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Eco Village as a Model for Achieving Climate Resilience in Marginalized Communities: Case Study of the 1000 Households Project, Sindh, Pakistan

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ABSTRACT

Pakistan is among the countries most affected by climate change, facing loss of life and property due to flooding caused by cataclysmic rains across the country each year. In response to the catastrophic flooding in 2022, The Heritage Foundation Pakistan initiated the "1000 Households Project", to help mitigate the impact of climate change using the eco-village model as a potential solution. The project focused on the articulation of strategies catering to the social fabric and economic uplift through empowerment and by providing skills training and localized, adaptable solutions. By using the 1000 Households project as a case study, this paper has attempted to analyze the effectiveness of the eco-village model as a potential solution to achieving climate resilience in marginalized communities. The research findings also provided a framework for implementation in the event of future disasters in such areas, which can help build a more resilient and sustainable future.

Introduction

Climate change continues to affect the lives and livelihoods of millions living in developing countries where there is a pressing need for resilience (Fingleton et al., 2012). Pakistan is a negligible carbon footprint contributor yet faces severe climate change impacts. According to the German Watch's Global Climate Risk Index (GCRI), Pakistan ranks 8th among countries most affected by climate change and 7th most vulnerable country to climate change (Shah et al., 2022). According to the National Disaster Management Authority (NDMA), the 2022 floods damaged or destroyed more than 2.3 million homes and wiped out over 1.7 million hectares (4.4 million acres) of crops, while over 800,000 livestock perished, pushing more than 8 million people into poverty. The Government of Pakistan designated 84 districts as 'calamity-hit', with the most significant impact felt in the southern and central regions of the country. The economic impact was most prominent in Sindh, which suffered 70 percent of the country's total losses and damages (United Nations, 2023). The damages caused by these floods highlight the importance and the lack thereof of preparedness and response efforts to minimize the risks and impacts of future disasters. It is therefore imperative to develop mechanisms for capacity building and resilience against climate-related disasters in these affected communities. In an attempt to achieve this goal, a Nongovernmental organization; The Heritage Foundation Pakistan initiated a rehabilitation and reconstruction project. The project was designed in response to the devastation caused by the floods in 2022 in the affected region of Mirpurkhas in Sindh province, Pakistan. The project using the eco-village model was aimed at educating and equipping individuals in climate-affected communities with knowledge for economic sustenance and building affordable and eco-friendly homes. This paper has attempted to study the project as a case study model for achieving climate resilience and uplifting

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populations devastated by climate-related disasters to become self-reliant and self-sustaining.

Case Study: The 1000 Households' Project

In response to the flooding of the year 2022, The Heritage Foundation Pakistan initiated the "1000 Households Project" in a remote area of the Sindh province of Pakistan to help revitalize communities devastated. A cluster of 13 villages having 1000 households was identified to begin work with Pono eco-village as the center of operations (coordinates 25.306, 68.925). Pono and 12 other villages nearby were wiped out during the floods leaving behind destroyed infrastructure, the villages were then rebuilt using holistic models of intervention based on the Eco-village model. The Heritage Foundation of Pakistan developed a framework for rehabilitation and redevelopment of the affected villages based on the philosophies developed around three core principles of zeros methodology, i.e. zero cost / zero carbon / zero waste, and were referred to as The Barefoot Social Architecture (BASA) tenets. (Lari, 2022). These principles were implemented in the 1000 Households Project in the following manner. Utilization of locally sourced sustainable resources for sustainable development. To develop self-sustaining systems to eliminate the reliance on financial help from external sources. Utilization of available human capital to its maximum potential. All of the 13 villages that were part of "The 1000 Households' Project" were trained in craft-making skills such as shelter fabrication, chulah (stove) making, brick making, solar water stands, building hand pumps, pottery, raised beds/platforms and farming (table 1).

VILLAGE	NO. OF HOUSEHOLDS	DISTANCE FROM PONO ECO-VILLAGE	BAREFOOT ENTERPRISE
Pono eco-village	106 H/H	0 km	Lari Octa green (L.O.G) shelter fabrication
Kewal Kohli	57 H/H	3.5 km	Fish farming and Azzolla
Taj Muhammad I	53 H/H	1 km	Instant shelter, toilet seat
Taj Muhammad II	70 H/H	1km	Chicken farming
Jiwan Kohli	100 H/H	2km	Chatai matting
Jalo Jamadar I	100 H/H	1.5km	Chattai matting
Jalo Jamadar II	82 H/H	1.5km	Green fodder
Jalo Jamadar III	83 H/H	1.5km	Green fodder
Ram Basti	75 H/H	8km	Mother earth products
Dongro Kohli I	75 H/H	5km	Mosquito net making
Dongro Kohli II	75 H/H	5km	Mother earth products
Asu mal Bhel	56 H/H	2km	Nurseries and plants
Lachhman Kohli	76 H/H	3.5km	Terracotta pottery

Table 1. List of villages that are part of the 1000 Households Project and their corresponding craft specialties. Source:(Lari, 2022)

Methodology

This study utilized the case study research method. Primary data was gathered through direct observations, interviews with officials and locals, document analysis, and on-site photography. Secondary data sources included websites, published books, reports, archives, and academic journals. The collected data was then examined using a framework derived from the eco-village model.

The Eco-Village Model

Developing countries are the worst hit by climatic disasters where the impacted communities are already incapable of withstanding such shocks. The eco-village model presents itself as a potential model for building resilience and sustainable development in impoverished communities (Litfin, 2013). According to Nelson (2018), eco-villages can be defined as communities that are developed on a holistic regenerative development model that is adapted to local contexts, and consciously designed by the people through participatory processes to regenerate their environments, commonly characterized by low-impact, high-quality lifestyles. They aim to create a balanced ecology based on social dimensions, and the natural and economic environment of stability in a continuous integrated trend of human participation (Marzieh, 2012). It is a community not

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only concerned with the welfare of its individuals but also has strong links to neighboring communities (Westskog et al., 2018). The eco-village model emphasizes that while a regenerative human presence is built from the bottom up, communities need to work together at nested scales, and in solidarity with each other.

Eco-Village Framework

According to Chitewere (2015), The eco-village model is based on four pillars, environment, economy, community, and consciousness. While the economic pillar deals with systems of financial sustainability, the Environment includes ecological considerations while community and consciousness deal with social and cultural aspects. A framework was used to evaluate different facets of the 1000 Households Project (Figure 1).

Figure 1. Framework for analysis based on parameters of eco-village. (Source: Authors).

Results and Discussions

The 1000 Households Project was analyzed based on parameters derived from the Eco-village model. The following section discusses aspects of the project within the Eco-village framework in detail.

Social and Cultural Dimension

According to the (*Global Ecovillage Network*), it is important to develop systems of solidarity and mutual support between communities to facilitate the development and well-being of all Communities. Eco-villages aim to foster independent yet engaged communities by providing an environment of integrated human participation (Marzieh, 2012). Implementation of collaborative and cooperative forms of governance is necessary where each member's economic, social, and cultural needs and aspirations are considered integral to the whole. The 1000 Households Project fostered social cohesion and stability by utilizing human capital and engaging people in exercises aimed at reviving a sense of community. It implemented a social framework designed to enable empowerment from the bottom up without changing much of the existing social structures of the communities.

Social Structuring

The 1000 Households Project adopted an approach aimed at self-directed regenerative development that involved engaging people of all age groups from different villages toward achieving common goals. To utilize the human capital efficiently, an operational hierarchy for the working groups was established on a wider scale where entire villages operated as one unit. A hierarchy with one center for training, artisan villages, sponsoring villages, and friendship villages (Figure 2). This enabled redevelopment and strengthening of bonds between different individuals within those communities as well as communities at large.

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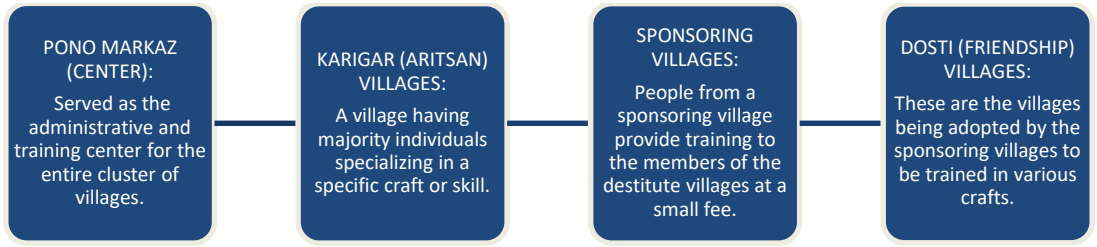

Figure 2. Hierarchy of the village operational structure. Source:(Lari, 2022)

A large portion of the population comprises women containing a potential source of human capital, The 1000 Households Project actively encouraged local women to engage in social, economic, and cultural practices. This was aimed at strengthening their self-assurance, building a sense of security, and providing access to platforms and networks, all of which contribute to advancing the goals of gender equality and women's empowerment. Some of the women-centric systems, committees, and franchises operating within the villages include financial committees, soup kitchens, and human resource management (Figure 3).

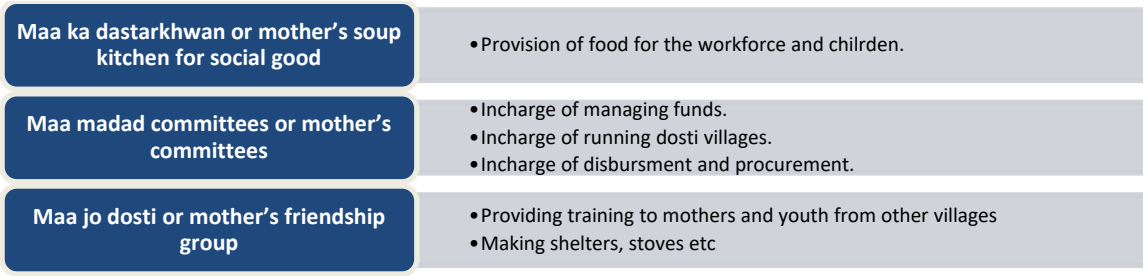

Figure 3. Women-centric groups along with the tasks they perform. Source: (Lari, 2022)

Education and Awareness

It is important to spread awareness and to educate people to rapidly engage in full-scale shifts towards systems capable of withstanding the effects of climate change (*Global Ecovillage Network*). The 1000 Households Project took initiatives to raise awareness about disaster mitigation and provide formal education and skill-based training to people in the community.

Disaster Risk Reduction (DRR)

To adapt and build resilience towards the ever-growing threat of climate change, it is important to raise awareness and train the people of the community through their own experiences. Adaptation requires learning from past adversities to minimize crises and vulnerability through incremental behavioral changes (Brian Walker, 2012). By engaging professionals and researchers with the local community, the 1000 Households Project spreads awareness about climatic anomalies and how to respond to them. Hazard maps of the area were created based on local knowledge regarding previous flood patterns. Factors such as water ingress based on the natural topography of the land and behavioral patterns of the people in response to the crisis were also observed. Hazard mapping also included satellite survey data, on-ground photography, and basic land topography surveys. The data was then analyzed to design infrastructure according to the findings to develop future systems of response.

Education

It is necessary to ensure that people have access to all modes of education that are inclusive of indigenous knowledge and traditional language, including educational opportunities that are culturally sensitive, respectful of legacy, and relevant (Global Ecovillage Network). Therefore it is imperative to educate the affected community to be better equipped with knowledge to deal with future disasters. The 1000 Households Project attempted to achieve this objective by initiating projects such as building reading rooms, teacher training programs, building schools, and engaging professionals and researchers through a network of volunteers (figure 4).

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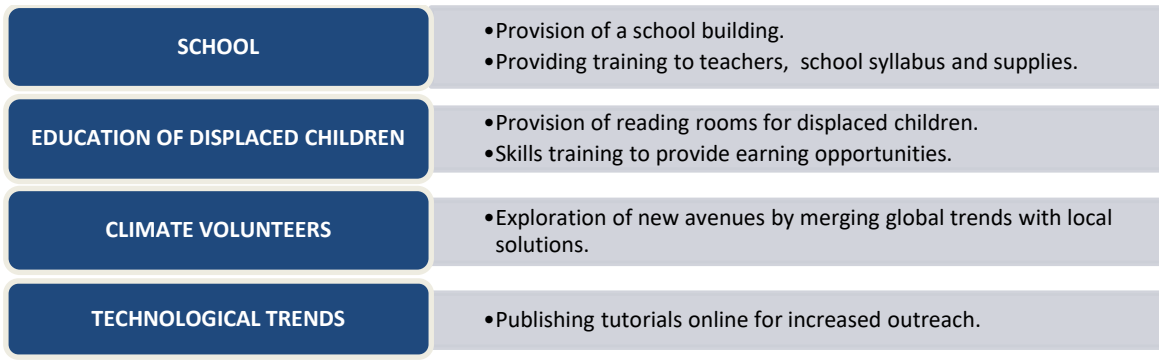

Figure 4. Initiatives taken by the 1000 Households Project for awareness and education. Source:(Lari, 2022)

Schools

The 1000 Households Project emphasized education for the local population by building the required infrastructure, training teachers, and supplying books with locally appropriate syllabi. A school has been built in the village with classes from primary to 8th grade in the Pono eco-village and its sister villages followed suit. The school building design comprised two Lari Octa-Green (L.O.G) structures combined into one room. Eco-friendly and locally sourced materials such as bamboo framing for wall panels with cane/reed matting as surface mesh, and lime/mud plaster as the finishing were used in the building. Half-scale bamboo L.O.G structures called reading rooms were built in villages to accommodate and ensure the education of children orphaned in floods. The program also linked the adoption of these children with private schools in developed cities to cover the finances for their education.

Training the Youth

While the education program was focused on providing formal education, children and teenagers were also trained in various crafts using local techniques and sustainable materials, based on their age group. This exercise aimed to help equip the younger age group with the necessary skills to be active members of their household and the community. Exposing kids to environmentally friendly activities fosters an awareness of our interconnectedness with other living things and the inherent right of all living things to life, health, and happiness (Global Ecovillage Network). Promotion and use of sustainable practices adopted by the 1000 Households Project, aimed at subconsciously embedding the idea of responsible use of environmental resources among the upcoming generation.

Knowledge Networks and Climate Volunteers

Another essential component in climate change adaptation strategies is the inclusion of indigenous knowledge and Western science perspectives to maximally optimize internally-sourced community resources (Mercer et al., 2007). In this regard, training workshops were conducted at the Pono eco-village as a recurring exercise. The Heritage Foundation Pakistan together with the International Network of Traditional Building and Urbanism (INTBAU) invited academicians and professionals from various fields as volunteers from all over the world to share their expertise. Such collaborations between educators, resource managers, farmers, and the general public help to develop knowledge networks as a management approach. The goal of such exercises is to increase information-sharing on climate patterns and effects throughout the community (Bolden et al., 2018). Participants of this network are referred to as climate volunteers, whose task is to engage with and train the locals to improve their existing crafting techniques or introduce new ones. (Lari, 2022).

Use of Technology

To increase the outreach of the program, The Heritage Foundation Pakistan used online media to train people through its YouTube channel. The channel showcases tutorial videos on how to build shelters and other components such as making mud/lime bricks for construction, reed matting, pottery, and stove making etc. This made it easy for people who cannot ensure physical presence to be able to still get the necessary knowledge.

Art and Cultural Development

Arts and recreational opportunities play an important role in the improvement of health. Getting the affected community involved in creative work has been recognized to have a positive effect on mental health after the loss and grief experienced in disasters. The 1000 Households Project encouraged each resident to decorate their own house, stove, and temple. The artworks done on the objects of everyday life not only provided a medium of self-expression but also represented a sense of pride and ownership. The decorations

included floral drawings, traditional motifs, colors, and patterns used in fabrics of the region.

Crafts Training Workshops

The 1000 Households Project's model ensured access to skills training and equal livelihood opportunities. Production of crafts based on the specialization of each village and their traditional local techniques was encouraged (figure 5). Workshops were conducted at Pono eco-village to develop a socially embedded economic activity with a focus on using suitable technologies, socio-ecological innovation, and practices that allowed each person to realize their full potential. Each village was trained to produce one handicraft item or Karigar product for use by the local population. The crafts were then sold among other villages which helped develop an economic network. Every member of the community was engaged in some form of activity, this engagement created conditions for people of all ages to become active members of society. The availability of opportunities to everyone allowed people to experiment with and develop their true vocations and build creative capacities through these mechanisms jointly providing for the basic needs of the people.

Figure 5. A diagram showing the different crafts taught as a part of the training program as part of the 1000 households project. (Lari, 2022)

Rilli Making

Rilli is a traditional form of sewing fabric that involves patchwork from different clothes sewn into one. The fabric may be used in dresses, quilts, pillowcases, curtains, carpets or bedspreads. Although the traditional craft of Rilli making was already being practiced, it was further developed and refined to produce a variety of everyday use products for the villagers such as handbags, wall hangings for storage of items, etc. Women and girls of all ages were involved with the craft, the products were then sold among other villages by the women themselves. This input of the women in the household economic uplift proved them to be productive assets and promoted equal rights for women in generating livelihoods. It helped initiate a step towards awareness and emancipation from social, cultural, and economic systems of patriarchal dominance which are universally relevant yet locally framed.

Pottery Making

Pottery making is a vital skill in these communities, as it helps make essential household items such as kitchen utensils, and cutlery. After being provided training regarding sanitation systems the people of the villages used clay pottery to make products such as bathroom sinks.

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Bamboo Furniture

To create and sustain a steady supply of materials available to the community for construction and other purposes, locally sourced materials are encouraged. Materials such as bamboo were utilized for making sellable furniture items of everyday use that could be sold in the market. Workshops were conducted in the Pono eco-village where people of the villages were trained to make household items using materials such as bamboo, cane, reed, etc. Everyday items ranging from tables, beds, storage shelves, wall hangings, swings for children, and storage units were made using bamboo.

Improvement of Health

Health is an immediate concern in the wake of calamities such as floods. Once the waters recede the community is left to deal with all sorts of health issues even long after the event. Mental distress is a significant after-effect of flooding. There exists a direct correlation between the magnitude of floods with the severity of the impact on the mental health of the people (Bei et al., 2013). The loss of lives, and properties, and displacement of people due to floods may also lead to grief and other psychosocial stress (Shailaja Bandla,NR Nappinnai, 2019). A healthy lifestyle and promotion of well-being for all ages can be achieved with careful considerations given to systems such as the provision of clean water, food security, sanitation/waste management systems, provision of safety through stable infrastructure, and promotion of the arts. Therefore need for an infrastructure that ensures a healthy living environment is a top priority (Global Ecovillage Network). The 1000 Households Project took multiple steps to provide a healthy lifestyle to the people. Concepts such as eco-toilets for managing human and animal waste and practicing concepts such as agroecology to combat food security issues significantly helped improve the health of malnourished children. Steps to ensure recovery from habitat degradation caused by the floods and provision of sustainable locally sourced materials for the construction of shelters were all efforts made towards providing a healthy life to the residents.

Economic Dimension: Craft Economy

Eco-villages attempt to develop economic and social security by creating self-reliant communities of people working to improve natural, social, and economic growth to utilize their resources (Westskog et al., 2018). Through the capacity building of the community and individuals, the 1000 Households Project aimed at an active pursuit of eliminating extreme poverty. The development of Local economic franchises, alternative banking systems, and the creation of entrepreneurial opportunities were all steps taken to build economic resilience, autonomy, and prosperity so that people become capable of surviving catastrophic events.

Economic Model – The Champa Model

Named after a resident of one of the villages of the 1000 households - Champa, the model is based on Barefoot Social Architecture (BASA) principles of sharing expertise and teaching other disadvantaged people for a small fee (Lari, 2022). The artisans that received training in the 1000 Households Project went on to teach their knowledge and skills as barefoot eco-entrepreneurs (B.E.E) to people of other communities creating a self-sustaining economic system.

Local Economic Franchises/ Alternative Banks

Empowering community banking mechanisms helps to build community wealth and increase local regenerative capacity (Global Ecovillage Network). The 1000 Households Project launched economic franchises, providing loans of up to Rs.10, 000 for setting up commerce-driven barefoot enterprises. (Lari, 2022). This helped in accelerated marketing of local products, regenerated livelihoods and provided equal opportunities to all for meaningful work.

Craft Economy - Barefoot Enterprises

In regions where the majority population lives below the poverty line, economic activity needs to be closely coupled with cultural and social regeneration in the region (Global Ecovillage Network). The concept of Barefoot Entrepreneurs (B.E) was introduced to train the locals to produce affordable craft products to achieve financial stability with a focus on empowering women. The people trained were called barefoot trainers and went on to develop barefoot enterprises to market their craft. The barefoot trainers after receiving training from the Pono eco-village went on to train people in the neighboring community. All age groups were trained according to their potential, enabling every member of the community to work towards the same goal (figure 6).

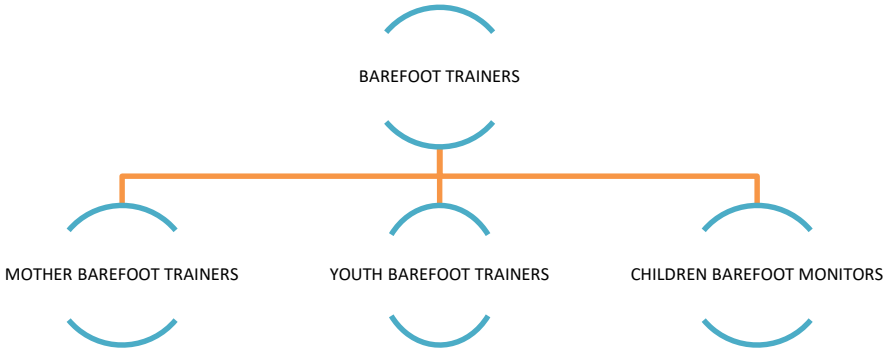

Figure 6. A diagram showing the structure for the barefoot trainer's system in the villages Source: (Lari, 2022).

Ecological Dimension

It is important to rely on low-tech and low-impact non-engineered structures and products that ensure the shrinking of the ecological footprint using green skills and sustainable, locally sourced materials.

Sustainable Living

It is important to develop mechanisms that ensure universal access to adequate, safe, and naturally constructed infrastructure and housing. The 1000 Households Project encouraged the development of such resilient infrastructure by making use of available resources.

Lari Octa-Green (L.O.G) Structures

The local construction practices in the region; the wattle and daub method of construction proved itself unsuitable in the event of disasters such as floods. As a solution to the problem, Heritage Foundation Pakistan introduced a new scheme of design incorporating existing knowledge of materials and assembly as much as possible. Lari Octa-Green or L.O.G structures were designed as shelters, each room can be co-joined to form a complex of rooms as per requirement. Octagonal in shape and 12 feet in diameter the structure can accommodate up to 4 people. It consists of 8 modular panels, having a bamboo rectangular frame with diagonal bracing in between. They are then finished with reed matting and plastered with a mixture of lime and mud. The roof uses bamboo for the framing hammered and tied together in place with matt/reed as roof covering. Each shelter is built by the villagers themselves after receiving training at Pono eco-village.

Innovation and Experimentation: Floating Shelters

Risk perception is a fundamental difficulty for flood-prone communities. Cultural links to ancestral land hinder a community's capacity to react to warnings. Communities are reluctant to leave their lands because of sentimental attachments to them or because they fear losing their homes and being unable to provide adequate documentation to prove their ownership (Shah et al., 2023). Apart from efforts to raise awareness and put DRR mechanisms in place, the 1000 Households Project attempted to cater to this issue by experimenting with structures that can be anchored to the ground and in the event of a flood, float on the high waters till the time the rescue teams arrive. This eliminated the concern of people for losing their land and their homes, once the waters recede the structure can settle down in place. Another case scenario is that these floating structures can be floated away on the water like boats and can help people move from flooded areas to safer grounds together with their belongings or even livestock. The shelters used bamboo frames of various sizes as the main structural component, with cane matting and mud-plastered wall panels and roofs. Plastic drums were fixed at the bottom of the frame acting like the hull of a ship, which would serve as the floating devices in case of a flood. (Lari, 2022).

Use of Locally Sourced Sustainable Materials

By implementing mechanisms to regenerate materials and resources used, The 1000 Households Project ensured development that seamlessly blended into the local ecology. The low-carbon structures built in the villages used materials that did not require industrial production methods, instead were produced and sourced locally. Materials used for construction included bamboo, cane, and reed, while mud and lime were used in roofing, wall cladding, and making infrastructure such as stoves and platforms.

Lime and Mud Brick Making

The villagers were trained to cast bricks for construction using a mud and lime mixture. The entire

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production cycle had a zero carbon footprint, from the procurement of the mud from surrounding areas to transporting it using donkey carts and making wooden dye casts. The bricks are then dried in the sun for a few days before they are put to use. The training required for the brick-making process is provided at Pono eco-village by trainers as well as through tutorials made available online by The Heritage Foundation Pakistan's YouTube channel. Bricks are used for all construction, boundary walls, and platforms for houses, verandahs, stoves, and food drying platforms. (Lari, 2022).

Reed and Cane Matting

Cane or reed being a sustainable and readily available local material was used in construction from covering bamboo frames in walls to roofing of the shelters. The process did not require any use of machinery or expertise and was as simple as tying cane sticks together into sheets which are then used according to the requirement (Lari, 2022). Women of the village were trained how to use cane and reed matting for purposes other than what was known to them including window blinds and furniture.

Mother Earth Products

Mother Earth products were products of everyday use by the villagers which have been made using natural materials such as plant-based matter, cow dung, etc. These products include Reetha organic soap, Moringa powder, Tikki or sawdust/cow dung briquettes Compost, kitchen waste, human waste, and cattle waste. The briquettes were used in construction and as fuel for burning (Lari, 2022). The products produced are small in size hence portable, making them easy to trade in the nearby villages.

Environmental Improvement

Boundary Wall

As a part of the DRR measures, a boundary wall was built to prevent flood waters from freely entering the village. The boundary wall consists of three stages, a bund wall to prevent direct access of water into the villages, and dense plantation pits having plants that absorb water. The third step involved digging aquifer trenches to speed up to process of absorption of water into the ground. The materials used for these constructions included clay lime sun-dried bricks.

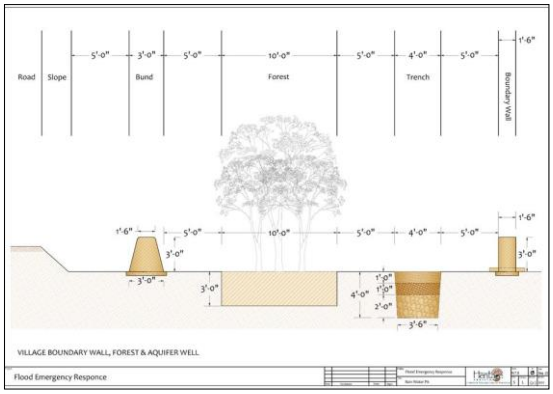

Figure 7. Drawings showing the profile of the boundary wall, bund wall, aquifer trenches, and the use of vegetation. Source: (Lari, 2022).

The Aquifer Trench Project

Excess rains cause waterlogging in the soil, an aquifer trench was dug along one side of the entire village as a solution for draining this water. The location of the trench was decided considering the natural topography of the land and points for water ingress in previous flooding events. The use of stones and gravel gathered from nearby fields in the trenches ensured filtration of the water keeping the ground water from being polluted.

Pakistan Chulah

Pakistan chulah or Pakistan stove was designed by architect Yasmeen Lari. The stove comprises three chambers each slightly raised from the previous one. It runs on one-third of the fuel consumption of a regular stove being used in the village reducing the use of wood for burning as fuel. A chimney on top of the stove that also serves as a third burner helps keep the smoke away from the user, reducing the health hazards associated with burning wood and other fuels. The women of the household take great pride in decorating their stoves with geometric patterns and floral motifs which is a testament to the sense of ownership of the craft.

Developing Mud and Lime Brick Platforms

To avoid food and other household items from being washed away during flood, Mud/lime brick

platforms raised to at least two feet were built by the families on their own according to drawing instructions provided by The Heritage Foundation Pakistan (Lari, 2022). These platforms also serve as high places for people during floods and can also be used for solar drying of food and building stoves.

Waste Management

The 1000 Households Project followed a model of zero-waste, this concept was realized by putting in place mechanisms for efficient waste management. Following were the measures taken to reduce the production of and utilization of the existing waste.

Use of Waste Materials

The use of by-products from crops as fuel or for construction purposes was encouraged to decrease waste production. One such example was the use of Bagasse, a pulpy fibrous material that remains after crushing the sugarcane. It was collected and put to use in the construction of briquettes for construction, as bio-fuel for cooking and as fertilizer. Other biological waste such as cow dung patties were also used as biofuel and the production of briquettes for construction with a mixture of sawdust (Lari, 2022). Experimentation with wax made from banana leaf waste for waterproofing of roofs etc. was also done to reduce the waste as much as possible.

ECO-Toilets

The basic need for providing resilient infrastructure and promoting sustainable mechanisms for waste management was met with a solution called the Eco-Toilet. The Eco-toilets not only created awareness about health and hygiene among the community but also provided a solution to reduce health issues. The method provided a way for safe sanitation and ensured appropriate means of integration of human excrement with the ecosystem in an ecological way. The waste collected from the toilets was used for composting, which was to be used as organic fertilizer in the fields. The toilets were built as separated/isolated structures away from the residential units and hence were used as a public amenity. Communal use of the toilets helped actively build the capacity of the people for self-governance and maintenance of the waste management systems.

Optimal Management of Energy Resources

Access to affordable, reliable, and sustainable modern energy is a basic right to be provided to the people of a community. In the arid context of the region, sunlight is the only source of energy available in abundance. In a bid to ensure the provision of clean and free energy to the communities, the 1000 Households Project provided Solar panels, where each solar panel provided electricity to 12 (Lari, 2022). The provision of such means of affordable clean energy systems led to the elimination of the need to burn fossil fuels to carry out their essential tasks at night such as cooking. Small-scale interventions such as this displace traditional destructive energy sources such as wood burning and decentralize and democratize power to access clean energy to individual members of the community. This simple provision of technology has made these eco-villages more sustainable and energy-efficient than most modern cities.

Optimal Management of Water and Agriculture/Food Security

Provisions must be made to provide optimal nutrition for all in the face of natural calamities. The 1000 Households Project emphasized natural, fresh, and high-quality produce with a focus on small-scale/local producers to regenerate the local economic systems.

Hand Water Pump

Access to clean drinking water is a basic human right. To provide access to safe drinking water a manually operated hand water pump was installed. Each village had one hand pump per 8 households (Lari, 2022). The water pump was placed on communal grounds which eradicated issues such as private ownership and commodification of the common facilities.

Tree Plantation Drives

Restoration of the damaged landscapes and promotion of sustainable reuse of terrestrial ecosystems requires an effort on a community level. The 1000 Households Project combated this issue by planting trees that helped not only halt ecological degradation but also tackled the issue of biodiversity loss. Plantation drives were carried out in the villages, and trees that helped prevent waterlogging and provide food e.g. fig trees, mango, and other fruit-bearing trees were planted. Successful experimentation was also done in planting bamboo being used in the construction of the buildings in the villages. Community forests were planted at every twenty-foot distance circling the village boundary wall. Careful consideration was given to ensure all plants were native species consisting of a mix of fruit, flowering, and other trees (Lari, 2022).

Food Sovereignty

In disaster-stricken areas where malnutrition is a serious concern, achieving food sovereignty is a basic requirement. The eco-village model uses sustainable land management practices including agroforestry, mixed farming, and composting (Kerr, 2018). Mixed farming methods that involve growing a wide variety of plant

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species that complement each other on the same piece of land have been proven to improve soil carbon storage (Amoak *et al* 2022). To further improve fertility of the degraded soils, compost from the crops and organic manure both human and animal, were used as fertilizers to restore the nutrients in the soil and to counteract the loss of soil carbon. The result was a regenerative agricultural process that was adopted by all communities with ease.

Kitchen Gardens

To make the dry sandy and barren land into a fertile, food-growing area, the hard crust of the soil was removed from twelve to eighteen inches, and treated with water and organic compost. The project introduced the practice of growing vegetables such as lemons, okra, and potatoes, and fruits such as banana, mango, fig, and dates planted in the kitchen gardens (Lari, 2022). The women and men of the household both take part in this activity.

Fish Farming

Flooding leaves behind multiple water reservoirs in the area. These natural aquifers then become breeding grounds for fish. Using this opportunity, fish farming was introduced as an alternative food source. The fish can also be dried and stored for use in the off-season with surplus storage (Lari, 2022).

Chicken and Goat Farming

Livestock farming was encouraged as a means of achieving food security and economic strength for the people of the villages. The people of the villages were provided with animals and trained in improved methods of chicken farming and goat. Many villages resorted to these means as a source of not only nutrition but also as a source of making money by selling eggs or goat milk in the market (Lari, 2022).

Solar Dehydration of Food

Solar dehydration was introduced in the villages as an innovative method of rationing food during the crisis. The process facilitated long-term storage of food items ensuring availability of off-season periods or serving as a contingency mechanism in the event of a disaster. Special solar drying platforms elevated at least two feet from the ground were constructed using sun-dried mud/lime bricks finished with lime plaster, made by the villagers themselves (Lari, 2022). Using the solar drying method provided opportunities for ensuring food security and generating income. Various locally produced food items such as banana chips, spinach, mangoes, spices, etc. were dried and stored for long-term use using this method.

Conclusions and Findings

The findings of this research demonstrated the potential of the eco-village model for revitalizing a marginalized community impacted by a climatic disaster. Using a holistic integrative approach the 1000 Households Project addressed issues of environmental degradation, economic collapse, and infrastructural failure. Using concepts such as eco-friendly infrastructure, sustainable agricultural practices, renewable energy solutions, and fostering regenerative economic practices, the 1000 Households Project managed to lay the foundation for a long-term self-sustaining system of development. The participatory approach of the project ensured the people of the community were not mere spectators but active agents of change, in control of every aspect of the project. This led to the empowerment of the people, increased social cohesion, building resilience against future disasters, and an overall improved lifestyle. The initiative highlighted the importance of integrating environmental stewardship with community-driven efforts to achieve inclusive and sustainable development. The 1000 Households project not only addressed the immediate needs of the affected communities but also equipped them with the tools and knowledge to thrive independently and build a more resilient and equitable future.

Moreover, the research has provided a replicable model for other marginalized communities facing similar challenges due to climatic disasters, using the eco-village model as a sustainable development strategy.

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