India

Afforestation and Pasture Development Project Along Indira Gandhi Canal Area

Field Study: July 2003

1. Project Profile and Japan's ODA Loan

Project Location

Waterway shelterbelt trees planted by this project

1.1 Background

In the western part of Rajasthan State lies the extensive Thar Desert, which is covered in rolling dunes for almost its whole expanse. The annual precipitation in the northeastern area is 200 mm to 300 mm, and during the rainy season the area temporarily becomes green. However, as one heads southwest, the amount of precipitation and vegetation declines. Due to this situation, the area residents earn their livelihood primarily with pasture animals and one crop per year during the rainy season, but since it is an arid area, rainfall varies each year and income is not stable.

Residents live in approximately 500 villages scattered around the desert, and since they have no means of communication with the outside world except for minimal roads, their lives have been socially isolated. Moreover, desertification is proceeding steadily in this area. Not only is desertification making the villages' infrastructure markedly fragile, it is also threatening the existence of many villages due to the strong winds that move sand dunes.

The government of Rajasthan State has carried out the Indira Gandhi Nahar Project (IGNP) in areas that can be irrigated (1,500,000 ha) at the Thar Desert since the 1950s. IGNP is a comprehensive regional development project with the aims of actualizing the establishment of infrastructure, the increase and stabilization of income, and the improvement of living conditions. Specifically, through the construction of the Indira Gandhi Nahar Canal, the project provides a stable water supply that can be used for irrigation, greenification, increase of tillable land, road construction, and drinking water over a wide area. IGNP is divided into two stages, Stage I and Stage II, and this project is concerned with afforestation, one of the components of Stage II of IGNP.

1.2 Objective

This project was designed to improve productivity by increasing production of firewood and fodder and to conserve the infrastructure and the land through planting trees to protect canals, roadways, and farmland, etc., in the desert region of western Rajasthan State, and thereby contribute to the alleviation of poverty in the region.

1.3 Output

As part of the Irrigation Region Development Program of the Indira Gandhi Nahar Project (IGNP), this project conducts afforestation in the selected areas in Stage II of IGNP. The outline of the overall IGNP is as follows.

■ IGNP Overall Outline

	Stage I	Stage II
Main Canal	189 km	256 km
Branch Canal	2,950 km	5,000 km
Irrigated Area	525,000 ha	1,012,000 ha

■ ODA Loan Project

As part of the above-mentioned Stage II, this ODA loan project will implement afforestation of 70,300 ha and development of pasture, etc., and also will implement research*[1] and dissemination activities and strengthen the organization of the executing agency. Details are as follows.

1) Canal Side Plantation	15,000 ha
2) Road Side Plantation	400 ha
3) Block Plantation / Forest Preserves	6,000 ha
4) Sand Dune Stabilization	25,000 ha
5) Pasture Development	15,000 ha
6) Agricultural Forest	10 million trees
7) Environmental Plantation	2,400 ha
8) Farm Forestry	6,500 ha
9) Project Management	
10) Dissemination, Research, Training	
11) Monitoring	

Out of the total project cost of 9,258 million yen, the amount of 7,869 million yen, equivalent to 85% (the total of the foreign currency portion of 418 million yen plus the local currency portion of 7,451 million yen) was funded by the ODA loan. The remaining amount was funded by the capital of the executing agency.

1.4 Borrower/Executing Agency

Borrower: President of India

Executing Agency: Forest Department, Government of Rajasthan

[1] Tests which are indispensable for afforestation, including the soil analysis tests, seed germination tests, fertilizer and pesticide tests, and plant pathology tests.

1.5 Outline of Loan Agreement

Loan Amount/Loan Disbursed Amount	7,869 million yen / 4,711 million yen
Exchange of Notes/Loan Agreement	September 1990 / January 1991
Terms and Conditions -Interest Rate Repayment Period (Grace Period) -Procurement	 2.5% 30 years（10 years） General Untied
Final Disbursement Date	February 2002

2. Results and Evaluation

2.1 Relevance

In Rajasthan State, which has a population of over 56 million, reliance on forests for fuel and animal feed, etc., grew sharply due to the increase in the number of domestic animals accompanying the sudden human population growth (in the 10 years from 1971 to 1981, human population increased by 190% and domestic animals increased by 148%). So, at the time of this project's appraisal (1990), devastation of the forest was already advanced.

The Indian Government's Seventh 5-Year Plan (1985-1989) contained countermeasures for poverty by improving the environment through afforestation and social afforestation, etc. The Bikaner region and the Jaisalmer region which benefit from this project are located in the Thar Desert, and the villagers who dot the regions earn their livings mainly through pasture animals and a single crop per year, in the rainy season. However, there was a high likelihood that the villages would vanish because of sand dune movement caused by wind, and remaining settled in one place was difficult for the villagers. Together with increasing the forested area, this project aimed to improve the lives of the residents by protecting the settled areas and canal waterways constructed in Stage II of IGNP and by supplying pastures and firewood and creating jobs, etc. So, it can be said that this project was consistent with the national plan and the needs of the local residents.

At the time of evaluation, the afforestation rate (the percentage of forest area out of the total area*[2]) in Rajasthan State was low, at 9%. The Tenth Rajasthan State 5-year Plan (FY2002-FY2006) states the goal of increasing the afforestation rate to 25% during FY2007 and to 33% by FY2012. The plan apportioned a budget of 45 million rupees to the forestry sector. Moreover, the state emphasizes prevention of desertification and creation of employment opportunity, and on these points, the objectives of this project are consistent with the state's development plan.

Also, separate from the state's comprehensive development plan, in 1999 the Government of Rajasthan drew up the "Action Plan Converting Desertification*[3]," which encourages afforestation projects for

[2] "Forest Area" as it is used here includes dense forest (40% or more covered ground surface), open forest (from 10% up to 40% covered ground surface) and scrub forest area with less than 10% covered ground surface. Furthermore, the national average forest area rate was 20.9% in FY1995.

[3] Action Plan Converting Desertification 1999, Rajasthan State Government

the prevention of desertification in the state. Consequently, at the time of evaluation, it can be said that afforestation projects were accorded extremely high priority and the relevance of this project was amply recognizable.

2.2 Efficiency

2.2.1 Output

The output of this project was generally achieved according to plan, as shown below.

Afforestation Scheme	Planned Levels at Appraisal Time (ha)	Planned Levels Following Revision（1995）	Final Planned Levels（2000）
1) Canal Side Plantation	15,000	19,400	21,400
2) Road Sid Plantation	400	1,250	1,250
3) Block Plantation / Forest Preserves	6,000	3,500	4,248
4) Sand Dune Stabilization	25,000	30,100	34,070
5) Pasture Development	15,000	5,500	5,990
6) Agricultural Forests	-	-	10 million trees
7) Environmental Plantation	2,400 ha (0.8 million trees)	(0.5 million trees)	896 ha
8) Farm Forestry	6,500 ha （25 locations）	50 locations	50 locations
9) Dissemination, Research, and Training	—	—	Additional Item: Formation of 100 JFMs（Joint Forest Management Committees）

The afforestation area was increased, except for some categories (block plantation /forest preserves and environmental plantation). (Total afforestation area increased from 40,400 ha to 56,720 ha, if the decrease in block plantation /forest preserves and environmental plantation are excluded.) According to the executing agency, this was because the amount of land suitable for pasture development around the canal was less than originally estimated, and so emphasis was placed on protection of the canal system by reducing the area of pasture development and increasing the area of canal shelterbelt trees and sand dune stabilization trees.

The area of block plantation /forest preserves was revised downward (from 6,000 ha to 4,248 ha) because one on hand, farmland preparation was delayed due to the delay in irrigation in Stage II of IGNP, and on the other hand, provision of roads in Stage II progressed faster than originally planned, and so road side plantation was given priority. Furthermore, environmental plantation was revised downward (from 2,400 ha to 896 ha) to offset the fact that other parts of the scheme were revised upward.

With regard to dissemination, research, and training, the plan was for this project to train village people who were hired to work in the afforestation project, but since the afforestation project was delayed, the research did not progress as originally planned. Meanwhile, because Joint Forest

Management (JFM) *[4] was introduced in Rajasthan State, this project incorporated JFM into its dissemination, research, and training, and implemented its approach to the residents through JFM. Thus, JFM was added to the output of this project.

The above revisions were changes that enabled the project to be implemented efficiently and effectively, and the changes can be considered appropriate.

2.2.2 Project Period

This project was affected by the delay in construction of the canal and waterways which were components of Stage II of IGNP, and all work was finally completed in May 2002, seven years behind the original plan.

The detailed reasons for the delay may be listed as (1) due to the delay in canal and waterway construction, the water supply that is indispensable for afforestation was delayed, (2) the afforestation project itself was delayed due to abnormal weather including an unprecedented drought*[5], (3) the problem on the land availability, etc.

IGNP's canal and waterway construction is handled by the IGNP Agency, and the irrigation-related projects are handled by the Irrigation Development Agency, and so it appears that it would have been difficult for this project's executing agency (Rajasthan Forest Department) to prevent the delay in (1) above by itself. Regarding (2), the scale of the abnormal weather conditions exceeded expectations, and so the delay could not have been prevented by the efforts of the executing agency. Furthermore, the delay of IGNP caused an increase in the project cost (for the afforestation funded by the ODA loan) and caused changes in the above-mentioned output of this project.

2.2.3 Project Cost

The project cost was 5,785 million yen, which represents 62% of the originally planned cost. The reduction was due to devaluation of local currency that exceeded the rate of inflation. The total project cost in local currency was 1,711.5 million rupees, which is approximately 160% of the originally planned cost (of 1,077 million rupees) (see table below).

The cost of afforestation work, which was the main cost, was 1.8 times the amount originally planned because the minimum wage prescribed by the Rajasthan Government was nearly tripled progressively over the course of 10 years from 22 rupees to 60 rupees. Another factor that can be mentioned is the increase in expenditures accompanying the additional output (i.e. the increase in afforestation area) for the purpose of maximizing the effects.

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[4] Programme for conducting forest nurturing and management cooperatively by the state government agency (the Forest Department in the case of India) and local farmers and residents. Within this, a "Forest Preservation Committee" is formed by residents for conducting forest management (see 2.2.5).

[5] When abnormal weather conditions occurred, such as drizzling rain, heavy downpours, and sandstorms, many of the cultivated trees withered and died due to dryness or flooding, and so it became necessary to replant.

Project Cost Comparison（Original Plan and Actual Cost）

Item	Yen Base			Rupee Base		
	Original (million yen)	Actual (million yen)	% of Plan (%)	Original (million rupees)	Actual (million rupees)	% of Plan (%)
Afforestation Work Cost	6,054	4,163	69	703.9	1,231.8	175
Administrative Expense	1,333	1,257	94	155	371.8	240
Buildings	127	164	129	14.8	48.6	328
Machinery, Materials, Vehicles	73	39	53	8.5	11.5	135
Communications, Dissemination, Research, Training	184	43	24	21.4	12.8	60
Drafting Plan, Monitoring	10	-	-	1.2	-	-
Tax	186	118	64	21.6	35	162
Money in Reserve	799	-	-	92.9	-	-
Interest During Construction	492	-	-	57.2	-	-
Total	9,258	5,785	62	1,077	1,711.5	159

Note: Exchange rate at planning was 1 rupee = 8.6 yen; exchange rate at completion was 1 rupee = 3.38 yen.

2.3 Effectiveness

2.3.1 Improvement of Productivity

According to the report of the Agricultural Financial Corporation Ltd.(AFC)*[6], it is reported that the branches collected from area afforested by this project supply the residents' demand for fuel. Also, in the interviews with beneficiaries (with approx. 30 persons in the region that benefited from the project) described below, 60% of residents responded that the amount of firewood they collect increased due to the afforestation project, and 77% responded that the amount of animal feed increased, and so it appears that the afforestation is provided benefits of a certain scope.

2.3.2 Maintaining the Integrity of Infrastructure and Land

When the planned level (the final planned level following 2 revisions) and actual level of afforested area are compared for each afforestation scheme, 85% to 105% of the plan was achieved (and the average achievement level for schemes 1 thru 6 whose afforested area can be expressed numerically is 99.9%). So, it can be said that the goal for afforested area was basically achieved.

Through this project, disaster prevention as well as maintenance of environmental integrity (protection of waterways, roadways, farmland, etc.) was achieved. Specifically, the total planned figure for afforestation and others at the time of appraisal was 61,400 ha, which is equivalent to approximately 1.5 times the area of Yokohama (which is 437 km^2), and the actual figure was 66,853 ha. The actual level represents 108.9% of the planned level.

Also, the survival rate of the planted trees is on average 50% to 70%, which exceeds the overall goal level of IGNP of 40%, the level which is also upheld by the Rajasthan Forest Department.

[6] A consortium established by a commercial bank aiming to promote loans for agriculture sector and rural development. It deals with the consultation and research activities in agriculture and forest sectors (www.afcindia.com).

2.3.3 Creation of employment opportunity

According to the records of the executing agency, the number of jobs created by this project is roughly estimated at 5.18 million man-day. Also, residents are still employed after the project for operation and maintenance. Furthermore, women as well as men were being employed for afforestation work.

2.3.4 Internal Rate of Return (IRR)

Since this project was not intended to be a project with financial return, FIRR was not calculated. Also, EIRR was not recalculated because data was not collected on the economic value of the firewood and animal feed, which may be considered economic benefits of this project.

To sum up the above, although some of the qualitative information is limited, to the extent that one looks at the afforested area, the tree survival rate, and increase in the amount of firewood collected, this project can be considered to have basically fulfilled its objective of "planting trees in order to protect the canals, roads, villages, and farmland in the beneficiary region from being buried by blowing sand, and moreover, of supplying pasture and firewood and providing employment opportunity."

2.4 Impact

Since this project was implemented as part of Stage II of IGNP, it is difficult to measures the impact of this project alone. With that in mind, the degree of the achievement of the anticipated impact will be verified, including the supply of water through canals and waterways provided by IGNP.

2.4.1 Impact on Agricultural Production

As pointed out by the executing agency, the afforestation project had an indirect impact on agricultural yield due to the expansion of water supply to farmers through the erosion-control effects of the irrigation waterways. Due to the building of canals by IGNP and the start of the water supply for farmers, a change was brought about in the farming pattern in the region from a single crop per year to a double crop. Furthermore, in the report of the agricultural financial organization, it is pointed out that the increase in the area planted in trees due to the afforestation project has brought moisture to the farmland, and this has caused changes in the planting pattern. In actuality, the agricultural produce pattern in the Bikaner region has changed so that it is now possible to grow crops in the summer, as shown below. From these facts, the projects included in IGNP can be considered to have made a certain contribution to the increased yield in farm produce in the project site, as one part of the overall effect of IGNP.

Changes in Planting Patterns in the Bikaner Region

Before Start of IGNP		After Implementation of IGNP	
Summer	Winter	Summer	Winter
None	Pearl Millet (Bajra) Jowar Misc. Grains	Cotton Wool Beans Rice Peanuts Sugar Cane	Mustard Wheat Vegetables Misc.Grains

Source: Evaluation of Afforestation and Pasture Development Project, Indira Gandhi Canal, Stage II, Bikaner District, Agricultural Finance Corporation Limited, Northern Regional Office, New Delhi, January 2000.

2.4.2 Environmental and Social Impact

When this project was implemented, no land was acquired and no residents were relocated. In addition, the results of the study of beneficiaries, which was implemented when the site was visited, are as follow.

Result of Study of Beneficiaries

A questionnaire survey was implemented concerning the effects and the impact of this project. There were 30 respondents from 4 villages that were located in the project site. Since this project was divided into 4 regions, one village from each region was chosen.

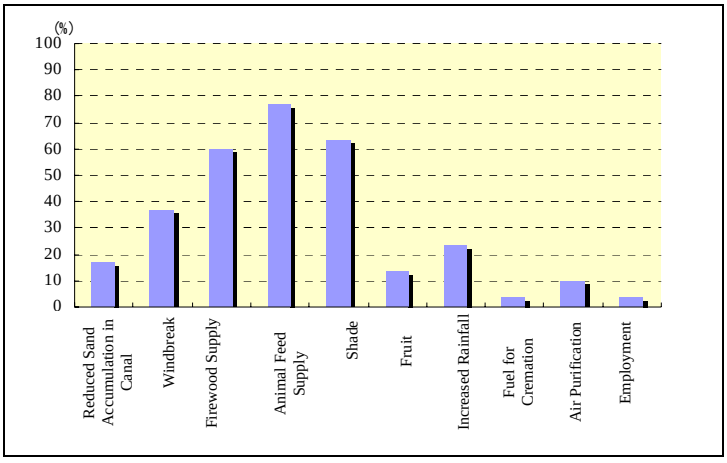
Beneficiary Village	Region
Amarpura Village	Bikaner（Region 1）
Madasar Village	Bikaner（Region 2）
Diggha Village	Jaisalmer（Region 4）
Badda Village	Jaisalmer（Region 5）

Among the 30 respondents (sampled at random), there were 22 men and 8 women. Almost all respondents were employed ether in farming, raising stock animals, or both. Of the respondents, 90% were landowners, and the size of their land ranged from 2.5 to 13.75 ha, or 8.23 ha on average.

-Effects of the Afforestation Project

When respondents were asked about the effects of the project (free response), 77% replied, “animal feed increased,” 60% replied, “the amount of firewood collected increased,” and 63% replied, “shade was created that benefits not only the residents but also the stock animals.” In addition, 37% mentioned “the wind-break effects of the planted trees.” It can be said that the effects anticipated in this project were recognized by the residents in these ways.

Effects of Afforestation



-Usage of Forest Products

Of the respondents, 93% were using products from the afforested area and other forests, and the main by-products were firewood, animal feed, and fruit. However, since tree-cutting and illegal entry is forbidden, such forest products cannot necessary be collected at anytime, and the amount that can be used varies depending from time to time. Eight respondents replied that the amount of firewood collected by one household in a year is roughly estimated at 123 kg. However, since sale of these forest products is forbidden, all of them are used privately.

2.4.3 Impact on Residents

As shown in the results of the survey of beneficiaries, the increase in animal feed, which is a forest by-product (grassy undergrowth), was extremely beneficial. Also, as stated above, the residents became able to use small branches as firewood, and as a result residents can save money by purchasing less firewood.

Since the scheme for the development of farmland involves planting the type of trees that can be used as animal feed, residents no longer need to move their households in search of animal feed, and so permanent settlement in the beneficiary region was promoted. In addition, it was pointed out by some residents that a windbreak was provided and the scenery was improved, etc., by the afforestation (greenification).

Moreover, the project has provided positive impacts on the residents' lives and livings, thus it is inferred that the project has contributed to the reduction of poverty.*[7]

2.5 Sustainability

2.5.1 Current State of Afforested Land

The overall state of operation and maintenance can be called satisfactory. In the field survey implemented during this study as well, no phenomena could be confirmed that would have serious effects on the realization of the effects of this project or its sustainability. Also, the tree survival rate is satisfactory, as stated above in "2.3.2" of the section on Effectiveness."

2.5.2 Village Forest Protection and Management Committee (VFPMC)

(1) Operation and Maintenance System

Based on Joint Forest Management (JFM), VFPMCs conduct the operation and management of the afforested region*[8]. In regions where a VFPMC has not been formed, a system is used wherein Forest Guards and Watch Guards from the Rajasthan Forest Department reside in and supervise the afforested region.

Joint Forest Management (JFM) is a programme where government agencies (the Forest Department, in the case of India) and the local residents cooperate to carry out nurturing and management of the forest. Rajasthan State enforced a law for this in 1999.

Under this programme, the State's Forest Department contracts with an association formed by residents, and they establish a VFPMC. The objective of the VFPMC is to nurture and protect the forest, and moreover, to improve the lives of residents, by having forest management implemented by the residents and by constructing a system for sustainable forest management.

At the time of evaluation, 102 VFPMCs were in the process of being formed in relation to this project.

(2) Technical Capacity

The Forest Department is implementing the necessary training for the farmers who participate in VFPMCs.

(3) Financial Status

Forest Guards for the afforested region were hired by the Forest Department, but in cases where a VFPMC conducts supervision itself, it has been decided that the Forest Department will bear the

[7] The poverty ratio in Rajasthan State declined from 27% to 15% from FY1993 through FY1999. This was a large decline in comparison to the national average decline of 36% to 26% during the same period. The poverty line is defined by nutritional intake standards, etc.

[8] JFM was introduced during the implementation of this project. Consequently, VFPMC was established mainly for maintenance management.

financial expense. Also, when a VFPMC is in its start-up stage, it is granted 25,000 rupees *[9] from the Forest Department, and interest from this grant as well as association membership fees are used as revenue sources.

2.5.4 Rajasthan Forest Department

(1) Operation and Maintenance System

The executing agency for this project is the Forest Department of Rajasthan State. Operation and maintenance not handled by a VFPMC is handled by the Forest Department itself. An operation and maintenance manual was also prepared and is used sufficiently even at the field level, and so overall it can be said that the operation and maintenance system is established. The main operation and maintenance activities in the afforested region are removal of weeds, supplying water to the trees, and tree pruning. The Forest Department staff is also in charge of monitoring and evaluating the trees planted by this project. No problems are visible in the organization of the operation and maintenance at the current time.

(2) Technical Capacity

According to the executing agency, the stability of the staff is high. Many staff members have over 10 to 20 years of experience in afforestation projects, and so they possess a high skill level. Henceforth, an increasing number of staff members who have abundant experience are expected to reach retirement age, but a staff training system is established (a comprehensive training center exists in Jaipur, the capital of Rajasthan), so it is said that there is no problem since the training program for newly hired employees is fully prepared.

The organizational system is headed by the Chief Conservator of Forests, under whom there are two Conservators of Forests. The next level is divided into four Divisions, with a Deputy Conservator in charge of each. Deputy Conservators patrol their divisions, are actively involved in the formation of VFPMCs, and work to start up the committees by participating in committee meetings, etc.,

Furthermore, the table below shows the assignments and the number of staff at the Forest Department's Bikaner Headquarters, which has jurisdiction over the beneficiary area of this project.

Number of Technical Workers at Bikaner Headquarters

	98/99	99/00	00/01	01/02
Forest Officers	14	14	14	15
Forest Rangers	27	30	30	28
Foresters	89	96	93	81
Forest Guards	270	291	312	284
	400	431	449	408

Source: Material from the executing agency

(3) Financial Status

The budget for this project (the portion handled by the Bikaner office) is apportioned by the Rajasthan Forest Department.

[9] Of the total amount of the State Government subsidy, 5,000 rupees are granted upon establishment of the committee (without any condition), and the rest (20,000 rupees) are granted to the committee based on the reserve fund by the residents (the same amount of case or/and goods paid by them).

In the state's Tenth 5-Year Plan, a budget is assembled for each program. Of the budget allotted to forest sector programs, approximately 55% is planned for allotment to the IGNP Afforestation Project from FY2003 onward (see table below). Furthermore, the actual budget for operation and maintenance was 13 million rupees for FY2002, and the executing agency believes that an adequate budget is being secured. The executing agency expects to maintain the same budget level henceforth.

Budget Allocation for Forest Sector in Rajasthan State（unit: million rupees）

	1999	2000	2001	2002	2003-2007
States's Forest Sector Overall	999.2	498.6	531.3	1,735.2	11,457.0
Portion for IGNP Afforestation Project	130.3	155.7	220.0	950.8	6,249.5
Percentage（%）	13%	31%	41%	55%	55%

Source: Tenth Five Year Plan 2002-2007, Government of Rajasthan, Planning Department

3. Feedback

3.1 Lessons Learned

None.

3.2 Recommendations

None.

Comparison of Original and Actual Scope

Item	Planned	Actual Performance
Output		
1) Canal Side Plantation	15,000 ha	21400 ha
2) Road Side Plantation	400 ha	1250 ha
3) Block Plantation/ Forest Preserves	6,000 ha	4248 ha
4) Sand Dune Stabilization	25,000 ha	34070 ha
5) Pasture Development	15,000 ha	5990 ha
6) Agricultural Forests	10 million trees	825 million trees
7) Environmental Plantation	2,400 ha	896 ha
8) Farm Forestry	6,500 ha （25 locations）	50 location
9) Project Management	—	As planned
10) Dissemination, Research, Training	Technological guidance, Testing, etc.	Addition of introduction of JFM
Project Period		
1) Canal Side Plantation	1991-1995	1991-2002
2) Road Side Plantation	1991-1995	1992-1998
3) Block Plantation/ Forest Preserves	1991-1995	1991-2002
4) Sand Dune Stabilization	1991-1995	1991-2002
5) Pasture Development	1991-1995	1991-2002
6) Agricultural Forests	—	—
7) Environmental Plantation	1991-1995	1991-2002
8) Farm Forestry	1991-1995	1991-1999
Project Cost		
Foreign Currency	492 million yen	Unknown
Local Currency	8,766 million yen (1019.3 million rupees)	Unknown （1711.5 million rupees）
Total	9,258 million yen	5,785 million yen
ODA Loan Portion	7,869 million yen	4,711 million yen
Exchange Rate	1 rupees ＝ 8.6 yen	1 rupees =3.38 yen

Third Party Evaluator's Opinion on
Indira Gandhi Canal Region Afforestation Project

Subrata K Mandal
Senior Economist
National Institute of Public Finance and Policy, New Delhi

Relevance

The objective of the project is to alleviate poverty by improving the environment through afforestation programs implemented in the Indira Gandhi Canal Region of Rajasthan. The objectives are consistent with the Indian Governments' policy of poverty alleviation followed during the successive Five-Year Plans in the last fifty years and the State Government's policy to combat desertification. Poverty alleviation and environmental improvement are aspects that are also stressed by the recently formulated United Nations' Millennium Development Goals

The project area is located in Bikaner and Jaiselmer districts of the Thar Desert. The area has scant vegetation and there has been a huge deficit of fuelwood and animal feed. Fuelwood is used for cooking and it is collected by women members of the household. Scarcity of fuelwood availability put pressure on women who have to spend longer time for collection and consequently, have less time to perform other household activities. Any forestry program which increases supply of fuelwood would help the women of the region.

Livestock rearing is one of the main occupations of the people of the region and the dependence has grown over the years. Livestock population has grown at a very high rate since seventies, demand for animal feed too has increased with the increase in livestock population. The forest is the main source of animal feed, an increase in forest area or density would help to ease the fodder constrain for livestock development in this region.

The formation of sand dunes is a typical feature of arid regions of the Thar Desert. High velocity of winds often shifts these mounds of sand, sometimes even covering a whole village. Tree cover has the potential to hold the sand on the ground and prevent the shifting of dunes thus, giving protection to the villages. Besides, the tree cover helps in retention of soil moisture and increases the productivity of land. The tree cover gives protection to the canal from the shifting sand dunes and also minimizes the evapo-transpiration rate of the canal water, thus preserving it for a longer time.

Hence, it can be concluded that the project is extremely relevant for the region and consistent with the national priorities and local needs.

Impact

The impact of the project has to be understood along with other complimentary components of the Indira Gandhi Nahar Project. Tree canopy along the irrigation waterways has allowed water to be carried to longer distances and minimized loss of water due to seepage and erosion control effect. Thus the tree canopy has increased the productivity of water by not only providing more water but also bringing more area under irrigated cultivation than otherwise possible. The afforestation program has increased productivity of agricultural crops like wheat, mustard and other vegetables grown during the winter season due to increase in soil moisture during the relatively drier period.

The project increased the availability of fuelwood, this has benefited women immensely since they can save time and money. Further, the project also increased the supply of animal feed; this allowed the local people to settle permanently rather than move around in search of it for rearing livestock which is the main occupation of the region. The project also provided a windbreak and a more acceptable and enjoyable ambience for living.

The afforestation project has contributed positively towards increased income generation and employment. The increase in agricultural activity has created more employment opportunities.

Forest plantation and collection of forest products have also engaged local residents and allowed them to supplement their income.