

Exploring the potential of Eco-village for Sustainable Development: A Case at Lele

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Abstract

Eco-villages are social groups highly dedicated to sustainable living. It is one example for grassroots level sustainability. Humanity is faced with numerous social, economic, and environmental challenges on individual, community, national, and global scales. Human actions have led to irreversible impacts on the natural resources and the ecosystem. Employment-based migration from rural Nepal to urban cities or foreign countries has been the trend in many villages. Economic growth is needed to provide essential public services (infrastructure, education & health services) to create opportunities. The study of Lele as an Eco-village and its potential for sustainable development would highlight various parameters and indicators for sustainable development. It would help in improving livelihoods in villages and resilience to climate change while also reducing environmental degradation. The study is concerned with potential of eco-village concept to deal with various problems (social, economic, environment, cultural) in a village. The study focuses on how resources (water, forest & land) are used in Lele and how its use pattern has helped in sustainability. Organic farming (vegetables, fruits, flowers) is the major potential of Lele village and the water resources is also adequate. This can help in economic boost along with environment protection and land conservation. Organic farming needs to be enhanced and done logically, technologically for high yield of crops and vegetables. The concept needs to be included in the national policy level for effective results for environment benefits along with social development and economic opportunities. The concept of eco-villages needs to be replicated in other laid-back villages for the sustainable development.

Keywords

Eco-village, Sustainability, Environment, Ecology, Community

1. Introduction

World population has been rapidly migrating to cities for better opportunities and living condition. World is facing the problem of climate change and global warming. Cities around the world are making increasing demands on natural resources and energy as population increase and consumerist culture continues to expand. The modern world is bound to continuous growth with limited resources, and human actions have led to irreversible impacts on the natural resources and the ecosystem. Free market and globalized economy change often lead to breakdowns of traditional communities especially hampering the relationship of people with their immediate ecosystem and natural resources[1]. Eco-village is a resilient human settlement where social, ecological & economic sustainability go along side with their own

culture. Eco-village is one example for grass root level sustainability. It indicates the combination of community development and nature conservation at local level and emerge as a model for shaping a sustainable future. GEN is responsible for developing eco-villages around the world. GEN builds bridges between policy-makers, academics, entrepreneurs and sustainable community networks across the globe. It helps to develop strategies for a global transition to resilient communities and cultures. Majority of poor population and communities inhabits the rural Nepal (82% Nepalese are residing in rural parts or vulnerable zones)[2]. This concept can pave the way for stronger rural communities with better livelihood-opportunities, with less adverse climate impacts and with more resilience to climate change. CRT/N has successfully implemented EVD programs in three villages namely Chyamrangbesi,

Dhungkharka and Chalal Ganesthan of Kavre district in Nepal. The EVD program has been included in the policy & program of Bethanchowk VDC, 2075/76.

2. Research Objective

Main objective:

- To explore/ assess the level of sustainability of an Eco-village: a case at Lele

Specific objective:

- To study the available resources (forest, water, land etc) and its use pattern at Lele
- To study about eco-villages as an effective response to the environmental, social, cultural & economic problems of rural context

3. Methodology

The research is a qualitative research. The research investigates about the four dimensions of sustainability (social, economic, cultural and environmental) and local knowledge and understanding of people living in Lele. This research uses constructivist paradigm where the phenomena under study cannot be separated from its context. The methods of data collection are by observation, focus group discussion and questionnaire survey. 25 household sample is taken, and the questionnaire survey is based on level of saturation.

3.1 Case Area

The case study area is Ward No. 5 of Lele. It lies in Godawari Municipality in Lalitpur District in the Bagmati Zone of Central Nepal which is 14 km from Lagankhel (Patan). Agriculture is the main occupation of people residing in Lele village. It is an important site under the ancient Lichhavi dynasty; stone pillars dating to that era can be found here. Lele is a gateway to southern villages of Lalitpur including Bhardeu, Nallu, Chaughare and Gotikhel, and a centre of tourism. Lele valley is considered to be the older settlement where civilization began before Kathmandu valley. There was settlement in Lele village when Kathmandu valley was a lake.

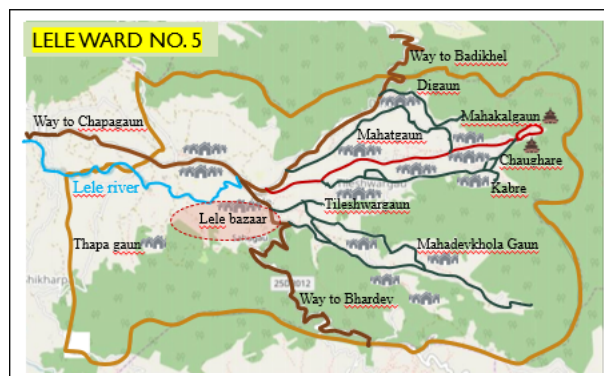


Figure 1: Lele (Ward No. 5) Site map

4. Literature Review

Eco-village: Human-scale full-featured settlement in which human activities are harmlessly integrated into the natural world in a way that is supportive of healthy human development and can be successfully continued into the indefinite future [3]. It is conceptualized around keeping the community together with socially harmonious, economically viable and ecologically sustainable settlement to demonstrate that human beings can live cooperatively with each other and natural resources. Eco-villages comprise of following dimensions [1]:

- Environmental friendliness
- Economic alternatives
- Social Networks & Organizations

4.1 Dimensions of Sustainability Overview in an Eco-village

4.1.1 Social Sustainability

Eco villagers tend to actively work to build trust, collaboration and openness between people, and to make sure they feel empowered, seen and heard. Eco-villages often provide a sense of belonging through community relationships, common projects, shared goals, and social processes, but do not demand that everyone is the same – unity and strength through diversity is important to the eco-village movement.

- Sense of place / sense of belonging
- Embrace diversity and build community
- Ensure equal access to holistic education and healthcare
- Cultivate inclusive, responsive and transparent decision making
- Empower participatory leadership and governance

Table 1: Framework with various Indicators of an Eco-village

Dimensions	Parameters	Indicators
Environment	Water	Re-use
		Recycle
		Water Quality
		Ground water recharge
		Water Efficient Irrigation
	Land	Agricultural Land
		Green field and brown field
		Land Conservation
	Forest	Conservation and management of forest
		Afforestation programmes
		Tourism Development
	Agriculture and Livestock Farm	Protection of Wildlife
		Organic Farm (vegetables, fruits, flowers)
		Cattle Rearing, poultry farm & fish pond
		Food Self Reliance
		Diversified farming
	Buildings	Biological Control
		Micro Irrigation
		Use of Local materials
		Re-use of materials
		Retrofitting
		Availability
	Streets	Vernacular style
		Passive Solar/Green Design
		Spatial use
		Pedestrian friendly Streets
		Less travel distance
Open Space and community Building	Less vehicles	
	Non-metallic permeable streets	
	Space for playgrounds	
	Spaces for parks	
	Socially gathering space	
Waste management	Space during disaster time	
	Multi-purpose area	
	Following 3Rs (Reduce, re-use and recycle)	
	Composting	
Renewable Energy Technologies	Local treatment for waste (reed bed system; Eco-san toilet etc)	
	Bi-products from organic manure	
	Cleaning campaign	
Social	Sense of place	Use of Solar PV Cells, ICS, Bio-gas
		Landmark /Identity
		Regional Culture
		Way of life/ Nature of Occupation
	Social Groups (Finance, co-opertives, aama samuha, etc)	Architecture
Participation of people		
Activities by groups		
Cultural	Cultural tradition	Local business for livelihood
		Income generating skills, trainings
		Celebration of festivals
Economic	Eco-Tourism	Socio-cultural tradition
		Five zoning system (Settlement, Kitchen Garden, Market crops, Cash crops, Pasture land and wilderness zone)
		Organic Farm
		Culturally rich heritages
	Sustainable local Entrepreneurship	Preservation of natural landscape
		Safer trekking route
		Organic Farm
		Handy crafts
		Local family business
		Local home stays/ hotels

- Social Inclusion / Social Groups / Clubs / Women's Group
- Practice conflict facilitation, communication and peace building skills
- Maintaining Safety

4.1.2 Cultural Sustainability

Eco-villages aim to build or regenerate diverse cultures that support people to empower and care for each other, their communities and the planet. Many actively engage with practices that encourage people to feel deeply connected to each other, to the planet, and to themselves. Celebration, art, dance and other forms of creative expression are often embraced as central to thriving human life and communities. Most eco-villages find their own ways to talk about, connect with, respect and support life and the beings and systems that sustain it.

- Regenerate diverse cultures that support people to empower and care for each other, their communities
- Respect cultural traditions that support human dignity
- Rituals, festivals & celebrations
- Engage actively to protect communities and nature
- Celebrate life and diversity through art
- Reconnect to nature and embrace low-impact lifestyle

4.1.3 Environment Sustainability

Eco-villages aim to access food, shelter, water and energy in ways that respect the cycles of nature. They aim to integrate human with the rest of nature in ways that increase biodiversity and regenerate ecosystems, and that give people a chance to experience their interdependence with systems and cycles of life on a direct and daily basis.

- Access to food, shelter, water and energy in ways that respect the cycles of nature
- Resources use (Water, Forest, Land)
- Renewable energy sources and uses (Solar, Bio-gas, ICS, micro hydro etc)
- Waste water management (Grey Water separation)
- Solid waste management (Composting, Bio-gas, fodders for animals)
- Organic farming and agricultural products
- Physical infrastructure

- Buildings : Traditional / Vernacular, use of local materials, sustainable building techniques
- Transportation : Walkable distance; less travel distance; within near proximity

4.1.4 Economic Sustainability

Eco-villages aim to build economic practices and systems that contribute to sharing of resources, mutual support, and strong local economies and networks that serve the needs of local people and ecosystems. Most eco-villages actively work to provide sustainable alternatives to the mainstream economy and monetary system and reclaim ways of thinking about wealth and progress that include all aspects of life. Local currencies, sharing, social entrepreneurship, circular economy and collaborative forms of ownership are central to many eco-villages.

- Economic activities that are environment friendly
 - Agricultural products (organic farms)
 - * Vegetables, fruits, cash crops etc.
 - Animal rearing
 - * Cows, buffaloes, pigs, poultry farm, fish farm etc
- Sustainable local entrepreneurship (traditional business etc)
- Food availability, production and distribution
- Eco-tourism

4.2 Elements of Eco-village

4.2.1 Sustainable Design

Sustainable design, green building, ecological design and organic architecture involve more or less similar concepts of ecologically appropriate design and building practices. Such design approaches attempt to address the negative impact on nature by using suitable materials in environmentally friendly construction practice.

4.2.2 The necessity of Ecological Design

The ecological design improves the flow of materials and energy by aiming to provide the same material benefits but with reduced energy, cost transportation, pollution and waste. Ecological design aims to address the conflict that seems to exist between economic development and ecological principles [4].

It requires novel approaches and innovation in finding suitable solutions. Problems must be thought and hence require more time than standard

4.2.3 Green Building and Ecological Architecture

The aim of ecological building is to enable circular metabolisms for buildings. In this case air, energy, water and materials are treated as resources that are to be re-used and recycled in a variety of ways. By means of passive heating and cooling techniques, efficient buildings can save 70 to 90 percent of traditional energy use [5]. Infrastructure costs can also be significantly lower in ecologically designed buildings and settlements. Hawken describes green building or development as a fusion of resource efficiency, environmental sensitivity, attention to human wellbeing and financial success. Buildings constructed with locally available building materials saves the energy, transportation cost and time. In context of Nepal, traditional buildings with traditional constructing materials like mud, wood, sun burnt brick reduces the embodied energy of the building. It is also thermally sound.

4.3 The Relevance of Eco-villages

4.3.1 Mixed use, compact settlements

Eco-villages can serve as smaller experimental versions of compact, mixed-use and pedestrian-oriented communities. A strategy of higher residential densities with mixed-use development not only protects rural land and limits sprawl but enable strong social centers and distinct communities. Denser building configurations can also enhance climate control.

4.3.2 Innovative Approaches

Eco-villages and other innovative settlement designs can create awareness in this regard and can illustrate how new energy-efficient and environmentally-friendly technologies can be applied. Eco-villages particularly can highlight the value of “green” architecture and development. With fewer restrictions on land use and building codes, rural eco-villages can experiment more with alternative technologies.

4.3.3 Retrofitting

To attain a suitable level of urban sustainability, it would not be sufficient to merely focus on new

settlements. A vital difference can be made by retrofitting existing settlements to conform to relevant standards. Eco-villages, as can be seen in the Los Angeles Eco-village, can illustrate ways of transforming existing areas or brownfield sites into physically and socially responsible communities.

4.3.4 Resource Consumption

The eco-village development concept involves the implementation of appropriate, affordable, renewable energy technology, climate resilient agro-practices and capacity building activities for climate change adaptation and mitigation in villages. Other than implementing solutions, the concept also advocates for improving existing livelihood based on indigenous practices that are closely associated with the culture of the rural dwellers. With primary focus on promoting clean and renewable energy technologies and creating economic opportunities mobilizing youths in project villages.

4.3.5 Productive Open Spaces

Shared open spaces become increasingly important and should cater for different functions and cultures. It has the potential to take on different cultural meanings. It can also provide in obvious ecological functions such as detention ponds. City farms can be created on small pockets of land that would otherwise require maintenance without being nearly as productive.

4.3.6 Pedestrian oriented planning

Pedestrian and non-motorized oriented developments also visually and socially improve townscapes. Encouraging people to walk, rather than drive, to local destinations requires the integration of safe, human-scale pedestrian access throughout sites. Pedestrian-scale design is development that balances pedestrian – and auto-transit needs while providing comfortable environments and places for people to assemble, plan and associate with others. Community design should be human-scale with services in reasonable distance from one another, to the best extent possible. For example, Dan Burden of Walkable Communities Inc. suggests the following standards: homes within 1/4 mile of most services; neighborhood elementary schools within 1/4 mile of homes; high schools accessible to most children within 1 mile of most homes; parks within 1 /8 mile of homes.

5. Analysis, Findings & Discussion

5.1 Analysis

5.1.1 Water

Out of 25 samples taken maximum households (80%) follow the practice of grey water re-use in their kitchen garden which is appreciable.

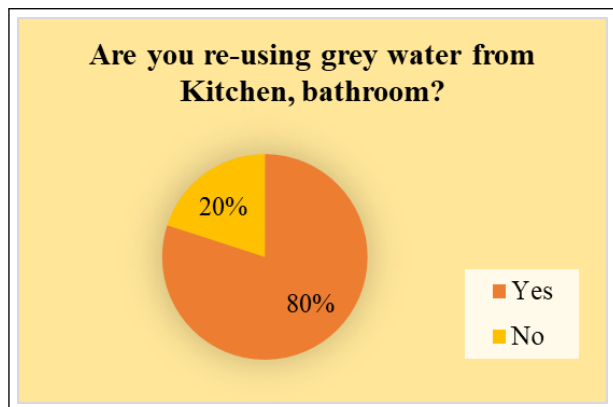


Figure 2: Grey water re-use

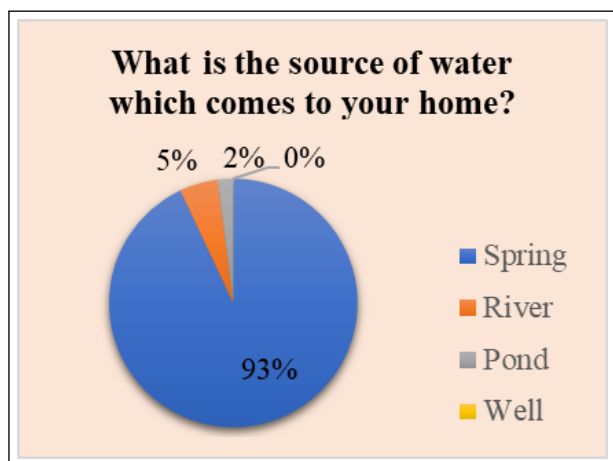


Figure 3: Source of Water

Regarding recycling of water none of the houses seem to follow rain water harvesting. May be this is due to abundance supply of water from the source almost 24x7. There is no any water treatment system for water purification like reed bed system. Even no filtration for drinking water in the main source There is a gravity flow system since the settlement is at lower level which has provided easy access to water in each household directly with the help of tap. Spring is the main source of water at almost all households (93%). The water from the spring is collected in a distribution chamber/tank and distributed to each household via pipeline through tap. Few households

(5%) use river as their source for everyday use. 2% depend upon ponds. Spring water is considered safer and cleaner for drinking and domestic use compared to other sources like river and ponds. People in Lele used water without any treatment yet they found it safer to consume.

There is a natural way of ground water recharging found in Lele. Since there are many agricultural lands (50%) natural percolation of water takes place when it rains. Besides, the roadways are non-metallic and are graveled, this also allows ground water recharge. There are irrigation canals beside roads running for irrigation. There are few public taps which flows throughout day and this is helping in ground water recharging once the unused water flows and joins the irrigation canal. Also, there are various natural water sources like Mahadev khola river, taar pond, Bhutmul pond, dhunge dhara, streams which allows ground water recharge in Lele.



Figure 4: Dhunge Dhara

Drip irrigation and sprinkler irrigation was practiced by few households for growing vegetables and fruits. Such water efficient irrigation system which save water and nutrients by allowing water to drip slowly needs to be encouraged. In terms of water resources, the Lele village had no major issue and was found sustainable.

5.1.2 Land

Almost 50% [6] of the land is used for agriculture at Lele. Maximum household depend upon agriculture for their livelihood. Protecting agricultural land enables long-term food security and provides essential environmental benefits.

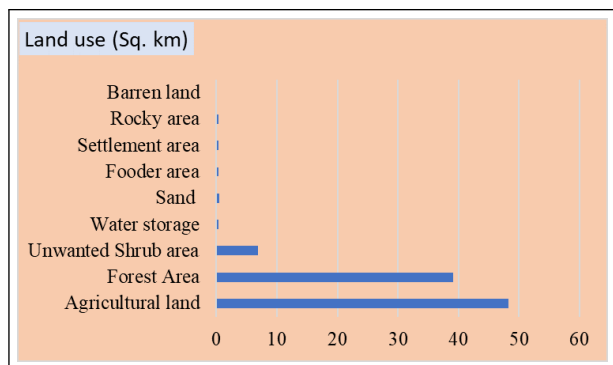


Figure 5: Land use of Lele

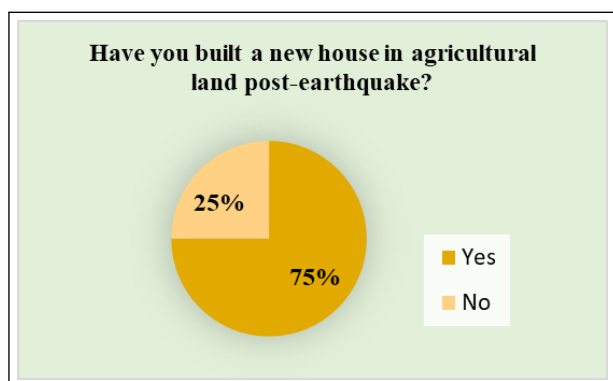


Figure 6: New construction in agricultural land



Figure 7: Agricultural land

Post-earthquake the new construction of buildings is taking place rapidly in Lele just like in any other villages. But the new construction is not done in the previous brown field where the house is damaged. New buildings are being constructed in green field (agricultural land) and thus harming cultivable land. Such practice needs to be stopped and properly addressed.

Land is protected by cultivation of plants and crops. It

does not let the land be destroyed and barren. Since most of the lands were used for agricultural purpose the land seemed well conserved. Thus, sustainability was seen in Land resource.

5.1.3 Forest

About 40% land is covered by forest at Lele [6]. There is various forest at Lele divided as Community, Leasehold, Government, Religious forest. Such categorization of forest has helped in protection of forest from being diminished. Locals could collect firewood twice a week from left out and dried branches. The forest committee is responsible for taking care of these forests. Conserving forests also support the lives of local communities & help them to thrive.

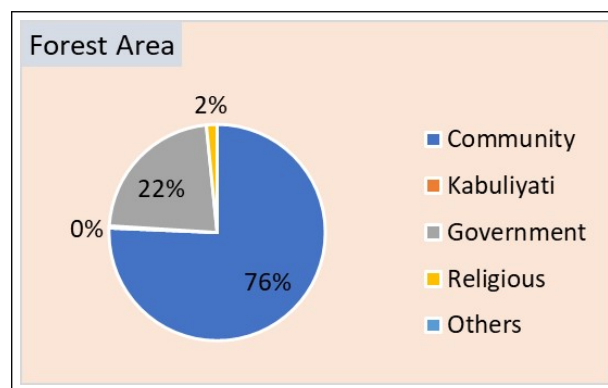


Figure 8: Forest categorization

Various programmes regarding forest development and promotion is organized at Lele. Also, the afforestation awareness programmes are organized time to time. Such activity needs to be organized and promoted more often so that it helps in conservation of forest and its sustainability.

Forest has been a prominent part for Tourism Development and vice versa. There has been development of natural trail route for hiking from Lele Manakamana temple to Phulchowki having 6084 steps by Tourism Ministry. Forest itself has created beautiful scenery and landscape which has attracted many tourists in that area. Tourism development has also helped in forest conservation. The local forest committee is concerned for protection of forest not allowing illegal hunting of wildlife. Protection of wildlife and forest is co-related both helps in each other's sustainability. The forest resources seem to be well preserved in Lele.

5.1.4 Agriculture & Livestock

Agriculture is one of the major occupations followed by people living in Lele. Females are seen mostly working on fields growing crops, vegetables, fruits, flowers etc. Vegetable farming along with tunnel farming is popular in Lele and is flourishing rapidly in recent time.

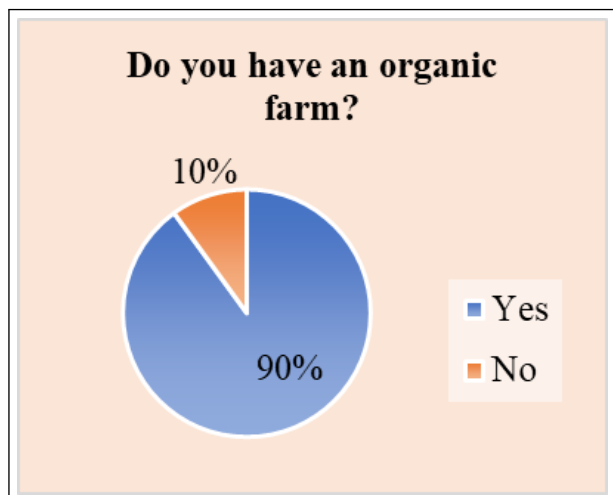


Figure 9: Nos.of HH with organic farm

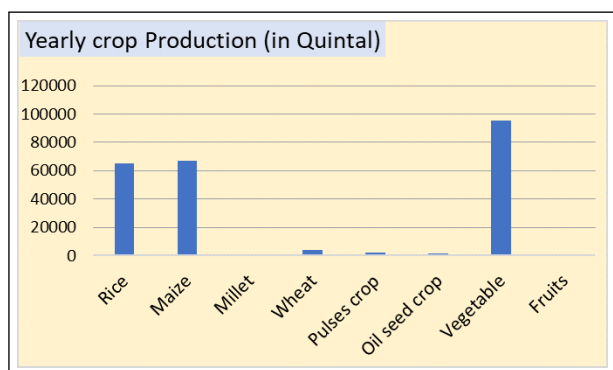


Figure 10: Yearly crop production

Cattle are commonly raised as livestock for milk (cow, buffalo) for meat (goat, buffalo). Also, poultry for eggs, meat (chicken, duck). There was cattle rearing done by individual family but not in a community. The products from those domestic animals are consumed by themselves and few households sell for earning. The cattle are reared for organic manure for increasing fertility of soil in farming. But in the village the households keeping livestock has decreased rapidly in recent time. The reason is due to modernization. People are more educated, and they are busy in some other technical & skilled job. Modern generation are not as much interested as older

generation in cattle rearing. Only few are concerned to collect fodder for cattle and look after them.

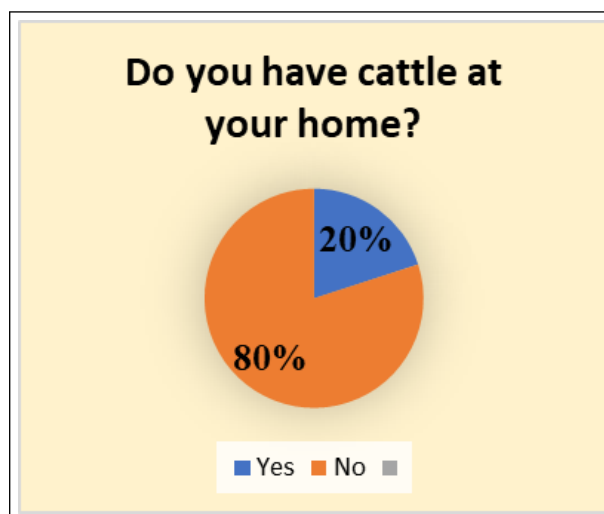


Figure 11: Cattle rearing by HH

Similarly, the analysis of other parameters along with indicators was done and sustainability was assessed just like water, land, forest, agriculture and cattle rearing.

5.2 Findings

A matrix is prepared to explain the findings of the parameters along with the indicators of an Eco-village at Lele.

Legends

- 1 – Sustainability seen
- 2 – Sustainability not seen
- 3 – Sustainability seen to some extent and can be improved

5.3 Discussion

Lele can be considered as an eco-village as it consists of various parameters that is required for any village to be environment friendly village.

5.3.1 Water

The households at Lele consume fresh water from spring source. The quality of water is good and has no negative impact upon human health. Also, for irrigation water is supplied from spring source as well as from river (Mahadev Khola, lele Khola). Regarding water re-use the grey water from kitchen is directed to kitchen garden. Maximum household follow that and

Table 2: Framework with various Indicators of an Eco-village with remarks

Dimensions	Parameters	Indicators	Remarks
Environment	Water	Re-use	1
		Recycle	2
		Water Quality	1
		Ground water recharge	2
		Water Efficient Irrigation	2
	Land	Agricultural Land	2
		Green field and brown field	2
		Land Conservation	2
	Forest	Conservation and management of forest	2
		Afforestation programmes	2
		Tourism Development	2
		Protection of Wildlife	2
	Agriculture and Livestock Farm	Organic Farm (vegetables, fruits, flowers)	2
		Cattle Rearing, poultry farm & fish pond	2
		Food Self Reliance	2
		Diversified farming	2
		Biological Control	2
	Buildings	Micro Irrigation	2
		Use of Local materials	2
		Re-use of materials	2
		Retrofitting	2
		Availability	2
		Vernacular style	2
	Streets	Passive Solar/Green Design	2
		Spatial use	2
		Pedestrian friendly Streets	2
		Less travel distance	2
	Open Space and community Building	Less vehicles	2
		Non-metallic permeable streets	2
		Space for playgrounds	3
		Spaces for parks	2
		Socially gathering space	2
Waste management	Space during disaster time	2	
	Multi-purpose area	2	
	Following 3Rs (Reduce, re-use and recycle)	2	
	Composting	2	
	Local treatment for waste (reed bed system; Eco-san toilet etc)	2	
Renewable Energy Technologies	Bi-products from organic manure	2	
	Cleaning campaign	2	
Social	Sense of place	Use of Solar PV Cells, ICS, Bio-gas	4
		Landmark /Identity	2
		Regional Culture	2
		Way of life/ Nature of Occupation	2
	Social Groups (Finance, co-opertives, aama samuha, etc)	Architecture	2
		Participation of people	2
		Activities by groups	2
Cultural	Cultural tradition	Local business for livelihood	2
		Income generating skills, trainings	1
		Celebration of festivals	2
Economic	Eco-Tourism	Socio-cultural tradition	2
		Five zoning system (Settlement, Kitchen Garden, Market crops, Cash crops, Pasture land and wilderness zone)	1
		Organic Farm	2
		Culturally rich heritages	2
	Sustainable local Entrepreneurship	Preservation of natural landscape	2
		Safer trekking route	2
		Organic Farm	2
Local home stays/ hotels	Handy crafts	2	
	Local family business	2	
		Local home stays/ hotels	1

is a sustainable approach. None of the household seem to collect rain water. Rain water harvesting was not found may be because there is no problem of scarcity of water now. But in near future along with population growth the demand of water might increase. Since Lele has agricultural land, there is good ground water recharge during monsoon. For effective irrigation the water from source is collected in a community tank during night time when not in use and used later for irrigation by locals. Drip irrigation and sprinkler irrigation system was used by few households. Such system of irrigation which saves water needs to be well promoted.

5.3.2 Land

More than 50% of the land in occupied by agricultural land in Lele. Cultivation of crops, vegetables, fruits, flowers has helped in land conservation making it alluvial. But after earthquake of April 2015, there has been a trend of constructing new houses diminishing agricultural land. The green fields are being used for construction instead of old brown field. Such practice needs to be controlled from local government or concerned authority.

5.3.3 Forest

40% of the land is covered by forest at Lele. For conservation and management of forest, it has been divided into community forest (76%), leasehold forest (0.32%), religious forest (1.67%), government forest (22%). The forest committee is responsible to look after the forest and its conservation. The community forest was serving the locals and at the same time it was also conserved because forest committee had made rule that only broken, dried branches were allowed to cut. Afforestation programmes were conducted by various NGO's time and again which helped in forest growth in future. Protection of forest also helped in protecting of wildlife. At Lele, various varieties of animals and birds prevails, and forest committee has made strict rules not to hunt them. Such act of conservation of forest is worth appreciating. Forest conservation has also helped in development of tourism. A trail route through forest from Lele to Phulchowki was developed where various local and international tourist go for hiking

5.3.4 Agriculture and Livestock Farming

Almost 90% of the household had organic farming at Lele. Various cash crops, green vegetables, fruit,

flowers were grown in the farm. Many of households consumed themselves while few were taking it for commercial purpose as well. There was many tunnel farming for growing vegetables effectively for high outcome. The materials for tunnel farming was provided by ward office like plastics but the locals themselves need to set up everything at farm land. Such 50 -50 % partnership in cost was found which helped to make the farming sustainable. Such practice was good which created employment opportunities to farmer who had low budget to start a vegetable business. Cattle rearing was done by few households due to drudgery to go to nearby forest and collect fodder for animals. But cattle rearing, and farming had two-way relation. Both helped each other to grow. The organic compost obtained from cattle rearing could be used in farm for good yield of crops and vegetables. And similarly pasture land could be created for feeding livestock. And it would be beneficial for consuming dairy products.

5.3.5 Building

The traditional buildings in Lele were built using locally available materials like sun dried brick, timber, mud mortar, lime, roof tiles (jhungati) etc. But there is a trend of constructing RCC buildings post-earthquake of 2015. Only few traditional houses are remaining at Lele. Almost all newly constructed houses are of concrete though they do not fulfill the life function required in the village. The houses lack spaces suitable for livestock. But still RCC construction is in demand because locals feel RCC houses are stronger compared to traditional houses. This must be the misconception among locals that only Cemented houses were stronger. Even the traditionally constructed buildings using local materials can be made stronger considering design techniques required for traditional style buildings. The government and local authority need to provide such skilled technician who can guide labors to construct such strong traditional style buildings. Also, there are traditional houses which faced minimal damage during earthquake. Such houses need to be restored by simple maintenance and repair rather than starting a completely new building.

5.3.6 Streets

The roads, streets in Lele are mostly unpaved and graveled. They allow rain water percolation and help in ground water recharge. The streets are pedestrian

friendly as people are given more priority to use the roads more than the vehicles. There are few vehicles running in the village at certain time only. The travel distance is also minimum to reach the work places within 5km distance for most of the people. The agricultural farm lands are also within the walking distance.

5.3.7 Open Space & Community building

There are plenty of open spaces, play grounds in the village for social gathering and recreation. There seem to be lack of community building in the village. Various events, meetings, programs could be organized in a community building. Now, its all done in open space. There is park and garden around Manakamana area but not so organized. The village committee should construct park in more organized manner. Also, the picnic spots at present are not enough to cater the visitors during peak time. Thus, more picnic spots also needed for that place.

5.3.8 Waste Management

Each household separate the degradable and non-degradable waste obtained from their home. Organic waste is used for compost making digging a pit near the house. While inorganic waste is burnt. There is no provision of door to door waste collection system like in urban areas. There is a cleaning campaign going on every fortnight by the local committee and clubs. The heritage areas are usually kept clean by these committees thus attracting more visitors. The waste management system is well managed, and the villages looks clean. There are few households who have reared livestock for compost manure at farm and at the same time they have also been successful in producing bio-gas. Such practice needs to be encouraged more in the villages. Due to tedious effort needed for maintenance of biogas, many households refuse to adopt the bio gas system. Also, the households who rear livestock is decreasing every year as people are more attracted to modern lifestyle.

5.3.9 Renewable Energy Technology

Solar PV Cells can be seen in many households which they use for lighting during power cut off. Electricity is provided to all households from the main grid line. There are few households using bio-gas technology. Very few households seem to have ICS at their home as LPG is widely used for cooking. There is scope for using renewable energy technology like solar water

PV panels, Solar dryers so that these technologies would help to make their life easier and help in income generating. But there is necessity to give more awareness about renewable energy technologies and its benefits along with subsidy provision among locals. Then only the local would accept these technologies in their home and their life.

5.3.10 Sense of place / belonging

Lele is rich in its natural as well as cultural diversity. It has its own architecture, culture and heritages. The monuments and cultural heritages like Tileshwor dham, Manakamana temple, Saraswoti kunda are the land marks of this place. They reflect the identity and history of the Lele village. They need to be well preserved so that the new generation would get an opportunity to learn and understand about the beauty of culture and history of Lele village. Agriculture being the major occupation of people at Lele and this lifestyle needs to be continued generation after generation. The farm lands need to be well preserved without deteriorating. All these elements give the sense of place and belonging to Lele village.

5.3.11 Social Groups

There is various finance, cooperatives, aama samuha, children's club. Youth club. Women's club in the Lele village. These groups are helping to develop the village as well as helping to enhance the lifestyle of locals residing there. The participation of people in such groups needs to be promoted so that many no. of people can be benefitted. The finances and cooperatives provide loans to individual (both men and women) who wants to start a new business and sustain their livelihood. They help to create income generating opportunities to people who are unskilled and unemployed. They even provide capacity development trainings, skill developing trainings. Thus, it is important to make every individual aware about the need of social groups for overall development of the village.

5.3.12 Cultural Tradition

People at Lele enjoy celebrating all kinds of festivals like Dashai, Tihar, shree Panchami, manghe sankrati, shiva ratri, bal Chaturdashi, chaite dasain, hari talika teej etc. Apart from these there is also tradition of each ethnic group. Like- Tamangs celebrate Lhosar, Newars celebrate Yomari punhe, Chhettris and Brhmin celebrate Dewalee festival. The Lele village has diversified ethnic

groups residing there & is rich in its socio-cultural tradition. It has helped in sustaining the identity of village.

5.3.13 Permaculture

Lele village consists of five zoning systems of permaculture. There is a settlement centrally and in the first phase is the kitchen garden which is frequently visited and in 2nd phase is the land for market crops like vegetables, flowers, tunnel farms. In the 3rd phase is the land area for cash crops like wheat, paddy, maize, mustard etc, 4th phase is for pasture land, fruit trees which requires minimal care. The 5th one is the forest zone which is a wilderness zone. Permaculture is an important aspect of an eco-village for its sustainability. Each zoning system is interlinked with one another. Permaculture is not just a green way of living or a guiding system of ethics, it is a way of designing using nature's principles as a model, 'bending' them as much as possible to create fertile, self-reliant, productive landscape and communities [7]

5.3.14 Eco-Tourism

Eco-tourism is gradually developing in Lele village. The tourists visit Lele for hiking and to see the green lustrous farm lands, natural landscape of green mountain. They also come to visit the religious places like Saraswoti kunda, Manakamana temple and for picnic to forget the hustle and bustle of city. Organic farm helps in flourishing eco-tourism. Thus, organic farm needs to be continued for developing eco-tourism. Apart from organic farm, the cultural heritages need to be well maintained and preserved. The heritages are the biggest asset which contributes in tourism development. The forest resources need to well conserve for good scenic view and natural landscape. The trekking route needs to be well defined and safer for tourists. Few home stays, cottages, restaurants are found in Lele village. But it's nos. would increase in future along with increase in tourists nos. The facilities of water, sanitation, energy consumption also need to be thought of from now for future sustainability.

5.3.15 Sustainable Local entrepreneurship

Organic farming plays major role in developing a sustainable local entrepreneurship. Since Lele area has many agricultural lands, there can good scope of various cash crops, horticulture and vegetables

farming. It can be followed business wise also to boost the local economy. Plastic Tunnel farming, Mushroom farming is prevalent in Lele village and the vegetables are sold commercially too. But in near future the business can be broader. The infrastructure required for developing vegetable farming can be built. For example: cold store for preserving vegetables for longer period to supply in nearby markets and in Kathmandu. Local tradition of alcohol making by Tamang family still exists in Lele. Other local traditional business-like handy crafts are no longer seen in village. Before there used to be crafts of bamboo. Baskets, dokos, dhakkis, perungas used to be made by men and women using bamboo. Also, the mat out of straw used to be made by women. All such local crafts are no longer prevalent in Lele. Such handy crafts need to be promoted from local government level. Eco-tourism can be good local entrepreneurship in future. At present time, it is slowly growing. Local home stays and restaurants are fewer in nos. which have helped in income generating to few households. Activities that helps to grow eco-tourism needs to be done in village which requires conservation and preservation of natural and cultural heritages. Also, restoration of local traditional business support in developing eco-tourism.

6. Conclusion

Lele village can be considered as an eco-village as there are maximum nos. of indicators where sustainability is seen. It has got huge potential in terms of organic farming (vegetables, fruits, flowers) and water resources for the sustainable development and grow as a remarkable eco-village. Eco-village has the potential to address the environmental, social, cultural & economic problems prevailing in the rural villages. By developing any rural village as an eco-village helps to protect environment. And provides with livelihood and income generating opportunities. The problem of environmental degradation, youth migration, unemployment could be eradicated to some extent if a rural village could be developed as an eco-village. Lele village has various significant features which eco-village contains. But also need more awareness in terms of renewable energy use, proper management of water resources in irrigation system, use of local materials etc. which needs to be overcome in near future with the help of local bodies and government.

7. Recommendations

In Lele, there has not been anything done for water recycling like rain water harvesting, reed bed system for water purification etc. Along with population growth the demand of water increases in future. So, such practice of water recycling can be adopted by the locals of Lele village. There has been a trend of constructing new houses diminishing agricultural land in lele after earthquake of April 2015. The green fields are being used for construction instead of old brown field. Such practice needs to be controlled from policy level of government or by the concerned authority. The newly constructed houses in Lele are all built using modern materials like cement. Locally available materials are not used for the construction like before. The essence of traditional looking buildings is not considered by any locals. There is misconception in locals that RCC houses are stronger compared to traditional houses. The awareness is necessary to make them understand that even the traditionally constructed buildings using local materials can be made stronger considering design techniques required for traditional style buildings. The government and local authority need to provide such skilled technician who can guide labors to construct such strong traditional style buildings.

The newly constructed buildings have also not considered passive solar design in terms of orientation & planning. The functional use of space is also not suitable according to the lifestyle of people. For those who needs to keep cattle at home there is no space for their accommodation. Such design consideration is missing in newly constructed houses.

For the management of waste, eco-san toilets could be considered which separates the liquid waste from fecal matter. Both wastes could be used in farm by composting.

The local traditional business-like handy crafts are no longer seen in Lele village. Before there used to be crafts of bamboo. Baskets, dokos, dhakkis, perungas used to be made by men and women using bamboo. Also, the mat out of straw used to be made by women. All such local crafts are no longer prevalent in Lele. Such handy crafts need to be promoted from local government level.

UNEP Industry Environment (2003) suggested 5 steps strategy that could be taken to reduce environmental impact: reduce material wastage, increase usage of recycled waste, improve efficiency of the energy, make a wiser use of the water, and increase service life of the structures [8]. If it is followed by all the villages which wants to develop as an eco-village then the positive result would be seen.

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