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Gharat Technology: An Indigenous and Eco-Friendly Source of Livelihood in Dewal Block, Chamoli, Uttarakhand, India

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Abstract: Gharat is a folk technology that operates on water, Gharat has been developed from the natural resources present in the surrounding area. The hill people of Uttarakhand have a deep connection with the Gharat, it is not only a source of local livelihood but is also deeply connected with the folk life and traditions of the hills. The sole purpose of documenting and presenting this research paper is to assess the present status of Gharat in the study area, document varied traditional information related to local materials used for the construction of traditional Gharat. The present study is based on primary data, field survey was conducted in 8 selected villages of Dewal Block. Information was gathered through field observations and personal interviews with Gharatis (owners), elderly informants, and residents living near Gharats. A semi-structured schedule was utilized to document various traditional aspects related to local materials and technology employed in constructing these water mills. During the field study, most of the people in the sample villages follow the "Bhagwar" traditions, exemplifying a harmonious display of community cooperation. The results show that in the surveyed village availability of electric mills (atacaki) is increased per village and major decline in traditional Gharat in almost all the survey villages in Dewal block. Therefore, there is an urgent need to revive the watermills to save the indigenous and environment-friendly technology practiced for ages by the local people. Its effective incorporation into regional livelihood systems fortifies cultural identity and preservation of the environment in addition to improving economic prospects.

Keywords: Gharat Technology • Indigenous • Eco-friendly • Dewal • Uttarakhand • India

Introduction

People living in remote hilly areas in the Himalayan region still use traditional knowledge based on their experience. Since ancient times, rural communities have adeptly utilized local resources to fulfill their basic agricultural requirements. They have ingeniously tapped into the energy of rivers and utilized forest resources in their immediate surroundings (Jasmine et al 2016). Through a straightforward and systematic approach, they have developed methods tailored to their needs, demonstrating a deep understanding of their environment. Gharat is a folk technology that operates on water, Gharat has been developed from the natural resources present in the surrounding area. the hill people of Uttarakhand have a deep connection with the Gharat, it is not only a source of local employment but is also deeply connected with the folk life and traditions of the hills. In the Himalayan and Sub-Himalayan areas, around 2.5 lac traditional wooden water mills are still functioning (Slathia Et al 2018). The majority of the state of Uttarakhand is hilly and mountainous, with many streams, rivers, and lakes that provide year-round water. The rural residents of the hilly region have built these gharats. In rural, hilly locations, grinding traditional crops by hand is a traditional technique that involves installing and operating Gharat. traditional water mills are commonly utilized for grinding purposes, these power mills were outdated due to changes in climate and the advancement and creation of power mills (Parajuli and Das 2013). In the present, the practice of grinding grains is struggling for its survival. This struggle stems from the widespread use of modern power grinding machines called "Atachaki," even in remote hilly

regions, and the lack of interest among rural youth in embracing traditional practices. These traditional farming and livestock-rearing techniques serve as vital supplementary sources of income. The sole purpose of documenting and presenting this research paper is to assess the present status of Gharat in the study area, document varied traditional information related to local materials used for the construction of traditional Gharat to make sure Uttarakhand's ancient Gharat technology is preserved, and sustainable, and turn these Gharats into a legacy for coming generations. purpose of documenting and presenting this research paper is to assess the present status of Gharat in the study area, document varied traditional information related to local materials used for the construction of traditional Gharat to make sure Uttarakhand's ancient Gharat technology is preserved, and sustainable, and turn these Gharats into a legacy for coming generations.

Study Area: Uttarakhand, situated in the central Himalayan region, encompasses the Dewal block in Chamoli District, located at 30° 3' 39.9594" E and 79° 34' 37.92" N. Dewal block, one of the 9 blocks in the district, is characterized by a mountainous ecosystem. This area boasts rich floral and faunal diversity, along with traditional livelihood practices typical of remote mountain regions (Shoryabh Srivastava et al 2020). Gharat technology is rooted in centuries-old customs and holds significant importance beyond its practical utility. Its functioning not only demonstrates sustainable resource management but also highlights the intricate relationship between environmental harmony and human ingenuity. In the setting of Dewal Block, Gharat technology emerges as a symbol of resilience, reflecting the reliance on natural cycles that govern daily routines. This offers insight into the adaptive strategies utilized by communities to address ecological challenges. Dewal block comprises 74 villages, of which 8 were selected for survey purposes.

Methodology

A field survey was conducted in 8 selected villages of Dewal Block, Chamoli district, Uttarakhand. Information was gathered through field observations and personal interviews with Gharatis (owners), elderly informants, and residents living near Gharats. A semi-structured schedule was utilized to document various traditional aspects related to local materials and technology employed in constructing these water mills. Discussions with Gharat owners, conducted entirely in the local Garhwali Pahari language, aimed to extract detailed insights into these mills, locally known as "gharat." Information was gathered from all Gharat owners across different sample villages to document and verify diverse details concerning their present number of functional Gharat and how many Gharat Prasant in the past, structures, materials, and contributions to livelihoods.

Result and Discussion

Status of Gharats in the Study Area:

A total of 8 villages were surveyed to collect information from a sample village, a total of 76 water mills (Gharats) were Prasant in the past, but currently, only 33 were found to be functional. In the dewal block, surveys were conducted in the Vaan, Balan, Bank, Ghes, Lwani, Mundoli, Sawad, and Devsari.

The results show that in the surveyed village availability of electric mills (atacaki) is increased per village and a major decline in the number of traditional Gharat in almost all the survey villages in the dewal block. The number of minor Gharats also observed which were damaged due to natural calamities like scarcity of water flowing in perennial nalla, and cloudburst, availability of food grains for grinding has decreased because of the change pattern of traditional crop cultivation and food habits of the local people, and Decline interests of the younger generation toward the age-old occupation of water milling due to modernization is also another factor responsible for the decline

People in the area believed that it has a social significance that adds to its popularity and importance for the rural population. the local people considered the place as a spot of interaction and exchange of information among the people living in nearby villages which added social cohesion among people These gharat serve as centres for intergenerational learning where skills are passed down from older generations to younger ones, ensuring the unity of these age-old practices (Bhatt et.al. 2021). .

Table: 1 Status of Number of Gharats in the Study Area

Name of Sample Village in Dewal block	Altitude (in Meters)	Present Number Functional Gharat	No. of Gharats in the Past
Vaan	2461	3	10
Balan	3032	7	9
Bank	1850	4	10
Ghes	2537	8	12
Mundoli	2147	5	9
Lwani	2461	2	12
Sawad	2067	3	9
Devsari	1726	1	5

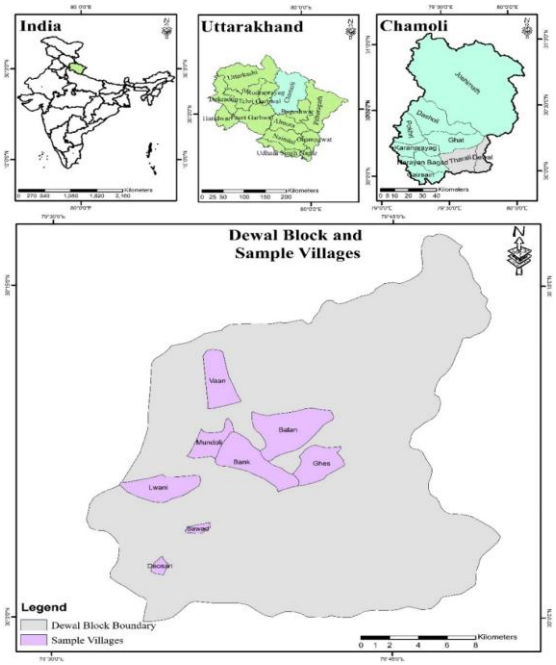

Fig 1. Map of the study area showing the boundary of surveyed villages

Social Significance of Gharat in Study Area:

During field study most of the people in the sample village Rather than paying for grinding services, villagers willingly set aside a portion of their flour for the Gharat owners. In the local surrounding Gharat, it is believed that neglecting to reserve a portion of milled flour for the Gharat owner brings the curse of the mill. Hence, locals ensure to set aside a portion known as *"Bhagwar"* near the Gharat, exemplifying a harmonious display of community cooperation in the sample village

Structure of Indigenous water mill (Gharat):

The watermills (Gharat), consist of a small two-story structure (fig.3) constructed by using locally available natural resources, such as stone boulders mud slate, and cow dung the roof is covered with slates or wooden planks of Chir (Pinus roxburghii) tree (Paish et al., 1997). The stones are piled one above the other in a regular pattern from the walls. On the inside walls and floor are smoothened using a mixture of clayey mud and cow dung that is well-plastered on the roofs are placed large logs wood as per availability of material and then covered with slates, flat stones, soil, etc. The whole structure of the mill consists of various parts installed inside this chamber. The installation process is the collaborative work of the local experienced person, local carpenters, and blacksmiths. The species of wood Banjh (Quercus leucotrichophora), Burans (Rhododendron), Raga (Abides windrow) chir (Pinus roxburghii) Wood are used to make different part

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Fig 2. (a) Local people showing different parts of gharat (b) Perennial naula near gharat (c) Bhagwar tradition in sample villages (d) Non-Functional gharat in sample villages

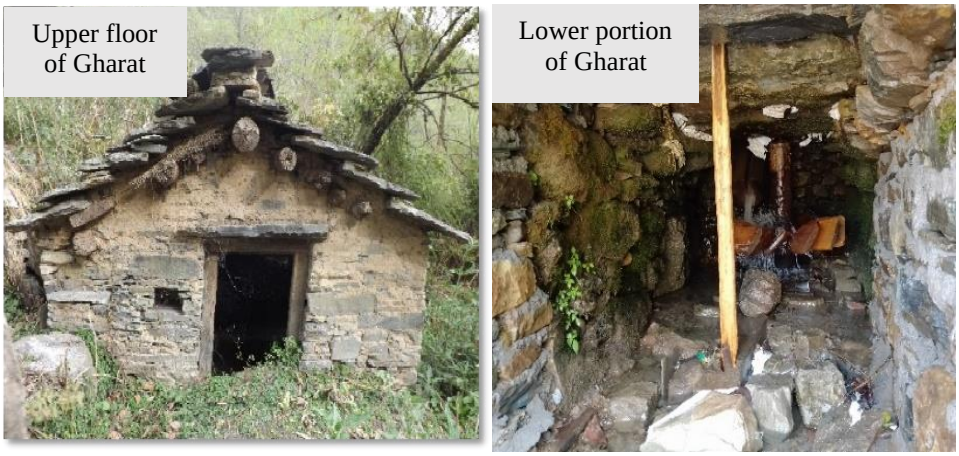

Fig. 3 Two-story structure Indigenous water mill (Gharat)

Different Components of the Traditional Gharat

It has been observed that these gharats, built by the community's elders utilising locally produced technology, are unique to the studied region. This secure, environmentally friendly building that has been in operation for ages has survived the test of time.

Above ground parts

Channel *(Gule):* This channel (Gule) is made up of locally available stone and mud and some channel is well plastered in the study region (fig.4 h. i) the channel is made to divert the water from the perennial nalla up to the location of Gharat, at a gradient slope which supplies water to the mill.

(a) Wooden Flume *(Panyala):* The wooden part called Panyala is generally made of the wood of Chir (Pinus roxburghii) Oak (Quercus Leucotrichophora) (fig.4.a) Normally the entire wooden log is used to make it. In some cases using wooden planks, which are joined with each other with nails to make it a flume. Water is controlled at its mouth, with the help of an iron or wooden plank. This falling water rotates the shaft and

due to this gharat starts functioning (Chandra, G. 2002)

(b) Hopper *(Red), Hopper Channel*: Constructed from Quercus leucotrichophor, a tree known locally as "banj," it is referred to as "Redi" (fig.4.b) in the local language. The main function of the hopper is to store the grains, which subsequently move through the channel (Redi) to the grinding stone. Grain is put into it for grinding, and it can hold between 15 and 20 kg of grain. It is installed above the rotating stone of a traditional water mill. At the bottom of this section, there is a small opening where grains fall into a hole created in the centre of the revolving stone.

(c) Grinding stones *(Grinders):* The Grinders are the main component of the mills, It is basically the two grinders, made of hard rocks, available locally. The lower stone locally called “Aithar” is of stationary type (Fig.4.f) Second stone is of revolving type and fixed over the stationary stone locally called “Paathar” (Fig.4.c). the grains from the hopper are dropped into a hole at the centre of the upper stone.

(d) Iron and wooden water sieve: Material into the main rotator shaft, such as grasses and any thin wooden items that may be flowing with the water (fig.4.d) respondent reported that if any of this material were get inside a wooden channel, it may break the rotatory shaft, which would harm the traditional water mill. Iron rods are used by gharat owners for this purpose in place of wooden sieves.

(e) Controller Plank *(Chediya):* The most interesting part of the water mill is a unique device called Chediya in the local dialect (fig.4.e) These are simple two small wooden plank owned together at the mouth of hopper channel to control the flow of seeds from the hopper. The two planks hung on the blocker and rallies as the upper grinder revolves. This device is fixed to make the seeds fall systematically at controlled rate. To completely block the flow of seeds in the watermills (Gharat) the (Chediya) are displaced.

Underground parts of Gharat

(a). Water Wheel *(Bairan):* The water wheel, known as "Bairan," is a crucial part of the water mill, rotating on its axis. Made of sturdy Kemu wood, it weighs around 60 to 70 kg. Shaped like a cylindrical bulb, it tapers towards the ends. Wooden blades called "Pankha," about 8 to 10 in number, are fixed at its centre. When water strikes these blades, the wheel spins. The blades are slightly angled (fig.5.b) and spaced about 1.5 cm apart to maximize the water's force and increase wheel speed. At the top, a wooden bar called "Sua" extends upwards, connecting to horizontal wooden clamps known as "Alrain" in the upper story. These clamps hold the grinding stones, so as the wheel turns, it powers the grinding process.

(b). Base Plank *(Chamalta):* It is a wooden plank and forms a lowermost part of the water mill. It carries the entire load of the water wheel. It carries the water wheel's whole weight. the water wheel spins around the plank's centre of rotation. The plank is laid horizontally over the ground and its upper surface is reinforced with a slate of the size of 4 to 6 cm. It supports the water wheel and has a reinforced top surface with an iron ring for the wheel's movement. There's also a long, (fig.5.c) vertically fixed wooden lever with holes for controlling grain grinding. Moving the lever up makes coarse grinding; while moving it down makes fine grinding.

Indigenous technology environment-friendly best fit for the region:

The informants in study area believed that Gharat is a simple indigenous technology that is environment-friendly and made from available local resources making it cost-effective. Traditional watermill does not pollute the environment. due to difficult terrain, though weather conditions and irregular supply of electricity in these high-altitude areas, the inhabitants of the region believed that Gharats were the most suitable option to meet the need of local people.

Gharat on the verge of extinction

Gharats, traditional water mills, are disappearing for several reasons. First, there are fewer water sources due to factors like low rainfall, droughts, and climate change. Second, making flour in Gharats takes a lot of time and effort, which isn't practical in today's fast-paced world. Electric mills are faster and easier, so Gharats are closing down. Younger people are less interested in running Gharats because they prefer modern jobs. Also, people don't grow as many grains for grinding anymore (Bhatt et.al. 2021). They buy ready-made flour from stores instead. This makes Gharats unnecessary, leading to their closure (G. Tsering et.al 2015)

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Fig. 4 Upper ground Parts of Indigenous Flour Mill (Gharat)

Advantages of these Indigenous technology water mills (Gharat)

Most of the informants of higher age groups believed that flour from the Gharat was of better quality and taste than the packaged flour brought from the market or the one grinded through electric mil. Local people believed and reported that Gharat is a simple indigenous technology that is environmentally friendly made from available local resources that make it cost-effective (Hussain A & Hussain N 2014). During abnormal weather situations regular electric power supply gets interrupted for a longer duration at a stretch, then under such conditions, these Gharat are the only source of grinding grain especially in hilly areas. These gharats are cost-effective having negligible running cost, eco-friendly and require less maintenance.

(a). Wooden Flume (Panyala) directs and controls the flow of water to rotate the shaft, enabling the Gharat to function ***(b).*** Daal (Red), Hopper stores and channels grains to the grinding stone of the Gharat, enabling the grinding process. ***(c).*** Upper Grinder stone (Paathar) is of revolving type and fixed over the stationary stone locally called “Paathar” (Fig.4.c). ***(d).*** Iron and wooden water sieve filter debris from the water, protecting the Gharat's rotatory shaft from damage ***(e).*** Controller Plank (Chediya) This device is fixed to make the seeds fall systematically at a controlled rate. ***(f).*** Lower Grinder stone locally called “Aithar” is of stationary type ***(g).*** Alrain it is a

wooden plank that acts as a link between wooden turbine and alrain. it is either made up of wood or iron, it is also a T-shaped structure ***(h).*** Kachha water channel (Gule) ***(i).*** Pakka water channel (Gule) (fig.4 h. i) The channel is made to divert the water from the perennial nalla to Gharat, at a gradient slope that supplies water to the mill.

Conclusion

In conclusion, based on different observations and discussions held with Gharat owners, it is concluded that major decline in a number of traditional Gharat in almost all the sample villages modern tools like electric mills have now become popular among people. Further, the easy availability of food grains from shops and cooperative societies is also contributing to the shutting down of the Gharat in the villages. Therefore, there is an urgent need to revive the watermills to save the indigenous and environment-friendly technology being practiced for ages by the local people. Its effective incorporation into regional livelihood systems fortifies cultural identity and preservation of the environment in addition to improving economic prospects. Building resilient and inclusive communities in the face of continuous environmental and socioeconomic changes requires embracing and supporting such indigenous innovations.

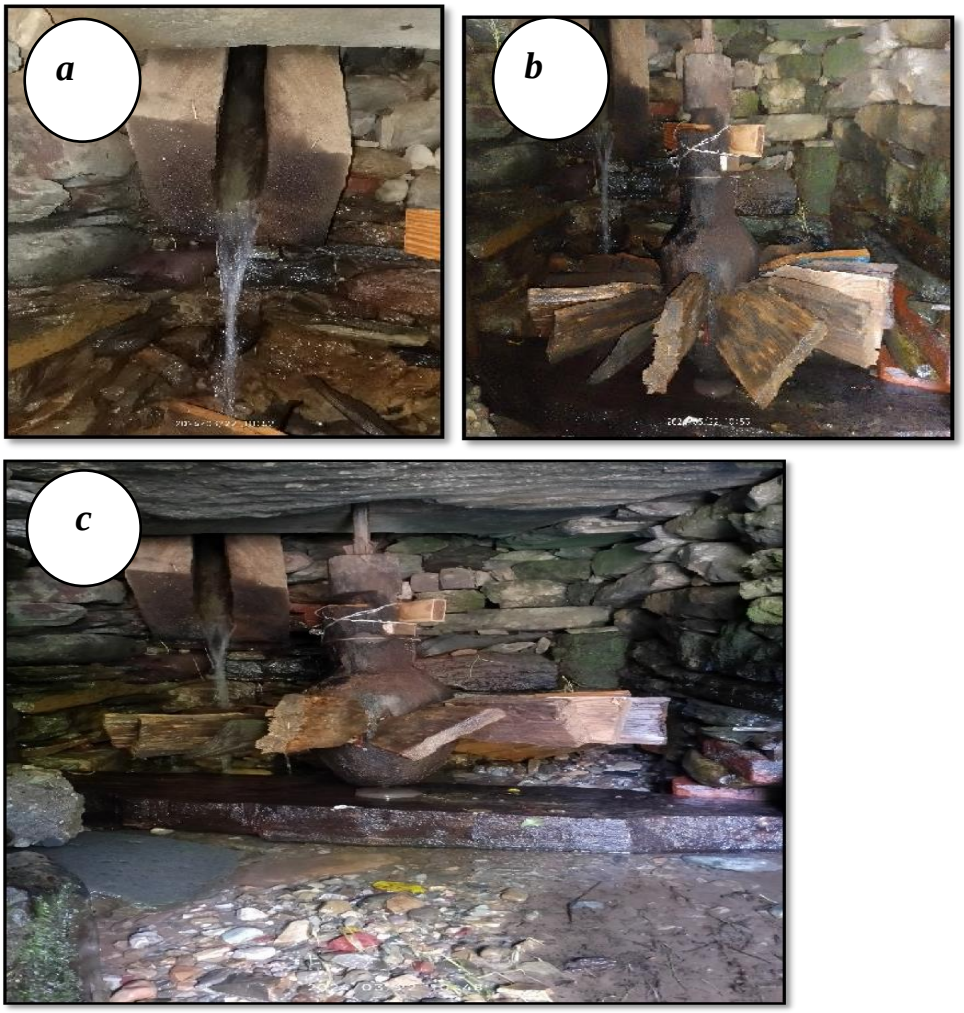

Fig. 5 Under-ground Parts of Indigenous Flour Mill (Gharat)

(a). Under Ground Poration of (Panyala) ***(b).*** Water Wheel (Bairan) converts the force of water into rotational energy, powering the grinding stones in the Gharat. ***(c).*** Base Plank (Chamalta) supports the water wheel and controls grain grinding precision through a vertical lever system.

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