Integrated Watershed Development: A Success Story from Bundelkhand

Supported by
Sir Dorabji Tata Trust (SDTT)
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Akhil Bhartiya Samaj Sewa Sansthan (ABSSS)

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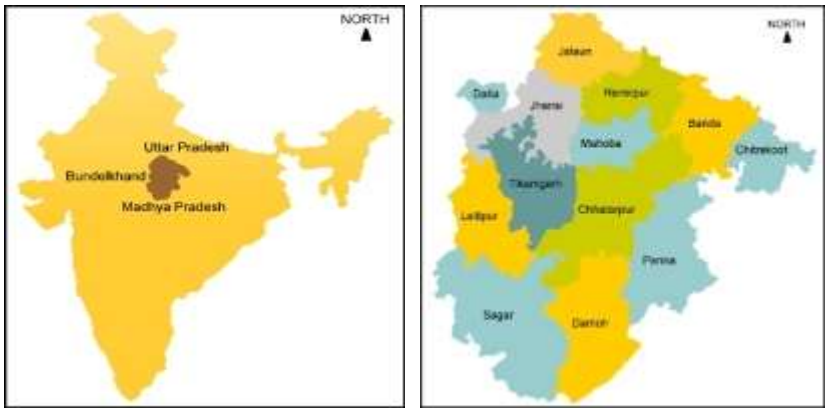
Introduction:

Bundelkhand is a cultural and agro-ecological region which includes several districts of southern Uttar Pradesh and northern Madhya Pradesh. The name is derived from the Bundela Kings who reigned here and the region has a rich historical legacy. The Hindu God Rama is said to have spent a part of his exile here. Medieval rulers built world-renowned monuments like the temples in Khajuraho which attract millions of tourists every year. The legendary freedom fighter Rani Laxmibai also hailed from this area.

Today this largely agrarian region is facing enormous problems of crushing poverty and lawlessness. According to the Sarma Committee (Sarma, 1997), all districts of Bundelkhand except Jhansi rank among the 100 most backward districts of India. The falling quantity and increasingly erratic nature of rainfall over the past decade has exacerbated these problems. Driven by issues of marginal landholdings and falling productivity, 50-70% of households in these districts have at least 1 member migrating to towns annually or permanently (ABSSS, 2002). Other sociological and developmental issues include a feudal overhang, high illiteracy, low status of women, etc.

Fig 1: *Location of Bundelkhand and the districts*



The Akhil Bharatiya Samaj Seva Sansthan has been active in the region since its inception in 1978 (ABSSS). A 2 pronged approach incorporating non-violent struggle and livelihood development has been followed to bring about the uplift of the poorest of the poor. ABSSS has worked to free bonded labourers, ensure redistribution of land, educate the tribals and other backward sections, enhance incomes, etc. In association with Sir Dorabji Tata Trust (SDTT) and PRADAN, the NGO embarked on 2 watershed development projects in Chitrakoot and Banda districts in 2007 with an emphasis on aiding small and marginal farmers.

The rest of this document is organized as follows: We have provided a brief macroeconomic and sociological overview, described the context and location of the projects, detailed the planning and activities and analysed the results and benefits. Finally we have distilled learnings for application in future projects.

Economic and sociological overview

Macroscope – Agriculture in India

The agriculture sector accounts for ~17% of India's GDP and employs around half the population (CIA World Factbook, 2011). The green revolution in the 1960s and 70s helped India move away from a "ship to mouth existence". India is among the world's leading producers of rice, wheat, cotton, sugar, etc. However, per capita availability of foodgrains and pulses has declined over the past 2 decades. While population growth has slowed in this period, food production has slowed even more sharply. An area of major concern is that per hectare productivity lags global standards (FAO, 2010). For example, the average rice yield in India is 2.3 tons/hectare which is far lower than the world average (4.4), China (6.5) and Australia (10.1). In wheat too, India (2.9 tons/hectare) lags USA (3.1), China (4.8) and France (7). In the Global Hunger Index, India ranks 67 among 81 countries and has the largest number of malnourished children under the age of 5 in the world. All of these point to the need for urgent, major interventions in agriculture – both in production and supply chains (to reduce rampant wastage).

Another major issue is the falling availability of water. Currently, the total utilizable water in India is 1,122 bcm annually which is just enough to meet our current needs. According to estimates by the Water Resources Group (WRG, 2009), half our water demand would be unmet by 2030 if present trends continue. In terms of usage, agriculture accounts for 85% of the consumption and is a highly inefficient user (IIR, 2011). Agriculture is also a highly inefficient user. For example, water productivity of rice in India is 0.2-0.26 per cubic metre which is half of China's. In case of wheat, it is 0.32-0.42 per cubic metre which is one-third of China (Cai, 2003). A great deal of government focus has been on expanding irrigation by large canal projects which are capital intensive and inefficient (Shah, 2011). Excessive groundwater exploitation (partly fuelled by supportive government policies such as financing and free electricity) has led to a sharp lowering of the water table, increasing salinity and quality problems in many parts of states such as Punjab, Rajasthan, Gujarat, Tamil Nadu and Uttar Pradesh (Gandhi, 2011). The emphasis on groundwater based irrigation has also increased inequity since richer farmers can afford more powerful pumps while the costs (in terms of falling water table and quality) are borne by all.

Hence, we need to increase access to water for agriculture while promoting more efficiency in usage to ensure that both food and water security are taken care of.

Bundelkhand – a profile

Bundelkhand has a population of around 18 mn as per 2011 census which implies a population density of less than one-third of the UP state average. While there is no clear consensus on the extent of poverty, it is generally agreed that over 40% of the population lives below the poverty line and a large fraction are clustered around it. Access to healthcare and sanitation remain areas of concern. In terms of education, the Sarva Shiksha Abhiyan

(SSA) has resulted in the opening of schools in most villages and pushed up enrolment. Further progress is expected with the implementation of the RTE (Right to Education).

Economy: Over 80% of the workforce is involved in agriculture. Several households (especially those with low of no landholdings) supplement their incomes by collecting forest produce like mahua flowes, tendu leaves, etc. There are very few large industrial units in the region. The beedi industry and the government are the largest non-agricultural employment providers (ABSSS, 2009). Gradual reduction of the forest cover and policies such as the Reserve Forests Act have reduced the incomes derived by tribals from forest produce – most of them are now agricultural labourers with marginal holdings.

Climate: The region is subject to extremes of climate with temperatures exceeding 50 degrees at times during summer and falling close to freezing point during winters. Rainfall is moderate and ranges from and averages around 1000 mm – most of it between June and August. However, rainfall is highly erratic leading to droughts or floods at times. 4 districts have been classified as drought prone and the region suffered from a shortage of water as recently as last year and twice in the last decade.

Demographics: The region is overwhelmingly Hindu and highly stratified along caste lines. Violence against women is commonplace and largely uncontested. Landholdings are concentrated among the upper castes.

Fig 2: *Mining activities (especially stone) has denuded soil and damaged agricultural land*

Description of watershed sites

Location

The Mangawan site on Patha plateau is located in Manikpur block of Chitrakoot district and falls in the agro ecological zone (AEZ) 11 of India. The Baraichha site located in Banda district is an undulating alluvial tract typical of the Bundelkhand part of AEZ 4.

Demographics

The Mangawan site comprised 8 hamlets of 4 Gram Panchayats (GPs). Four hamlets, viz. Mangawan, Chhiwlaha Motwan and Gursarai, fall under Mangawan gram panchayat. Two hamlets—Masnaha and Tikariya—are in Tikariya panchayat and one hamlet each viz., Doda and Bambiha, are from Doda and Bambiha panchayats respectively.

Mangawan is the largest of the 4 GPs and a total of 330 households live in its 4 above-mentioned hamlets. Additionally, the project covered around 270 households living in the 4 hamlets of Tikariya, Doda and Bambiha panchayats.

Mangawan and Tikariya are the largest hamlets and the only ones in project site to be connected by tar road. While Motwan and Chhiwlaha hamlets are adjacent to Mangawan hamlet, Gursarai hamlet is at a considerable distance, in a remote jungle area that was frequently attacked by dacoits in the past and was hence abandoned by households. Tikariya and Masnaha hamlets are adjacent to each other. Doda is a very small Kol hamlet, with less than 20 households.

Around 66% of the households (HHs) covered by the project at Mangawan site are of Kol tribals, classified as SC in Uttar Pradesh (Kols are ST in MP), who are target group of the project. They constitute 90% of the HHs in the 4 hamlets of Mangawan panchayat but in other hamlets, other than Doda, they are in a minority. Of the total HHs covered, 25% belong to General category castes, 6% to OBCs and 3% are Muslims. The breakup of social background of HHs is given in Table 3.

Table 1: *Social structure in Mangawan*

Village	**Households (HHs) by social category**				**Total HHs**
	SC	**OBC**	**Gen**	**Muslim**	
Mangawan (+3 hamlets)	294	6	14	16	330
Bambiha	50	28	82	0	160
Tikariya (+1 hamlet)	37	3	54	0	94
Doda	18	0	0	0	18
Total	*399*	*37*	*150*	*16*	*602*

The Baraichha site comprised three villages—Baraichha, Neduha and Chandpura (also known as Chandrapura)—of which one, Baraichha has two hamlets: Chunwapura and Salmatpur. SC households comprise nearly 30% of the total population and OBCs form 50% (Table 4). Muslims constitute 8% of the population. Salmatpur hamlet is entirely inhabited by Muslim HHs.

Table 2: *Social structure in Baraichha*

Village	**Households (HHs) by social category**				**Total HHs**
	SC	**OBC**	**Gen**	**Muslim**	
Baraichha (+ 2 hamlets)	32	106	8	21	167
Neduha	70	121	23	-	214
Chandpura	59	42	40	22	163
Total	*161*	*269*	*71*	*43*	*544*

Topography and drainage

The Mangawan watershed is surrounding by hillocks in southern part. Falling within the catchment area of Paisuni River in western side, it consists of irregular uplands with outcrops of rock intermingling with lowlands. The average level difference between the ridges and valleys found in the area is 10 m. The general slope is from south to north and varies from 1.0 to 2.5%. The soil is entirely disintegrated sandstone overlying a substratum of rock and is never very deep. This tract was largely under forests, which now stand almost denuded. One river, Kali Barah, passes through the watershed from south to north, and falls into Paisuni River. Another nala named Sarbhanga passes along the boundary of watershed in southern side.

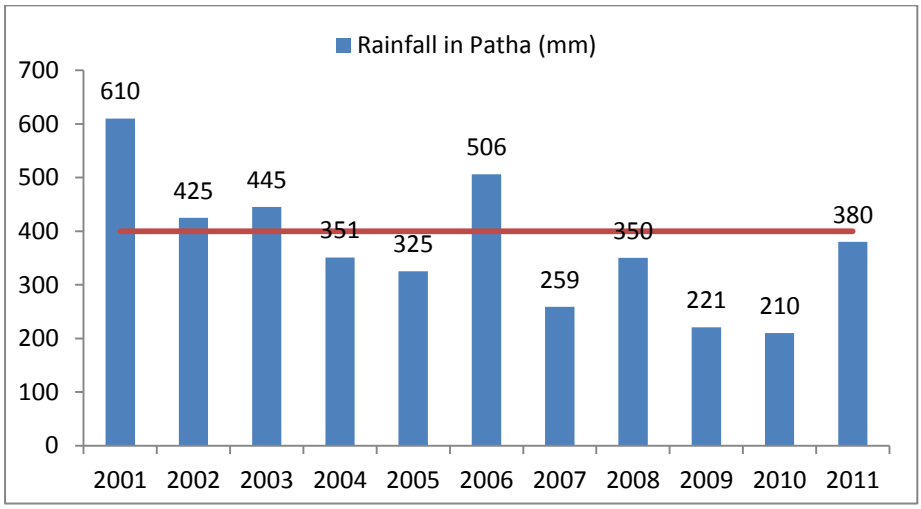
The Baraichha watershed area falls within the catchment area of Ranj River, a tributary of Baghain River which finally joins the Yamuna. The level difference between the ridges and valleys here is 5 m. The general slope of the area is from south to north, varying from 1.0 to 2.0%. The watershed area largely consists of irregular uplands with outcrops of rocks intermingling with mostly lowlands, frequently under water during rainy season. The soil is mostly Mar and Kabar, eroded and converted into ravines. One rivulet (nala) named Gharar passes along boundary of watershed from western- northern side and falls in Ranj River. Another nala named Patihar passes through watershed from southern- northern side and falls in Rang River. Two hamlets, Baraichha and Nedhuwa, are on the bank of Rang River in west side and Baraichha is on the east side bank. The Gharar Nala and Rang River have perennial flow from south to north.

Agroclimatic conditions

The Mangawan (Patha) site experiences extremes of climate with temperatures exceeding 45 degrees during summer and falling close to freezing point during January which is the coldest month. The Patha region receives extremely poor rainfall. The pattern is becoming increasingly erratic and 7 of the last 11 years saw rainfall falling below 400 mm which is the cutoff used to declare an area drought prone.

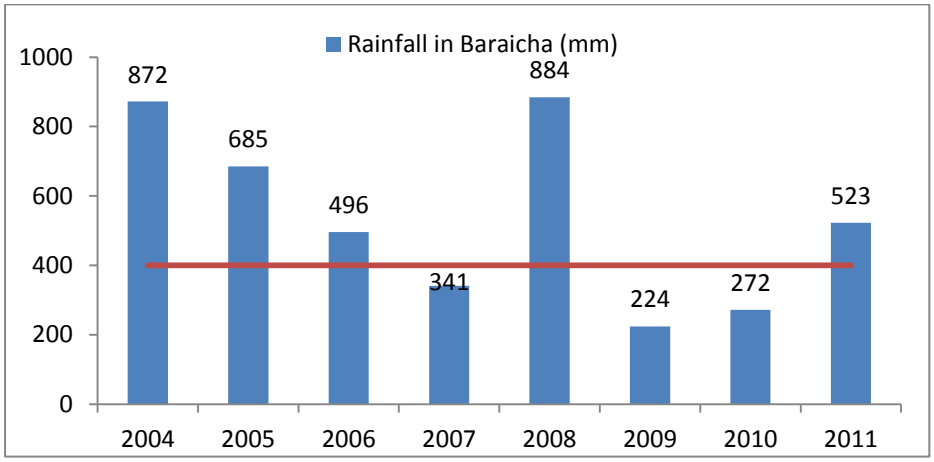
The graph below shows the rainfall recorded during 2001-11, at a rain gauge maintained by the State Irrigation Department, at a dam site in Patha close to Mangawan. Very significant is that fact in 7 of the 11 years, rainfall was below the 400 mm mark, which is generally used to declare an area as drought-prone. It must be noted that low rainfall was experienced for 5 years since 2007 – the period over which the watershed program was carried out.

Fig 3: *Rainfall in Patha (Mangawan)*



In the Baraichha site, the normal rainfall is much higher as shown in the graph below, which shows data available for 2004-11 from a rain gauge near the site. However this site too experienced low rainfall in 2009 and 2010.

Fig 4: *Rainfall in Baraicha*



At both sites the onset and withdrawal of monsoons is highly uncertain. Long intermittent dry periods are common as also brief and strong spells of rain. As such both sites prone to drought as well as flooding especially down barren slopes where there is a quick run off.

Land use

As shown below, the area of watershed demarcated in Mangawan is 1219.15 hectares (ha). A total of 145 ha fall under reserved forest and NGOs are not permitted to carry out any treatment work there. Privately owned lands available for treatment amount to 1009.75 ha. The Baraichha watershed is slightly smaller but has virtually no reserved forest. Hence the privately owned land available is almost the same as in the Mangawan site. Over three-fourths of the watershed areas were targeted for treatment under the project. At each site 500 ha was targeted for intensive in situ treatment.

Table 3: *Land use in Mangawan & Baraichha watershed in ha*

Use	**Mangawan**	**Baraichha**	**Total**
Privately owned agri land	1009.75	995.16	2004.9
Reserved forest	145	0.06	145
Land used for other purposes	49.5	58.5	108
Uncultivable wasteland	14.9	22	36.4
Total	**1219.15**	**1075.72**	**2294.3**
Watershed treatment area	813	946.6	1759.6
Area under in situ treatment	500	500	1000

Ownership

In both sites almost all HHs own land. However, in Mangawan we found that around a fifth of the Kol households had pattas allotted by government, but no demarcation had been done. Through the project's efforts, these households could gain possession of land during 2009-2010. Hence, as per last information, in the Mangawan site, there were only 24 HHs with no agricultural land at all—16 of them are Kols. However, the conventional understanding of landlessness is not applicable in the Mangawan site as before the project, a large number of Kol households with land had not cultivated their lands for years. In effect, they too had been landless.

Most land owners have only marginal or small holdings, as evident from the table below. Many of the holdings are in scattered plots of 0.07 to 0.5 ha each. Land ownership is skewed in favour of upper castes: while Kols constitute 66% of households in the Mangawan site, they own only 43% of the total privately owned land.

Table 4: *Distribution of holdings in Mangawan (598 holdings) and Baraichha (525)*

Size of holding	Holdings (%) in Mangawan	Holdings (%) in Baraichha
< 1 ha (marginal)	50	48
1-2 ha (small)	37	34.1
2-5 ha (semi medium)	10	13.8
5 - 10 ha (medium)	2	4
> 10 ha (large)	1	0.1

Soil properties and cropping patterns

Other than the land owned by upper caste landlords, most of the farmland in Mangawan has poor quality soil. As per soil testing done under the project, the soil has low organic content, low zinc and sulphur, average nitrogen and medium to high potash. In Baraichha the land is relatively more fertile. However, productivity was hampered by undulating terrain. While wheat, mustard and gram were the main rabi crops in both sites before the project, there was considerable crop diversity in kharif in the Baraichha site. In Mangawan, there was virtually no kharif cultivation; a small amount of paddy was grown depending on rainfall.

Table 5: Main pre-project crops in project sites

Season	Mangawan	Baraichha
Kharif	Paddy	Jowar, arhar, groundnut
Rabi	Wheat, mustard, gram	Wheat, mustard, gram

Though most families owned agriculture land and did cultivate it in years of average to good rainfall, the Kols in the Mangawan site were not truly `farmers'. Brought to the Patha several generations ago for cutting forest wood, their involvement with agriculture was limited to cultivation of coarse cereals in clearings. Over the past two generations, there was a clear shift towards growing wheat, and coarse cereals have (unfortunately) gone out of the diet of most Kols. Even so, knowledge about good agriculture practices remained average to poor. In the entire watershed area, there were less than half a dozen Kol families who could have been considered `good farmers'. Given the soil and water conditions in the area, there was little incentive to focus on agriculture. As observed by us, cultivation and production of crops by households was marginal in years of poor rainfall. In 2007-08, less than 5% of land owned by Kols was cultivated in kharif and in rabi only around 20% was cultivated. Big landlords of upper castes having considerable holdings and resources did of course cultivate a higher proportion of their lands. There was negligible vegetable production in monsoon. In Baraichha there was some vegetable cultivation along banks of streams.

Biomass

Pre-project biomass in Mangawan site was restricted to around 800 mature trees on private lands, or less than 1 tree per ha. For meeting fuel wood requirements, poor households

exploited denuded jungles, at a distance of 5-10 km from the hamlets. Fodder was scarce and no fodder crop was grown. In Baraichha, the tree population was somewhat higher and many livestock owners were meeting fodder needs through jowar and wheat crop residues.

Livestock

As per a baseline survey of Mangawan gram panchayat, total livestock owned by 330 households was 1104 animals, the majority of which were cows (435) and goats (269). Most animals were of poor quality. Average production of milch animals was 2 litres/day. Nearly a third of households owned no livestock.

Income

An intensive survey conducted under the project at the Mangawan site in May-June 2008 on a sample of 77 households (around 10% of total households) showed that, even in the best of years, agriculture constituted only around a sixth of total income. The main source of income was wage labour (45% of total income) followed by sale of fuel wood (27%) procured from jungles. The average annual net income of 60% of surveyed households was less than Rs 36,000 and only 9% had income above Rs 60,000 - none of these were Kol households. Food accounted for 38%-83% of total expenses of households, with the proportion of expense rising inversely with the total income.

Fig 5: Baseline planning and interviews with villagers:

Project strategy:

According to the Parthasarathy Committee report (Ministry of Rural Development, 2006), existing watershed programs suffer from a major weakness – that time is not allocated setting up durable, village level institutions and participatory processes are not put in place. Hence, the report advocated an 8 year program divided into 3 phases – a 2 year preparatory phase (involving baseline surveys, planning, impact assessment, etc), a 4 year implementation phase with yearly reviews and finally a 2 year "sustainable livelihood and productivity enhancement phase".

Having a similar approach in mind, we divided our project into 3 parts. The first 6 months were devoted to planning, surveys regarding incomes, demographics, employment, etc. The technical staff also carried out surveys of the land and made baseline plans. The 2nd stage involved construction of the planned structures. A part of this has also been dedicated to building agricultural knowledge. There is some overlap with the last phase since livelihood based initiatives such as SRI (System of Rice Intensification) were also carried out during this 4 year period.

The project design followed 2 broad strategic strands. The first strand was that the entire Bundelkhand region calls for integrated development of land and water resources with attendant farming systems. In other words, the land and farming systems must be so developed/ managed such that rainwater is used to the maximum extent possible where it falls in the farmers' fields instead of being allowed to escape as runoff. The bulk of monsoon rains fall in short and intense spells, often separated by several days or weeks, allowing little time for the rainwater to penetrate the soil. Therefore, much of the rainwater runs away and only a fraction is available locally. The approach used in this project was to arrest the rainwater close to the plants that needed it as far as possible while following a watershed plan. Leveling lands, making field bunds and impounding rainwater in each field were the main techniques used.

Bunding, leveling and terracing are widespread practices in rain-fed regions all over the country – indeed, all over the world. Unfortunately, farmers in rain-fed regions tend to be poor and do not have the capital to undertake these practices themselves on a large scale. This disability has become more acute over time as land availability per capita has declined, further reducing the ability to accumulate capital. Hence there is need for external funding.

Complementing the *in situ* approach outlined, some larger water impounding structures were planned in the lower reaches, to help capture water seeping through the ground.

The second strand of the strategy was to harness the riverine resources in the region. Little of the available water in the rivers was used before the project. Small lift irrigation schemes with buried PVC pipes to transport river water to farm fields within a distance of 1500 m were chosen as an eminently cost-effective option to utilize river water.

These activities were augmented by livelihood enhancement efforts which will be intensified in the next phase.

The above activities were customized based on the needs and terrains of each of the watershed sites. At the Patha site, more intensive land development was carried out, with both in-situ or on-farm water harvesting (through PRADAN's 5% farm pond model and bunding) and ex-situ water harvesting (earthen checkdams), besides development of open wells, lift irrigation and tree plantation. In the relatively flat region in Baraichha, the main activities were land development through leveling and bunding, lift irrigation, and tree plantation. At both locations, agriculture development was carried out along with capacity building in specific areas. Women's self-help groups were formed to initiate the practice of household savings, to build capital for emergencies and farm investment. SHG members were also motivated to do vegetable cultivation in small plots near their homes.

A total of 1000 ha was to be covered under land development and in-situ rainwater harvesting and 50 ha was to be covered under land use diversification, including forestation. Importantly, considerable work was to be done through convergence with government agencies and programmes.

Objectives

Under the goal of "Improved food security, sustainability of livelihoods and wellbeing of the poor", the project had the following objectives:

- Develop micro watersheds with people's participation and an emphasis on sustainability
- Prevent soil erosion & increase water availability
- Preserve and regenerate vegetation
- Develop awareness among people to adopt new agricultural practices
- Increase agricultural production and productivity
- Empower women through active participation in decision making process, increase income and access to resources
- Improve socioeconomic conditions food security of the poorest of the poor

Project management team:

The project was implemented by a small team of ABSSS with close consultation and guidance from Pradan, and experts, including members of a specially constituted Project Advisory Committee (PAC).

The project team, apart from part-time director, was as follows (headcount in parentheses):

- Project coordinator (1)
- Engineer (2)
- Agronomist (1)
- Community organiser (4, including one woman)
- Accountant-cashier (2)
- Documentation (1)

Works were executed with locally hired labour according to a quarterly and monthly schedule. Progress and quality of work were supervised on a continuous basis and progress reports were filed weekly. Weekly staff meetings were held to discuss issues of concern. Documentation of number of cultivating households, cultivated area, etc was done as per cropping season. Apart from production data, data on inputs and production costs were obtained for different crops from samples of farmers at both sites. The woman community organiser was in bi-weekly contact with women in all hamlets covered by the project. Monitoring of water levels in sample wells at both sites was done every month.

For facilitating community-led management of water resources, 5 ‘sajla samitis’ were formed with a total of 51 members. Of whom 15 were women and 33 belonged to SC groups. The sajla samitis met almost every week. Apart from this, 5 water user associations (WUAs) were formed for lift irrigation schemes in Baraichha. The WUAs have a total of 47 members including 9 women and 19 persons from SC groups. A total of 88 WUA meetings were held till March 31, 2012.

Guidance and inputs were received on various issues as stated below:

- Land development and in situ rainwater harvesting: Dinbandhu Karmarkar (PRADAN)
- Agriculture related issues: Prabhat Pandey (PRADAN), Dinbandhu Karmarkar, Dr Yashwant Singh (PAC member) and local KVK officials
- Technical guidance for lift irrigation: Randeep Sadhu
- Impact measurement: Ashok Gopal
- Feedback and evaluation: Abhay Gandhe and Bhaskar Mittra (SDTT)
- Overall strategic guidance: Vinod Jain (PAC) and Gopalbhai (ABSSS founder)

Project execution

As designed with technical assistance from PRADAN, the main activity of the SDTT-ABSSS project was development of land and in situ rainwater harvesting, with some ex-situ rainwater harvesting. Greater emphasis was on in situ measures, which were allocated ~42% of the total budget. Around ~16% allocation was for ex situ measures. Secondary aspects of design and implementation were water resource development, land use diversification (forestation), and agriculture development.

Vis-à-vis the two project sites, greater emphasis was laid on the Mangawan site and the aim was to develop it as a model for similar efforts in Patha and other remote, chronically poor regions of Bundelkhand with degraded soils. The project effort at Baraichha was treated more like a pilot, for learning and demonstrating cost benefit of developing fertile but undulating ravine land.

Project implementation was done in a phased manner with focus on different sets of activities in each year:

- Year 1: Focus on detailed planning, community mobilisation, site/beneficiary selection for soil conservation and in situ rainwater harvesting
- Year 2: Most of the ex-situ and much of the in-site work was completed
- Year 3: Completing in situ work
- Year 4: Building agricultural knowledge

Construction work carried out

The entire area planned to be covered by water harvesting measures was done as per schedule by March 2012. A 6 month extension was taken after this since surplus funds were available and these were used to support improved practices for the kharif crop.

Work was hampered in 2009-10 at the Baraicha site due to the undulating terrain which made manual levelling very difficult. This was exacerbated by the low availability of manual labour – owing to the nature of the work, people preferred taking up employment under MGNREGA. Hence, 'Rajasthani tractors' were used to do levelling. Subsequently, efforts were made to come as close as possible to the target of completing all land development and in situ water harvesting work by the end of March 2011.

Despite poor rainfall during the years of the project's execution, a great deal of involvement and cooperation was received from the locals. However, there was a setback due to dacoit attacks in Mangawan site in 2010-11, which led to stoppage of work for several weeks. As a result, the target of completing all physical works by end of March 2011 could not be achieved. The setback was made up with vigorous efforts in 2011-12.

Under the head of water resource development, the major achievement was design and execution of lift irrigation schemes in the Baraichha site. Each scheme, constructed at a low cost of Rs around 3.3 lakhs, lifts and transports water for a distance of 500 to 1 km, covering

approximately 18.50 ha. Water user associations have been formed to manage distribution of water and recover fees to cover pumping and maintenance costs.

A summary of the construction work carried out is given in the tables below and maps are shown in the appendix:

Table 6: *Details of in situ measures*

Activity	Mangawan			Baraicha		
	Number	Area covered	HHs benefited	Number	Area covered	HHs benefited
Land bunding		392	220		370	450
Land leveling		53	91		44	62
Earthen gully plug		16	15			
Farm ponds	32	63	51			
**This includes coverage by convergence; area in hectares*						

Table 7: *Details of ex situ measures*

	Mangawan			Baraicha		
	No.	Area covered	HHs benefited	No.	Area covered	HHs benefited
New check dams	6		51			
Check dam renovation	1		25			
Ponds renovated	2		8			
Renovation of earthen bunds	1		2			
Stone gully plug	21		5	14		14
Nala excavation			9			
Diversion drain		225 m				
Masonry outlet				3		3
Gabion	3					

Table 8: *Details of water resource development measures*

	Mangawan			Baraicha		
	No.	Area covered	HHs benefited	No.	Area covered	HHs benefited
New well construction	4		13	1		3
Well renovation	2		25			
Lift irrigation				5	119	210

The irrigated area went up substantially in both sites as shown below:

Fig 6: *Irrigated area before and after interventions*

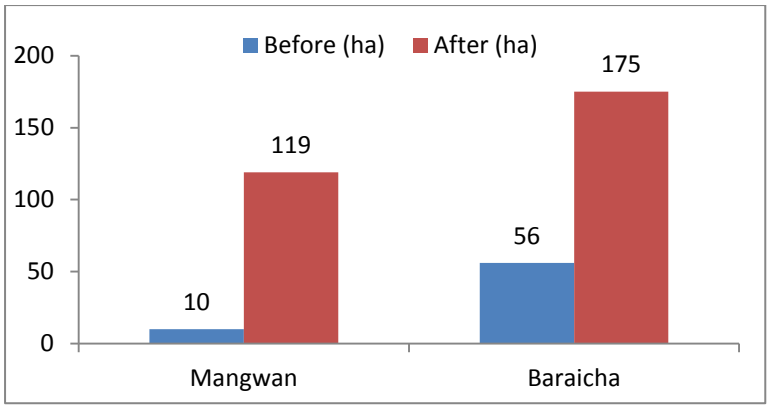


Fig 7: In-situ measures - farm pond and bunding

Fig 8: *Ex-situ measures – check dam and gully plug*

Fig 9: *Water resource development - Lift irrigation in Baraicha*

Promoting new agricultural practices and capacity building

As per the project plan, emphasis in the first three years was to be on completing planned treatment works and on improved agriculture in the last part of project period. Nevertheless, considerable efforts were devoted towards promotion of new practices in the earlier years too.

Select farmers were motivated and guided to increase yields, through input support for specific crops and green manuring, as shown in the table above. Additionally, on-field training with input support was provided to motivate 39 farmers to adopt System of Rice Intensification (SRI) and 22 farmers to adopt System of Wheat Intensification (SWI).

Table 9: *Number of farmers given input support (both sites)*

Activity	**Families benefited**	
	Mangawan	**Baraicha**
Paddy, Wheat ,Gram & Mustard PoP	54	57
Green manuring	19	36
Improved variety seeds	231	199
Seed for vegetables	11	43
SRI	18	15
SWI	9	13

A major activity conducted in 2010-11 was an intensive awareness campaign on good agriculture practices, conducted at both sites before the rabi season. Over 500 farmers were covered and the overall feedback given was that the effort was "highly useful".

In 2011-12, the effort to agriculture awareness was stepped up through farmer learner groups, formed with the objectives of:

- Facilitating learning among farmers through discussion, sharing of information, and knowledge inputs
- Encouraging individual and collective reflection on agriculture issues among farmers
- Promoting agriculture planning and problem-solving through community forums

As on March 31, 2012, in Mangawan site, 7 farmer groups were active with around 100 members, of whom 10% were women. In Baraichha site also there were 7 active farmer clubs with around 80 members, of whom 14% are women. In the 11 months from inception of this activity in August 2011, the clubs at both sites had a total of over 200 meetings. Meetings guided by Project staff were used to discuss, and share knowledge on a number of topics like crop planning, seed varieties, use of insecticides, benefit of dhaincha cultivation, etc. Meetings were also used to plan for activities like training programmes, tree plantation and making arrangements for timely irrigation.

Apart from all this, training programs were conducted on specific topics as shown below:

Table 10: *Capacity building programmes conducted till March 31, 2012*

Topic	**Participants**
Orientation to watershed	35
Organic fertilizers	30
Nursery development	6
Improved agriculture	37
Lift irrigation & social study (2 times)	32
Household planning	15
SHG training, APMAS	42
Rabi crop awareness program	540
Farmer awareness campaign	14
Agriculture trend study	12
Kharif crop orientation & training	40
Reflection on achievement of SAJALA programme	142
Farmers learning programme	34
Meet with experts, NABARD	79
SHGs strengthening- training, APMAS	5
Common guidelines for watershed development, SIRD , Lucknow	2
SHG book-keeping, APMAS	5
Enabling SHGs to graduate to microenterprises, BIRD, Lucknow	2
Financing for producers company, BIRD, Lucknow	2

A number of exposure visits were conducted for farmers:

- 29 farmers visited model farms in Sidhpur (Barwara) and lift irrigation project in Sitapur, Chitrakoot district
- 8 farmers visited model farms in Jatara, Tikamgarh district (MP)
- 14 farmers visited model vegetable farms in Naraini, Banda (UP)
- 40 farmers visited Kissan Mahakumbh organised by Agriculture Department, Banda
- SHG exposure visit, APMAS, Hyderabad
- Exposure on watershed & post- watershed approaches at NM Sadguru Water and Development Foundation , Dahod, Gujrat

Preservation and regeneration of green cover

Efforts to increase the vegetation, especially tree cover, were limited by distance of project sites from large nurseries. This greatly increased landed cost of saplings. Hence, saplings were obtained from government agencies, and a small nursery at ABSSS head office. Volumes available from these sources were low. A total of 21,086 trees could be planted in Mangawan site, on structures and lands of 166 farmers. In Baraichha, 19,673 trees were planted on structures and lands of 266 farmers. Appropriate local species like amla, neem, mango, subabul, guava, bel, mahua, beheda and karvanda were planted. The overall survival rate was 62.5%. There is need for intensification of this activity and this would be carried out during the next phase.

Empowerment of women

20 SHGs with a total of 219 members were formed as platforms for women to meet and talk about income generating possibilities and also to accumulate savings that could be used for productive or emergency purposes. By March 31, 2012, 18 SHGs had bank accounts. Total saving in bank accounts as on March 31, 2012 was Rs 2.34 lakhs or around Rs 12,000 per SHG. A total of 106 interloans amounting to Rs 1.26 lakhs were taken by members for purposes such as starting a kirana shop, buying inputs vegetable cultivation and basket-making, and for meeting marriage expenses. The substantial difference between amount loaned and accumulated savings is due to the fact that there are few viable and low-risk business opportunities available at either site. Further, at both sites, the women are more interested in building a cushion against shocks like major illnesses or drought and also in building savings for major life expenses like marriages of children.

The formation of SHGs has benefited poor families substantially since the loans taken from SHG savings typically carry interest rates of 0.5-1% per month as compared to 5-10% when loans are taken from moneylenders. Most of these women do not have the knowhow or collateral to access bank credit by themselves – even the paperwork for the SHG accounts was carried out by ABSSS workers.

The details of SHG activities are summarized below:

Table 11: *Summary of SHG related activities*

Detail	Mangawan	Baraicha
SHGs formed	7	13
Total members	82	137
Bank accounts	7	11
Total meetings	302	287
Total savings till Dec 31, 2011 (Rs)	95,768	85,206
Balance in saving A/c (Rs)	1,73,068	61,470
Interloaning (Rs)	88,500	37,860
Interloans taken (no.)	67	39

Convergence with governmental schemes

An important aspect of the project was convergence with government schemes. Around 25% of programme investments were to come from this source. Considerable success was achieved in this respect, especially by leveraging MGNREGA. Sanctions for convergence work amounting to over Rs 1.20 crores were obtained, and till March 31, 2012, Rs 68 lakhs were spent under different activity heads are shown below.

Table 12: *Expenditure through convergence till March 31, 2012*

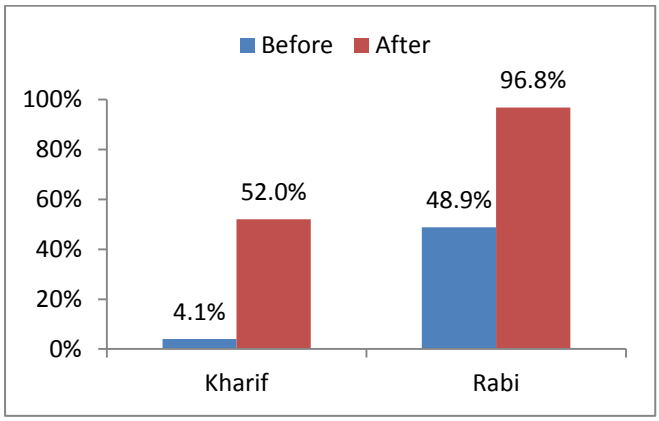
Activity	Amount spent (INR)
Land bunding	10,37,940
Land levelling	6,15,000
Ex situ rainwater harvesting	26,82,540
Lift irrigation scheme	9,15,162
Forestation	3,91,454
Demonstration of improved agri techniques	38,960
Purchase of farm machinery for increasing yield	11,24,600
Total	**68,05,656**

Impact:

Increase in cultivated area

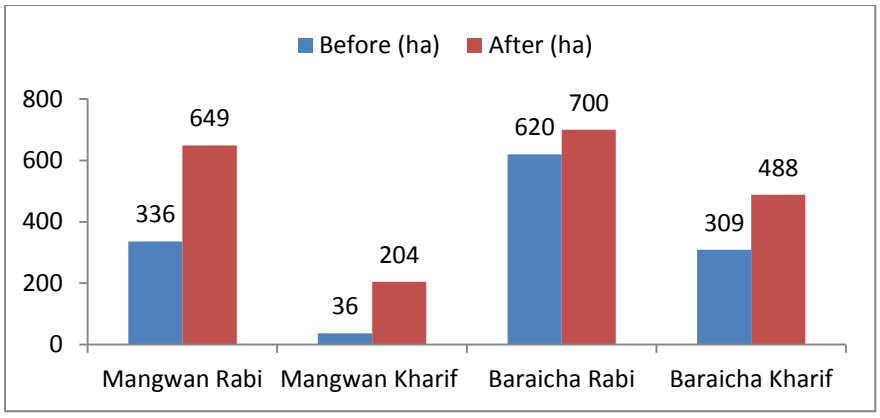
As a direct consequence of the project, the irrigated area in both watershed sites went up manifold. The improved availability of water ensured greater cultivation in the kharif season. Before the interventions, low availability of water had made cultivation uneconomical in the kharif season. This was especially true for small farmers who could not afford powerful pumps to tap groundwater sources. At the Mangawan site, the number of cultivating their lands went up each year and this reached 95% by the end of the project even though almost all the years witnessed drought-like conditions.

Fig 10: *Percentage of households cultivating their holdings*



The area under cultivation also went up substantially in both sites as shown below.

Fig 11: *Area cultivated – season and watershed-wise*



The impact was more pronounced in the Mangawan site since it was an area with low fertility soils that received a great deal of focus whereas Baraicha had fairly intensive agriculture even before the interventions. However, as seen later, the area under wheat cultivation went up substantially in Baraicha which indicates that farmers were able to increase their returns as the water content in the soil went up.

Higher production and yields

As mentioned earlier, most of the project duration witnessed drought-like conditions in both the watersheds. Despite this, improvement in food security for the poorest families was achieved at the sites – especially in Mangawan which was witness to chronic shortages earlier. Even in Baraicha, where agriculture was fairly intensive before the project and interventions began a year after Mangawan, there were significant increases in production and paddy cultivation was begun for the first time. The increases in production of crops are shown in the table below.

Table 13: *Rise in production of major crops in both watersheds*

Crop	Prodn in Mangawan (kg)		Prodn in Baraicha (kg)	
	Before	After	Before	After
Wheat	1,12,610	4,95,750	2,33,770	4,05,990
Paddy	6,170	52,081	0	17,010
Jowar*	NA	NA	1,09,253	1,70,950
Gram	5,620	18,818	86,572	1,67,935
Arhar*	Negligible	7,430	38,795	80,890

Due to improved water availability coupled with interventions promoting proper usage and improved agricultural practices like SRI and SWI (System of Wheat Intensification), productivity went up sharply in case of most crops as shown below.

Table 14: *Changes in productivity at the watershed sites*

Crop	Mangawan (kg/ha)			Baraicha (kg/ha)		
	Before	After	% change	Before	After	% change
Kharif						
Paddy	340	1,518	346%	-	1,572	NA
Til	213	60	(72%)	311	79	(75%)
Arhar	282	288	2%	155	288	86%
Jowar	-	-	-	437	608	39%
Groundnut	-	-	-	708	1,058	49%
Mung/urad	-	-	-	405	130	(68%)
Other kharif	-	279	NA		132	NA
Rabi						
Wheat	970	1,802	86%	1,755	2,037	16%
Mustard	469	540	15%	-	-	-
Gram	296	326	10%	386	706	83%
Linseed	-	398	NA	-	4,073	NA
Barley	780	958	23%	1,062	1,114	5%
Other rabi	184	357	94%	290	140	(52%)

Change in cropping patterns

Due to a combination of the increased availability of water and persuasion by ABSSS workers, many households modified their cultivation patterns. Sown area in kharif went up substantially as seen above. In Mangawan, til has emerged as a popular new crop and area under pulses trebled in kharif. During rabi, area under wheat came close to that mustard or exceeded it. This was made possible by the increased availability of water. The changes in cropping patterns can be observed in the graphs below.

Fig 12: *Changes in cropping pattern in Mangawan in kharif and rabi*

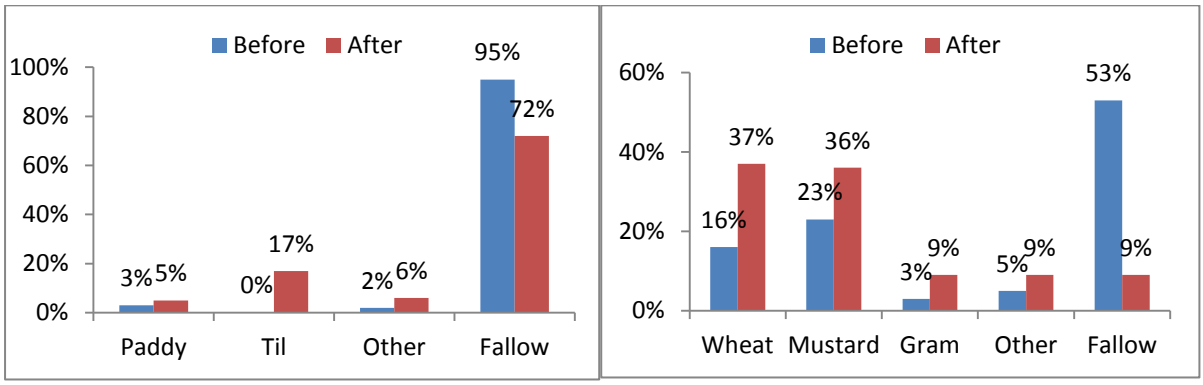
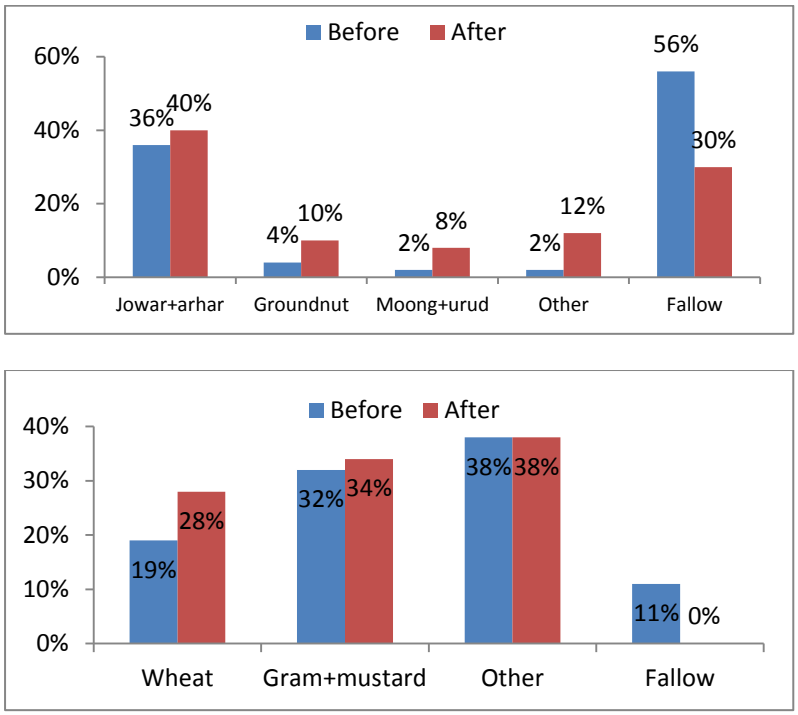


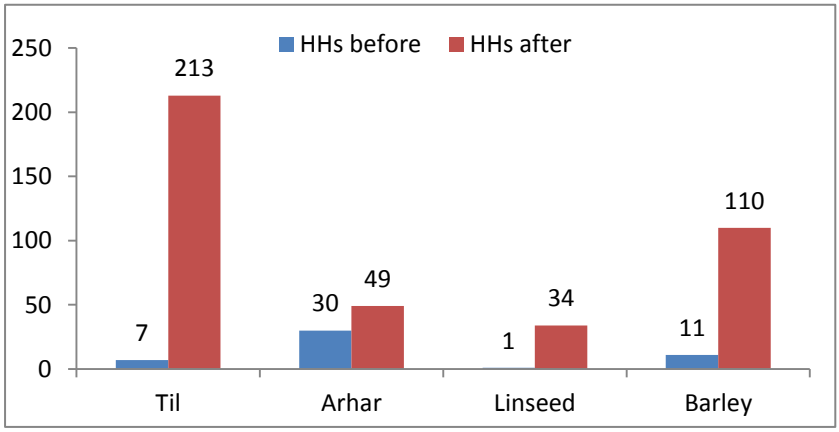
Fig 13: *Changes in cropping pattern in Baraicha in kharif and rabi*



The concerted efforts of the project team also led to an increase in cultivation of alternate crops. As shown in the figure below, many households in Mangawan began to grow linseed, barley, etc. In Baraicha, paddy was added to an already diversified crop basket. In a region with erratic rainfall and poor soil quality, this diversification will help poor households get

some returns even in worst case scenarios such as prolonged dry spells, pest and animal attacks, etc.

Fig 14: *Number of households in Mangawan growing alternate crops*



Efforts were also made to promote vegetable cultivation. As a result, nearly 20 HHs in Mangawan and over 30 HHs in Baraichha grew a variety of vegetables for the first time with input and technical support from the project. The results demonstrated to the people that even from small plots one can grow a variety of vegetables to enhance nutritional status of family, and also gain additional income.

Vegetable cultivation was thus demonstrated as a good source of income, as shown in table 18, which shows gross value of some vegetable production in 2011-12. As the data shows, gross value of vegetables cultivated per HH was nearly Rs 2000.

Table 15: *Gross value from some vegetable production in 2011-12 (both sites)*

Vegetable	HHs cultivating	Area (sq m)	Output (kg)	Value (INR)
Tomato	23	2,324	1,941	22,634
Potato^	9	2,629	4,380	43,800
Onion^	10	2,675	2,000	12,000
Garlic^	4	117	80	4,800
Chillies	17	2,437	841	25,235
Bhindi	9	1,793	2,428	24,280
Total	**72**	**11,975**	**11,670**	**1,32,749**

*Some HHs cultivate more than one vegetable. ^ Only in Baraichha site

Nevertheless, vegetable cultivation it is not an option for all farmers because of the following reasons:

- Only HHs with water harvesting structures close to their lands can meet irrigation needs – this issue is gradually being addressed
- On area basis, vegetable cultivation requires more investment than food crops. This is an issue for small farmers since many of them lack capital and access to affordable credit.

- Vegetables are also highly susceptible to frost/hail and 1-2 days of such weather can ruin the crop.
- Local market for vegetables is limited due to lack of a large urban centre, and possibility of transporting produce to long distance destinations is hampered by lack of infrastructure (cold storage, inadequate transport facilities).
    - Due to issues with market access, farmers cannot easily monetize their vegetable produce to purchase other food items – hence growing some cereals to ensure food security is necessary.

Hence, vegetables cannot be a major crop in any season – especially for small farmers.

Fig 15: *Vegetable cultivation by small farmers*

Empowerment of women

As mentioned earlier, the formation of SHGs and accumulation has savings has provided a relatively inexpensive source of financing for women, especially when it comes to needs like cropping loans. The cost of borrowing from the SHG corpus is far lower than from moneylenders – 0.5-1% per month as compared to 5-10%.

This development has helped free families with small holdings from the clutches of the zamindars and consequently they have begun to voice their opinions regarding village development and usage of common resources more vocally. For example, spontaneous action was taken by women in November 2009 to prevent farmers outside the watershed area from lifting water from a checkdam's reservoir using large diesel pumps. The women compelled the farmers to shut down the pumps and called for a meeting to determine the commercial terms on which outsiders could take water. This is particularly remarkable since the women leading the process were Kol tribals; many women from this tribe used to be forced to be the concubines of the powerful as recently as a generation ago.

Women have also begun to take the initiative regarding increasing their incomes and diversifying the sources. In September 2010, following a suggestion given by SDTT official Abhay Gandhe, a women's SHG in Mangawan started fish farming in a checkdam reservoir,

with 22,000 seedlings. Many women have also taken to vegetable cultivation and have expressed keen interest in other income-generating activities.

Reduction in migration

Fragmented landholdings, low productivity and the rainfed nature of Indian agriculture usually induce seasonal migration by a number of small and marginal farmers – they usually seek employment as manual labourers in brick kilns, construction sites, etc. There are no official statistics regarding the number of migrant workers but estimates vary from 30 to 100 million per year annually across India.

One of the impacts of increased area under cultivation noticed in Baraichha was that a number of HHs that used to migrate routinely for 6 or months stopped doing so. From discussions in villages it emerged that seasonal migration had substantially or totally stopped in 170 HHs (51 in Baraichha, 119 in Nedhua), of whom 78 were SCs.

Cost benefit analysis of the interventions

The economics of the cost of cultivation for the major crops were worked out in the pre and post intervention periods for each of the watersheds. The cost of cultivation was worked out item-wise (seeds, fuel and machines hired for irrigation, fertilizers, etc). In certain years, the contribution (revenues from output less variable costs) was even negative for crops like wheat (due to lack of irrigation in winter) and til (due to untimely rainfall).

The watershed interventions were successful in both the areas. The crops considered for the analysis were as follows:

- Kharif: Paddy, til, arhar. Jowar, groundnut, mung/urad
- Rabi: Wheat, mustard, gram, linseed, barley

Apart from these, the production of several other minor crops grew as shown below:

Output in kgs	**Mangawan**		**Baraicha**	
	Before	After	Before	After
Kharif	60	5580	0	2580
Rabi	2655	275	580	1450

Also, cultivation of vegetables was begun in garden patches for the 1st time by many small farmers. However, these are not factored into our analysis.

Discussions of assumptions

- In both areas, the quality of soil is improving with agriculture becoming more regular. Hence, we assume a high growth of productivity for the next 2-3 years (12% in Mangawan and 6% in Baraicha) and then a steady state annual growth for 2 years
- The life of structures has been assumed as 20 years for Mangawan and 18 for Baraicha
- The output price growth has been taken to be 4% (approximately the same as long term food inflation). The pre-project revenues have been grown at this rate in order to compute the increase in profits
- The opportunity cost of working in one's own fields needs to be considered since a number of small farmers were working as manual labourers within the village or elsewhere. For Mangawan, the data was available. In Baraicha, we have the data for fall in migration and consider this to be the number of families not working as manual labourers any more. The wage rate has been taken to be the average NREGA wage
- All costs have been grown at 4%. The wages have been grown at 6%
- The discount rate has been assumed to be 10%

Sensitivity analyses have been done for all key variables.

Results for Mangawan

The Mangawan watershed was intended as a model of sorts for our watershed projects since this is an area where agriculture was not carried out too intensively. As recently as 2 decades ago, this area had known bonded labour and a number of small farmers were allotted pattas which were rocky and unirrigated

We calculated a benefit-cost ratio of 3.3 considering only the improvements as a result of the work carried out in this phase. The returns will increase substantially without much extra cost if livelihood and improved agriculture oriented improvements are carried out. The results of these were seen in a few plots in this phase when SRI and organic farming were carried out and improved yields were obtained with far lower investments in seeds and other inputs. On the flip side, these techniques are more labour intensive than is the case now.

The results are summarized below:

NPV of interventions (Rs)	9,00,28,327
Cost of interventions (2013 value)	2,71,64,467
Benefit cost ratio	**3.3**

		Days of wage labour				
	3.3	70	75	80	85	90
	6%	5.8	5.5	5.3	5.0	4.7
	8%	4.6	**4.4**	**4.2**	**3.9**	3.7
Disc rate	10%	3.7	**3.5**	**3.3**	**3.1**	2.9
	12%	3.0	**2.8**	**2.7**	**2.5**	2.4
	14%	2.5	2.3	2.2	2.1	1.9

		Productivity growth steady state				
	3.3	1.0%	1.5%	2.0%	2.5%	3.0%
	2%	0.8	1.0	1.2	1.4	1.6
O/P price growth	3%	1.7	1.9	2.2	2.4	2.7
	4%	2.7	3.0	**3.3**	3.6	4.0
	5%	3.9	4.3	4.6	5.0	5.4
	6%	5.3	5.7	6.1	6.6	7.1

		Initial high growth				
	3.3	8%	10%	12%	14%	16%
	6%	3.8	4.5	5.3	6.0	6.8
	8%	3.0	3.6	4.2	4.8	5.4
Disc rate	10%	2.4	2.8	**3.3**	3.8	4.3
	12%	1.9	2.3	2.7	3.1	3.5
	14%	1.6	1.9	2.2	2.5	2.9

		Life of structures				
	3.3	16	18	20	22	24
	6%	4.0	4.6	5.3	5.9	6.3
	8%	3.3	3.7	4.2	4.6	4.8
Disc rate	10%	2.7	3.0	**3.3**	3.6	3.7
	12%	2.2	2.5	2.7	2.9	3.0
	14%	1.9	2.0	2.2	2.3	2.4

Results for Baraicha

The Baraicha watershed required some mechanized work since a lot of the work was focussed on levelling apart from lift irrigation. Soil quality was better in this watershed although a lot of it had been eroded into ravines and some of the fertility had been lost where the land lay fallow for some years. Hence, the assumptions regarding productivity growth have been modified to some extent.

We calculated a benefit-cost ratio of 4. In this case too, the ratio will be far higher once interventions planned in the next phase are carried out.

The results are summarized below:

NPV of interventions	5,92,04,823
Cost of interventions (2013 value)	1,46,27,021
Benefit cost ratio	**4.0**

		Days of wage labour				
	4.0	80	85	90	95	100
	6%	8.0	7.3	6.6	5.9	5.2
	8%	6.4	**5.8**	**5.2**	**4.5**	3.9
Disc rate	10%	5.1	**4.6**	**4.0**	**3.5**	3.0
	12%	4.1	**3.6**	**3.2**	**2.8**	2.3
	14%	3.3	2.9	2.5	2.1	1.8

		Productivity growth steady state				
	4.0	1.0%	1.5%	2.0%	2.5%	3.0%
	2%	-0.6	-0.2	0.3	0.7	1.2
	3%	1.0	1.5	2.0	2.6	3.2
O/P price growth	4%	2.8	3.4	**4.0**	4.7	5.4
	5%	4.9	5.6	6.3	7.1	7.8
	6%	7.3	8.1	8.9	9.7	10.7

		Initial high growth				
	4.0	3%	4%	5%	6%	7%
	6%	4.9	5.7	6.6	7.5	8.4
	8%	3.8	4.5	5.2	5.9	6.6
Disc rate	10%	2.9	3.5	**4.0**	4.6	5.2
	12%	2.2	2.7	3.2	3.7	4.2
	14%	1.7	2.1	2.5	2.9	3.4

		Life of structures				
	4.0	14	16	18	20	22
	6%	4.5	5.5	6.6	7.7	8.9
	8%	3.7	4.4	5.2	5.9	6.7
Disc rate	10%	3.0	3.5	**4.0**	4.6	5.1
	12%	2.4	2.8	3.2	3.6	3.9
	14%	2.0	2.3	2.5	2.8	3.0

Conclusion

Key learnings

The following are key findings/learning from the programme:

- Despite extremely low rainfall in Mangawan, there has been a remarkable increase in cultivated area in the project site, thus indicating that a majority of the HHs are keen on pursuing agriculture as a viable source of income and thus avoiding or minimizing migration
- Despite poor rainfall, farmers following good agriculture practices could secure yields equal to or higher than average yields reported for UP Bundelkhand. This is clear evidence of the benefits of soil and water conservation in degraded soils of this region.
- While vegetable cultivation is more remunerative, scope for vegetable cultivation is limited by factors like high capital/labour requirement, poor transport infrastructure for daily transport of produce, and distance from large markets/cities.
- Farmers in both sites are keen on increasing yields/returns from agriculture by enhancing their agriculture-related knowledge.
- Apart from trend of poor rainfall, poor knowledge about and access to improved agriculture technologies (improved variety seeds, nutrient use based on soil test reports, etc) are key constraints to increasing yield.
- There is good scope for converging soil and water conservation work with MGNREGA.

For the reasons stated above, there was need for a `watershed plus' project after the end of the current project, focussing on plugging gaps in agriculture knowledge and technology through a participatory approach.

Issues of concern

Though the project was successful in attaining its main objectives, there remained some issues of concern:

<u>High production costs due to local factors</u>

As there are very few good-quality draught animals in Mangawan, all farmers at this site use tractors for ploughing, apart from diesel pump sets for irrigation. Both machines have to be hired from a few large farmers of the area, who charge exorbitant and varying rates, as per demand. As a result, expense incurred on ploughing and irrigation is unreasonably high, and affects overall profitability. The problems was partly resolved by obtaining a tractor and diesel pump through convergence (Table 13), but this is not enough to meet the needs of all farmers. SHGs will have to be supported and motivated to raise funds and buy more units of this equipment, which can be given on hire to members at reasonable rates.

<u>Knowledge and technology gaps</u>

Analysis of yield data from project sites across years showed that there was wide variation in yields and a large number farmers were getting less than optimum yields, with the result that

while cultivation of food crops partially met food security needs, agriculture was not very cost-effective for them.

At the same time, the project demonstrated that higher yields are possible. Significantly, many of the farmers who got good yields were small and marginal landholders with limited investment capacity. That is, their yields were not related to ability to make high investments in inputs. Through focused group discussions, explanations were sought for each farmer getting high yields, and invariably, participants gave one or more of the following reasons:

- The farmers getting high yields are "knowledgeable" about farming; they know how to do "good farming".
- The farmers use good amount of fertilisers, including relatively high amount of manure.
- The farmers "take care of their crops better".

It is thus clear that the yield-gap is a result of a gap in level of agriculture knowledge and management.

While considerable effort was made in the project to fill the knowledge gap, and agriculture education was the major activity for the last year of the project, a more intensive effort needs to be taken, focussing on:

- large number of closely monitored participatory demonstrations of improved seed varieties and agriculture methods
- systematic farmer learning programme for improving yields through good agriculture practices

Recommendations

Based on lessons learnt from the project, ABSSS suggests that when undertaking or supporting similar projects in areas of Bundelkhand with under-developed agriculture, the development agencies concerned should look at following issues:

- Introducing agriculture education and planning as a major activity from the very start of the project (after the planning phase) through farmer groups/clubs
- Enabling the creation of on-site nurseries at the start of the project, for supply of large volumes of appropriate tree species for forestation/bund plantation
- Grant support for purchase of power tillers/diesel pumps by SHGs/farmers' groups
- Support for community-managed revolving fund, to enable poor households to access finance at low rate of interest, for purchase of inputs of right quantity and quality
- Creating an institutional setup to manage common watershed assets from the very start of the project, rather than at the end

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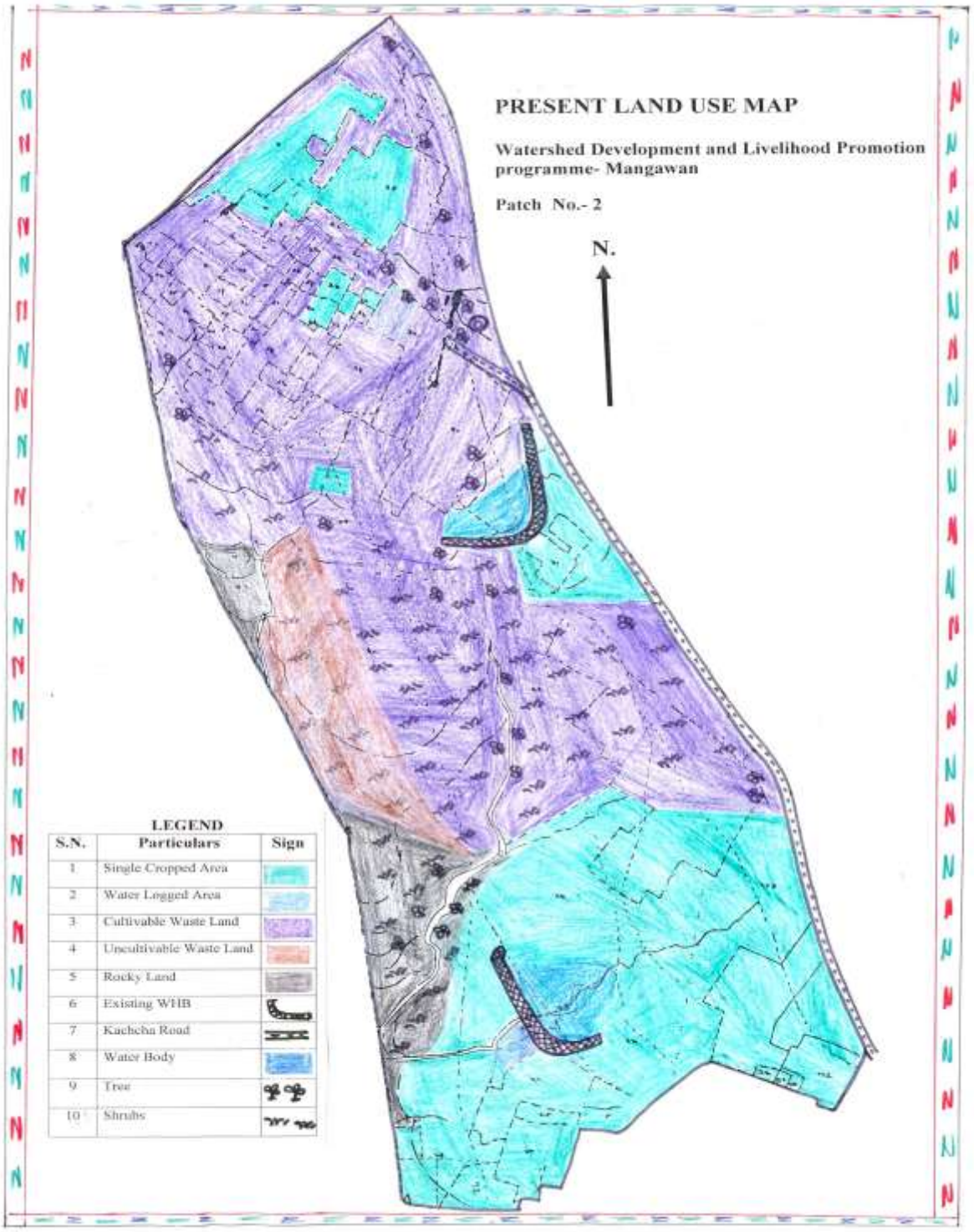
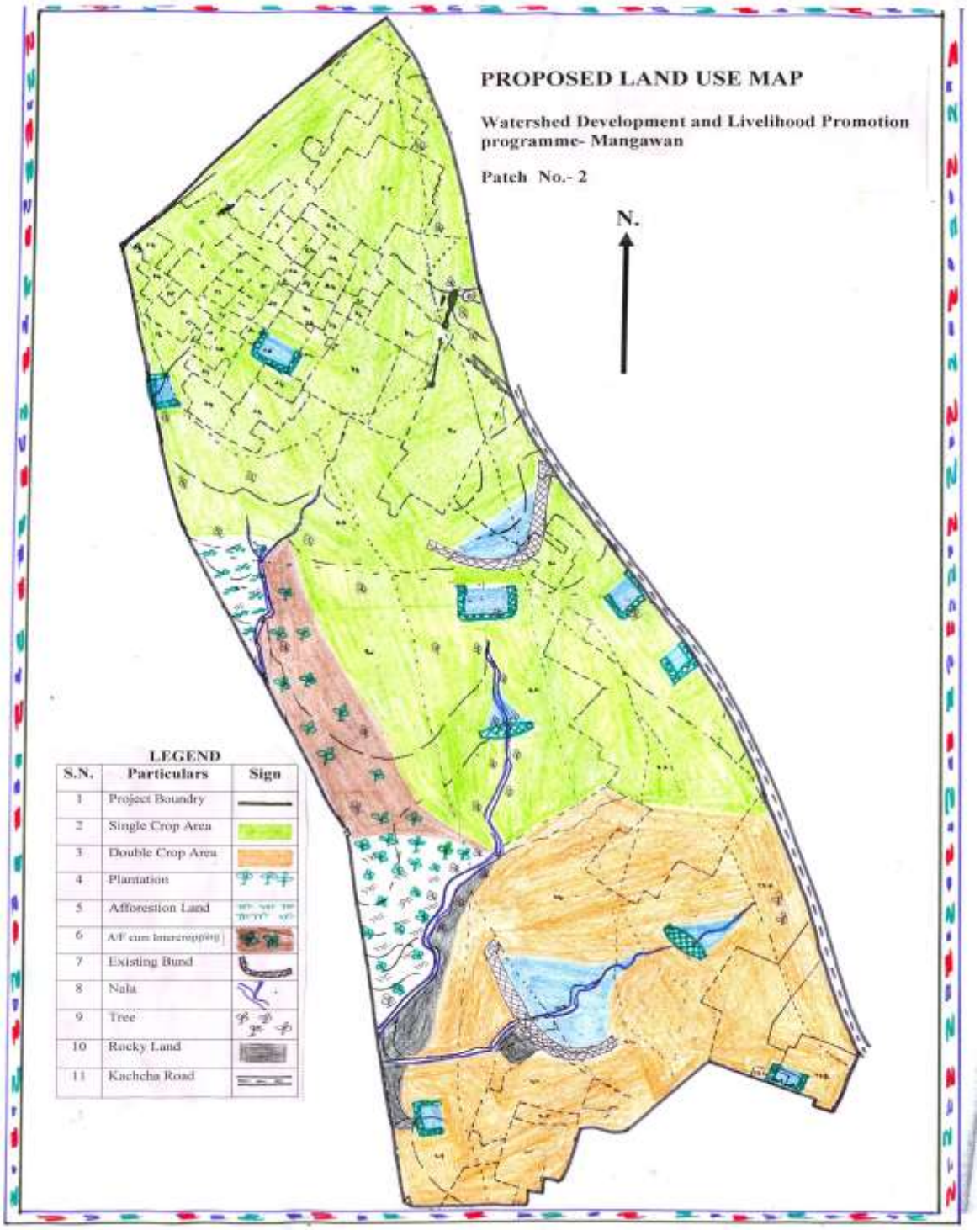
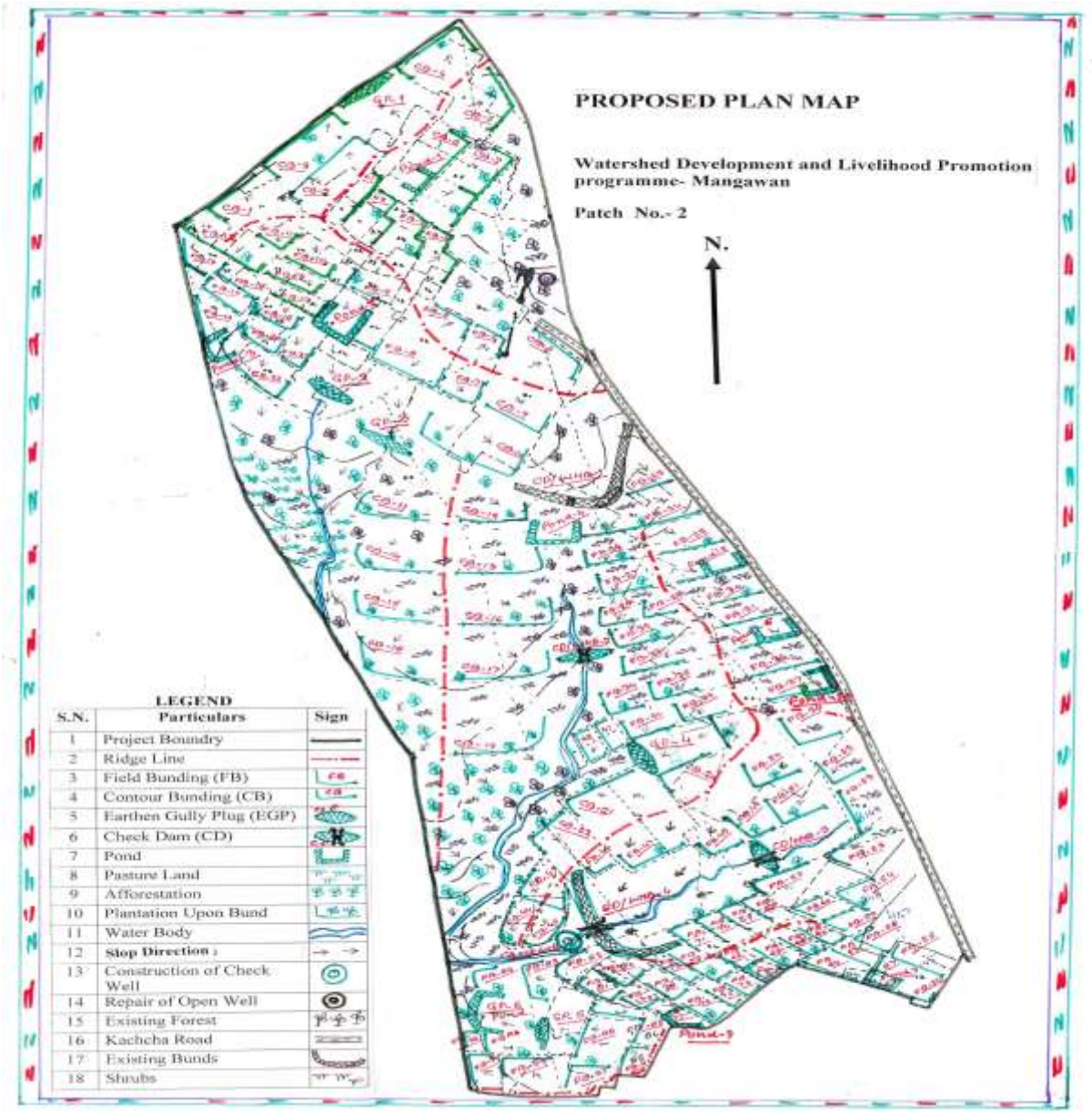
Appendix

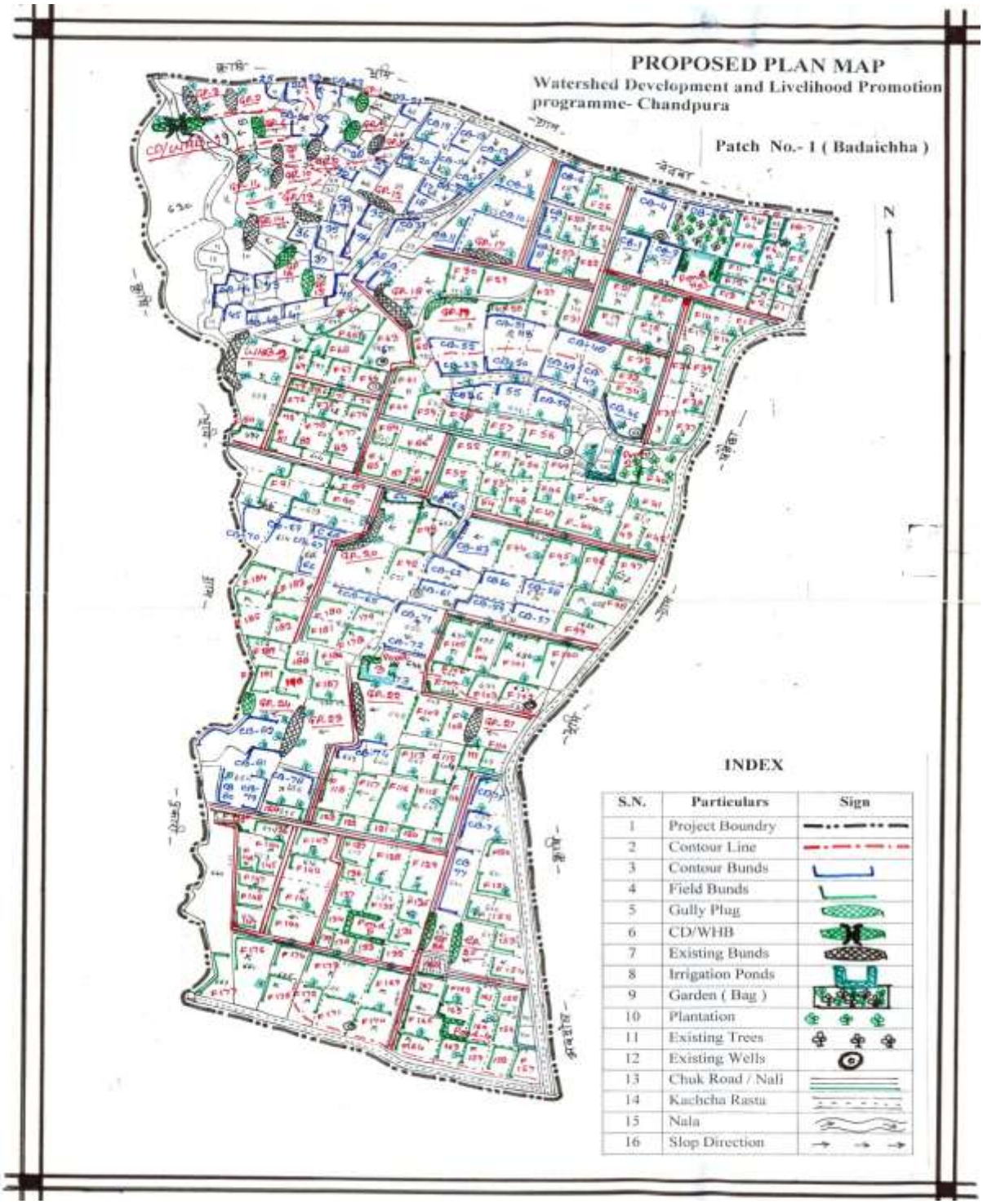
Appendix 1: Locations of watershed structures in Mangawan

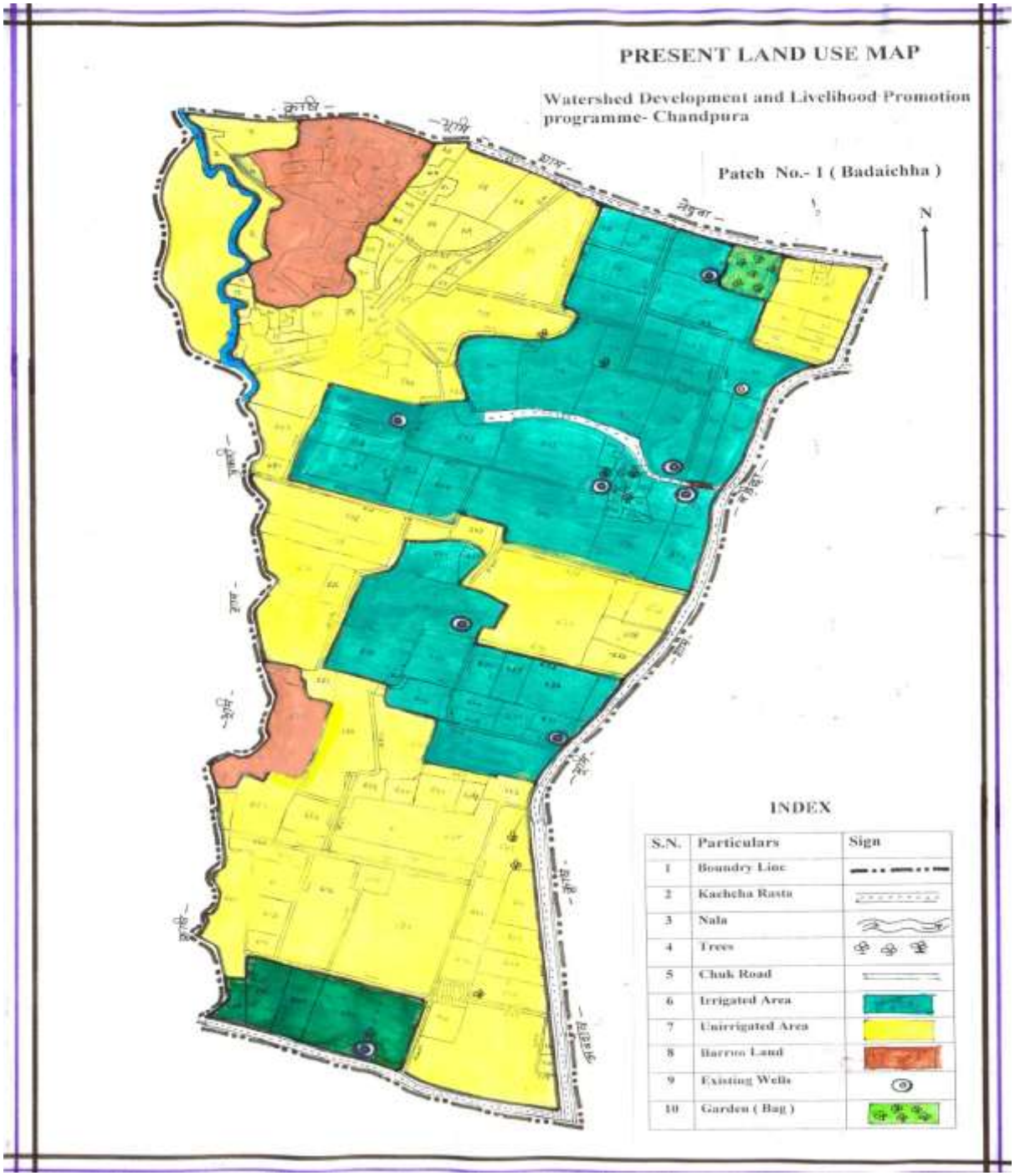


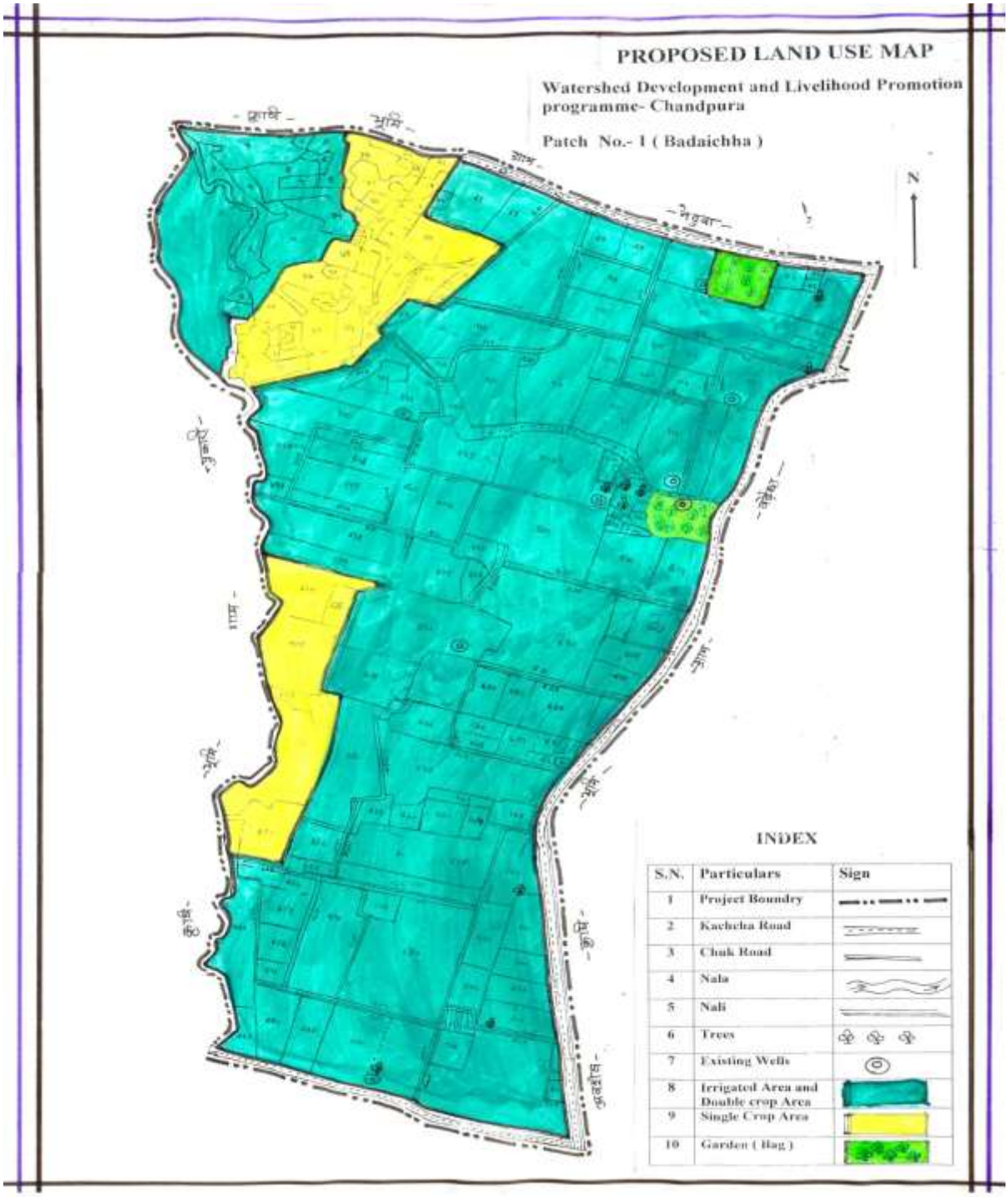

PROPOSED LAND USE MAP
Watershed Development and Livelihood Promotion programme- Mangawan
Patch No.- 2
N.
LEGEND
S.N. Particulars Sign
1 Project Boundry
2 Single Crop Area
3 Double Crop Area
4 Plantation
5 Afforestion Land
6 A/F cum Intercropping
7 Existing Bund
8 Nala
9 Tree
10 Rocky Land
11 Kachcha Road


PROPOSED PLAN MAP
Watershed Development and Livelihood Promotion programme- Mangawan
Patch No.- 2
N.
LEGEND
S.N. Particulars Sign
1 Project Boundry
2 Ridge Line
3 Field Bunding (FB)
4 Contour Bunding (CB)
5 Earthen Gully Plug (EGP)
6 Check Dam (CD)
7 Pond
8 Pasture Land
9 Afforestation
10 Plantation Upon Bund
11 Water Body
12 Slop Direction :
13 Construction of Check Well
14 Repair of Open Well
15 Existing Forest
16 Kachcha Road
17 Existing Bunds
18 Shrubs

Appendix 2: Locations of watershed structures in Baraicha




PRESENT LAND USE MAP
Watershed Development and Livelihood Promotion programme- Chandpura
Patch No.- I (Badaichha)
N
INDEX
S.N. Particulars Sign
1 Boundry Line
2 Kachcha Rasta
3 Nala
4 Trees
5 Chuk Road
6 Irrigated Area
7 Unirrigated Area
8 Barren Land
9 Existing Wells
10 Garden (Bag)


PROPOSED LAND USE MAP
Watershed Development and Livelihood Promotion programme- Chandpura
Patch No.- 1 (Badaichha)
N
INDEX
S.N. Particulars Sign
1 Project Boundry
2 Kachcha Road
3 Chak Road
4 Nala
5 Nali
6 Trees
7 Existing Wells
8 Irrigated Area and Double crop Area
9 Single Crop Area
10 Garden (Bag)