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Reviving Springs in Himalayan Region to guarantee Clean and Safe Drinking Water Supply to Remote Villages

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Abstract: ***The Eco-geological labyrinth of Himalaya is under the grip of various natural disasters and human interventions that has created a cascade of environmental problems. Natural Springs's water that was used traditionally round the year for meeting drinking , domestic and agricultural needs .In the last few decades these water sources are rapidly moving towards vulnerability and had become seasonal or sometimes even defunct.***

Till now, no serious attempts have been taken in a planned way to regenerate the drying springs in Uttarakhand which is still a vital natural resource. Instead, the government has launched large scale scheme of centralized piped water supply system and is failed to fulfill the constraint of the local people due to faulty planning, maintenance and lack of people's participation in its management.

It has been well recognized that by reviving and enhancing water yield of traditional water sources like springs, we could meet the water demand of rural population residing in remote and inaccessible terrain of Himalaya. Abundant water is available in the Himalayas, as the rain is plentiful but it is an irony the inhabitants still deprived of water even for drinking and other allied domestic need because of their uncomfortable access to these sources.

If the drinking water requirements of the people living in the remote rural hilly terrain are to be met in a cost effective way and eco-friendly manner, a strategy to conserve existing and revive the drying springs has to be made. Such a strategy when implemented successfully would solve the water associated problem to the people permanently.

To address this problem, Himalaya Sewa Sangh (HSS) and Himalaya Consortia For Himalayan Conservation (HIMCON) – two grass root voluntary organization with support of various national and international funding agencies has been undertaken the work of springs rejuvenation in Garhwal Himalaya (Tehri & Pauri) in last two decades.

The initiative undertaken in the recharge zone of the springs with appropriate interventions now resulted in water conservation and rejuvenation of traditional sources in Himalayan regions.

More than 45 Mahila Mangal Dals (SHGs), had actively participated in water, sanitation and other environment issues. Innovative rainwater harvesting technique was demonstrated in about 24 villages. 14 springs were revived and managed by the community benefitting 500 households.

6 springs has been regularly monitored with monthly discharge data and half-yearly water quality assessment. Clean and safe drinking water supply made available in the 16 villages either by repairing the defunct water supply hardware or by taking up appropriate interventions such as installation community based Slow-Sand- Filter (Mand Baloo Chhanna), Eco-san toilets. Recharge area treatment works such as construction of percolation pits and plantation of broadleaved species have been undertaken in 50 hectares.

Keywords: Drying Himalayan springs, Water scarcity, Garhwal Himalayas, Drinking water source, Slow Sand filter

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I. INTRODUCTION

A. *Why Spring Rejuvenation is a Gravely Needed In Himalayas ?*

Since time immemorial, Springs has served as a major and important freshwater source for domestic and agricultural use in Himalayan villages (Bartarya 1991; Bartarya and Valdiya1989; Negi and Joshi 2004; Pandit et al. 2007; Vashisht and Sharma 2007; NDF 2014).

The eco-geological labyrinth of Himalaya is under the grip of various natural and manmade environmental problems. In spite of being endowed with adequate rainfall, most part of Himalaya regarded as dry land as far as agriculture is concerned (less than 2% of land is irrigated), and water stressed in terms of easy access of water to the people. There is enormous evidence of geo-hydrological evidences that postulate the fact.

Valdiya and Bartarya (1989) reported that due to changes in land-use patterns and vegetation a there was about 40% reduction in spring discharge over a 35-year period (1951 to 1986) in the Kumaun Himalayan region.

They Inference that about 75% of the springs in the region are drying up and the average stream discharge has declined by~40%. . This has led to the increase in the distance of such water sources by 10 fold (from 200 meters to more than 2 km) in the previous two decades only (Singh, et al. 2002).

These changes are the reflection of the changes that the recharge zone of these water sources has witnessed. Vashisht (2008) indicated that, if springs and small seepage canals are managed properly in the Siwalik foothill regions of the Himalayas, water scarcity could be averted. Negi (2002) highlighted the urgency of systematic monitoring to aid the management of Himalayan springs. Mahamuni and Kulkarni (2012) identified that nearly 8,000 villages in the Himalayan region, were facing acute water shortages due to the drying up of springs.

Climate change and unplanned watershed management have led to a decrease in discharge in many Himalayan springs (Agarwal et al. 2012).Similarly, ICIMOD (2015) reported that, in the Nepal Himalayan region, a combination of biophysical (e.g., climate variability, changes in land use) and socioeconomic (e.g., spring maintenance) factors were responsible for the drying up of springs. Earlier Researchers like Bruijnzeel and Bremmer (1989) and Alford (1992) concluded that the current understanding of hydrological processes in the Himalayas is inadequate, and management plans prepared from inadequate understanding would not solve the problem of water scarcity.

Till now, no serious attempts have been taken in a planned way to regenerate the drying springs and Naulas in Uttarakhand which is still a vital natural source of drinking water in whole of Himalayan region. Instead, mammoth scheme of centralized pipe water supply system have been launched that failed to fulfill the requirement of the local people due to faulty planning, maintenance and lack of peoples participation in management.

It has been well recognized throughout the Himalayan region, about the needs and importance of revival and enhancing water yield of traditional water sources which can meet the water demand of rural people residing in remote and inaccessible terrain of Himalaya.

II. THE HENWAL RIVER VALLEY

Henwal River Valley lies in the central part of the Tehri Garhwal district of the Central Himalayas. The valley stretches from the Surkanda Range of mountains in the North to the Shivpuri in the East. Henwal is a spring n-fed river that takes its origin in the dense natural forests of the Surkanda Range and drains into the Ganga in Shivpuri, a few kilometers above Rishikesh while Shivpuri lies in the Pauri district of Uttarakhand.

The altitude of the Henwal valley ranges from less than 800 to above 3000 msl. The valley area comprises narrow belt of flatland or moderately undulated land along the Henwal River which is used for agricultural and drinking purposes. The upper areas are mostly covered with natural oak forests.

Large parts of the natural forests have been transformed into apple orchards. The famous Chamba-Mussoorie Fruit Belt lies in the upper reaches of the Henwal.

Henwal River is the main source of drinking water supply for rural and urban settlement of Tehri district. It originates from the Surkanda Hills about 33.9 km far from ‘Hill Queen – Mussoorie’. The catchment area of this River is delineated with latitude 30°24’-30°41’N and longitude 78°17’-78°21’E.

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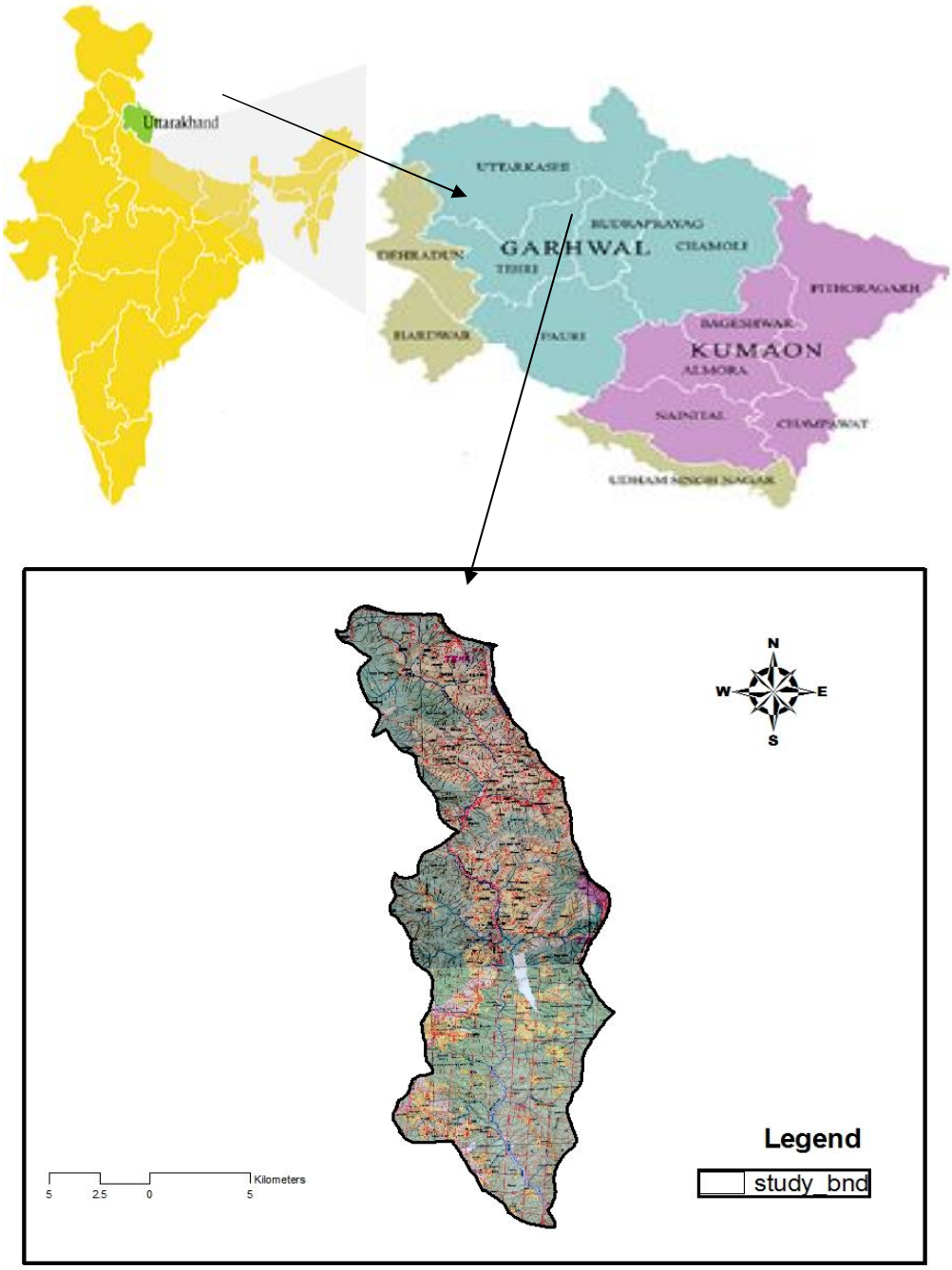

Fig 1. Location map of Study area of Henwal River Valley ,Uttrakhand

A. Drastic Changes In Land Use/ Land Cover In Henwal River Valley: A Comparative Case Study From 1965 To 2014.

Land use/ land cover change is critically linked to natural and human influences on environment. Keeping the above in view, the change detection Henwal Valley was done by using Post-classification change detection method (Singh, R.B.P & Singh, Perminder, 2015). The land use/ land cover maps prepared from two data sets i.e. Topo Map (Prepared by Survey of India in 1965) and Liss III Satellite Image (2014) were used for change detection.

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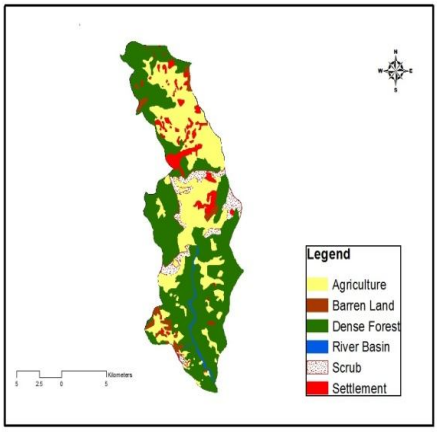

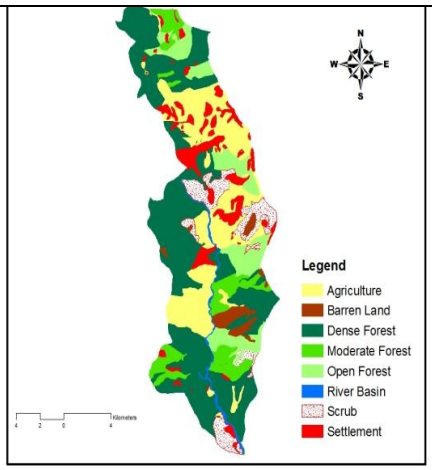

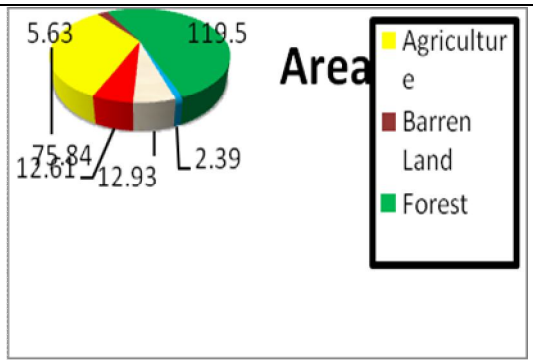

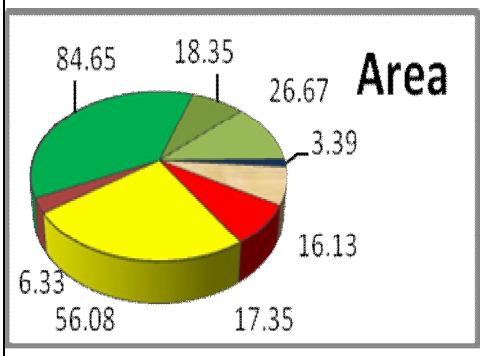

Fig-*2:* Land use/ Land cover map of Henwal River Valley (1965)

Fig-*3:* Land use/ Land cover map of Henwal River Valley (*2014*)

By comparing the respective maps (Fig.2 & Fig.3) of two years, a general scenario of the major changes that have taken place in the catchment was derived. (Table -1)

S#	Class Name	Area (sq km)		Area change	% change
		1965	2014		
1	Dense Forest	119.5	84.65	-34.85	15.22
2	Moderate Forest	0	18.35	-18.35	8.01
3	Open Forest	0	26.67	-26.67	11.64
4	Agriculture	75.84	56.08	-19.76	8.6
5	Settlement	12.61	17.35	4.74	2.07
6	River basin	2.39	3.39	1.0	0.43
7	Scrub	12.93	16.13	3.2	1.39
8	Barren Land	5.63	6.33	0.7	0.30
Total		228.95	228.95		

Table -1: Areas for change in different land use/land cover classes

From Table 1, it is quite evident that the land use/land cover pattern in the Henwal valley has undergone considerable changes from 1965 to 2014.

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Decline in water volume in River Henwal led to reduction in operation time of Drinking Water Supply Pump at Nagini.(Table-2)

Year	Hours of pump in operation
2000	24 hours
2006	19 hours
2007	17 hours
2008	13.5 hours
2014	Only 5-6 hours

Table-2 Decline in Operation time of Water Supply Pump
(Source: Personal communication from the authority)

III. SUSTAINABLE SUPPLY OF CLEAN & SAFE DRINKING WATER THROUGH COMMUNITY SLOW SAND FILTER IN THE VILLAGES OF HENWAL RIVER VALLEY – A HIMCON INITIATIVE

In the past one decade HIMCON has been organized a number of training programs while constructing the slow sand water filters and have also prepared a manual in Hindi for wider circulation among voluntary organizations and communities actively working in the Himalayan region. A total of 11 slow sand filters have been constructed in this phase in Henwal River Valley. The details of which is given below

Table-2: Details of Slow Sand Filters Installed In Henwal River Valley

S#	Name of the village	No. of SSF Constructed	Beneficiary Family
1.	Indwal Gaon	05	98
2.	Jhaldiyal Gaon	01	24
3.	Kumar Gaon	01	19
4.	Mundan Gaon	01	22
5.	Chamthari Gaon	01	25
6.	Chopriali	02	63
7.	Sabli	01	30
8.	Ranichouri	01	40
Total		13	321

A. Lingniyam-name-Tank - the origin of river Henwal

The term 'Lingniyam' locally referred to a plant called Lingra – belongs to pteridophyte class and are used for vegetables and 'tank' in Garhwali means a piece of land which is called 'Patta' in plain region. Lingniyame-name tank falls under a dense vegetation covered Reserve Forest Area, where canopy density is much higher than other surroundings. Due to dense forest cover in the upper reaches of mountain, a large numbers of springs have been originated from this forest. The water discharge of these springs has laid to the formation of a small stream i.e. Henwal River – a tributary of river Ganga. Indwal Gram Sabha (with six villages) is located in upper reaches of Henwal River. About 21 perennial spring sources have been also existed in the villages of Indwal Gram Sabha and are the major source of water for drinking and other domestic uses for the villagers. However, the discharge of these springs varied considerably and sometimes in drought condition water discharge reduced considerably to meet water need of the people. In 2004 - 2005, the people of this area experienced acute shortage of water for drinking and domestic need, mainly because of majority of these springs either dried up or discharge of these springs decline considerably, when people were supplied drinking water through tankers. Similarly water discharge in Henwal river also saw the poor discharge (please refer to pattern of water discharge in Henwal river) in summer months. Henwal River is the main source of drinking water supply (3-steps lift drinking water supply system) of Chamba Township and adjoining villages.Spring water is the main source of pipe water supply in the Indwal Gram Sabha. The source of this pipe water supply is located in the dense forest covered area on the mountain ridge, and it is about 3 – 4 km away from water storage tank constructed at Sursain-name-tank. Earlier spring water has been tapped and stored in water storage tank (40,000 liters capacity) built at Sursain-name-tonk. From this water storage tank it was only supplied to Kumar Gaon and Indwal

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Goan respectively. Earlier water supplied to these two villages were neither properly treated nor chlorinated, hence people becomes victim of diseases especially during summer and monsoon months. It was Shri Madan Singh, the Gram Pradhan who had constantly approached to HIMCON and requested for installation of 'community slow sand filter' for this storage tank, so that people could get clean and safe drinking water and protect themselves against waterborne diseases. In 2007, HIMCON constructed one SSF (Mand Baloo Chhanna) near this water storage tank. After installation of this filter, it was observed remarkable change in quality of drinking water as complain of waterborne diseases reduces considerably. After observing the benefits of SSF, Gram Pradhan make repeated approach to Jal Sansthan for another pipe water supply and storage tank because the diameter of old pipeline was very narrow (1/2 inch only), hence water could not be supplied to other four villages of this Gram Sabha. It was repeated approach and pressure created by Gram Pradhan and people of this area, Jal Sansthan finally sanctioned the new pipe water supply scheme. Under this scheme- a thick pipeline having diameter of one and half inch has laid down from a spring head at Lingniyma-name-tonk and stored in a newly built water storage tank (100,000 liters capacity) an Sursaine-name-tonk close to old tank. A large size Slow Sand Filter (SSF) was also installed at the spring head and filtered water directly stored in this tank. From this storage tank five separate pipelines laid down to cover all the villages of this Gram Sabha except Chamthari Gaon. Chamthari Gaon was not included in this scheme mainly due to its location in valley side. Due to high water pressure in the pipe, check valve could not able to control water pressure. Overall, water sources in Lingniyam-name-tonk are the main source of pipe water supply in the Indwal Gram Sabha.

B. Sursain-name-Tank (Indwal Gaon)

Sursain-name -tank is located on the flat ridge above the Indwal Gaon. Actually it is pasture land area. In the past it was believed that there was a natural lake existed here that become degenerated in due course of time. However remains of such a natural depression now restored through de-siltation activities under MGNREGA programme by the villagers. Both old and new water storage tanks are constructed at this area for pipe water supplies to all the six villages of Indwal Gram sabha.

C. Katkilisain-name-Tank (Indwal Gaon)

Katkilisain-name-tank is located above the main settlement area of Indwal Gaon. It is located just below the Sursain-name-tank – a flat ridge mostly used as pasture land by the villagers. Dense forest covers in this area. About 14 hectares of Van Panchayat chiefly dominated by oak are also existed. In Katkilisain-name- tonk, there is good agricultural terraces where peas and other cash crops are cultivated by the villagers of Indwal Gaon.

The farmers of Indwal Gaon also used this place for their summer settlement. About 10-12 families of Indwal Gaon live in their summer houses. Drinking water was a major problem for their stay in summer months. Only a tiny seepage locally called 'Katkili Dhara' were used for drinking water for people and their cattle. However, Katkili spring is a perennial water source but during summer months water discharge of this spring decline considerably.

People collect spring water stored in a earthy ditch. From potability point of view water of this spring was highly contaminated due to decaying organic matter. But people living in this area had no other choice but to drink contaminated water manly because there is no other water source in the surrounding. In 2008, HIMCON installed SSF at this source and filtered water is directly supplied to all the 12 families living in this area. After installation of SSF, water supplies to the community are clean and safe from potability and public health point of view.

D. Gamarkhud-name-Tank (Indwal Gaon)

Gamarkhud-name-tank is located just above the main settlement area of Indwal Gaon and about 30 family's houses are closely situated. One perennial spring locally called Gamarkhud Dahra existed in this tonk. Earlier spring water was neither treated or cleaned and directly stored in a tank with 1500 liters capacity. Stored water was distributed to all the 30 houses of Indwal Gaon. In 2007, HIMCON installed another SSF at the spring source and filtered water first stored in storage tank. After storage in tank, water is distributed to the household through pipeline.

All the house-hold has separate stand post. In Indwal Gaon, out of total 40 families living in this village, about 30 household has 3 pipeline tap-water connections and 10 families has 2 pipeline tap-water connections while 10 households who are living in upper reaches i.e. at Katkilisain-name-tank has only one pipeline tap-water connection.

Therefore, one can observe the drastic change in water access made in last couple of years through better management of water supply to meet drinking and other domestic need of the people. Before the launch of Arghyam programmes in the area, water was regarded as a scarce commodity and in summer months drinking water supplied through tanker. At present the villager get round the

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clock with clean and safe drinking water at their doorstep not only through one pipelines but majority of the families have more than 3 pipelines connection.

E. Kumar Gaon-name-Tank (Kumar Gaon)

It is located above the Kumar Gaon settlement area. There are two perennial spring sources existed in this zone i.e. Kumar Gaon Pani Dhara and Nagraj Pani Dhara. Both the springs are located along the natural drainage line locally it is called 'Kumar Khala'. Nagraj Dhara is located about 300 meters above the 'Kumar Gaon Dhara'. Water discharged from both of these two spring forms a small stream locally called 'Kumar Khala'. In 2006, this stream water was harvested for irrigation of crops. Under MGNREGA programme a cemented tank with a capacity of about 60, 000 was constructed near the Kumar Pani Dhara by the Gram Panchayat. As the location of this storage tank is on the steep slope and due to lack of slope stability, there appears a narrow slit in the tank and it becomes defunct in 2008. It has remained defunct since 2013, when HICON initiated revival of irrigation tanks in villages of Henwal river Valley. With the help of Mahila Mangal Dal (MMD) of Kumar Gaon this important water harvesting structure was restored with minor repair work. Now more than 12 farmers of Kumar Gaon has been directly benefited and started cultivation of cash crops/vegetables. Out of total 22 families living in the village, about 12 families are directly dependent upon this spring for drinking and other domestic need. According to the local people, this spring (Pani Dhara) never dries out even in extreme drought period, when majority of spring sources in the surrounding village were dried out, this spring meet out the drinking need of surrounding villages. Spring discharge has been diverted and stored in a 1500 liters cemented storage tank. From storage tank water has been distributed to 8 families of Kumar Gaon. Earlier water stored in this tank was neither properly treated nor cleaned; hence due to use of contaminated water people became victims of water borne diseases. Decomposed leaves, decaying silt, worms, frogs and protozoan's were commonly observed in drinking water supply. In 2008, HIMCON installed one SSF at the spring source and filtered water has been stored in cleaned tank and then supplies to 10 families separately through pipeline. Now user of this water proudly explained about the good quality of their drinking water. They get clean and safe drinking water supply round the clock at their doo step.


Overflow water from SSF installed near at Kumar Dahara is now stored in a 60,000 liters irrigation tank which was constructed in 2006 under MGNREGA. This tank became defunct in 2008 when a crack appears in the tank and became inefficient in water storage. In 2013, HIMCON revived this irrigation tank and now stored water is fully utilized by 12 farmers of this village for cultivation of vegetables and cash crops. Gram Pradhan of Indwal Gram Sabha has constantly made contact to various Govt. departments for construction of another water storage tank, so that each drop of Kumar Khal could be harvested and properly used

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for farming activities. Gram Pradhan showed the proposed site for irrigation tank which is located just above the Kumar Dhara and only waste water flowing from the Nagraj Dhara will be tapped in the proposed tank. In Kumar Gaon out of total 22 household in the village, 12 house hold have clean and safe water supply through taps with three separate pipe lines round the clock while 10 families have two separate pipeline tap water supply.

IV. CONCLUSIONS

The Spring rejuvenation initiative that had been taken up by the Himcon in Henwal River Valley in the past decades are now reaping benefits.The villages of the region, which earlier required water supply through tankers has now become water sufficient and are getting round the clock potable water supply by the springs that have been revived as a result of hard work of Himcon and Mahila Mangal Dals (MMD).The various intervention that had been taken for spring rejuvenation in the area includes construction of new recharge structures called locally as khals. Large scale Plantation of broad leaved tree species like Banj(Oak),Peepal etc. and maintenance of Green cover in the recharge areas of defunct springs. Beside that old water tanks or reservoirs are repaired and maintained to meet demand of agricultural water supply. Himcon had also installed its Slow Sand Filter (SSF)in various villages of Henwal River valley for providing access to clean drinking water to the vil. Due to Spring rejuvenation initiative the region which was once water deficient has now become water sufficient area. Most of the springs that had become defunct or seasonal in the past, has now revived with good water discharge round the year. Our Spring Rejuvenation model should be replicated on a large scale in the water stressed regions of the Indian Himalayas to attain water security and should be considered as a milestone in the conservation of the Earth's vital resource water.

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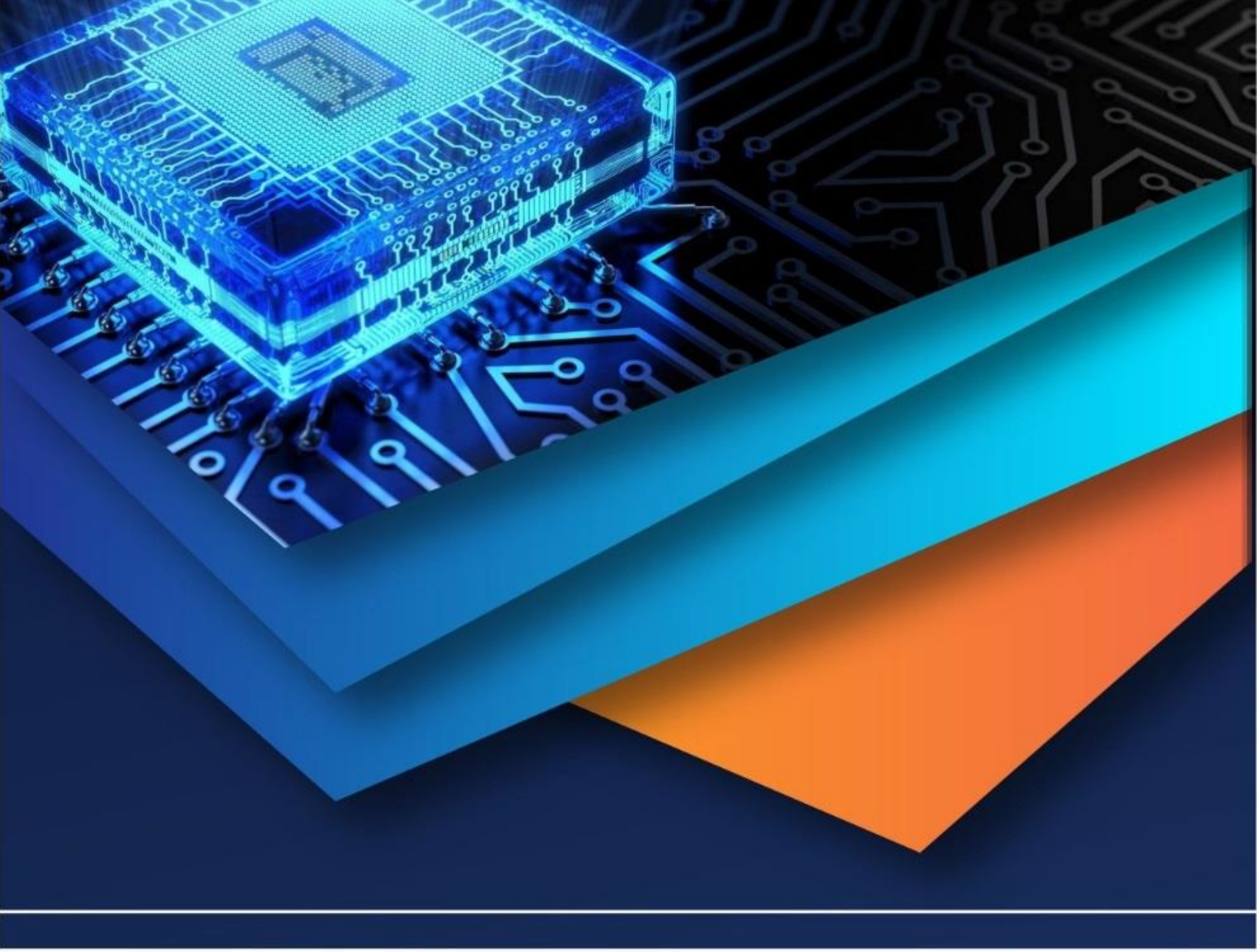

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