

Role of Irrigation in Development: The Rajasthan Experience

Priyanka Payal, Poonam

Abstract: Rajasthan is the largest state of India in terms of area and it covers about 10.4% of the total area of India but only 1.04% of the water resources, hence there is lack of water resources for 70% of the state's agricultural economy. The uncertainty of the monsoon creates problems of employment and irregularity along with hindering the development of agriculture. Such problems have revealed an important requirement of irrigation in the state. The paper will explain about the main sources, needs and importance of irrigation in Rajasthan. The study also focuses on the area irrigated by irrigation resources in Rajasthan. Main irrigation projects of Rajasthan like interstate multipurpose river valley projects of Rajasthan, major irrigation projects of Rajasthan, medium projects of Rajasthan, minor irrigation projects of Rajasthan are explained properly with facts and figures in the study. The paper also highlights the development of irrigation during plans and its progress in gross irrigated area in Rajasthan. Allocation of expenses of public sector irrigation and flood control under the five-year plans in Rajasthan were part of the study. In the last paper ended explaining about the barriers to irrigation development, suggestions and conclusion. Financial difficulty, rising cost of irrigation projects, problem of full utilization of irrigation potential, reservoir problems, inter-State disputes, problem of environmental protection, corruption, red tape and political partisanship, unnecessary delay are the various problems faced by the farmers. To overcome these problem suggestions given like government should focus on mobilizing more resources, seek foreign cooperation, control over corruption, careful use of water and proper drainage system, disputes should be settled quickly and without political pressure, timely completion of projects, etc.

Keywords: Agricultural, Economy, Irrigation Resources, Irrigation, Projects.

I. INTRODUCTION

Different irrigation sources have been developed in different parts of the state due to the variation of land structure, surface and water availability in Rajasthan. The total irrigated area in the state is about 78 to 85 lakh hectares, and wells are the main means of irrigation in the state. Canal irrigation in about 30 to 35 lakh hectare of land is the second major means of irrigation. The third major means of irrigation is tube wells which irrigate about 23 to 25 lakh hectare area of the state whereas the ponds irrigate an area of 82 to 85 lakh hectare. Thus, the major means of irrigation differ in different districts of the state. A brief description of the important irrigation mediums is as follows.

Wells: The major means of irrigation in Rajasthan are wells and wells irrigate about 30 to 35 lakh hectares of land in the state, which is about 38.6% of the accumulated area of the state. Irrigation from wells is mainly in the areas where

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Priyanka Payal, Assistant Professor, Swami Keshvanand Institute of Technology, Management and Gramothan, Jaipur (SKIT College), Ram Nagariya Rd, Shivam Nagar, Jagatpura, Jaipur, Rajasthan

Poonam, Assistant Professor, Department of BADM, University of Rajasthan, Jaipur

geographical conditions are favorable and the water level is high. Alwar, Bharatpur, Sawai Madhopur, Chittorgarh, Bhilwara, Udaipur, Ajmer and Jaipur districts of the state have wells for irrigation. Where the area irrigated by wells was only six lakh hectares in 1951-52, there was 30.15 lakh hectares in 2005-06.

Canals: Canals are the second major source of irrigation in Rajasthan, about 24 to 27 lakh hectare area of the state is irrigated through canals which are about 30% of the total irrigated area. Sri Ganganagar, Bikaner, Bharatpur, Kota and Bundi districts are the prominent areas irrigated by canals. Where there was only 2.24 lakh hectares irrigated by canals in Rajasthan in 1951-52, it has increased to 30.51 hectare in 2005-06, which is almost 10 times more. Indra Gandhi canal irrigation facility in western desert districts to convert dry districts into lush field is a successful attempt.

Tubewells: Tubewells are becoming an important means of irrigation in Rajasthan, in the western districts of the state where the average rainfall is very low and the underground water level is low at depths from 30 meters to 150 meters and electricity facility is available. In districts like Jaipur, Jaisalmer, Bikaner and Nagaur, irrigation is provided from tubewells. Where the irrigated area from tubewells in 1950-51 was about 82-84 thousand hectares, the area was estimated to be 22.8 hectares in 2005-06, which is about 29.14 percent of the total area.

In the southern and southeastern parts of Rajasthan, where the surface is rugged in the hilly areas, and there is hard rocky terrain in which water cannot be stopped, the rain water is filled in the ponds and is used for irrigation. There are about 450 such reservoirs in the state. The major areas of irrigation from ponds in Rajasthan are Bhilwara, Udaipur, Chittorgarh, Bundi and Pali districts. Apart from this, Banswara, Dungarpur, Ajmer, Bara, Kota, Tonk, Sawai Madhopur and Jaipur districts are also irrigated with ponds. The role of ponds in the total irrigated area in Rajasthan is continuously falling because of canals and the tubewells. In 1950-51, the total irrigated area from the ponds was about 82 thousand hectares, which in 2005-06 was only 80.8 hectares.

Other Sources: Other important sources of irrigation in Rajasthan include water collected in the river drains, irrigation held by drawing water. In Rajasthan from 1950-51, about 17000 hectare area was irrigated by other sources. There, irrigated area from other sources is estimated to increase to 89.82 thousand hectare during 2005-06 which is the total irrigated area. The area is about 1.15%, thus the importance of this source is also very less in terms of irrigation.

Objective of the Study:

- To study the need and importance of irrigation in Rajasthan.
- To study the main irrigation projects of Rajasthan.
- To study the expenses of public sector irrigation and flood control under the five-year plans in Rajasthan.
- To explore the barriers to irrigation development in Rajasthan.

II. NEED AND IMPORTANCE OF IRRIGATION IN RAJASTHAN

Agricultural Economy: The economy of Rajasthan is an agrarian economy. 70% of the population of Rajasthan is dependent on agriculture and animal husbandry for income and employment, so it is difficult to imagine the livelihood of agriculture based population in the absence of irrigation.

Dependence on Monsoon Rainfall: The economy of Rajasthan is also dependent on monsoon rains like India, and monsoon rains remain only from June to October, so irrigation becomes necessary for crops in seasons other than rainy season.

Uncertainty, Inadequacy and Irregularity of Monsoon: In Rajasthan, irrigation becomes necessary to protect agricultural crops from drying out in the absence, uncertainty and irregularity of monsoon.

Special Crops Require More Water: Some crops like paddy, sugarcane, juice, greens vegetables require more water.

Multi Cropping: The success of the multi cropping program is also very much dependent on irrigation because it is not possible to produce more in the absence of irrigation.

Relieve Famine and Drought: Irrigation facilities provide the state with income and employment opportunities in times of drought by providing relief to the state.

Intensive Farming and Higher Productivity: Irrigation paves the way for intensive agriculture and with the timely irrigation facilities, it is possible to increase and improve agricultural productivity.

Increase the Possibility of Expansion in Agriculture: About 61% of the land area of Rajasthan is spread in 12 districts in the form of desert land. In the absence of irrigation, it is possible to expand the agricultural area in Rajasthan by converting it into stagnant fields by irrigation, so the Indira Gandhi Canal Narmada Canal can expand the agricultural area in the state.

Increase in Income and Employment: The people of the state gets the benefit of increase in both income and employment due to the development of irrigation resources.

Increase in Government Income: With increase in agricultural production due to the development of irrigation resources, the government will also get more funds from tax on agricultural production and will also get income from the expansion of agricultural land.

Help in Economic Prosperity and Proper Development: Increase in irrigation facilities, increase in production income, employment and productivity paves the way for economic prosperity and helps in balanced and proper development of agriculture and industries.

III. AREA IRRIGATED BY IRRIGATION RESOURCES IN RAJASTHAN

The following table shows the progress of irrigated area by major means of irrigation in Rajasthan.

Gross Area irrigated by major means of irrigation in Rajasthan (in 000' hectare)

S.No	Particulars	2006-07	2007-08	2008-09
1.	Wells and Tube wells	5363	5382	5338
2.	Canals	2371	2515	2461
3.	Tanks	137	104	34
4.	Other Sources	87	87	77
	Total Irrigated Area	7958	8088	7910

Source: Economic Review 2010-11

It is clear from the above table that the area irrigated by wells and tube wells in Rajasthan is 53.63 lakh hectares, which is about 67.39% of the gross irrigated area 79.58 lakh hectares. The area irrigated by canals is 23.71 lakh hectares which is about 29.79% of the total irrigated area.

The area irrigated by lakes is stable at about 83 thousand hectares and is only 1.06% of the total irrigated area. Thus, the area irrigated from other sources has increased from 17 thousand hectare in 1950-51 to about 90 thousand hectare and its share in total irrigated area is 1.15 percent.

IV. MAIN IRRIGATION PROJECTS OF RAJASTHAN

A. Interstate Multipurpose River Valley Projects of Rajasthan

These projects have been done with the mutual cooperation of many states with the motivation to fulfil many objectives together. These projects are fulfilling many objectives like power generation, irrigation, fisheries, tourism, flood control, pasture and plantation etc.

Bhakra-Nangal Dam: This joint multipurpose project of Punjab, Haryana and Rajasthan state is the largest project in India. For this, there are 222 meter high dam and two big power houses at Nangal and 25.5 meter high dam and 2 power houses near Bhakra village in Hoshiarpur district on Sutlej river. The construction of 46 km Nangal Hydrel Channel, 1104 km long main canal and 3360 km long canal is included on this for a total of Rs 238 crore. The share of Rajasthan in this has been Rs. 22 crores. The total capacity of the Bakhra Nangal project is 14.7 lakh hectares. Rajasthan's share of 2.3 lakh hectares, has increased irrigation facility in Sriganganagar district and electricity availability in Bikaner, Sriganganagar, Churu and Jhunjhunu districts of the state.

Beas Project and Prong Dam: This joint multipurpose project of Punjab, Haryana and Rajasthan states has been constructed in two phases to utilize the water resources of the Sutlej, Ravi and Beas rivers. In the first phase Beas Sutlej link, a dam above the Bhakra Nangal dam near Pandoh in the state of Punjab, two 12 - 12 kilometer long

tunnels, hydel channels with a capacity of 165 MW and four power houses are included.

A 133 meter high dam has been built on the Beas River which has a scope of 24 lakh KW capacity power houses in Rajasthan to get 150 MW power from this project and provides permanent water supply to Indira Gandhi Canal.

Chambal Project: This multipurpose river valley project is a 50-50% share project of the Government of Madhya Pradesh and Rajasthan. The main objectives of this project are power generation, irrigation, flood control, fisheries, plantation, stopping land erosion and developing drinking water system etc. This is a joint effort to divert the vast water resources of the Chambal river from destruction to development which has been completed in three phases:

First: Gandhi Sagar Dam on the Chambal River, between the Rampura-Manpura plateaus of the Mandsaur district of Madhya Pradesh, 5 power houses of 23-23 MW capacity, Kota Irrigation Dam and two canals on the right and left. This has provided irrigation and 115 MW power generation capacity to both the states in about 5-6 lakh hectares.

Second phase: In the second phase, 42 meters high and 11 hundred meters Rana Pratap Sagar Dam has been built on the Chambal River at a place called Rawatbhata in Chittorgarh district, on which four power houses of 43-43 MW capacity and underground tunnel for drainage of Chambal dam are constructed.

Third phase: The third phase of this project involves the construction of 45 meters high and 440 meter long Jawahar Sagar Dam on the Chambal River and three power houses of 33-33 MW capacity, 8 km above the Kota barrage at Borawas in Kota district.

The total expenditure of ₹ 30 crore on this project in three phases has been borne by the Governments of Madhya Pradesh and Rajasthan equally i.e. Rs 65-65 crores. The total power generation capacity of this project is 3.86 lakh KW and irrigation capacity is 5.6 lakh hectares. Bundi and Kota districts of Rajasthan are getting the benefit of irrigation. In addition to the Rana Pratap Sagar Dam in Chambal, Rajasthan Vidhanksha Project at Rawatbhata has a total capacity of 940 MW.

Under the Chambal project itself, 38 thousand hectare area is estimated to be irrigated in the command area with an expenditure of about ₹ 40 crore on 21 irrigation projects.

Mahi Bajaj Sagar Scheme: It is a joint multipurpose project of Rajasthan and Gujarat government. It has a provision of 45.55% expenditure on the project. The expenditure was initially estimated at Rs 397 crores but now the revised estimate is Rs 1265. Under the project, construction of a dam on the Mahi river near Borkheda village, about 16 km from Banswara, 45 MW capacity at Lilavati Minister's two powerhouse near village full of 25-25 MW, including two electrical and construction of 104 km long canal Irrigation facility has been provided in 83 decimal 6000 hectare area with an amount of Rs 880 crores till March 2007, on completion of the entire work, one hundred 400000 kilowatt power generation capacity and 89000 hectare area will be irrigated.

B. Major Irrigation Projects of Rajasthan

Irrigation facility has been provided in 83.6 thousand hectare area with an amount of Rs 880 crores till March 2007, on completion of the entire work, one hundred 40 lakh

kilowatt power generation capacity and 89 thousand hectare area will be irrigated.

Indra Gandhi Canal Project: Major construction works of the world's largest canal system with the aim of converting the vast desert area of western Rajasthan into leased fields and providing drinking water to its residents and animals by providing irrigation facilities (i) Rajasthan Feeder (ii) Construction of Rajasthan Main Canal (iii) Canal's 9 branches and 21 branches (iv) Lift Canal and (v) Small Power Planets were included.

Rajasthan Feeder: This canal, 204 km long, has been constructed to supply water to Indira Gandhi Canal from Harike Dam built at the confluence of Beas and Sutlej rivers in Punjab, its work has been completed in the first phase.

Rajasthan Main Canal: Rajasthan is connected to Sirohi, the main new is 445 km long, and its construction work has been completed in 1986.

The work of 8081 km of branches and distributor Canal has been completed against the total proposed length 9413 km of 9 branches 21 sub-branches and many distributors Canal.

Seven Lift Canals: To bring the Indira Gandhi Canal to water high and remote terrain, along with the lift canals are Kanwar Sen lift canal, Gajner lift canal, Pokharan lift canal, Bangar sir lift canal and Kolayat lift canal respectively.

Small Power House: Plans to build up two small power houses of 13-13 MW Anupgarh and Suratgarh branch based on modern technology

Introduction of Indira Gandhi Canal Project: Till December 2007, a total of Rs 3166.18 crore has been spent on this ambitious project in which Rs 444.03 crore has been spent in the first phase and Rs 2722.15 crore in the second phase.

Potential Benefits of Indira Gandhi Project

The objective of this project is to use about 70 lakh acre feet of water in Ravi and Niwas rivers, Sriganganagar, Bikaner, Jaisalmer, Jodhpur, Barmer, Hanumangarh and Churu etc. Irrigation facility is available in 16.1 lakh hectare area by December 2007 has been held. Drinking water is being provided to Bikaner city and 99 villages from Kanwar-Sen lift canal to 175 villages in Churu district under Gandhli-Sahiba lift scheme. Water will be available to about 1.8 crore residents of 8 districts, industries and power generation centers due to irrigation facilities. Additional agricultural production in irrigation command area development will increase employment in the government and will pave the way for border security and industrialization.

Bisalpur Project: The dam work on the Banas river near village Bisalpur, about 13 km from Todarai Singh town in Tonk district, started in 1986-87. The project aimed at 6 big cities Jaipur, Ajmer, Beawar, Tonk and Kekri as well as towns coming in the way. To provide drinking water, it is necessary to irrigate 81.8 hectares of agricultural area in the district. The revised cost of the project is estimated at Rs 657.91 crore out of which, by the end of March 2008, irrigation capacity of 81.8 hectare land has been developed with an investment of about 686 crores rupees.

Narmada Project: The construction of Sardar Sarovar Dam on the Narmada River under this joint scheme of Rajasthan and

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Gujarat State and to provide irrigation through canals in both the states, its total estimated cost is Rs 548 crores. This project has 76 villages in Jalore district of Rajasthan. Irrigation facility will be met in about 14000 hectare area of water in canal in Rajasthan in 2007-08.

Sidhmukh Project: In this mega project, according to the 1981 agreement of Punjab, Haryana and Rajasthan, the water brought by canal from Nangal Head Works for the use of additional water of Ravi-Vyas rivers, Bhaadra and Nohar tehsil of Shriganganagar district and in Sadulpur and Taranagar tehsils in Churu district. Irrigation facility will be available in 37000 hectare area. Its estimated cost is likely to be Rs 103 crore. It has been funded by the European Economic Community.

Nohar Project: This large project is also being implemented under the European Economic Cooperation for the use of surplus water from Ravi and Vyas rivers, on which an estimated irrigation potential of about 13663 hectares of agricultural land in Nohar district of Shriganganagar district is estimated at Rs 40.6 crores.

Jakhm Project: Under this mega project, a dam of 5000 cubic feet of water storage capacity has been built on the river Jakhm near AnoopPura village in the new Pratapgarh district and two main canals from the pickup dam 13 km ahead of the main dam. The right canal is 23.8 km and the left canal is 39.9 km. On this project, irrigation facility will be available in about 23.5 thousand hectare area of 104 villages of Dhariwad district of Udaipur district and 3 villages of Pratapgarh district by paying Rs. 7.25 crores.

Gurgaon Canal and Okhla Reservoir: Both of these are two parts of the same project, irrigation potential has been created in about 28.2 thousand hectares of agricultural land in Bharatpur district from Gurgaon Canal.

C. Medium Projects of Rajasthan

Medium irrigation project refers to the project in which the agricultural command area is 2000 to 10000 hectare. With a view to this, a brief description of the main medium irrigation projects in Rajasthan is as follows:

Medium Irrigation Project of Rajasthan

Project	River on which Dam is Constructed	District	Irrigation Potential in Lakh Hectare	Benefited Districts
Jawai Dam	Jawai	Pali	41	Pali, Jalore
Meja Dam	Kothari	Bhilwara	10	Bhilwara
Panchna Dam	Confluence Of Five Rivers	Sawai Madhopur	10	Sawai Madhopur
Som kamla Dam	Som-Kamla Rivers	Dungarpur	14	Dungarpur
Morel Dam	Morel	Sawai Madhopur	8.6	Sawai Madhopur, Dosa
Som-Kangdhar Dam	Som Kangdhar Rivers	Udaipur	6.84	Udaipur
Bilas Dam	Bilas	Kota	2.5	Kota

Source: Economic Review Rajasthan Government 2007-08

D. Minor Irrigation Projects of Rajasthan

Small irrigation projects are meant for those projects whose arable command area is less than 2 thousand hectare, the state is taking advantage of irrigation by completing many such small schemes and 56 minor irrigation projects are under construction.

V. DEVELOPMENT OF IRRIGATION DURING PLANS

In view of the great need and absolute lack of irrigation resources in Rajasthan, the State Government has spent a lot on the development of irrigation resources in the Five Year Plans. In the first plan, irrigation development was given the highest priority and later on the Sixth Plan and the total on irrigation development. More than 26% of public expenditure was spent thereafter.

Expenses of public sector irrigation and flood control under the five-year plans in Rajasthan

Amount in Crore

Plan	Total Public Sector Expenditure	Expenditure on Irrigation and Flood Control	Irrigation and Flood Control Expenditure (In Percentage)
First	54.15	31.31	57.8
Second	102.74	27.86	27.2
Third	212.70	87.88	41.3
Third annual plan (1966-69)	136.8	46.6	34.1
Fourth	308.79	105.26	34.09
Fifth	857.62	271.17	31.6
Sixth	2120.25	547.08	25.8
Seventh	3106.18	690.51	22.23
Eighth	11998.97	1836.19	15.3
Ninth	19566.82	2250.65	11.55
Tenth	33735.14	3774.71	11.19
Eleventh	71731.98	7302.06	10.18

Source: Economic Survey 2007-08

In the last 56 years from 1951-52 to 2006-07 of the planned development, a total of Rs 10144 crore has been spent in the public sector on irrigation and flood control in Rajasthan, as a result of which the gross irrigated area increased from 11.7 lakh hectare in 2006-07, 78.2 lakh hectare has been reached which is 6.5 times as compared to 1950-51. The increase of 66.5 lakh hectare in irrigated area during the Plan period is commendable as is evident from Table

Progress in Gross Irrigated Area in Rajasthan (In lakh hectares)

Year	Gross Irrigated Area	Gross Irrigated Area Part of Total Agricultural Land (In Percentage)
1950-51	11.7	12

1960-61	20.8	14.9
1970-71	24.5	14.7
1980-81	37.5	21.6
1990-91	46.5	24
1999-2000	69.34	35.8
2006-07	79.58	36

Source: Economic Review Rajasthan Government 2007-08

It is clear from the above table that although the total reported area in Rajasthan has increased from 11.7 lakh hectares to 78.2 lakh hectares, yet the gross irrigated area is only 36% of the total agricultural area. Even now, about 64% of the agricultural area is dependent on monsoon rains. In the year 1988-98, the centrally supported project Million Well Scheme (MWS) was also implemented in Rajasthan to expand irrigation capacity. Initially it was started as a subsidiary project of "National Rural Employment Scheme" (NREP) later in April 1979 after merging "National Rural Employment Scheme" and "Rural Landless Employment Guarantee Scheme". The "Jawahar Rozgar Yojana" (JRY) was introduced even then the Million Well Scheme continued as a subsidiary project of JRY till December 1995. The MWS started as a separate scheme from 1 January 1999 and lasted till 1999. The nickname of this scheme was "Jeevan Dhara Yojana". Other minor irrigation projects were also included in this project. After the commencement of "Swarna Jayanti Gram Swarozgar Yojana" in 1999, "Jeevan Dhara Yojana" was discontinued. A survey conducted by Sujatha Singh in 2000 revealed the fact that 74% of the dug wells in the "Jeevan Dhara Yojana" were completed while work was on at 10.6% and 15.17% of the wells failed. The completion of the well is not intended to be successful, later the wells dried up. 57539 wells were completed from 1988-89 to 1998-99 against a total of 77398. This scheme failed due to lack of water in the wells and many farmers were burdened with debt.

VI. BARRIERS TO IRRIGATION DEVELOPMENT AND SUGGESTIONS AND CONCLUSION

Although the amount of successful irrigated area has increased from 11.7 lakh hectare to 78.2 lakh hectare by giving about Rs 10144 crore on irrigation and flood control during the planned development, still only 36% of the total agricultural area has been irrigated and 64% agriculture is still dependent on rain. So, there is still a lot to do but there are many problems and obstacles that need to be overcome

Financial Difficulty: The financial resources of the state government are limited and the cost of irrigation schemes is continuously increasing. For this, there is a problem of aligning both. The solution to this problem should be to mobilize more resources, seek foreign cooperation and resort to more assistance from the Center.

Rising Cost of Irrigation Projects: Due to rising inflation in the country, the cost of irrigation projects is continuously increasing, causing unnecessary delay in completion, for this, the government should take effective control over cement, iron and rising wages.

Problem of Full Utilization of Irrigation Potential: Irrigation potential of irrigation projects is not fully utilized due to problems of financial means, distributary Canal or water disputes, etc. Therefore, the government should focus fully on the solution of this problem.

Reservoir Problems: Many irrigation projects cause water leakage or excessive flow of water from farmers in the fields leading to the problem of alkaline land, depletion of fertility and crop failure. The solution to this problem lies in the careful use of water and proper drainage system.

Inter-State Disputes: At times, disputes between various state governments arise over water sharing, such as the dispute between Punjab Haryana and Rajasthan over the sharing of water in Ravi-Vyas. Such disputes can arise again from the neighbouring states of the state, so in the national interest such disputes should be settled quickly and without political pressure.

Problem of Environmental Protection: In a state where there is no awareness of environmental protection, there is a problem of mass movements in the construction of irrigation, dams, canal etc., so public cooperation in the development of environmental protection and irrigation resources, and in development works and environmental protection needs to be reconciled.

Corruption, Red Tape and Political Partisanship: This also leads to delay in development of irrigation projects and increase in cost, hence effective control over corruption with no political partisanship and ban on red tape.

Unnecessary Delay: Sometimes due to lack of resources, interstate water disputes, political partisans etc. many times there is unnecessary delay in completion of projects. As there has been a lot of delay in the construction of Indira Gandhi Canal in the state, there should be emphasis on timely construction.

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AUTHORS PROFILE



Ms. Priyanka Payal, Assistant Professor, Swami Keshvanand Institute of Technology, Management and Gramothan, Jaipur (SKIT College), Ram Nagariya Rd, Shivam Nagar, Jagatpura, Jaipur, Rajasthan 302017
bhaskarpriyanka18@gmail.com
Contact No: 9521850759
Qualification: MBA, M.Com (EAFM)



Dr. Poonam, Assistant Professor, Department of BADM, University of Rajasthan, Jaipur
drpoonambussadmn@gmail.com
Contact No: 8619307585