CHAPTER - 2

THE EVOLUTION OF WATER RESOURCE DEVELOPMENT IN INDIA

It is difficult to trace the origin of man's recognition of the relation of land use to the flow of water. But no reader of classical literature can remain unaware that its origin lies in antiquity. In ancient Greece, the relation between land and water was seemingly well recognised and wide spread. The ancient Chinese expressed it in the proverb "to rule the mountains, rule the river". Early records indicate that people of Mediterranean had some knowledge of watershed management even before the birth of Christ. Water was scarce. The demand for irrigation and municipal use was high. Knowledge of the effects of poor land use existed. The record was silent through the ages until 1215, when Louis VI of France issued a decree on water and forests. In 1342 a committee in Switzerland imposed the first 'ban' on the reckless exploitation of forests (Kittredge, 1948). The period from 18th to 19th century was characterized by contradicting attitudes in watershed management.

Watershed management has been followed in India from ancient times, though not in an organised way. As civilization grew the basic need for food, cloth and shelter also grew. The basic needs were derived from agriculture. Agriculture underwent many reforms and water development was actively undertaken by different experts of the past. Since water is a basic need of
humans, animals and plants, many steps had to be taken for meeting the need. Many interesting features of water resources, structures do exist in the country.

History dates back to Indus valley civilization, (3200 BC to 2750 BC) which is crowned to be the first known case of water resources development. Knowledge existed on under water drainage and granaries. Rishi Narada inquired from King Yudhistir (3150 BC) whether farmers were sturdy and prosperous and whether dams had water for distribution in different parts of the kingdom. The notable water resources structure after Indus Valley civilization are the one, developed during Magadha Empire (547 B.C to 347 B.C). During this period agriculture developed and also ruler Bindusara built many types of public utilities such as buildings, roads, tanks and irrigation canals. Likewise Mauyan Empire (322 BC to 185 BC) also promoted water resource development by way of irrigation projects. (Sen, 1998).

As evident from the note of Magastenes, importance of land and water management was realised even during 300 B.C for social welfare. During the period famous Sudarshan lake in Girnar was constructed. In Southern India Chola rulers constructed several water resources structures, namely the famous 'grand ancient' at the Cauvery (1 A.D), Gangaikonda Tank near Tirunelveli (11 A.D) in Tamil Nadu and Anantraja Sager (14 A.D), 3 K.m east of Perumamila Village in Cudappa district in Andhra Pradesh. There existed knowledge about location, design and construction of successful tank. There also existed
awareness regarding political, technological and sociological factors involved in successful functioning of tank for irrigation. Water resource development was also well promoted during Gupta Empire (32 AD to 467 AD). Skand Gupta repaired and widened the Sudarsan lake. Rain water was collected and utilized for irrigation in central Asia. This practice is now known as water harvesting for storage and recycling. Western Yamuna canal was constructed by Muhammad Shah Tuglak in 1355 A.D for irrigation of his hunting ground in Hissar district. Smaller and scattered water development projects were also promoted during Lodi dynasty (145 A.D to 1526 A.D). Burhia Tal at Etamadpur was built during this period. Ruler Akbar (1556 A.D to 1606 A.D) was the first to introduce land laws and to enforce many reforms under the guidance of his finance minister Thodar Mal. He renovated the western yamuna canal in 1568 A.D., and built the famous Taj Mahal at Agra, also made gardens in Lahore, Delhi and Kashmir, and built roads, canals, bridges and Tanks (Yadav and Bhushan, 1996). The water storage structures as evident from the remains, were also of different types, varying in shape and size and types of construction. The large size water bodies were lakes (such as Sudarsan lakes), reservoirs, tanks, baories (step wells) and quonats. Construction of Tanks (talabs) and (baori) was much earlier (1520 AD). In Southern India tanks form prominent source of irrigation. In the arid part of India people have been depending on water collected from rain, which is known as rain water harvesting (RWH) and water stored in small ponds (Nadis) reservoirs, underground tanks either for drinking purpose or for agriculture. Since time immemorial, there were
practices like run off farming in arid tracts. Construction of Tanks (underground tanks) were taken much later than quorats, reservoirs and tanks; the first known tanks in Rajasthan was during the year 1607 A.D by Raja Sursinghji in village Vadi (Bhagirath, 1996). The development of water resource have been undertaken since time immemorial. It was evident that water management was considered one of the factors for social welfare.

The first scientific investigation at erosion were probably those carried out by the German soil scientist by E. Wolliny between 1877 and 1895. Wolliny used small plots to measure effects of such factors as vegetation and much on interception of rainfall and soil structure. Not until 1930's did the practical application of modern day soil conservation began on a large scale. Thus there has been in general lack of technological knowledge in structural erosion control measures. For water harvesting structures such as of Burhara Tal, control of sedimentation was necessary to have its functioning.

In ancient India, water resources system were well developed, which were comparable to those of other countries in the world. (Table 2.1). Concept of runoff water farming, water harvesting, water development by surface runoff collection (eg. tanks etc), water management for social welfare, knowledge on aspects of good water, development projects seem to have persisted in ancient time. However it appears that there was less awareness on erosion control measures. (Moreland and Chatterjee, 1993). So it is clear that a strong political will.
scientific knowledge and management skill were realized for integrated approach for water resources development in the ancient time. The water resources project, should be free from territorial disputes. Role of water management was realised as a logical way of social welfare. Water harvesting, as an old art, needs more scientific approach for its successful working. Anti-erosion control measures should also be given adequate care in the water resource project

Table 2.1: Water resources development in historical periods in India

<table>
<thead>
<tr>
<th>Period</th>
<th>Water resources development*</th>
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<tbody>
<tr>
<td>3200 BC to 2750 BC</td>
<td>Indus Valley civilization (Mohen Jodaro) planned dwelling, town planning, under ground drainage, great bath hammam and granaries.</td>
</tr>
<tr>
<td>547 BC to 347 BC</td>
<td>Magadh Empire (prosperous agriculture)</td>
</tr>
<tr>
<td>300 BC</td>
<td>Magasthenes, the famous Greek Ambassador to the court of Chandra Gupta recorded that district officers, measure the land inspect studies by which water is distributed in the branch canals (water courses) so that every one may enjoy his major share of benefit, (Rao, 1975).</td>
</tr>
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</table>
547 BC to 495 BC: Bimbisara; built public utilities such as buildings, roads, tanks and irrigation canals.

322 BC to 185 BC: Mauryan Empire, promoted agriculture and means of irrigation, established irrigation department, constructed Sudarsan lake in Gimar.

Chandra Gupta Maurya (322 BC to 298 BC) built canals, lakes and dams to promote irrigation.

1 AD: Chola rulers made most famous grand ancient on the cauvery in order to prevent water flowing into the coleroon, which is a low level one and to enable water to pass through the cauvery and irrigate fertile Tanjore delta lands.

11 AD: King Rajendra Chola built Gangikonda Tank 15 km from Tirunelveli in Tamil Nadu. It has long embankment of nearly 26 km.

14 AD: Anantaraja Sagar tank was built at 3 km east of Perumamila village in Cuddaph Distt. A.P. The tank has water spread of 42 sq.km.
320 AD to 467 AD : Gupta Empire: Rulers built lakes and tanks to promote irrigation.

Skand Gupta repaired and widened Sudarsan lake during his regime.

Rain water was collected and utilized for the purpose of irrigation in the whole central Asia.

1351-1388 AD : Feroz Shah Tughlaq built the western Yamuna canal (1355 AD) to carry water to his hunting ground at Safidom in Hissar district. This canal became non-functional after his death.

1451 AD to 1526 AD : Lodhi Dynasty: Ruler Sikaner Lodhi founded town of Agra; constructed tank-Buria ka tal.

1556 AD to 1606 AD : Ruler Akabar enforced land laws and land reforms. Agricultural land classified and revenue system devised under the able guidance of his finance minister Raja Todamal. Buland Darwaja constructed 1572-73.
Emperor Akbar renovated the canal in 1568 AD for irrigating land in Hissar district. It was later improved by Emperor Shah Jahan, Grand son of Akbar.

A branch canal was taken to Delhi.

1607 AD : First underground reservoir (Tanka) was constructed in Rajasthan by Raja Sigsinghji.

1627 AD to 1658 AD : Shah Jahan construct Taj Mahal, Agra Fort and Red Fort and Jama Masjid in Delhi. Also constructed gardens in Lahore, Delhi and Kashmir. Built roads, canals, bridges and tanks.

1765 AD : Maharaja of Bharatpur constructed Keola Deo Jheel (lake) named Ajan dam.

1821 AD : During the British period the western Yamuna canal was realigned and repaired.

1857 AD : Revolt began against British rulers.

WATERSHED PROGRAMMES LAUNCHED BY GOVERNMENT OF INDIA

Traditionally, Indian farmers managed their watersheds like the village ponds and tanks for their better use. Regular desiltation of these small reservoirs and protecting the vegetation are some common practices aimed at effective watershed management. However, the mounting population pressure and erosion in the well-established socio-religio-political system resulted in degradation of vital land, water and vegetation resources. A crisis is often the biggest window of opportunity to bring about change. The biggest success of India's environmental movement which began with the 'Chipko movement' of the early 1970's has been to demonstrate that it can reverse the degradation of its land resources.

In the post-independent plan era a number of river valley projects were created in the country and these were based on the catchment basis. However, the adoption of integrated watershed approach was hardly followed in the development of the command area. Similarly, most of the soil conservation programmes initiated in India during early decades of the twentieth century, were also implemented without a watershed approach in view.

However, the establishment of central soil and water conservation Research and Training Institute (CS & WCR & TI) at Dehra Dun after independence and a network of other regional centres in the country, opened up the vistas in the field of soil conservation research, demonstration and training. The CS &
WCR & TI has been conducting research over the past 35 years on integrated land-use-planning and other dimensions related to watershed management. Besides' various state Agricultural Universities have started department of soil science, water management and other similar departments. Watershed management has been incorporated into the curriculum. Damodar Valley corporation (DVC) has launched a number of watershed projects. DVC has been a pioneer in the field of watershed management in India (Jaiswal and Kolta, 1981). It was created by Government of India in 1948, for the development of the Damodar Valley in the provinces of Bihar and West Bengal to promote irrigation, water supply, drainage, flood control, navigation, afforestation, control of soil erosion, promotion of Public Health and the agricultural, industrial, economic and general well being of the Damodar Valley area (Bhagwan and Bhushan, 1979).

Several watershed projects have been launched in India, sponsored by Government of India, state governments, social activists and NGO's. The international funding agencies like World Bank, DANIDA, ODA, EEC, UNDP etc: have also assisted a number of watershed development projects in the country by spending vast amounts.

It was from the 5th Five Year Plan (1974-79) that the Government of India strongly recommended the planning and implementation of Drought Prone Areas Programme (DPAP) through watershed approach. The programme was intended to
achieve the twin objectives of optimum utilization of natural resources and the integrated development of the area. The DPAP was initially launched in 74 districts covering 13 states of the country. During the successive Five Year Plans the geographical coverage of drought area underwent a number of revisions following which 92 districts spread over 13 states have been brought under DPAP (Purandare and Jaiswal, 1995). The programme was funded both by the central government and the respective state governments on 50:50 basis. The World Bank came forward to assist the implementation of DPAP in six selected districts namely; Sholapur and Ahamed Nagar (Maharastra), Jodhpur and Nagpur (Rajastan), Anantapur (Andhra Pradesh) and Bijapur (Karnataka).

The Integrated Wasteland Development Project (IWDP) taken up by the National Wasteland Development Board in 1989 was also aimed at developing waste lands on a watershed basis. This programme has been brought under the administrative jurisdiction of the Department of Wastelands Development in the Ministry of Rural Development.

The Government of India also emphasized the watershed approach in other land based programmes. Under the Prime Ministers 20 point programme (1982), it was planned to develop dry land technology on watershed basis to attain integrated development. During 1983, two schemes namely (i) Pilot project for propagation of water conservation/harvesting Technology for Rainfed Areas on watershed basis and (2) Popularization of Seed-
Cum-Fertilizer Drills, were initiated covering 19 districts in 15 states. Indian Council of Agricultural Research was also involved in providing technology and research support to those watersheds which were popularly known as "On Farm Dry Land Development Projects". Another programme called "On Farm Dry Land Development" (OFDLD) was launched by Government of India on watershed basis wherein 100 percent subsidy was extended for implementing the dry land development activities viz. soil conservation, water harvesting and tree planting and pasture development and use of suitable crop varieties. However the programme could not yield the expected results for want of effective inter-departmental co-ordination and organizational constraints.

The experience gained through these projects provided the base for the launching of massive National Watershed Development Programme for Rainfed Agriculture (NWDPRA) during the Seventh Five Year Plan (1985-90) covering 99 districts and 16 states. The programme aimed at enhancing and stabilizing the production levels through improved crop technology and efficient use of natural resources. Realising the vital role of rainfed agriculture in Indian economy, committee of secretaries was constituted in November 1987, to reveal the progress of the schemes mentioned above and devise a policy framework in respect of approach and strategy, agriculture structure, mode of financial requirements and pattern of subsidy, provided valuable policy directions. The planning commission also constituted a special working group on Rainfed/Dry Land
Agricultural Programmes for the formulation of Eighth Five Year Plan (1992-1997) to deliberate extensively, on constraints related to dry land farming and suggest a suitable strategy.

Based on the directives provided by the committee of secretaries and the broad framework recommended by the above Working Group on Dry land Farming, the National Watershed Development Project for Rainfed Areas (NWDPRA) was initiated with the twin objectives of sustainable production of biomass and restoration of ecological balance in the vast tracts of rainfed areas in the country during the Eighth Five Year Plan period.


The National Watershed Development Project for Rainfed Areas (NWDPRA) is a major thrust programme launched by the Department of Agriculture and Cooperation, Government of India, during the Eighth Five Year Plan (1992-1997). It was a cent per cent centrally sponsored scheme. This scheme intends to generate successful models of development in all the community development blocks of the country where less than 30 per cent arable area is under assured means of irrigation. In each of the selected blocks, a micro-watershed of about 500-1000 ha. would be taken up for integrated development (Purandare and Jaiswal, 1995). The area constituting a watershed should be having a preponderance of small and marginal farmers, scheduled castes, scheduled tribes and backward classes. It was expected to be a pace setter for comprehensive development in all the backward
regions of the country and was intended to put an end to migration from rural areas to the over-crowded urban conglomerations.

It promises to bring the benefit of Green Revolution to the hitherto untouched areas by adopting a farming system approach on watershed management principles in order to conserve water, top soil and ecology through peoples participation.

In many areas of the world water is wasted or used in excess of the actual needs. More often water is not used efficiently and economically for agriculture purposes, owing to loss in transit, unsuitable irrigation system or lack of institutional co-ordination. Since irrigation is the principal water user in many countries and since there is scarcity in water and land capable of being cultivated with irrigation facilities or rainfed conditions, there is a greater need to achieve greater efficiency and economy in the use of both these resources. In this context utilisation of water in India plays a vital role in the full development of the country, which has a predominantly agriculture-oriented economy.

The NWDPRA project would endeavor to achieve the objects of sustainable production of biomass and restoration of ecological balance in the vast tracts of rainfed areas in the country. It will specifically focus on conservation, upgradation and utilisation of natural endowments like land, water, plant, animal and human resources in a harmonious and integrated manner. The project will aim at perpetual availability of food, fodder, fuel, fibre, timber
and biomass for rural and cottage industries to meet the growing demands of human and livestock population through diversified land use. Generation of massive employment during the project period and regular employment after the completion of the project in the rain fed areas to ensure livelihood, security, particularly for under privileged sections of the rural population like small marginal farmers, landless labours, tribals etc. Improvement of production environment and restoration of ecological balance through scientific management of land and rain water are the major goals of watershed development programmes in the Third World. In the process, introduction of scientific production system, network of run-off management structures and devices for recharge of ground water will ensure enhanced availability of water for human and livestock drinking purpose, domestic consumption, life saving irrigation and raising of appropriate cash crops according to agro-climate potentials.

Reduction of inequalities between irrigated and rain fed areas is one of the goals of the programme. Ultimately stable production and processing of biomass would contribute towards better life in rural areas. This will reduce large scale migration from rural areas to the cities (Shah, 2001). In addition to food, fuel and fodder the project would endeavor to enhance cash flow to the rain fed farmers and landless agricultural labourers through increased opportunities for casual employment creation of marketable surplus of agricultural and dairy produce, growing of crops like vegetables, coriander, cumin, medicinal plants and manufacture of bio-fertilizer, sericulture, bee-keeping, agro-
processing unit etc: in suitable areas (Wasi Ullah, 1994). The ultimate objective of this project is to develop the natural resource-base, sustain its productivity, improve the standard of living of millions of poor farmers and landless labourers and endeavor for restoration of ecological balance.

Asia has 21 percent of global land and has 69 percent of world population who depend on agriculture for sustenance. There is concentration of livestock in this region. Therefore it is imperative that land management would have to be in consonance with the choices and compulsions of individual farmers and village communities (CWRDM, 1990).

Water is limited, yet it is a vital natural resource that is indispensable for the existence of all living matters - plants, animals and human beings. History bears eloquent testimony to the fact that civilisation developed around abundant supply of water and disappear in its absence. The correct combination of land and water is very important for prosperity and survival. It will set the upper limit to the population carrying capacity of the earth (Thungabhadra Board, 1982).

The NWDPRA project was intended to develop 2.8 million hectare of land through 2554 watershed projects with an expenditure of 1120 crores in the then 25 states and union territories (GOI, 2002).

A number of soil and water conservation programmes were implemented in India in the post independence era. The soil
conservation in the catchments of River Valley Projects (RVP) was launched during the Third Five Year Plan period (1961-66) in 48 watersheds of 18 states. During the Fourth Five Year Plan (1969-74), Integrated Watershed Management in Catchments of Flood Prone Rivers (FPR) was launched to moderate runoff in 234 watersheds in 8 states. The Desert Development Programme (DDP) was launched during the Fifth Five Year Plan period (1974-79). During the Sixth Five Year Plan period (1980-85) projects like the soil, water and tree conservation programme in the Himalayas (Operation Soil Watch) and the Operation Research Project on Integrated Watershed Management and the Ravine Reclamatoin in the Dacoit Prone Area of U.P, M.P and Rajasthan to accelerate their development were started.

A host of development programmes were started during the Eighth Five Year Plan period (1992-97). The Reclamation of special problem Areas and improvement of productivity launched during this period to reclaimate alkali soils in Punjab, Haryana and U.P., Reclamation and Development of Alkali Soils in U.P, Bihar were started with the assistance of European Economic Community (EEC). Other projects included Watershed Management for Shifting Cultivation Areas in North-East India, Indo-Dutch North Bengal Terai Development Project, the Indo-German Bilateral Programme of Watershed Management, the World Bank aided Integrated Watershed Development Project (IWSD) for Hills and Plains, the Danish Institute Development Assistance (DANIDA) programmes, Swedish Development Corporate (SDC) assisted projects; the Assam Rural Infrastructure and Agricultural Support

NEED OF NWDPRA

Indian villages are highly integrated ecological systems. However, this finely tuned system can easily be split up. If too many trees are cut or growing population pressure reduces the area of forests and grazing lands there would be shortage of firewood. It would force people to burn cowdung as cooking fuel, leaving little manure to fertilize croplands.

Moreover, the fodder sources decline, animals will starve and will not produce much cowdung. As a result, the biomass production will steadily go down. The system will soon take the shape of a pseudo-desert.

The country already has 129.78 million hectares (mha) of wasteland, of which 35.92 mha is degraded forest land and 93.86 mha. is degraded non-forest land (CSE, 1997). So attempts are made to increase the productivity of all the components of the village ecosystem, and in a sustainable manner. Village should be the primary unit of planning in India and villagers should be educated in a manner that would equip them with the capacity to better their own health as well as that of the village, and improve
their productivity and economy (Gandhi, 1939). His vision of self-sufficient villages has yet to become a reality.

Compared to the 1970s India has been quite successful in cutting down the rate of deforestation and somewhat stabilising the forest cover during the 1980s and 1990's. But India's forest estate still face major challenges and threats from natural pests and timber smugglers to poorly conceived management plans.

**Figure 2.1: Change in actual forest cover**

![Change in actual forest cover](image)

in million hectares

*Source: Forest Survey of India, 1997.*

India has a high and growing population density and India's economy has a voracious appetite for forest resources, no management plan will succeed unless it involves the people and provides them with adequate incentives. In the villages, barren
lands and uncultivated lands can be used for planting trees to satisfy the village fuel and wood needs so that they will not encroach the evergreen forest to exploit. The NWDPRA programme stresses its importance.

**Figure 2.2: India's forest cover in 1995 and 1997**

![Forest Cover Chart](image)

India has a dense forest cover of only about 12 percent. This is much less than the goal of having 33 percent of forest cover (GOI 1988). India's forest cover went down from 63.89 mha in 1995 to 63.34 mha in 1997 (Figure 2.1). Forest area (Govt. owned land area kept for forestry purposes) accounts for 23 percent of the total geographical area, and forest cover about 19 percent. Dense forest decreased in the two-year period between 1991-93 and 1993-95 by 1.78 mha. to 36.72 mha. and account for only 11.17 percent of the total land area. (GOI, 1997). The loss of dense forests is a cause for alarm (Figure 2.2)

**Approach and Strategy of NWDPRA**

The approach and strategy are primarily based on the twin concept of Integrated Watershed Management and sustainable farming systems. Watershed consists of three physical sectors (1) Arable or cultivated lands which are privately owned (2) Non-Arable land which includes village pastures and grazing grounds, cultivable wastelands and barren and uncultivable lands and (3) Network of natural drainage lines. These three sub-sectors are hydrologically interspersed and would be treated as an organic geo-hydrological entity for project planning and implementation to ensure sustainable use of natural resources of land and water.

**Sustainable Farming System**

A rainfed farmer derives his sustenance partly from his own cultivated land and partly from common property resources and community lands. He depends upon livestock resources and off-farm activities like wages by working as labourer on
government projects and also by working on the fields of other farmers. In some areas specialised activities like sericulture, beekeeping, lac cultivation, cultivation and collection of medicinal and industrial plants also supplement the incomes of the farmers. The landless labourers mostly depend upon common property resources for fuel and fodder. Thus the project will treat the following sub-components of the household farming systems.

a. Food sub-component

b. Fodder sub-component

c. Fuel sub-component

d. Income generation component.

The inter-relationship and inter-linkages among various components and sub-components of the farming system will be analysed and treated as a part of one organic unit.

Village or Community Farming System

There are many community owned resources and assets which exercise influence on farmers in important decision making. For example common property resources, common village ponds for supplemental irrigation, village wood-lots etc. The project would analyse and treat the inter-dependence of individual farming system, with the community production systems.
People's Participation

Stimulating and promoting people's participation in project planning, project preparation, implementation and post project management of assets would be an integral part of the approach and strategy.

Conservation Measures

The project will heavily rely on low cost and vegetative conservation measures in place of costly engineering structures which are costlier to install and require adequate finance for maintenance.

Holistic Approach

The project would address both the ecological and productivity concern and would aim at harmonising ecology, economy and equity. Lessons learnt and experiences gained would be documented to serve as a base for expanding and developing the programme during the next Five year plans, and the project is futuristic in outlook.

People's Participation and Training

During the course of the survey the current farming systems and practices of the farmers will be analysed in detail and due weightage would be given to farmers' perceptions and experiences. The project will be planned and implemented with active participation of the concerned village community in association with voluntary agencies.
Concept of Mitra-Kisan and Gopal

Keeping in view the importance of scientific feedback from farmers in research participation, the concept of Mitra-Kisan (contact farmer) is being suggested. These farmers will serve as important links between scientists and farmers and will receive training at training centres and provide feedback to scientists. Frequent meaningful contacts between scientists and farmers at the training centres and participation in on-farm research will help the research system to have better perception of the prevailing farming systems and farmers conditions and limitations imposed on them by their physical, social and economic conditions. Two of such farmers would be practising farmers and would be known as Mitra-Kisan and a third one would be a landless agricultural labourer to be called Gopal, in order to signify his or her concern for tending cattle as well as to look after common grazing lands. While the Mitra Kisans will concentrate on cultivated lands, Gopal would focus attention on common property resource management on behalf of the village community or farmer group. Farm women in good numbers will be selected, so that they may also contribute to agricultural development efforts.

A scientist-farmer inter-action for deciding research priorities is a phenomenon in NWDGRA. Group action on behalf of the farmers will help in dissemination of new technologies evolved in consultation with them.
The programme will have two major components

a. Farmer training

b. On-farm research programme

The nodal agencies for farmers training will be the Krishi Vigyan Kendras (KVKs), the Farmer Training Centres (FTC's), the Regional Research Stations and other such centres where farmer's training facilities are available. The on-farm research programme will be restricted to only KVKs, Regional Research Stations and Directorate of Extension of Universities, since they have required infrastructural facilities for research. Demonstration of research findings of applied nature would also be conducted by F.T.Cs.

A series of institutional training sessions of three-days duration for about 30 contact farmers at a time would be conducted by the training centre twice a year. The members of the Watershed Development Team would also participate in these three days farmers training. The three Mitra Kisans from each village would take turns to re-visit the training centre for a one-day-orientation-cum-feedback session three times after the three day training, once after sowing, a second time before harvesting, and again after harvesting.

During these sessions the contact farmers and scientists will discuss the details of the agricultural situation in the village. Suitable documentation will be done by the scientists to prepare a future course of action. In the process, the scientists will get a direct
feedback on the new technology which they passed on to the Mitra-Kisan in the three-day institutional training programme.

Training Curriculum

The three day institutional training programmes will not only concentrate on crop production but also on management of community assets and common property resources and give an over-view of the integrated farming system, which is nearer to the reality of the farming situation. It is natural for the farmer to explain an integrated view of his problems. The broad parameters of the three day institutional training will be the following.

First Day: Concept of integrated farming system approach, analysing inter dependence of private and common property etc: Problems of the micro-watershed as a whole.

Second Day: Management of cultivated lands to maximise production, both crops as well as allied agricultural activities.

Third Day: Management of common lands including village forests, pastures, grazing lands etc: other activities like animal husbandry, dairy, poultry, fisheries etc.

The Mitra-Kisan needs to be trained about agro-forestry and in the three-tier management of common lands for optimum promotion of animal husbandry and vegetation.
Training Strategy

The main message in the new training strategy will be soil and water conservation and the integrated farming approach. It would be based on field constraints and would have local relevance. The training materials like posters, charts and printed materials would be in the local language. The use of various audio-visual aids would be made so that the communication gap between scientists and Mitra-Kisans is reduced to the minimum. The training materials will have direct relevance to the agro-climate conditions of the villages selected under watershed projects of the NWDPRA.

Training Infrastructure

The institutes for conducting training programmes of the Mitra-Kisans would operate at the district level. These institutes may be Krishi Vigyan Kendras, Farmers Training Centres and Research Stations of Agricultural Universities, ICAR Institutes etc. The Mitra-Kisans would be important agents in the formulation of the watershed projects.

Role of Women in NWDPRA

Women play an important role in farming systems and influence decision making of farmers in a significant manner. They are involved in activities like collection of fuel-wood, fetching of drinking water-often from distant areas, cleaning, storage and preservation of seeds and processing of milk and milk products. They also participate in feeding livestock, agricultural operations
sowing, weeding, harvesting, threshing, winnowing, storage of produce etc. Their exclusive role of house-keeping, cooking and attending to numerous household activities are always there. In development programmes specific attention is not generally given either in generation of technology or its dissemination to address problems of women. NWDPRA will focus on activities of women both for reducing their drudgery and increasing their efficiency, and will plan and provide for development of specific implements suited to women; provide fuel efficient stoves to save energy and also promote healthy environment in homes and in the kitchen. Special training courses would be arranged to train women in processing and handling of bio-fertilizers in order to develop a cottage industry able to supply bio-fertilizers to the entire Block, where the micro-watersheds is located. There are a number of women-related activities in the NWDPRA project, which are suited to each micro-watershed. The state government and project authorities would endeavor to develop location-specific strategies to involve women in their areas in activities meant for women. Women groups will be encouraged to take up income generation activities like Mahila Mandal Nurseries from which the project would buy seedlings and other planting materials. Activities like primary processing of agricultural produce could also be promoted as cottage industries. Income generating activities for the weaker sections of society would occupy a central place in NWDPRA.
Group Activities and Community Action

NWDPRA will operate through established democratic decentralised institutions like village panchayats. Informal groups in the village will participate in project survey, planning and preparation, implementation and especially in post project maintenance and operation of community assets. Community prizes would be instituted for maintaining common property resources and project assets. Active participation of all sections of society is established. It is to convert the watershed development project from a government scheme to people's movement. In fact, NWDPRA is a people's programme and government will participate in it to provide necessary support.

Role of NGOS

Voluntary agencies, wherever available, will be actively involved in the project, particularly for creation of awareness and farming system education, training of field functionaries and beneficiaries and preparation of training materials for farmers and evaluation and monitoring of project activities and their impact from people's point of view.

Organisation and Management

An efficient organisational structure is necessary for the successful planning and implementation of the watershed development programme.
Policy Support

This may be provided by a committee of ministers under the chairmanship of Chief Minister with Ministers in charge of Agriculture Forest, Animal Husbandry, Horticulture etc. as members. Secretary, Agriculture, would be the member-secretary.

Direction

Direction for implementation of the policies decided by the Committee of Ministers would be the function of the committee of senior level officers in the state government headed by the Chief Secretary.

Planning and implementation

This will be accomplished by a multi-disciplinary watershed development team (WDT) for each micro watershed in consultation with the farmers trained in each village and also the general body of the beneficiaries in the project area. At the block level, there will be a supervisory committee headed by the block pramukh with pradhans of participating village as members and B.D.O as Vice-chairman. The leader of the WDT would be the convener of the committee.

Project Financing

The average unit cost as a whole in plain area will be Rs.3500/- per ha. including Rs.500/- for management. However, for hilly areas, the unit cost may go up to Rs.5000/- per ha. The
unit cost of Rs.3500/- per ha. is the average cost for the entire NWDPRA in a state. Emphasis on low cost technology is inevitable.

**Pattern of Assistance**

The project will be financed by Government of India in the form of 75% grant-in-aid and 25% loan to State Governments.

There will be some financial contribution from the beneficiaries so that they are financially involved and do not perceive the project as a total government exercise. During the entire project period, no individual farming family would get subsidized inputs for demonstrations, other subsidies including dug wells, implements etc., beyond Rs.5000/. This Rs. 5000/- limit will be equally applicable to all the farmers irrespective of their size of holdings. Project costs, relating to all the common property areas and resources, and even for community works located on private holdings, will be fully borne by the project. However, for community assets to be created on individual holdings, the owner will have to give a written undertaking that the assets will be used for community purposes, and not only for individual use.

Socio-economic survey should be conducted to note Human Resources which will give an overall picture of population growth, and density number/unit area, composition of sex, age, caste groupings, people in working age, number of persons in need of wage employment, range and average size of families, literacy, educational level, number of school dropouts, young farmers and farm women who may read and write, village crafts and skills, number of families practising village crafts and rural
industry, carpenters, blacksmith and leather craft. The survey also should picture migration and movement, seasonal and regular, in and out.

Infrastructural facilities like rail, road, approach, cart track, market, input supply points, credit facilities, hospitals, schools etc. must be noted. Survey may be conducted on income generation activities like off-farm activities, agro-processing, and wage opportunities.

Major problems in the project area, like declining productivity, the nature and intensity of erosion hazards and declining vegetative cover, non-availability of water for human beings and livestock, shifting cultivation, salinity, alkalinity, weed infestation, problems caused by faulty lay out and construction of roads, drainage congestion in plains and problems caused by mining, need to be addressed in the project.

Food balance of the project area, whether it is self sufficient, deficient or surplus. Fodder balance, whether it is surplus or deficient. fuel balance, sources and availability of fuel etc., may be noted before the project implementation.

The survey and investigation of the project area will give an inventory of ecological and socio-economic settings of the microwatershed. The physical treatment will be decided in active consultation with the individual farmers and village communities. The current farming systems and practices should be thoroughly analysed and farmers' experiences and skills should be given due
weightage. The project staff may have to learn a lot from the village community and unlearn some of their orthodox views and presumptions about people's capabilities. The ultimate analysis of science and technology from research institutions, technical and managerial know-how of the project staff and accumulated experience of the village community should be integrated to finalize the choice of treatments.

PROJECT AREAS

Blocks-Selection Criteria

All the community development blocks in the country with less than 30% of their cultivated areas under assessed irrigation would qualify for inclusion in the project. There would be no higher or lower limit of average annual rainfall.

Micro-Watershed

In each of the selected blocks, a Micro Watershed of about 500-5000 ha. would be taken up for integrated development. The ideal size would be about 1000 ha. area which could be saturated within the period of the Five Year Plans. The selection of the watershed would be based on the following basis:

1. The micro watershed should be easily accessible and preferably be located in the vicinity of Block Headquarters/Taluk/NARP Research Station/ICAR Research Institution or its centre/Krishi Vigyan Kendras / Farmers Training Centres. This will facilitate effective supervision in the programme.
2. The micro-watershed should be visible. The project area should be selected by the side of the main roads through which people and government officers frequently pass. This will ensure visual impact on visitors.

3. It should be located at a central place where farmers from the surrounding areas may easily assemble and see the process and feel the impact of the project.

4. The micro-watershed should have preferably 50% or more of its area under cultivation, so that the farmers are directly involved and benefited.

5. Villages constituting a micro-watershed have a preponderance of small and Marginal Farmers, Scheduled Caste, Scheduled Tribes and Backward Class should get priority while selecting micro-watersheds.

PROJECTISATION

Before the project implementation, integrated surveys are conducted to collect facts and figures regarding production systems and environment for project formulation and also to establish benchmarks for evaluation of impact made by the project on selected parameters (Table 2.2)

Surveys are to be conducted on land resources (Slope, Erosion, Texture, Depth) especially soil survey, water resources, particularly rainfall, ground water level, surface flow runoff. Vegetative resources particularly climax species, forest type,
natural vegetation on wastelands grazing grounds, conservation flora, economic and utility species, medicinal, aromatic, industrial fuel, fodder species, etc. also need to be surveyed and analysed.

On the production side, crop and cropping systems especially land use including agro forestry, horticulture, fisheries etc: should be noted. Dry land horticulture, Livestock and Animal Husbandry, the type of grazing grounds and pastures, village industries like bio-fertilizer, sericulture, agro-processing units and their role in village economy is noted.

Documentation-Feedback and Reporting

Proper documentation should be made in such a manner that Registers and Tables are made and fed in to computers. Detailed formats and guidelines are prepared in consultation with National Informatics Centre. Contact may be made at state and district level with personnel and National Informatics Centre.

Quarterly and Annual Reports will be furnished by Watershed Development Team to state government and to Government of India.

Monitoring & Evaluation

In the NWDPRA project there will be two types of monitoring-internal built-in monitoring and external monitoring and evaluation by professional bodies and NGO's. A completion report will be written at the end of the project giving detailed accounts of lessons learned and experiences gained. The report
will be helpful and will give future directions to the next plan periods, based on the benefits accrued to the people.

For the proper and integrated development of arable and non-arable lands and drainage lines, certain measures would be adopted. Contour bunds/vegetative hedges to filter runoff water and control soil erosion may be made and repair of the existing conservation structures including inter-bund treatments may be undertaken. Opening of contour dead-furrows at appropriate intervals to trap moisture for recharge of the soil profile can also be made. Measures for gully control, organic farming, use of legumes, bio-fertilizer and bulk organic manures to promote a moisture holding capacity of the soil, mixed cropping, intercropping, crop sequences, alley cropping, agro-forestry, contingency cropping, dry land horticulture, cultivation of fodder etc. should be implemented.

Construction of check dams, small run-off management structures, vegetative barriers, brushwood dams, loose boulder dams, earthen bunds fortified with vegetation would be planned and implemented in non-arable lands. The cost of individual water storage structures will not exceed Rs.25000/. Livestock rearing is an integral part of rainfed farming systems, so specific measures be planned and implemented to regulate the livestock population and enhance their productivity.
Table 2.2  Frame work of NWDGRA and Indicative Cost Structure

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Survey: Field investigation, cartographic equipment and material for preparing resource inventory and projectisation</td>
<td>10%</td>
</tr>
<tr>
<td>2</td>
<td>Conservation Measures: Mostly vegetative measures for erosion control</td>
<td>30%</td>
</tr>
<tr>
<td>3</td>
<td>Production system: Sustainable production systems will include demonstration on crop production, agro-forestry, silvi pastural systems, fuel wood plantation, sericulture and other utility plantation, pasture development, village industries etc.</td>
<td>30%</td>
</tr>
<tr>
<td>4</td>
<td>Training to the staff: Landless agricultural workers and farmers for public participation, project staff, farmers, public participation activities like Kisan Mela, crop competition, secured for maintaining project assets to individuals and village community etc.</td>
<td>10%</td>
</tr>
<tr>
<td>5</td>
<td>Establishment and Management support:</td>
<td>10%</td>
</tr>
<tr>
<td>6</td>
<td>Research Support</td>
<td>5%</td>
</tr>
<tr>
<td>7</td>
<td>Infrastructural cost: For establishment of composite nurseries and kisan nurseries etc.</td>
<td>25%</td>
</tr>
<tr>
<td>8</td>
<td>Reserve: For public participation, support to NGO's and other programmes, preparation of training material, awareness generation and monitoring &amp; Evaluation</td>
<td>2.5%</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Source: WARASA (1991)

All works in NWDGRA will be implemented through the beneficiaries themselves. Common land works may be done though
the village panchayat or group or association of beneficiaries residing in the micro-watershed. No contractors are to be engaged in the programme implementation.

The second chapter examines the evolution of water resource development in India from ancient times and the different watershed development programmes launched by the Government of India. This chapter covers the details of NWDPRA, the need of NWDPRA in India and the approach and strategy of NWDPRA. Project financing and pattern of assistance, details of project areas, framework of NWDPRA and the indicative cost structure of NWDPRA.