DCB BANK

A Report on

Outcome Analysis of the Project Jal Sanrakshan, Aurangabad, Maharashtra

Submitted by

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Contents

1. Background

Agriculture is the primary source of livelihood and 84% of the cultivated area is rain-fed of it, more than 30% of the state falls under rain shadow area in the State of Maharashtra (Economic Survey of Maharashtra 2017-18). The Marathwada region (comprising eight districts namely Aurangabad, Beed, Hingoli, Jalna, Latur, Nanded, Osmanabad and Parbhani) is one of the five most undeveloped regions in Maharashtra and it is facing the fourth consecutive drought since 2012-13 resulting in crop failures and decreasing incomes. According to the Groundwater Survey and Development Agency (GSDA), 1,844 villages have shown the steepest decline (over 3 meters) in the groundwater table and about 948 villages are from Marathwada. As a result, the region faces acute shortage water for irrigation and a particularly very serious shortage of drinking water. Both Rabi and Kharif crops have been hit in these areas with water scarcity taking a toll on humans and animals alike. Failure of crops like jowar, Napier grass, maize, among others, has triggered a serious fodder crisis, which has threatened livestock across the state[1].

Aurangabad district, located in the heart of Maharashtra, is known as a drought-prone district of the Marathwada region. In 2018, the district received only 56% of the average rainfall[2], and about half the villages in the district received less than 50% rainfall. Low and erratic monsoon in the district has negatively impacted farm livelihood as 73.83 percent3 population of the district is dependent on rain-fed agriculture. Cotton is the most important cash crop which occupies about 44% of the district's gross cropped area.

The major concern in the Sillod block is declining groundwater levels due to heavy dependence on groundwater during lean periods (December onward)[4]. Similarly among 9 blocks of Aurangabad district, Phulambri block has the lowest groundwater level i.e. 200 meters below ground level (m bgl)[5].

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[1] https://indianexpress.com/article/india/as-water-crisis-grips-marathwada-region-parbhani-civic-body-fines-local-residents-for-wasting- water-5662906/

[2] Average annual rainfall received during the monsoon period was 732.5 mm in Maharashtra (Source: IMD, 2015)

[3] District Census Handbook Aurangabad, Maharashtra 2011

[4] Report on Aquifer maps and ground water management plan, Soygaon and Sillod Taluka, Aurangabad District Maharashtra, CGWDB November 2016

[5] Ground Water Information Aurangabad District Maharashtra, CGWDB, 2013

2. About Project

Recurring droughts in the Marathwada region, have highlighted the urgent need for water conservation and increasing water availability through different water augmenting techniques.

S M Sehgal Foundation's team surveyed five villages of Phulambri and Sillod block to identify the scope of water augmenting structures. The team selected two villages, namely Wawna and Nidhona in Phulambri block and Hatti village in the Sillod block for groundwater augmentation. The S M Sehgal Foundation proposed to implement the groundwater augmentation project "**Jal Sanrakshan I**" in Wawna and Nidhona villages of Phulambri Panchayat and the "**Jal Sanrakshan II**" project in Hatti village of Sillod block.

The project was aimed at constructing 7 Nala bunds and 16 recharge wells to harvest and conserve 180 million litres of water annually, benefitting 787 households in the Wawna and Nidhona villages of Phulambari block. Similarly, construction of 2 Nala Bunds with a capacity to conserve 60 million liter of water annually, directly benefitting 80 households with over 400 persons and 300 livestock and indirectly benefitting the entire village, i.e. 3511 people living in 675 households in Hatti village of Sillod block.

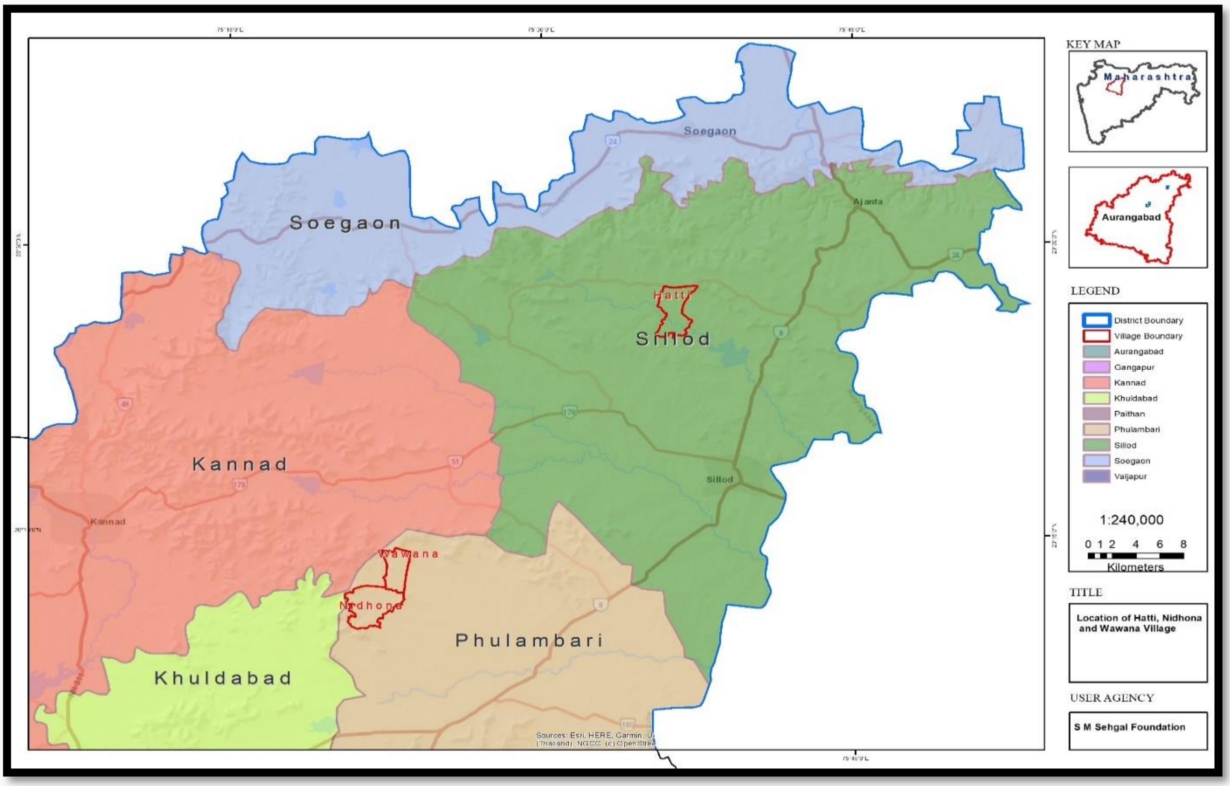
3. Project Objectives

The overall goal of the project was to make groundwater resources sustainable through a groundwater management approach. The project consisted water augmenting structures to harvest rainwater and channel it into the ground, which addresses the issue of groundwater depletion, while improving the volume and quality of groundwater in the long run, and providing water security for agriculture and households. The specific objectives of the study are as follows:

1. To check the technical feasibility of the CNB Sites using spatial (GIS) tools
2. To assess the impact of water availability on family income from agriculture
3. To assess the impact on agriculture through spatial technique and individual survey – change in crop type and pattern
4. To assess the ecological impact on vegetation/green cover using the geospatial data and tools
5. To assess the level of understanding of village development committee

4. Geographical Location

The project was implemented in three villages namely Nidhona, Wawna in Phulambri block and Hatti village in Sillod block of the Aurangabad district (shown in Map1). All three villages fall under drought hit blocks of the district and faces acute water scarcity in summer season. The location in Phulambri block is about 55 km from district headquarter and locations in Sillod block is about 125 km from the district headquarter.



Map 1: Location of Hatti, Nidhona, and Wawna Village

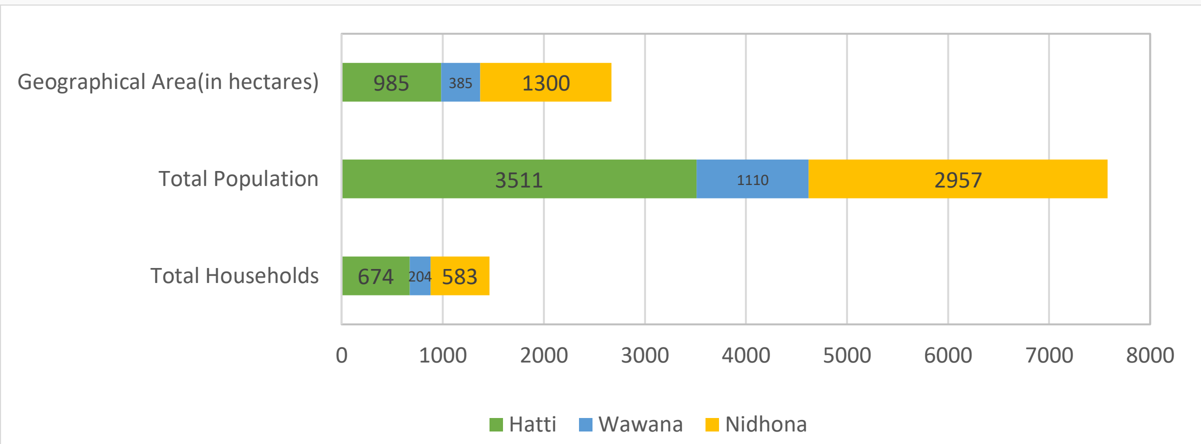


Table 1: Demographic Features of Hatti, Nidhona, and Wawna villages

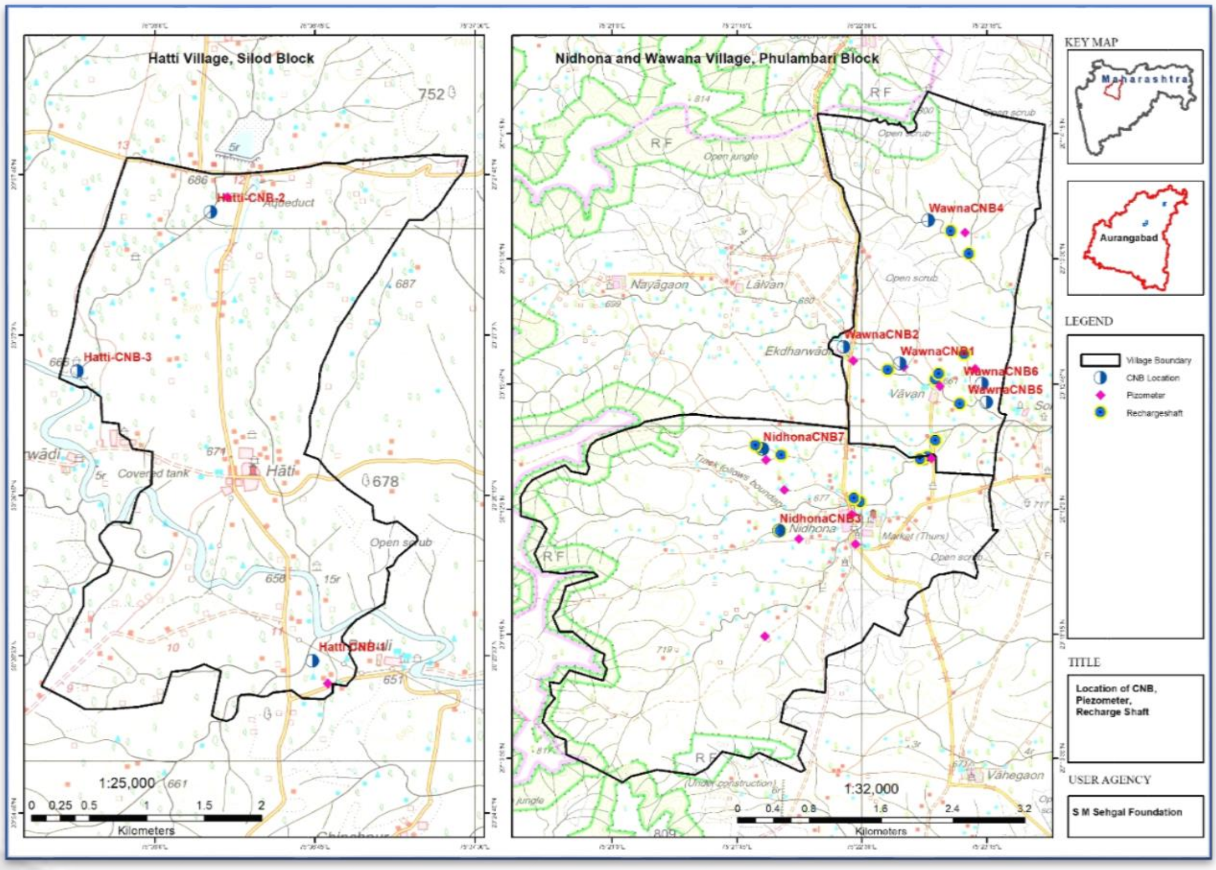
(Source: Census 2011, GOI) The geographical area of Wawna village is different from the reported in Census 2011.

5. Project Components

The project had two key components as described in the section given below

5.1. Groundwater recharge through water harvesting structures

Nala Bunds, which are also called as check dams, are helpful for harvesting runoff generated during rainy season otherwise which would find its way to the river or drains in the villages and finally flow out of the village boundary. It also helps in minimizing the chances of soil erosions and enhance ground water recharge. S M Sehgal Foundation team identified 2 locations for construction of Concrete Nala Bund in Hatti Village and 7 concrete Nala Bunds and 16 Recharge Wells in Wawna and Nidhona villages. The locations of these structures are marked in the map given below (Map 2).



Map 2: Location of CNB, Piezometer, and Recharge Shaft Overlaid on Survey Of India Toposheet

The location of the structure decides useful impact on ground water recharge and its coverage. Scientifically selected locations which are at recharge points of underlain aquifers provides encouraging and sustainable results.

5.2. Capacity building through Village Development Committee (VDC)

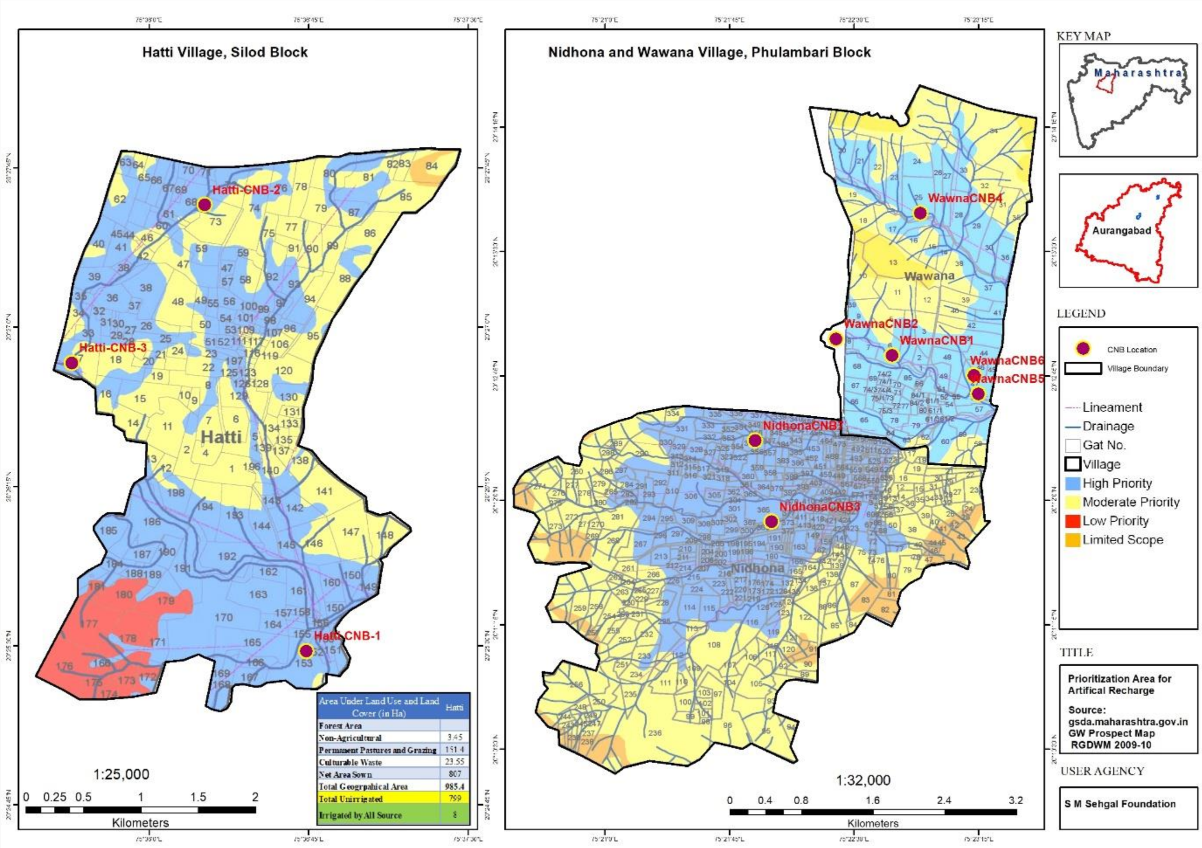
Under the project, one VDC in each village was formed where members are trained on water augmentation technologies, repair & maintenance of the structures created , and judicious use of water. Further, their capacity was built and awareness was created about various government programs and how to avail benefits from that program. In VDC women farmers were also given representation.

6. Outcome Analysis

6.1. Feasibility of Check Nala Bunds

As mentioned earlier, geographical location of the structure decides efficacy and beneficiary coverage. Therefore, to check the technical feasibility of the CNB sites, the GIS based spatial tools and data sets are used. The geographical positioning system (GPS) locations of CNBs were accurately located on satellite images with the help of Google Earth Images. The catchment of each site was demarcated using the Watershed Delineated Tool. The secondary data from Ground water survey and development agency (GSDA) of Maharashtra was utilised to find out the groundwater recharge priority area vis-à-vis location of CNB sites. The below map shows the location of the CNB sites overlaid on the priority area maps developed by GSDA for artificial recharge to groundwater. The blue colour indicates priority area whereas red indicates low priority and yellow limited scope.

All three CNB locations of Hatti Village and seven CNB sites of Nidhona and Wawna villages were accurately constructed in a priority area for artificial recharge.



Map 3: Location of CNB structure overlaid on high priority artificial recharge area in Hatti, Nidhona, and Wawna Villages

6.2. Harvestable Runoff Potential

There are 3 CNBs in Hatti, 3 in Nidhona, and 5 in Wawna villages. A detailed description of each CNB and its average harvestable water is given below. The runoff coefficient was obtained from the CN method for the individual catchment of each CNB.

Table 1: Details of Nala bunds in Hatti Village and runoff potential estimated

Name of Bund	Location	Net Catchment Area (sq mt)	Annual Rainfall (mm)+	Average Annual Runoff Coefficient*	Harvestable water (in mm)	No of the times structure received runoff**
Hatti CNB-1	20° 25' 28.556" N 75° 36' 44.310" E	2416989.09	936	0.26	140	12
Hatti CNB-2	20° 27' 34.709"N 75° 36' 15.584" E	663835.26	936	0.30	156	15
Hatti CNB-3	**20° 26' 50.000" N 75° 35' 38.000" E**	1805293.61	936	0.30	156	15

+ 2021 Annual Rainfall obtained from CHIRPS data
*Runoff coefficient is estimated from the CN method for 2021
**No times runoff occurred during 2021

Table 2: Details of Nala bunds in Wawna and Nidhona Village and runoff potential

Name of Bund	Location	Net Catchment Area (sq mt)	Annual Rainfall (mm)+	Average Annual Runoff Coefficient*	Harvestable water (in mm)	No of the times structures received runoff
Nidhona CNB7	20° 12' 21.769" N 75° 21' 54.246" E	478704.47	895.00	0.28	160	15
Nidhona CNB3	20° 11' 52.439" N 75° 22' 0.183" E	837167.33	895.00	0.26	139	16
Wawna CNB1	20° 12' 52.550" N 75° 22' 43.768" E	1099645.20	914.31	0.23	130	12
Wawna CNB2	20° 12' 58.580" N 75° 22' 23.460" E	14493828.5	914.31	0.23	150	18
Wawna CNB4	20° 13' 44.000" N 75° 22' 54.000" E	1766410.43	914.31	0.21	138	16
Wawna CNB5	20° 12' 38.686" N 75° 23' 14.917" E	Not computed				
Wawna CNB6	20° 12' 45.327" N 75° 23' 13.359" E	Not computed				
				Total		

+ 2021 Annual Rainfall is obtained from CHIRPS data
*Runoff coefficient is estimated from the CN method for the year 2021
For Wawna CNB 5 and 6, the catchment area and runoff coefficient were not determined

The spatial analysis of harvestable runoff potential is considerably larger than the storage capacities of the structures, it indicates there is significant quantity of rain water is available for storage and recharge. This analysis supports claim of considerable benefit to the ground water.

6.3. Change in Area Under Crop Cultivation

The construction of Check Bunds will surely increase the local surface water availability as well as groundwater due to recharge to the groundwater table. This increase in water availability will envisage the expansion of area under irrigated crops and changed cropping patterns from low value crops to high value crops. To estimate the change in Rabi crops during pre and post-construction of the structure, the Sentinel images (remote sensing data), and the Google Earth Engine platform was used. The Sentinel satellite image of the Rabi season from 2019 to 2022 were analysed to identify and estimate the crop acreage. The crop area, particularly from March 2019 to February 2022 (reflect irrigated winter crop), was estimated for Hatti, Nidhona, and Wawna Villages in the district.

Figure 1 shows the red colour field as the vegetation and figure 3 shows the crop coverage from March 2019 to 2021 and February 2022. As seen in figure 2, the crop area in Hatti village particularly during the rabi season has been increased from 146 ha in March 2019 to 603.8, 383.77, 643.87 ha in March 2020, 2021, and February 2022 respectively.

The increase in crop area during February 2022 is 4.4 times of March 2019, indicating considerable increase in area under rabi crops in Hatti Villages. This change is contributed to enhanced water availability in the village.

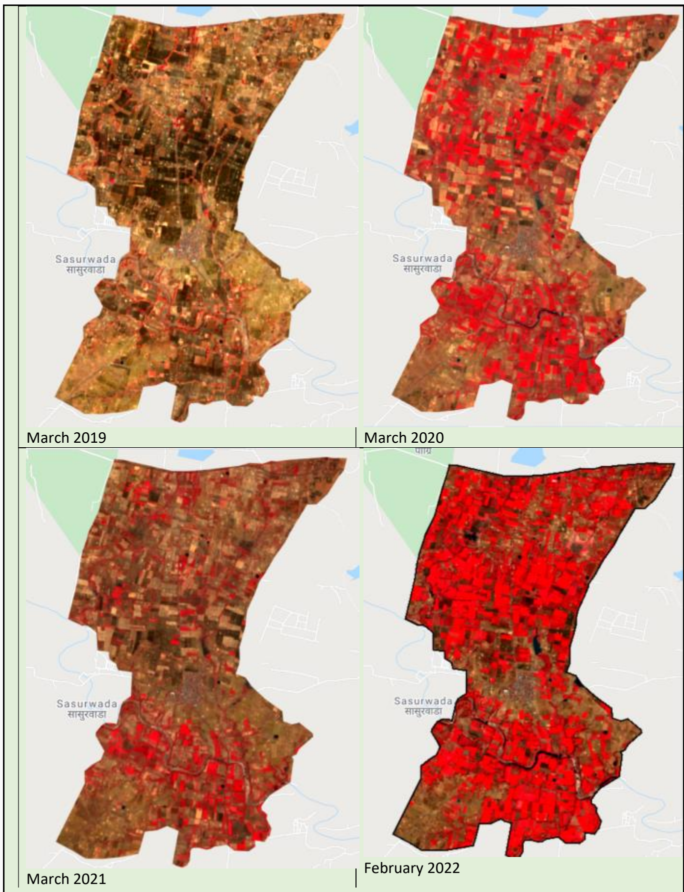


Figure 1: FCC[6] Sentinel Image of Hatti Village, Sillod Block, from March 2019 to 2021 and February 2022. The red colour field is the crop cover/vegetation.

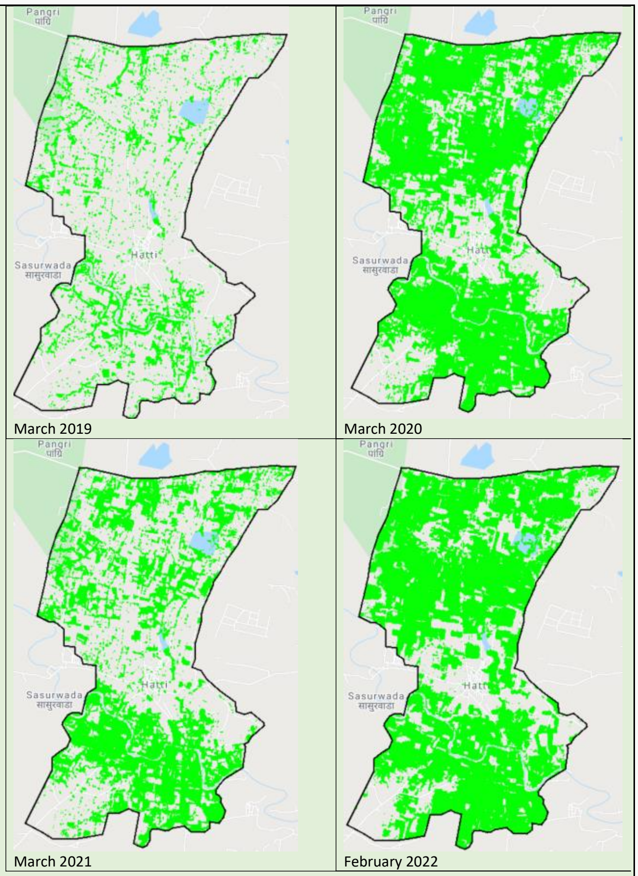


Figure 2: Crop cover in Hatti village in Rabi season from March 2019 to 2021 and February 2022

Similar estimates of rabi crop area are observed in Nidhona and Wawna villages as obvious from figure 3 and figure 4

Rabi crop cover has been increased from 212.65 ha in March 2019 to 606.9, 515.04, and 612.06 ha in March 2020, 2021, and February 2022 respectively in Nidhona village. The increase in cropped area during February 2022 is 2.87 times of March 2019, indicating the substantial increase of rabi crops in Wawna Villages.

Rabi crop cover particularly in Wawna village has increased from 139.43 ha in March 2019 to 427.51, 388.41, and 369.1 ha in March 2020, 2021, and February 2022 respectively. The increase in crop area during February 2022 is 2.64 times of March 2019, indicating the substantial increase of rabi crops in Wawna Villages.

[6] FCC is False Colour Composite used to enhanced the vegetation (Red Colour) representation compared with soil or other land cover

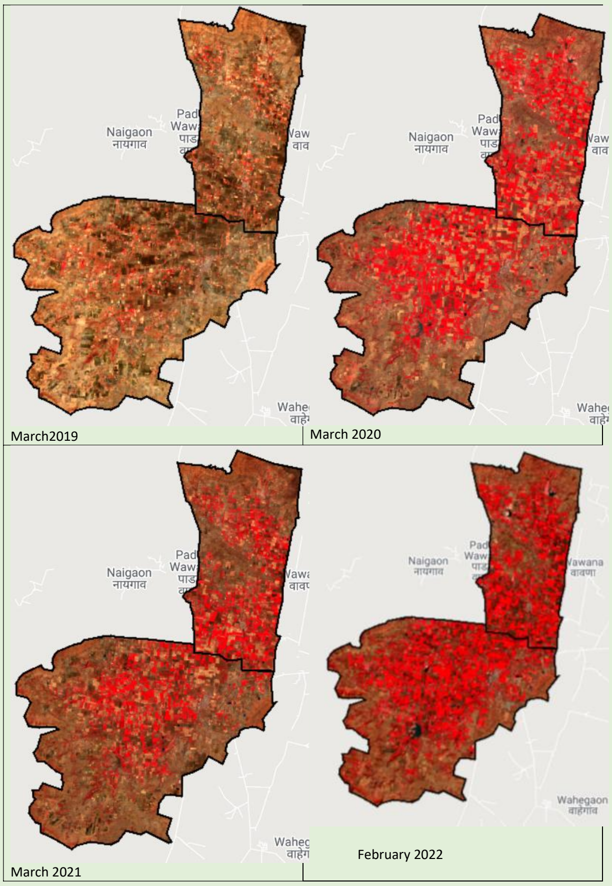


Figure 3: FCC Sentinel Image of Nidhona and Wawna Village, Phulambari Block, from March 2019 to 2021 and February 2022. The red colour field are the crop cover.

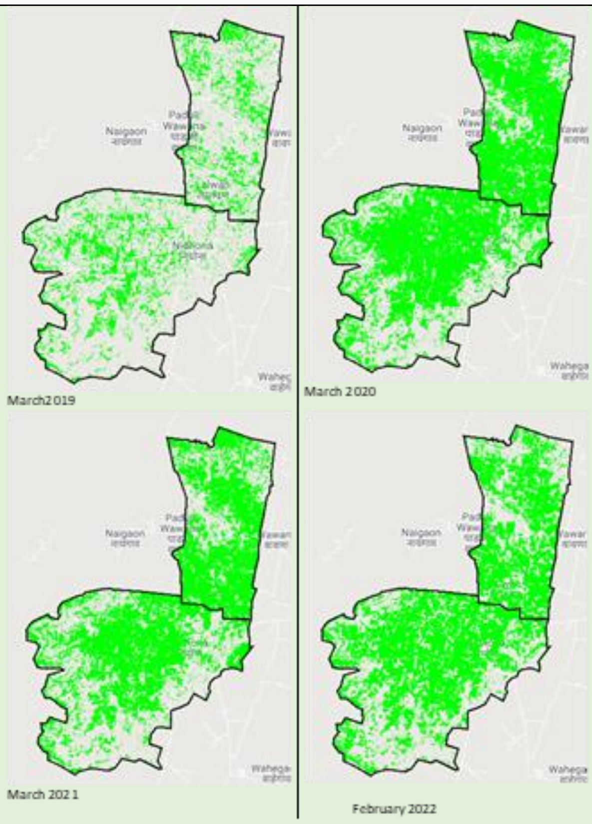
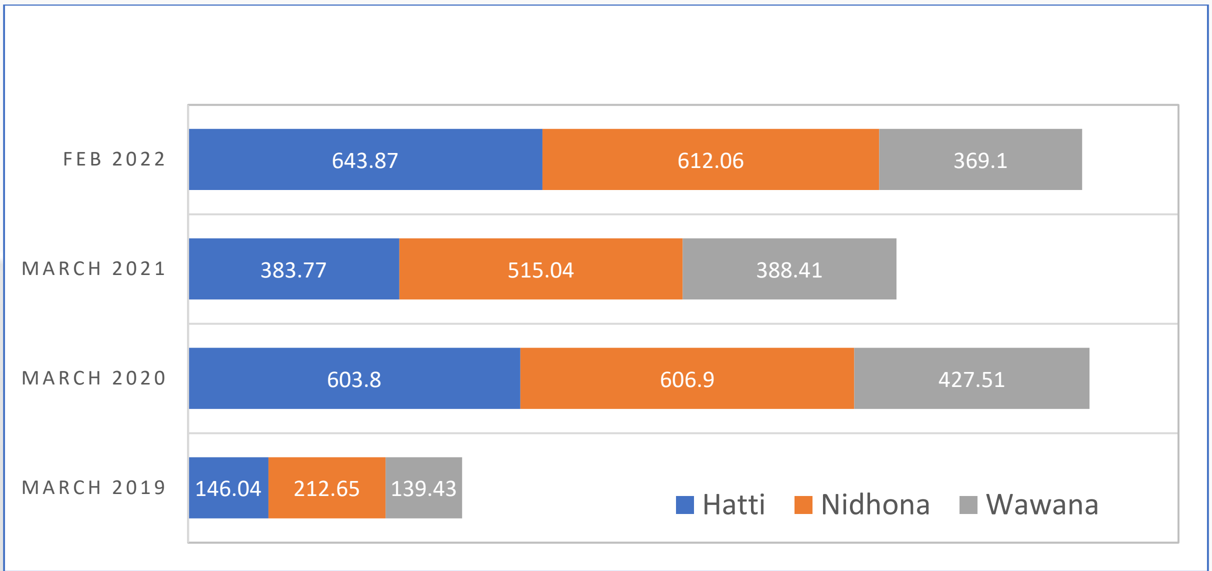
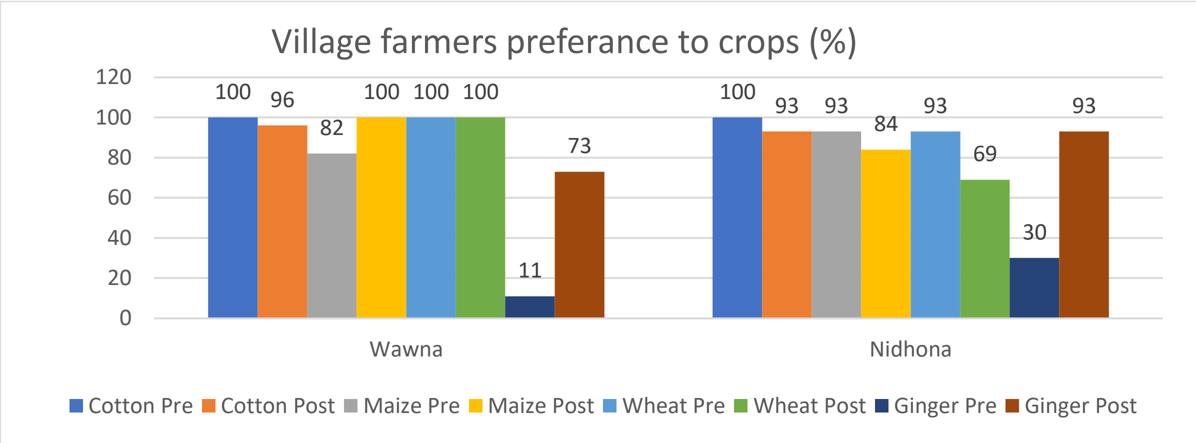


Figure 4: Crop cover in Nidhona and Wawna village in Rabi season from March 2019 to 2021 and February 2022



The survey data collected and analysed indicated that in Nidhona village, kharif area under conventional crops such as cotton, maize and wheat is showing reducing trend whereas rabi area under ginger crop is increased by 210%. This shows that farmers are assured of enough water availability to fulfil ginger crop water requirement. Ginger is 9-12month crop which require considerable number of irrigations and is cultivated by those who have assured enough water in the well. The increasing trend shows due to construction of check dams well has enough water. The same trend is observed in Wawna village where increase in ginger area is 5.63 times more than preconstruction period.



6.4. Change in Green Cover

The Green cover is defined as '' natural or planted vegetation covering a certain area of terrain function as protection against soil erosion, protecting fauna and balancing the temperature''. Primarily the Green cover analysis was performed to visualise the impact of soil-water conservation work in the three villages of Aurangabad district of Maharashtra.

The analysis utilised the public domain data and Geospatial cloud platform of Google Earth Engine (GEE). The main source of the satellite data was

1. The Sentinel 2A-surface reflectance satellite product for 2019 and 2022,

2. European Space Agency (ESA) World Cover 10 m 2020 product.

The satellite data were the first filter for cloud-free data. In the second stage cloud, free monthly data was mosaic using the mean function. In the last stage, monthly Normalised Difference Vegetation Index (NDVI)[7] was calculated for all years of 2018-2022. Accordingly, the monthly NDVI profiles for permanent vegetation were generated. From the NDVI profiles, months and ndvi threshold values were selected and used in classification of plantation/tree pixels. *The NDVI value is positive for vegetation ranging from 0.1 to 0.8.*

[7] NDVI is band index (Band Ratio) and it is calculated as (NIR-RED)/(NIR+RED)

As seen in the figure 6, November 2019 onward the NDVI value was always greater than 0.27 for plantation/tree cover as compared to crops (figure 7) as compared with agricultural fields. NDVI values greater than 0.27 for each month were used to discriminate the tree/planation from agricultural fields for 2019 and 2022.

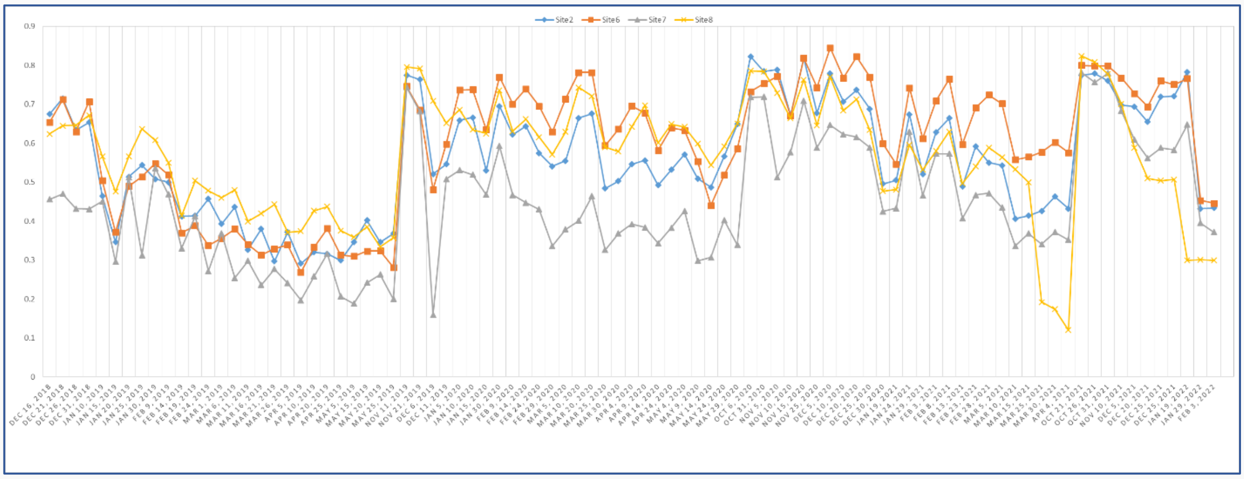


Figure 6: NDVI profile generated for planation/tress for period 2018-2022

Higher value indicate the healthy green vegetation. Figure 7 shows the crop NDVI value less than 0.2 in May 2019, however the NDVI value of greater than 0.6 at crop maturity stage in year 2020 and 2021 indicate the healthy crops. The continuous high value of NDVI for long period is indication of the good crop growth of medium to long duration crops like Cotton, Sugarcane or double crops.

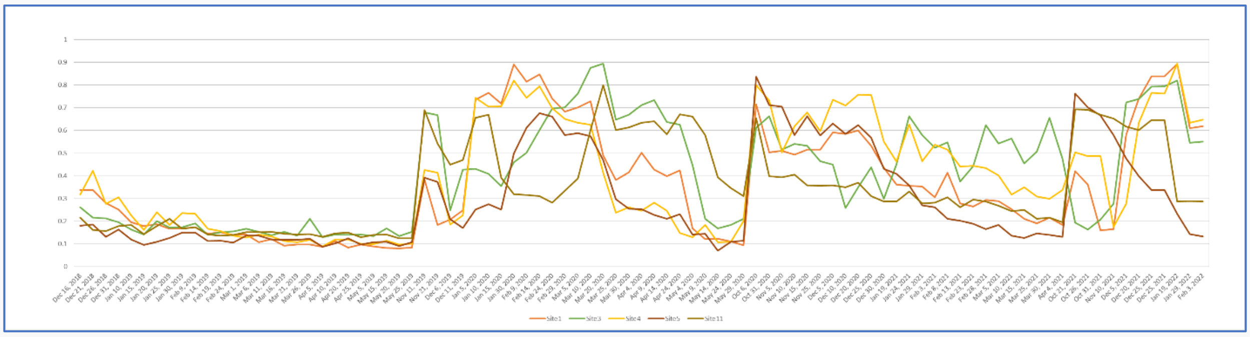


Figure 7: NDVI profile generated for agricultural fields for the period 2018-2022

Figure 8 depicts the final image of green cover for March 2019 for Hatti Villages. It is found that the Green Cover area is estimated to be 52.28 ha as of March 2019 and 65.43 ha as of January 2022. This indicates 25.15 % increase in green cover in 2022 as compared to 2019. One of the reasons for this could be increased soil moisture availability and enhanced water in the well through conservation work carried out under the project.

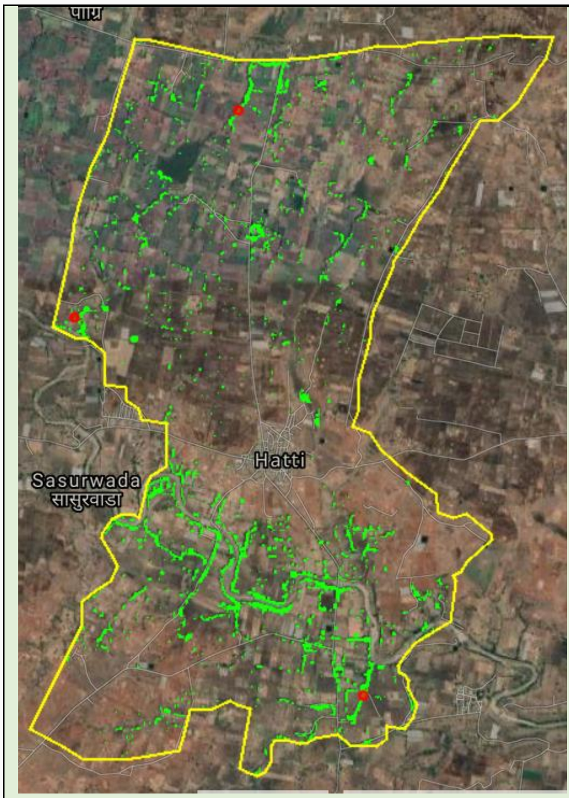


Figure 8: Hatti village Green Cover* as of March 2019

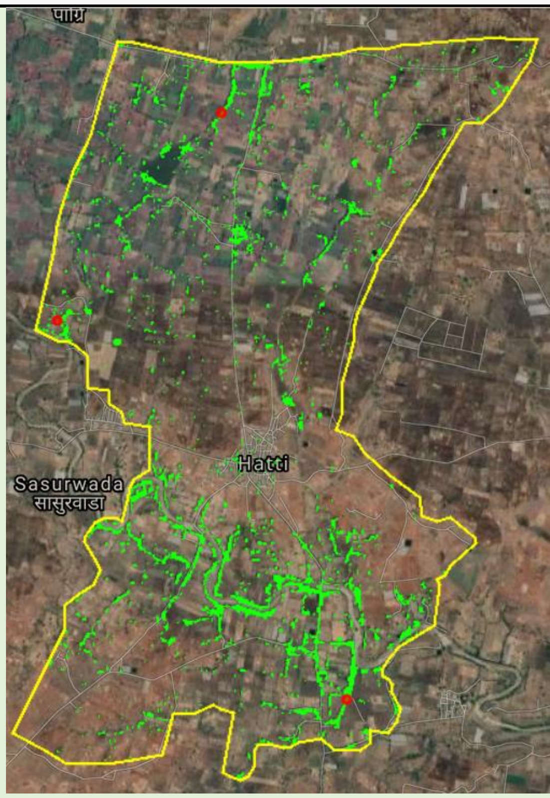


Figure 9: Hatti village Green Cover** as of January 2022

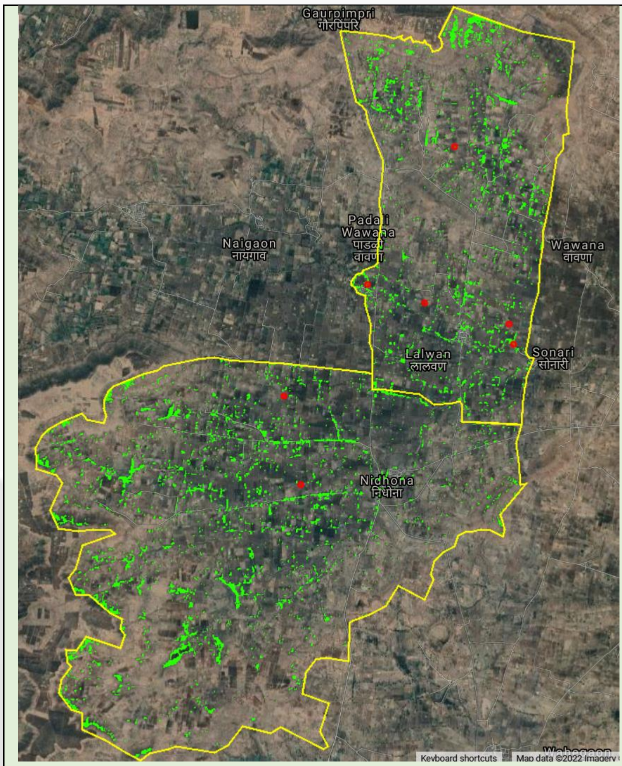


Figure10: Green Cover* as of March 2019 in Nidhona and Wawna Villages

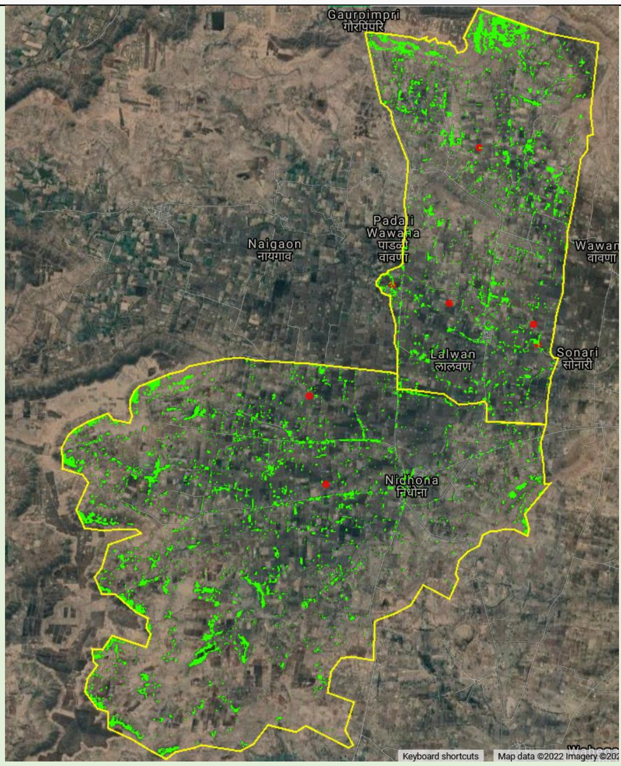


Figure 11 : Green Cover** as of January 2022 in Nidhona and Wawna Villages

*Estimated from Jan, Feb, March, April, and May 2019 sentinel images

**Estimated from April, Dec 2021, and May 2020 sentinel images

Similarly, Figure 10 shows the green cover for March 2019 and Figure 11 shows green cover for January 2022 for Nidhona and Wawna Villages. It is found that the Green Cover area estimated to be 76.51 ha as of March 2019 and 101.25 ha as of January 2022. This indicates the 32.34 % increase in green cover in 2022 as compared to 2019 in Nidhona Villages.

The green cover area of Wawna Village found to be 46.26 ha in March 2019 and 68.58 ha in January 2022, indicating the 48.25% increase in green cover in 2022 than 2019 in Wawna Village.

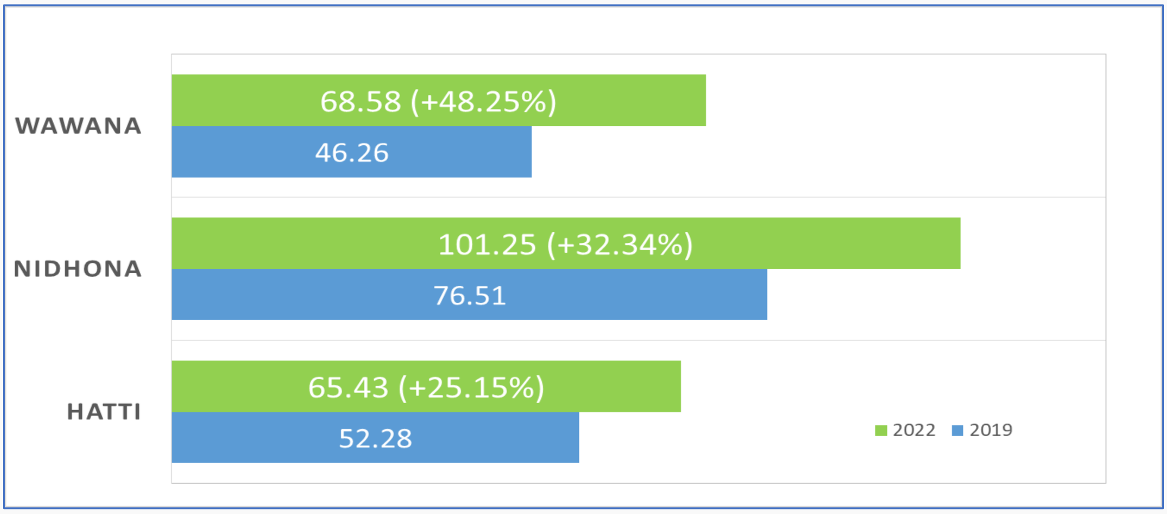


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Figure 12 : Green Cover Area (in ha) of Hatti, Nidhona and Wawna Village from 2019 and 2022

In specific case, the CNB no-2 is constructed in upper areas of Wawna panchayat. It is constructed on major drain of the village contributing considerable amount of runoff during rainy season.

Using satellite data and google engine tools a 500mt impact zone of CNB-2 is demarcated. The data analysis indicated that a rise of 19.72ha area under rabi crop (February end 2022) as compared to preconstruction period i.e Early March 2019. Both the data are from Rabi season indicating 1.6 times rise in rabi crop. The dark green indicates area under rabi crops.

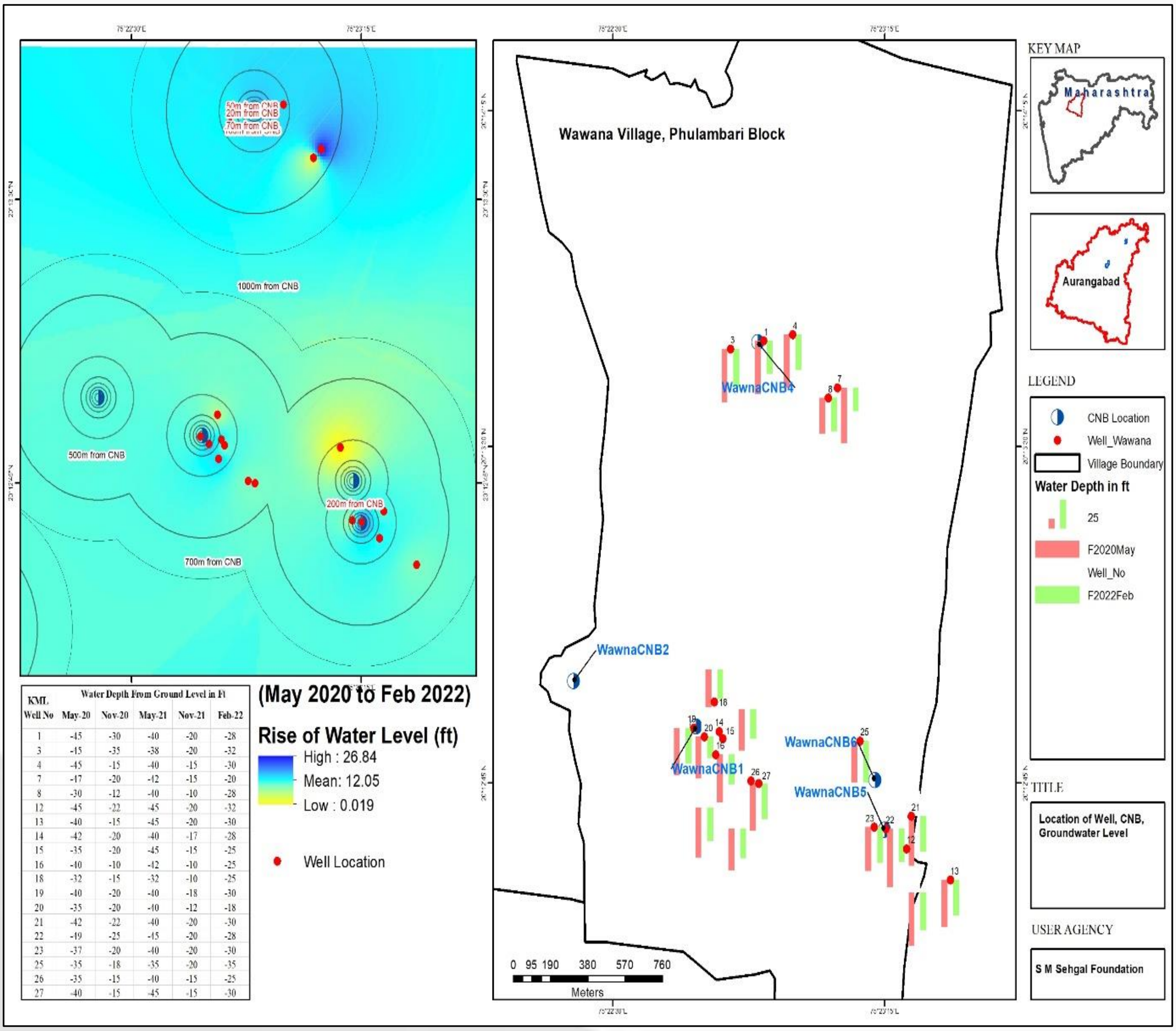
Rabi Crop Area of Wawana CNB2 Buffer of 500 m for March 2019 = 11.96 ha	Rabi Crop Area of Wawana CNB2 Buffer of 500 m for February end 2022 = 31.68 ha

6.5. Change in Groundwater Situation

The figure 14, indicates the rise in well water levels in the Wawna village. The rise is in the range of 0 ft to 27 ft from pre-construction period i.e May 2020 to February 2022. The average rise is found to be 12 ft in the wells located around CNBs.

The red bars in fig-14 indicates water level in May 2020 and green bars indicate levels in February 2022. The rise of water level is more prominent up to 500-700 m distance from the CNB (Top left image in the figure 14, Blue colour), however there are few sample wells (e.g. well no 25) which does not show any improvement. This might be due to poor geological condition restricting the underground water movement.

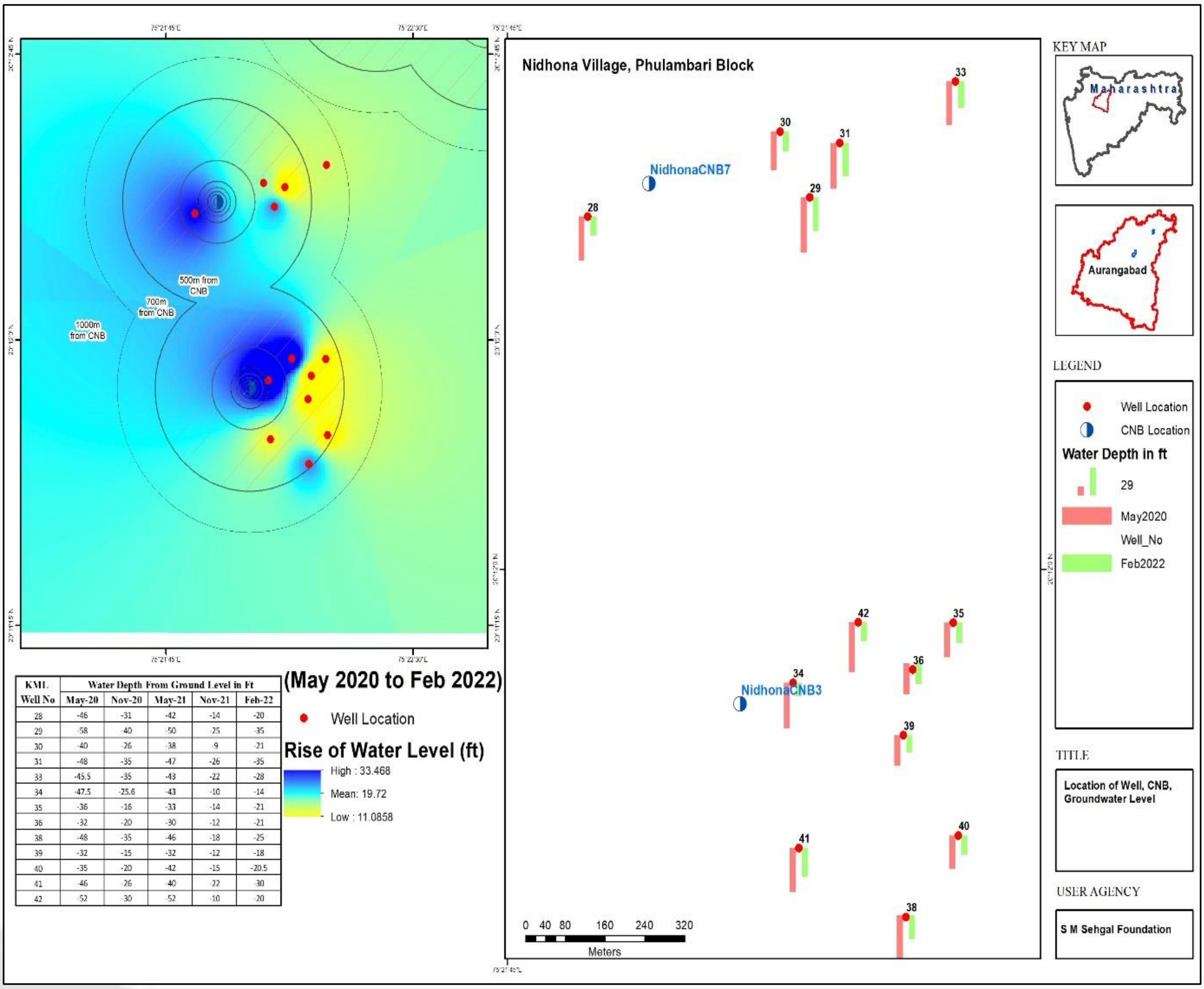
The table (bottom left) indicates year wise water levels (Below ground) for the observation wells monitored in the Wawna village.



KML Well No	Water Depth From Ground Level in Ft May-20	Nov-20	May-21	Nov-21	Feb-22
1	-45	-30	-40	-20	-28
3	-15	-35	-38	-20	-32
4	-45	-15	-40	-15	-30
7	-17	-20	-12	-15	-20
8	-30	-12	-40	-10	-28
12	-45	-22	-45	-20	-32
13	-40	-15	-45	-20	-30
14	-42	-20	-40	-17	-28
15	-35	-20	-45	-15	-25
16	-40	-10	-12	-10	-25
18	-32	-15	-32	-10	-25
19	-40	-20	-40	-18	-30
20	-35	-20	-40	-12	-18
21	-42	-22	-40	-20	-30
22	-19	-25	-15	-20	-28
23	-37	-20	-40	-20	-30
25	-35	-18	-35	-20	-35
26	-35	-15	-40	-15	-25
27	-40	-15	-45	-15	-30

Figure 14: Rise of Water Level in Wells Located around the CNB of Wawna

In case of Nidhona village, the rise of water levels is in the range of 11 ft to 33 ft (figure 15) from pre-construction period i.e May 2020 to post-construction (February 2022). The average water level rise is found to be as good as 20 ft. The increase in water level is uniform (Top left images in figure 15). The wells located within a distance of 200 m from the CNB has showed high rise. The significant water level increase is observed in few wells located within 200-500mt distance. This might be due to restricted movement of the water in a particular direction on account of change in geological formation. The overall it indicates significant rise in water levels in observation wells located at varied distance.



KML Well No	Water Depth From Ground Level in Ft				
	May-20	Nov-20	May-21	Nov-21	Feb-22
28	-46	-31	-42	-14	-20
29	-58	-40	-50	-25	-35
30	-40	-26	-38	-9	-21
31	-48	-35	-47	-26	-35
33	-45.5	-35	-43	-22	-28
34	-47.5	-25.6	-43	-10	-14
35	-36	-16	-33	-14	-21
36	-32	-20	-30	-12	-21
38	-48	-35	-46	-18	-25
39	-32	-15	-32	-12	-18
40	-35	-20	-42	-15	-20.5
41	-46	-26	-40	-22	-30
42	-52	-30	-52	-10	-20

Figure 15: Rise of Water Level in Wells Located around the CNBs constructed in Nidhona village.

6.6. Changes in Water Availability and Family Income

This objective was assessed on the basis of field survey and qualitative information collected during focussed group discussions with VDC members. A sample size of 39 beneficiaries selected on the basis of their farm location from the constructed CNBs. A care was taken while selecting survey sample, it should have beneficiaries of different landholdings such as small, marginal, and big land owner. Few farmers from upstream side of the structures were also included. The respondents were thrown the basic question to determine indicators such as Changed in irrigated areas, GW level, Water availability, and livelihood.

The result of all respondents was compiled, synthesised and indicator were determined. The 93% of the respondent were of opinion that there is an improvement in groundwater level, increase in area under irrigation and an improvement in livelihood. However, significant i.e 67% of the respondents experienced the increase in water availability. The average income has increased to Rs.1,28,000 from Rs. 86,900 in Nidhona whereas it has increased to Rs. 1,13,400 from Rs. 83,400 in Wawna village of Phulambari. The average rise of 47% in Nidhona and 36% in Wawna. The difference in rise is due to crop selection and land holding pattern.

The average recuperation rate (it is time taken to reach water level to its original position) of the well has improved from 23hrs before construction of CNBs to 12 hours post construction in Nidhona village whereas in Wawna village it is 5 hrs to 3 hours. This indicates considerable ground water recharge in the project villages. The significant improvement is contributed to appropriate site selection and construction of recharge wells. The higher recuperation rate in Nidhona is due to its geographical location and underground geological formations. As compared to lower reaches in a watershed upstream reaches always have comparatively less ground water. The phenomenon is observed here, Nidhona is in upstream reaches whereas Wawna is lower reaches of a watershed. Therefore, Wawna has more benefits in terms of groundwater availability.

6.7. Drinking Water Security:

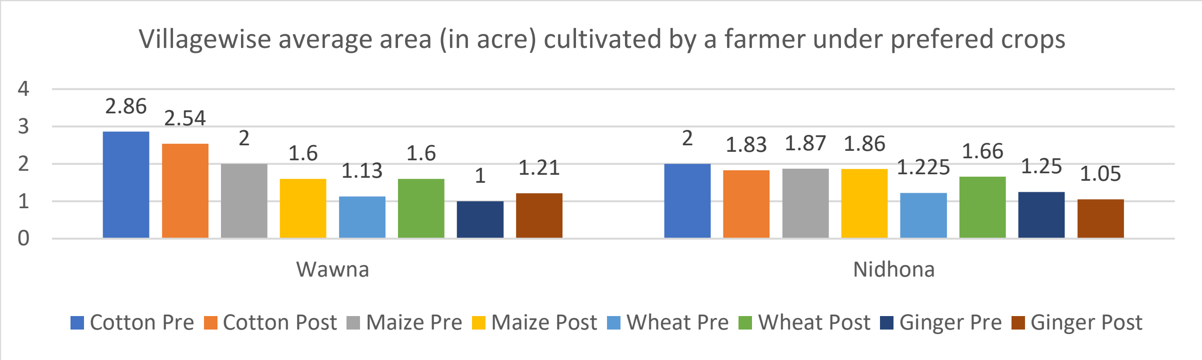
When asked about any change or improvement in drinking water availability 90% respondent mentioned that their drinking water problem is completely resolved. Whereas only 8% said their problems in partly resolved. It clearly indicates farmers recognises benefits of CNB in meeting their drinking water needs.

6.8. Change in Crop Choices

In rainfed areas like Aurangabad farmers are rarely get chance to cultivate high value cash crops that requires irrigations. Continued below average rainfall considerably depleted ground water levels, some wells even dry before onset of monsoon. In recent 2-3 years' rainfall is good and construction of check dams has recharged ground to the great extent.

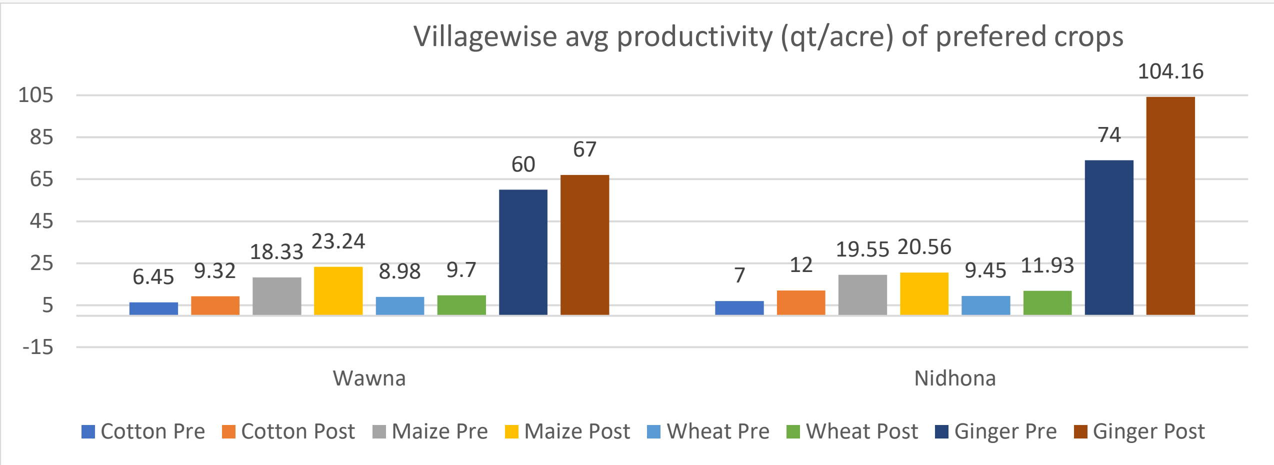
Assured water availability in the well led farmers to grow crops of their choice. The survey data compiled and analysed indicated that in Wawna village where 5 CNBs are constructed average area cultivated under conventional crops such as cotton & maize by individual farmer is showing decreasing trend whereas average area under rabi crops such as wheat and ginger is showing rising trend. This clearly indicates due to enhanced ground water availability farmers were comfortable about irrigation so cultivated wheat on about 18% more area whereas in case of ginger they increased area by 21%. Since ginger is sown in the rainy season so area under rainy season crop is showing decreasing trend.

In case of Nidhona village this increasing trend is observed in wheat crop. Area under kharif crop almost remained same or the change was not significant.



The enhanced ground water availability not only increased water levels in the well but also helped to increase crop productivity. The timely and enough irrigation avoided water stress on growing crop. This has resulted into rise in productivity. Also, it can't be denied various trainings organised on improved POP has also helped farmers to improve nutrient management. Rainy season crop which does not require applied irrigation, rise in crop productivity implies good nutrient management by farmers and if provided then protective irrigation. In case of rainy season crop rise in crop productivity is observed in the range of 16 to 58%.

The rabi crop productivities are increased in the range of avg 17 to 26%. The percent rise was more in Nidhona village than Wawna village.



6.9. Capacity Building of VDC

The focused discussions were conducted with members of the VDCs of all three villages. The below photograph was captured during the meeting with VDC members. Many VDC members were presented their opinion and experience on VDC training and awareness programmes organised by SM Sehgal Foundation team in their respective villages. All VDC members asserted the importance of awareness of many government schemes viz; Nanasaheb Krushi Sichai Yojana (POKHARA), Sukanya Samriddhi Yojana (SSY), Pradhan Mantri kisan Samman Nidhi Yojana (PMKNY), Ayushman Bharat Yojana (ABY), Mahatma Phule Jan Aroyog Yojana, and MNREGA schemes. As per eligibility, all members of the VDCs have taken benefit of 1 or 2 available schemes and support their livelihood. The members have considerable knowledge on water conservation structure, maintenance, and management of rural irrigation infrastructure. They were exposed to various repair and maintenance tips/practices of water harvesting structures and recharge shafts.

With the support of VDC, many villagers have availed the benefit of POKHARA, SSY and ABY for various needs of their family members. The SSY scheme was the most popular and all eligible families have registered and opened their daughter's accounts at the nearest Postal Office. Nanasaheb Krushi Sichai Yojana (POKHARA) is the second most popular scheme in all three villages and many villagers have availed irrigation equipment such as drip, pipe, motor, and other irrigation facilities.

7. Findings

All the water harvesting structures were built on the priority area for artificial recharge demarcated by Maharashtra State Ground Water Surveys and Development Agency. Therefore, there is significant impact on enhanced ground water availability.

The runoff analysis conducted using GIS based modelling indicated that all CNB structures could get filled more than 8-9 times during the monsoon period. This indicates there is enough water available for storage and recharge. The number of fillings is indicating structure with respective storage capacity would store rain water 8-9 times of its individual storage capacity.

The groundwater table has shown an improvement in water level after the construction of the CNB and recharge shaft. The average rise of 12ft is observed in Wawna village whereas 20ft rise is observed in Nidhona village. Significant rise in observation wells is noted in the wells located up to 700mt from the structure.

The construction of the Nala Check Bunds and recharge shaft has indicated the improvement in green cover in 2021-22. In Hatti village increase is observed 25.15% whereas 32.34% is observed in Nidhona village. The maximum rise was 48% in Wawna village. This maximum rise signifies that Wawna has got maximum benefit due to construction of check dams.

Similarly, as a result of an increased water availability and augmentation in groundwater, rabi area has significantly increased from 2019 to 2022 in all three villages. The rise is observed in the range of 2.64 to 4.41 times of the rabi cultivated area in pre project period i.e 2019.

Farmers admitted that after construction of CNBs, they have enough water to irrigate winter crop and cultivate summer crops. Also, their drinking water problem is considerably resolved.

During interaction it has noticed that farmers have considerable awareness about water conservation, use of improved irrigation practices. Many uses drip system to irrigate their crop.

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