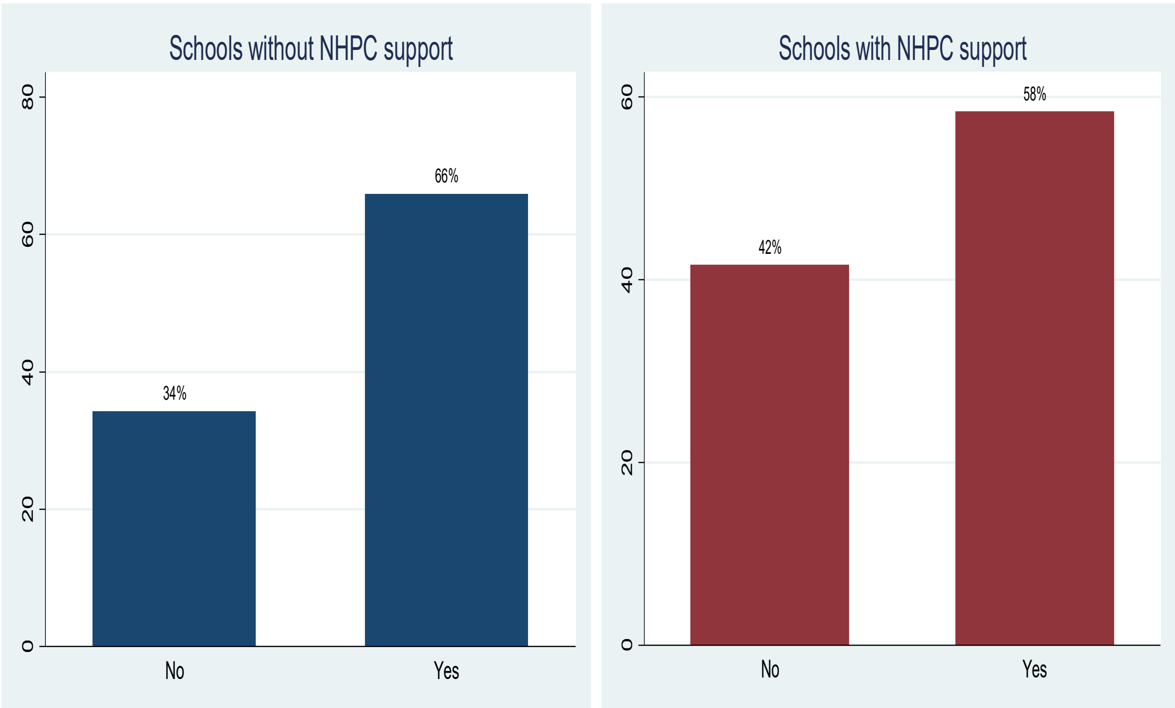
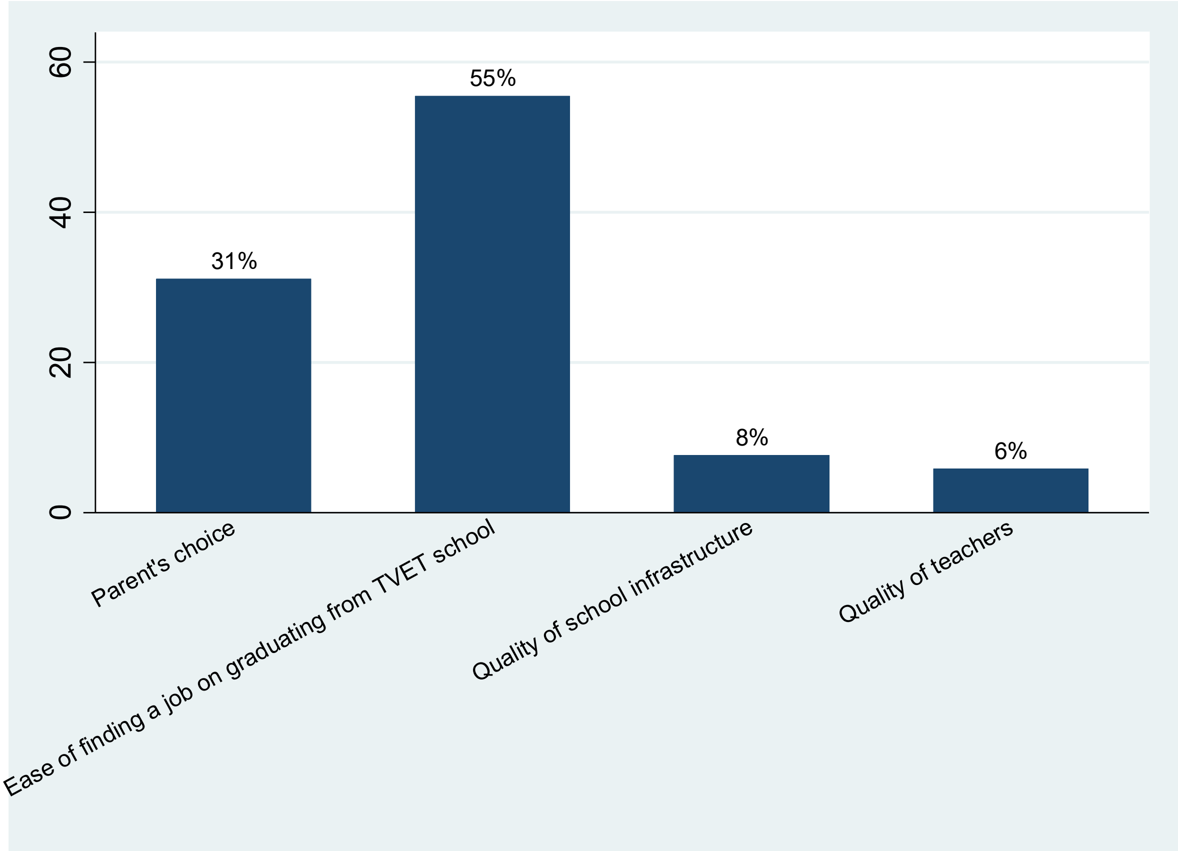


Figure 12: Whether students plan to work at the dam after completing school (control vs. treatment, in %)



Probing further into the motivating factors for the choice of school, we asked students to give the principal reason for enrolling in the school they currently attend (Figure 13). Once again, job expectations feature prominently: For over half of students, the main reason for choosing a technical and vocational school was the perception that this would facilitate finding a job upon graduation. Parental influence also plays a major role in students' choice of school, with 31% reporting that their parents chose their current school. The quality of school infrastructure and teachers played much smaller roles, at 8% and 6%, respectively.

Figure 13: Students' principal reason for choosing to study at their current school (in %)



8. Impact of Nachtigal Hydro Power Company's investments on school enrolment

Table 8 presents the impact of NHPC's investments on enrolment. Overall, we see an upward trend in student enrolment for both types of schools, with NHPC-supported and non-NHPC-supported schools experiencing net increases of 25% and 13%, respectively, between 2015 and 2019. Much of the enrolment increase for treatment schools occurred in 2017, the year when school renovations were undertaken. From 2016 and 2017, student enrolments in NHPC-supported schools increased by almost 13%, compared to a reduction of 2% in control schools over the same period. This indicates that the enrolment gain in NHPC-supported schools might have been at the expense of schools without NHPC support. Overall, treatment schools saw their enrolments increase by 16% between 2016 and 2018, when classroom renovations were performed and training equipment was provided by NHPC. In comparison, the enrolment increase for control schools in the same period was just 1.2%.

These results suggest that NHPC's investments had a positive impact on enrolment in technical and vocational education and training schools in the project area. Although some of the increase for NHPC-supported schools in 2016-2017 came at the expense of schools without NHPC support, the percentage gain was greater than the decline. Nevertheless, these effects seem not to have been sustained as enrolments fell after 2017. In fact, from 2018 to 2019, schools without NHPC support had a slightly higher percentage increase in enrolments of 3.4%, compared to 2.4% for NHPC-supported schools.

Table 8: Impact of NHPC's investments on student enrolments

Change in average enrolment	2015 to 2016	2016 to 2017	2017 to 2018	2018 to 2019	2015 to 2019
Change in NHPC-supported schools	5.8%	12.8%	3.9%	2.3%	24.9%
Change in non-NHPC-supported schools	8.5%	−2.0%	3.2%	3.4%	13.0%

March to April 2015: Public information meetings for affected communities

August 2015 to May 2016: Impact assessment surveys

June 2017 to January 2018: Renovation of technical schools and provision of training equipment

9. Econometric results

This section presents results on how (if at all) the NHPC's investments affected the time spent by students working on a farm, their knowledge of the job opportunities presented by the dam's construction, and their motivation to seek employment at the Nachtigal dam.

9.1. Impact on the time devoted to farmwork

The results show that students in NHPC-supported schools spend less time working on farms than their peers in the control schools (Table 9). This finding suggests that the intervention is delivering on its aim to shift students' motivation towards non-farm employment.

Table 9: Impact of NHPC's intervention on time devoted to farmwork

Number of observations = 289	**LR chi² (17) = 28.69**	**Prob > chi² = 0.0375**

Number of hours spent working on a farm (1=None, 2=Less than 1 hour, 3=Between 1 and 2 hours, 4=More than 2 hours)	
Whether a student attends NHPC-supported school (0=No, 1=Yes)	−0.499**
	(0.178)
Student's gender (1=Male, 2=Female)	−0.030
	(0.222)
Student's age (years)	0.007
	(0.034)
Size of student's household	−0.009
	(0.023)
Mother literate (0=No, 1=Yes)	−0.082
	(0.195)
Father literate (0=No, 1=Yes)	0.100
	(0.192)
Number of rooms in the family home	−0.039
	(0.070)
Number of meals eaten per day	−0.134
	(0.119)
Students can access help with homework	0.232*
(1=Always, 2=Often, 3=Never)	(0.125)
Time per day spent on homework outside school (1=Less than 1 hour, 2=Between 1 and 2 hours,	0.135
3=More than 2 hours, 4=None)	(0.113)
Student's family owns a farm (0=No, 1=Yes)	1.150***
	(0.433)
Journey time to school (minutes)	0.006*
	(0.003)
Student has repeated a class (0=No, 1=Yes)	0.116
	(0.193)
Reason for choosing the current school	−0.080
	(0.106)
Family member attended a TVET school (0=No, 1=Yes)	0.003
	(0.178)
Student plans to seek employment at the dam after completing school (0=No, 1=Yes)	0.162
	(0.175)
Constant	−1.707*
	(0.979)

Note: Standards errors are in parentheses, LR chi2 refers Likelihood Ratio (LR) Chi-Square, Prob refers to the probability
****, ** and * denote significance at the 1%, 5% and 10% level, respectively.*

9.2. Impact on students' knowledge of Nachtigal dam construction

As Table 10 illustrates, students in NHPC-supported schools were more likely to know about the dam's construction than those in schools that did not receive NHPC support.

Table 10: Impact of NHPC's intervention on students' knowledge of Nachtigal dam construction

Number of observations = 289 LR chi^2 (18) = 101.22 Prob > chi^2 = 0.0000

	Student knows about Nachtigal dam (0=No, 1=Yes)
Whether student attends NHPC-supported school (0=No, 1=Yes)	1.908***
	(0.332)
Student's gender (1=Male, 2=Female)	−0.603**
	(0.297)
Student's age (years)	−0.041
	(0.055)
Size of student's household	0.015
	(0.031)
Mother literate (0=No, 1=Yes)	−0.539*
	(0.327)
Father literate (0=No, 1=Yes)	0.334
	(0.263)
Number of rooms in family home	0.179*
	(0.096)
Number of meals eaten per day	0.228
	(0.180)
Student can access help with homework	0.038
(1=Always, 2=Often, 3=Never)	(0.176)
Time spent working on farm on a typical school day (1=None, 2=Less than 1 hour,	−0.111
3=Between 1 and 2 hours, 4=More than 2 hours)	(0.094)
Student reads books outside school (1=Often, 2=Occasionally, 3=Never)	0.128
	(0.166)
Student's family owns a farm (0=No, 1=Yes)	0.536
	(0.422)
Journey time to school (minutes)	−0.001
	(0.004)
Student has repeated a class (0=No, 1=Yes)	0.581**
	(0.272)
Reason for choosing current school	0.138
	(0.158)
Family member attended a TVET school (0=No, 1=Yes)	−0.225
	(0.256)
Student plans to seek employment at the dam after completing school (0=No, 1=Yes)	1.153***
	(0.254)
Constant	−0.213
	(1.366)

*Note: Standards errors are in parentheses, LR chi2 refers to Likelihood Ratio (LR) Chi-Square, Prob refers to the probability ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.*

9.3. Impact on students' motivation for employment at Nachtigal dam

Given their greater awareness of the dam's construction and thus greater insights into the job opportunities this presented, we would have expected students in NHPC-supported schools to also be more enthusiastic than their control-school peers about seeking employment at the dam on graduation. However, our results paint the opposite picture. Students in NHPC-supported schools are less likely to seek employment at the Nachtigal dam (Table 11), which implies that the intervention has not successfully motivated these students to work at the dam after completing school. As discussed in Section 7, this finding may be explained by students in treatment schools having a more realistic view of the limited prospects for future employment at the dam. Families in the dam area are familiar with many local projects (for instance, involving roads or agriculture), and thus have good knowledge of what such projects can realistically be expected to provide as job opportunities.

Another plausible explanation for this finding is that parents decided to enrol their children in NHPC-supported schools based on insights gleaned from attending consultative meetings without sharing knowledge about the opportunities presented with their children. Given that no specific job awareness programmes were implemented to educate students on available job opportunities at the dam, it is possible that many students were simply unaware of these opportunities.

Table 11: Impact of NHPC's intervention on students' motivation for employment at Nachtigal dam

Number of observations = 289 **LR chi^2 (18) = 58.78** **Prob > chi^2 = 0.0000**

Student plans to seek employment at the dam (0=No, 1=Yes)	**1**
Whether student attends NHPC-supported school (0=No, 1=Yes)	−0.610***
	(0.213)
Student's gender (1=Male, 2=Female)	−0.455**
	(0.219)
Student's age (years)	0.064*
	(0.036)
Size of student's household	0.009
	(0.024)
Mother literate (0=No, 1=Yes)	−0.158
	(0.212)
Father literate (0=No, 1=Yes)	0.240
	(0.201)
Number of rooms in family home	−0.039
	(0.076)
Number of meals eaten per day	−0.008
	(0.126)
Student can access help with homework	0.099
(1=Always, 2=Often, 3=Never)	(0.130)
Time spent working on farm on a typical school day (1=None, 2=Less than 1 hour,	0.111
3=Between 1 and 2 hours, 4=More than 2 hours)	(0.076)
Student reads books outside school (1=Often, 2=Occasionally, 3=Never)	−0.207*
	(0.120)
Student's family owns a farm (0=No, 1=Yes)	−0.138
	(0.369)
Journey time to school (minutes)	0.002
	(0.004)
Student knows about Nachtigal dam (0=No, 1=Yes)	1.116***
	(0.246)
Student has repeated a class (0=No, 1=Yes)	−0.504**
	(0.209)
Family member attended a TVET school (0=No, 1=Yes)	0.373**
	(0.183)
Reason for choosing current school	0.151
	(0.114)
Constant	−0.927
	(0.996)

Note: Standards errors are in parentheses, LR chi2 refers to Likelihood Ratio (LR) Chi-Square, Prob refers to the probability
****, ** and * denote significance at the 1%, 5% and 10% level, respectively.*

10. Conclusion

This study set out to assess whether NHPC's investments in school infrastructure and training equipment increased human capital in terms of higher student enrolment in STEM fields, less time devoted to farmwork on school days, increased knowledge of the dam's construction and related job opportunities, and motivation to seek employment at the dam on graduating.

The results suggest that NHPC's investments may have had a positive impact on student enrolment. Enrolment in NHPC-supported schools increased by almost 13 percentage points during the period when infrastructure was renovated and training equipment delivered. In comparison, enrolment in schools not receiving NHPC support dropped by 2 percentage points over the same period. The investments produced this positive outcome through two main channels. First, they provided additional space to accommodate students, as NHPC's intervention added one extra classroom — on average — to each school receiving support, whereas the number of classrooms remained unchanged in unsupported schools. Second, the intervention improved parents' and students' perception of the quality of teaching in NHPC-supported schools. Moreover, the intervention was quite timely as all the schools surveyed reported having poor-quality training equipment.

Notwithstanding this increase in enrolment, the gender gap in STEM training remains very wide. Hardly any female students are enrolled in STEM subjects traditionally studied by male students, particularly masonry and carpentry, although a small number of females study electrical engineering and management. The gender gap seems persistent over the five years of the study and was not reduced by NHPC's intervention, which is unsurprising as there were no specific strategies for attracting female students into STEM subjects. Moreover, the massive difference in enrolments between men and women is not unique to this study but reflects the global phenomenon of women being less likely to enrol in STEM subjects than men (UNESCO, 2016). These results thus highlight the need for affirmative-action interventions to boost female students' enrolment into technical and vocational schools and thereby close the gender gap in technical education.

The results also show that students in NHPC-supported schools spend less time on farmwork during school days, indicating that the intervention has successfully motivated students to pursue non-farm employment. Additionally, students in NHPC-supported schools are more likely than their peers in control schools to know about the dam being constructed. We thus expected students in NHPC-supported schools to indicate a higher likelihood of pursuing employment at the dam after graduating. Instead, these students are less likely than their control-school peers to opt for a future career at the dam. This finding reflects treatment-school students' more realistic understanding that future employment opportunities at the dam may be limited. It may also imply that students at NHPC-supported schools have little knowledge about the job opportunities presented by the dam's construction, perhaps because parents who were key participants in the early decision to support vocational schools decided to enrol their children without informing them of potential job opportunities. As NHPC's investments aimed to build a workforce for the dam, the intervention may have fallen short of this objective. It could have been helpful to add a component focused on raising awareness about available job opportunities.

A key limitation of this research is that comparing trends in treatment and control groups is more intuitive than rigorous. Therefore, although our method is roughly similar to a regression discontinuity, the small number of yearly observations meant we could not employ that method. Consequently, our results may be affected by selection bias as our research method could not match characteristics across treatment and control schools.

Appendix

1. General information about technical and vocational education

For many years, technical and vocational education in Africa has been considered as a career path for less academically gifted individuals. This perception has been driven by the low academic requirements for admission to technical and vocational education and training (TVET) programmes and the limited prospects for further education and professional development.

The TVET is particularly important and needs a voice because it is promoting economic development, expanding employment size and improving the quality of employment. For instance, Mason et al. (1992) showed that vocational education in the Netherlands contributes to higher productivity through better maintenance of machinery, more consistent product quality and lower manning levels. Cho et al. (2013) provide experimental evidence on the effects of vocational and entrepreneurial training for Malawian youth, in an environment of extremely low access to schooling and formal-sector employment. They also argue that vocational training may improve labour-market outcomes through multiple channels: 1) teaching practical, technical skills increases trainees' skills, and possibly their productivity; 2) training sessions may increase awareness of higher-paying job opportunities and improve knowledge of how to access these jobs and connect with potential employers.

Focusing on the Dominican Republic and Columbia, respectively, Card et al. (2011) and Attanasio et al. (2011) explored the impact of training programmes for youth with classroom and on-the-job training components. Attanasio et al. (2011) found fairly large effects on the probability of employment and on wages, whereas Card et al. (2011) found no effect on employment but a modest effect on earnings.

Technical and vocational education and training in most high-income countries has been found to effectively bridge the education system and the working world, supporting a decisive transition to the employment system for young people (Grollmann and Rauner, 2007). In other countries, such as China, linking technical and vocational education and training with the national economic development strategy has positively contributed to economic development (Zouliatou, 2017).

However, technical and vocational education and training is still a challenge in all African countries (UNESCO, 2017). The sector is not only small but also characterised by limited funding, insufficient infrastructure and equipment, a lack of practical relevance to the labour market and poor-quality teaching (Lolwana and Oketch, 2017). Yet governments and international institutions are paying increasing attention to technical and vocational education and training. For instance, it was one of eight priority areas in the African Union's Second Decade of Education (2006-2015) and a key priority area for African heads of state at the recent Abidjan declaration in July 2021.

This commitment to technical and vocational education and training was also reflected in the various poverty-reduction strategy papers that governments developed in collaboration with the World Bank (Bloom et al., 2006). For example, Cameroon intends to develop vocational and professional training to facilitate integration into the labour market; Côte d'Ivoire focuses on strengthening vocational training; Ghana links vocational education and training with youth education and development of technical and entrepreneurial skills; Lesotho and Rwanda link technical and vocational education and training to businesses; and Malawi emphasises the need to promote self-employment through skills development. Other countries that have prioritised technical and vocational education and training initiatives in their national development policy documents include Chad, Ethiopia, Guinea, Senegal, Sierra Leone, Uganda and Zambia (African Union, 2007).

In general, vocational education and training form a separate, parallel structure within the education system. This situation tends to reinforce the perceived inferiority of the vocational path. Technical and vocational education and training systems in Africa differ between countries and are delivered at different levels by various types of institutions, including technical and vocational schools (both public and private), polytechnics, enterprises and apprenticeship training centres.

Throughout sub-Saharan Africa, formal technical and vocational education and training programmes are school-based. In some countries, training models follow those of the former colonial power. In general, however, students enter the vocational education track at the end of primary school after six to eight years of education in countries such as Burkina Faso and Kenya, or at the end of lower or junior secondary school after nine to 12 years of so-called basic education in countries such as Ghana, Nigeria, Mali and Eswatini. The vocational education track has the unenviable reputation of being a dead end for academic progression and fit only for those pupils unable to advance to higher education. The duration of school-based technical and vocational education and training is three to six years, depending on the country and model (African Union, 2007).

2. The technical and vocational education and training context in Cameroon

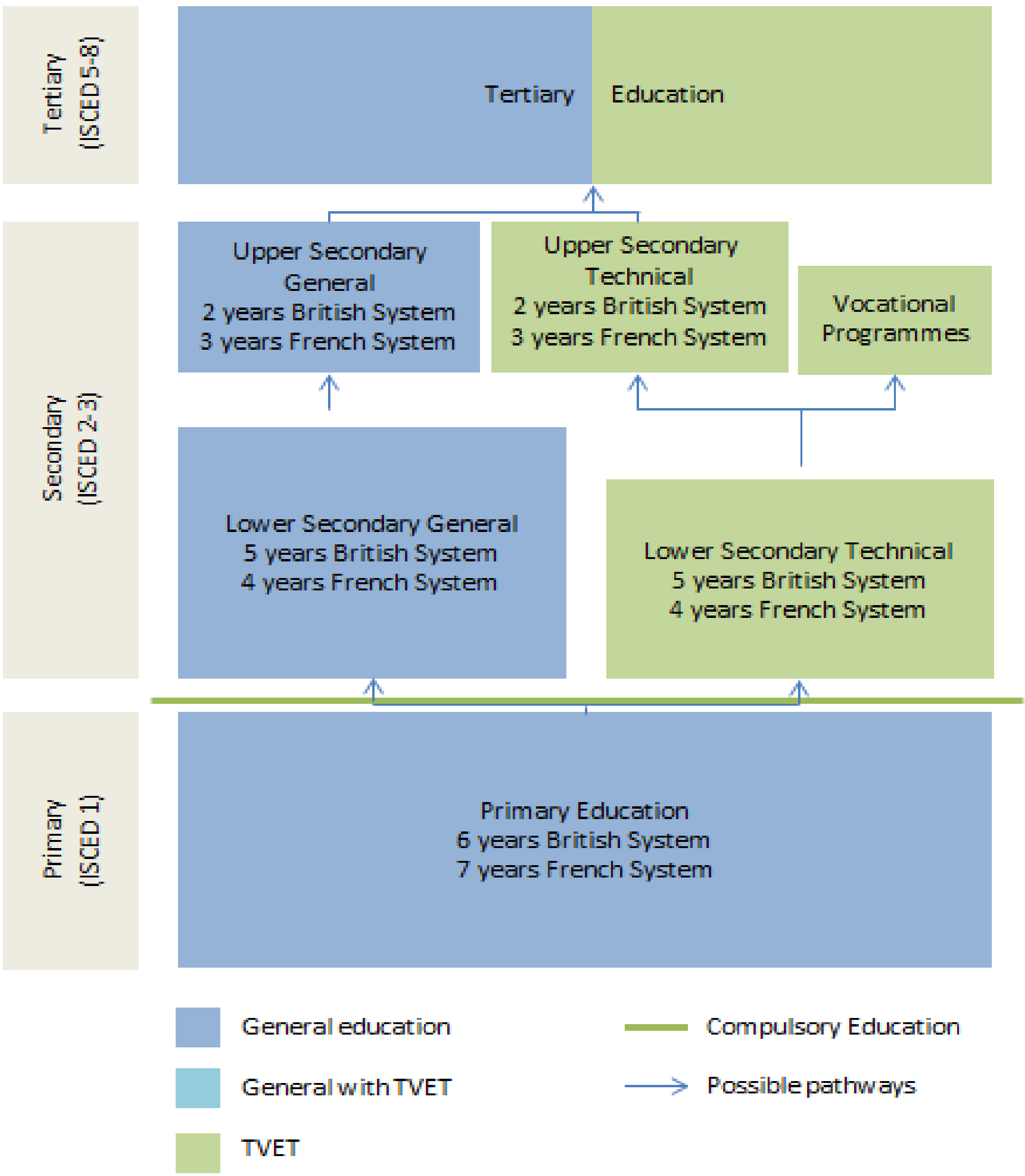
Technical and vocational education and training in Cameroon aims to create a trained workforce for various employment sectors, increase understanding of technology and enable individuals to fully participate in society as responsible citizens. Promotion of technical and vocational education and training has been supported by several strategies: (i) the Education Plan 2013-2020, which calls for expanding and diversifying such programmes; (ii) the Vocational Education Strategy 2008, which recognises vocational education as a pathway to normal and accelerated socio-professional integration and wages; (iii) the Education Sector Strategy Plan 2006-2012, which aimed to develop vocational education programmes to improve training quality and workplace productivity, limit student dropouts, make technical and vocational education and training socially acceptable and financially feasible, and introduce vocational training as a post-primary education alternative; and (iv) the 2002 National Education Plan Education For All (*Plan d'Action National de l'Education Pour Tous 2002*), which sought to address technical and vocational education and training by promoting equal access to training programmes for young people and adults (UNESCO-UNEVOC, 2015).

Structure of general and vocational education systems in Cameroon

Cameroon's education system has two subsystems, British and French, in which the languages of instruction are English and French, respectively (Figure A1). Within general education, the British subsystem is divided into primary (six years), lower secondary school (five years), upper secondary (high school, two years) and tertiary (university), whereas the French subsystem is divided into primary (seven years), lower secondary school (four years), upper secondary (high school, three years) and tertiary (university).

At secondary level, technical and vocational education and training is offered as an alternative to general academic education. Technical and vocational education and training programmes are also offered in both English and French, and graduates have access to higher professional training courses at undergraduate and postgraduate levels. In the British subsystem, secondary technical and vocational education and training last five years in the first cycle and two years in the second cycle, after which students can join tertiary education; in the French system, the first cycle lasts four years and the second lasts three years, before students join tertiary institutions (UNESCO-UNEVOC, 2015).

Figure A1: Structure of the education system in Cameroon



Source: UNESCO-UNEVOC (2015).

Technical and vocational education and training are organised into three formal channels: rural craft, domestic science, and technical and vocational. Rural craft schools offer two-year courses in carpentry, masonry, pottery and agriculture for people who drop out of school or individuals who may be too old for secondary school. Domestic science schools offer two-year courses for girls who have not attended secondary school. Finally, technical and vocational high schools or colleges offer three- to four-year courses in civil engineering, electricity and electronics, maintenance and production engineering, dressmaking, nursing, clerical studies, economic and commercial studies, and industrial studies for those that have attended secondary school (Atayo, 2000).

Apart from the formal technical and vocational education and training channels above, Cameroon also has non-formal and informal programmes. Non-formal technical and vocational education and training are offered by various ministries including those responsible for agriculture, youth and culture, which organise apprenticeships and youth training programmes. In addition, extensive training is delivered in informal settings as Cameroon has a large informal sector. For instance, the *Groupement Interprofessionnel des Artisans* (Interprofessional Group of Craftsmen) provides traditional apprenticeships to improve the instructional skills and training levels of its masters, which leads to apprentices with higher knowledge levels and better skills.

While data on technical and vocational education and training participation are rather scarce, the available literature shows that Cameroon has historically had one of the highest technical and vocational enrolment rates in Africa, averaging over 25% of total secondary enrolment in the 1970s and 1980s. During the same period, technical and vocational education and training enrolment rates elsewhere in Africa were around 10%. However, like the rest of the continent, Cameroon experienced a decline in enrolments in the late 1980s and 1990s, mainly due to reductions in government spending on education generally and technical and vocational education and training in particular. For instance, the technical and vocational education and training enrolment rate dropped from about 27% in 1980 to about 17% in 1994 (Oketch, 2009). Since in the 2000s, however, the enrolment rate has hovered at around 18-21%, albeit constrained by several challenges including poor infrastructure and management, inadequate resources, poor linkage with the labour market, low-quality teaching and training, and gender imbalance, with limited enrolment of women in technical and engineering sectors (Zouliatou, 2017).

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European Investment Bank
The EU bank

GDN
Global Development Network

Economics Department
economics@eib.org
www.eib.org/economics

European Investment Bank
98 -100, boulevard Konrad Adenauer
L-2950 Luxembourg
+352 4379-22000
www.eib.org – info@eib.org

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