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Regional Geography and Sustainable Development: The Case Study of Shekhawati Region, Rajasthan

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Abstract: ***The Shekhawati region, located in the northern part of Rajasthan, India, is known for its unique geographical features, including semi-arid conditions, rich cultural heritage, and historical significance. Sustainable development in this region must account for its distinct geographic constraints, such as water scarcity, arid climate, and limited agricultural productivity. The region's geography also influences its socio-economic structure, with a reliance on agriculture, handicrafts, and tourism as major sources of livelihood. This abstract explores the geographical basis for sustainable development in the Shekhawati region, examining factors such as climate, natural resources, land use patterns, and socio-economic activities.***

In Shekhawati, effective sustainable development strategies must incorporate water conservation techniques, efficient agricultural practices, and diversification of income sources. The region's infrastructure, particularly in rural areas, requires improvement for equitable access to services such as education, healthcare, and energy. Additionally, the rich cultural and architectural heritage of Shekhawati presents opportunities for ecotourism, which can be harnessed to boost the local economy in a sustainable manner.

Keywords: Regional Geography, Sustainable Development

1.1 INTRODUCTION

Shekhawati region of Rajasthan comprising of two districts viz. Jhunjhunu and Sikar is using its available resources is most disastrous manner without considering of the future consequences. The land resources are in the process of degradation and desertification, which are creating conditions of losing productivity in gradual manner. The water resources are of the region are leading at the extinction point in continuous process and these resources cannot last long. The total area is leading towards over exploitation of ground water resources where further draft is dangerous for the humanity. About half of the area of Shekhawati region is arid and remaining falls under sub-arid conditions where extremity of temperatures and rainfall failure are constant features.

Human resources of the region are largely dependent on land and water resources, which are not in a position to sustain the growing population. The density of human and livestock is beyond the carrying capacity of land and land resources are quite limited to bear increased burden of these resources. The sustainable development of the region is completely at the stake, as mismanagement of all the resources has become unwarranted feature of the region. The sustainable development manifests the use of resources in the manner to remain intact for future generation but the present situation of utilization of all the resources is most unpleasant and idea of future planning cannot be more than academic exercise.

Sustainable development of Shekhawati region is possible with people participation in preservation of the area and destructive activities need to be stopped with immediate effect. Human activities have reached to most critical stage which need reversal for creating pro-development environment. Various aspects of devastation are main cause of hampering the progress and there is necessity to understand the causes of destruction and create environment where the development process can be restarted. People of the region need to understand the status of their own destructive acts and decide whether the present situation of mismanagement of resources should continue in the same manner and reach at the level where human existence is impossible like other desert regions of the world or take corrective measures in their own interest.

The land and water resources are limited which cannot be expanded with the growth of population. The process of population growth is regular feature as government does not want to take strict measures to control the uninterrupted population growth. The present pressure of population is vital on land and water resources which would further imbalance with the growth of population. The present and future course of action possible in this situation is the rationale use of natural resources. The land resources need to be maintained in the manner to achieve maximum productivity to feed the population and water resources need to be used in the manner that the resources remain intact without further damage. These are the pre-requisites for preparation of development plan of the Shekhawati region.

The population density of Shekhawati region is 308 persons per square kilometer where density of Jhunjhunu and Sikar district is 323 and 296 persons per sq km. The present density of population of the region is much intensive than the state density of 165 persons per sq km. The trend of population growth would further increase the population pressure on land and water resources. In addition pressure of livestock population is 223 units per sq km. Human and livestock activities are most destructive to the natural resources in the present and population pressure would increase in future also. The project population of Shekhawati region is expected to increase the density of population by 2051 to become 755 persons per sq km which may increase density of Jhunjhunu and Sikar district as 799 and 722 persons per sq km respectively.

The livestock population would continue to remain within the limit of 250 units per sq km in view of drought and other problematic diseases and the situation remain restrictive. Thus the pressure of human and livestock population would raise to more than 1000 per sq km from present 530 and land resources would be required to bear the pressure of increased number. The situation can be imagined as the present pressure of population is quite unbearable which would create further problems in view of rapid growth. It is therefore necessary to understand the consequences which express from arithmetic equations to ruin the natural resources completely. Survival of human and livestock population would become impossible before reaching in the most inconvenient situation.

Pressure of human and livestock pressure is relative term which becomes burden when the land and water resources are deteriorated but if these resources are well maintained, the problem is likely to substantiate to requisite extent. This situation is only possible if land and water resources are well maintained to meet growing requirement. This situation seems impossible as the present situation of these resources has reached at most critical stage and it is difficult to imagine the future consequences of these resources based on the present trends. Therefore the future development plan need to prepared in the manner where land and water resources are available to more than double human population and this seems quite difficult task in the present environment.

Land and water resources are necessary for human requirements and all the resources are inter-dependent on each other. Human being is supreme authority on the earth surface and manage the situation according to the suitability. In the situation where human efforts have deteriorated the land and water resources, it is difficult to imagine the conditions where human acts can be changed altogether for meeting the present crisis and its assured availability in future also. This means that human beings are required to change their present practices to manage these resources in the manner that these are sufficient for the present and remain sufficient for the future also. This is only possible in case human beings decide to stop their own present destructive acts and continue those in the similar manner to suffice human requirements.

1.2 PRE-REQUISITES FOR SUSTAINABLE DEVELOPMENT

Sustainable development requires some sacrifices from the people which are given in the form of pre-requisites as the sustainable development is only possible with restricted use of land and water resources, without compromising the present level of develop-ment. It is misnomer to stop completely use of land and water resources to reserve for future needs but use in the controlled manner and these controls need to be imposed by human beings on themselves. These pre-requisites are self control of the activities of human beings which remained destructive to reach at the present situation. The people of the region need to understand that development and destruction cannot run together and for sustainable development, there is necessity to stop destructive acts of human beings.

The sustainable development is to be carried out by the government at state level as sustainable development is the government responsibility but all the activities cannot be carried out by the government like present system of preparation of plan and implement those without understanding the future consequences. The present development process is not leading to the path of sustenance as the present drastic situation has reached with the faulty mode of preparation of plan and its implementation. Thus the state government need to shoulder the responsibility of preparation of sustainable development plan and implement in the manner where destructive acts of human beings are stopped completely.

The first pre-requisite of sustainable development is participation of the people for whom the development is to be done. Involvement of the people of the region is necessary as the development is meant for the people of the region and unless they participate in the process actively. Peoples participation is required in total decision making process from preparation to implementation of the activities for the region. There are various activities already being practiced like approval of the activities in gram sabha but those are not being materialized in the requisite manner as the activities are pre-decided and got approved without understanding the consequences. Such type of empowerment to people is meaningless. For this purpose the state government need to overall spectrum of the region.

Peoples participation is relevant when the people of the region are made aware about the problems they are facing in the present and understand the reason of the problem cropped up in view of human interface. The peoples participation is relevant when the people are completely aware of their own acts creating the deteriorating conditions. Referring the issue related to loss of vegetation in Shekhawati region, activities of people remained destructive by felling of trees for meeting various human requirements and open grazing creating loss of vegetation. The vegetative cover is necessary for successful agriculture practices and extremity of temperatures and failure of rainfall are the consequential impacts of human acts.

Role of the state government remained disguised as there was no thinking of the genuine requirements of the people. The loss of vegetative cover and deteriorating conditions of forests is the ultimate result of failure of the government by not understanding the human requirements of availability of fuel wood, fodder and timber. Considering the issue of fuel wood, government efforts for provision of liquefied gas is not fully possible to urban people and rural people are largely uncovered. Fuel wood is the genuine requirement of rural people and some of the urban people who are left uncovered with gas facilities for cooking. Similarly the fodder is genuine requirement of the people who own livestock which is assured livelihood source of many families of the region.

Requirements of timber is necessary for rural housing, furniture making and running of various industrial activities. These issues are relevant for rural people and if these things are not in access to the people, they will encroachment in to government and community assets. Similarly livestock rearing is necessity of rural people having meagre cultivated land or landless labour. Small livestock species graze on land for feeding and harmful for environment and ecology of the region. Fodder for all the species of livestock is necessary. Thus fuel wood, fodder and timber are legitimate necessities of rural people, which need to be managed for safety of forest land and vegetation cover. If these commodities are not available even on cost basis, conflicts are eminent.

Water is most essential natural resource of the

people and government is already managing drinking water to rural and urban people. Water for irrigation is also necessary to feed growing population. People engaged in cultivation practices try their best grow maximum from land but water is the constraint. There is necessity to manage water resources in the manner that present and future requirements are met without any difficulty. The state government is well aware the depleting ground water resources of the region but not taking corrective step to worsen the situation. Total Shekhawati region is declared dark zone, which is warning for distinct of ground water resources. Therefore, the problems created in Shekhawati region are well known to the government but not intending to take remedial measures.

Sustainability of Shekhawati region is only possible with peoples participation and govern-ment is required to take strategic changes in the implementation system. This region possesses enormous potential to reverse the degradation of land and water, which are necessary for sustainable development of the region. Peoples participation is to be managed in the manner where they are empowered to take active role in total decision making process and also avail benefits of the development. The situation has worsened to drastic level but it is possible to convert the region is green land with concerted efforts, where people participate in the process and allowed to avail benefits from the created assets.

The pre-requisites of sustainable develop-ment mentioned above are necessary to be adhered in the region as the destructive acts need to be eliminated completely and this is possible when the people get alternative measures to solve their genuine problems. One of the prominent issue of the region is mismanagement of land resources by encroachment over the government land and destruction of forest areas. This region has very scanty forest land and most part of the region is put under cultivation practices which has obstructed other activities in the region. Encroachment on government land and land meant for community use need to be freed strictly as these areas are necessary for ecological development of the region.

Technological developments are helpful in changing the situation of the region and it is necessary to introduce research findings for the benefit of the people. Technological support is necessary for solution of the problems of the region and it is pertinent to apply them in agriculture and water management sectors which are most critical for the sustainable development of the region. Agriculture is most neglected section of development and as per government thinking the land development and application of technology is the responsibility of the rural people as their land is private. This approach needs reconsideration as government is spending huge money on agriculture department particu-larly on research, which needs to be transferred to the people for their betterment.

The theme of empowerment of the people for sustainable development of the region requires government positive response to adopt sensitivity by administrative machinery at the people who will be beneficiaries with the activities. The people of the region understand their problems in most befitted manner and also fully aware of the measures to sort out those. Empowerment requires active participation of people in total decision making process starting from awareness generation to sharing of the benefits from created assets. Prioritization of activities for the benefit of village area and the people can be well handled by the people as government has limited funds for developmental activities. For this purpose, the schemes need not be sanctioned on target based approach but there is necessity to provide flexibility as per field conditions.

It has been witnessed that failures in schemes planned and implemented by the government are inevitable as schemes are prepared at national or state level and sanctioned from their without understanding the field realities. Even the people of area are not consulted in selection of site of sanctioned activities. This approach is not fit in democratic system of development where the benefits need to reach to the people of the area. The deterioration of forest areas is one of the example of similar nature. People of the region want fuel wood and fodder which is available in forests. No arrangement for provision of availability has been envisaged and when few persons enter into forest land to fell trees and collect fodder or carry their livestock inside forests for grazing, other people are encouraged for undertaking similar efforts as forest personnel did not intervene earlier efforts.

Forest land are government property which is supposed to be watched by departmental machinery. In the system where the land is provided to people of the region out of waste and barren lands for plantation and raising grass. People would control similar acts carried out in forest department. This is the difference in government efforts and efforts of government with participation of the people. The empowerment is handing over rights to associated families and plantation area remains secured from similar destructive acts of the people. In both the cases, the people of the region are same but the empowerment has assigned them task to feel government land as their own property. Activities carried out in the region on government lands are allowed to be maintained by the people and also empowered them to share the benefits.

People have managed various lands of common property resources where pasture activities are carried out by dividing total land into two equal parts and fenced the area. One part of pasture land developed in earlier year is allowed to the people to collect grass on head-load basis and pay fees as decided by village community. The area is reversed next year and shifting remains regular feature. In this manner, people of the region is not faced from of fodder for livestock. Similar activities are also possible on degraded lands are helpful in ecological development of the region and people associated with the activity are benefited to significant estent. Thus every land lying unattended can be developed with government efforts.

It is not justified to keep government land unattended simply for the region that government property need not to be given to people for plantation activities to retain the ownership of the government. The land becoming without vegetative cover are harmful to the government as replantation is possible on government. With this process the land ownership will remain with the government and area will become rich in plantation with peoples participation. People of the region need to be associated in various activities which are beneficial to the government also. People want total empowerment which includes sharing of the benefits. Social forestry failed simply for the reason that government wanted 50 percent produce when the community is carrying out activities fully without any support from the government.

1.3 SUSTAINABLE DEVELOPMENT PLAN FOR WATER RESOURCES

Presently ground water resources are being used for meeting all the human requirements. The rapid growth of population

has increased pressure on water resources and as per study undertaken by Central Ground Water Board and Ground Water Department of the state government, Jhunjhunu district is using 200 percent water from ground, which has categorized the district in to over-exploitation condition. This situation is not sustainable as ground water resources may extinct within two-three decades if the ground water draft rate continues at the existing level. Sikar district is also facing similar problems with annual draft rate of 136 percent. With present rate of ground water draft, the ground water resources may extinct within four to five decades.

The present status of ground water is most critical in total Shekhawati region and need reversal to continue water availability for future human requirements. The present crisis has developed simply for the reason that the state government never bothered for the deteriorating situation and even no intention is visible to save the region from devastation. The ground water level has reached at the average level of 70 meters and in most parts of the region the cultivators are compelled to deepen the sources further for availability of water. Tube wells and pump sets on wells have further aggravated the problem as available water in the ground resources is finished within few hours and number of wells and tube wells is increasing very fast.

There is no reason to blame cultivators and the state government as the cultivators remain anxious to irrigate their crops to the maximum possible extent and the state government remained hesitating to stop further construction of wells and tube wells. Wells and tube wells are easy options and the state government also used these resources for connecting villages with drinking water facilities. The Shekhawati region was practicing rain water harvesting arrangement for centuries which have been neglected after availability of water to the people for meeting their drinking requirements. Presently use of ground water for drinking and industrial uses is about 15 percent and remaining 85 percent water is used for irrigating crops. The ground water resources have no capacity to bear the present level of draft.

In the greater interest of the Shekhawati region, there is necessity for preparation of sustainable development plan for water resources. This is well known that the region is water deficient and no sectoral consumption can be curtained. Therefore the water resources development plan is to address all these issues in the greater interest of the people in terms of present and future requirements. Preparation and implementation of sustainable develop-ment of water resources is quite difficult in the view of existing critical conditions. The problem of depleted ground water resources are multifaceted and dependence on ground water resources alone is not feasible approach. With annual depletion situation, ground water resources start contamination and salinity is the visible impact. Presence of fluoride and iron are other contamination factors developed.

Rainfall in the Shekhawati region is more than 40 cms but the surface water is charged only about 20 percent to ground resources in view of depth factor. Therefore direct use of surface water is necessary to reduce the pressure on ground water. It is pertinent to mention here that efforts made for using surface water from high altitudes through runoffs under watershed approach could not succeed as the approach is not fit for arid and semi arid regions. There is necessity to collect water in cemented structures and carry the stored water through pipe line to fields. In addition water saving practices are necessary for the region for maximum coverage of area. This approach can yield success for reducing the pressure on ground water resources to great extent.

The sustainable development plan of water resources need to be practiced in the manner that existing use of drinking water and industrial use need to continue from ground water resources. the existing consumption of drinking water and industrial use is 15 percent of total water draft. If the ground water resources are restricted for these sectors, the rate of repletion of ground water level would start with immediate effect and there is every possibility to reach the level of ten meters depth within a period of ten years. Ground water resources will help in meeting the growing population requirements of future and replenished ground water resources would be free from all types of contamination impacts.

The surface water availability through watershed approach has been estimated to benefit 1.40 lakh hectares area in Jhunjhunu but if the water is stored in cemented structures, the area benefited for irrigation of crops and plantation will be 4.20 hectares, which is more than existing coverage area of irrigation. In addition the saving in water use for crop cultivation and plantation through water saving devices would be helpful in increasing the area coverage. The area under cultivation is about 80 percent of the geographical area where 40 percent area is irrigated. Run off water from high altitudes would be helpful to irrigate 60 percent cropped area and also provide water for plantation activities. There are some safeguards necessary to be practiced for sustainable use of surface water for cultivation and plantation activities and adherence of these safeguards is necessary for regular use of available water.

Situation of Sikar district is slightly varied from Jhunjhunu and availability of surface water under watershed approach is assessed 2 lakh hectares, but water storage in cemented structures would benefit 5 lakh hectare cultivated and plantation area. The watershed approach intends to charge water in wells but that could not yield much as the level of ground water has depleted to great extent and increase in water level is subsidized with the depleted conditions and coverage of smaller area and quantum of water. Surface water structure need to be prepared in close vicinity of mountains and hills not allowing running water to disappear in sand. The watershed approach failed to achieve twin objectives of soil erosion and ground water charging and not feasible in sandy regions.

Long term benefit with surface water harvesting is coverage of larger area on assured basis as land and water resources will remain intact and not affected with time span like population growth. Irrigation facilities will be helpful in crop yield on continuous basis and plantation area would be helpful in moisture retention. Requirements in plantation sector are limited for three years as grown up trees become self sufficient in meeting their water requirements after three years. Plantation on mountains and hills will be part of this approach and this sector would be covered in phased manner. Thus plantation sector would require about 10 percent of stored water and remaining water would be used in cultivation sector.

During field study, views of people were taken about the surface water approach and the issue was also discussed with the experts of water management. The general fear expressed is reduction in charge level of ground water. The fear is genuine in general situation but not perfect in the conditions where the ground water level has reached in the Shekhawati region. The average ground water level is about 70 meters and rain water received on the surface reaches the

ground water up to 20 percent while remaining water remains at the depth of 10 to 40 meters in the layers but not beneficial for ground water resources. The moisture retained up to 10 meters from surface is evaporated and the crop root area cannot get benefit.

In case of surface water there is necessity to cover the cemented structures for prevention from evaporation. In addition, maintenance of these structures and water distribution need to be left to village level who are made responsible to collect water charges from users and use the money for maintenance. Peoples participation would be helpful in water distribution in rationale manner and in case of problem, the conflicts need to be solved by government administration. There would be problems in water distribution in the beginning but transparent system need to be developed and cultivators get water as per land size and through water saving devices. Beginning can be made with demonstration pattern and people of the region would be accustomed soon. Handling water use by a village committee is most liked idea and people will accept the arrangement willingly. The rain water harvesting structures need to be constructed after formation of village committee to avoid quality and efficiency issues.

Rain water will be free from contamination and will be available on assured basis. Each cultivator intending to use water for irrigation will be aware in advance about the quantum of water and coverage of area under irrigated crops. Similarly plantation sector will get assured water in phased manner. The area coverage of tree times than watershed approach is feasible with water saving devices. In cultivation sector, 15 to 30 percent more water is required in areas using chemical fertilizers and if the use of bio-fertilizers is started by cultivators, this saving is inevitable. In addition water transported through field channels consume more water which is purely wastage.

Use of sprinkler is helpful in saving water but the cultivators need perfect demonstration as sprinkler system is not perfect to save water but this is the cultivator who has to adjudge the status. Rainwater harvesting structures need to be constructed on wasteland and further structure in village connected through pipe line. One rain water harvesting structure will be able to collect water for many village and instead of increasing the capacity of one structure, similar structures in each village are more appropriate to avoid conflicts. People of the region need to understand value of precious water and use it in judicious manner without any wastage. This will help in coverage of larger area under irrigation facilities.

Mountains and hills are situated in western part of the region while eastern part is arid with limited drainage system. The western parts of the region will harvest water to cater requirements of total region and in addition there are various feasible sites in the region where water harvesting is possible. Sand dunes of more than 9 meters of height are vulnerable source of rain water harvesting and water received to surface level can be collected in cemented structures. The eastern part has some depletion areas where small units of rain water storage are feasible. Some community structures prepared in the past are now deteriorated for being neglected and ruined for want of proper maintenance.

For sustainable water management, it is necessary to select all the feasible sites where water can be stored for irrigation. The arid region receives one rainfall with heavy showers and this water is fit for harvesting for use in plantation and irrigation purposes. There are some hard structures in the form of pavement and pediments where water collection is possible with similar efforts. The objective is to use maximum surface water to save ground water resources from further deterioration and replenishment thereof. Some step wells were constructed earlier by rich people and those can be renovated with peoples participation. The larger area of these structures is helpful in collection of rain water in the storage tank, which is helpful in irrigation of crops. The small units at feasible sites can be helpful in solution of individual village requirements and those villages can be self sufficient in water requirements.

The surface water storage through run off water will not affect the ground water charge as mountains and hills cover meagre area of 10 percent. Water in plain areas is charged to underground sources and that arrangement would continue in future also. The Shekhawati region has mountains and hills in some parts and these are fit for rain water harvesting. With coverage of total irrigation and plantation activities with rain water harvesting system, the ground water resources will be used for drinking water and industrial requirements. Presently the consum-ption of these sectors is fifteen percent of total water draft from ground sources. Present rate of ground water draft is maximum 300 percent, which means that maximum 45 percent of available water will be carried out and remaining 55 percent would remain in reserve. The repletion rate would be higher in such conditions and total region will be able to get ground water at the depth of 10 meters in 10 years.

Surface and ground water resources of Shekhawati region need to be treated as supplementary to each other, but people of the region are required not to disturb ground water resources when the surface water is available to them up their fields. The economic aspect of both the conditions are varied as surface water reached to cultivated fields will be cheaper than drafted from underground. If the condition of use of surface water is imposed in a manner that every user will be charged water use even if using ground water would help in full control as no cultivator would like to share double burden. In this situation government would be free from various problems as people will be able to sort out local issues.

Plantation sector will cover forest areas, waste and barren lands, which is discussed in land use management. Cultivators having marginal and degraded lands would prefer plantation activities as various tree species are more beneficial than crop cultivation. Fallow land of more than 5 years becomes waste land where crop yield is not economic beneficial. Water availability will be helpful in sustainable development of the region as there will be perfect coordination between surface and ground water resources for meeting present and future requirements. This arrangement is helpful for the people of Shekhawati region.

1.4 SUSTAINABLE DEVELOPMENT PLAN FOR LAND RESOURCES

Land resource management is necessary for sustainable development as the land used in productive uses for feeding population growing fast. The present use of land resources is most mismanaged which has imbalanced the ecology of the region. Nine fold classification of land use of Shekhawati region is evident that most of the land possible to put under cultivation and more than 80 percent land is cultivable. In view of this situation, no land is left for vegetation and plantation activities. For sustainable environment

management 33 percent of land is required to put under forest and plantation activities. Crop land of region must not exceed 60 percent of the geographic area and remaining 7 percent land is to be used under habitations, industrial and other uses of present and future. This land use management is ideal condition for sustenance of all the requirements of human beings.

The land use pattern is related to ownership and use under different activities. Recapitulating the land use pattern of Jhunjhunu and Sikar district of Shekhawati region, land put under non-agriculture activities like habitations, roads, railways, transmission lines and buildings is 3.65 and 4.40 percent respectively. Area under forests is 6.70 and 7.89 percent respectively and barren, waste and pasture land combined is 10.60 and 8.87 percent respectively. The cultivable land of these districts is 79.05 and 78.84 percent respectively. This is evident that availability of forest and plantation area is difficult to reach to the level of 33 percent as cultivable land has exceeded the limit. For maintaining the productivity of the land used for crop production, forests and vegetative cover need to be made perfect as water availability is possible for these lands and these conditions can meet the requirements of sustainable development.

Land use pattern is related to ownership issue and cultivated land is owned by individual cultivators who would not like to leave their land for other activities even though their lands are marginal and degraded. Efficiency of land is necessary to achieve maximum production in respective sectors and for this purpose, deficiency level of land is necessary to be assessed. This is possible in laboratories existing at Krishi Vigyan Kendras established in each district. The cultivators and other users are required to get the soil testing of their respective lands and deficiency existing in soil need to be met with suitable applications. Soil scientists are able to guide about the deficiency level and measures to treat with suitable application. The land resources are limited and cannot be expanded according to growth of population and all the human requirement can be met with maintenance of the land efficiency and this process is necessary for all lands intended to put under productive use

The population pressure is tremendous and feeding the population in the present and in future is only possible with increased productivity level. Cultivable land of 79.05 percent of Jhunjhunu district and 78.84 percent of Sikar district is significantly high. In this situation achieving 33 percent land for forest and vegetation cover is not possible to achieve. Therefore sustainable land development planning can be initiated with existing land and land under forests and plantation sector need to put under tree plantation of full density. For this purpose, forest land and other category lands need to be differentiated as forest lands possess legal sanctity and this land is to be developed by forest department. Encroach-ments in forest lands are carried out for cultivation purposes and felling trees or open grazing is carried out at people have no area to get the requisite material for their needs.

For protection of forest lands from destruction, it is necessary to associate people of the region for plantation activities on government land categorized under barren land, waste land, permanent pastures and tree crops. In addition some land under mountains and hills is also available for plantation activities, which is about one percent of the geographical area. Area under mountains and hills is almost denuded and no soil cover exist which is necessary for plantation activities. Therefore digging of pits up to two metre depth is necessary for plantation activities. With proposed arrangement, area under forests and plantation will be 18.30 percent in Jhunjhunu district and 17.76 percent in Sikar district. Thus land for tree cover will be about half of the standard norms and beginning with this arrange-ment can be treated as working arrangement.

Maintenance of forest land will continue the responsibility of forest department and total forest land need to be fenced to avoid encroachment and physical destruction in the form of felling of trees and open grazing of livestock. Forest department is required to make suitable arrangement for treatment of the area for dense plantation and gap area need to be used for raising of grass, which can be sold in the market at any rate decided by the department. Area available for plantation activities with peoples participation is 68618 hectares in Jhunjhunu district and 76418 hectares in Sikar district. Number of total families in the rural areas of the districts of Jhunjhunu and Sikar are 246092 and 272376 respectively. Out of these families residing in rural areas about fifty percent of the families belonging to small and marginal farmers and agriculture labour which would be ready for participation in plantation activities.

Under this arrangement the land used for plantation activities will continue to remain government land under specific categories and families intended to associated in plantation activities need to provide half hectare land on lease basis only for plantation activities. The people so associated at village level for plantation activities will be required to raise 125 plants comprising of 25 timber trees, 25 trees meant for fuel wood, 25 trees for fodder and 50 tree plants of horticulture. The associated families will develop their leased land and maintain trees. Water will be available for plantation activities from rain water harvesting structures. The associated families will maintain trees and use branches of trees related to fodder and fuel wood species i.e., from 50 trees after three years and would not harm timber and horticulture trees.

Use of water saving devices for plantation activities is necessary for which each associated family would be demonstrated water saving device where tree plants can be grown with 50 litres of water per year. The associated families will be required to place one T shape iron rod to be fixed attached with the plant where empty bottle of glucose with syringe will be placed on iron rod and fix the water discharge at minimum level and one full bottle would be sufficient for three days in scorching heat. The syringe is to be placed at the root area of the plant allowing to suck water fully. The associated family member will be required to stop water outlet during night and open at minimum level. This system has been tried in desert region and plant survival rate of three samples will be more than 90 percent and there will be no requirement of water after three years as the grown up trees will manage their water requirements without further support.

After four years fruit trees will be able to provide produce which the associated family will be required to market it. If all the associated families of one village or cluster of villages grow one or two fruit species, marketing will be no problem in view of bulk production and people will start reaching to villages for negotiating cost of the produce. In such situation, tree growers need not to wander for marketing their produce. Fuel and fodder trees are meant for specific use by the associated family where the benefits are enormous. Trees of timber may like be saved from felling down by miscreants and these trees will be cut for selling

after completion of their life span. Total plantation area will remain intact as associated families will maintain the land and would not allow others to harm their trees or their produce.

Raising grass in the gap area is possible and would not harm trees. The associated families will start getting income after four years from fruit plantation and they will be entitled to take total sale value. In case of timber, the government may impose some levy charges over the families for which they would not resist as 25 trees will fetch substantial money to them. Forest area will be free from destruction as people engaged in plantation activities will get enough fuel wood, fodder and grass for their family requirements. With this system about 17 percent area of Shekhawati region would convert in dense plantation area and would be helpful in controlling the extremity of temperatures and climatic conditions. There is likelihood to change in rainfall pattern due to vegetative cover and cropped area will be benefited with this arrangement.

Area under cultivation need to be managed for treatment of land degradation and deficiency of nutrients. For this purpose the cultivators are provided short, medium and long term loans from land development banks and there seems no difficulty as cultivators would like to get maximum return from their land. Water saving devices need to be practiced for coverage of larger area with irrigation facilities. For this purpose, the cultivators need to be motivated to switch over to bio-fertilizers by banning use of chemical fertilizers. The cropped areas with application of chemical fertilizers require 15 to 30 percent more water depending on soil conditions. If all the cultivators of Shekhawati region are motivated to use bio-fertilizers there will be no problem of loss of natural fertility of soil. This approach needs careful application of bio-fertilizers to avoid loss of productivity.

The cultivated fields using chemical fertilizers are infested with various problems of soil deficiency and total process of shifting to bio-fertilizers is suggested to be four year duration. In the first year 75 percent chemical fertilizers and 25 percent bio-fertilizers are befitted for maintaining the productivity level. In second and third year use of bio-fertilizers need to be increased to 50 and 75 percent respectively and use of chemical fertilizers is to be decreased in similar proportion. In fourth year use of chemical fertilizers is to be stopped completely. Other benefits from bio-fertilizers application are 10 percent increase in productivity in the fifth year onwards. The agriculture produce with use of bio-fertilizers provides 10 to 20 percent higher value of produce with certification method. Thus the system is beneficial to the cultivators and the environment.

Presently 35 percent area is irrigated with wells and tube wells and with suggested manner 60 percent of the cultivated area will be put under irrigation facilities. For maintaining the level of irrigation in further duration the cultivators are required to use all the systems of application in the suggested manner as all the issues incorporated in sustainable development plan are inter-related and disturbance in one area will collapse total system. In addition, water saving in suggested manner are essential for future course of action. The land use pattern is most disturbed but revision to some extent is possible. Presently 3.22 land of Jhunjhunu district and 5.19 percent land of Sikar district has become waste land which is categorized as cultivable land but due to remaining fallow land for more than five years, land degradation process was carried out. These lands can be treated again by putting in plantation area. These efforts will be helpful in increasing vegetative cover by motivating their owner cultivators.

Government land proposed to be brought under plantation activities will also regain its fertility and environment development of the area will be helpful in changing the overall scenario of the region. Present degraded land is yielding meagre volume which will increase substantially with treated land by meeting out all the existing deficiencies. The land regaining its fertility will be helpful in sustainable development of land resources. The population will continue to grow as there is no control and people of poor classes still not aware with the small family norms in their own interest. Pressure on land resources is bound to increase but growth with plantation sector will be helpful in initiation of ancillary activities based on land produce.

Production of bio-fertilizers and bio-pesticides is proposed to be carried out at the village level which will be helpful in meeting the village requirements on sustainable basis. For converting total land area put under productive uses preparation of bio-fertilizers and bio-pesticides is necessary. The procurement of earthworm and preparation of sheds will be one time expenditure and cattle dung available in villages will be used with agriculture residue. The bio-fertilizers and bio-pesticides prepared in village will be cheaper and free from all environmental problems. Half of existing diseases in human beings are impact of chemical fertilizers and chemical pesticides. Deterioration of soil fertility is matter of environmental degradation. All these problems will be solved in the suggested manner.

Land resources of Shekhawati region are fertile and with availability of water the land production and productivity will increase to feed increasing population. Once the land is treated with all the degraded impacts, cultivators will be able to treat their land on regular basis as no cultivator will like to loose the production possible from land. Plantation and cultivated areas are supplemental to each other. Various insects grown in plantation areas are helpful in growth of agriculture produce. Honey is one of the product of this nature, which is possible in significant quantity. This will help in employ-ment generation through ancillary activities and village economy will become self revolving. Land and water use in suggested manner will change the situation of Shekhawati region.

1.5 SUSTAINABLE DEVELOPMENT PLAN FOR HUMAN RESOURCES

Human resource development is ultimate objective of the research study as all the activities carried out on land are for the long term benefit of human population. Shekhawati region has various in-built problems where land and water are most critical factors. Land and water management as part of sustainable development plan are dependent on human behaviour which remained main factor of deterioration of these factors. Level of environment degradation caused in last four decades and the situation has become worst in the present. Both the natural resources are victim of human interface and they are facing all the natural adversities in view their own disastrous acts. Agriculture sector is worst affected as the people associated with land based activities are unable to get minimum wage from this task. People remained associated with land as they are not skilled to start other activities.

Natural disasters are most prominent in the region in view of impact of damaging acts of human beings and they

are suffering from their own fault. Human resource management is most critical issue in such condition where land and water resources are at the verge of extinction. Sustainable development plan of water and land resources has been prepared while keeping all he aspects in view and ultimate objective of this plan is to create conditions for sustainable develop-ment of human beings. The present status of employment of human resources is most critical as general condition of the region is very pity. Urban population flourish over the activities of rural people and sustainable development plan of human resources need to address all the socio-economic aspects.

Population density of Shekhawati region is 308 per sq km which is quite high in comparison to the carrying capacity of land. The projected population of Shekhawati region by 2051 will increase to 103.19 lakhs from 2001 population of 42.01 lakhs. The existing density of population of 308 persons will increase to 755 persons per sq km which will be quite substantial. Land and water resources are struggling in the present would be unable to bear 2.5 times population of the region. Water resources will be able to fulfill drinking requirements of population and survival of people would become difficult. The sustainable development plan of land and water resources is able to face the challenges of present and future. Presently 20 percent population of working age group is unemployed and another 25 percent are under-employed.

Management of human resources in the present and future is only possible with indicated plan and this is only mode to sustain the population. There are 5.18 lakh rural families as per 2001 census and the number of families by 2051 would become 12.96 lakhs. In sustainable development plan of human resources both the aspects need to be taken into account as both are relevant in the livelihood approach of Shekhawati region. The human resource management plan is based on the sustainable development plan of land and water resources and unless these sectors are addressed in the suggested manner, the situation of the region is bound to be affected significantly.

The water resource management plan will provide irrigation facilities to 60 percent of the cultivated land from existing 35 percent where ground water depletion is affecting crop produc-tion in significant manner. Water management plan will be helpful to provide two crops to 60 percent cultivators from existing 35 percent on sustainable basis and ground water resources would start repletion. The livelihood of one lakh cultivator families will be assured and they will get ten months employment with sufficient food and other livelihood resources. 2.60 lakh families associated with plantation activities will get sufficient income after four years and they would face no problem in feeding their livestock. Fuel wood requirements will be met from the trees, which is assured arrangement for which women members of family were required to shoulder this responsibility.

Preparation of bio-fertilizers and bio-pesticides will provide employment to 18000 families in the beginning which will increase to 90 thousand families when cropped area will require total application of bio-fertilizers and bio-pesticides. One rural family member associated with the work of preparation of 50 tonnes of fertilizers will get Rs. 50000 per year which is more than twice of families covered under below poverty line. Plantation area will also require bio-fertilizers and bio-pesticides which will help in additional employment to other families. Plantation area and cropped area for about 8 months in year will help rural families to initiate activities like bee keeping and about 50,000 families can get assured self-employment with remunerative return.

In this manner the rural families will be economically strengthened and total 3.10 lakh families will be benefited with additional employment activities on sustainable manner. There are 5.18 lakh rural families as per 2001 census in the Shekhawati region and the families benefited with additional employment facilities would be about 60 percent. Remaining 40 percent families are possessing sufficient assets of income and human resources management will become foolproof. Out migration to cities will be stopped as rural people belonging to landless category, small and marginal farmers remain problematic from gainful employment of view. This plan for sustainable development of land, water and human resources is based on the strategy of stoppage of all human destructive activities. If the things move in appropriate direction, the total arid and semi-arid region will become problem free and prosperous within a period of ten years as first four years will be hard hit to associated families who will work without significant return.

Laying down a systematic approach for sustainable of water, land and human resources will be quite difficult in the beginning as controlling human destructive activities will remain problem but the situation will be settled within four years in the hope of betterment of rural families. With better economic conditions, people of rural areas will send their children to schools and some of the brilliant students will be associated with skilled tasks for better economic return. The sustainable development plan of Shekhawati region has been prepared keeping in view all the resources in the present condition and future status in view of population growth. The burden of additional population would add significant pressure on these resources and all the resources would be able to bear the pressure.

Human lusts are responsible for destruction and this process remains unending till the people of the region are not empowered completely. The empowerment in total decision making process is helpful in sharing the benefits in most appropriate manner and rich and powerful persons are unable to take larger share from created assets. The empowerment allows transparency in sharing benefits in equitable manner as every person has right to avail equal opportunities. This process helps in controlling encroachments on the government property as there remains no land for such acts. Government is also required to control illegal activities of the people. The sustainable development is only possible when the destruction activities of the people are eliminated completely.

The system of sustainable development of Shekhawati region is the only mode to create conditions when the process of revitalization is initiated with complete vigour and people of the region feel them fully empowered to develop the area with their earnest efforts for their own benefits and for the coming generations. If the people of the region are fully vigilant to keep the natural resources in perfect conditions, the present would be difficult to pull on and future of the region would be dangerous. The sustainable development of land resources, water resources and human resources is able to convert the scenario of the region befitted to fulfill all the aspirations of the people, who are struggling for their survival.

1.6 CONCLUSION

The Shekhawati region, with its unique geographical challenges and opportunities, requires a tailored approach to sustainable development. Its semi-arid climate, limited water resources, and dependence on agriculture and traditional industries present both challenges and opportunities for growth. To achieve sustainable development, it is imperative to focus on the integration of environmental, economic, and social factors that consider the region's specific geographical features.

Key to the region's sustainability is the promotion of water conservation strategies, efficient agricultural practices, and the diversification of livelihoods. The use of modern technologies for water management and crop cultivation can help mitigate the region's water scarcity, while the promotion of alternative industries such as ecotourism can provide new avenues for economic growth without compromising the environment.

Furthermore, sustainable development in Shekhawati must focus on improving infrastructure and accessibility to essential services, such as healthcare, education, and renewable energy, to ensure inclusive growth. By leveraging its rich cultural and architectural heritage, the region can develop a sustainable tourism sector that not only boosts the local economy but also preserves its historical identity.

In conclusion, the geographical basis for sustainable development in Shekhawati hinges on a collaborative approach that blends traditional knowledge with modern solutions. With careful planning, investment in key sectors, and a focus on environmental conservation, Shekhawati can pave the way for a sustainable and resilient future that enhances the well-being of its communities while preserving its unique natural and cultural heritage.

1.7 REFERENCES

[1] **Choudhury, P. (2006).** The Impact of Geography on Sustainable Development in Rajasthan: A Case Study of Shekhawati. Journal of Rural Development, 24(2), 85-98.

[2] **Sharma, M. K. (2007).** Medical Plant Geography, Rachna Prakashan, Jaipur

[3] **Sharma, K. (2010).** Ecological and Cultural Tourism for Sustainable Development in Rajasthan. Tourism and Development, 3(1), 45-59.

[4] **Rathi, P., and Gupta, R. (2014).** Environmental Issues and Sustainable Development in Rajasthan: A Geographical Analysis. Journal of Environmental Management, 16(2), 189-203.

[5] **Meena, S. and Verma, S. (2015).** Water Resource Management in Arid Zones: The Case of Shekhawati Region in Rajasthan. International Journal of Environmental Science and Technology, 12(4), 1137-1146.

[6] **Paliwal, V. and Singh, R. (2017).** Sustainable Agricultural Practices in Arid Rajasthan: A Geographical Perspective. Environmental Sustainability Journal, 8(3), 202-213.

[7] **Government of Rajasthan (2017).** Rajasthan Water Resources and Agricultural Development Plan: Strategies for Shekhawati Region. Department of Agriculture and Water Resources, Government of Rajasthan.

[8] **Singh, J. and Patel, N. (2018).** Geography of Rajasthan: Challenges and Opportunities for Sustainable Development. Jaipur University Press.

[9] **Kumar, S., and Sharma, S. (2019).** Sustainable Development in Semi-Arid Zones: Case of Rajasthan's Shekhawati Region. Development Studies, 15(2), 129-145.

[10] **Jain, S. and Mahajan, R. (2020).** Land Use and Regional Development: A Geographic Study of Shekhawati's Growth and Sustainability. Journal of Rural and Urban Studies, 14(1), 65-80.

[11] **Chauhan, A., and Soni, R. (2022).** Climate Change and Sustainable Development in Arid Rajasthan. Indian Journal of Climate Change and Sustainable Development, 6(4), 248-261