



SPILL ENERGY FROM MICRO HYDROPOWER PLANTS FOR SMALL SCALE LIFT IRRIGATION IN HILL AND MOUNTAIN REGION—AN UNTAPPED SYNERGY

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COUNTRY CONTEXT



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नेपालमा काम पाएको भए किन आउनुपर्छ



नेपालबाट अमेरिका छिर्न

६ महिना

२२ लाख खर्च

विदेशमा नेपाली

३० लाख भन्दा बढी



BARREN VILLAGES
HIV AIDS

Foreign aid dependent

Stagnant Economic Growth
and Negative Trade balance

Remittance based Economy



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MHPs IN NEPAL: ISSUES OF SUSTAINABILITY



MORE THAN 700 MHPs

UTILIZATION (25-40%)

**NOT ABLE TO COVER OPERATION AND
MAINTENANCE COST**

FINANCIAL RISK & BURDEN:

- Government=19.2 m\$
- Community / private= 10.8\$

RESOURCE WASTE

MWh/day =172 MWh
Money =2.8 m\$

For the target of 25 MW How much we are putting in stake?

SUSTAINABILITY OF MHP IS VERY BIG CONCERN



ADDRESSING SUSTAINABILITY OF MHP

- **OPTIMIZATION THE UTILIZATION OF MHP CAPACITY**
 - **PRODUCTIVE END-USE DEVELOPMENT**
 - **POWER EVACUATION (GRID CONNECTION OF MHP AND MINI GRID FORMATION AND GRID CONNECTION)**



LIFT IRRIGATION IN NEPAL



**Conventional LI (eg Narayani Lift
Irrigation project)**



Non Conventional LI:
13,011 ha irrigated
through around 21,000
NCI scheme



Hydram



Rain water harvesting



Treadle pump



Drip Irrigation



Solar powered LI



Sprinkle Irrigation



ABOUT THE PROJECT.....

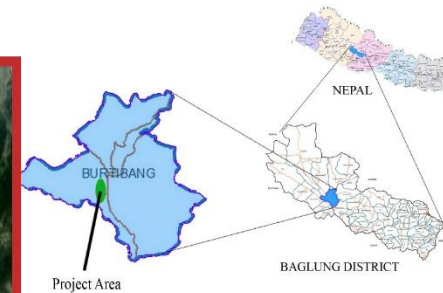
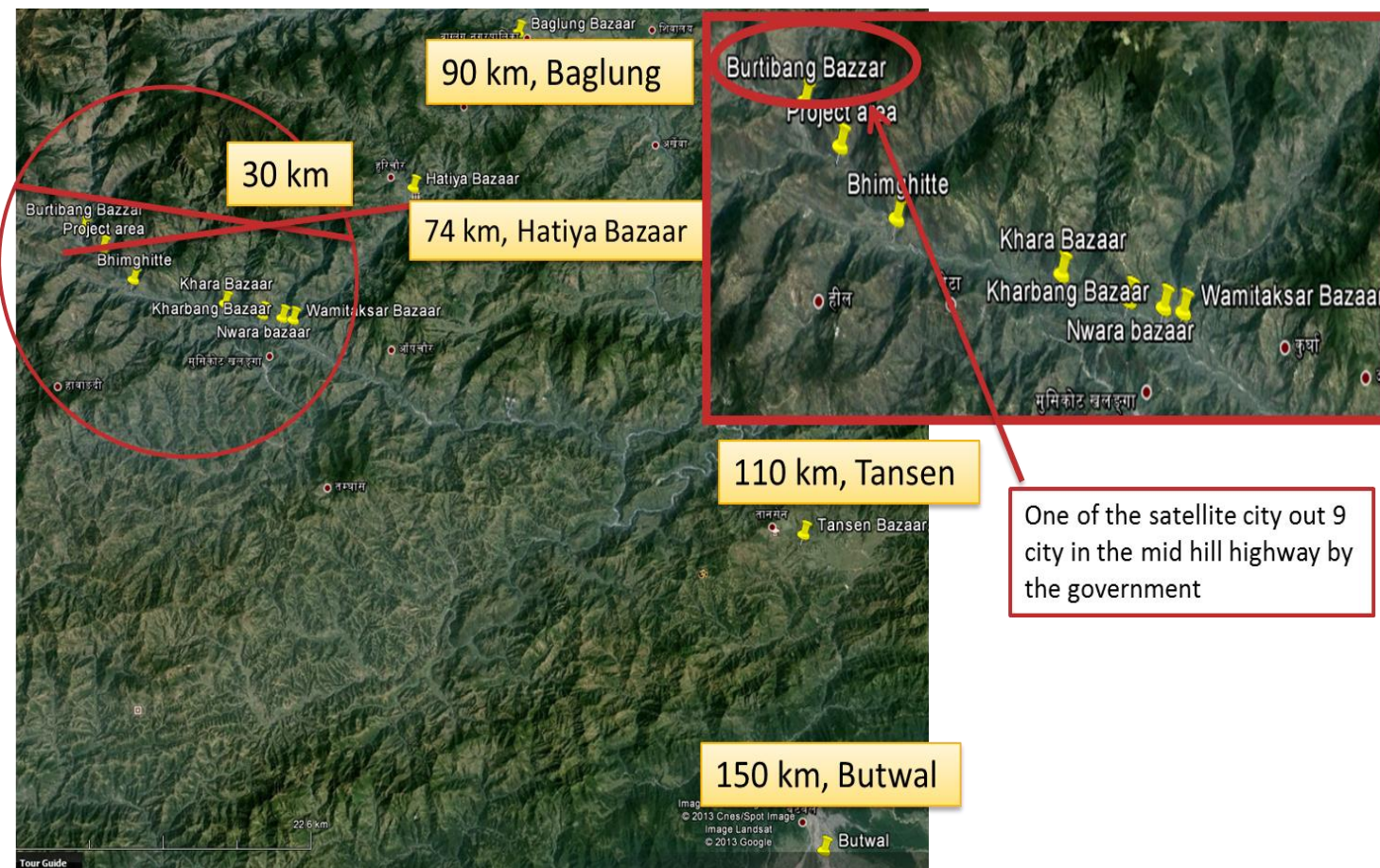
- **PROJECT TITLE:** DEVELOPING ALTERNATIVE SUSTAINABLE INCOME GENERATING ACTIVITY FOR KUMAL AND OTHER COMMUNITY BY EFFICIENT USE OF SPILL ENERGY FROM EXISTING MICRO HYDROPOWER PLANT

FUNDING ORGANIZATION: WISIONS, WUPPERTAL INSTITUTE FOR CLIMATE ENVIRONMENT AND ENERGY, DOEPPERSBERG 19, 42103, GERMANY

IMPLEMENTING PARTNER: MIT SOLUTIONS (P) LTD. (LEAD) AND DHAULAGIRI COMMUNITY RESOURCE DEVELOPMENT CENTRE (DCRDC), BAGLUNG, NEPAL
(LOCAL PARTNER)

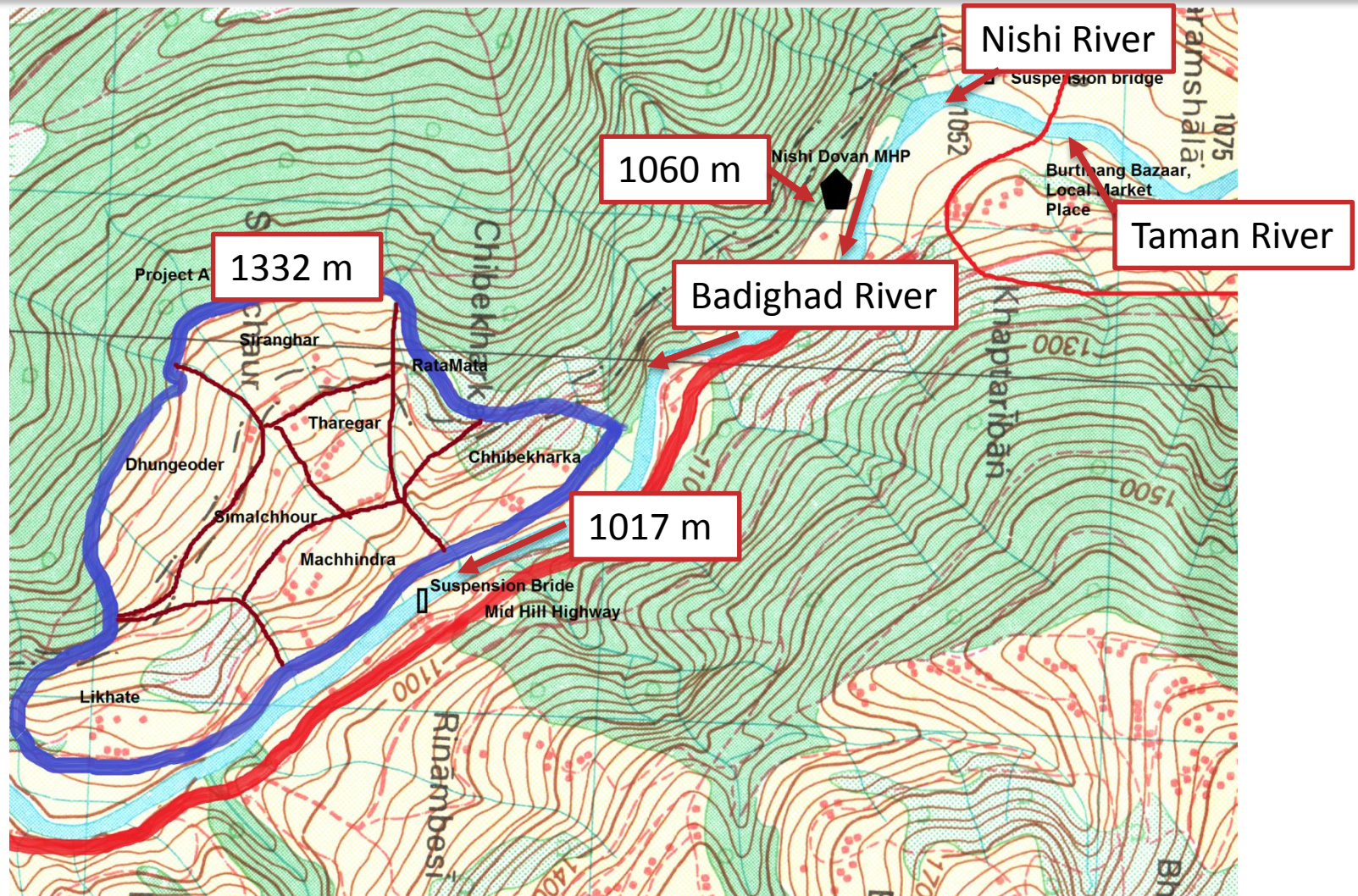


PROJECT LOCATION



One of the satellite city out 9 city in the mid hill highway by the government

PROJECT AREA



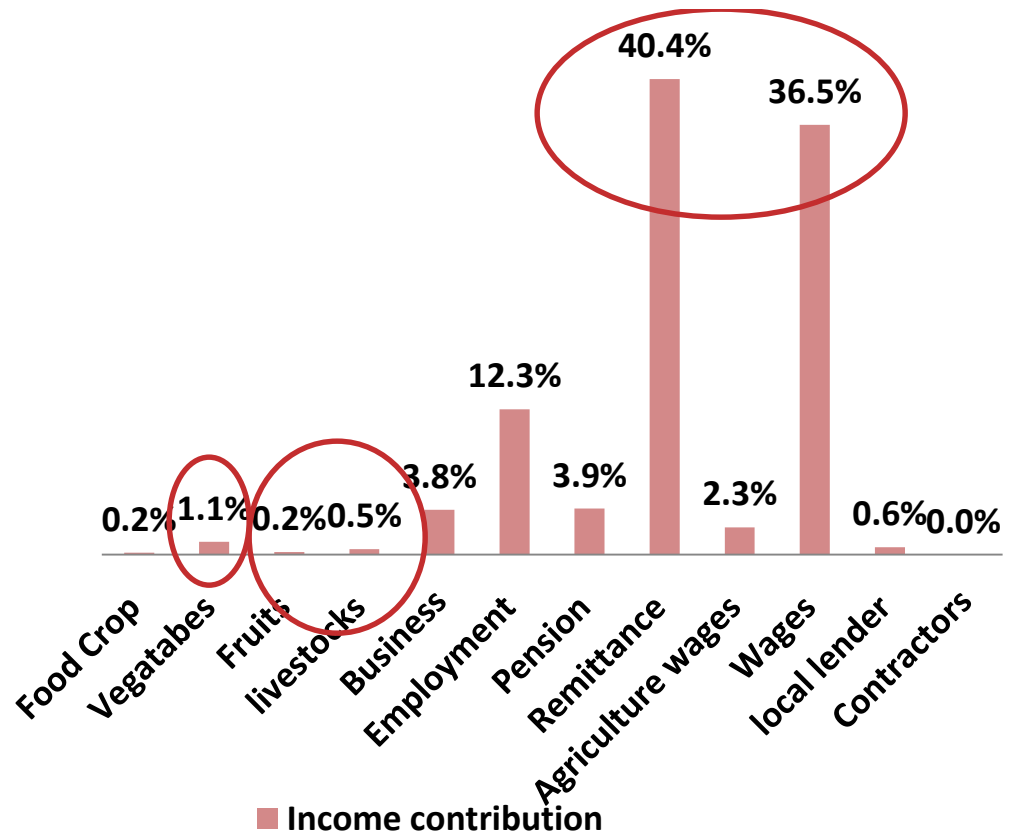
THE COMMUNITY

- **Total population: 518 (dominated by youth: 42.6%)**
- **Total migration: 27.7 % (age group: 16 to 40, Where: India and middle east)**
- **Literate: 40%, School goers: 39%, college goers: 2%, Illiterate: 19%**



THE COMMUNITY- INCOME

- Remittance is the main source of income for households in community followed by daily wages
- The average monthly income of a sampled household is NRs. 8550
- Although almost all the HHs is engaged in farming, income from agriculture contributes only 1.5 %.



THE COMMUNITY- LAND USE AND INCOME

- Total agriculture land: 582 Ropani
- Total food production : 74,400 Kg
- Total selling of the food product was 2,275 Kg
- Highly cultivate crops: Maize and Millet
- Total Income from agriculture was NRs. 93,550.00 per annum
- **Income per Ropani of Land is NRs. 161/ year**
- **Land use 8 month / year**
- Main cause: Lack of Irrigation



THE NISHI DOVAN MICROHYDROPOWER PLANT

Name of the source	Nishi Khola (River)
Gross head	13 m
Design discharge	500 litre per second
Rated capacity	32 kW
Load controller and Ballast Load	Electronic Load Controller , 39 kW
HH beneficiaries	280 HHs of 9 villages 4 enterprises (2 community owned and 2 privately owned)
Owned by	Nishi Dovan Lagu Jal Bidhyut Consumer Group
Investment	NRs 11,216,000
Subsidy	3,056,000
Cash Equity	1,840,000
Bank Loan	800,000 taken at 16% from cooperative
Kind Equity	5,520,000



CONSUMERS CONSUMPTION PATTERN

- **Household**

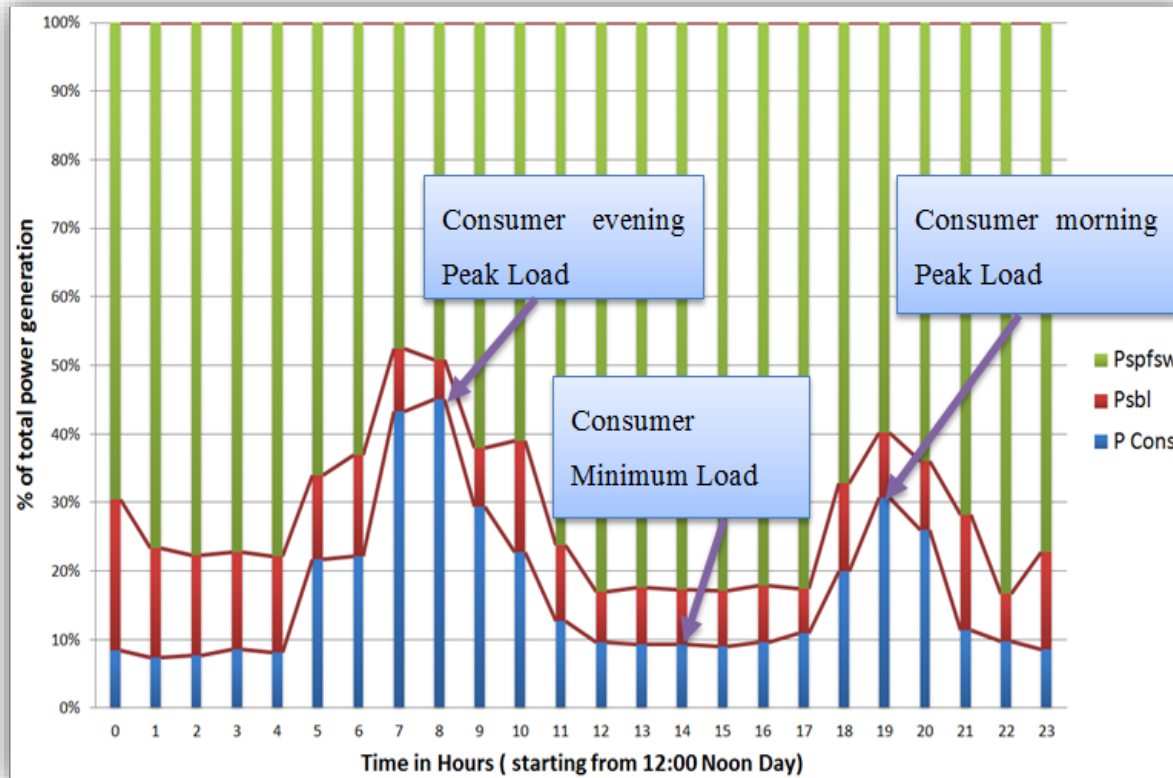
- Usage is mainly in morning (4:00 AM to 7:00 AM) and evening (6:00 PM to 9:00 PM)
- Consumes less than 12 kWh per month and their average expenditure remain 120 NRs/month for electricity

- **Enterprise**

- Operates only between 9:00am to 6:00pm but two community owned enterprises 24 hours a day
- The average monthly consumption by the 4 enterprises varies from 110 kWh to 450 kWh

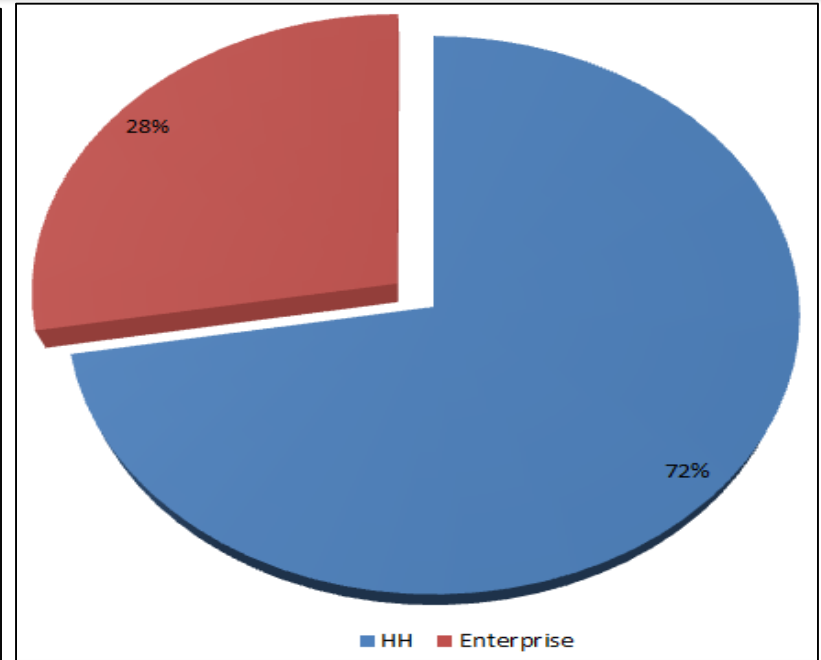
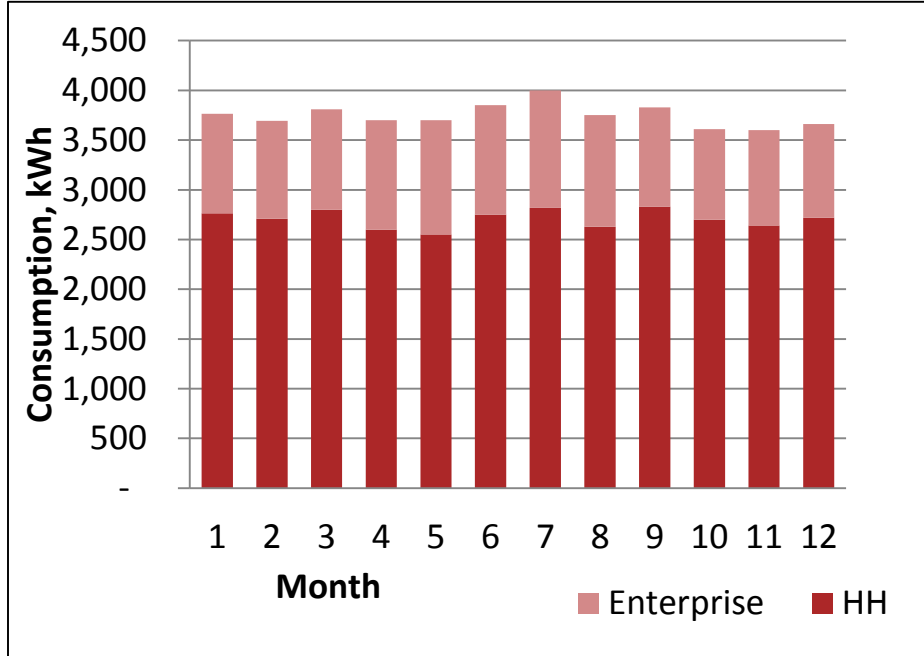


DAILY ELECTRICITY CONSUMPTION



- Daily consumption: **119kWh**
- Power spill to ballast: **76.9 kWh**
- Power spill in the form of water **=572 kWh**
- Daily plant factor = **16%** (**variation +20% to -5%**) Minimum load of around **3.2 kW** midnight **12:00 to 4:00 AM**
- Maximum load of around **16 kW** at **19:00-20:00 PM**
- Morning peak of **9kW** occurs at **7:00 AM**

ANNUAL ELECTRICITY CONSUMPTION



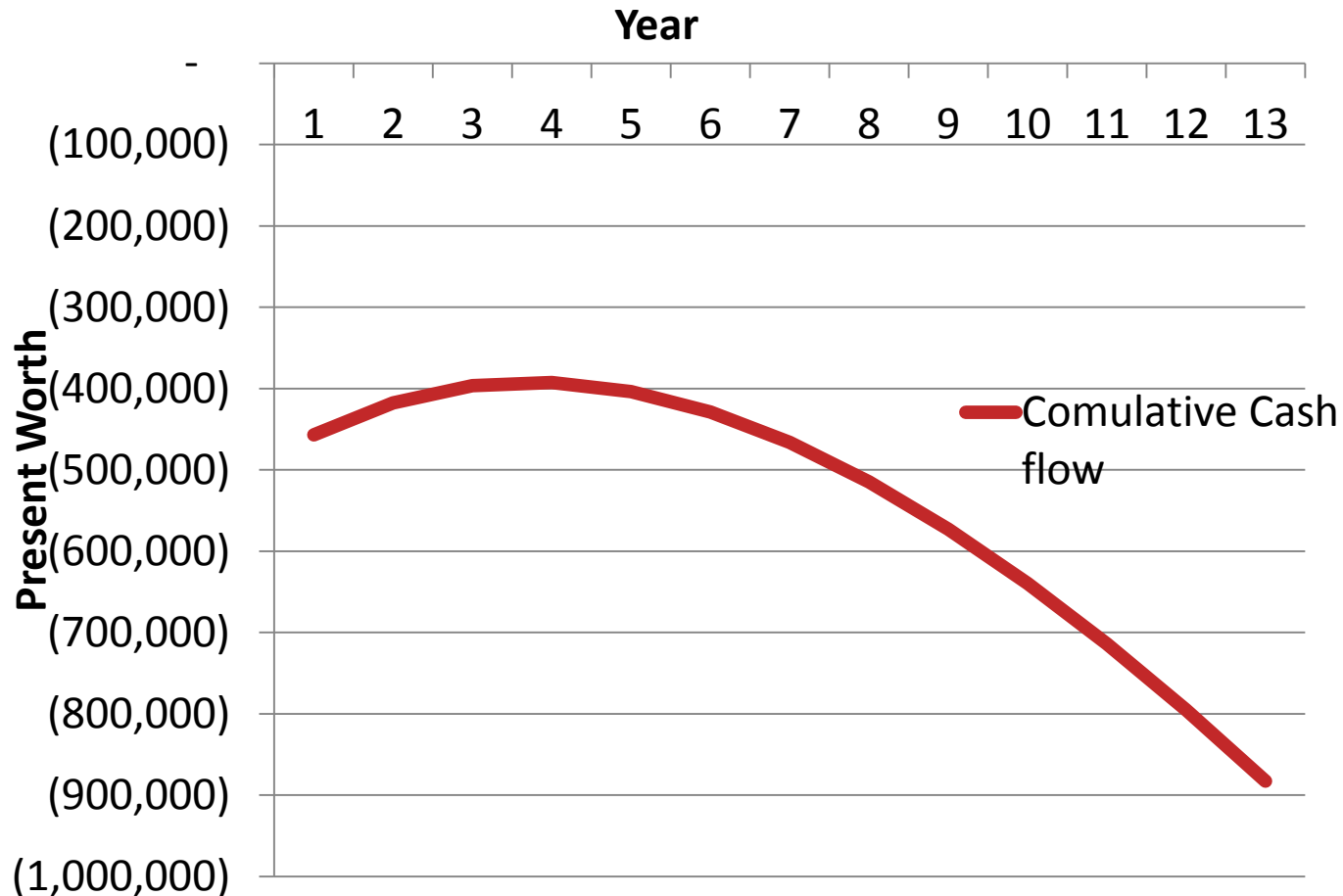
- Annual electricity consumption is found to be 44,980 kWh
- The annual plant factor is found to be 16%.

ANNUAL O&M AND REVENUE

- The total annual operating expense of the plant is NRs 369,500.00
- **Tariff:**
 - HHs : NRs 100/month for up to 10 units for HHs and NRs 10 for extra units
 - Enterprise: NRs 7 /kWh
- **Revenue**
 - From households: NRs 325,150 /year (79%)
 - From Enterprise NRs 87,185/year (12%)



FINANCIAL STATUS OF THE ND MHP



B/C ratio:

0.83

NPV :

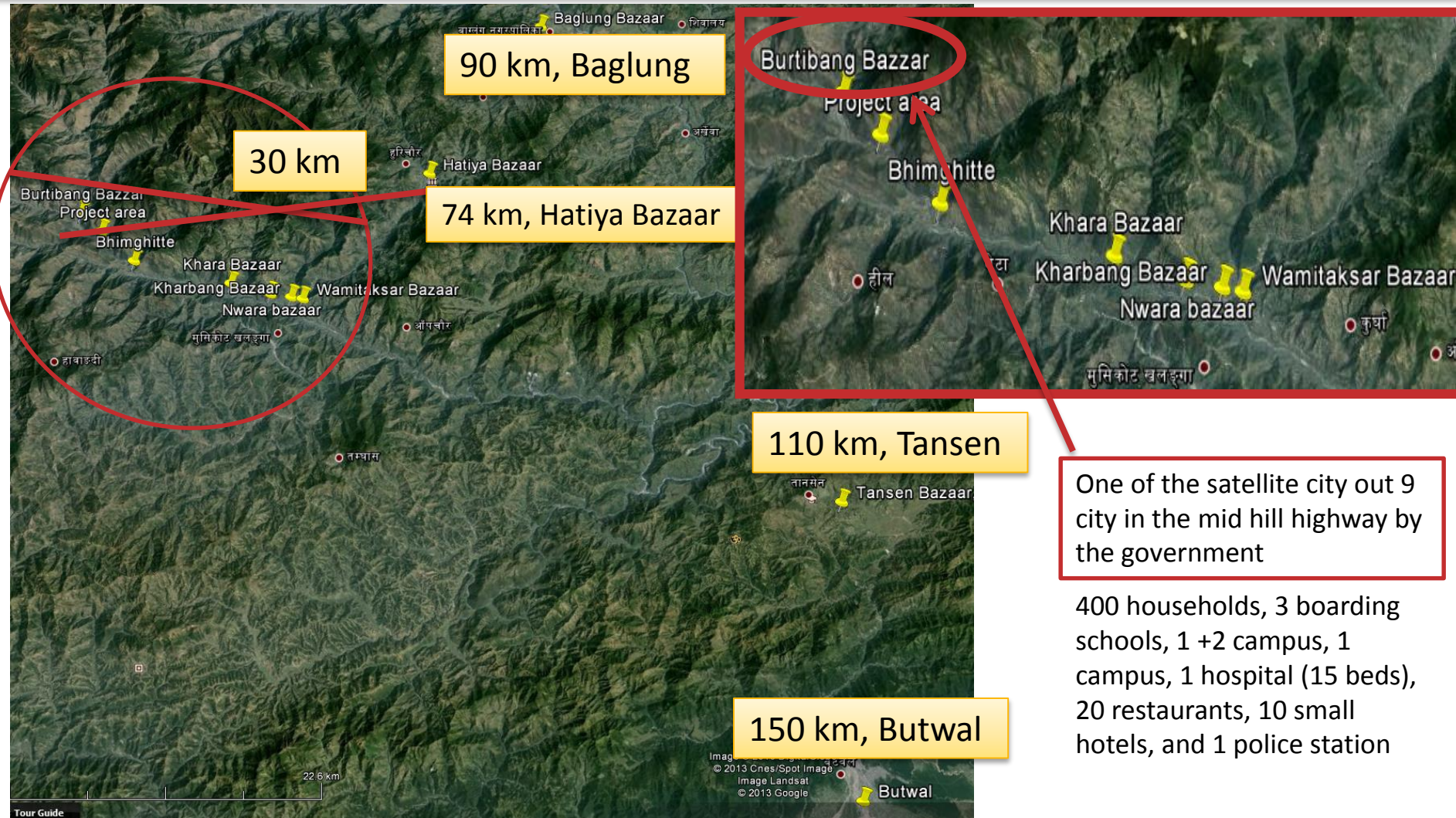
negative



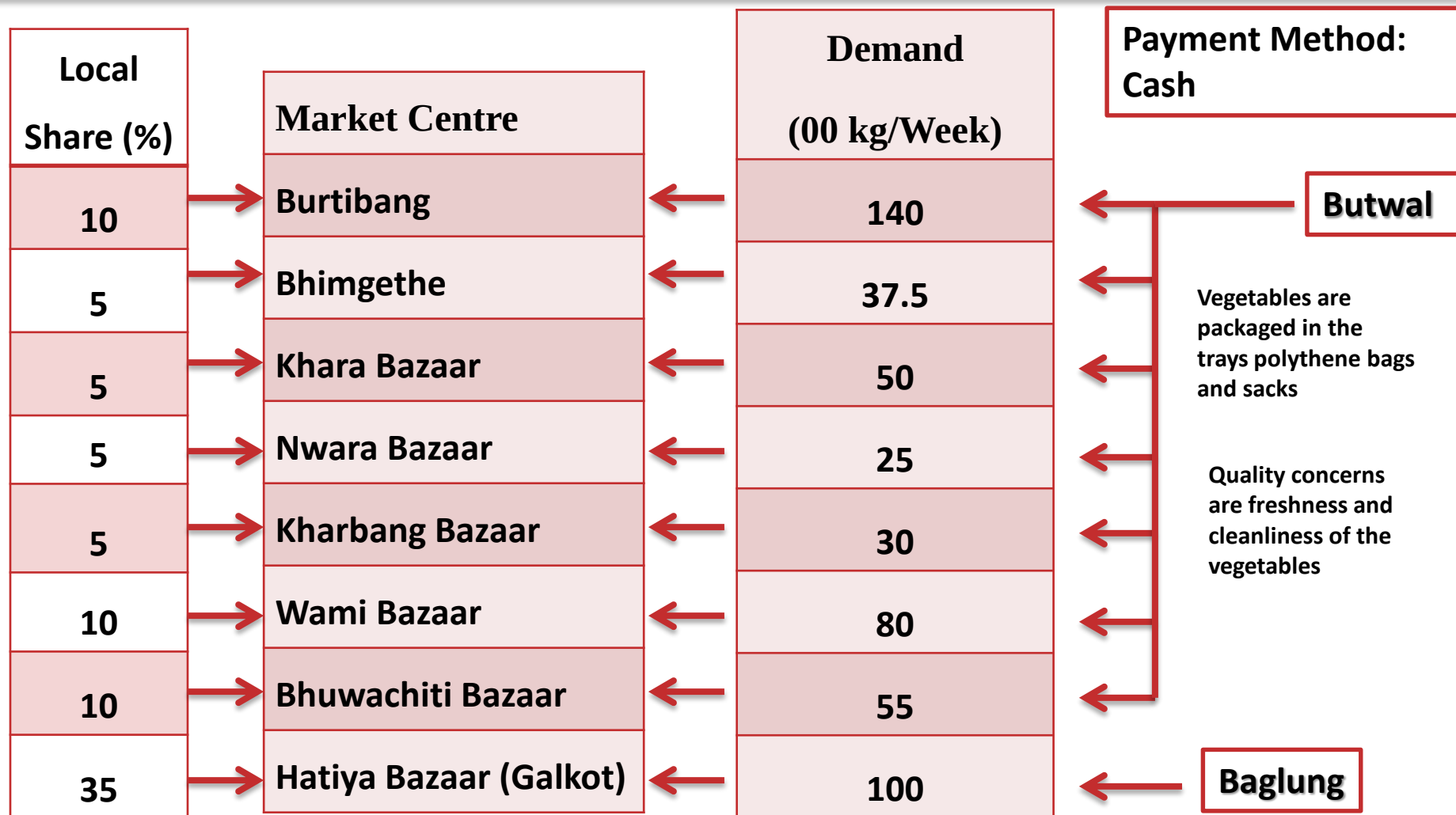
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PRODUCTION AND SALES OF THE VEGETABLE – MARKET CENTRE



PRODUCTION AND SALES OF THE VEGETABLE – SUPPLY AND DEMAND



PRODUCTION AND SALES OF VEGETABLES – TYPES AND PRICE

Summer Vegetables	Max. price (NRs)	Min. price (NRs)
Okra	80	40
Brinjal	50	30
Green chilly	40	25
Green beans	60	40
Bitter gourd	80	40
Capsicum	NA	NA
White beans	60	40
Dark beans	70	40
Snake gourd	80	40
Bottle gourd	90	40
Cucumber	NA	NA

Avg. Transportation Cost Per Kg (NRs.) = 5

Annual vegetables	Maximum Price (NRs)	Minimum Price (NRs)
Potato	35	25
Tomato	60	20
Onion	45	30
Cabbage	50	20
Cauliflower	70	30

Winter Vegetables	Maximum price (NRs)	Minimum price (NRs)
Mustard Green	80	40
Pumpkin	60	20
Broccoli	60	30
Green peas	55	40
Turnip	NA	NA
Carrot	50	25
Radish	30	15

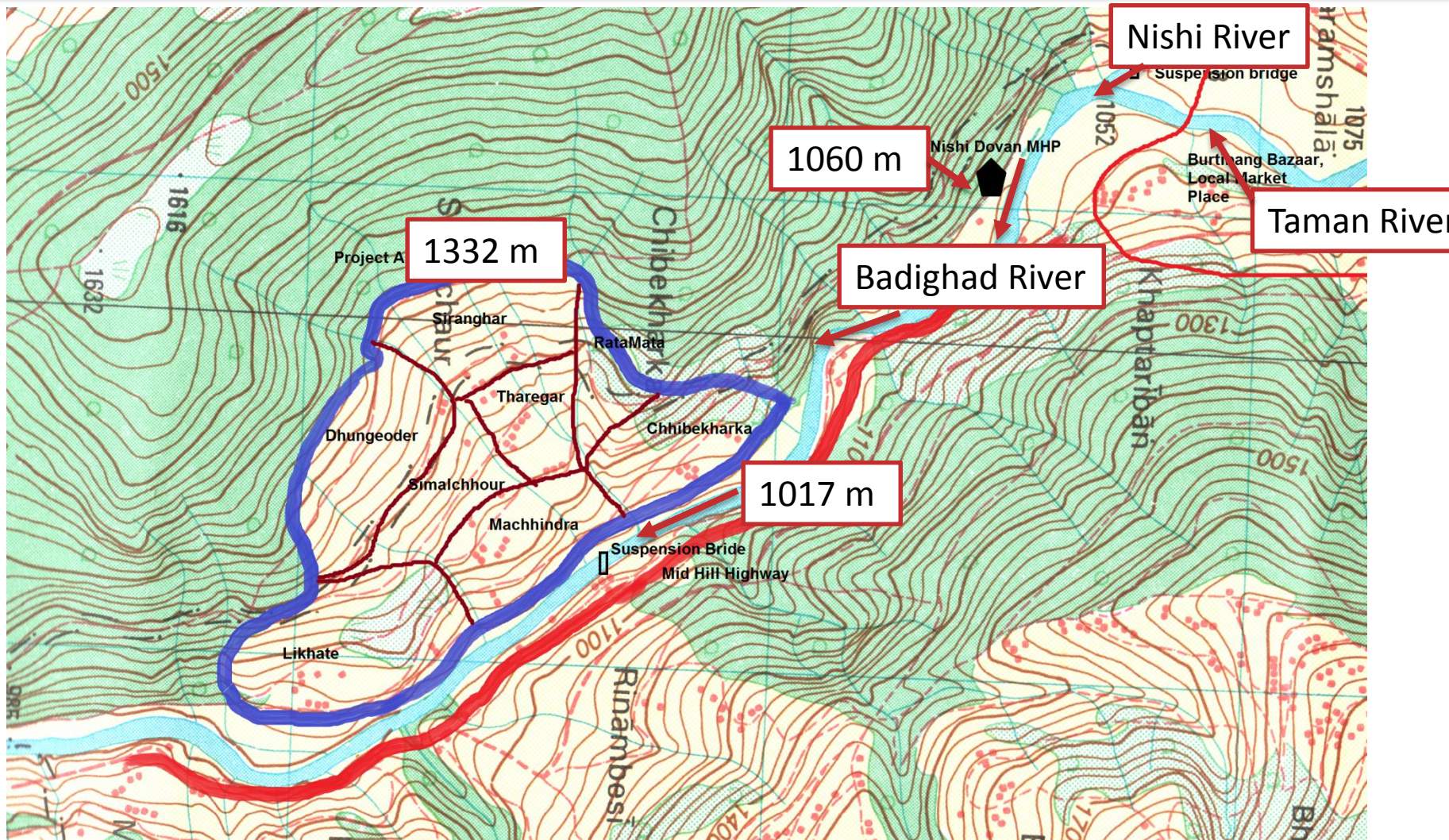




DESIGN AND COST OF WATER LIFTING AND IRRIGATION



WATER SOURCE, CLUSTERS AND HEIGHT



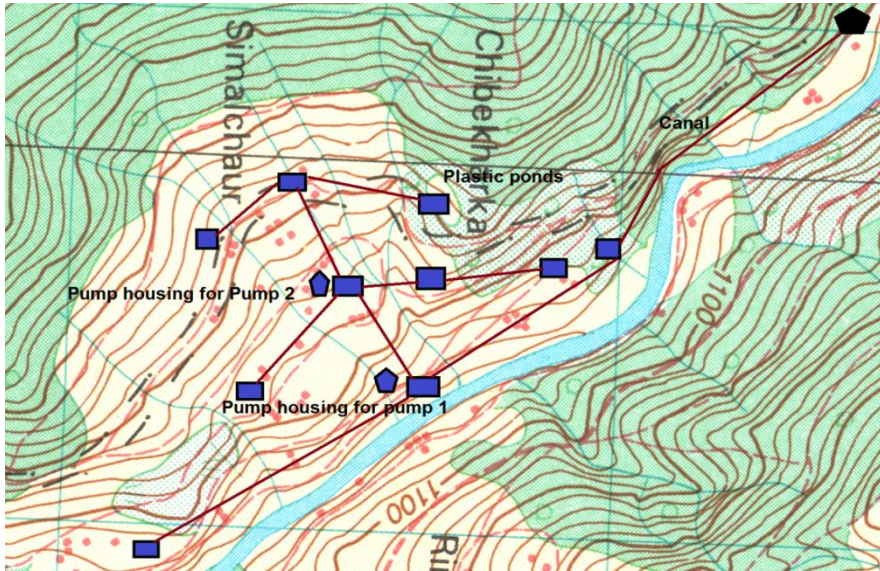
SIZING OF THE PUMP

- Size of pump for
 - Covering 582 ropani of land
 - Using single pump for 43% of total land i.e 252 ropani

Are excluded as the capacity of pump is found greater than 32 kW
- Based on daily load curve maximum of 12 hours daily operation is possible and 252 Ropani
 - m^3/hour = $21.6 \text{ m}^3/\text{hour}$, Litre per Minute (lpm) = 350 lpm
 - Litre per second (lps) = 6 lps
- Two pumps are anticipated
 - One will pump water up to 1151 m
 - Other will pump water from 1151 m to 1332 m.
- Vertical multistage centrifugal pump is deemed suitable for the particular site

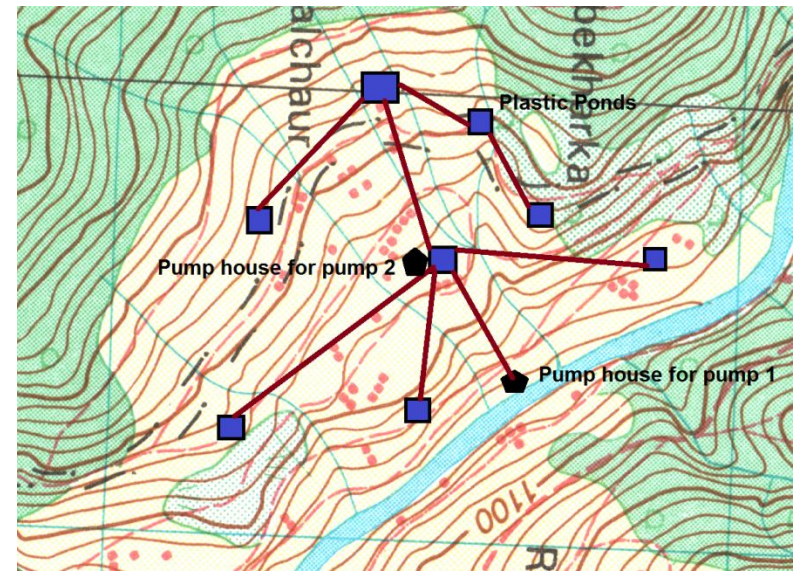


ALTERNATIVES MAPPING AND ANALYSIS



Option 1

P11	10.9 kW (= 14 HP)
P12	9.87 kW (= 12 HP)



Option 2

P21	14.72 kW (= 24 HP)
P22	9.87 kW (= 12 HP)

As per specification from manufacturer sheet

P11	15 kW (= 20 HP)
P12	7.5 kW (= 12 HP)

P21	18.5 kW (= 25 HP)
P22	7.5 kW (= 12 HP)

WATER STORAGE & APPLICATION TECHNOLOGY

One 50 m³ RCC tank will be main reservoir at the 1151 msl



Water storage tank in each cluster



Drip Irrigation



Sprinkle Irrigation



COST, O&M AND TARIFF FOR WATER LIFTING OF THE OVERALL SYSTEM

Investment Cost

Cost to the project	2,652,919
Community contribution	
• In kind labour	650,000
• Monetary	410,000
Total	3,712,919

O &M cost

	436,800
Electricity cost	
Maintenance cost	40,000
Human resource cost	72,000
Total Annual O&M cost	548,000

Cost of lifting one
liter of water, Nrs

0.015

Cost per 508
square meter per
month, Nrs

277





BUSINESS PLAN AND FEASIBILITY STUDY

(INTEGRATED ANALYSIS OF IRRIGATION, FARMING, AND SALES)



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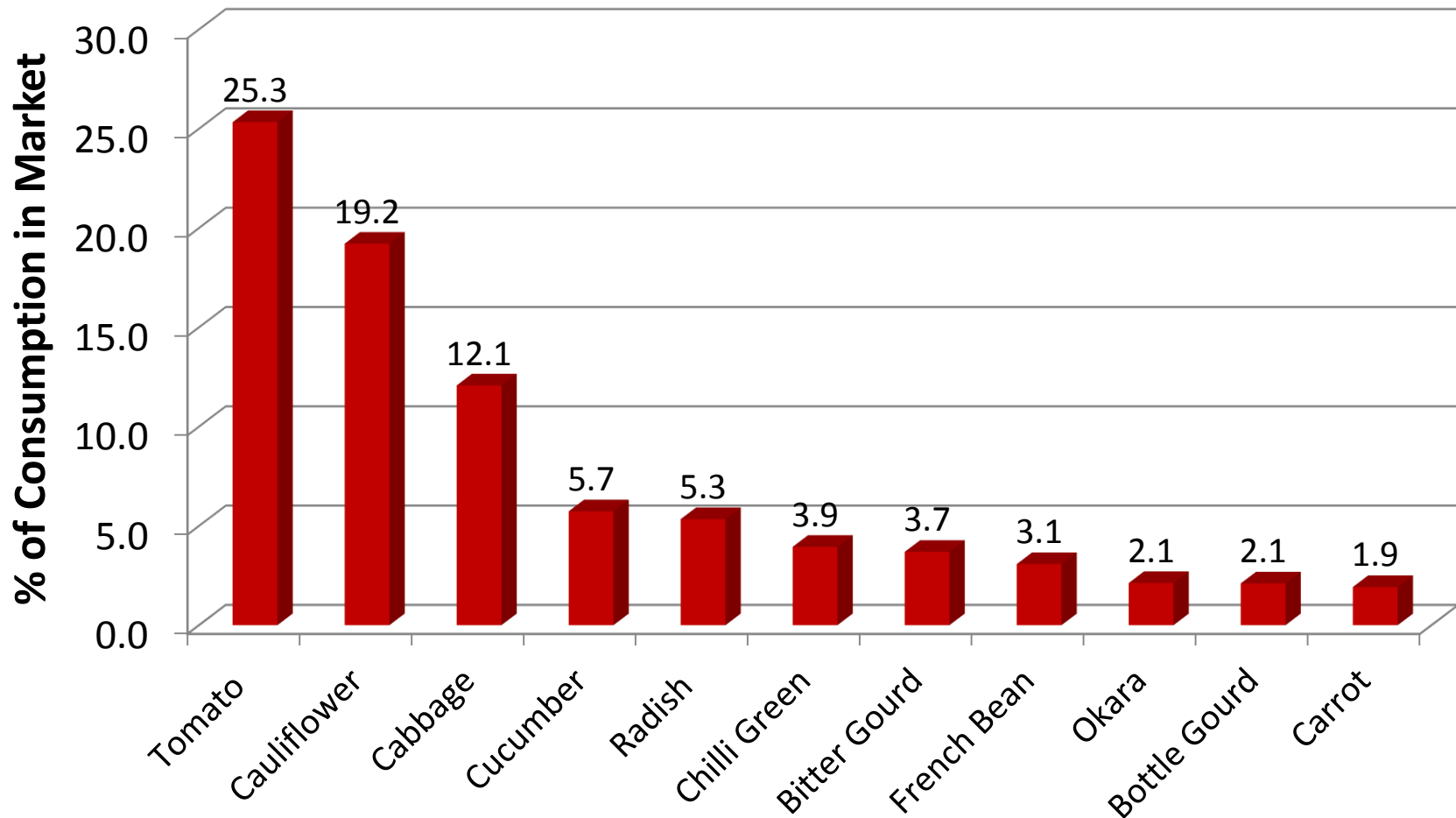
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Market plan

- Target Market– within 30 km radius
- Product strategy: early seasonal and off seasonal production from premium price
- Pricing Strategy: 15-20 % above prevailing price for early and off seasonal and at prevailing market rate for seasonal.
- Distribution strategy: Link farm directly to retailers



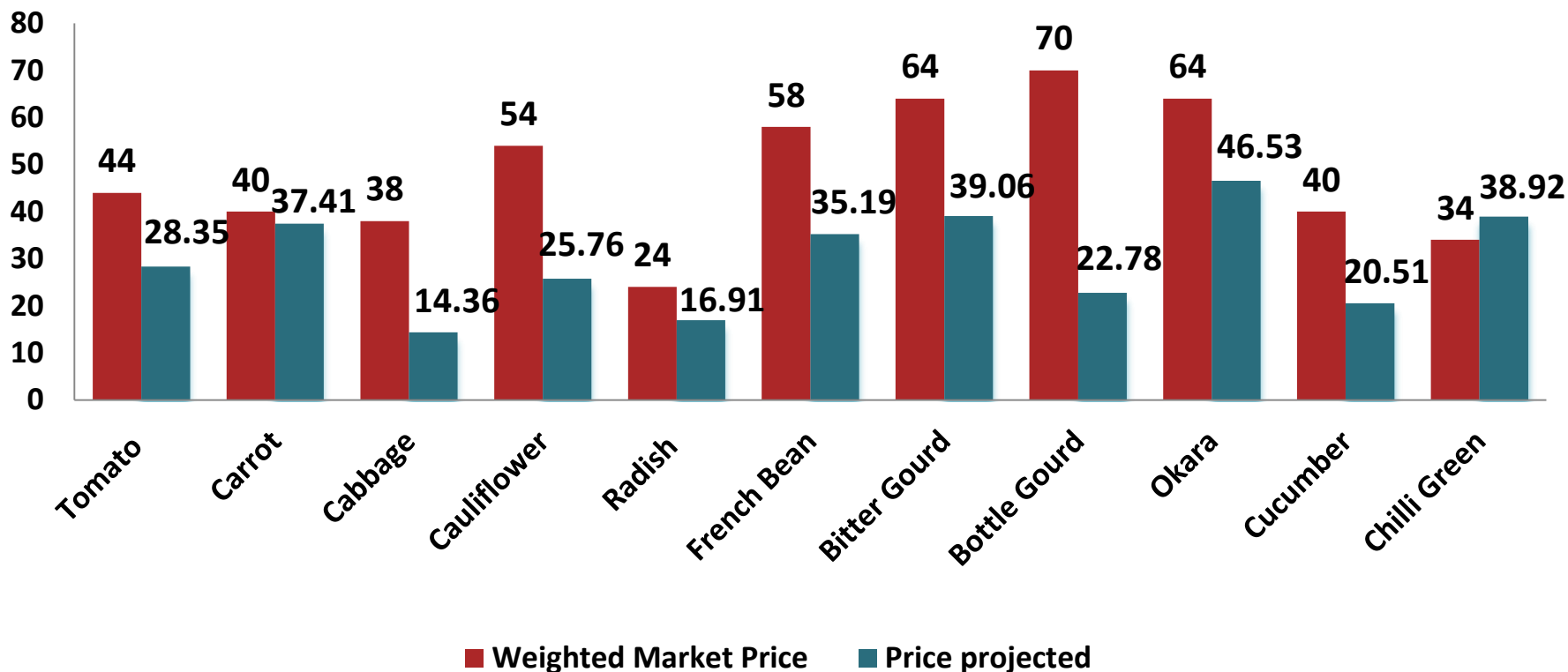
Vegetable Consumption Pattern (Contd.)



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CURRENT MARKET CONDITION: PRICING COMPARISON



Assumptions:

Wt. Market Price: Based on market survey

Price projected : Based on historical trend of prices of last 3 years of Butwal Market
Transportation Cost of NRs 5 per kg is deducted

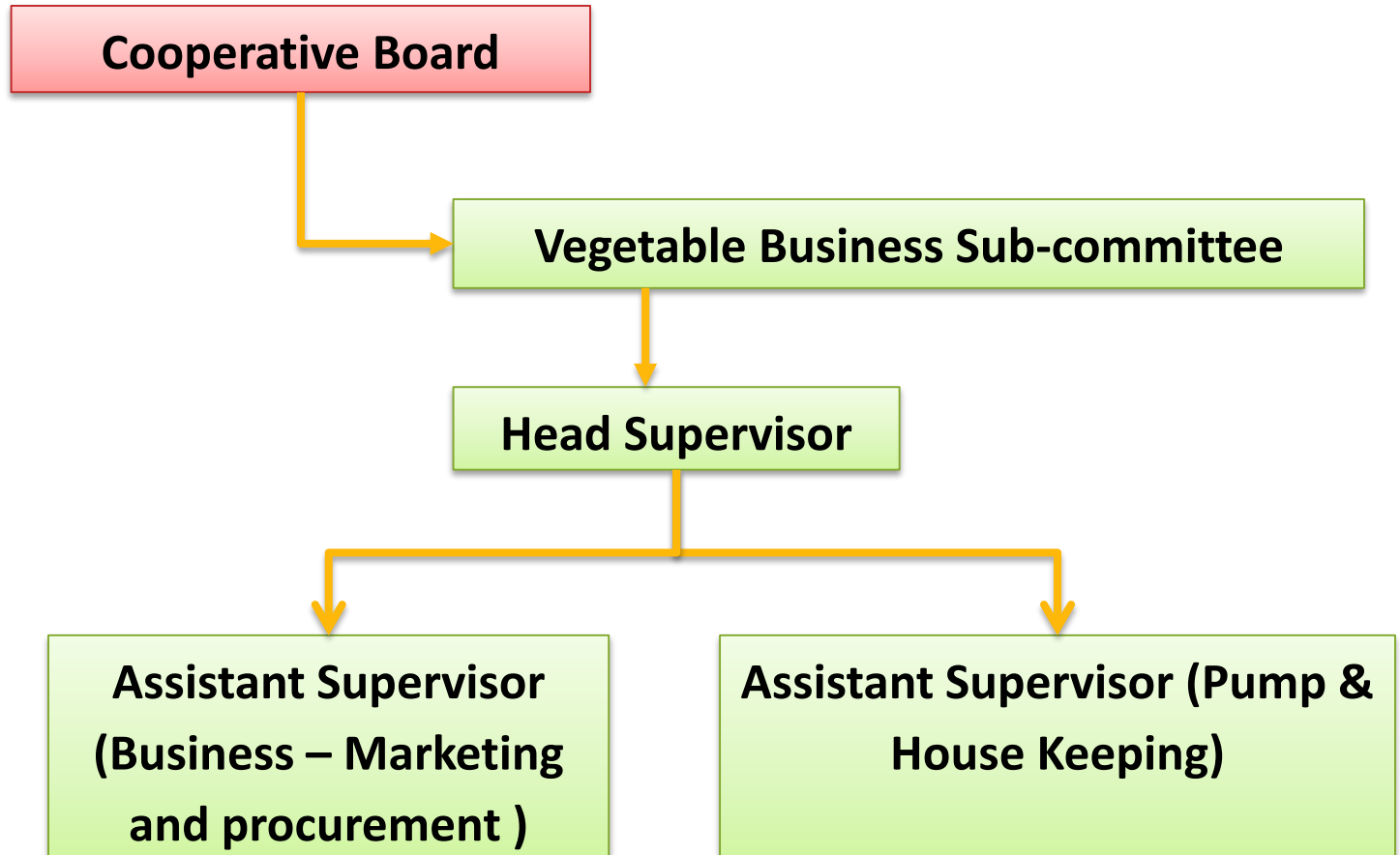


FARMING PLAN & VEGETABLE REVENUE

Name of Vegetables	Area required (Ropani)	Sellable production (in kg)	Rs (in 000's)
Tomato	29.51	185427.13	5256.86
Cauliflower	82.71	140607.98	3622.06
Chilli Green	18.88	36102.12	1405.09
Cabbage	25.99	88364.8	1268.92
Bitter gourd	7.95	27014.65	1055.19
Cucumber	12.34	41957.47	860.55
Radish	15.98	48898.02	826.87
French bean	16.57	22528.81	792.79
Okra	10.16	15544.55	723.29
Carrot	18.88	14066.29	526.08
Bottle gourd	6.97	15402.71	427.89



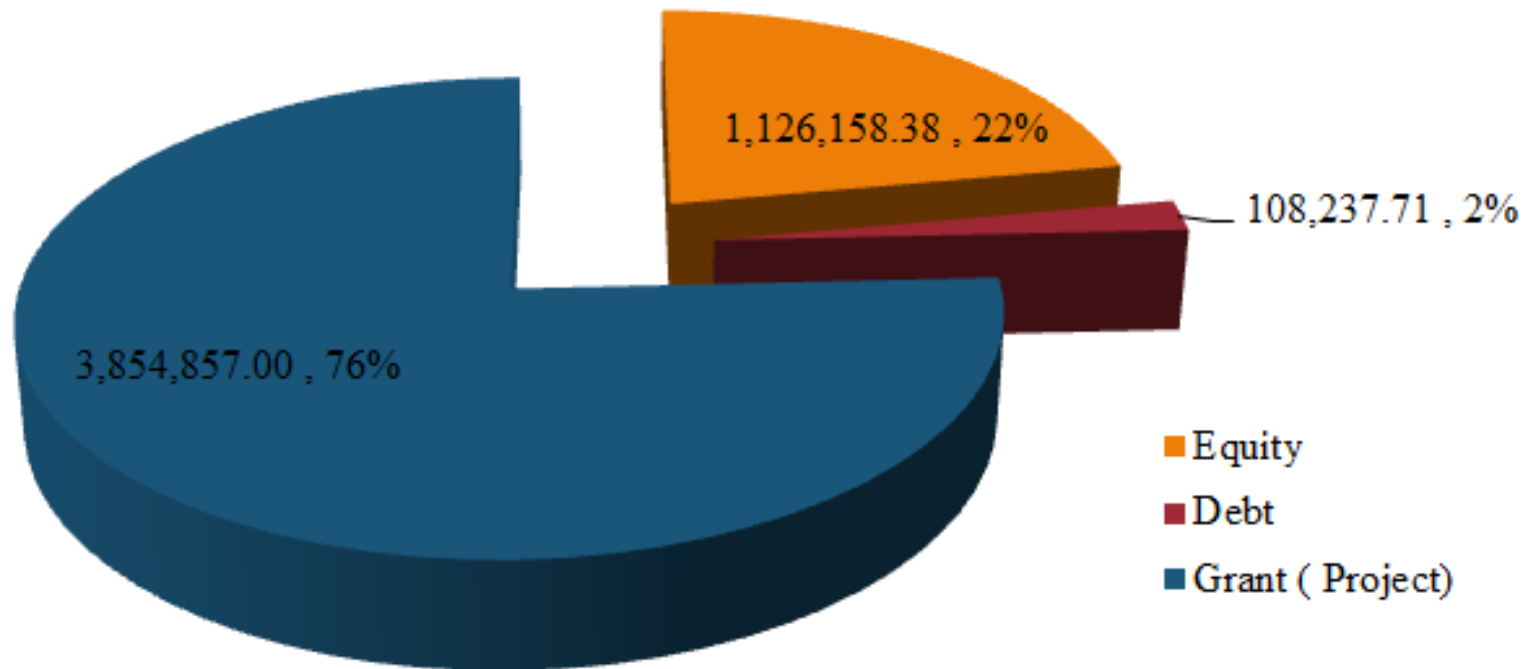
ORGANIZATIONAL AND OPERATION PLAN



FINANCIAL PLAN- INVESTMENT AND FINANCE MIX

Total Investment

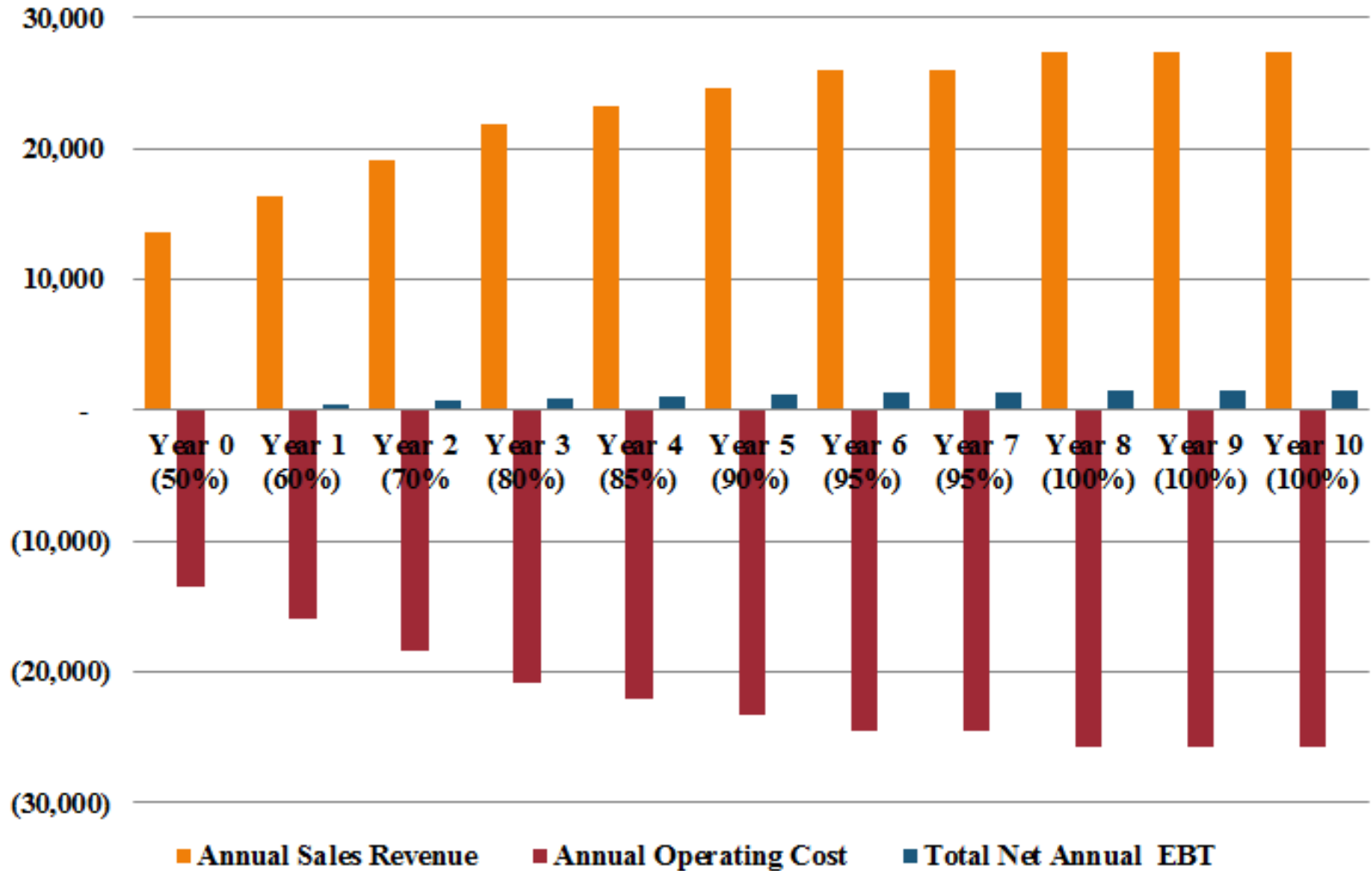
NRs. 5,089,253



Line of credit amounting to 2.6 m NRs to the households for irrigation equipment and start up cost is not considered



ANNUAL P/L STATEMENT

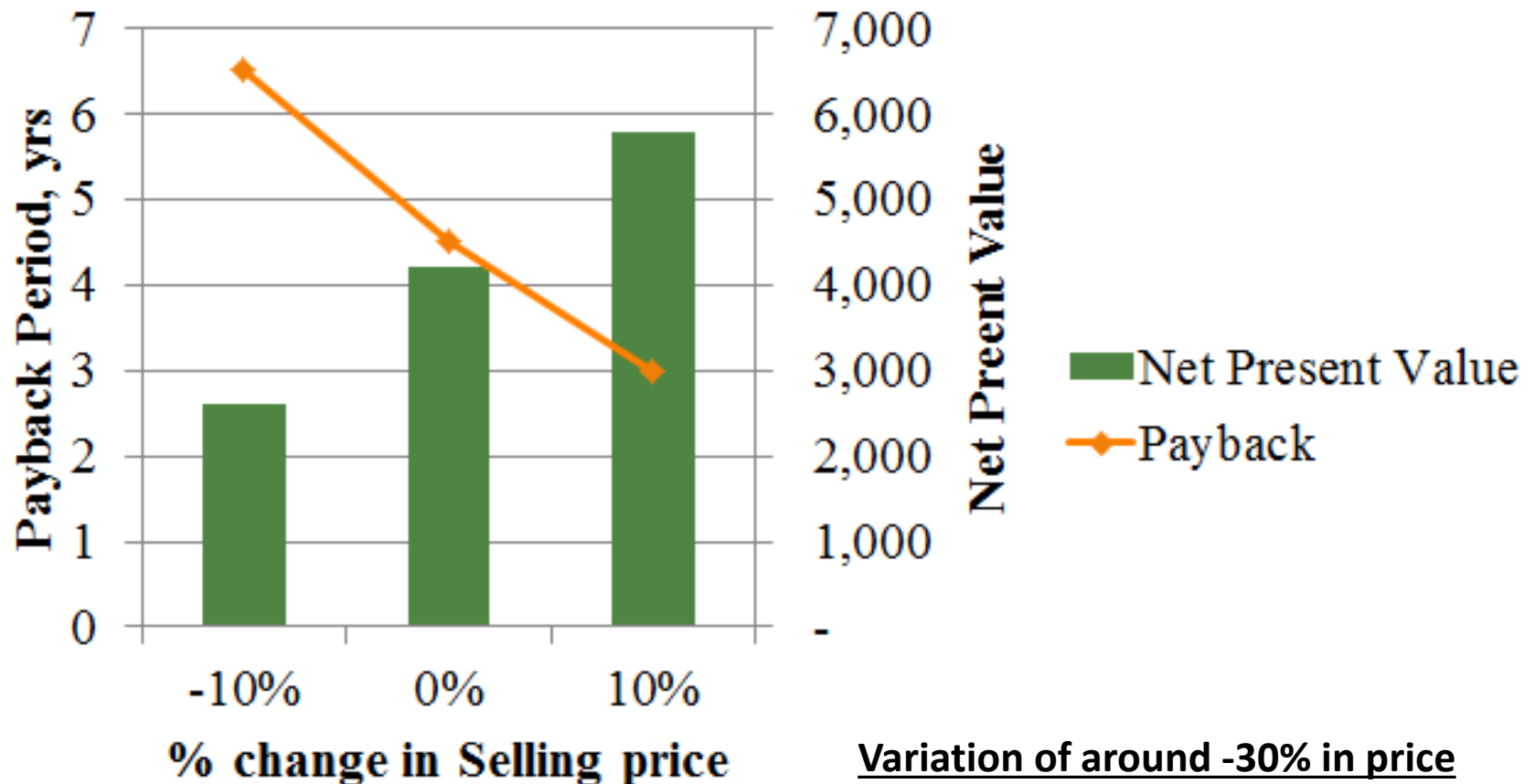


FINANCIAL INDICATORS – BASE CASE

Break Even Point	46%
Payback	4.5 years
IRR	19%
Net Present Value	4,201



SENSITIVITY ANALYSIS – NPV & PAYBACK PERIOD



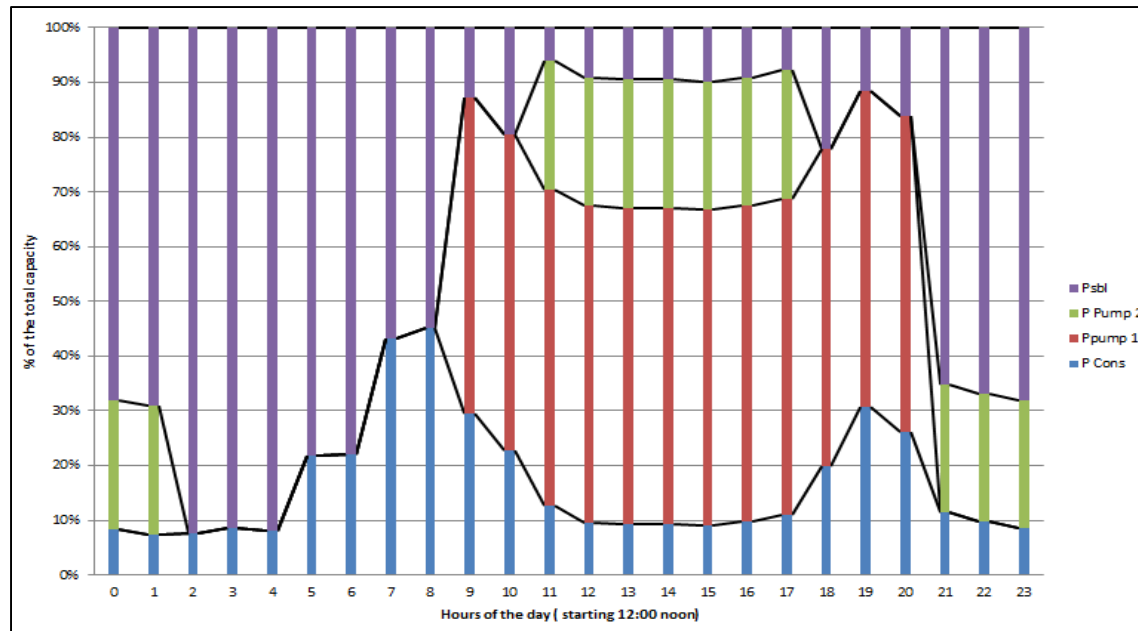
Variation of around -30% in price would make the project marginally feasible



IMPACT

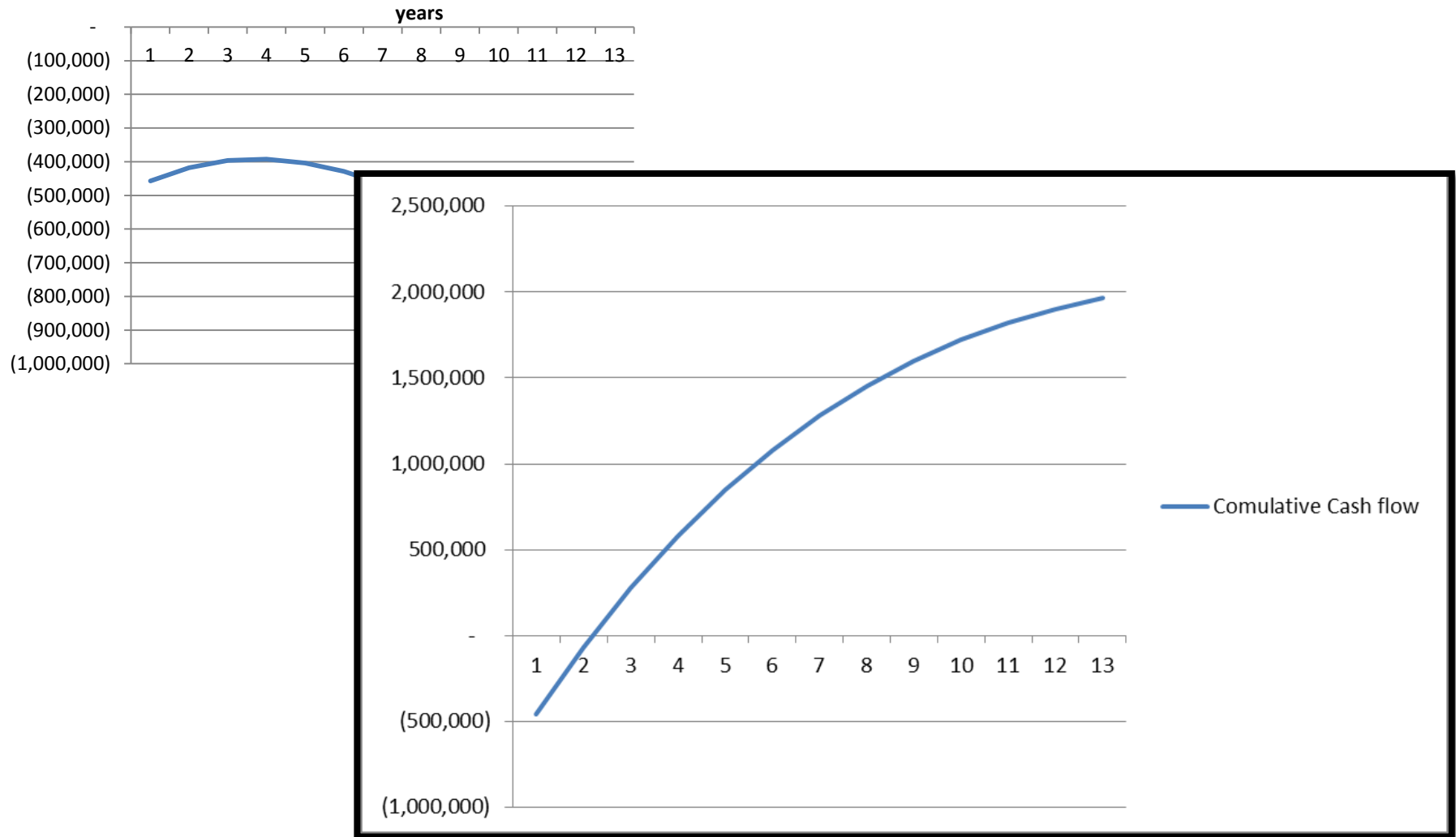


IMPACT ON CONSUMPTION OF MHP



- Additional consumption up to 292.5 kWh per day
- Increase the plant factor up to 55%
- Additional revenue up to NRs. 378,000

IMPACT ON FINANCIAL ASPECT OF MHP



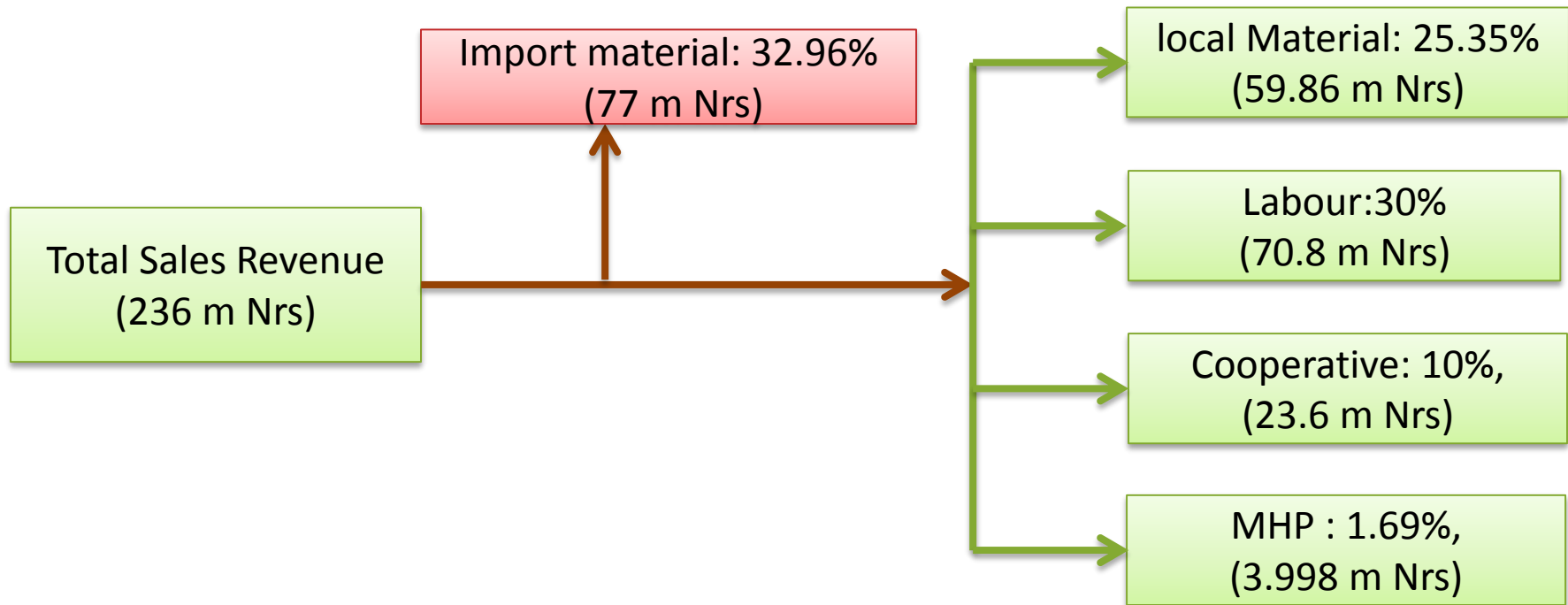
SOCIO ECONOMIC BENEFITS TO COMMUNITY

- Employment Generation
 - Generates two full time employment per household around the year
 - 5 people will get full time job in cooperative and irrigation equipment maintenance
- Organization development
- Know how and technology transfer



SOCIO ECONOMIC BENEFITS TO COMMUNITY

- Total vegetable import displaced: 1,128 tonnes per year



Net Cash Benefits per HHs per year: Min Nrs 172, 000 / year= 14, 398/Month



ISSUE AND CHALLENGES

- Induction motor operation in limited supply condition
- The farmers may find it a tedious task to use drip irrigation system over and over a period of time
- Implementing the farming plan
- Switching from existing occupation to farming
- Copying and crowding—market distortion
- Getting the regular price of Butwal wholesale market is challenge



CONCLUSION

- Feasible –yes for only high value crops
- Impact – Win - Win situation (both MHP and community)
- Case of Baglung District:
 - 90 MHP with total installed capacity of 2500 kW.
 - 60% of the spill energy can lift water 12,734 m³/day to 150 m.
 - This can irrigate 600 – 1000 ha of land only
- Recommendation
 - Integrated analysis
 - Open resource platform for NCI



PROGRESS TILL DATE

- Study completed
- Exposure visit completed
- Construction has started
- Demonstration set up is in construction
- Remaining activity
 - Organizational system set up
 - Capacity building(organizational and farming)
 - Market linkage



PICTURE FROM SITE



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THANK YOU

