CommunityLedVillageLevel Climate Adaptation Planning

Preparedundertheproject

Participatorygroundwatermanagementtoaddress water scarcity due to climate variability

BlockFulambri,DistrictChhatrapatiSambhajinagar (Erstwhile Aurangabad),Maharashtra

GrassRootsActionforSocialParticipation(GRASP)

ChhatrapatiSambhajinagar(Erstwhile Aurangabad), Maharashtra

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Contents

AbbreviationsandAcronyms

AB	Amygdaloidal basalt
AFPRO	ActionforFoodProduction
CB	Compact basalt
CBO	CommunityBasedOrganisations
CPR	Common Property Resources
CSR	Corporate Social Responsibility
FGD	Focus Group Discussion
FPO	FarmerProducerOrganisation
GIS	Geographic Information System
GoI	GovernmentofIndia
GoM	GovernmentofMaharashtra
GP	Gram Panchayat
GRASP	GrassRootsActionforSocialParticipation
GWP	Global Water Partnership
HTAB	Hydrothermally altered basalt
ICRISAT	InternationalCropResearchInstituteforSemi-AridTropics
IGWDP	Indo-German Watershed Development Programme
IMD	IndianMeteorologicalDepartment
IWP	India Water Partnership
IWDP	IntegratedWatershedDevelopmentProgramme
KVK	KrishiVigyan Kendra
MSL	MeanSeaLevel
MSSM	MarathwadaShetiSahayyaMandal
NABARD	NationalBankforAgricultureandRuralDevelopment
SHG	Self Help Group
VAB	Vesicularamygdaloidalbasalt
VWMC	Village Water Management Committee
WUG	Water User Group

CommunityLedClimateAdaptationPlanning

BlockFulambri,DistrictChhatrapatiSambhajinagar(Aurangabad),Maharashtra

1. Introduction

Adaptation refers to the adjustments in human and natural systems in response toactual or expected climate stimuli or their impacts that moderate harm or exploitbeneficial opportunities (according to IPCC, 2007).

IPCCdefinesadaptivecapacityastheabilityofasystemtoadjusttoclimatechange (includingclimatevariabilityandextremes),tomoderatepotentialdamages,totake advantage of opportunities, or to cope with the consequences.

InthecontextofMarathwadaregionofcentralMaharashtra,whererecurrentdroughts are having increasingly severe impacts on the community, a Village Level Climate Adaptation Plan (VLCAP) is viewed as a localized strategy designed to help the local communitiesadapttothechallengesposedbyclimatechange,particularlythoserelated to water scarcity and droughts. It involves a combination of identifying climate-related vulnerabilities,developingcommunity-drivensolutions,andimplementingsustainable practicestomitigatetheadverseeffectsofdroughtsonwaterresources,agriculture, livelihoods, and overall well-being. Given high vulnerability of drought prone regions to climate change, VLCAPs are crucial in building resilience at the grassroots.

1.1 AdaptationStrategies

In basaltic areas of central India, where agriculture is highly vulnerable to climatevariabilitythatisadverselyaffectingthewaterresources;vegetation;crops;livestock; andpeopleinthepastfewdecades,adaptationcanmeanseveralstrategiestosafeguard the livelihoods of rainfed farmers, such as:

- **Agriculturerelated:**changinglanduse,changingcroppingpattern,changingcrops orsoilmanagement,reducingsoilevaporationlosses,improvingseedresearch,etc.
- **Water related :** Rainwater harvesting, induced groundwater recharge, conservation, changing the water use practices, management of dykes or dams, redistribution ofwater to avoid scarcity, behaviour and rules of water use, improved irrigationmethods, etc.
- **Social :**It refers to the strategy of sharing losses by strengthening social supportnetworks, insurance, or social programmes.

Nationalpriorities: NationalActionPlanonClimateChange(NAPCC)forIndia, launchedin2008,emphasisesonsomeoftheabovestrategies.Therelevantamong thoseare:improvementinwateruseefficiencyunderNationalWaterMission, afforestationofdegradedforestlandsandtheextensionofforestcover,National MissionforSustainableAgriculturesupportsclimateadaptationinagriculture,through developmentofclimate-resilientcrops,expansionofweatherinsurance,mechanisms andinnovativeagriculturalpractices.AllthesecontextsguidedtheAdaptation Planning process in the present project in Fulambri cluster.

1.2 Short-andLong-termstrategies

Ashort-termplanistomanageimmediateclimaterisksandmitigatetheimpactsof current climate change events such as a drought, whereas a long-term adaptation planaims to increase and sustain resilience against future climate risks and embed climateadaptation in overall development processes. The present project emphasized a longtermapproachfocusingoninvestmentininfrastructure,institutions,andknowledge-buildingtowardssystemicandtransformativechangeswithaviewtoreduce vulnerabilitiesovertime.Atthesametime,theprojectroutinelydesigned,promoted and implemented short-term adaptation measures such as agronomic practices, in-situsoilmoistureconservationandsoilhealthduringdryspellsanddroughts.

This document is based on the systematic efforts of Grass-Roots Action for Social Participation(GRASP)carriedoutduring2022-24withagoalofincreasingresilienceof smallholder farmers against climate variability through participatory groundwater management. This initiative was supported by Global Water Partnership – South Asia (GWP-SA) and India Water Partnership (IWP) under their global theme of"Climate Resilience through Water". It covered five villages from Fulambri block of District ChhatrapatiSambhajinagar (erstwhile Aurangabad) in central Maharashtra.

S No	GramPanchayat	Villagescovered	Population	Households	Geographic area,ha
1	AdgaonKhurd	AdgaonKhurd	1,090	215	392.0
2	Murshidabadwadi	Murshidabadwadi andVitthalwadi	1,180	206	375.8
3	Ranjangaon	Ranjangaon	1,155	224	583.3
4	Sultanwadi	Sultanwadi	1,003	212	309.6

Climateadaptationplanningwasamaincomponentoftheprojectwhichculminated into development of village-level plans as described in this document.

2. PlanningProcess

Theprojectemphasizedonaparticipatoryandcommunity-centricapproachto preparingtheclimateadaptationplansbyinvolvinglocalstakeholdersintheprocess.It ensuredthatthepeoplewhoaredirectlyaffectedbyclimatechangehaveacentralrole inidentifyingrisksandsolutionsthatarecontext-specificandculturallyappropriate.

Towards preparation of the village level adaptation plans, GRASP adopted a four-step approach.Itsfoundationwaslaidinyear2022bywayofformationoftheVillageWater Management Committees and their capacity building. The four steps include :

- Trainingandcapacity buildingofVWMC
- Hydrologicmonitoring,waterbudgetingandwateruseplanning
- Observationandevidencebasedproblemanalysis
- Adaptationplanningexercise

2.1 Trainingandcapacitybuilding

Objectives : Training and capacity building of the community and the Village Water ManagementCommitteeshasbeenanimportantpillarofthisprojectwhichwasdriven by two objectives, namely,

- Toincreasetheknowledgeandcapacityofcommunitiestoadapttoclimate variability and change, and
- Tocontributeexperiencesinintegratingclimatechangeadaptationinlandand water management in drought-prone areas towards knowledge building.

Topicscovered: Trainingandcapacitybuildingcoveredfourmainareasofhydrology, groundwater,assessmentandbudgetingofwaterresourcesandplanning.Thesetopics were explained in the initial training programmes conducted during year 2022, and refreshertrainingsessionswereconductedin2023,priortotheplanningexercise.

- **Hydrology:**Thisareacoveredthebasicunderstandingofhydrologiccycle,its componentsandtheirmeasurement.Focuswasmainlyonrainfallandrunoff, together with various forms of water storage in the system.
- **Groundwater:**Thistopiccoveredtheoccurrenceofundergroundwaterintherocky formations typically found in central Marathwada region. The VWMC members were given special practical training in the field while carrying out the well inventory and the well water measurement.
- **Water resources assessment :**This topic covered the quantitative aspects of hydrologiccycleanditsmeasurement.Youthidentifiedandtrainedasbarefoot water technologists during the last year played an important role in assisting theVWMCmembersintheassessmentmethods.

2.2 Hydrologicmonitoringandwaterbudgeting

Objectives: Tobuildtheunderstandingofthecommunityonmethodsofmeasurement of water in their village and build their skills in measuring rainfall and storages. These formed the basis for vulnerability and risk assessment.

Approach : Together with the *Jaldoots*(barefoot water technologists), the VWMCmemberscollectedrainfalldatafromraingaugestationsandcarriedoutmeasurement of well water levels. These observations were discussed in the respective villages toassess the rainfall-recharge relationship and water availability on seasonal basis. Theseexercises were useful is understanding its relevance to rainwater harvestinginterventions.

Useofdata: Monitoringstreamflows(waterquantity)helpedinassessingseasonal andlongtermeffectsonwateravailabilityinthewatershed.Wellwaterleveldatawas corroborated with groundwater availability. These were used for crop planning for rabiand summer.

Waterbudgetingwasanimportantstepintheprocess,whichdealtwithasystematic method of identifying, classifying, verifying, summarizing, interpreting, and communicating water resource situation in the village. A simplified water balance modelwasusedintheanalysisintheprojectvillages,andbasedthereon,theVWMCs could discuss the optimal use of available water.

Water use planning was carried out in form of a collective crop planning exercise wherein the VWSC and the farmers decided on the crops to be taken in Rabi and summer seasons based on the groundwater availability in their wells. The first water budgetingandwateruseplanningexerciseswerecarriedoutinfiveprojectvillagesin year 2022, and it became a regular feature during the next two years.

Allthesestepsgreatlycontributedtothecommunity'sunderstandingontheexisting vulnerabilities and risks associated with climate change, particularly regarding rainfalldistributionandwateravailability.Italsohelpedthemunderstandtheimpactsof droughts,irregularrainfall,andfloodsonagriculture,livelihoods,waterresources,and the overall well-being.

2.3 Observationbaseddiagnosis

Preparations for planning : Systematic analysis of the problem is the key to identifying anysolutions.Priortothevillageleveladaptationplanningexercises,specialtraining and orientation sessions were conducted in each village with the help of experts from GRASP and the faculty from two academic institutions. Further, support was mobilised from experienced resource persons from KVK, Kharpudi, Jalna and GSDA, Aurangabad for facilitating the pre-planning workshops. These workshops revisited the experience ofandknowledgeaccumulatedduringthelasttwoyearsbythemainstakeholdersfrom monitoringofdataonrainfall,runoff,wateravailabilityinwells,croppingpatterns,and farmers'preferencesforcertaincrops.Suchreviewandrecapitulationhelpedsharpen the understanding of these key stakeholders on droughts and in identifying or refining the coping strategies.

Hydrogeology study : This was an important step in gathering information andknowledgeonthegroundwaterbemodifiedonthebasisofthehydrogeologyand aquiferstudyfindings.Mappingofaquifersandassessmentofgroundwaterpotential wasdonebasedonthedetailedhydro-geologicalstudyinthefivevillagesofthe cluster.Openwellswereidentifiedforwater-levelmonitoringandassessingthe present water use pattern. The findings were graphically represented in form of mapsandcharts,whichmadeiteasyforthecommunitytounderstandtheoccurrenceand complexbehaviourofgroundwaterintheirvillageanditsvicinity.

Itisproposedtocarryoutthewellwaterlevelmonitoringregularlyinfuture,which willbringinnewerobservationsandhelpinassessmentofgroundwaterpotentialin real time and undertake collective crop planning or water use and management planning accordingly.

2.4 Participatoryplanningexercise

TheparticipatoryplanningexercisewasconductedbytheVWMCandJaldootsineach village under guidance of GRASP. The exercise had three main steps, namely, compilationofallexistingknowledgeabouttheclimateactionsasthehomework,field assessment for identification and detailing of climate proofing interventions, and thirdly, discussion and finalisation of these plans in Gram Sabha.

Homework : The planning exercise was based on the understanding and knowledge gathered by the team in form of various studies, past water budgets and crop plans. The findings of hydrogeology study provided an important foundation for planning. In the first step, the VWMC and Jaldoots discussed these prior findings and their current understanding,someofitdepictedonmaps.Theyconductedthreeseparatemeetings-onewiththefarmersgroups,onewiththewomenfarmers,andthethirdwiththeyouth andGramPanchayatmembers-todiscusstheTransectWalkexerciseanddetermineits dates.Duringthesemeetings,theydiscussedthepurposeandstructureoftheTransect Walkandtheneedforreviewingthegroundsituationtoprepareadroughtactionplan.

Field-based planning :A Transect Walk exercise was conducted on the pre-planneddatesandtimes,whereintheVWMCandthemenandwomenfarmersvisitedvarious spots and studied the present situation of existing soil water conservation structures aswellaspotentialfortakingupnewactivities.Afterthevisit,theydiscussedtheneeds for repair and renovations of existing structures as well as taking up new soil waterconservationworks.Theyreceivedvaluableguidanceandtechnicaladvicefromthe technicalteamofGRASPintheprocess.Theydepictedtheirfindingsandsuggestions onlargescalevillagemapsforpresentationintheGramSabha.

Gram Sabha : In the third step, these plans depicted on the map were presented and discussed in the Gram Sabha for suggestions and modifications. These plans, with relevantmodifications,wereapprovedbytheGramSabha,andsubmittedtotheGram Panchayat for further action.

A few days prior to conducting the Gram Sabha, preliminary meetings were held in differenthabitations,mainlytoappraisethevillagersontheimportanceoftheexercise andtoencouragethemtoparticipateintheGramSabha.Thisstrategyworkedandthe turnout at the Gram Sabha was significant.

Theinitiativewasimplementedoverthelastthreeyearsinfivevillagesfallinginfour GramPanchayats.Thedetailsofthereportarepresentedinfourstand-alonereports, organised Gram Panchayat wise.

3. ClimateAdaptationPlan-VillageAdgaonKhurd

BlockFulambri,DistrictChhatrapatiSambhajinagar(Erstwhile Aurangabad),Maharashtra

Climate Adaptation Plan is essential to safeguard the livelihoods of rainfed farmers in drought prone areas of India, where agriculture is highly vulnerable to climate variability.Byfocusingonsustainablesoilandwatermanagement,cropdiversification, climate-resilient crops, and capacity-building, the plan can help farmers adapt to changing conditions and build resilience in their farming systems. Active involvement of farmers, supported by access to knowledge and entitlements, will ensure that the adaptation strategies are successfully implemented, leading to enhanced agricultural productivity and long-term sustainability in these vulnerable regions.

Acknowledging these imperatives, the project adequately emphasized on preparatory work,asexplainedinthefirstsectionofthischapter.Thesecondsectioncoversthekey findings of the hydrogeology study and its relevance to the adaptation options. The third section presents the community-led adaptation plan with its recommendations.

3.1 Preparatorywork

3.1.1 Reviewofexistingpractices

Indroughtproneareas,theruralhouseholdshavebeenspontaneouslyusingseveral risk management strategies against climate induced stress. Such micro level strategieslargely included natural resource management (soil and water conservation), farm-levelagronomic measures (like in situ soil moisture management and water use practices),non-farmactivities(diversification)andsocialmeasureslikemutualhelp.A participatoryreviewofsuchconventionalcrop-levelandvillagelevelnaturalresource managementadaptationmethodswascarriedoutineachvillage,whichprovidedthe basisforpreparingadaptationplansintheprojectvillages.Itwassupplementedby guidancebyexpertsfromKVKsatKharpudi(Jalna)andGandheli(Aurangabad).In addition,periodicguidancebytheofficialsfromAgricultureandGroundwater Departmentsprovedusefulinformingasolidfoundationfortheadaptationplanning.

3.1.2 Hydrologicmonitoring

Thegroundwaterlevelfluctuationwerestudiedbymonitoringwaterlevelsinwellsto understand the seasonal and spatial depletion in relation to the rainfall in the respectiveyears. These observations were corroborated with the hydrogeology study conductedduring 2023-24.

3.1.3 Hydrogeologystudy

The groundwater assessment was carried out in the five project villages as a part of hydrogeologicalstudy.Itwasfoundthatthegroundwateryieldestimate(105.43ham) invillageAdgaonisfarhigherthantheestimatedgroundwaterlevelsatpresent(16.23 ham).Itmaybenotedthatthiswaspartlyduetothelimitedinfrastructureavailablefor storage and recharge, and partly due to low rainfall in the last year (drought conditions).

3.1.4 Waterbudgeting

Preparationofwaterbudgetwastheprecursorofadaptationplans.Itwascarriedout bycalculatingthebalancebetweeninflowandoutflow,andthewaterrequiredforsoil to become saturated. Estimates of groundwater recharge and groundwater storage werecorroboratedwiththewellwaterlevelsdatacollectedtwotimesintheyear.

3.2 SituationalAnalysis

3.2.1 AboutVillageAdgaonKhurd

Village AdgaonKhurd is located at 20^{o}06’37” N Latitude and 75^{o}33’20”E Longitude in FulambariblockofDistrictChhatrapatiSambhajinagar(Erstwhile Aurangabad)andiscoveredin SurveyofIndiaToposheet46-P/12(Fig1).Spreadoverageographicareais392ha,the villagehasapopulationof1090belongingto115households,with10.4%belongingto ScheduledCastes.Ithas352.4haareaundercultivation,outofwhich36.7ha(10.4%)is irrigated.

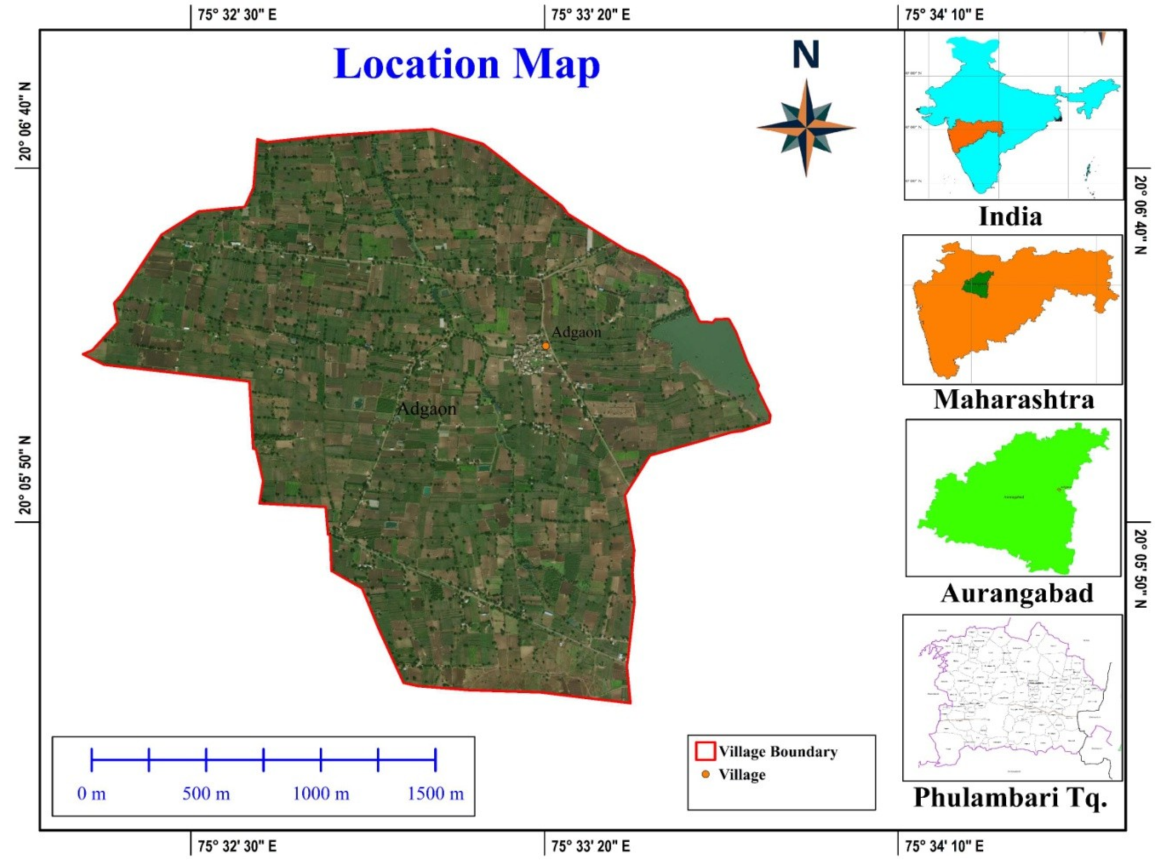

Fig.1LocationMapofVillageAdgaonKhurd

3.2.2 Topography andDrainage

Village Adgaon has a gently rolling topography with a gentle slope from the South to theNorth.Theelevationdifferenceof20metersfromRL635mto615mMSL(Fig2).

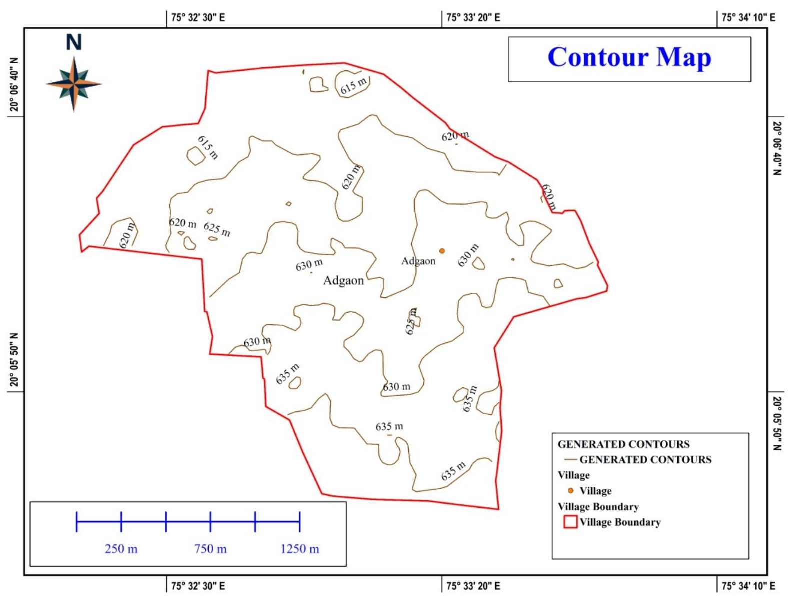

Fig.2ContourMapofVillageAdgaonKhurd

One small nalla originating in village Girsavali and Pirbavda in the South passes throughthevillageandflowsintoVillageSelgaonontheNorth.ItmeetsRiverGirija further down in the North (Fig 3).

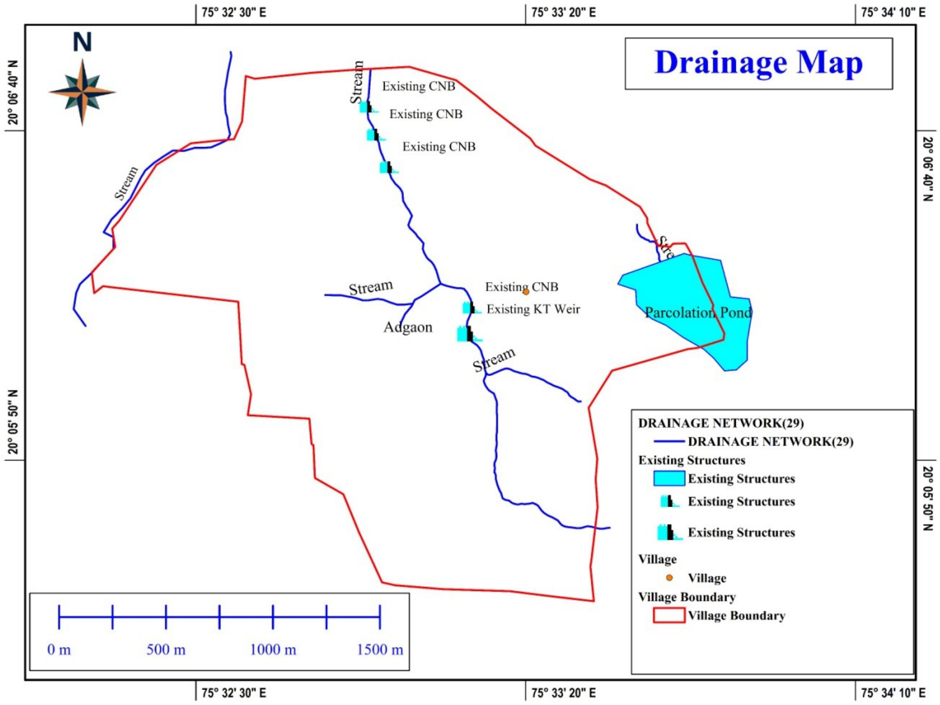

Fig3DrainageMapofVillage

3.2.3 ClimateandRainfall

Theclimateischaracterizedbyhotsummerwithtemperaturerisingtoamean maximumof42.0°Candmoderatewinterwithnighttemperaturesfallingtoamean minimumof10.3°C,withgeneraldrynessprevailingthroughouttheyearexceptduring rainy season. The average annual rainfall of Fulambri is 649.28 mm, with about 83% of itis received during June to September.

3.2.4 Hydrogeology

The entire area of village Adgaon is covered by Deccan trap lava flows of upper cretaceoustolowerEoceneage.Threemajorbasalticflowscouldbespottedinthe village-broadlyjointedbasaltwhichisexposedinthehighlyingareaandthelowlying area is covered by a mixed type of black cotton soil underlined by weathered - moderatelyjointedhardcompactbasaltrock(Fig4).Itimpliesthebroadconclusionthat the groundwater availability is quantitatively limited; thus implying demand side managementandremunerativewaterusestrategies(limitingwateruseonlyforcritical needs and high value crops in summer).

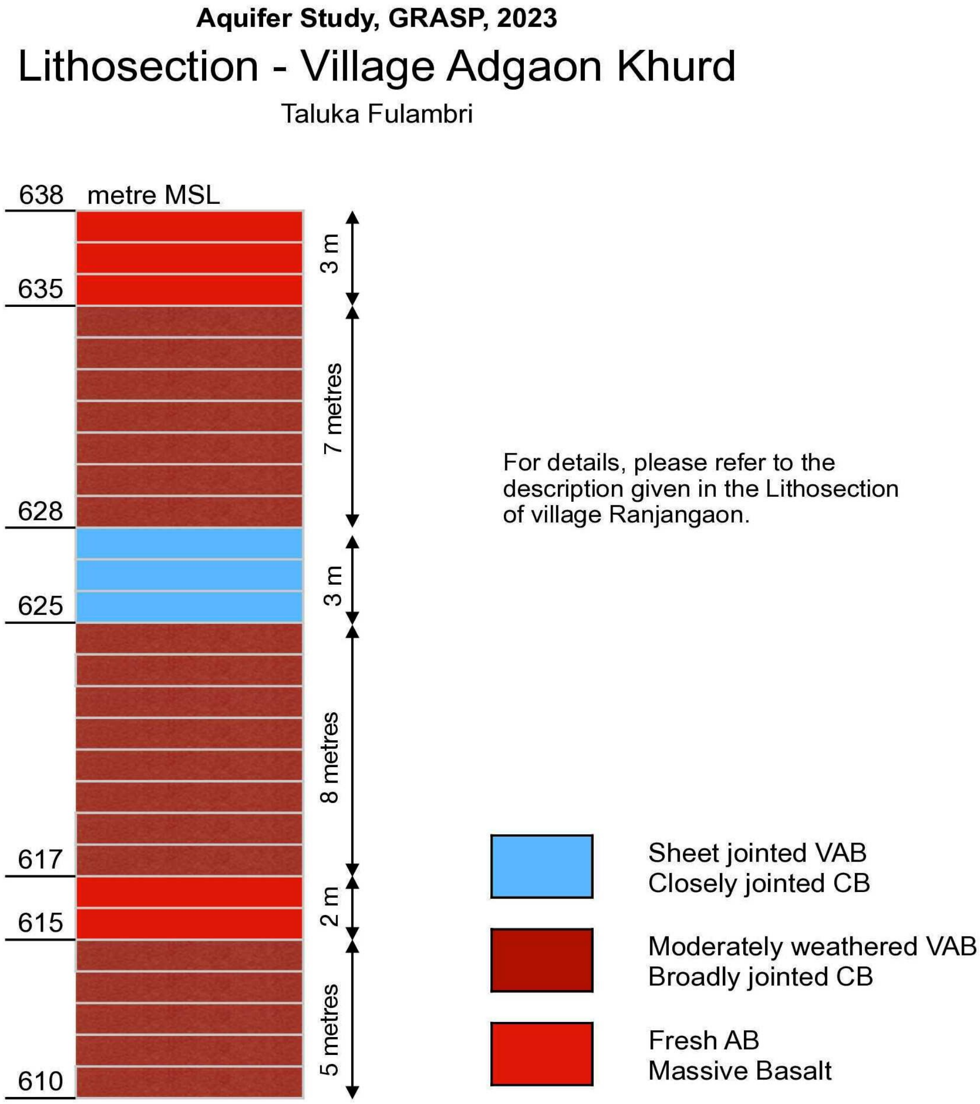

Fig.4Litho-sectionofVillageAdgaonKhurd

Thesurfacegeologystudyandthewellsectionspreparedfromthewellinventoryin villageAdgaonKhurddetectedthreebasaltflows,thelowermostflowextending beyondRL615m,followedbythesecondflowfromRL615mto625m,andthe uppermost flow from RL 625m to 635m overlain by fresh massive basalt above RL 635mMSLfoundonthesouthernboundaryofthevillage.ItsexpanseisshowninFig5.

The second flow occupies major part of the village, with its upper showing intensive weatheringfavourableforpercolation.Aswasobservedinthefield,thisareahashigher welldensity,asthegroundwaterrechargepotentialishigher.Thecloselyjointed,sheet jointed,broadlyjointedandweatheredbasaltflows(showninbrownandbluecolourin themap)aresuitableforrecharge,orinotherwords,forsoilwateconservationworks.

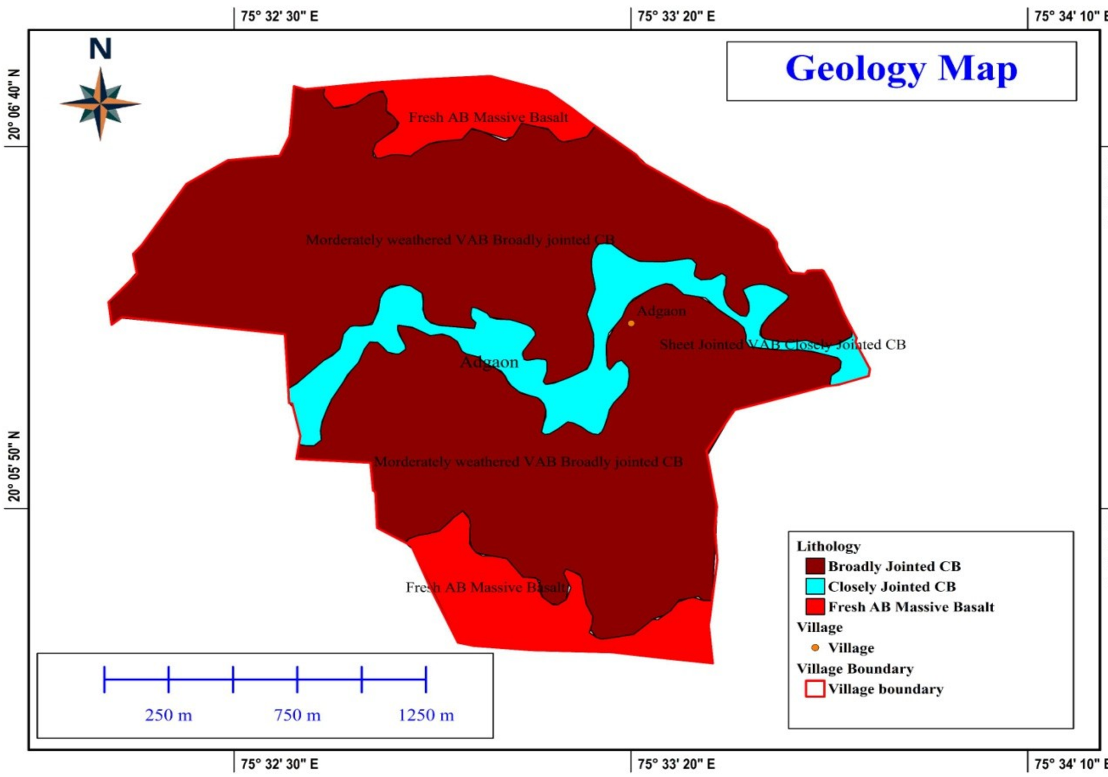

Fig.5GeologyofVillageAdgaonKhurd

3.2.5 Implications oftheabove findings

Groundwater assessment was carried out as a part of the hydrogeological study in villageAdgaon,whichshowedthatthegroundwateryieldestimate(rather,demand)of 105.43 ham is far higher than the present estimated groundwater potential (16.23 ham), indicatingashortfall.Itwaspartlyduetothelimitedavailabilityofinfrastructurefor storageandrecharge,andpartlyduetolowrainfall(drought)inthestudyyear.

Table1:GroundwatersituationinvillageAdgaon

SNo	Typeofbasaltflow	Area, ha	Flow Thickness, metre	Volume, ha-m	Ground water potential	Specific yield	Ground water demand
1	VAB - Moderately weatheredvesicular amygdaloidalbasalt	279.3	20.0	5,586.0	11.73	1.75	97.76
2	Hardorcompact basalt	57.4	5.0	287.0	0.34	1.00	2.87
3	Closely jointed compactbasalt/ sheetjointed	53.3	3.0	160.0	4.16	3.00	4.80
	Total	**390.0**	**28.0**	**60.33**	**16.23**		**105.43**

Water budgeting exercise also pointed out that the surface water storages in the villageare only 15.24 ham, which can be increased. In addition, there lies a vast potential inincreasingsoilmoisturethroughscientific*in situ* soilconservationmeasures.

3.2.6 Suggestedadaptationmeasures

Theaforementionedanalysishintsatthreetypesofadaptationmeasuresinthevillage.

Surface water storages : To increase water storage by collecting excess runoff during rainyseasons,andtotakeupnewdrainagelinestructures,alongwithcleaning, wideninganddeepeningexistingwaterbodiesandchannels.

Arearecharge: Itprovidesthelargestpotentialforincreasingthesoilmoistureand shallowgroundwaterrecharge,whencoupledwithplantationoftreesandincreasing green cover to protect against erosion of topsoil in flash floods.

Farm level water management :for allowing rainwater to percolate into groundwater through identified recharge zones. It will include farm bunding, tree plantation of bunds, creating micro-basins and farm ponds for water harvesting and recharge.

Demand side water management by using water saving irrigation techniques like ridges and furrows, drip and sprinkler, and fertigation. Increasing the use of organic manureswillimprovemoistureholdingcapacityandhelpbalancesoilnitrogen.Along withmulchingandbiochar,itwillhelpimprovethesoilhealthbyconservingsoilflora, fauna, and nutrients.

3.3 CommunityAdaptationPlan

The participatory planning process, comprising the steps and exercises explained in methodology section 2.4 above, was rigorously carried out in village Adgaon and a communityadaptationplanwasprepared.Basedontheaforementionedanalysisand findings during the Transect Walk, the following measures were suggested for soil waterconservationandgroundwaterrecharge.Thesehavebeenmarkedonthemap (Fig 6).

3.3.1 Arearechargemeasures

Trenching: Continuouscontourtrenching,togetherwithplantationonthebunds formed,wasproposedinthegrazingland(Gatno53)anditssurroundingareato improve soil moisture, and thereby, aid recharge of shallow aquifer.

Grassland development : Similarly, the grazing land on the eastern boundary (Gat nos12 to 15) was proposed to be treated with contour trenches, gully plugs and treeplantation,etcsoastoimprovetherechargeconditionsinthelongrun.

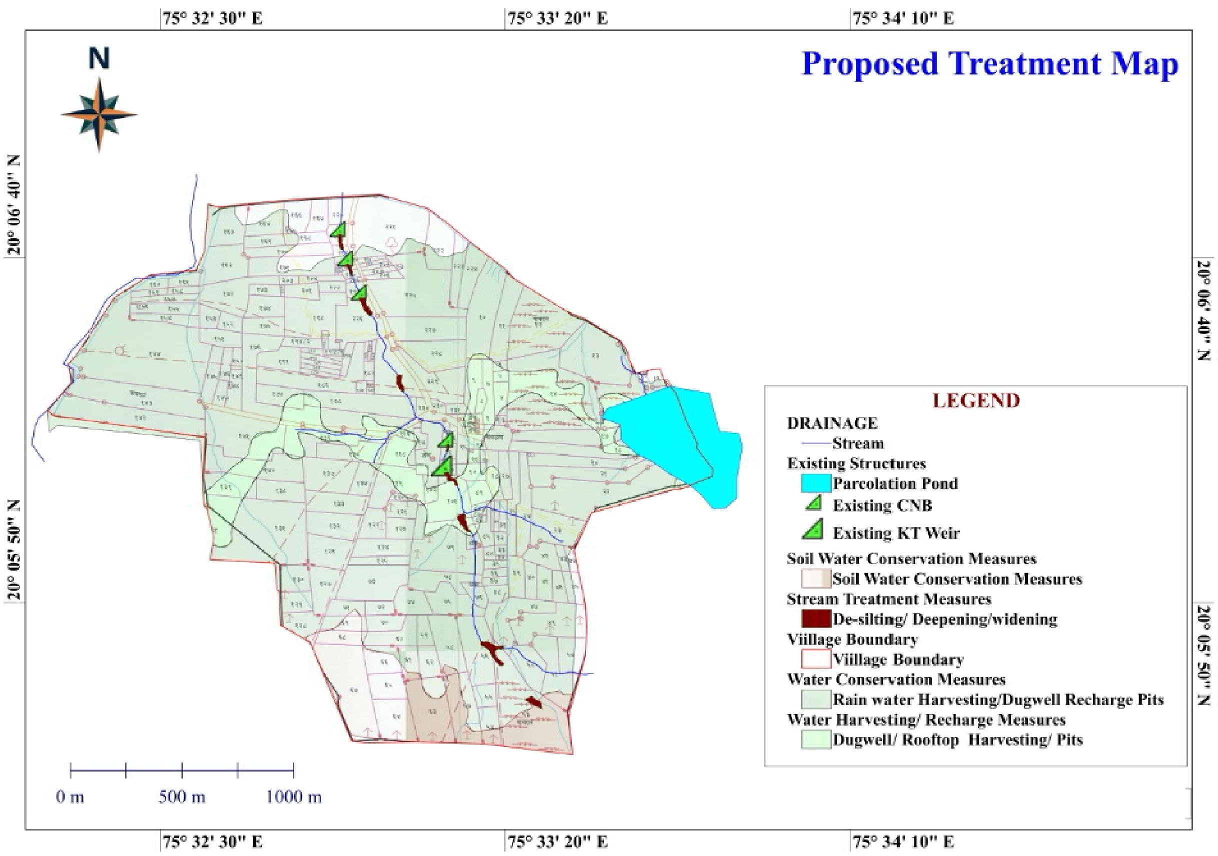

Fig.6ProposedTreatmentMapofVillageAdgaon

Intheentiresouthernpart(showninthemapinlightbrownandwhitecolour)anda smallportionnearthenorthernboundary(showninthemapinwhitecolour)ofthe villagehavepresenceofhardrockandarenotfavourableforgroundwaterrecharge. Hence,farmpondscanbetakenforseasonalsurfacewaterstorageintheseparts.In addition, trenching and bunding will help improve the soil moisture, which in turn would help establish vegetation.

ThecentralportionlyingbetweenRL625mand628misthemostfavourablezoneof groundwater recharge (shown in light green colour in the map). It was proposed to motivatefarmerstoadoptfarmbundingandrunoffharvestingintheirfarmlandsona large scale so as to increase the water level in their dug wells.

3.3.2 Recharge-cum-storagemeasures

Nallawidening: Excavationofsiltandclayforwideninganddeepeningofstreams wasproposedintheupstreamofexistingcheckweirsinGatnos28,31and89-90to increase groundwater recharge. In all three stretches of a total length of about 1500 metres was identified for this treatment.

Inaddition,excavationofaccumulatedsiltfromexistingpondsandcheckweirsonthe stream and widening and deepening of streams in northern part of the village was proposedinGatnos219/221,213,226,229and96.

New check weirs : Three check weirs were proposed in the central portion, which wasfoundtobefavourableforgroundwaterrecharge,inGatNos9,31and47,toincrease storage and recharge.

3.3.3 Inducedrechargemeasures

Recharge shafts : It was proposed to construct recharge shafts with appropriate filter medium to recharge the deeper (confined) aquifers in the upper and middle reaches. FourlocationswereidentifiedinGatnos47,24,101and91forthepurpose.

Wellrecharge: Itwasproposedtoencouragefarmerstotakeuponalargescalethe activityofrechargingtheiropenwellsbysimplyexcavatingrechargepitsnearthewell. For implementation in the coming year, twelve open wells were identified in Gat nos75,79,101,22,24,123,97,4,228,229and182.Further,itwasdecidedtoencouragethe farmers in the mid-northern and mid-southern regions (shown in dull green colour in the map) for rainwater harvesting on their own farms and around their dug wells.

3.4 Conclusion

SystematicimplementationoftheaboveAdaptationPlanisexpectedtosupportoverall development of the village community, especially the vulnerable sections. By participating in various activities under this project, the farmers have already become familiar with climate change challenges and pragmatic strategies to overcome the ill effects of droughts and towards building resilience. Implementation of the above adaptationmeasureswillgivethemanopportunitytopractisethosemethodsandgain further knowledge and skills.

Riskmanagementisakeyfeatureofadaptation;watermanagementmeasuresproposed abovewouldhelpinreductionandsharingofclimaterisks.ItisexpectedthattheGram Panchayat and the district administration will play a supportive role in this initiative. These climate proofing measures will thus be able to seek options for how thegovernment schemes could further prepare communities for climatic changeadaptation.

4. ClimateAdaptationPlans

VillagesMurshidabadwadiandVitthalwadi

BlockFulambri,DistrictChhatrapatiSambhajinagar(Erstwhile Aurangabad),Maharashtra

Climate Adaptation Plan is essential to safeguard the livelihoods of rainfed farmers in drought prone areas of India, where agriculture is highly vulnerable to climate variability.Byfocusingonsustainablesoilandwatermanagement,cropdiversification, climate-resilient crops, and capacity-building, the plan can help farmers adapt to changing conditions and build resilience in their farming systems. Active involvement of farmers, supported by access to knowledge and entitlements, will ensure that the adaptation strategies are successfully implemented, leading to enhanced agricultural productivity and long-term sustainability in these vulnerable regions.

Acknowledging these imperatives, the project adequately emphasized on preparatory work,asexplainedinthefirstsectionofthischapter.Thesecondsectioncoversthekey findings of the hydrogeology study and its relevance to the adaptation options. The third section presents the community-led adaptation plan with its recommendations.

4.1 Preparatorywork

Review of existing practices : In drought prone areas, the rural households have beenspontaneously using several risk management strategies against climate induced stress.Suchmicrolevelstrategieslargelyincludednaturalresourcemanagement(soiland water conservation), farm-level agronomic measures (like in situ soil moisturemanagement and water use practices), non-farm activities (diversification) and socialmeasureslikemutualhelp.Aparticipatoryreviewofsuchconventionalcrop-leveland village level natural resource management adaptation methods was carried out in eachvillage,whichprovidedthebasisforpreparingadaptationplansintheprojectvillages. ItwassupplementedbyguidancebyexpertsfromKVKsatKharpudi(Jalna)and Gandheli(Aurangabad).Inaddition,periodicguidancebytheofficialsfromAgricultureandGroundwaterDepartmentsprovedusefulinformingasolidfoundation for the adaptation planning.

Hydrologic monitoring : The groundwater level fluctuation were studied bymonitoring water levels in wells to understand the seasonal and spatial depletion inrelation to the rainfall in the respective years. These observations were corroborated with the hydrogeology study conducted during 2023-24.

Hydrogeology study : The groundwater assessment was carried out in the five projectvillages as a part of hydrogeological study. It was found that the groundwater yield estimate(220.10ham)invillageMurshidabadwadiisfarhigherthantheestimated groundwaterlevelsatpresent(43.41ham).Itmaybenotedthatthiswaspartlydueto the limited infrastructure available for storage and recharge, and partly due to low rainfall in the last year (drought conditions).

Waterbudgeting: Preparationofwaterbudgetwastheprecursorofadaptationplans. Itwascarriedoutbycalculatingthebalancebetweeninflowandoutflow,andthewater required for soil to become saturated. Estimates of groundwater recharge andgroundwater storage were corroborated with the well water levels data collected twotimes in the year.

4.2 SituationalAnalysis

4.2.1 AboutVillagesMurshidabadwadiandVitthalwadi

VillageMurshidabadwadiislocatedat20°02’23”NLatitudeand75°23’31”ELongitude in Fulambri block of District ChhatrapatiSambhajinagar (Erstwhile Aurangabad) and is found in SurveyofIndiaToposheet46-P/8(Fig1).Vitthalwadiisahamletlocatedat20°03’21”N Latitudeand75°22’19”ELongitudeinthenorth-westernpartofMurshidabadwadi.The villagehasapopulationof1,180belongingto206households,outofwhich13persons (1.1%)belongtoSCand30persons(2.5%)toST.ThetotalareaofMurshidabadwadi (including Vitthalwadi) is375.8 ha, out of which only 170.5 ha is under cultivation, whereas152.2haoccupiedbyforestand35.2haundercommunitywastelandsand grazingland.Thevillagehasabout25.5haunderirrigation(15%ofthecultivatedarea).

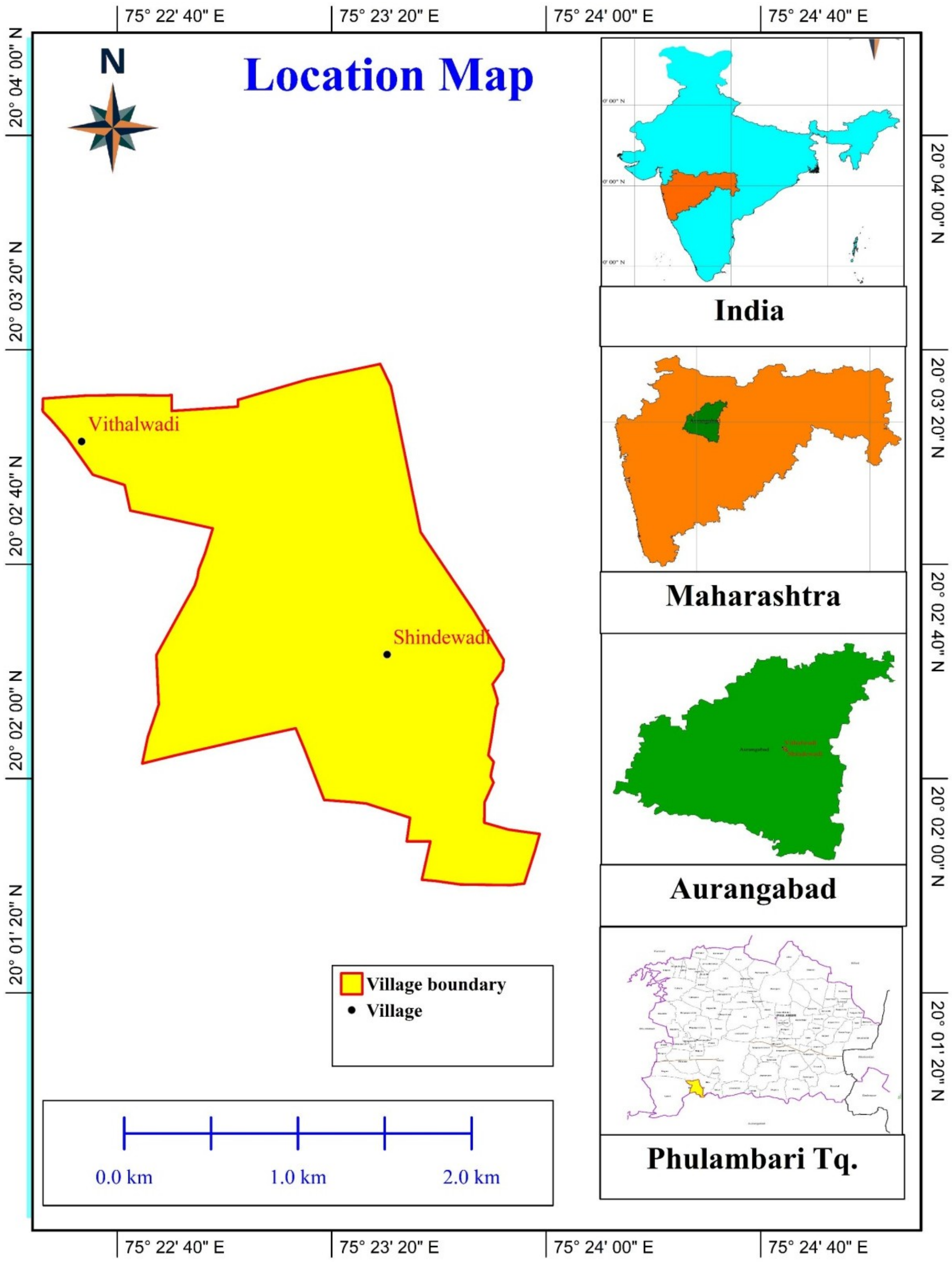

Fig.1LocationMapofMurshidabadwadiandVitthalwadi

4.2.2 Topography andDrainage

Village Murshidabadwadi, together with its habitation Vitthalwadi, is surrounded by thehillsonthenorth-easternpartofthevillageandinthemid-westernpart.Thenorth-eastern part is hilly area with elevation difference of 55 metres from RL 730m to 675m as shown in Fig. 2.

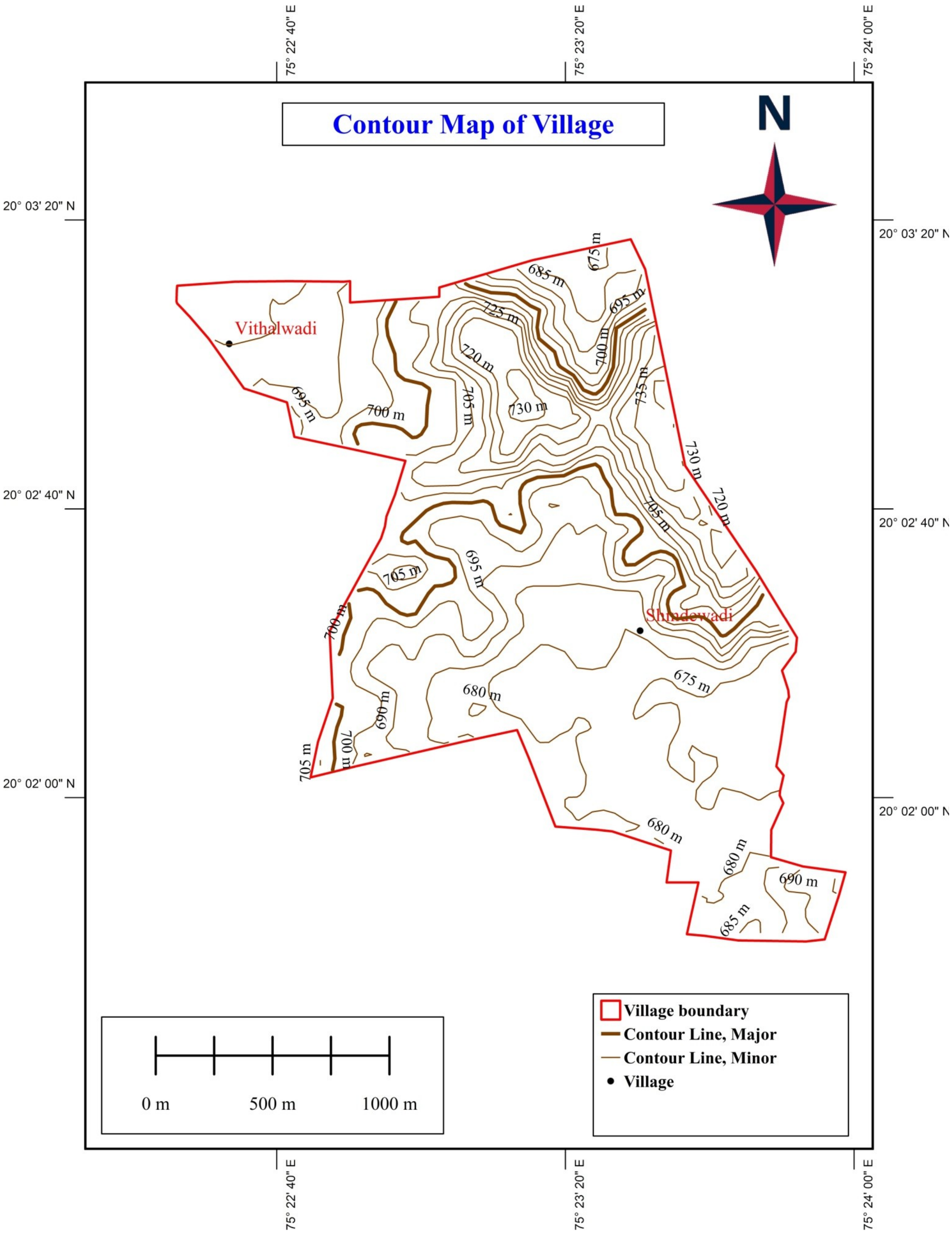

Fig2:ContourMapofVillageMurshidabadwadi

MajorpartofvillageMurshidabadwadiisahighlydissectedplateauhavingamoderate togentleslopetowardssouth-eastdirection.Localgulliesandstreamsoriginatingfrom the hillocks in the North, northwest and West form the drainage network of streams running in easterly direction and meeting the River Fulambri further in the North.

InVitthalwadi,locatedinthenorth-westpotionofthevillage,minornetworkoflocal gulliesandstreamsrunningtowardsnorth-westdirectionshowsadendriticdrainage pattern as shown in Fig 3.

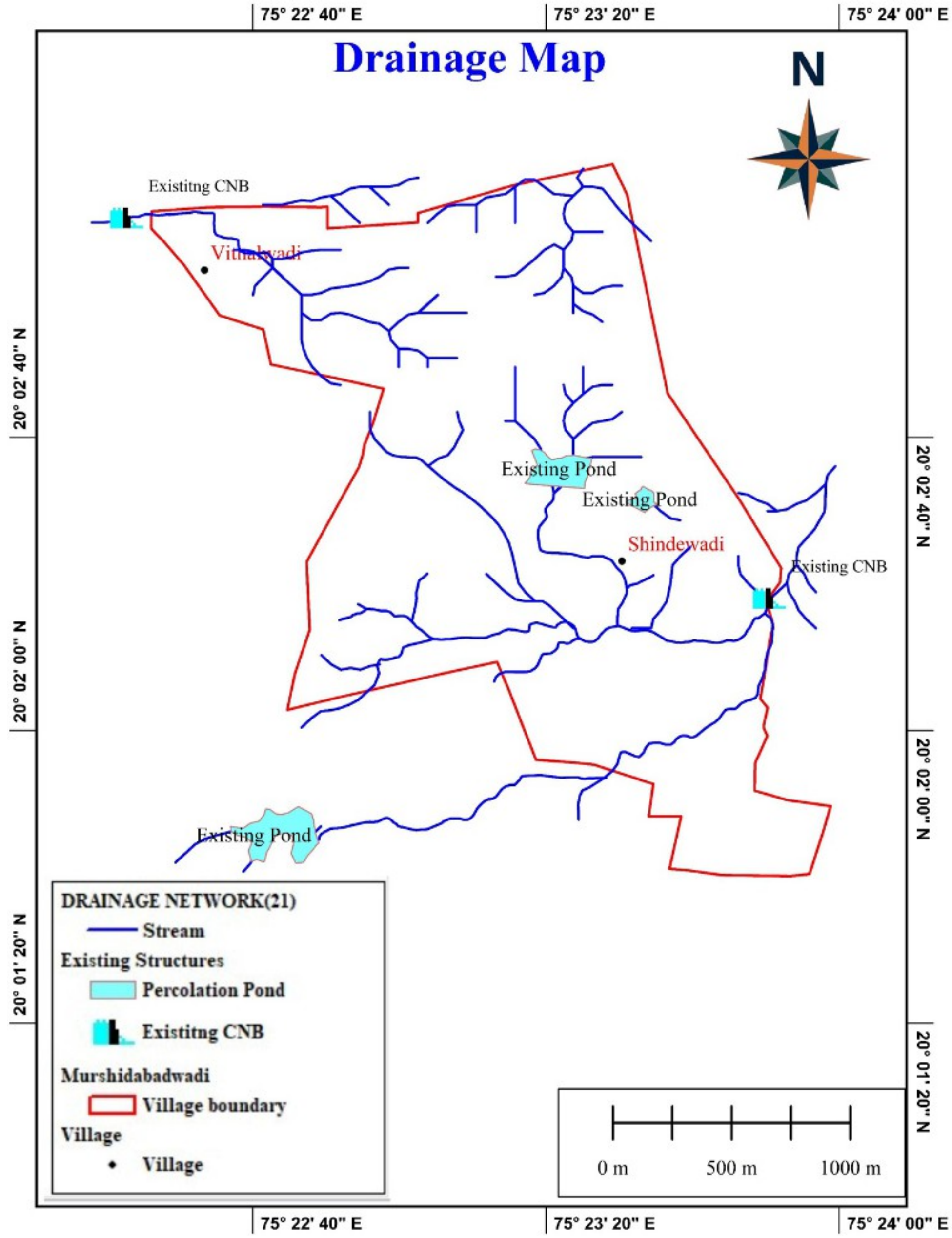

Fig.3DrainageMapofMurshidabadwadiandVitthalwadi

4.2.3 ClimateandRainfall

Theclimateischaracterizedbyhotsummerwithtemperaturerisingtoamean maximumof42.0°Candmoderatewinterwithnighttemperaturesfallingtoamean minimumof10.3°C,withgeneraldrynessprevailingthroughouttheyearexceptduring rainy season. The average annual rainfall of Fulambri is 649.28 mm, with about 83% of itis received during June to September.

4.2.4 Hydrogeology

ThewholeareaiscoveredbyDeccantraplavaflowsofuppercretaceoustolower Eoceneage.Thevillageconsistsofthreemajorbasalticflows,broadlyjointedbasalt whichisexposedinthehighlyingareaandthelowlyingareaiscoveredbyamixed type of black cotton soil underlined by weathered - moderately jointed hard compactbasalt rock(Fig 4).

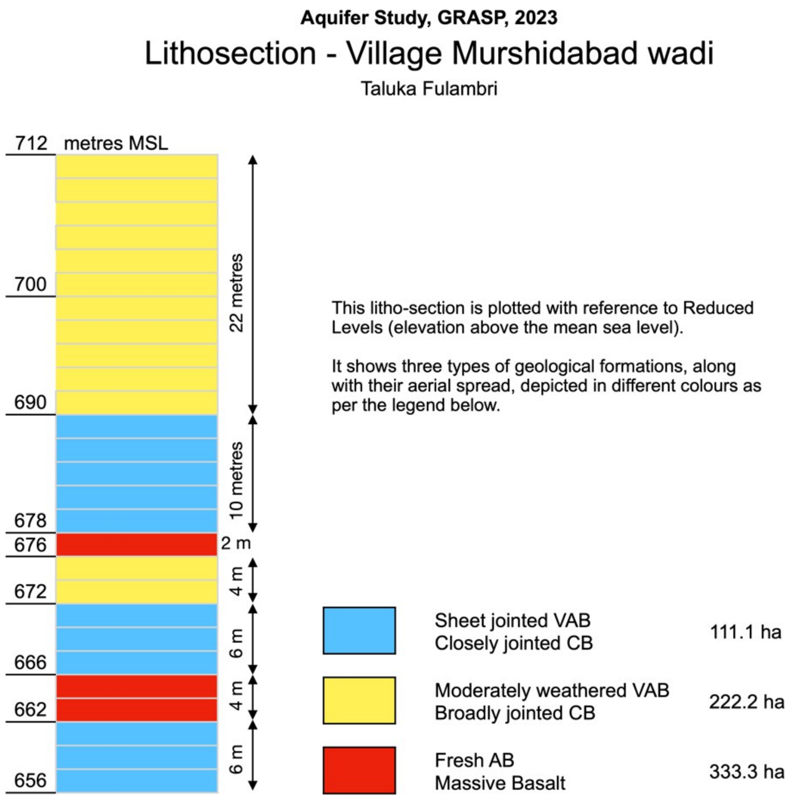

Fig4 :Litho-section ofvillageMurshidabadwadi

The lowermost basaltic flow was observed below RL 666m and was visible only in the well section from RL 656 m to 666m. The bottom part of the flow is closely jointed compact basalt of over6mthick.Thepercolationconditionsinthispartaregood.Thetopportionofabout4meters thickness is hydrothermally altered amygdaloidal basalt, which is moderately weathered (Fig 5). ThesecondflowwasobservedonlyinthewellsectionsbetweenRL666mto678m.The bottompartof6mthickness,extendingfromRL666mto672m,iscloselyjointed compact basalt, which is highly permeable and suitable for recharge. It is overlain by broadlyjointedportionofabout4mthicknessfromRL672mto676m.Thispartshows moderate percolation of water. Finally, this portion is overlain by about 2m thick hydrothermally altered vesicular amygdaloidal basalt (VAB), which is hard and compact. A small portion of it is visible in the northern part of the village.

Theuppermostflowcoversmaximumpartofthevillages,excepttheeasternfringeand asmallhillyterrainintheeast-northeast.BottompartoftheflowfromRL678mto 690m (12 m thick) is closely jointed compact basalt which is the main source of water forthefarmers,whotapitindugwellsinthispartwhichhaveshownconsiderableyield.
But its upper part from RL 690m to 712m is broadly spaced jointed CB, which reducethe percolation of water in this area.

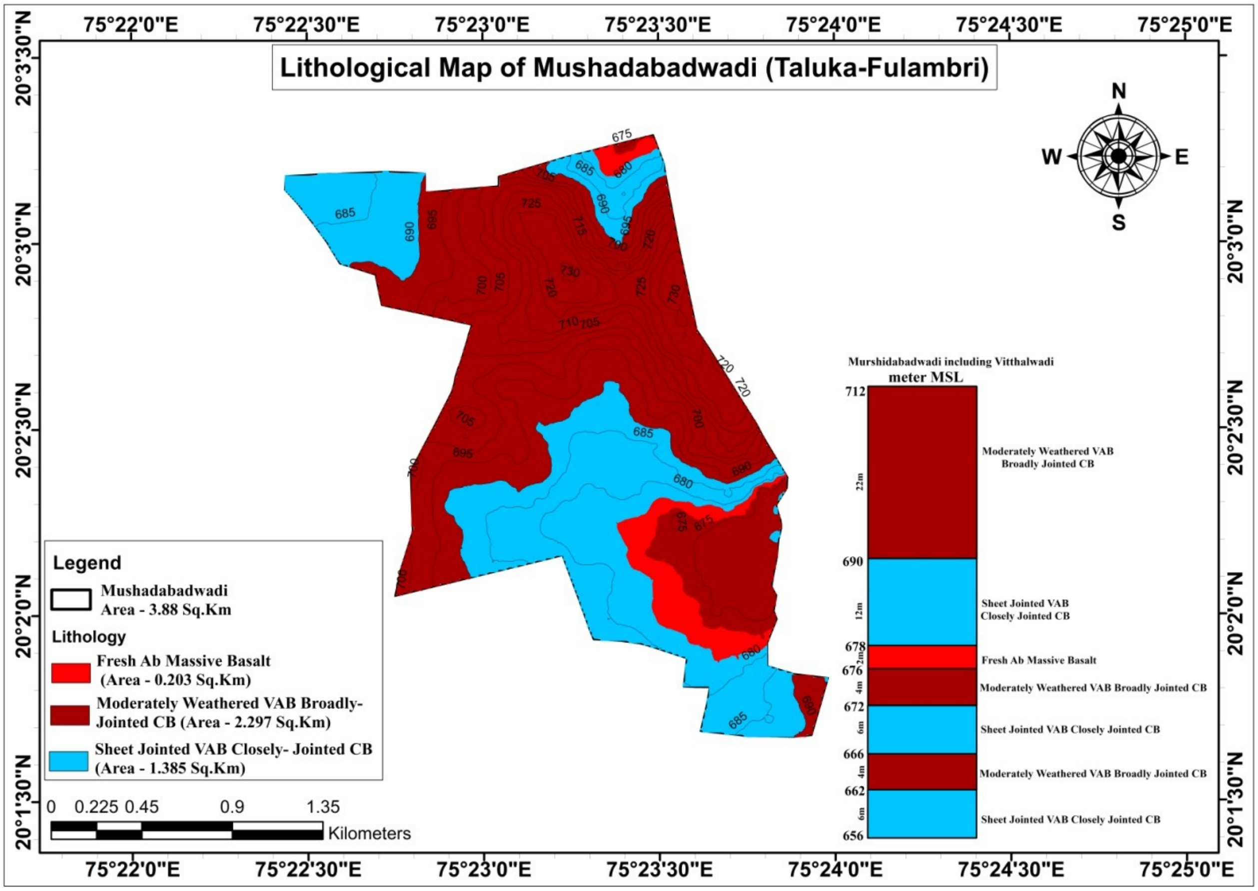

Fig.5GeologyofVillageMurshidabadwadi-Vitthalwadi

4.2.5 Implications oftheabove findings

Groundwaterassessmentwascarriedoutasapartofthehydrogeologicalstudyinthe village,whichshowedthatthegroundwateryieldestimate(rather,demand)of220.72 hamisfarhigherthanthepresentestimatedgroundwaterpotential(20.57ham), indicating a severe shortfall. It was partly due to the limited recharge and paucity of infrastructure for storage, and partly due to low rainfall (drought) in the study year.

Water budgeting exercise also pointed out that the surface water storages in the villageareonly27.97ham,whichisanimpressivefigure,butstillhassomescopetoincrease. Inaddition,thereliesavastpotentialinincreasingsoilmoisturethroughscientific*in situ* soilconservationmeasures.ThejointedandweatheredBasaltflowsaresuitablefor recharge and storage, which can be utilized for soil water conservation measures orinduced recharge structures.

Table1:GroundwatersituationinvillageMurshidabadwadi

SNo	Typeofbasaltflow	Area, ha	Flow Thickness, metre	Volume, ha-m	Ground water potential	Specific yield	Ground water demand
1	VAB - Moderately weatheredvesicular amygdaloidalbasalt	229.7	30.0	6,891.0	9.647	1.75	120.59
2	Hardorcompact basalt	20.3	2.0	40.6	0.120	1.00	0.41
3	Closely jointed compactbasalt/ sheetjointedAB	138.5	24.0	3,324.0	10.803	3.00	99.72
	Total	**388.5**	**56.0**	**10,255.6**	**43.4**		**220.72**

4.2.6 Suggestedadaptationmeasures

Theaforementionedanalysishintsatthreetypesofadaptationmeasuresinthevillage.

Surface water storages : Construction of new runoff harvesting and recharge structures, along with cleaning, widening and deepening existing water bodies and channels will help increase water storage by collecting excess runoff during rainy seasons.

Area recharge : Maximum portion of low lying area of the village is conducive for recharge. Soil conservation on farmlands using farm bunding will help increase soil moisture and recharge. Water table can be enhanced by taking up dug well recharge pits in this area. The village has a lot of public land with woodlots and prior soil conservation work (trenching and gully plugs). Desilting of trenches and reshaping of bunds will improve groundwater recharge considerably. Gullies and small rivulets in these areas can be treated with loose rubble gully plugs and gabions.

Farmlevelwatermanagement:bytakinguptrenchingandfarmbundingwillhelp increase soil moisture and recharge pits will enhance the water table.

Demand side water management by using water saving irrigation techniques like ridges and furrows, drip and sprinkler, and fertigation. Increasing the use of organic manureswillimprovemoistureholdingcapacityandhelpbalancesoilnitrogen.Along withmulchingandbiochar,itwillhelpimprovethesoilhealthbyconservingsoilflora, fauna, and nutrients.

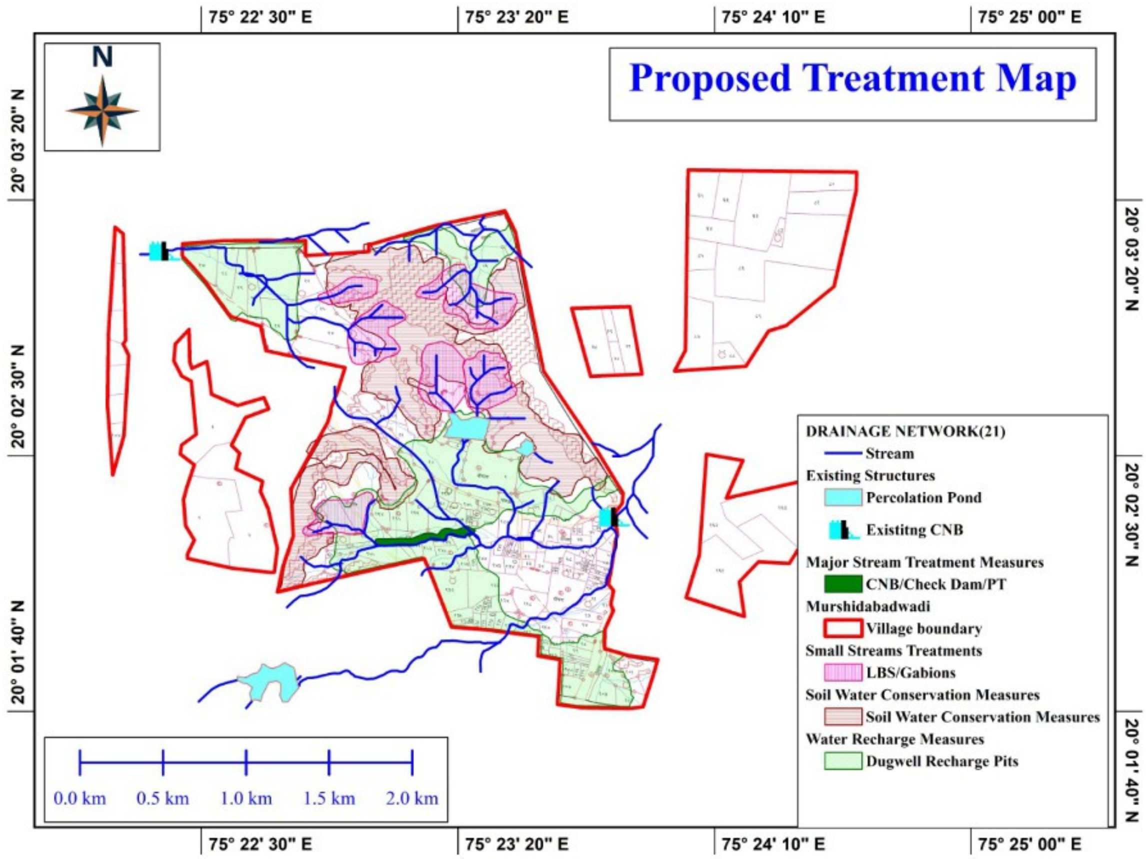

Fig6:ProposedTreatmentMap

4.3 CommunityAdaptationPlan–VillagesMurshidabadwadiandVitthalwadi

The VWMC and farmers conducted participatory planning in Murshidabadwadi and Vitthalwadi,asperthestepsandexercisesexplainedinmethodologysection2.4above, and prepared a community adaptation plan. It comprised the following measures for soil water conservation and groundwater recharge, based on the aforementioned analysis and findings during the Transect Walk, as shown in the map (Fig 6).

4.3.1 Arearechargemeasures

Trenching : The village has three blocks of woodlots, developed by the government withtrenchesandplantationinthepast–(1)ahillyportionof9hainthenorthadjacent to Gat nos 22 & 15, (2) the undulated patch around the old percolation tank in the northeast,and(3)thehillyareaonthemid-westernsidehasbeentreated.Desiltingof the old trenches and reshaping of bunds was proposed to considerably improve groundwater recharge. Gullies and small rivulets in these areas can be treated with loose rubble gully plugs and gabions. In addition, a water absorption trench of about 1500mlengthwasproposedatthefootofthehillockonthenorth-easternside

Farmland treatment : Maximum portion of low lying area of the village is conducive forrecharge.Soilconservationonfarmlandsusingfarmbundingisrecommendedto increase soil moisture.

4.3.2 Recharge-cum-storagemeasures

Nallawidening: Excavationofsiltandclayforwideninganddeepeningofstreams was proposed in the streams in Gat nos 2, 163-164, 100-102-103 to increase surface storage and groundwater recharge. About 1000 metres of stream length is proposed tobe developed in these three stretches.

Desilting of tanks : Excavation of silt and clay from two existing percolation tanks isproposed to increase the storage and enhance the recharge.

Newstructures: TwomasonrycheckweirsareproposedinGatnos154and162for runoff harvesting and recharge.

4.2.4Induced recharge measures

Recharge shafts : The area of a little over 100 ha around the south-eastern boundary of thevillageisunderseasonalirrigation.Itisunderlainbya2mthicklayerofHTAB,as showninredcolourintheGeologymap.Inducedrechargemeasureslikerecharge shafts drilled beyond this layer (below RL 662 m) can increase groundwater rechargeand its availability beyond winter. In the first year, it was proposed to construct threerecharge shafts with appropriate filter medium to recharge the deeper (confined)aquifers in Gat nos 155, 162 and 18-19.

Wellrecharge: Itwasproposedtoencouragefarmerstotakeuprechargepitsona largescaleforrechargingtheirdugwells.Elevendugwellswereidentifiedforrecharge inthefirstyearsinGatNos159,146,167,170,174(twowells),179,29,35,87and88.

4.4 Conclusion

SystematicimplementationoftheaboveAdaptationPlanisexpectedtosupportoverall development of the village community, especially the vulnerable sections. By participating in various activities under this project, the farmers have already become familiar with climate change challenges and pragmatic strategies to overcome the ill effects of droughts and towards building resilience. Implementation of the above adaptationmeasureswillgivethemanopportunitytopractisethosemethodsandgain further knowledge and skills.

Riskmanagementisakeyfeatureofadaptation;watermanagementmeasuresproposed abovewouldhelpinreductionandsharingofclimaterisks.ItisexpectedthattheGram Panchayat and the district administration will play a supportive role in this initiative. These climate proofing measures will thus be able to seek options for how thegovernment schemes could further prepare communities for climatic changeadaptation.

5. ClimateAdaptationPlan-VillageRanjangaon

BlockFulambri,DistrictChhatrapatiSambhajinagar(Erstwhile Aurangabad),Maharashtra

Climate Adaptation Plan is essential to safeguard the livelihoods of rainfed farmers in drought prone areas of India, where agriculture is highly vulnerable to climate variability.Byfocusingonsustainablesoilandwatermanagement,cropdiversification, climate-resilient crops, and capacity-building, the plan can help farmers adapt to changing conditions and build resilience in their farming systems. Active involvement of farmers, supported by access to knowledge and entitlements, will ensure that the adaptation strategies are successfully implemented, leading to enhanced agricultural productivity and long-term sustainability in these vulnerable regions.

Acknowledging these imperatives, the project adequately emphasized on preparatory work,asexplainedinthefirstsectionofthischapter.Thesecondsectioncoversthekey findings of the hydrogeology study and its relevance to the adaptation options. The third section presents the community-led adaptation plan with its recommendations.

5.1 Preparatorywork

5.1.1 Reviewofexistingpractices

Indroughtproneareas,theruralhouseholdshavebeenspontaneouslyusingseveral risk management strategies against climate induced stress. Such micro level strategieslargely included natural resource management (soil and water conservation), farm-levelagronomic measures (like in situ soil moisture management and water use practices),non-farmactivities(diversification)andsocialmeasureslikemutualhelp.A participatoryreviewofsuchconventionalcrop-levelandvillagelevelnaturalresource managementadaptationmethodswascarriedoutineachvillage,whichprovidedthe basisforpreparingadaptationplansintheprojectvillages.Itwassupplementedby guidancebyexpertsfromKVKsatKharpudi(Jalna)andGandheli(Aurangabad).In addition,periodicguidancebytheofficialsfromAgricultureandGroundwater Departmentsprovedusefulinformingasolidfoundationfortheadaptationplanning.

5.1.2 Hydrologicmonitoring

Thegroundwaterlevelfluctuationwerestudiedbymonitoringwaterlevelsinwellsto understand the seasonal and spatial depletion in relation to the rainfall in the respectiveyears. These observations were corroborated with the hydrogeology study conducteddu ring 2023-24.

5.1.3 Hydrogeologystudy

The groundwater assessment was carried out in the five project villages as a part of hydrogeological study. It was found that the groundwater yield estimate (67.7 ham) in village Ranjangaon is far higher (almost three times higher) than the estimated groundwaterpotentialatpresent(26.8ham).Itmaybenotedthatthiswaspartlydueto the limited infrastructure available for storage and recharge, and partly due to low rainfall in the last year (drought conditions).

5.1.4 Waterbudgeting

Preparationofwaterbudgetwastheprecursorofadaptationplans.Itwascarriedout bycalculatingthebalancebetweeninflowandoutflow,andthewaterrequiredforsoil to become saturated. Estimates of groundwater recharge and groundwater storage werecorroboratedwiththewellwaterlevelsdatacollectedtwotimesintheyear.

5.2 SituationalAnalysis

5.2.1 AboutVillageRanjangaon

The study area named Village Ranjangaon is situated at 20°5’50’N Latitude and 75°32’28”ELongitudeinFulambriblockofDistrictSambhajinagar(Erstwhile Aurangabad).Itis coveredinSurveyofIndiaToposheetno46P/12.(Fig1).Ithasapopulationof1155 belonging to 224 households, with 4.8% population belonging to Scheduled Castes. Spreadoverageographicareais583.3ha,Ithas532.7haareaundercultivation,outof which12.5ha(2.35%)isirrigated.

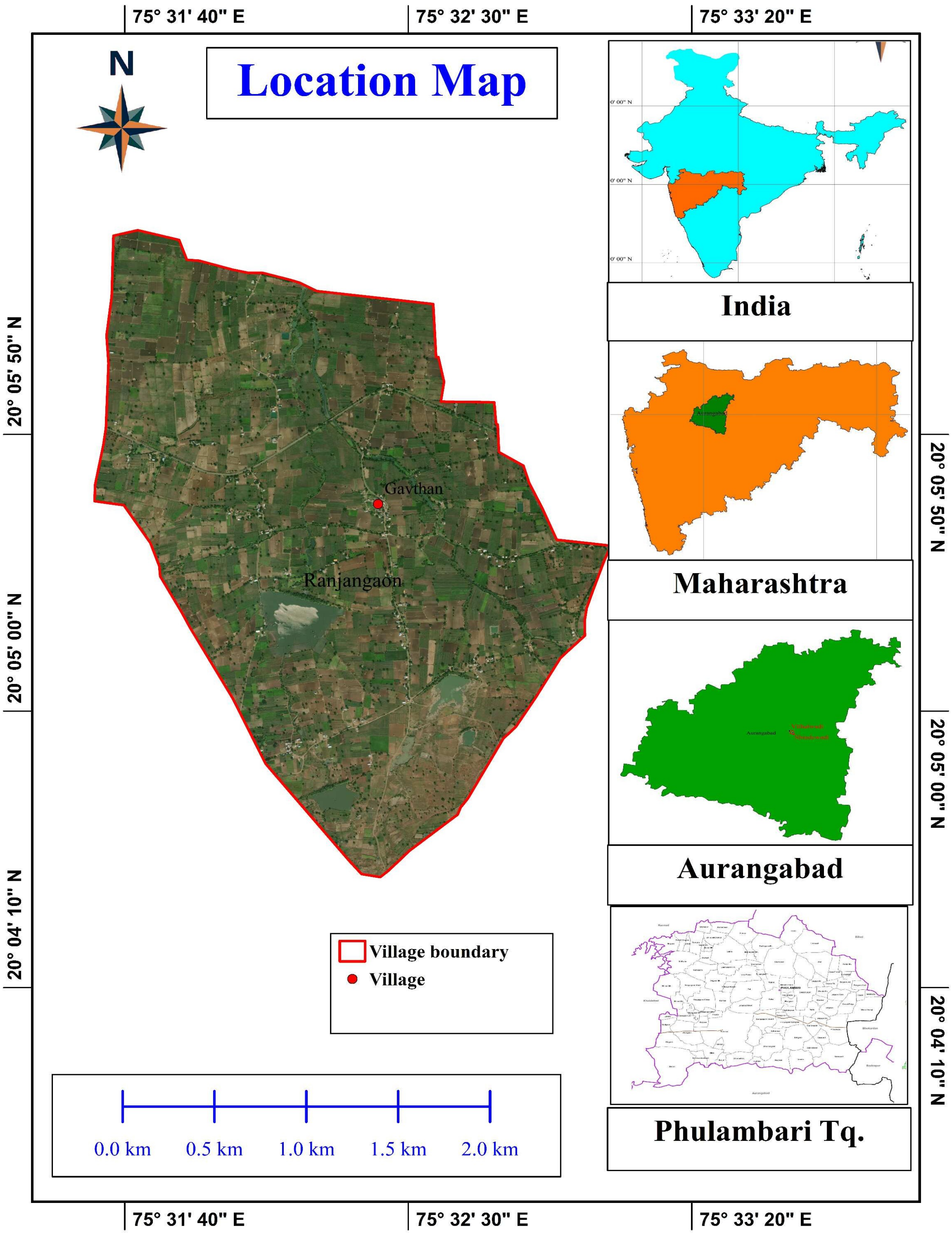

Fig.1LocationMapofVillageRanjangaon

5.2.2 Topography andDrainage

VillageRanjangaonshowshasamoderatereliefhavinganaveragegradientof2%.The triangularsouthernpartofthevillagehasamoderateslopewithelevationdifferenceof 35mfromRL475to440mwithin1500mofmaximumstretch(Fig2).

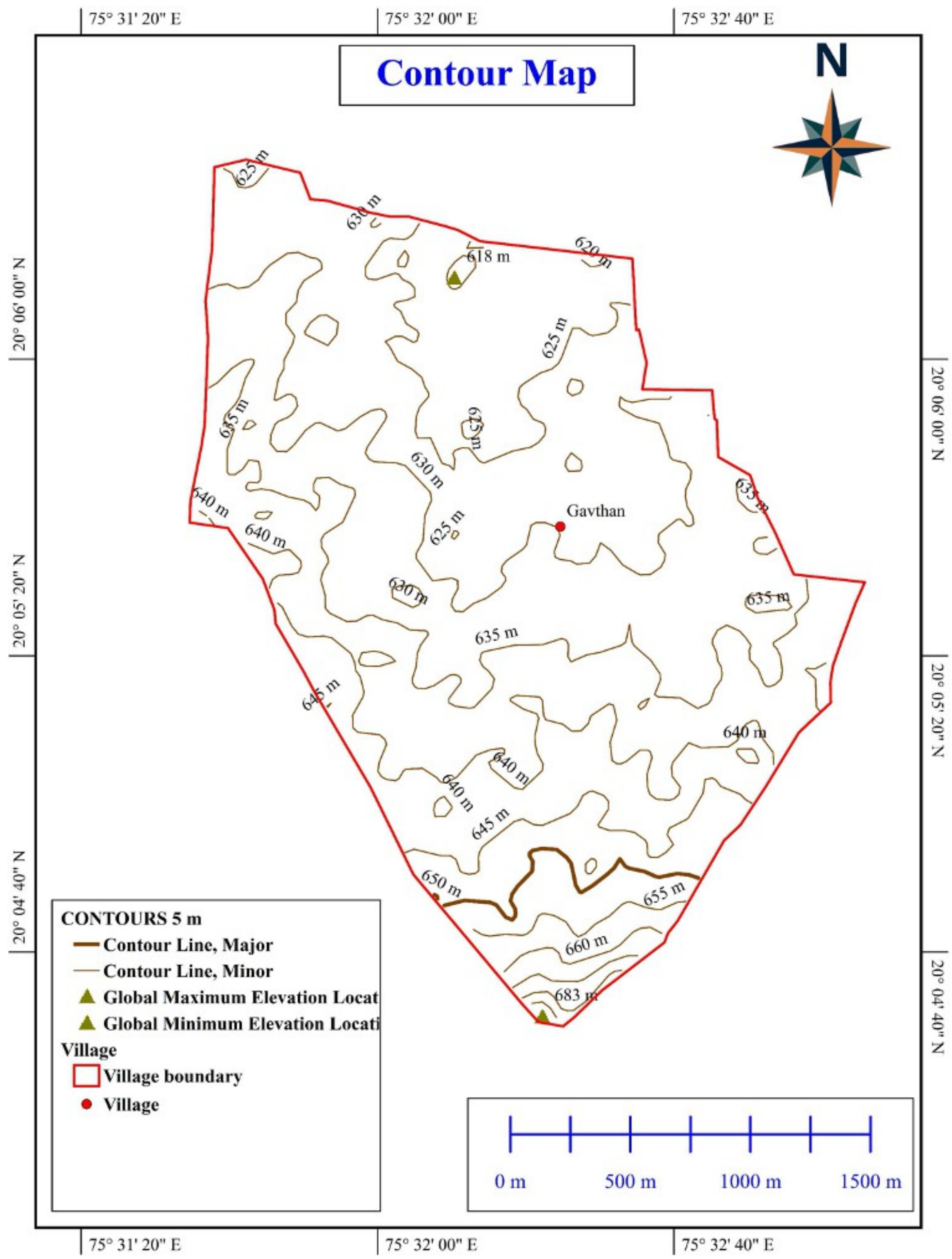

Fig2:ContourMapofVillageRanjangaon

The major network of streams are running towards north direction and meeting theRiver Girija further North (Fig 3).

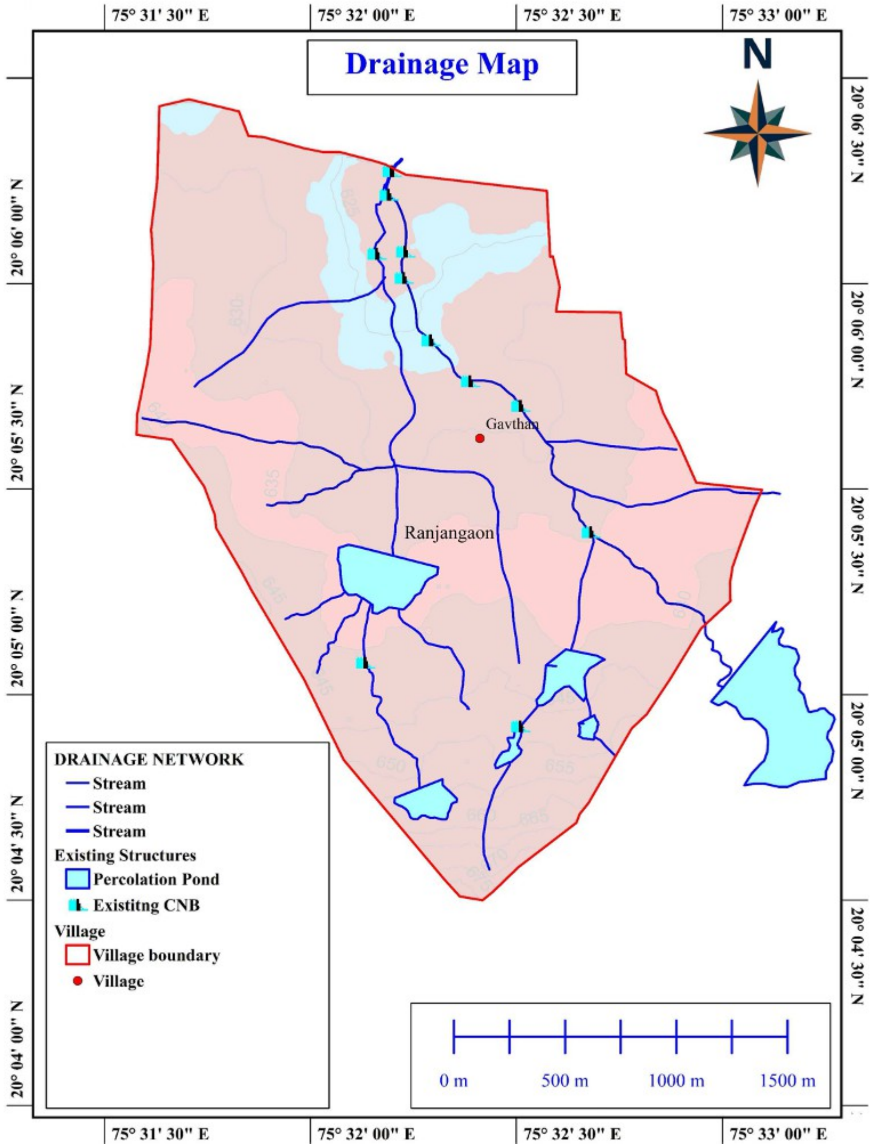

Fig3DrainageMapofVillageRanjangaon

5.2.3 ClimateandRainfall

Theclimateischaracterizedbyhotsummerwithtemperaturerisingtoamean maximumof42.0°Candmoderatewinterwithnighttemperaturesfallingtoamean minimumof10.3°C,withgeneraldrynessprevailingthroughouttheyearexceptduring rainy season. The average annual rainfall of Fulambri is 649.28 mm, with about 83% of itis received during June to September.

5.2.4 Hydrogeology

TheentireareaofvillageRanjangaoniscoveredbyDeccantraplavaflowsofupper cretaceoustolowerEoceneage.Threemajorbasalticflowscouldbespottedinthe village-itshowedabroadlyjointedbasaltexposedinthehighareaandamixedtype of black cotton soil underlined by weathered to moderately jointed hard compact basaltrock in the low lying area (Fig 4).

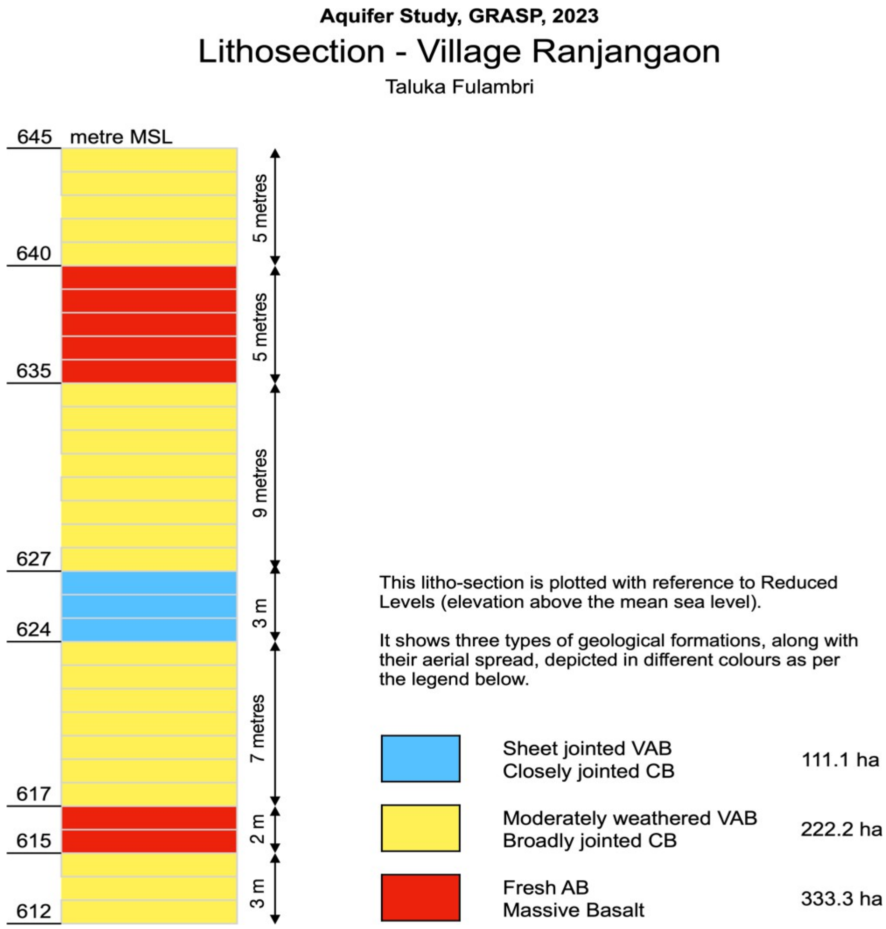

Fig4:LithologofVillageRanjangaon

ThelowermostflowwasobservedonlyinthewellsectionsfromRL612m.Itisbroadly jointedcompactbasaltwithjointspacingofaround1.5mtoupto2.0m.Itstoplayerof hydrothermallyalteredbrownishamygdaloidalbasaltisexposedbetweenRL615mto 617m(2mthickness).Itishardandcompact;hence,non-porous(Fig5).

ThesecondflowisexposedinthedugwellsasamoderatelyweatheredVAB,showing adequate percolation potential. It is subjected to moderate weathering due to favourableconditions. The flow becomes sheet jointed above RL 624m up to RL 627m due tointensiveweathering,therebyenablinghigherpercolationpotential.Upperportionof this flow shows moderate percolation possibility over a thickness of 9 metres from RL627m to RL 635m,.

The topmost flow is overlying the highly weathered VAB layers of the second flow. Hence, in continuation top portion of this flow has also undergone moderate weathering. The well sections in the lower middle part of the village show hard and compactHTABbetweenRL635mtoRL640m,whichisnotconduciveforpercolation.

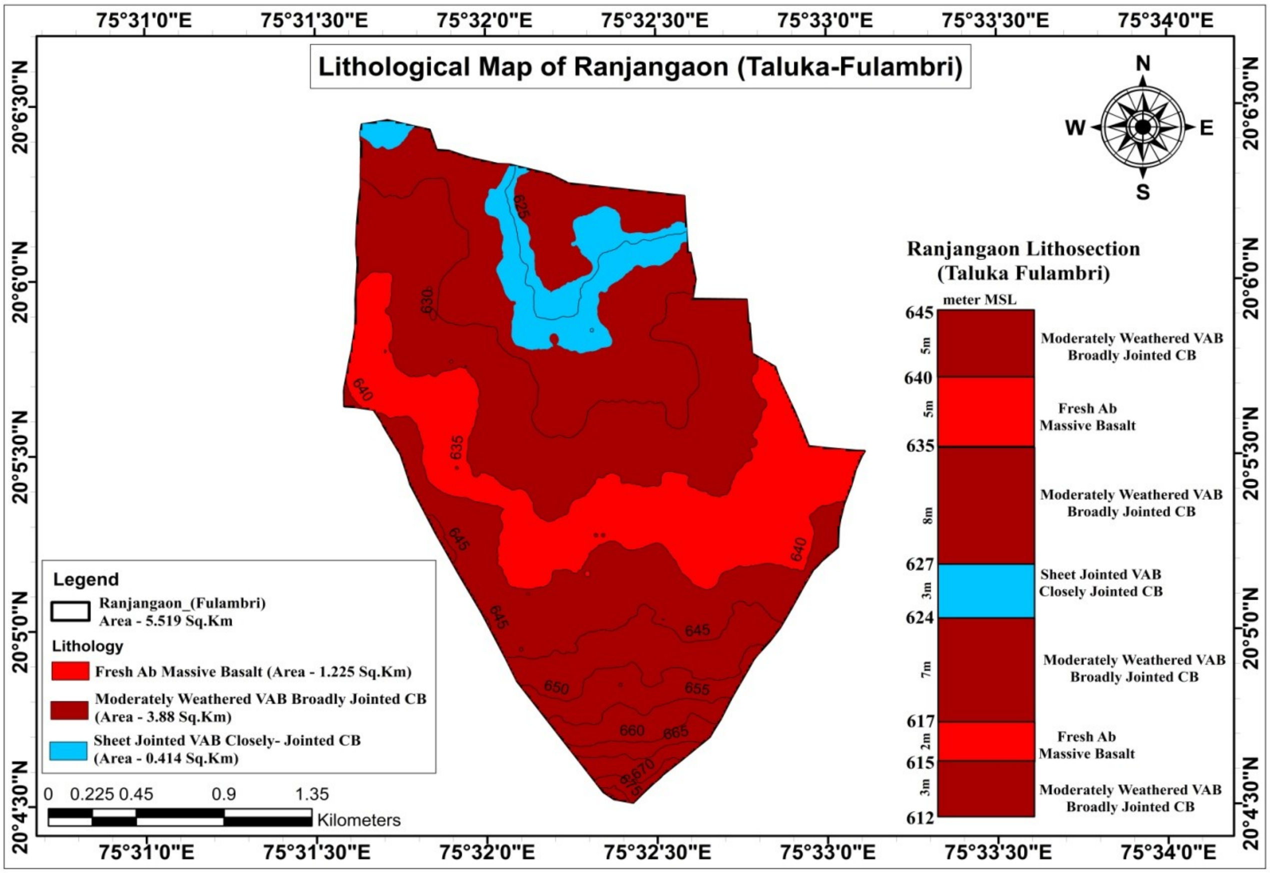

Fig5:GeologyMapofVillageRanjangaon

5.2.5 Implications oftheabove findings

Groundwater assessment carried out as a part of the hydrogeological study in village Ranjangaonshowedthatthegroundwateryieldestimate(rather,demand)of67.7ham isnearlythreetimeshigherthanthepresentestimatedgroundwaterpotential(26.82 ham),indicatingashortfall.Itwaspartlyduetothelimitedavailabilityofinfrastructure for storage and recharge, and partly due to low rainfall (drought) in the study year.

Table1:GroundwatersituationinvillageRanjangaon

SNo	Typeofbasaltflow	Area, ha	Flow Thickness, metre	Volume, ha-m	Ground water potential	Specific yield	Ground water demand
1	Closely jointed compactbasalt/ sheetjointed	41.4	13.0	538.2	3.22	3.00	16.10
2	Hydrothermally alteredbasalt	122.5	7.0	857.5	7.30	1.00	8.57
3	VAB-Moderately weatheredvesicular amygdaloidalbasalt	388.0	7.0	2,716.0	16.30	1.75	47.50
	Total	**551.9**	**27.0**	**3,811.00**	**26.82**		**67.70**

Water budgeting exercise also pointed out that the surface water storages in the villageare only 32.69 ham, which can be increased. In addition, there lies a vast potential inincreasingsoilmoisturethroughscientific*in situ* soilconservationmeasures.

5.2.6 Suggestedadaptationmeasures

Theaforementionedanalysissuggeststhreetypesofadaptationmeasuresinthevillage.

Surface water storages :can be taken up in two stretches of land, along the streams in themiddletonorthernportionofthevillage.Itispossibletotakeupnewdrainageline structures,alongwithcleaning,wideninganddeepeningexistingwaterbodiesand channels.

Area recharge : Maximum runoff takes place in the southern triangular portion of thevillagewherehighreliefwasobserved.Itcanbearrestedwithcontourtrenchingor waterabsorptiontrenchesandinthegulliesbyconstructinggullyplugsorgabions. SimilartreatmentcanbetakenupintheareaNorthofthehabitation,lyingbetweenRL 635m to 627m, which offers adequate percolation potential. It will help increase the soilmoistureandshallowgroundwaterrecharge,whencoupledwithplantationoftrees andincreasinggreencovertoprotectagainsterosionoftopsoilinflashfloods.

Farm level water management :for allowing rainwater to percolate into groundwater through identified recharge zones. It will include farm bunding, tree plantation of bunds, creating micro-basins and farm ponds for water harvesting and recharge.

Demand side water management by using water saving irrigation techniques like ridges and furrows, drip and sprinkler, and fertigation. Increasing the use of organic manureswillimprovemoistureholdingcapacityandhelpbalancesoilnitrogen.Along withmulchingandbiochar,itwillhelpimprovethesoilhealthbyconservingsoilflora, fauna, and nutrients.

5.3 CommunityAdaptationPlan

TheCommunityClimateAdaptationPlanforvillageRanjangaonwaspreparedusing theparticipatoryplanningprocesscomprisingthestepsandexercisesasdescribedin themethodologysection2.4above.Basedontheaforementionedanalysisandfindings during the Transect Walk, the following measures were suggested for soil waterconservationandgroundwaterrecharge.Thesehavebeenmarkedonthemap(Fig6).

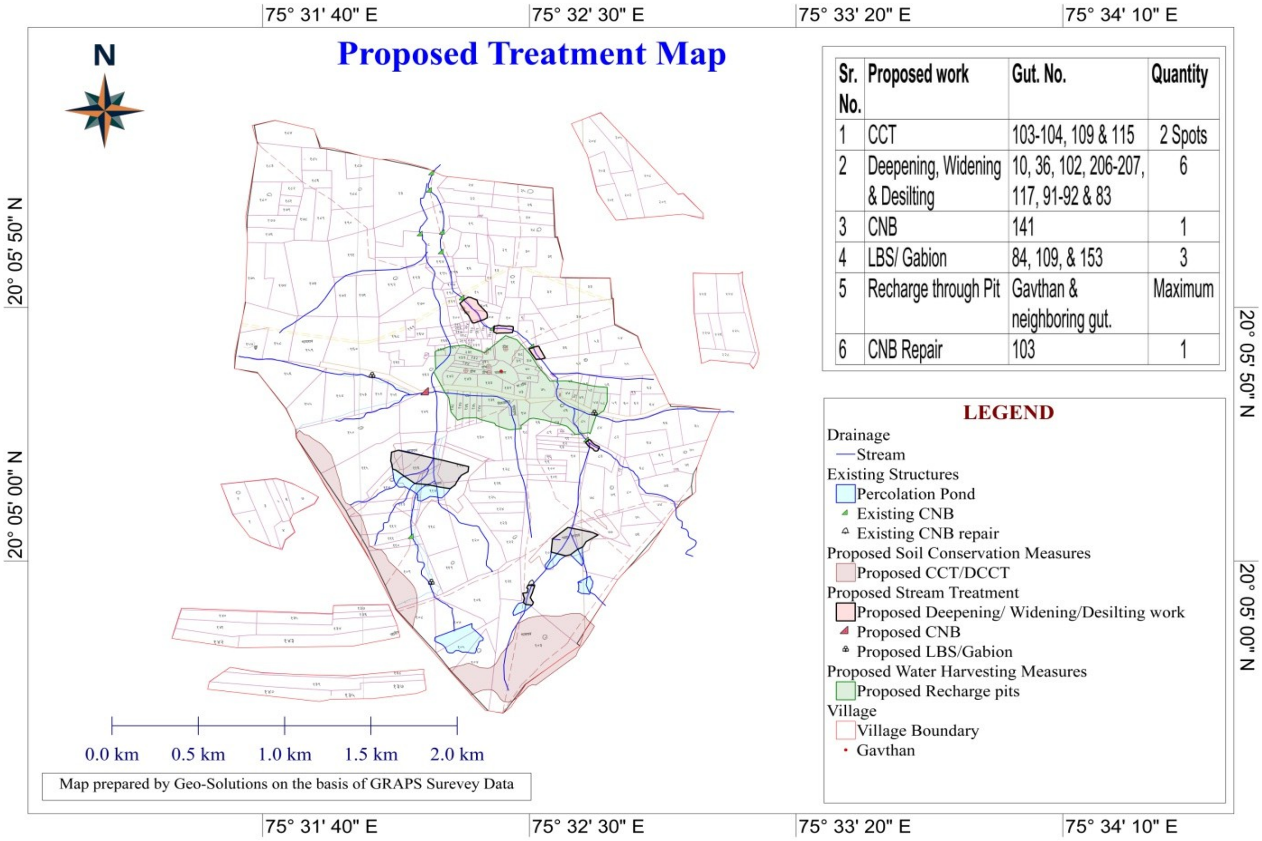

Fig.6ProposedTreatmentMapofVillageRanjangaon

5.3.1 Arearechargemeasures

Trenching: ThesoutherntriangularportionofvillageRanjangaoncontributes maximumrunoff,whichisproposedtobeharvestedthroughcontourtrenchingor water absorption trenches in Gat nos. 106, 107, 108 and 109. Trenching is also proposedinGatnos.115,116and121nearthegrazinglandintheWest.Similarly,gullyplugs and gabions are proposed across gullies and small streams in these areas (shown in palepink colour area in the Treatment Map). Two gabions are proposed in Gat nos 114-115and 144-149.

Farmland treatment : The moderately sloping and low lying area of the village in thecentralportionisconduciveforrecharge.Soilconservationonfarmlandsusingfarm bundingisrecommendedtoincreasesoilmoisture.Farmbundingisproposedtotreat farmlands of about 25 ha in Gat nos 215, 216, 217, 92, 162, 132, 133, and 143.

5.3.2 Recharge-cum-storagemeasures

Nallawidening: Wideninganddeepeningofstreamswasproposedinthestreamsin Gat nos 45-46, 34-35, and 116 to increase surface storage and groundwater recharge. About2000metresofstreamlengthisproposedtobedevelopedinthisfashion.

Desiltingoftanks: Excavationofsiltandclayfromexistingpercolationtanksand checkdamsGatnos196and206isproposedtoincreasestorageandenhancerecharge.

Newstructures: ThreenewmasonrycheckweirsareproposedinGatnos132-149,150 and 36-37 for runoff harvesting and recharge. In addition, it is proposed to repair an existing check weir in Gat No 121.

5.3.3 Inducedrechargemeasures

Recharge shafts : The middle portion of the village is underlain by a 5m thick layer ofHTABbetweenRL635mto640m,asshowninredcolourintheGeologymap.Induced rechargemeasureslikerechargeshaftsdrilledacrossthislayerareproposedinthis area. In the first year, it is planned to construct sven recharge shafts with appropriatefilter medium to recharge the deeper (confined) aquifers in Gat nos 35, 46, 96, 102, 27 (two sites) and 116.

Well recharge : It was proposed to encourage farmers to take up recharge pits for rechargingtheirdugwells.Thirteendugwellswereidentifiedforrechargeinthefirst years in Gat nos 203, 207, 3, 5, 138, 139, 130, 149, 162, 83, 29, 52 and 86.

5.4 Conclusion

SystematicimplementationoftheaboveAdaptationPlanisexpectedtosupportoverall development of the village community, especially the vulnerable sections. By participating in various activities under this project, the farmers have already become familiar with climate change challenges and pragmatic strategies to overcome the ill effects of droughts and towards building resilience. Implementation of the above adaptationmeasureswillgivethemanopportunitytopractisethosemethodsandgain further knowledge and skills.

Riskmanagementisakeyfeatureofadaptation;watermanagementmeasuresproposed abovewouldhelpinreductionandsharingofclimaterisks.ItisexpectedthattheGram Panchayat and the district administration will play a supportive role in this initiative. These climate proofing measures will thus be able to seek options for how thegovernment schemes could further prepare communities for climatic changeadaptation.

6. ClimateAdaptationPlan-VillageSultanwadi

BlockFulambri,DistrictChhatrapatiSambhajinagar(Erstwhile Aurangabad),Maharashtra

Climate Adaptation Plan is essential to safeguard the livelihoods of rainfed farmers in drought prone areas of India, where agriculture is highly vulnerable to climate variability.Byfocusingonsustainablesoilandwatermanagement,cropdiversification, climate-resilient crops, and capacity-building, the plan can help farmers adapt to changing conditions and build resilience in their farming systems. Active involvement of farmers, supported by access to knowledge and entitlements, will ensure that the adaptation strategies are successfully implemented, leading to enhanced agricultural productivity and long-term sustainability in these vulnerable regions.

Acknowledging these imperatives, the project adequately emphasized on preparatory work,asexplainedinthefirstsectionofthischapter.Thesecondsectioncoversthekey findings of the hydrogeology study and its relevance to the adaptation options. The third section presents the community-led adaptation plan with its recommendations.

6.1 Preparatorywork

6.1.1 Reviewofexistingpractices

Indroughtproneareas,theruralhouseholdshavebeenspontaneouslyusingseveral risk management strategies against climate induced stress. Such micro level strategieslargely included natural resource management (soil and water conservation), farm-levelagronomic measures (like in situ soil moisture management and water use practices),non-farmactivities(diversification)andsocialmeasureslikemutualhelp.A participatoryreviewofsuchconventionalcrop-levelandvillagelevelnaturalresource managementadaptationmethodswascarriedoutineachvillage,whichprovidedthe basisforpreparingadaptationplansintheprojectvillages.Itwassupplementedby guidancebyexpertsfromKVKsatKharpudi(Jalna)andGandheli(Aurangabad).In addition,periodicguidancebytheofficialsfromAgricultureandGroundwater Departmentsprovedusefulinformingasolidfoundationfortheadaptationplanning.

6.1.2 Hydrologicmonitoring

Thegroundwaterlevelfluctuationwerestudiedbymonitoringwaterlevelsinwellsto understand the seasonal and spatial depletion in relation to the rainfall in the respectiveyears. These observations were corroborated with the hydrogeology study conductedduring 2023-24.

6.1.3 Hydrogeologystudy

The groundwater assessment was carried out in the five project villages as a part of hydrogeologicalstudy.Itwasfoundthatthegroundwateryieldestimate(104.05ham) or groundwater demand in village Sultanwadi is far higher (almost ten times higher) thantheestimatedgroundwaterpotentialatpresent(10.78ham).Itmaybenotedthat thiswaspartlyduetothelimitedinfrastructureavailableforstorageandrecharge,and partly due to low rainfall in the last year (drought conditions).

6.1.4 Waterbudgeting

Preparationofwaterbudgetwastheprecursorofadaptationplans.Itwascarriedout bycalculatingthebalancebetweeninflowandoutflow,andthewaterrequiredforsoil to become saturated. Estimates of groundwater recharge and groundwater storage werecorroboratedwiththewellwaterlevelsdatacollectedtwotimesintheyear.

6.2 SituationalAnalysis

6.2.1 AboutVillageSultanwadi

VillageSultanwadiissituatedat20°04’56”NLatitudeand75°32’28”ELongitudein FulambriblockofDistrictSambhajinagar(Erstwhile Aurangabad).ItiscoveredinSurveyofIndia Toposheets46P/8and46P/12.(Fig1).Ithasapopulationof1003belongingto212 households, with 2.1% population belonging to Scheduled Tribes. Spread over a geographicareais309.57ha,ithas243.2haareaundercultivation,outofwhich145.2 ha (59.7%) is irrigated.

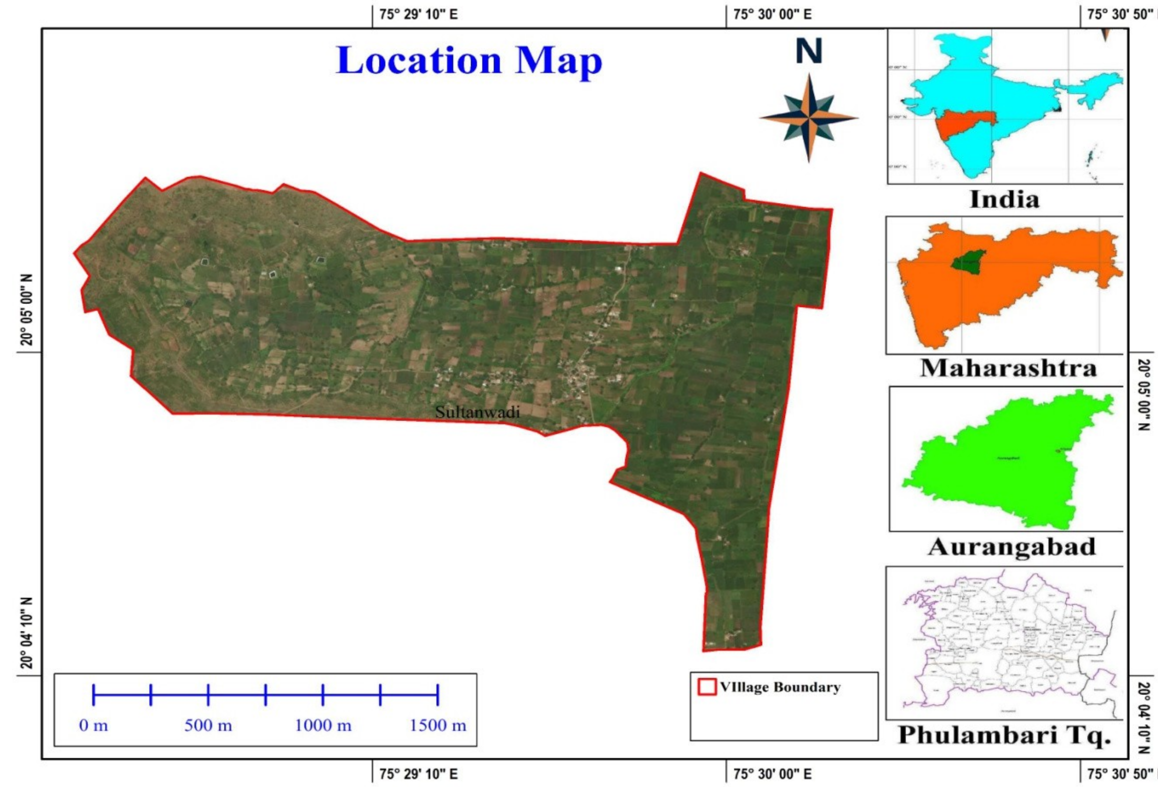

Fig1:LocationMapofVillageSultanwadi

6.2.2 Topography andDrainage

VillageSultanwadiisalmostrectangularinshapeandissurroundedbyhillsonthe West and Southwest, wheras the eastern part is gently sloping towards East. Totalelevation difference in the village is of 100 meters from RL 735m to 635m (Fig 2).

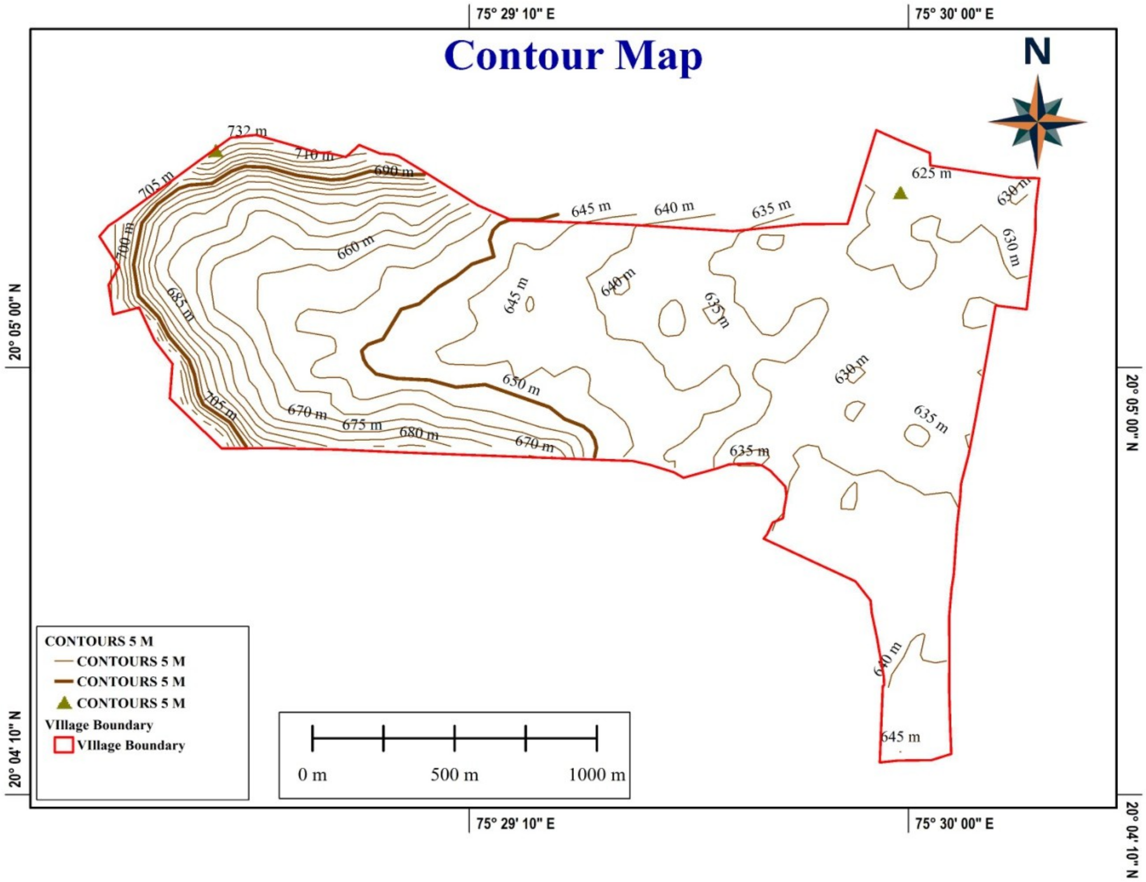

Fig2ContourMapofVillageSultanwadi

Thewesternportionofvillageisahighlydissectedplateauhavingtheslopetowards east and northeast direction and is the sources of two local streams that flow innortheastern direction, and later meet R*iver Girija*further North. A small portion of thelandonsoutheasterncornerdrainsthroughasmallgullytowardsEast.Allstreams flowinginvillageareseasonalwithdendriticdrainagepatternasshowninFig3.

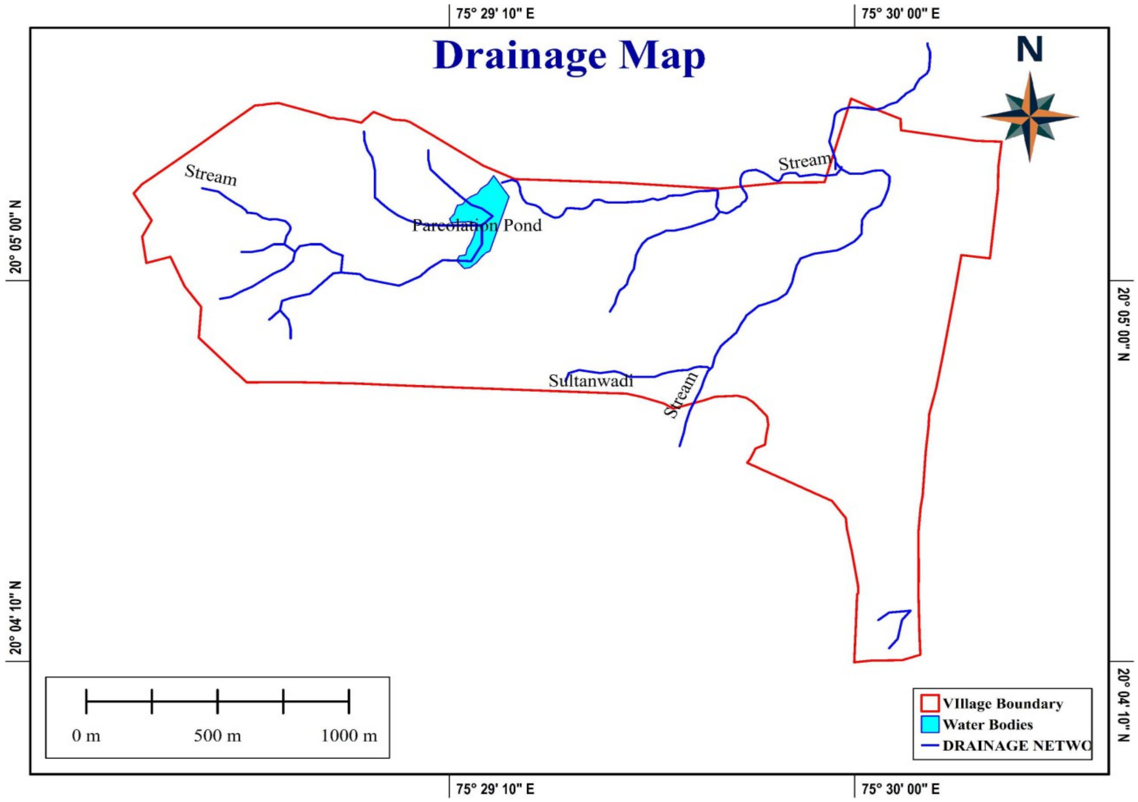

Fig3:DrainageMapofVillageSultanwadi

6.2.3 ClimateandRainfall

Theclimateischaracterizedbyhotsummerwithtemperaturerisingtoamean maximumof42.0°Candmoderatewinterwithnighttemperaturesfallingtoamean minimumof10.3°C,withgeneraldrynessprevailingthroughouttheyearexceptduring rainy season. The average annual rainfall of Fulambri is 649.28 mm, with about 83% of itis received during June to September.

6.2.4 Hydrogeology

TheentireareaofvillageSultanwadiiscoveredbyDeccantraplavaflowsofupper cretaceoustolowerEoceneage.Threemajorbasalticflowscouldbespottedinthe village-itshowedabroadlyjointedbasaltexposedinthehighareaandamixedtype of black cotton soil underlined by weathered to moderately jointed hard compact basaltrock in the low lying area (Fig 4).

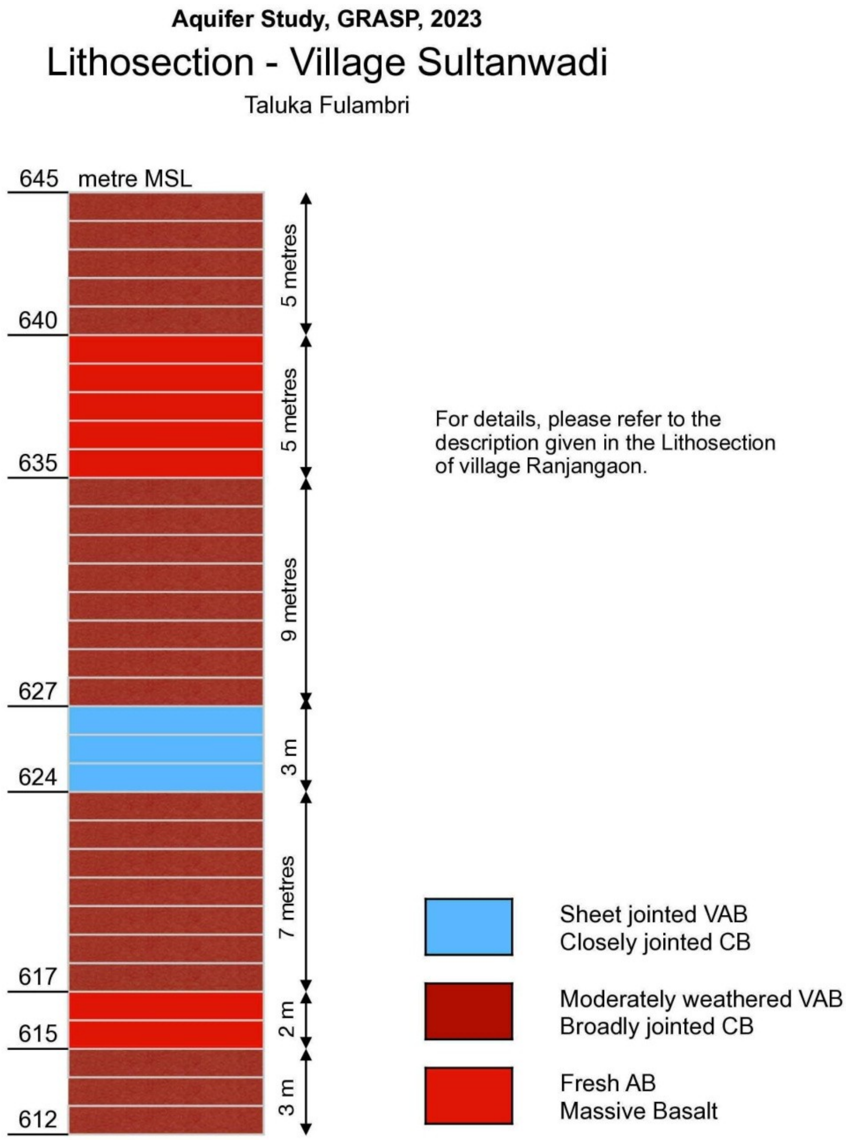

Fig4:LithologofVillageSultanwadi

The lowermost **Flow No 1** consists of moderately weathered VAB and was observed only in the well section above RL 612m to 615m. The top portion of this flow is of 2m thick HTAB.

Flow No 2 consists of compact basalt showing variation in jointing pattern from RL617m to 624m. It shows broadly spaced jointed pattern with joint spacing varying from1.0mto1.5mwhichintersectoneanother,indicatingmoderatepercolationpotential.

Atthetopofthisportionwasfounda3mthicklayerofcloselyjointedCBwhere percolationofwaterisadequate.Theopenwellsduginthispartarehighyielding.The topportionofthisflowisnotvisible,asitmayhavebeenabruptlypinchedout.

FlowNo3isexposedfromRL627m.ItismoderatelyweatheredVABwhere weathering is intensive due to presence of chlorophaeite. Hence, it shows adequatepercolationuptoRL635m.But,thetopportionofthisflowis visiblefromRL635mto 640masahardandmassivecompactbasalt,whichisnotconduciveforpercolation.

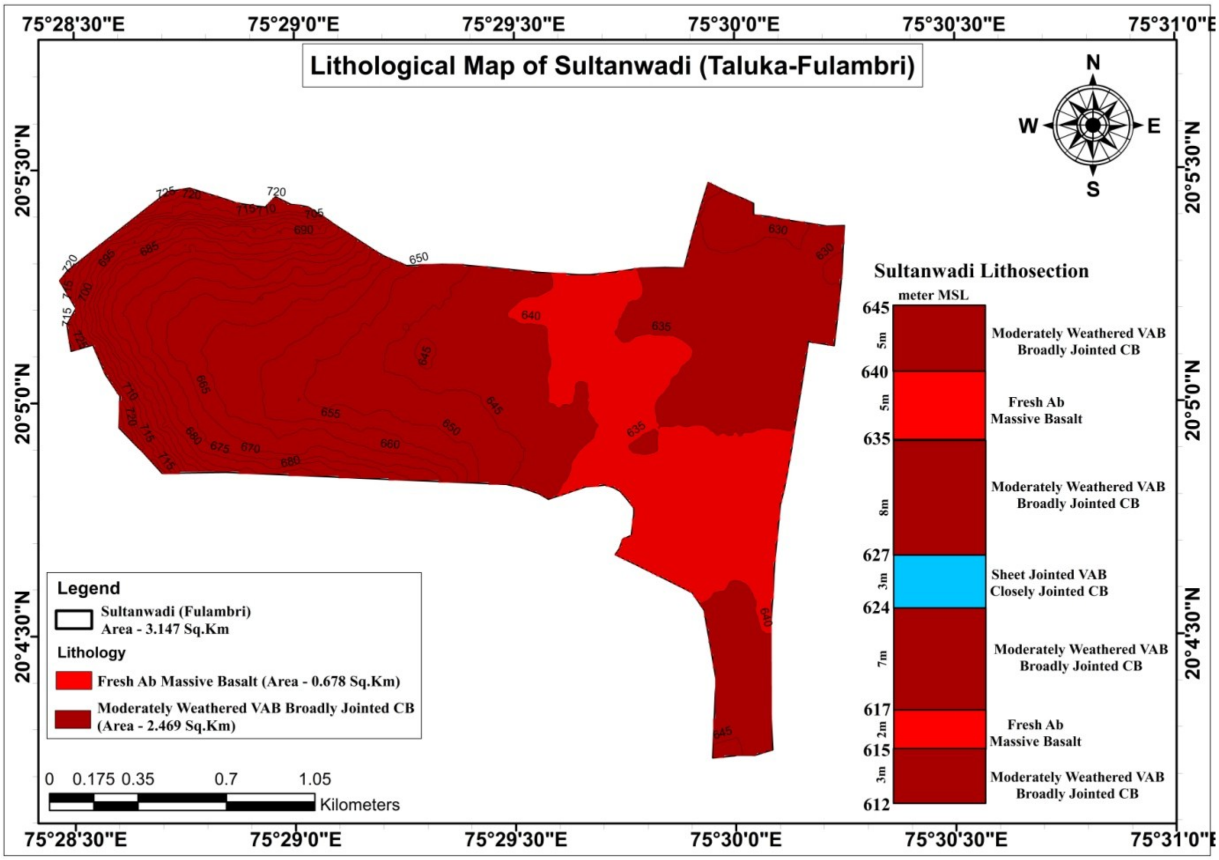

Fig5:GeologyMapofVillageSultanwadi

6.2.5 Implications oftheabove findings

Groundwater assessment carried out as a part of the hydrogeological study in village Sultanwadishowedthatthegroundwateryieldestimateof104.05hamisnearlythree times higher than the present estimated groundwater potential (10.78 ham), indicating ashortfall. It was partly due to the limited availability of infrastructure for storage and recharge, and partly due to low rainfall (drought) in the study year.

Table1:GroundwatersituationinvillageSultanwadi

SNo	Typeofbasaltflow	Area, ha	Flow Thickness, metre	Volume, ha-m	Ground water potential	Specific yield	Ground water estimate
1	VAB - Moderately weatheredvesicular amygdaloidalbasalt	246.9	23.0	5,678.7	10.37	1.75	99.30
2	Hydrothermally alteredbasalt	67.8	7.0	474.6	0.41	1.00	4.75
	Total	**551.9**	**27.0**	**3,811.00**	**10.78**		**104.05**

Water budgeting exercise also pointed out that the surface water storages in the villageare only 13.79 ham, which can be increased to some extent. In addition, there liesconsiderable potential of increasing soil moisture through scientific *in situ* soilconservation measures.

6.2.6 Suggestedadaptationmeasures

Theaforementionedanalysissuggeststhreetypesofadaptationmeasuresinthevillage.

Storage structures and recharge : The entire stretch of land lying in North-South direction from RL 635m to 628m provides a thick (8 m) zone for percolation. A varietyof soil water conservation measures and storage structures can be taken up. It is alsopossibletotakeupcleaning,wideninganddeepeningofexistingwaterbodiesand channels,alongwithmeasuresforinducedrecharge.

Area recharge : Over one-third of the area in the eastern part of the villages Sultanwadiishilly,leadingtohighrunoff.Itcanbeharvestedwithcontourtrenchingorwater absorptiontrenchesandinthegulliesbyconstructinggullyplugsorgabions.Similarly, existingrunoffharvestingstructurescanberepairedtoincreasetheirutility.

Farm level water management :for allowing rainwater to percolate into groundwater through identified recharge zones. It will include farm bunding, tree plantation of bunds, creating micro-basins and farm ponds for water harvesting and recharge.

Demand side water management by using water saving irrigation techniques like ridges and furrows, drip and sprinkler, and fertigation. Increasing the use of organic manureswillimprovemoistureholdingcapacityandhelpbalancesoilnitrogen.Along withmulchingandbiochar,itwillhelpimprovethesoilhealthbyconservingsoilflora, fauna, and nutrients.

6.3 CommunityAdaptationPlan

TheCommunityClimateAdaptationPlanforvillageRanjangaonwaspreparedusing theparticipatoryplanningprocesscomprisingthestepsandexercisesasdescribedin themethodologysection2.4above.Basedontheaforementionedanalysisandfindings during the Transect Walk, the following measures were suggested for soil waterconservationandgroundwaterrecharge.Thesehavebeenmarkedonthemap(Fig6).

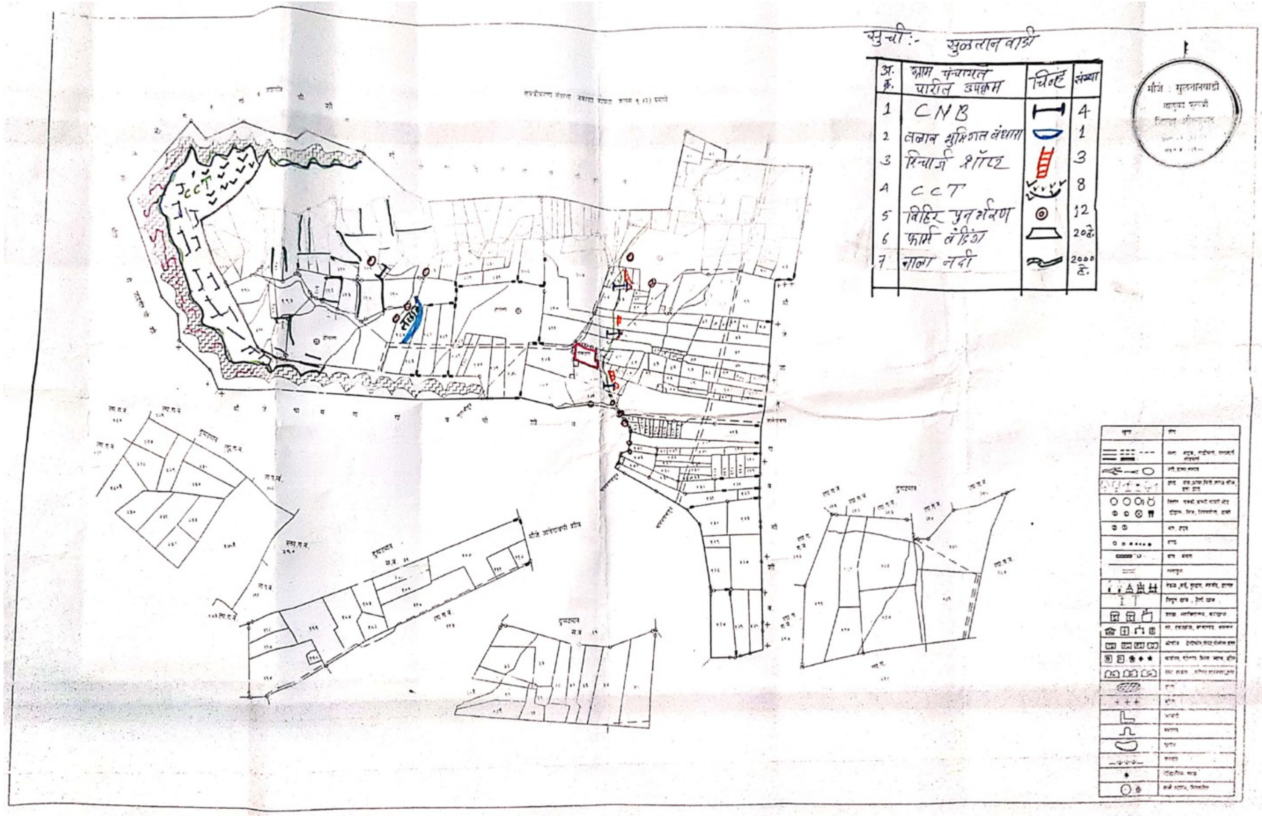

Fig 6 : Adaptation Plan– Sultanwadi

6.3.1 Arearechargemeasures

Trenching: Itwasproposedtobeexcavatedeepcontinuouscontourtrenchesand waterabsorptiontrenches(CCTandWAT)inthewesternhillyportionofthevillagein guts no. 193, 194, 202, 203 and 218 to minimize the runoff and reduce the soil erosion. Itisproposedtodevelopaplotof8hainthevillagegrazinglandinGatNo198asaplot of grassland with trees.

Farmland treatment : The moderately to gently sloping area in the mid-eastern portion ofthevillageisconduciveforrecharge.Soilconservationonfarmlandsusingfarm bunding was proposed on about 2o ha in Gat nos 191, 201, 202, 207, 208, 211, 214, 215, 216,221,and222.

6.3.2 Recharge-cum-storagemeasures

Nallawidening : Widening and deepening of the entire length of about 2000 metres ofthe easternallas was proposed around Gat nos 140 to 24 to increase surface storage andgroundwater recharge.

Newstructures: FournewmasonrycheckweirsareproposedinGatnos216,170,5 and 16-17 for runoff harvesting and recharge.

Subsurfacedyke: Inordertoretardthebaseflowsfromthestreambedoftheeastern nalla,itisproposedtoconstructasubsurfacedykeGatNo184-85.

6.3.3 Inducedrechargemeasures

Recharge shafts : The eastern stream is located in the area where a 5m thick hard layer ofhydrothermallyalteredbasaltliesfromRL640mto635m.Inordertorechargethe surplusrunoffinthisstream,threerechargeshaftsareproposedtobedrilledthrough this layer in the upstream of the masonry weirs near Gat Nos 170, 6, and 17.

Well recharge : It was proposed to encourage farmers to take up recharge pits for rechargingtheirdugwells.Inthecurrentyear,twelvedugwellswereidentifiedfor recharge in Gat nos 216, 184, 215, 223, 21,9, 171 (x2), 168, 163, 148, and 143.

6.4 Conclusion

SystematicimplementationoftheaboveAdaptationPlanisexpectedtosupportoverall development of the village community, especially the vulnerable sections. By participating in various activities under this project, the farmers have already become familiar with climate change challenges and pragmatic strategies to overcome the ill effects of droughts and towards building resilience. Implementation of the above adaptationmeasureswillgivethemanopportunitytopractisethosemethodsandgain further knowledge and skills.

Riskmanagementisakeyfeatureofadaptation;watermanagementmeasuresproposed abovewouldhelpinreductionandsharingofclimaterisks.ItisexpectedthattheGram Panchayat and the district administration will play a supportive role in this initiative.

These climate proofing measures will thus be able to seek options for how thegovernment schemes could further prepare communities for climatic changeadaptation.