situated in the Central Development Region of Nepal was planned to have a discharge of 523 Lis and an output power of 46.8 kW using a gross head of 15.135m. These comprised of a weir, gravel trap, settling basin, headrace canal, penstock with anchor blocks, tailrace canal, Francis turbine and synchronous generator. Hydrologic characteristics were estimated using WECS­ DHJv1 and Gumbel's methods predicting flood peaks as well as flow duration for different return periods. Manual design was further conducted on several components adhering to standard formulas. Environmental impacts such as land use changes as well as erosion were identified with mitigation strategies including tree plantation and awareness programs. Socio-economic benefits included employment growth, community development, and rural electrification. The economic analysis revealed a cost-benefit ratio of 4.19 and a payback period of 7.16 years.

2.2.2 Objectives

The major target to be accomplished included the study of energy supply and land suitability for temporary resettlement in Sindhupalchowk.

Further aims were;

• To enhance rural electrification and support the establishment of small-scale industries in

the local community.

• To reduce environmental impact through eco-friendly design and implementation of mitigation measures.

22.3 Organizational chart

Kathmandt1 University

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Biplav Acharya (Me)

Fig]: Organizational chart

22.4 Duties

• To assess project feasibility with further exploration of the procedure of the design flow requirement as well as understanding in detail about the project.

• To design civil as well as mechanical components, including intake, weir, penstock, turbines, and electrical systems.

• To estimate hydrologic characteristics using methods like WECS-DHM determining flow duration curves and seasonal discharge variations for ungauged locations.

• To analyze flood probabilities with Gumbel's method of computing flood discharges for various return periods to ensure infrastructure resilience.

• To design several components including the weir, ogee profile along with the orifice with the adoption of standard formulas.

• To evaluate environmental as well as socio-economic impacts, propose mitigation measures, and assess economic viability with cost-benefit analysis and payback period.

23PEA

23.1

I accumulated related information to determine the feasibility of a hydropower project by focusing on energy supply, land suitability, and camp management. I gained knowledge on hydropower components as well as the importance of assessing land suitability to ensure ideal project placement and minimize environmental impact. I studied the design flow requirements which included assessing the gross head and understanding its role in maximizing power generation efficiency. I researched the flood flow analysis to determine the possibility of high flow conditions to design for the worst-case scenario. I checked flow measurement methods to determine correct values of water outflow which were crucial for computing energy production as well as evaluating performance. I executed the economic feasibility study to determine the viability of the project. I got to know about different techniques of evaluating land suitability which was useful in identifying the right site with the least negative impacts. I conducted land suitability assessment of open and spontaneous sites assessing the coordinates, population, and approximate area. I prepared the sketch included the scope of work. I prepared the drawings with the adoption of standard units.

Figure 2: Sketch of recommended scope of work-Site 1

Figure 3: Sketch of recommended scope of work-Site 2

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Figure 4: Hea,dwork plan

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2.60

0.40

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L-..J Flushing Channel (oullel)

Figure 5: Gravel Trap Plan

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Figure 6: Orifice and trash rack

1.40---+--+0.30

0.30

0.70

Stone Masonry in 1:4 cement monar

100 mm PCC (1:2:4)

1-----2.00 1

Figure 7: Headrace canal

Figure 8: Powerhouse plan

23.2

I determined that the Jhyandi Khola Micro Hydropower plant (MHP) was situated in the Central Development region of Nepal. I measured the stream discharge at Jhyadi Khola on July 11, 2015, finding it to be 2822.9 Lis. I determined that the stream could provide 523 Lis of discharge for 65% of the year which I used as the design discharge after setting aside 10% for downstream release. I computed the scheme's output power as 46.8 kW using a gross head of 15.135 m and an overall efficiency of 0.6. I designed civil components including a side intake at Kunchowk

Besi a weir with a 20-year return period for a Q20 flow of 132.2 m3/s, a gravel trap of I 2 m total length, a settling basin, and a 525 m headrace canal. I included four anchor blocks along the penstock, with support piers placed between them at 6 m intervals. I also designed a 1.25 m by

2.5 m tailrace canal. I specified the trash rack dimensions to minimize head loss and enhanced the penstock diameter at 0.55 m. I selected a Francis turbine, sized a synchronous generator, and specified three distribution transformers and one step-up transformer. I recommended a 70 kW electronic load controller for speed and frequency regulation, incorporating a control and protection system with alarms. I designed the earthing system, specified ACSR conductors, included stay wire sets, and proposed lightning arrestors and poles to ensure reliable electricity distribution.

Figure 9: Site Location

23.3

I then initiated the estimation of hydrologic characteristics at ungauged locations in Nepal specifically using the WECS-DHM method. I computed the catchment area, which measured

35.93 km2 across all elevation zones. I then estimated instantaneous flood peaks for different return periods including Q2 = 44.67 m3/s and Q100 = 207.02 m3/s using regression equations with

parameters a and p. I applied a standard normal variate for the 20-year return period to adjust the

flood discharge resulting in Qr = 132.29 m3/s. I also estimated the flow duratfon curve which gave discharge values for various exceedance probabilities, such as Qo% = 13.35 m3/s and Q95%

= 0.21 m3/s. I used these values to determine monthly flow rates adopting tlhe WECS-DHM

method resulting in Qmean for July at 4.99 m3/s. Additionally, I compared these results to the MIP method for discharge predictions obtaining a monthly discharge series and confirming the seasonal variations in discharge across the year.

T ta! Area (km2)

35.93

Area below 5000 elevation (km2)

35.93

Area below 3000 elevation (km2)

35.93

Figure 10; Catchment area through the WECS-DHM method

16.000

14.000

12.000

10.000

8.000

6.000

4.000

2.000

0.000 T

Flow Duration Curve

discharge Q(m3/s)

0 20 40 60 80 100

Figure 11: Flow Duration Curve Adopting WECS-DHM method

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J:

Monthly Flow EAN

3

i5 2

1

0

MONTHS

Figure 12: Monthly flow Qmean by WECS-DHM method

HYDROLOGICAL CALUL GED MHP RIVER

INPUT

River name

Jyadi Khola

L ation Measured flow for

MfP Region

al ho, k

2822.9

Measurement

I I-Jul

3

Area below 3000 m,km2

Uo nstream, aler relea e due to en ironmenlal reasons,%

35.96

522.

5%

15%

Figure 13: Data for evaluation adhering to the MIP method

FLOW DURATION CURVE

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0

0.00 20.00 40.00 60.00 80.00 100.00 120.00

Probability of Exceedence %

Figure 14: Flow Duration Curve Adopting MIP method

23.4

I evaluated the probable flood using Gumbel's Extreme Value Distribution Method where I determined the flood values for different return periods. For the JOO-year return period, I found a discharge of 207.020 m3/s, and for the 2-year return period, I found 44.670 m3/s. I used the formulae and computed the values of a as 36.410 and u as 31.294. I then used these to assess the magnitude of flood for various return periods, such as 2 years (44.64 m3/s), 5 years (85.9 I m3/s),

10 years (I 13.23 m3/s), 20 years (139.44 m3/s), and up to 1000 years (282.79 m3/s). I also performed flow measurements using an electrical conductivity meter, which gave a discharge of

2.3 m3/s. I applied the float method for velocity evaluation resulting in a discharge of 2.8229 m3/s. Lastly, I used the CAR method to estimate the discharge of Jhyadi Khola as 0.89825 m3/s based on the ratio of the catchment areas of tlhe lndrawati and Jhyadi rivers, confirming the results.

Flow Measurement

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400

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200

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u

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0 20 40 60 80 100 120 140 160

Time in second

Figure 15: Flow Measurement by Electrical Conductivity Meter

Figure 16: Cross Sections 1-1 and 2-2

20 km2

Di at Jh adi Kh I (Qb}

Figure 17: Discharge evaluation adopting the CAR method

23.5

I designed a weir and under sluice considering a 20-year return period flood discharge of 132.2 m3/s, with the crest level set at 1002.2 m and the height of the weir at 2.5 m. I computed the specific discharge, silt factor, regime scour depth, and velocity head, ensuring stability and hydraulic efficiency. I developed the ogee profile for the weir's upstream and downstream curves using standard equations. I designed a gravel trap with a settling velocity of 0.283 mis and a length of 5.6 m to achieve 90% sediment trap efficiency. I provided a transition zone and flushing system setting the total gravel trap length at 12 m as well as ensuring proper flushing velocity with a canal slope of I in 140. I also designed an orifice with an area of 0.523 m2 and optimized its dimensions for efficient flow and sediment flushing. I further optimized the penstock and conducted the design of the expansion joint along with the anchor block. I then

conducted the stability analysis of the anchor blocks and conducted the design of support piers with further analysis of the stability of the support pier.

23.6

I further conducted an environmental and socio-economic assessment. I identified possible environmental impacts such as land use changes, erosion, and minor effects on vegetation as well as agricultural lands. I suggested preventive measures like awareness programs along with tree plantation to mitigate these impacts. I also assessed socio-economic impacts highlighting increased employment opportunities, community development, and land price growth. I foresaw problems like land acquisition along with health of the workers by suggesting to compensate them with cash and provided them with health checkups. I provided equal employment opportunities and did not employ children. I also evaluated the economic viability of the project I computed the total project cost to be NRs 18354039 and the final cost after subsidies to be NRs I 9354464. I determined the cost-benefit ratio as 4.I 9 and simple payback period as 7.16 years. I inspected the site reviewing the sheet shelte ralong with tent shelter. I determined that the micro­ hydro scheme was technically, financially and socially sustainable.

ription of work

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Figure 18; Project Total Cost

Figure 19: CG! Sheet Shelter -View from the Eastern end

Figure 20: Tarps/Tents Shelter - View from North-East Corner

Figure 21: Typical Trap Center

2.4 Issue and Solution

I found out a problem of workforce health which was a major concern as it impacted on the productivity along with the morale of the workforce. I noticed that many employees were absent from work and others were always tired which made the project to take too long. I engaged the teammates in a discussion by sharing my observations and also stressing on the need to take preventive measures on our health. I and the team further discussed possible solutions like organizing medical camps at the workplace or collaborating with clinics. Realizing the importance of top management support, I went to supervisor and explained to him the importance of health checkups for workers and how it would increase productivity as well as decrease sick days. I noticed that the supervisor encouraged the idea and arranged for the participants to meet healthcare providers to arrange for monthly health camps at the workplace. With the solution, I discovered that the laborers were able to access medical care on time and this boosted their health as well as productivity.

2.5 Creative Task

I undertook a detailed analysis of the Jhyandi Khola Micro Hydropower Plant. I quantified stream discharge, planned civil components, and selected electromechanical equipment. I applied hydrologic as well as flood characteristics such as WECS-DHM and Gumbel's distribution. I assessed the environmental and socio-economic effects along with the project viability. I determined that the payback period was 7.16 years. I addressed issues such as land acquisition along with health of the workforce through offering cash incentives to the affected parties as well as conducting health check-ups on the employees.

2.6 Team management

I played a crucial role in confirming smooth collaboration within the team. I actively listened to the colleagues' ideas as well as contributed my thoughts to discussions. I prioritized clear communication and assured to clarify any uncertainties. I supported my teammates by sharing knowledge as well as offering assistance whenever needed. I respected diverse perspectives and adapted my approach to align with team goals. I focused on completing tasks on time and upheld high-quality standards in my work. I resolved conflicts and encouraged a positive working environment. I maintained accountability for my responsibilities and sought feedback to improve my performance. I celebrated my team's achievements and acknowledged individual efforts. I participated in regular meetings as well as contributed to decision-making processes. I adapted to changes in project plans and ensured my tasks aligned with new objectives. I valued teamwork and consistently aimed to strengthen trust among my colleagues

2.7 Codes

To know the criteria for the intake design, I adopted the IS 9761: 1995 code. I adhered to the University protocols and completed my project work.

2.8 Summary

The project with the focus on the study of energy supply and land suitability for temporary resettlement in Sindhupalchowk was accomplished. The feasibility of the Jhyandi Khola Micro Hydropower Plant was evaluated with a detailed analysis of technical, economic, and environmental aspects. Situated in Nepal's Central Development Region, the plant was designed to operate with a discharge of 523 Lis and generate 46.8 kW of power using a gross head of

15.135 m. The design incorporated all the critical components. Hydrological studies utilized WECS-DHM and Gumbel's methods to estimate flood peaks and flow duration for various return periods. Environmental concerns including land use changes as well as erosion were addressed with strategies such as tree planting along with community awareness programs. The project provided socio-economic impacts such as employment opportunities, along with community welfare, as well as rural power supply. Economic analysis revealed cost-benefit ratio of 4.19 along with payback period of 7.16 years which supported the technical, as well as financial & social feasibility of the plant. The improvement of rural electrification coupled with the achievement of eco-friendly design mentioned stated achievement of the secondary objectives.

I learned about flow measurement, along with flood analysis, as well as components. I enhanced the ability to utilize hydrological methods such as WECS-DHMs well as Gumbel distribution for estimating the discharge. I developed skills in economic feasibility analysis evaluating cost­ revenue ratios and payback periods.