eISSN 2583-6986
IDEALISTIC JOURNAL OF ADVANCED RESEARCH IN PROGRESSIVE SPECTRUMS (IJARPS)
A MONTHLY, OPEN ACCESS, PEER REVIEWED (REFEREED) INTERNATIONAL JOURNAL
Volume 04, Issue 04, April 2025

Impact Of Sustainable Water Resource Management Strategies On Livelihood In Baghelkhand Region Of Madhya Pradesh

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Received: 15 April 2025 Accepted & Reviewed: 25 April 2025, Published: 30 April 2025

Abstract

Water is the essential of all natural resources. It provides the life support system for all living beings. Water sources like streams, Tanks and Ground water are products of the water resources. Land and water together support plant and animal life. Conservation of these basic resources is the key to food security, fuel and fodder supply, a healthy environment, and social and economic stability.

The demands on the limited amount of land we have for agriculture, forestry, industrialization, housing and transportation systems are steadily increasing with the burgeoning human population. The per capita availability of land in India has come down from 0.48 hectare in 1952, to 0.15 hectare in present scenario, and is posing a threat to the food chain and people's livelihoods.

A vast amount of forest land has been denuded for agriculture use; and for greater exploitation of water, mineral and forest products. Erosion is another serious problem that causes soil loss and reduces soil fertility, and reduces the area of cultivable land food grain production.

In baghelkhand region natural resource base, sustaining its productivity, improving the standard of living, and endeavouring to restore the ecological balance. After the treatment of that particular area, it has shown a positive significant in livelihood. Watershed mission, it has reduces the waste of water and control the water depletion through ground water recharge by percolation tanks. The substantial increase in crop and livestock production as well per-capita income in GDDP so, we can say that in area proper of water resource management has great potential in development.

Keywords: Conservation, food chain**,** erosion**,** livelihood, watershed**,** depletion**,** exploitation

Introduction

Water is the essential of all natural resources. It provides the life support system for all living beings. Water sources like streams, Tanks and Ground water are products of the water resources. Land and water together support plant and animal life. Conservation of these basic resources is the key to food security, fuel and fodder supply, a healthy environment, and social and economic stability (Bilas, 1988). The demands on the limited amount of land we have for agriculture, forestry, industrialization, housing and transportation systems are steadily increasing with the burgeoning human population.

The per capita availability of land in India has come down from 0.48 ha. in 1952, to 0.15 ha. today, and is posing a threat to the food chain and people's livelihoods. A vast amount of forest land has been denuded for agriculture use; and for greater exploitation of water, mineral and forest products (Narayana and Ram Babu, 1983). Erosion is another serious problem that causes soil loss and reduces soil fertility, and reduces the area of cultivable land food grain production (Narayana and Ram Babu, 1983).

There are wide variations in rainfall. An undependable and erratic monsoon introduces an element of risk, uncertainty and instability in crop production. About 80 % of total rainwater is lost within 75-80 days,

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with the rain causing an excess of soil moisture and water runoff. After the rains, the situation reverses, with moisture scarcity prevailing, mainly due to the topography, poor organic content in the soil, and a lack of suitable water storage sites.

How to meet the demands of food, fodder, fuel, fibre, timber and water on a sustained basis is the greatest challenge facing us today. It has now been firmly established that conservation of soil and water, development of degraded lands, and the rational utilization of available resources are the most important inputs for meeting the needs of the people and for the eradication of poverty.

Sustainable Watershed Management with proper planning is a scientific and efficient approach for the management of land, water and vegetation.

It has shown excellent results for the people living in watershed managed areas. Conservation and development have together made achieving the goal of higher productivity and stability possible. Therefore, resource management by the people, and for the people, with a scientific approach, is the answer for sustainable management of watershed areas.

Watershed management is an area development strategy. In this strategy, the area being developed is a watershed area, and the subject is soil and water conservation. Watershed management is the harmonious development and management of soil and water resources within the natural boundaries of a watershed area, on a sustainable basis, for the equitable benefit of the people, while delivering clean and controlled water flow downstream.

It is also to prevent the depletion of the water table by ensuring that each year the rain water and the ground water meet so that the rain can re-charge the ground water and stabilise the water table level.

RESEARCH METHDOLOGY

Primary and Secondary both data were used in this study work, structured questionnaire and sampling technique has been selected for study area. Different characteristics of the selected villages have be taken by using stratified Sampling techniques like Patni village has selected from out of 20 villages from region for study of status of micro watershed management.

A multistage stratified random sampling technique has been adopted for the study. First it will base on physical parameters relief, climate, drainage, soil, and natural vegetation. Chakra nala has been selected through random sampling and khuntatola and paprkhunta villages of anupur district have been selected out of five district and 200 villages for aquaculture study.

The data has been tabulated, analytical represented using different statistical and graphical techniques. For this purpose different software used like MS word, Excel, Erdas Imagine , Arcview etc.

GEOGRAPHICAL PROFILE OF STUDY AREA

Baghelkhand region extends between the latitudes 22° 50' to 25° 28' North and the longitudes 80° 20' to 82° 58' east in Madhya Pradesh. Located as it is in the central part of the peninsular ‘foreland’ and between the alluvial stretch of the great Plains and the Deccan.

It’s naturally presents a transitional zone incorporating the vindhyanchal. The very name of the region is derived from the combination of physical and cultural complex. Rewa, Shahdol, Satna, Umaria, Anuppur, Sidhi, Singrauli districts are included in this region of Madhya Pradesh.

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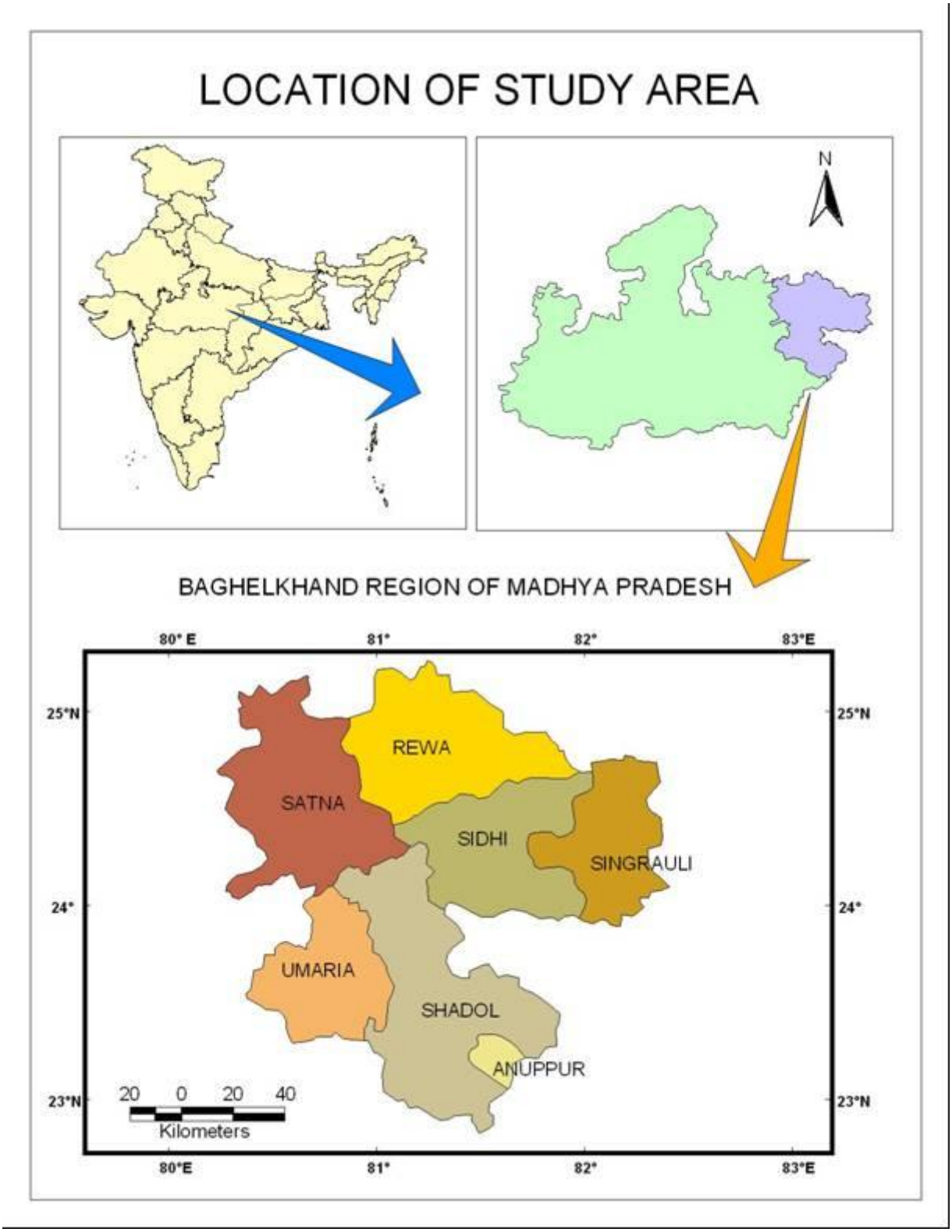

The region is one of the less densely populated parts of India as it carries a population of 9.355 million (2011) over 38,370 km² of territory, thus providing an average density of 234 persons per km² (2011). The region is one of the least urbanized parts of the country with only 18% of the population as urban.

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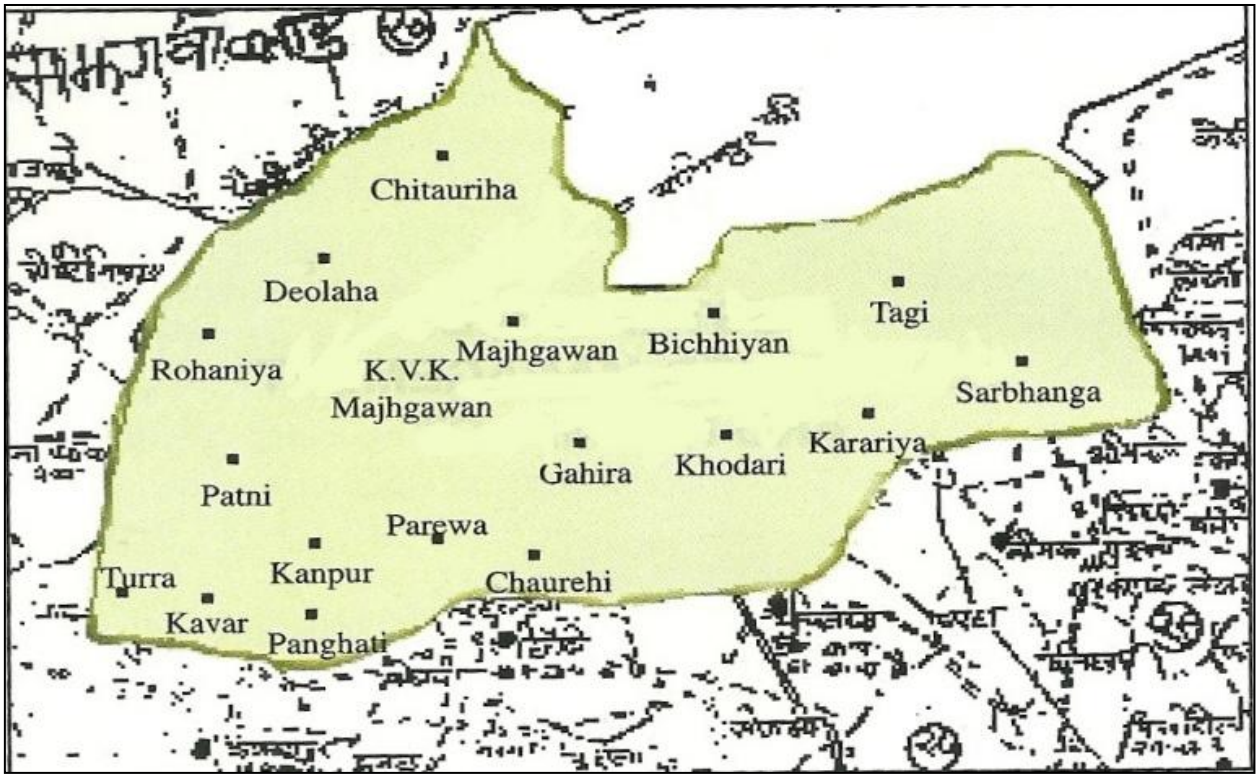
ABOUT THE WATERSHED AREA OF CHAKRA NALA, MAJHGAWAN, SATNA

The watershed area is situated in the Vindhya Hill Range. It extends Majhgawan block of Satna and Kotma block in Anuppur district in region. This area comprise of Vindhyan and Kaimur sandstone, Shale, gneiss, granite, quartz and Carboniferous rock. The annual rainfall of the area varies from 800 to 1100 mm. July to September are the wettest months, accounting for about 80 % of the total precipitation in the area. The soil's moisture holding capacity is low, so it is only able to support crops of an inferior nature under rain-fed conditions. During the high rainfall months, water flows freely on the ground surface, due to poor percolation and the compact nature of the soil.

Aonla, Chironji, Mahua, Tendu, Teak, Bamboo Palas, Khair etc. grow in the area. The watershed area is maze of natural system. Due to the steepness of the slopes, rainwater frequently drains into the Chakra Nala, from where this project has got its name while in Shahdol and Anuppur districts; the main factor was ground water depletion due to coal mining so this issue made necessary to development of watershed.

NEED OF WATERSHED DEVELOPEMNT IN MAJHGAWAN, SATNA

Problem Identified in the Watershed Area. The major problems faced by people in the watershed area given below. These problems are assumed in field data and also taken through KVK, Satna and Shahdol district report.



- Very low crop productivity.
- Lack of Irrigation facilities and decreasing ground water table.
- Unavailability of drinking water during summer months.
- Degraded forest and declining vegetal cover.
- High rate of soil erosion, poor soil fertility, and an undulating topography.

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- Low milk production, due to inferior breeds and poor health of the animals.
- Poor marketing facilities and low purchasing power of the villagers.
- Depletion of water levels near Coal mines and efforts of artificial recharge & rain water harvesting is Nil in Anuppur district.
- Dewatering of Coal Mines leading to decline in groundwater level and Under-utilisation of groundwater resources for irrigation in Shahdol district.

PLANNING & STRATEGIES USED IN THE CHAKRA NALA PROJECT IN MAJHGAWAN, SATNA

Resource development technologies specific to the geography and requirements of the particular area were used in the project. These included water and soil conservation, water harvesting, pasture development, agro-forestry, etc. for conservation and management of hillocks, drainage systems, cultivable and marginal/waste land, and pasture development. A key to the watershed management strategy was the locally available material for the construction of the structure required. However, steel/cement was used where necessary, especially for the spillways, where a re-in forced concrete central spillway was constructed on one of the four earthen check dams at the Karariya micro-watershed project.

Over exploitation of forest for major and minor products, uncontrolled grazing, faulty crop management and inadequate soil and water conservation had resulted in a high rate of water runoff and soil lass in vast tracts of the project area (Zila Panchyat Bhawan, Satna). To face these challenges, and meet the needs of people within the watershed boundary, an integrated programme of resource conservation, development and management was implanted under the Rajiv Gandhi Watershed Management Mission. The total area covered through the Chakra Nala watershed project was 12,536 ha. through 17 micro-watershed programs. The major asks were soil and water conservation, and the development of vegetal cover. The technologies were adopted were:

Staggered Contour Trenches

Staggered contour trenching is the most effective strategy for *in situ* moisture conservation in areas that have steep inclines. They are effective in controlling water runoff velocity by changing the nature of barren slopes, as they break the free flowing nature of water during the monsoon. This results in the conversion of surface water into sub-surface water, creating favourable moisture conditions for plant growth, which increases agricultural, grass and legume productivity.

The soil taken out from trenches was placed downhill in the form of a bund. Seeds of grassed and shrubs suitable to the area were sown on the bunds to control erosion and improve vegetation cover. The gap between trench lines varied from 5 to 10 metres according pressure on the steepness of the hill. In order to reduce hydraulic pressure on the trenches some uncut space was left in between trenches of the same line.

Contour/field Bunding

Contour bunding is an important and effective mechanical measure for checking soil erosion and increasing *in-situ* water conservation. The stored water is absorbed in the soil and the surplus water can be used for irrigation purposes. These bunds were constructed on farmer's fields with inclines of upto 5 %to harvest runoff water.

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Contour trenches in Patni.

Contour/field Bund in Majhgawan.

Loose boulder check dams

Loose boulder check dams are very effective in the collection of upstream sediments loads, stabilization of vegetation, and maintenance of soil moisture for long periods. These structures reduce the velocity and erosiveness of rain water, and control the displacement of sediment. Loose boulder check dams were constructed in series on narrow points of the gully bed. Loose stones/boulders were arranged in trapezoidal shapes.

loose boulder check dam at Chitauriha

Gabion Structure at Majhgawan (Satna)

Gabion Structures

Where the velocity of the water in nalas and main drainage channels is extremely swift, with relatively large quantity of runoff water and debris, and a normal loose boulder check dam would be unable to withstand the water pressure, a gabion structure is constructed across the nala. The gabion is made with stones/loose boulders that are tightly packed in wire mesh cages of galvanized wire of 10 guage thickness, to a height of 1 m and width of 1.25 m and then ties together with steel wire. Gabion structures were constructed where necessary.

Water Harvesting

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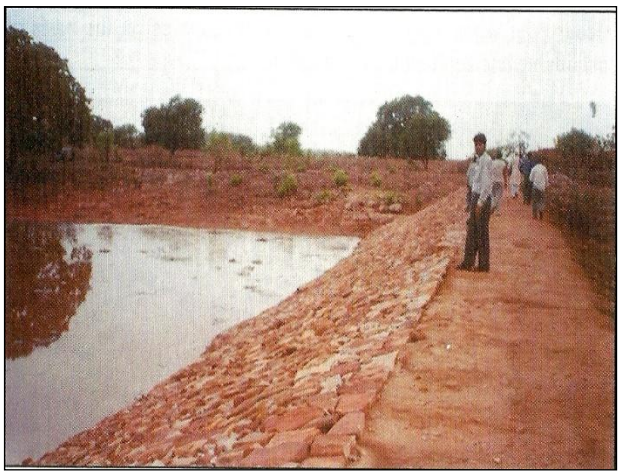
Water harvesting is the collection and storage of runoff water. For this, a series of farm (dugouts and embankment type) ponds, small earthen nala check dams and percolation tanks were constructed in depressed areas, and across natural nalas to collect and impound the surface water runoff and store it for longer periods. The tolls available for water harvesting are in like Patni, Majhgawan etc. under chakra nala watershed project. They are:

Farm Pond in Majhawan



Stone Pitching on Earthen Bund at Khodari village

a) Farm ponds are multipurpose water conservation structures for irrigation, drinking water for cattle, fishery, ground water recharge, etc. that help control erosion, runoff water and stabilising the water channel. While constructing dugout and embankment ponds for these purposes, care should be taken to ensure the pond is large enough for its primary purpose, keeping in mind the rate of evaporation, seepage, and other water loss. A spillway is to be constructed at zero level to check water pressure on the structure and overflows.

b) Earthen nala check dams store water for percolation and irrigation, thereby raising the water table, increasing crop productivity and availability of drinking water. The nala bund is constructed with a core wall made of clay.

c) Percolation tanks store water for recharging ground, raising the water table. They are constructed across natural streams and nalas to collect and impound surface runoff water and store it to facilitate infiltration and percolation of water table. Spillways are to be provided for as required.

In most cases, a simple side spillway that may require reinforced concrete at zero level is sufficient to ensure that water pressure does not break the check dam. However, in certain cases, depending on the topography, a central spillway would be required to ensure the stability of the dam.

Cattle-Proof Trenches

Contour trenching on denuded hillsides is carried out to reduce the velocity of runoff water and also to re-vegetate the hillsides to check soil erosion. The greatest danger for a re-vegetating hillside is stray cattle. To protect the treated area until the plantation is mature enough to look after itself, a continuous cattle-proof trench is dug around the boundary.

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Dry Stone Dykes (Walls)

Where a hard ground surface makes the digging of a cattle-proof trench difficult, and there is a large quantity of loose stones available, dry stone dykes (Walls), constructed by placing one stone on top of another to a height of 1m , with a base width of 1 m and the top width of 0.8m, can be used instead of cattle-proofing is dependent on the cost-effectiveness of cattle-proofing is dependent on the cost-effectiveness of cattle trenches and dry stone dykes in the particular treatment area.

Agro-forestry

Agro-forestry is a sustainable management system in which trees are grown along with agriculture crops. This system is not confined only to agricultural land, but is also applicable to waste and marginal land. Under the watershed development programme, fruit and forest plant saplings were distributed to farmers so that they can be planted amidst field crops or as a plantation. The main objective of tree plantation with grasses and/or crops is to rehabilitate degraded land. This result in optimum land productivity; conservation of plants and grasses, soil and nutrients; and enhancement of the production of food, forage, firewood, timber and other products

Pasture Development

Deforestation, uncontrolled fires and increasing grazing pressure results in the replacement of the natural perennial grass cover by weeds and other undesirable bushes in watershed areas. This reduction in cover causes an acceleration of the erosion process and loss of grass seeds. For the conservation of degraded pasture areas and improvement in forage production in the watershed area, treatment areas need to be fenced in with cattle-proof trenches o dry stone dykes and reseeded with suitable varieties of fodder grass.

The Bund of a percolation tank with ground water seepage at Tagi village

Cattle-proof trench at Kavar village

Crop Development

Farmers in the watershed area have been using local seeds that over years of unchanged use have turned into low yielding varieties. Their farming techniques were also found to be inefficient. To improve crop yields and productivity, seed replacement was good concept to exchanged 1kg of new seed for 1.25 kg of old seed which enhance the productivity in the watershed areas.

Farmers were also taught that their fields gave poor yields because of the loss of top soil due to water runoff, and also due to imbalanced cropping patterns. To improve the soil condition, legume crops, such as cow pea,

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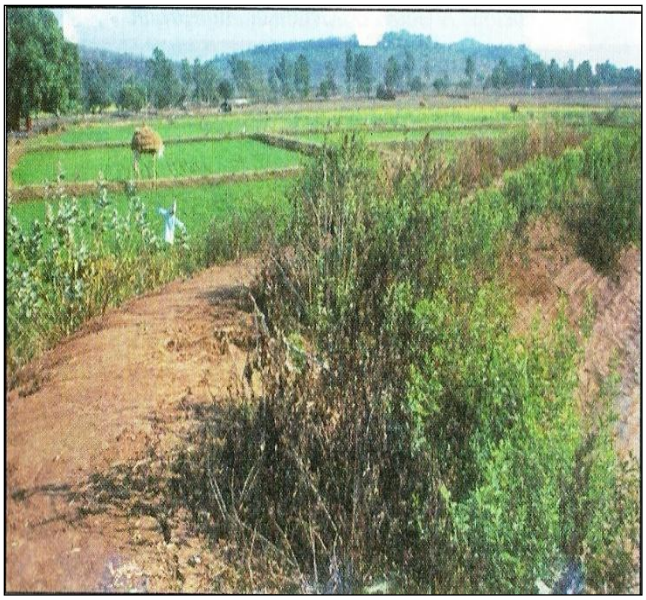
dhaincha, etc. were first grown and ploughed on the fields, as this increases the nitrogen and organic matter content of the soil.

Plantation of grasses on contour trenches at Majhgawan village

A side spillway at zero level, Khodari village.

An Aonla plantation at Patni village



Field bunding for moisture conservation Majhgawan.

PATNI VILLAGE: MICRO-WATERSHED MANAGEMENT

The criteria for selection of the Patni village includes: 1) Acute of shortage of drinking water. 2) Low crop Productivity. 3) Low percentage of cultivable land and high percentage of marginal/waste and barren land. 4) Easy availability of manpower. 5) Lack of economic resources.

Before the watershed management in this village was very critical condition in availability and accessibility of water resource, and the socio-economic status of the village was well below the average to Majhgawan Block (Pandit, 2002). Patni village is situated 7 km. away from the Majhgawan block. The village consist of 67 farmer families totalling 362 persons, of whom 65 families belong to SC/STs while all houses are made of stone, mud and thatch.

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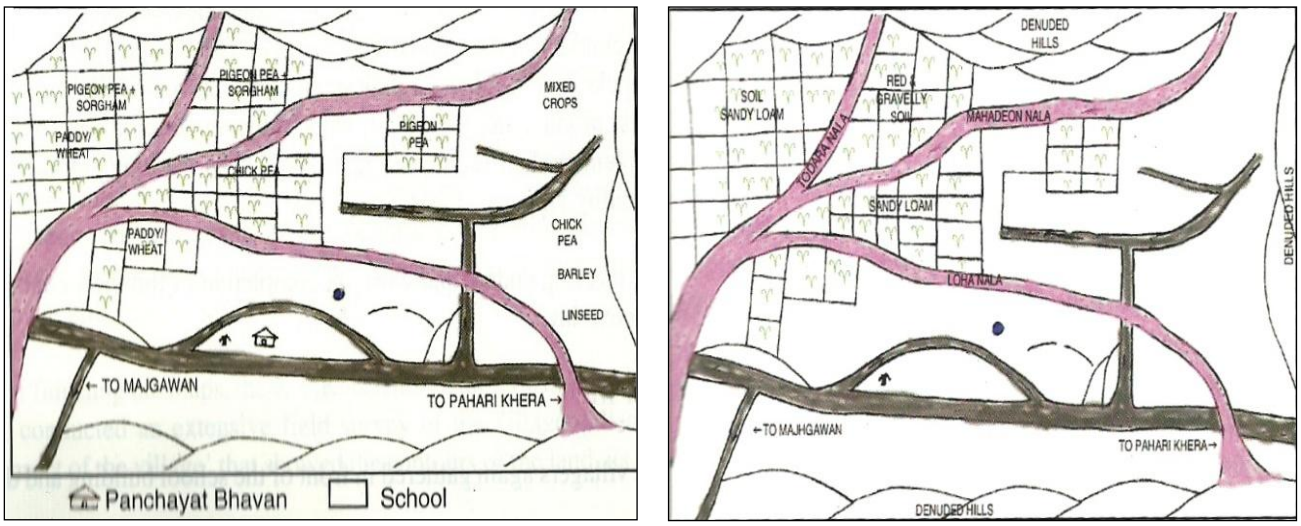

Patni Village: Topography, Hydrology, Agriculture Map by KVK, Majhgawan.

Villagers of Patni are engaged in limited enterprises only i.e. agriculture and livestock rearing. Water is the major limiting factor for agriculture because of this; farmers are restricted to a single cropping pattern, either in the Kharif or Rabi season, using residual moisture content. The only source of irrigation is a seasonal nala, which partially full fills the needs for a single crop- usually as life saving irrigation for about 35 hectare of land in the Rabi season. The Kharif crops in the village are entirely rain-fed. The major crops of this village are paddy, pigeon pea, Jowar, kodo in Kharif and gram and wheat in Rabi season. Farmers usually adopt a paddy- wheat; fallow-wheat, paddy-fallow, fallow-gram while other crops in rotation,

Livestock is secondary enterprises in the village. On an average each household has 7 animals, but the productivity of the cattle is very low ranging 0.5-1 litre animal per day. People rarely practise stall-feeding, and provide concentrates even to their milch animals. The animals are totally dependent on grazing in nearby forest areas and it also has *Anna Pratha* which domestics animals are left free to graze after harvesting the Rabi crop, till the sowing of the Kharif crop. Impact of the treatment in Patni village:

- Area of wheat, rice and mustard crops are grown rapidly and use of fertilizer has also increased. Due to construct of source of irrigation irrigated area has increase 13.2 hectare in 1996 to 180 hectare in 2010.
- Water level of wells increments up to 3.05 in 2010 from 1996.

Strategies for Watershed Management in Baghelkhand Region

SI. No.	Area	Strategies
1	Hillocks	Trenching
		Plantation of fruit & forest species
		Seeding of trees, bushes and grass seeds on trench bunds and inter-spaces
		Stone dykes & cattle-proof trenching
2	Nalas &Natural Drainage	Loose Boulder check dams
		Earthen embankments for water harvesting

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	Systems	Gabion structures
3	Barren, Marginal & Waste land	Trenching
		Plantation
		Seeding of grasses and legumes
		Fencing
4	Fallow & Pasture land	Pasture development
		Cattle proof trenching
5	Cultivated land	Bunding
		Contour cultivation
		Fodder production
		Agro-forestry (Agriculture + horticulture)
		Water harvesting
		Demonstration of HYV, fertilization, moisture conservation etc.

Source: Field Data and Zila Panchyat Bhavan, Rewa, Satna, Shahdol and Anuppur, 2012

- Watershed management has directly impact in Income source. (A) Reduction in migratory labour. (B) Income through forest products increase from 1615 Rs./year in 1996 to 3000 Rs./year in 2010. (C) Income through Agriculture has increased 5935 in 1996 to 15472 Rs. /year in 2010.

- Grass and legume production has also increased in Patni village as well as in livestock population (which has discussed in chapter 4) but the breed productivity is less in this village.

IMPACT ASSESMENT IN THE CHAKRA NALA WATER SHED PROJECT

An integrated management system for natural resources land, water, vegetation, animals and the environment was used as it is the most effective approach for sustainable development. There are 17 villages come Chakra Nala watershed project in Majhgawan block, Satna district.

The impact of watershed management on checking soil erosion and harvesting of water can be seen in all water harvesting structure, from the bottom to top.

- Loose boulder check dams: loose boulder check dams that were constructed with a view to check the velocity of water flowing in small and big nalas, have checked soil erosion considerably. Loose boulder check dams constructed in 1996-97 are now completely filled with eroded soil, and vegetation has started growing on them which is easily accessible for grazing of livestock.

- Contour trenches: contour trenches were dug from ridge to valley. The trenches collect rainwater during the monsoon. This rainwater percolates into the soil, raising the water level and enhancing moisture content. The impact of contour trenches can be seen clearly from the growth and development of transplanted trees.

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- Earthen nala bunds and ponds: 1195 farmers have benefited with the construction of earthen nala bunds and ponds. These farmers are now harvesting good crops as water for irrigation is available from these ponds. About 1504 ha. of land is now being irrigated with water from these ponds. However, the major impact of these water harvesting structures can be seen in wells and hand pumps that were dry during summer, and now have enough drinking water all year long.

- Watershed management projects have also generated employment for the rural people by increasing the land under cultivation, intensity of cultivation, and the formation of SHGs this has checked their migration towards towns and cities which is given below in table 5.2. This form of activity reduces risk of income generation and it enhances the livelihood.

- Watershed management has achieved a major breakthrough by making 287 rural youths self-reliant. The watershed committees of the 17 micro watershed projects have formulated 78 self help groups, and after imparting vocational training to them, 245 men and 42 women are now engaged in different occupations. These rural youth are now earning Rs. 1,000-2,500 per month for their families.

Increase in Productivity

The productivity of different crops, crops, grass and legumes in micro-watershed managed areas has increased appreciably. The highest increase in crop area and production is mustard in watershed area while Arhar has less growth. The production of grass and legume has increased 2.1 ton/ha. in 1996 to 34 ton/ha. in 2007 (This figure includes Natural grasses + Stylo-grasses).

Ground water recharge

- The cumulative effect of intensive soil and water conservation, and water storage activities in various micro-watersheds has contributed much to raising the level of water in the wells of the treated area so the drinking water availability will be provide throughout the year.

- After a treatment of area through watershed development so, the availability of water in wells has increased up to 4.5 meter in December followed by 3.5 meter in May month of a year of 2007. While the impact of watershed management on irrigated areas has also increased through Earthen Embankment, Ponds and Natural Nala. Only 66 hectares of land was irrigated before 1996, which has increase 1438 hectare of irrigated area in 2007. So we can say; the water conservation has huge potential to develop the livelihood.

- The data demonstrates that the chakra nala watershed project has achieved great significant in cropped area and production. After raising the water table and using improved inputs in agriculture, the area and production of crops has increasing which enhance the food security.

The table shows the water resource management has been significant effect on livelihood by increasing ground water table so water available entire year for irrigation, drinking purposes and etc.

Impact assessment of Chakra Nala Project on Livelihood.

Effects of management and works in the catchment area	Early (1996)	Current (2014-15)
Rise in water level of wells (In meter)	0.93	3.10
Agricultural Land (Hectare.)	2038	4746.7

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Improved varieties of seeds used (Hectare)	16	3742
Expansion in Irrigated Area (In hectare)	66	3236
Crop density (in %)	87.2	141
Increase in crop productivity (kg./Ha.)	8.77	14.39
Average increase in man days (day/month)	9.4	21.7
Increase in average income of Family (Rs.)	11905	20109
Reduction in migration (labour)	815	123

Source: KVK and BDO Majhgawan, Satna, 2010-11.

WATER MANAGEMENT STRATEGY AND IMPACT IN ANUPPUR DISTRICTS

As per Ground Water Resource Estimation of Anuppur district for the year 2004, the available ground water resources and gross annual ground water drafts are 408.80 MCM and 57.31 MCM respectively, making stage of ground water development 14.02 % as a whole for district. Thus there is ample scope for future development of ground water resources in the district. All four blocks namely Pushprajgarh, Anuppur, Kotma and Jaithari are falling under Safe categories. Considering hydrogeological situation of the area, there is tremendous scope for artificial recharge work, especially in water depleting areas around coal mines, in Kotma block (CGWB, 2010). In Kotma block area where maximum coal mines are operative, “Kewai Watershed” is taken up for implementation of artificial recharge project at large scale. The Kewai watershed is divided into micro watersheds for implementation of various artificial recharge structures, according to hydrogeological feasibility and adopting hill to valley approach in the watershed. All kinds of artificial recharge structures may be implemented in this watershed. For sub-surface dykes and check dams, impervious foundation is required to prevent leakage/seepage from base of the these structures .Benefit zones of percolation tanks is at downstream direction, where as sub-surface dykes and check dams will recharge upstream part of structures.

Case Study of Pancham a villager, village Khuntatola, District Anuppur

Pancham Singh grows fish in a perennial pond near Khuntatola (Piparkhunta) village in Anuppur block, Anuppur district. He has leased the small pond, which is amongst rice paddies close to the village, for ten years now. The venture got off to a bad start when, after taking the lease in 2000, the pond was poisoned in 2001. No one is sure who would do that, but such events are not uncommon and are reported to be the result of jealousy.

The Panchayati Raj Act (the 73rd Amendment to the constitution) empowers the Gram Sabha to administer natural resources including ponds. It recommends leasing larger ponds to co-operatives, whilst those below five hectare might be leased to individuals or groups. The act directs local government to consider the likely remuneration from such assets and to lease them accordingly. In Madhya Pradesh, though much less so in other states, this is very commonly interpreted to mean that it is advisable to lease ponds below a hectare to individuals. Madhya Pradesh has also introduced leasing for substantial periods of seven to 10 years, which is good for lessees and makes the asset easier to manage than the much shorter lease periods operated in other some states. However, leasing a valuable rare asset to an individual for half a generation is almost certain to give rise to local unrest (MPRLP,2011).

eISSN 2583-6986
IDEALISTIC JOURNAL OF ADVANCED RESEARCH IN PROGRESSIVE SPECTRUMS (IJARPS)
A MONTHLY, OPEN ACCESS, PEER REVIEWED (REFEREED) INTERNATIONAL JOURNAL
Volume 04, Issue 04, April 2025

Aquaculture in Piparkhunta village, Anuppur district

Since the 'poisoning', Pancham Singh built a small 'watch and ward' hut beside the pond and poisoning and theft have not featured in his fish business and *Singada* cultivation since, which brings him many benefits. Mr Singh reported covering livelihood shocks through his fish stock but added that partial harvests are not always necessary in such circumstance. His stocked pond ensures him the credit he needs for emergency purchases.

He pays his debts after harvesting. Aquaculture can also contribute significantly to more strategic expenditure. Pancham Singh, has deepened his 0.43 ha pond which now holds water year round; over the past years he has derived from his pond the capital to build a house (around Rs 25,000), to lease additional farm land - expanding his agricultural output, and to pay for the marriage ceremony of his son.

CONCLUSION

At finally, we can conclude that the appropriate water management in water scare region gives the boost in development of livelihood. In the Baghelkhand region Satna district get less rainfall in monsoon period, while the maximum quantity of rainfall water is flow in runoff through Nalas. Though, the less quantity of water was store in northern hilly part of Satna district in every year so, the KVK and in collaboration with DRDA has developed the Chakra Nala watershed project in Majhgawan, Satna District.

This joint project has given significant impact on local people first, ground water table has raised and second the income of people has grown due to increase in area and productivity of crops. While the rearing of livestock population has increased, for instance the per-capita stock has increase upto eight in 2008 from four was stocks in 1996. The small scale industries have also grown rapidly in this watershed area due to water availability.

Drinking water availability and accessibility has rises because of sustainable water shed management in Majhgawan. Before the, construction of projects villagers had faces more difficulty to collect drinking water. After the treatment of that particular area, it has shown a positive significant in livelihood.

The some villages of Umaria, Shahdol and Anuppur district has face ground water depletion due to coal mine activity. They also had in use of inappropriate water resource management technique but after, treatment in

Kotma, Anuppur district by DRDA and Ranjiv Gandhi watershed mission, it has reduces the waste of water and control the water depletion through ground water recharge by percolation tanks.

The substantial increase in crop and livestock production as well per-capita income in GDDP so, we can say that in research area proper of water resource management has great potential in development.

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